V—INSECT CONTROL

Relative Toxicity of Pesticides to Honey Bees....74
Reducing the Risk of Pesticide Poisoning to Honey Bees....75
Insect Control in Field Corn....76
Insect Control in Grain Sorghum....80
Insect Control in Small Grains....82
Insect Control on Cotton....83
Cotton Insect Resistance Management....87
Insect Control on Peanuts....89
Insect Control in Soybeans....91
Insect Control on Flue-Cured and Burley Tobacco 94
Insect Control for Commercial Vegetables....103
Relative Effectiveness of Insecticides and Miticides for Insect and Mite Control on Vegetables....138
Preharvest Intervals for Pyrethroid Insecticides in Vegetable Crops....140
Insect Control for Greenhouse Vegetables....141
Insect Control for Livestock and Poultry....144
Community Pest Control....151
Industrial and Household Pests....155
Arthropod Management for Ornamental Plants Grown in Greenhouses....158
Arthropod Management for Ornamental Plants Grown in Nurseries or Landscapes....162
Arthropod Control on Christmas Trees....168
Commercial Turf Insect Control....172
Insect Control for Wood and Wood Products....177
Insect Control for the Home Vegetable Garden....181
Control of Household Pests....185
Insect Control for Home Lawns....192
Insect Management in Industrial Hemp....196

Relative Toxicity of Pesticides to Honey Bees

David R. Tarpy, Professor and Extension Apiculturist

Most pesticides are at least somewhat toxic to honey bees and other pollinators, although the degree of toxicity varies considerably from product to product. Insecticides are generally the most likely to cause a bee kill; herbicides, fungicides, and defoliants present relatively minor danger to bees if used according to label directions. **Check the pesticide label** for the relative toxicity of the active ingredient to bees and other pollinators (Table 5-1A) and apply with caution around beehives or when pollinators are actively foraging.

Table 5-1A. Relative Toxicity of Pesticides to Honey Bees

Label Information	Highly Toxic	Moderately Toxic	Relatively Non-toxic
LD50	Less than 2 micrograms per bee	Between 2 and 11 micrograms per bee	Above 11 micrograms per bee
Precautionary statement.	This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees are visiting the treatment area.	This product is toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product if bees are visiting the treatment area.	No statement required.

Table 5-1B. Pesticide Use Inside and Around Honey Beehives

Pests	Chemical (Brand)	Formulation	Precautions and Remarks (Always follow product label directions for handling, product application, and disposal)
Tracheal Mite	menthol (Mite-A-Thol)	Crystalline granules	Both products generate vapors that kill tracheal mites. Apply onto inner cover/ top super according to label directions. Best if used when ambient temperatures are above 70ºF for menthol and 50ºF for formic acid. Use gloves when handling crystals or gel packets.
	formic acid (Mite-Away)	Various delivery methods	
Varroa Mite	tau-fluvalinate (Apistan)	Plastic strip; pesticide-impregnated	Strips contain contact poison to kill mites. Use protective gloves when handling strips. Hang strips in brood-chamber according to label directions. Caution should be used, as mites have evolved a resistance to this particular chemical, and it may not be effective in many instances.
	formic acid (Mite-Away)	Various delivery methods	Product generates vapors to kill mites. Kills mites in sealed brood cells. Treat colonies according to label directions.
	coumaphos (CheckMite+)	Plastic strip; pesticide-impregnated	For varroa mites, product should be used only when fluvalinate-resistance has been confirmed by NCDA Bee Inspectors. Caution should be exercised, as mites have evolved a resistance to this particular chemical and may not be effective in many instances.
	amitraz (Apivar)	Plastic strip; pesticide-impregnated	Strips contain active ingredient to kill mites upon contact. Use protective gloves when handling strips.
	thymol (ApiLife VAR or Apiguard)	Pesticide-impregnated vermiculite tablets or gel	Essential oils volatilize to kill mites outside of brood cells.
	oxalic acid (API-Bioxal)	Various delivery methods	Use ONLY during broodless periods. Spray all adult bees with fine mist (must be completely wetted to kill mites) or use a vaporizer with appropriate protective clothing.
Small Hive Beetle (adults)	coumaphos (CheckMite+)	Plastic strip; pesticide-impregnated	Use protective gloves when handling strips. Attach to cardboard or other material as specified on label direction and place strip-side down on bottom board to kill adult beetles. Application for varroa mites (see above) is not simultaneously effective for SHB.
(pupae)	permethrin (GardStar)	Liquid; mix with water	For ground treatment around hive(s) only. Kills larvae/pupae during soil-inhabiting phase of beetle life cycle. Mix and apply to soil according to label directions.
Wax Moth	paradichlorobenzene (Para-Moth)	Crystalline granules	Use to prevent infestation of stored hive equipment (drawn-comb) only. Do not use in hives containing honey bees. Use protective gloves when handling crystals. Store product in sealed container when not in use.

Always follow label directions, which require the removal of honey from beehives prior to most pesticide treatments.

Reducing the Risk of Pesticide Poisoning to Honey Bees

Precautions for the Pesticide Applicator

1. Always read and follow any warning statements regarding honey bees on the pesticide label.
2. If more than one product gives good control of the target pest, select a pesticide from the moderately toxic or relatively non-toxic groups instead of the highly toxic group from Table 5-1A.
3. Avoid applying any bee-toxic pesticides on blooming plants that attract bees. Keep pesticide drift from nearby blooming weeds that are attracting bees.
4. Time of pesticide application is very important. Apply pesticides that are toxic to bees in the late afternoon (after 3 p.m.) or in the evening if at all possible. Most honey bees have stopped foraging and have returned to their hives by 3 p.m. This allows maximum time for the active ingredient to break down before the bees come into contact with it the next day.
5. Select the safest formulation of the pesticide that is available for the intended use. "Drifting" of the pesticide from the target pest or crop to areas frequented by bees should be minimized and formulation selection is the key to this problem.
    a. "Dusts" almost always drift more than other pesticide formulations and are generally more dangerous to bees than are sprays or granular applications.
    b. Spray formulations are usually safer to bees than dusts, but there are differences among the spray formulation types. Generally, water-soluble formulations are safer than are emulsifiable-formulations, and fine sprays are less dangerous than are coarse sprays. Sprays of undiluted technical pesticide (ULV) may be more dangerous than diluted sprays.
    c. **Granular applications generally are the least likely to drift and accidentally kill bees.** Consider a granular formulation if it is suitable for controlling the target pest.
6. The mode of pesticide application is also important, particularly from a drifting standpoint. Aerial applications are generally more dangerous than applications by ground equipment. If a pesticide application is being made by air, it is the contractor's responsibility to notify any beekeepers that have *registered* apiaries (one or more hives of bees) within 1/2 mile of the area to be aerially sprayed. These regulations are defined in the N.C. Pesticide Laws, and the person responsible for the notification is the person who contracts for the aerial application.
7. Never apply any pesticide directly over a beehive. The NC Department of Agriculture & Consumer Services provides a voluntary program (DriftWatch) where you can check for apiaries near your location: ncagr.gov/pollinators/Driftwatch.htm
8. Notify beekeepers who have beehives near an area to be treated with a pesticide so that they may attempt to protect their bees.
9. Follow proper precautions in disposing of unused pesticides and pesticide containers. Be particularly careful not to contaminate water with pesticides, as the water may be collected by bees and result in bee kills.

Precautions for the Beekeeper

1. If your bees are located in any area where pesticides are commonly used, then identify yourself as a beekeeper to your neighbors who may use pesticides. The NC Department of Agriculture & Consumer Services provides a voluntary program (DriftWatch) where you can map your apiary location: ncagr.gov/pollinators/Driftwatch.htm
10. Identify your apiaries with your name and address or telephone number if the apiary is not associated with your residence so that you may be notified if pesticides are to be used by a neighboring individual.
11. Explain the importance of your bees in the pollination of crops being grown on nearby fields to those growers so that they may consider the value of the bees in pollination before applying any pesticides that may kill the pollinating insects.
12. Be aware of the precautions that apply to the pesticide applicator (above) so that you can serve as a resource in providing solutions to reducing bee kills.
13. Do not place apiaries in areas used to grow crops that require heavy and frequent usage of pesticides.
14. Register your apiary locations with the N.C. Department of Agriculture if aerial applications of pesticides are used in your apiary locations.
15. As a very last resort, move your beehives if possible when bee-toxic pesticides are being applied near your apiary. Covering the hives (for instance, with wet burlap) is usually not possible for large apiaries and can cause bees to overheat or suffocate.

Additional resources

NC State Extension – Pesticide Stewardship: pesticidestewardship.org/pollinator-protection

NC Department of Agriculture – Protecting NC Pollinators: ncagr.gov/spcap/bee

Reducing pesticide poisoning in bees (OSU): catalog.extension.oregonstate.edu/sites/catalog/files/project/pdf/pnw591.pdf

Insect Control in Field Corn

D. D. Reisig and A.S. Huseth, Entomology and Plant Pathology

Table 5-2. Insect Control in Field Corn

Insect	Insecticide, Mode of Action Code, and Formulation	Per Acre		Acres/gal (lb)	Preharvest Interval (PHI) (Days)	Precautions and Remarks
		Amount	Active (lb)			
Annual White Grub — At Planting Seed Treatments/In Furrow	bifenthrin, MOA 3 (Capture) LFR	3.4 to 13.6 oz	0.047 to 0.062	38 to 9.4	30	Provides control alone, without addition of seed treatment
	clothianidin, MOA 4A (Poncho) 600 FS		0.25 mg per kernel			0.5 and 1.25 mg per kernel rate can provide improved control under high pest pressure or slow grow off conditions.
	thiamethoxam, MOA 4A + chlorantraniliprole, MOA 28 (Lumivia) 5 FS		0.25 mg thiamethoxam + 0.25 mg chlorantraniliprole per kernel			The amount of chlorantraniliprole per seed can be increased to 0.5 or 1.25 mg per seed. Additional chlorantraniliprole will provide a marginal improvement over the base rate of 0.25 mg chlorantraniliprole + 0.25 mg thiamethoxam. Lowest use rates should be adequate in most situations.
Billbug — At Planting Seed Treatments	clothianidin, MOA 4A (Poncho) 600 FS		1.25 mg per kernel			Must be special-ordered from a seed dealer. In most situations, these products will provide adequate control. Corn planted near previous year's corn, corn planted mid-April, and corn near good overwintering habitats are most at risk. In these situations, these products will not provide adequate control. Not advisable to use more than 0.5 mg clothianidin per kernel with terbufos to avoid seedling injury.
	clothianidin, MOA 4A (Poncho) 600 FS + terbufos, MOA 1B (Counter) 15G		0.5 mg clothianidin per kernel + 8 oz/1,000 ft terbufos per acre			
	thiamethoxam, MOA 4A (Cruiser) 5 FS		1.25 mg per kernel			
Brown Stink Bug- At Planting Seed Treatment	clothianidin, MOA 4A (Poncho) 600 FS		0.25 to 1.25 mg per kernel			Brown stink bug is labeled by the manufacturer for control up to the 0.5 mg per kernel. However, NC State efficacy data indicates that clothianidin reduces stink bug injury at the 1.25 mg per kernel; this rate is permitted in NC under FIFRA 2(ee).
Brown Stink Bug	beta-cyfluthrin, MOA 3 (Baythroid XL) 1.0 EC	2.8 fl oz	0.022	45.7	21	Management recommendations and thresholds can be found at: corn.ces.ncsu.edu/stink-bug-management-in-corn Seedling injury mainly occurs in no-till situations. On larger plants, apply to stages just prior to tasseling. On tall corn, use ground application only at 15+ gallons spray volume per acre. If applied by air, work with applicator to ensure adequate coverage in the zone where the ear is forming. Results may be poor to mediocre depending on application. Insecticides can be effective up to, or less than, one week after application. Bifenthrin is the superior pyrethroid (MOA 3), but all pyrethroids listed and MOA 1B are effective.
	Bifenthrin, MOA 3 (Brigade, Discipline, Sniper, and others) 2 EC	6.4 fl oz	0.10	20	30	
	bifenthrin, MOA 3 + zeta-cypermethrin, MOA 3 (Hero) 1.24 EC	10.3 fl oz	0.1	12.4	60 (forage) 30 (grain and stover)	
	bifenthrin, MOA 3 + zeta-cypermethrin, MOA 3 (Steed) 1.5 EC	4.7 fl oz	0.055	27.2	60 (forage) 30 (grain and stover)	
	cyfluthrin, MOA 3 (Tombstone) 1.0 EC	2.8 fl oz	0.044	45.7	21	
	lambda-cyhalothrin, MOA 3 (Lambda-cyhalothrin, Silencer) 1.0 EC	3.84 fl oz	0.03	33.3	21	
	lambda-cyhalothrin, MOA 3 (Warrior II) 2.08 CS	1.92 fl oz	0.03	66.7	21	
	zeta-cypermethrin, MOA 3 (Mustang Maxx) 0.8 EC	4.0 fl oz	0.025	32	30	
	zeta-cypermethrin, MOA 3 + bifenthrin, MOA 3 (Hero) 1.24 EC	10.3 fl oz	0.033 + 0.066	12.4	30	
Corn Leaf Aphid	pyrethroids, MOA 3 and pyrethroid combinations	(see brown stink bug above for rates)				
Corn Earworm — In Whorl	*Bacillus thuringiensis* (Bt) transgenic corn, MOA 11A (Agrisure, Viptera, Optimum Leptra, and Trecepta)					This is transgenic corn seed. Plants will express Bt endotoxin. Observe the refuge specifications on the label. Corn earworm is not a yield-limiting pest in timely planted corn. Treating corn earworm with a foliar insecticide in field corn is ineffective for control.
	chlorantraniliprole, MOA 28 (Prevathon) 0.43 SC (Vantacor) 5 SC	 14 to 20 fl oz 1.2 to 1.7 oz	 0.047 to 0.067 0.047 to 0.067	 9.1 to 6.4 9.1 to 6.4	 14 14	

Table 5-2. Insect Control in Field Corn

Insect	Insecticide, Mode of Action Code, and Formulation	Per Acre		Acres/gal (lb)	Preharvest Interval (PHI) (Days)	Precautions and Remarks
		Amount	Active (lb)			
Cutworm — Postemergence	Bt transgenic corn, MOA 11A (Agrisure Viptera, Herculex, Leptra, PowerCore, Optimum Intrasect, SmartStax, Trecepta)	See remarks				This is transgenic corn seed. Observe the refuge specifications on the label.
	beta-cyfluthrin, MOA 3 (Baythroid XL) 1.0 EC	1.6 to 2.8 fl Oz	0.017 to 0.022	80 to 45.7	21	Best to direct spray to the plant base and use at least 15 gallons volume per acre by ground. Pyrethroids are suggested for organic soils. Use higher insecticide rates for heavier infestations or aerial application.
	bifenthrin, MOA 3 (Brigade, Discipline, Sniper, and others) 2 EC	2.1 to 6.4 fl oz	0.033 to 0.10	61 to 20	30	
	bifenthrin, MOA 3 + zeta-cypermethrin, MOA 3 (Hero) 1.24 EC	2.6 to 6.1 fl oz	0.25 to 0.06	49.2 to 21	60 (forage) 30 (grain and stover)	
	bifenthrin, MOA 3 + zeta-cypermethrin, MOA 3 (Steed) 1.5 EC	2.5 to 3.5 fl oz	0.029 to 0.041	51.2 to 36.6	60 (forage) 30 (grain and stover)	
	cyfluthrin, MOA 3 (Tombstone) 1.0 EC	0.8 to 1.6 fl oz	0.013 to 0.025	160 to 80	21	
	esfenvalerate, MOA 3 (Asana XL) 0.66 EC	5.8 to 9.6 fl oz	0.03 to 0.05	22.1 to 13.3	21	
	gamma-cyhalothrin, MOA 3 (Declare) 1.25 EC	0.77 to 1.28 fl oz	0.0075 to 0.0125	166.2 to 100	21	
	lambda-cyhalothrin, MOA 3 (Lambda-cyhalothrin, Silencer) 1.0 EC	1.9 to 3.2 fl oz	0.015 to 0.025	67.4 to 40	21	
	lambda-cyhalothrin, MOA 3 (Warrior II) 2.08 CS	1 to 1.6 fl oz	0.015 to 0.025	128 to 80	21	
	methoxyfenozide, MOA 18A (Intrepid) 2F	4 to 8 fl oz	0.06 to 0.12	32 to 16	21	
	zeta-cypermethrin, MOA 3 (Mustang Maxx) 0.8 EC	1.3 to 2.8 fl oz	0.008 to 0.0175	98.5 to 45.7	30	
European Corn Borer	Bt transgenic corn, MOA 11A (Agrisure Viptera, Genuity VT Double/Triple PRO, Herculex, Leptra, Optimum Intrasect, PowerCore, SmartStax, Trecepta)	See remarks				This is transgenic corn seed. Plants will express Bt endotoxin. Observe the refuge specifications on the label.
	beta-cyfluthrin, MOA 3 (Baythroid XL) 1.0 EC	1.6 to 2.8 oz	0.017 to 0.022	80 to 45.7	21	Must be applied before borers enter stalk. Apply by ground only and into plant whorls with at least 25 gallons water per acre. Use 30 psi or less. A surfactant may improve whorl penetration.
	Bifenthrin, MOA 3 (Brigade, Discipline, Sniper, and others) 2 EC	2.1 to 6.4 oz	0.033 to 0.10	61 to 20	30	
	bifenthrin, MOA 3 + zeta-cypermethrin, MOA 3 (Hero) 1.24 EC	4.0 to 10.3 oz	0.4 to 0.10	32 to 12.4	60 (forage) 30 (grain and stover)	
	bifenthrin, MOA 3 + zeta-cypermethrin, MOA 3 (Steed) 1.5 EC	3.5 to 4.7 oz	0.041 to 0.055	36.6 to 27.2	60 (forage) 30 (grain and stover)	
	chlorantraniliprole, MOA 28 (Prevathon) 0.43 SC (Vantacor) 5 SC	14 to 20 fl oz 1.2 to 1.7 oz	0.047 to 0.067 0.047 to 0.067	9.1 to 6.4 9.1 to 6.4	14 14	
	cyfluthrin, MOA 3 (Tombstone) 1.0 EC	1.6 to 2.8 fl oz	0.025 to 0.044	80 to 45.7	21	Must be applied before borers enter stalk. Apply by ground only and into plant whorls with at least 25 gallons water per acre. Use 30 psi or less. A surfactant may improve whorl penetration.
	esfenvalerate, MOA 3 (Asana XL) 0.66 EC	9.6 fl oz	0.05	13.3	21	
	gamma-cyhalothrin, MOA 3 (Declare) 1.25 EC	1.02 to 1.54 fl oz	0.01 to 0.015	125.5 to 83.1	21	
	lambda-cyhalothrin, MOA 3 (Lambda-cyhalothrin, Silencer) 1.0 EC	2.6 to 3.8 fl oz	0.02 to 0.03	49.2 to 33.7	21	
	lambda-cyhalothrin, MOA 3 (Warrior II) 2.08 CS	1.28 to 1.92 fl oz	0.02 to 0.03	100 to 66.7	21	
	methoxyfenozide, MOA 18A (Intrepid) 2F	4 to 8 fl oz	0.06 to 0.12	32 to 16	21	
	spinosad, MOA 5 (Blackhawk) 4 SC	1.67 to 3.3 fl oz	0.038 to 0.075	76.6 to 38.8	28	
	zeta-cypermethrin, MOA3 (Mustang Maxx) 0.8 EC	2.7 to 4.0 fl oz	0.017 to 0.025	47.4 to 32	30	
Fall Armyworm — In Whorl	Bt transgenic corn, MOA 11A (Agrisure Viptera, Genuity VT Double/Triple PRO, Leptra, PowerCore, SmartStax, Trecepta)		See remarks			This is transgenic corn seed. Plants will express Bt endotoxin. Observe the refuge specifications on the label.
	chlorantraniliprole, MOA 28 (Prevathon) 0.43 SC (Vantacor) 5 SC	14 to 20 fl oz 1.2 to 1.7 oz	0.047 to 0.067 0.047 to 0.067	9.1 to 6.4 9.1 to 6.4	14 14	Use a minimum of 15 gallons per acre by ground for whorl treatment (not by air). Low pressure spray and addition of surfactant may help liquid to penetrate into whorl. Application to large caterpillars may not give satisfactory results.

Table 5-2. Insect Control in Field Corn

Insect	Insecticide, Mode of Action Code, and Formulation	Per Acre		Acres/gal (lb)	Preharvest Interval (PHI) (Days)	Precautions and Remarks
		Amount	Active (lb)			
Grasshopper	bifenthrin, MOA 3 (Brigade, Discipline, Sniper, and others) 2 EC	2.1 to 6.4 fl oz	0.033 to 0.10	61 to 20	30	Apply by air or ground uniformly over foliage as a broadcast treatment. Early morning treatment preferred. Use higher rates for heavy infestation. Grasshoppers are often confined to field margins.
	pyrethroids, MOA 3 and pyrethroid combinations	(see European corn borer above for rates)				
Sod Webworm, Chinch Bug	bifenthrin, MOA 3 (Brigade, Discipline, Sniper, and others) 2 EC	2.1 to 6.4 fl oz	0.033 to 0.1	61 to 20	30	Apply to base of seedlings as a directed spray or over the row. Seldom an economic problem. Use higher rates for chinch bugs. Drop nozzles at 15 gallons per acre or above will give better results.
	carbaryl, MOA 1A (Sevin XLR Plus) 4 EC	2 pt	1	4	14	Apply to base of seedlings as directed spray or over the row. Seldom an economic problem. Use higher rates for chinch bugs. Drop nozzles at 15 gallons per acre or above will give better results.
	clothianidin, MOA 4A (Poncho) 600 FS		0.25 to 1.25 mg per kernel			1250 rate must be special-ordered from a seedsman.
	pyrethroids, MOA 3 and pyrethroid combinations	(see European corn borer above for rates)				
	thiamethoxam, MOA 4A (Cruiser) 5 FS		0.5 to 1.25 mg per kernel			
Sugarcane Beetle — At Planting Treatments	clothianidin, MOA 4A (Poncho) 600 FS		1.25 mg per kernel			This seed treatment combined with an in-furrow insecticidal granular or liquid application will still provide only fair control. 1250 rate must be special-ordered from a seedsman.
	clothianidin, MOA 4A + in-furrow insecticide, MOA 1B (Poncho 500) + (various, for instance., chlorpyrifos (Lorsban 15G), phosphorothioic acid + bifenthrin (SmartChoice), tebupirimphos + cyfluthrin (Aztec), and terbofos (Counter).					See recommendations for seed treatment above. Granular insecticide alone without seed treatment, or 500 rate of seed treatment alone without granular insecticide, will not provide adequate control. Expect only fair control.
True Armyworm — In Whorl and on Foliage	bifenthrin, MOA 3 (Brigade, Discipline, Sniper, and others) 2 EC	2.1 to 6.4 oz	0.04 to 0.16	61 to 20	30	Apply into plant whorls where caterpillars are located and use a minimum of 15 gallons per acre. Treat when caterpillars are small. Aerial application is satisfactory when caterpillars are not in whorl (post-tassel). Armyworm problems are usually confined to no-till planted corn seedlings in non-Bt corn. Consult county agent for scouting information.
	chlorantraniliprole, MOA 28 (Prevathon) 0.43 SC (Vantacor) 5 SC	14 to 20 fl oz 1.2 to 1.7 oz	0.047 to 0.067 0.047 to 0.067	9.1 to 6.4 9.1 to 6.4	14 14	
	methomyl, MOA 1A (Lannate) 2.4 LV	0.75 to 1.5 pt	0.23 to 0.45	10.7 to 5.3	3 (forage)	
	methomyl, MOA 1A (Lannate) 90 SP	0.25 to 0.5 lb	0.23 to 0.45	4 to 2	21 (fodder)	
	pyrethroids, MOA 3 and pyrethroid combinations	(see European corn borer above for rates)				
	spinosad, MOA 6 (Blackhawk) 4 SC	1.67 to 3.3 fl oz	0.038 to 0.075	76.6 to 38.8	7 (forage or seed) 28 (grain)	

Table 5-2. Insect Control in Field Corn

Insect	Insecticide, Mode of Action Code, and Formulation	Per Acre		Acres/gal (lb)	Preharvest Interval (PHI) (Days)	Precautions and Remarks
		Amount	Active (lb)			
Western or Northern Corn Rootworm — At Planting, Seed Treatments	Bt transgenic corn, MOA 11A (Agrisure, Herculex XTRA, Genuity VT Triple PRO, Optimum Intrasect XTRA, SmartStax, SmartStax PRO)		See remarks			This transgenic corn is designed to prevent root injury from rootworm larvae. Usually only needed in corn following corn. Observe the refuge specifications on the label. There is known resistance to the traits Cry3Bb1 and mCry3A (Agrisure, Genuity VT Triple PRO). No known resistance to products with Cry34AB1/Cry35Ab1 (Herculex XTRA, Optimum Intrasect XTRA, SmartStax, SmartStax PRO).
	clothianidin, MOA 4A (Poncho) 600 FS		1.25 mg/kernel			Must be special-ordered from a seedsman. Rootworms mainly a problem in Piedmont and mountain regions where corn is not rotated.
	phorate, MOA 1B (Thimet) 20 G	6 oz/1,000 ft				Apply granules in a 6- to 7-inch band over the open seed furrow and in front of the planter press wheel at planting time. Consult product label for incorporation instructions. Terbufos may be applied directly into the seed furrow. Do not apply phorate into seed furrow as seedling injury may occur. Terbufos may interact with Beacon herbicide and injure plants. Consult label.
	tefluthrin, MOA 1A (Force) 3.0 G	4 to 5 oz/1,000 ft	*			
	tefluthrin, MOA 1A (Force) CS	0.46 to 0.57 oz/1,000 ft				
	terbufos, MOA 1B (Counter) 20 G	6 oz/1,000 ft	*			
Wireworm — At Planting Treatments	bifenthrin, MOA 3 (Capture) LFR	3.4 to 13.6 oz	0.047 to 0.062			Apply as an in-furrow spray, microstream, or t-band.
	clothianidin, MOA 4A (Poncho) 600 FS	0.5 to 1.25 mg/ kernel				1250 rate must be special-ordered from a seedsman.
	phorate, MOA 1B (Thimet) 20G	6 oz/1,000 ft				Apply only in T-band over open furrows. Results may be poor if approximately 50% fails to fall with the seed (into seed furrows); however, in-furrow application may reduce stand.
	tefluthrin, MOA 1A (Force) 3.0 G	4 to 5 oz/1,000 ft	*			T-band or in-furrow. If T-banded, some granules must fall with seed for wireworm control. Wireworm control is improved when used in-furrow. Terbufos may interact with Beacon herbicide when used in-furrow.
	tefluthrin, MOA 1A (Force) CS	0.46 to 0.57 oz/1,000 ft				
	terbufos, MOA 1A (Counter) 20 G	6 oz/1,000 ft	*			
	thiamethoxam, MOA 4A (Cruiser) 5 FS	0.5 to 1.25 mg/ kernel				
	thiamethoxam, MOA 4A + chlorantraniliprole, MOA 28 (Lumivia)		0.25 mg + 0.25 mg per kernel			

* For 30-inch or wider row spacings.

PRECAUTIONS: Always use pesticides according to label directions. Be mindful of reducing the impact of pesticides on wildlife and groundwater.

Insect Control in Grain Sorghum

D. D Reisig and A.S. Huseth, Entomology and Plant Pathology

Table 5-3. Insect Control in Grain Sorghum

Insect	Insecticide, Mode of Action Code, and Formulation	Per Acre		Acres/gal (lb)	Preharvest Interval (PHI) (Days)	Precautions and Remarks
		Amount	Active (lb)			
Aphid (including sugarcane aphid) — At Planting, Seed Treatments	clothianidin, MOA 4A (Poncho) 600 FS	5.1 to 6.4 oz/cwt	See label			Follow label instructions for mixing.
	clothianidin, MOA 4A + *Bacillus firmus* (for nematodes) (Poncho/VOTiVO)	6.13 fl oz/cwt	See label			
	imidacloprid, MOA 4A (Gaucho) 480 FS	8 fl oz/cwt	See label		45 (forage)	
	imidacloprid, MOA 4A (Gaucho) 600 FS	6.4 fl oz/cwt				
	thiamethoxam, MOA 4A (Cruiser) 5 FS	5.1 to 7.6 fl oz	See label		45 (forage)	
Aphid (excluding sugarcane aphid) — Foliar	beta-cyfluthrin, MOA 3 (Baythroid XL) 1.0 EC	1.6 to 2.8 oz	0.017 to 0.022	80 to 45.7	21	Ground application with at least 15 gallons water per acre is preferred. Aerial application should use at least 5 gallons water per acre. At least 300 aphids per plant are necessary to justify treatment.
	cyfluthrin, MOA 3 (Tombstone) 1.0 EC	1.3 to 2.8 oz	0.2 to 0.044	98.5 to 45.7	14	
	dimethoate, MOA 1B (Dimethoate) 4 EC	0.5 to 1 pt	0.25 to 0.5	16 to 8	28	
	lambda-cyhalothrin, MOA 3 (Lambda-cyhalothrin, Silencer) 1.0 EC	2.56 to 3.84 fl oz	0.02 to 0.03	50 to 33.3	30	
	lambda-cyhalothrin, MOA 3 (Warrior II) 2.08 CS	1.28 to 1.92 fl oz	0.02 to 0.3	100 to 66.7	30	
	zeta-cypermethrin, MOA 3 (Mustang Maxx) 0.8 EC	3.2 to 4.0 fl oz	0.02 to 0.25	40 to 32	14 (grain) 45 (forage)	
Aphid (sugarcane aphid only) — Foliar	flupyradifurone, MOA 4D (Sivanto) 200 SL	4 to 7 fl oz	0.052 to 0.091	32 to 18.3	21 (grain) 7 (forage)	A maximum of 28 ounces per acre can be used in a season.
	sulfoxaflor, MOA 4C (Transform) 50 WG	0.75 to 1.5 oz	0.024 to 0.047	171 to 85	14 (grain) 7 (forage)	A maximum of 3 ounces per acre can be used in a season.
Chinch Bug — At Planting	clothianidin, MOA 4A (Poncho) 600 FS	5.1 to 6.4 oz/100 lb seed	See label			Follow label instructions for mixing.
	imidacloprid, MOA 4A (Gaucho) 480 FS	8 fl oz/cwt	See label		45 (forage)	
	imidacloprid, MOA 4A (Gaucho) 600 FS	6.4 fl oz/cwt	See label		45 (forage)	
	thiamethoxam, MOA 4A (Cruiser) 5 FS	7.6 fl oz	See label		45 (forage)	
Chinch Bug — Foliar	carbaryl, MOA 1A (Sevin XLR Plus) 4 EC	3 pt	1.5	2.7	21	Apply to base of plants where insects congregate. Begin applications when insects migrate from small grains or grass weeds to sorghum. Expect fair control from pyrethroids (MOA 3).
	chlorpyrifos, MOA 1B (Lorsban-4E) -4E	0.67 to 1.33 lbs	0.5 to 1.0	1.5 to 0.75	28	
	pyrethroids, MOA 3 and pyrethroid combinations	(use highest labeled rates)	See label			
Corn Earworm/Webworm — In Heads	*Bacillus thuringiensis*, MOA 11A (Various)				0	Best when larvae are small.
	carbaryl, MOA 1A (Sevin XLR Plus) 4 EC	3 pt	1.5	2.7	21	Ground application with at least 15 gallons water per acre is preferred. Aerial application should use at least 5 gallons water per acre. Use higher rates by air for serious infestation. Threshold is one medium to large earworm or armyworm per head or three webworms per head. Entrust is OMRI listed.
	chlorantraniliprole, MOA 28 (Prevathon) 0.43 SC (Vantacor) 5 SC	 14 to 20 fl oz 1.2 to 1.7 oz	 0.047 to 0.067 0.047 to 0.067	 9.1 to 6.4 9.1 to 6.4	 14 14	
	methomyl, MOA 1A (Lannate) 2.4 LV	0.75 to 1.5 pt	0.23 to 0.45	10.7 to 5.3	14	
	methomyl, MOA 1A (Lannate) 90 SP	0.25 to 0.5 lb	0.23 to 0.45	4 to 2	14	
	spinosad, MOA 5 (Blackhawk) 4 SC spinosad, MOA 5 (Entrust) 80 WP	1.7 to 3.0 oz 1 to 2 oz	0.039 to 0.068 0.05 to 0.01	75.3 to 42.7 16 to 8	21 (grain) 3 (forage)	

Table 5-3. Insect Control in Grain Sorghum

Insect	Insecticide, Mode of Action Code, and Formulation	Per Acre		Acres/gal (lb)	Preharvest Interval (PHI) (Days)	Precautions and Remarks
		Amount	Active (lb)			
Fall Armyworm	chlorantraniliprole, MOA 28 (Prevathon) 0.43 SC (Vantacor) 5 SC	 14 to 20 fl oz 1.2 to 1.7 oz	 0.047 to 0.067 0.047 to 0.067	 9.1 to 6.4 9.1 to 6.4	 14 14	Difficult to control—ground application only with high volume. Direct spray into whorls. Treat at 80% infestation (one worm per plant) or 40% infestation (multiple worms per plant). Treat when worms are small. Addition of surfactant and application when dew is on plant may be helpful. Entrust is OMRI listed.
	methomyl, MOA 1A (Lannate) 2.4 LV	0.75 to 1.5 pt	0.23 to 0.45	10.7 to 5.3	14	
	methomyl, MOA 1A (Lannate) 90 SP	0.25 to 0.5 lb	0.23 to 0.45	4 to 2	14	
	spinosad, MOA 5 (Blackhawk) 4 SC	1.7 to 3.0 oz	0.039 to 0.068	75.3 to 42.7	21 (grain)	
	spinosad, MOA 5 (Entrust) 80 WP	1 to 2 oz	0.05 to 0.01	16 to 8	3 (forage)	

Insect Control in Small Grains

D. D. Reisig and A.S. Huseth, Entomology and Plant Pathology

Table 5-4. Insect Control in Small Grains

Insect	Insecticide, Mode of Action Code, and Formulation	Per Acre		Acres/gal (lb)	Preharvest Interval (PHI) (Days)	Precautions and Remarks
		Amount	Active (lb)			
Aphid — At Planting, Seed Treatments	imidacloprid, MOA 4A (Gaucho) 480 FS	1 to 3 fl oz/cwt	See label		45 (forage)	Early season protection against aphids. Has shown barley yellow dwarf suppression. Most effective on early planted grains. Check label for plant-back restrictions. See Hessian fly section.
	imidacloprid, MOA 4A (Gaucho) 600 FS	0.8 to 2.4 fl oz/cwt				
	imidacloprid, MOA 4A (Gaucho) XT	3.5 fl oz/cwt				
	thiamethoxam, MOA 4A (Cruiser) 5 F	0.75 to 1.33 fl oz/cwt	See label		45 (forage)	
Aphid — Foliar	beta-cyfluthrin, MOA 3 (Baythroid XL) 1.0 EC	1.8 to 2.4 fl oz	0.014 to 0.019	71.1 to 53.3	7 (forage) 30 (harvest)	
	cyfluthrin, MOA 3 (Tombstone) 1.0 EC	1.8 to 2.4 fl oz	0.028 to 0.038	71.1 to 53.3	30	
	dimethoate, MOA 1B (Dimethoate) 4 EC	0.5 to 0.75 pt	0.25 to 0.37	16 to 10.7	35	Could reduce barley yellow dwarf virus infection if sprayed before March, especially on susceptible varieties. Consult local Extension agent for scouting and threshold suggestions. Keep lambda-cyhalothrin away from waterways.
	lambda-cyhalothrin, MOA 3 (Lambda-cyhalothrin, Silencer) 1.0 EC	2.56 fl oz	0.02	50	30	
	lambda-cyhalothrin, MOA 3 (Warrior II) 2.08 C	1.28 fl oz	0.03	100	30	
	zeta-cypermethrin, MOA 3 (Mustang Maxx) 0.8 EC	3.2 to 4.0 fl oz	0.02 to 0.025	40 to 32	14	
Cereal Leaf Beetle	beta-cyfluthrin, MOA 3 (Baythroid XL) 1.0 EC	1.0 to 1.8 fl oz	0.008 to 0.014	128 to 71.1	7 (forage) 30 (harvest)	Use where beetle eggs/larvae are above threshold. Application of insecticide with topdress fertilizer for preventative control is not advised. Lower rates should only be used where population densities are above threshold, but moderate.
	carbaryl, MOA 1A (Sevin XLR Plus) 4 EC	1 pt	0.5	8	21	
	chlorpyrifos, MOA 1B + lambda-cyhalothrin, MOA 3 (Cobalt Advanced) 2.63 EC	11 to 25 fl oz	See label	11.6 to 2.3	30	
	cyfluthrin, MOA 3 (Tombstone) 1.0 EC	1.0 to 1.8 fl oz	0.016 to 0.028	128 to 71.1	30	
	gamma-cyhalothrin, MOA 3 (Declare) 1.25 EC	1.02 to 1.54 oz	0.01 to 0.015	125.5 to 83.1	30	
	lambda-cyhalothrin, MOA 3 (Lambda-cyhalothrin, Silencer) 1.0 EC	2.56 fl oz	0.02	50	30	
	lambda-cyhalothrin, MOA 3 (Warrior II) 2.08	1.92 fl oz	0.03	66.7	30	
	methomyl, MOA 1A (Lannate) 2.4 LV	1 to 2 pt	0.22 to 0.45	8 to 4	7	
	methomyl, MOA 1A (Lannate) 90 SP	0.25 to 0.5 lb	0.22 to 0.45		7	
	zeta-cypermethrin, MOA 3 (Mustang Maxx) 0.8 EC	1.6 to 4.0 fl oz	0.011 to 0.025	80 to 32	14	
Hessian Fly— Fall Generation	imidacloprid, MOA 4A (Gaucho) 600 FS	1.2 to 2.4 fl oz/cwt	See label		45 (forage)	Early season protection against Hessian fly. Seed usually treated by seedsman. Acknowledge plant-back restriction.
	imidacloprid, MOA 4A (Gaucho) XT	3.5 fl oz/cwt				
	imidacloprid, MOA 4A (Rancona Crest)	5.0 to 8.3 fl oz/cwt				
	thiamethoxam, MOA 4A (Cruiser) 5 FS	0.75 to 1.33 oz/cwt	See label		45 (forage)	
Hessian Fly— Fall and Late Winter Generations	beta-cyfluthrin, MOA 3 (Baythroid XL) 1.0 EC	2.4 fl oz	0.019	53.3	3 (forage) 30 (harvest)	Apply to fields with high egg count in fall; preferable at or before the 2 to 3 leaf stage. In spring, apply to infested fields as flies emerge. Use high rates for heavy infestations. Recent NC State University experiments suggest that a resistant variety or seed treatment are far superior to foliar sprays as rescue treatments.
	cyfluthrin, MOA 3 (Tombstone) 1.0 EC	2.4 fl oz	0.038	53.3	30	
	lambda-cyhalothrin, MOA 3 (Lambda-cyhalothrin, Silencer) 1.0 EC	3.8 fl oz	0.03	33.7	30	
	lambda-cyhalothrin, MOA 3 (Warrior II) 2.08 EC	1.92 fl oz	0.03	66.7	30	
	zeta-cypermethrin, MOA 3 (Mustang Maxx) 0.8 EC	4 fl oz	0.025	32	14	

Table 5-4. Insect Control in Small Grains

Insect	Insecticide, Mode of Action Code, and Formulation	Per Acre		Acres/gal (lb)	Preharvest Interval (PHI) (Days)	Precautions and Remarks
		Amount	Active (lb)			
True Armyworm — Spring	beta-cyfluthrin, MOA 3 (Baythroid XL) 1.0 EC	1.8 to 2.4 fl oz	0.013 to 0.019	71.1 to 53.3	3 (forage) 30 (harvest)	Apply by air or ground when armyworms are at 2 per square foot or greater. Use higher rates when caterpillars are very numerous. High volume (3 to 5 gallons per acre) may be beneficial in thickly planted wheat. Poor performance may result when temperatures are cool or when rainfall washes residues from plants. Best to apply when conditions are warm (60ºF or greater) and armyworms are active. Carbaryl may stimulate aphid populations. Entrust is OMRI listed.
	carbaryl, MOA 1A (Sevin XLR Plus) 4 EC	1.5 pt	0.75	5.3	21	
	chlorantrapiliprole, MOA 28 (Prevathon) 0.43 SC	14 to 20 oz	0.047 to 0.067	9.1 to 6.4	21	
	cyfluthrin, MOA 3 (Tombstone) 1.0 EC	1.8 to 2.4 fl oz	0.028 to 0.038	71.1 to 53.3	30	
	gamma-cyhalothrin, MOA 3 (Declare) 1.25 EC	1.02 to 1.54 oz	0.01 to 0.015	125.5 to 83.1	30	
	lambda-cyhalothrin, MOA 3 (Lambda-cyhalothrin, Silencer) 1.0 EC	2.6 to 3.8 fl oz	0.02 to 0.03	49.2 to 33.7	30	
	lambda-cyhalothrin, MOA 3 (Warrior II) 2.08	1.28 to 1.92 fl oz	0.02 to 0.03	100 to 66.7	30	
	methomyl, MOA 1A (Lannate) 2.4 LV	1.5 pt	0.45	5.3	7	
	methomyl, MOA 1A (Lannate) 90 SP	0.5 lb	0.45	2	7	
	spinosad, MOA 5 (Blackhawk) 4 SC	1.1 to 3.0 oz	0.026 to 0.068	116.4 to 42.7	3 (forage)	
	spinosad, MOA 5 (Entrust) 80 WP	1 to 2 oz	0.05 to 0.01	16 to 8	21 (harvest)	
	zeta-cypermethrin, MOA 3 (Mustang Maxx) 0.8 EC	1.6 to 4.0 oz	0.011 to 0.025	80 to 32	14	
Wireworm — At Planting	imidacloprid, MOA 4A (Gaucho) 480 FS	1 fl oz/cwt	See label		45 (forage)	See remarks under Aphids. Seed treatments must be applied by seedsman.
	imidacloprid, MOA 4A (Gaucho) 600 FS	0.8 fl oz/cwt				
	imidacloprid, MOA 4A (Gaucho) XT	3.5 fl oz/cwt				
	imidacloprid, MOA 4A (Rancona Crest)	8.3 fl oz/cwt				
	thiamethoxam, MOA 4A (Cruiser) 5 FS	0.75 fl oz/cwt	See label		45 (forage)	

CAUTION: Always use pesticides according to label directions. Be mindful of reducing the impact of pesticides on wildlife and groundwater.

Insect Control on Cotton

D. D. Reisig and A.S. Huseth, Entomology and Plant Pathology

NOTE: Use the Mode of Action (MOA) codes following each insecticide to combat the development of insecticide resistance. Active ingredients sharing the same letter/number have the same mode of action.

Table 5-5A. Insect Control on Cotton

Insect	Insecticide, Mode of Action (MOA), and Formulation	Per Acre		Acres/gal (lb)	Pre-harvest Interval (days)	Precautions and Remarks
		Amount	Active (lb)			
Beet Armyworm — Foliar	chlorantraniliprole, MOA 28 (Prevathon) 0.43 SC (Vantacor) 5 SC	14 to 27 fl oz 1.2 to 2.5 oz	0.047 to 0.067 0.047 to 0.098	9.1 to 6.4 9.1 to 6.4	14 14	Bollgard II, Bollgard 3, TwinLink, TwinLink Plus WideStrike and WideStrike 3 varieties show high resistance to beet armyworm damage unless larvae move to cotton from late burned-down weed hosts (see Bollworm/Budworm section for Bt cotton notes). Refer to labels for seasonal total active ingredient restrictions for all products.
	chlorantraniliprole, MOA 28 + lambda-cyhalothrin MOA 3 (Besiege) 1.25	6.5 to 12.5 oz	0.063 to 0.12	19.8 to 10.4	14	
	chlorantraniliprole, MOA 28 + bifenthrin, MOA 3 (Elevest) 2.22 SC	4.8 to 9.6 fl oz	See label	26.7 to 13.3	18	
	emamectin benzoate, MOA 6 (Denim) 0.16 EC	6 to 8 oz	0.0075 to 0.01	21.3 to 16	21	
	indoxacarb, MOA 22 (Steward) 1.25 SC	9.2 to 11.3 oz	0.09 to 0.11	14 to 11.5	14	
	methoxyfenozide, MOA 18A (Intrepid) 2F	4.0 oz	0.06	33	14	
	methoxyfenozide, MOA 18A + spinetoram, MOA 5 (Intrepid Edge) 3F	4.0 to 8.0 oz	0.094 to 0.188	32 to 16	28	
	spinosad, MOA 5 (Blackhawk) 4 SC	2.4 to 3.2 oz	0.054 to 0.072	53.3 to 40	28	

Table 5-5A. Insect Control on Cotton

Insect	Insecticide, Mode of Action (MOA), and Formulation	Per Acre		Acres/gal (lb)	Pre-harvest Interval (days)	Precautions and Remarks
		Amount	Active (lb)			
Bollworm[a] / Tobacco Budworm	Bollgard 3, MOA 11A (various varieties)	—	See remarks	—	—	Cry1Ac and Cry2Ab and Vip3A proteins in Bollgard 3 have activity against bollworm and high activity against other pest caterpillar species on cotton except cutworms. No activity against insects other than caterpillars. Bollworms are resistant to the Cry1Ac and Cry2Ab proteins, but there is no known Vip3A resistance.
	TwinLink Plus, MOA 11A (various varieties)	—	See remarks	—	—	Cry1Ab and Cry2Ae and Vip3A proteins in TwinLink Plus have activity against bollworm and high activity against other pest caterpillar species on cotton except cutworms. No activity against insects other than caterpillars. Bollworms are resistant to the Cry1Ab and Cry2Ae proteins, but there is no known Vip3A resistance.
	WideStrike 3, MOA 11A (various varieties)	—	See remarks	—	—	Cry1Ac, Cry1F and Vip3A proteins in WideStrike 3 have high activity in combination against all pest caterpillar species on cotton except cutworms. No activity against insects other than caterpillars. Bollworms are resistant to the Cry1Ac protein and Cry1F is not lethal to bollworm, but there is no known Vip3A resistance.
	chlorantraniliprole, MOA 28 + lambda-cyhalothrin MOA 3 (Besiege) 1.25	6.5 to 12.5 oz	0.063 to 0.12	19.8 to 10.4	14	This insecticide is most effective when applied before larvae are present at the beginning of an egg-lay event. Of all the foliar insecticides, formulations that include MOA 28 are most effective.
	chlorantraniliprole, MOA 28 + bifenthrin, MOA 3 (Elevest) 2.22 SC	5.6 to 9.6 fl oz	See label	22.9 to 13.3	21	
	chlorantraniliprole, MOA 28 (Prevathon) 0.43 SC (Vantacor) 5 SC	14 to 27 fl oz 1.2 to 2.5 oz	0.047 to 0.067 0.047 to 0.098	9.1 to 6.4 9.1 to 6.4	14 14	
	indoxacarb, MOA 22 (Steward) 1.25 SC	9.2 to 11.3 oz	0.09 to 0.11	13.9 to 11.4	14	Steward must be applied to early-stage larvae for effective control.
	methoxyfenozide, MOA 18A + spinetoram, MOA 5 (Intrepid Edge) 3F	6.0 to 8.0 oz	0.140 to 0.188	21.3 to 16	28	
	spinosad, MOA 5 (Blackhawk) 4 SC	2.4 to 3.2 oz	0.054 to 0.073	74 to 55	28	
Cotton Aphid	acetamiprid, MOA 4A (Assail, Strafer Max) 70 WP	0.6 to 1.1 oz	0.025 to 0.05	28 to 14	28	Due to a high potential for cotton aphid resistance to insecticides and because of the routine presence of significant levels of predators, parasites and pathogens that limit cotton aphid build-ups, treat for cotton aphids only as a last resort.
	dicrotophos, MOA 1B (Bidrin) 8EC	4 to 8 oz	0.25 to 0.5	32 to 16	10	
	flonicamid, MOA 9C (Carbine) 50 WG	1.4 to 2.8 oz	0.044 to 0.089	22.7 to 11.2	30	
	sulfoxaflor MOA 4C (Transform)	0.75 to 1 oz	0.023 to 0.031	171 to 128	14	
European Corn Borer	Bollgard II, MOA 11A (various varieties)	—	See remarks	—	—	This is transgenic cotton seed.
	Bollgard 3, MOA 11A (various varieties)	—	See remarks	—	—	
	TwinLink, MOA 11A (various varieties)	—	See remarks	—	—	
	TwinLink Plus, MOA 11A (various varieties)	—	See remarks	—	—	
	WideStrike, MOA 11A (various varieties)	—	See remarks	—	—	
	WideStrike 3, MOA 11A (various varieties)	—	See remarks	—	—	
	beta-cyfluthrin, MOA 3 (Baythroid XL) 1.0 EC	1.6 to 2.6 oz	0.013 to 0.021	77 to 47.6	0	
	bifenthrin, MOA 3 (Brigade, Fanfare, Declare, Discipline, Sniper and others) 2 EC	3.2 oz	0.05	40	14	European corn borers are generally more of a problem in rank, non-Bt cotton. Other materials listed for bollworm may provide some control.
	lamda-cyhalothrin, MOA 3 (Warrior) 2.08 CS (Warrior II, Silencer) 1 EC	1.6 oz 3.2 to 5.12 oz	0.025 0.025 to 0.04	80 40 to 25	21	
	zeta-cypermethrin, MOA 3 (Mustang Max) 0.8 EC	2.9 to 3.55 oz	0.018 to 0.025 oz	44.4 to 32	14	
Fall Armyworm	chlorantraniliprole, MOA 28 (Prevathon) 0.43 SC (Vantacor) 5 SC	14 to 27 fl oz 1.2 to 2.5 oz	0.047 to 0.067 0.047 to 0.098	9.1 to 6.4 9.1 to 6.4	14 14	Various rates and combinations may be recommended, depending upon cotton phenology and the age distribution and population levels of larvae. Pyrethroids keep some fall armyworms from hatching. Bollgard II, Bollgard 3, TwinLink, TwinLink Plus and WideStrike 3 varieties show high resistance to fall armyworm damage.
	emamectin benzoate, MOA 6 (Denim) 0.16 EC	8 to 12 oz	0.01 to 0.015	16 to 10.7	21	
	indoxacarb, MOA 22 (Steward) 1.25 SC	9.2 to 11.3 oz	0.09 to 0.11	14 to 11.5	14	
	chlorantraniliprole, MOA 28 + bifenthrin, MOA 3 (Elevest) 2.22 SC	5.6 to 9.6 fl oz	See label	22.9 to 13.3	21	
	lambda-cyhalothrin, MOA 3 + chlorantraniliprole, MOA 28 (Besiege) 1.25 ZC	6.5 to 12.5 oz	0.063 to 0.12	19.8 to 10.4	14	
	methomyl, MOA 1A (Lannate) 2.4 LV (Lannate) 90 SP	1.5 pt 0.5 lb	0.45 0.45	5.3 2	15 15	

Table 5-5A. Insect Control on Cotton

Insect	Insecticide, Mode of Action (MOA), and Formulation	Per Acre: Amount	Per Acre: Active (lb)	Acres/gal (lb)	Pre-harvest Interval (days)	Precautions and Remarks
Fall Armyworm (continued)	methoxyfenozide, MOA 1BA (Intrepid) 2F	4 to 10 oz	0.06 to 0.16	33 to 12.5	14	Various rates and combinations may be recommended, depending upon cotton phenology and the age distribution and population levels of larvae. Pyrethroids keep some fall armyworms from hatching. Bollgard II, Bollgard 3, TwinLink, TwinLink Plus and WideStrike 3 varieties show high resistance to fall armyworm damage.
	methoxyfenozide, MOA 18A + spinetoram, MOA 5 (Intrepid Edge) 3F	6.0 to 8.0 oz	0.140 to 0.188	21.3 to 16	28	
	novaluron, MOA 15 (Diamond) 0.83 EC	6 to 12 oz	0.04 to 0.08	21.3 to 10.7	30	
	spinosad, MOA 5 (Blackhawk) 4 SC	2.4 to 3.2 oz	0.054 to 0.072	53.3 to 40	28	
Plant Bug	acephate, MOA 1B (Orthene and other brands) 75 S 90 S 97 ST	 0.3 to 1.3 lb 0.25 to 1 lb 0.25 to 1 lb	 0.25 to 1 0.225 to 0.9 0.24 to 0.97	 3.3 to 0.77 4 to 1 4 to 1	 21 21 21	Prebloom treatment not recommended if square retention is in excess of 80%. If square retention is less than 80%, confirmation of threshold levels of plant bugs should be met prior to treatment. Note that Belay cannot be applied to foliar after pinhead square formation. Postbloom treatment more likely in low-spray environment, such as with Bt cottons. Neonicotinoids (MOA 4A) tend to be less effective mid- to late-season, but control can be erratic, as they will sometimes work season-long. In general, imidacloprid tends to be the least effective of the neonicotinoids, which is why it is not included in this table. Some populations are resistant to pyrethroids (MOA 3) and organophosphates (MOA 1B). **Rotating insecticide modes of action is critical for long-term management of this insect**. Nearly any insecticide can be improved by an immediate follow-up insecticide spray within 3 days of the initial spray. Fields adjacent to corn, potatoes, weedy areas, ditch banks, and other sources of plant bugs may be at higher risk of plant bug injury. Likelihood of damage levels of plant bugs on cotton generally higher in northeastern North Carolina counties. Bidrin is toxic to humans. Be sure to follow label directions and observe 6-day reentry interval.
	acetamiprid, MOA 4A (Assail) 70 WP	1.1 oz	0.5	14	28	
	dicrotophos, MOA 1B (Bidrin) 8 EC	6 to 8 oz	0.375 to 0.5	21 to 16	10	
	dicrotophos, MOA 1B + bifenthrin MOA 3 (Bidrin XP II) 5 EC	8 to 12 oz	0.313 to 0.54	16 to 9.3	30	
	flonicamid, MOA 9C (Carbine) 50 WG	1.7 to 2.8 oz	0.054 to 0.089	75.3 to 45.7	30	
	methomyl, MOA 1A (Lannate) 2.4 LV (Lannate) 90 SP	 12 oz 0.25 lb	 0.225 0.225	 10.7 4	 15 15	
	novaluron, MOA 15 (Diamond) 0.83 EC	9 to 12 oz	0.06 to 0.08	14 to 11	30	
	oxamyl, MOA 1A (Vydate)	8 to 32 oz	0.125 to 0.5	16 to 4	14	
	pyrethroid combinations, MOA 3	(see European corn borer above for rates)		—	—	Note that pyrethroid resistance has been documented in North Carolina. Therefore, applications of pyrethroids are only recommended as a tank mix.
	sulfoxaflor MOA 4C (Transform)	2 to 2.25 oz	0.063 to 0.071	64 to 57	14	
	thiamethoxam, MOA 4A (Centric) 40 WG	2 to 2.5 oz	0.05 to 0.0625	64 to 51	21	Recommended application window is during June. During the later season, this, and other neonicotinoids (for instance, Admire Pro and Belay) fall off in efficacy, but can be used as tank-mix partners.
	ThryvOn, MOA 11A (various varieties)	—	See remarks	—	—	ThryvOn has received full regulatory approval for planting in the United States; however, specific plans for commercialization depends upon regulatory approval and other factors.
Soybean Looper	chlorantraniliprole, MOA 28 (Prevathon) 0.43 SC (Vantacor) 5 SC	 14 to 27 fl oz 1.7 to 2.5 oz	 0.047 to 0.067 0.066 to 0.098	 9.1 to 6.4 9.1 to 6.4	 14 14	Bollgard II, Bollgard 3, TwinLink, TwinLink Plus, WideStrike, and WideStrike 3 varieties show high resistance to looper damage.
	chlorantraniliprole, MOA 28 + bifenthrin, MOA 3 (Elevest) 2.22 SC	5.6 to 9.6 fl oz	See label	22.9 to 13.3	21	
	chlorantraniliprole, MOA 28 + lambda-cyhalothrin, MOA 3 (Besiege) 1.25 ZC	10.0 to 12.5 oz	0.098 to 0.12	12.8 to 10.4	14	
	emamectin benzoate, MOA 6 (Denim) 0.16 EC	6 to 12 oz	0.01 to 0.015	10.6 to 16	21	
	indoxacarb, MOA 22 (Steward) 1.25 SC	6.7 to 9.2 oz	0.065 to 0.09	19 to 14	14	
	methoxyfenozide, MOA 18A (Intrepid) 2 F	4 to 10 oz	0.098 to 0.16	33 to 12.5	14	
	methoxyfenozide, MOA 18A + spinetoram, MOA 5 (Intrepid Edge) 3F	4.0 to 8.0 oz	0.094 to 0.188	32 to 16	28	
	spinosad, MOA 5 (Blackhawk) 4 SC	2.4 to 3.2	0.054 to 0.073	74 to 54	28	

Table 5-5A. Insect Control on Cotton

Insect	Insecticide, Mode of Action (MOA), and Formulation	Per Acre: Amount	Per Acre: Active (lb)	Acres/gal (lb)	Pre-harvest Interval (days)	Precautions and Remarks
Spider Mite	abamectin, MOA 6 (Zephyr, Abamectin) 0.15 EC	8 to 16 oz	0.01 to 0.019	15 to 7.9	20	Control often unnecessary because of beneficial arthropods and fungi. Apply with 20-plus gallons of water (applies to all chemicals).
	bifenthrin, MOA 3 (Brigade, Fanfare, Sniper, Declare, Discipline and others) 2 EC	3.8 oz	0.06	33	14	
	dicofol, MOA UNC (Dicofol) 4 E	0.8 to 1.6 qt	0.8 to 1.6	5 to 2.5	14	
	etoxazole, MOA 10B (Zeal) 72 WP	0.66 to 1 oz	0.03 to 0.045	45 to 30	28	
	fenpropathrin, MOA 3 (Danitol) 2.4 EC	10.7 to 16 oz	0.2 to 0.3	12 to 8	21	
	fenpyroximate, MOA 21A (Portal, Fujimite) 0.4 E	12 to 16 oz	0.037 to 0.05	10.8 to 8	14	Use 1.5 to 2X the amount of product if applied by aircraft.
	propargite, MOA 12C (Comite) 6.55L	1 qt	1.6	4	14	
	spiromesifen, MOA 23 (Oberon) 2 SC	6 to 16 oz	0.094 to 0.25	21.3 to 8	30	Use 6 ounces only in early season to control low populations.
Stink Bug	acephate, MOA 1B (Orthene) 75 S (Orthene and others) 97 S	1 lb 0.75 lb	0.75 0.75	1.3 1	21	Do not spray acephate prior to a bollworm flight.
	dicrotophos, MOA 1B (Bidrin) 8 EC	4 to 8 oz	0.25 to 0.5	32 to 16	10	Bidrin is extremely toxic to humans. **Be sure to observe the 3-day reentry interval.**
	dicrotophos, MOA 1B + bifenthrin, MOA 3 (Bidrin XP II) 5EC	8.0 to 12.8 oz	0.313 to 0.54	16 to 9.3	30	Product contains 4.0 pounds dicrotophos and 1.0 pound bifenthrin per gallon. Toxic to humans; be sure to follow label directions and observe 6-day reentry interval.
	oxamyl, MOA 1A (Vydate) 3.77 SL	17 oz	0.5	7.5	21	
	pyrethroids, MOA 3 and pyrethroid combinations	(see European corn borer above for rates)		—	—	Pyrethroids provide good to excellent control of green and brown marmorated stink bugs but are **less effective against brown stink bugs**. Bifenthrin is more effective than other pyrethroids against brown stink bugs and provides a residual advantage over Bidrin.
Thrips (at planting treatment)	abamectin, MOA 6, + thiamethoxam MOA 4A (Avicta Duo 500FS, Avicta Complete, Acceleron-N)	—	0.15 abamectin + 0.375 thiamethoxam mg/seed	—	—	Seed treatments with, or without an in-furrow insecticide, may require a supplemental foliar treatment for thrips control. Determine thrips risk for specific planting dates using the Thrips Infestation Predictor for Cotton (https://products.climate.ncsu.edu/ag/cottontip/). Note that resistance to neonicotinoids (imidacloprid and thiamethoxam) has been confirmed in tobacco thrips throughout the state. Variable control should be expected. During 2023, Deltapine is offering Gaucho as a base treatment. AERIS may be requested at the dealer level.
	imidacloprid, MOA 4A (Gaucho Grande 600 FS, Acceleron-I)	—	0.375 mg/seed	—	—	
	imidacloprid, MOA 4A + thiodicarb, MOA 1A (AERIS)	—	0.375 imidacloprid + 0.375 thiodicarb mg/seed	—	—	
	thiamethoxam, MOA 4A (Cruiser) 5 FS	—	0.34 mg/seed	—	—	
	imidacloprid (MOA 4A) + clothianidin (MOA 4A) + *Bacillus firmus* (biological) (Aeris/Poncho/VOTiVO)	—	0.375 imidacloprid + 0.424 clothianidin mg/seed + 2 x 10^9 cfu/ml *B. fermis* units	—	—	
	aldicarb, MOA 1A (AgLogic 15G Aldicarb Pesticide)	3.5 to 5 lb	0.53 to 0.75	_	_	
	imidacloprid, MOA 4A (Admire Pro) 4.6F (Wrangler) 4.0F	7.4 to 9.2 oz 8.5 to 10.5 oz	0.27 to 0.33 0.27 to 0.33	17.3 to 13.9 15.1 to 12.2	—	Apply liquid into open furrow directly onto seed before furrow closure. Works best in combination with another at-planting treatment, such as a seed treatment. Note that resistance to imidacloprid has been confirmed in tobacco thrips throughout the state. Variable control should be expected.
	ThryvOn, MOA 11A (various varieties)	—	See remarks	—	—	ThryvOn has received full regulatory approval for planting in the United States; however, specific plans for commercialization depends upon regulatory approval and other factors.
Thrips (post-emergence)	acephate, MOA 1B (Orthene) 75 S (Orthene) 90 S (Orthene) 97 S (Orthene) 97 ST[b]	3 to 4 oz 0.2 lb 2.5 to 3 oz 6 oz	0.14 to 0.19 0.18 0.15 to 0.18 0.375	5.3 to 4 5 6.4 to 5.3 2.67	21	Not suggested to replace at-plant insecticides in cotton. With the high thrips populations often found in North Carolina, consider at least 0.25 pound a.i. per acre, the standard rate for Orthene. Pyrethroids do not provide adequate thrips control on cotton.
	cyantraniliprole MOA 28 (Exirel)	13.5 to 20.5 oz	0.088 to 0.133	9.5 to 6.2	7	
	dicrotophos, MOA 1B (Bidrin) 8 EC	4 oz	0.25	32	10	
	dimethoate, MOA 1B (Dimethoate) 4 EC	8 oz	0.25	16	10	
	spinetoram, MOA 5 (Radiant) 1 SC	1.5 to 3 oz	0.01 to 0.02	85 to 43	28	Provides improved control of western flower thrips, as well as good control of tobacco thrips. Use higher rates for improved control.

[a] Lowest labeled rates for bollworms and budworms

[b] 2 (ee) state local need label for higher rates

NOTE: Upper or lower rate ranges do not indicate equivalent activity.

Cotton Insect Resistance Management

D. D. Reisig and A. S. Huseth, Entomology Department

Resistance occurs when some insects in a population survive a chemical treatment and are therefore able to pass on an inherited gene(s) for this survival to their offspring. Because these offspring are better able to survive the insecticide than those that are not resistant, the resistant individuals increase their numbers faster in the presence of the insecticide. After several generations, the resistant insects can outnumber the susceptible ones, and the insecticide becomes ineffective. Because the alleles that allow insects to survive an insecticide are often initially present in very few individuals out of a very large population of susceptible insects, resistance development may take years. Five to 20 years would be a common range for effectiveness of many insecticides.

Insects vary greatly in their ability to develop resistance to insecticides. For example, cotton aphids have been able to develop resistance to various classes of chemicals rapidly, while the boll weevil remains susceptible to several organophosphate insecticides after more than 50 years of exposure.

Insects develop resistance to insecticides in several ways. Some are able to break down (metabolize) insecticides, while others are able to eliminate the toxins. Some can sequester insecticides (move them to a less harmful place in or on the body), and still others can avoid the toxin (behavioral resistance). The above are examples of different modes of action (MOA). Unfortunately, once an insect develops resistance to one insecticide, in most cases the insect is also resistant to others in the same class or group of insecticides sharing the same mode of action. For example, if tobacco budworms are resistant to the pyrethroid Baythroid, they are also resistant to the pyrethroid Warrior. To make matters worse, some insects may be resistant to several classes of insecticides, such as is presently the case with plant bugs in the Midsouth. In North Carolina, some populations of cotton aphids (neonicotinoid class) and bollworms/corn earworms (pyrethroid class) have developed resistance to these chemical classes that were initially very effective.

As you can see from the table below, many different kinds of possible insecticide resistance have been identified. Most have complicated, hard-to-remember names. To make it easy to recognize different classes or modes of actions that can lead to resistance development, each chemical has been identified with a number, and occasionally subdivided with a letter. Products sharing the same number or letter and number combination have the same mode of action (for additional detail see: www.irac-online.org/modes-of-action).

One major strategy in managing resistance is to avoid using products with the same mode of action (sharing the same number in the table) in the same year. Also, tank mixing insecticides with different modes of action may delay resistance development but can also exacerbate development of resistance in the case of pre-mixed products when additional insecticide may not be needed or is included at a low rate. Additionally, if only a single class of insecticides is listed for control of an insect (for instance, Assail, Centric, and Admire Pro – all neonicotinoids – for cotton aphids), one should try to either limit insecticide use to a single spray or try to avoid treatment. One final strategy in minimizing insect resistance to insecticides is to avoid unneeded treatments by following recommended thresholds.

Listed below are common transgenic insect protection packages, specific Bt toxin combinations, and scouting recommendations.

Table 5-5B. Transgenic cotton trait packages for insect management

Trade Name	**Bt proteins**	**Scouting strategy**
Bollgard 2	Cry1Ac and Cry2Ab	Egg threshold. 25 eggs on 100 terminals, leaves, and bracts of bolls and squares.
Bollgard 3	Cry1Ac, Cry2Ab, and Vip3A	Damaged boll (4%) or larval threshold. Three second-stage (instar) bollworm or larger per 100 squares, blooms, or bolls
ThryvOn	Cry51A	Treatment for thrips is not recommended. For tarnished plant bug, treat at 8* plant bugs per 100 sweeps (from initiation of squaring until the first or second week of blooming) AND <80% square retention. Post-bloom thresholds begin approximately one to two weeks after bloom initiation and are two to three adult plus nymph stage plant bugs per 5 row feet taken from six to eight locations in the field.
TwinLink	Cry1Ab and Cry2Ae	Egg threshold
TwinLink Plus	Cry1Ab, Cry2Ae, and Vip3A	Damaged boll (4%) or larval threshold
Widestrike	Cry1Ac and Cry1F	Egg threshold
Widestrike 3	Cry1Ac, Cry1F, and Vip3A	Damaged boll (4%) or larval threshold

Listed below are the economically important cotton pests found in North Carolina, followed by the chemical and brand names and mode of action.

Table 5-5C. Cotton Insecticide Modes of Action (MOA); Insecticide Resistance Action Committee Designations

Insect	**Chemical Name (Brand Name)**	**Mode of Action**
Beet Armyworm	*Bacillus thuringiensis* var. *kurstaki* (Bt toxin expressed by various varieties)	11A
	chlorantraniliprole (Prevathon)	2B
	emamectin benzoate (Denim)	6
	indoxacarb (Steward)	22
	methoxyfenozide (Intrepid)	18A
	spinosad (Blackhawk)	5
Bollworm/Tobacco Budworm	*Bacillus thuringiensis* var. *kurstaki* (Bt toxin expressed by various varieties)	11A
	chlorantraniliprole (Prevathon, Vantacor)	28
	chlorantraniliprole + lambda-cyhalothrin (Besiege)	28 + 3
	chlorantraniliprole + bifenthrin (Elevest)	28 + 3
	indoxacarb (Steward)	22
	methoxyfenozide + spinetoram (Intrepid Edge)	18A + 5
	spinosad (Blackhawk)	5
Cotton Aphid	acetamiprid (Assail)	4A
	dicrotophos (Bidrin)	1B
	flonicamid (Carbine)	9C
	sulfoxaflor (Transform)	4C
European Corn Borer	*Bacillus thuringiensis* var. *kurstaki* (Bt toxin expressed by various varieties)	11A
	beta-cyfluthrin (Baythroid XL)	3
	bifenthrin (Brigade, Fanfare, Discipline, Sniper and others)	3
	lambda-cyhalothrin (Warrior II)	3
	zeta-cypermethrin (Mustang Maxx)	3
Fall Armyworm	*Bacillus thuringiensis* var. *kurstaki* (Bt toxin expressed by various varieties)	11A
	chlorantraniliprole (Prevathon)	28
	chlorantraniliprole + lambda-cyhalothrin (Besiege)	18A + 5
	chlorantraniliprole + bifenthrin (Elevest)	28 + 3
	emamectin benzoate (Denim)	6
	indoxacarb (Steward)	22
	methomyl (Lannate)	1A
	methoxyfenozide (Intrepid)	18A
	methoxyfenozide + spinetoram (Intrepid Edge)	18A + 5
	novaluron (Diamond)	15
	spinosad (Blackhawk)	5
Plant Bug	acephate (Orthene, and others)	1B
	acetamiprid (Assail)	4A
	Bacillus thuringiensis ((Bt toxin expressed by ThryvOn varieties)	11A
	dicrotophos (Bidrin)	1B
	flonicamid (Carbine)	9C
	methomyl (Lannate)	1A
	novaluron (Diamond)	5
	oxamyl (Vydate)	1A
	pyrethroids (various)	3
	sulfoxaflor (Transform)	4C
	thiamethoxam (Centric)	4A
Soybean & Cabbage Looper	*Bacillus thuringiensis* var. *kurstaki* (Bt toxin expressed by various varieties)	11A
	chlorantraniliprole (Prevathon, Vantacor)	28
	chlorantraniliprole + lambda-cyhalothrin (Besiege)	3 + 28
	chlorantraniliprole + bifenthrin (Elevest)	28 + 3
	emamectin benzoate (Denim)	3
	indoxacarb (Steward)	22
	methoxyfenozide (Intrepid)	18A
	methoxyfenozide + spinetoram (Intrepid Edge)	18A + 5
	spinosad (Blackhawk)	5
Spider Mite	abamectin (Abamectin)	6
	bifenthrin (Brigade, Capture, Discipline, Sniper and others)	3
	etoxazole (Zeal)	10B
	fenpropathrin (Danitol)	3
	fenpyroximate (Portal)	21A
	propargite (Comite)	12C
	spiromesifen (Oberon)	23
Stink Bug	acephate (Orthene, and others)	1B
	dicrotophos (Bidrin)	18
	dicrotophos + bifenthrin (Bidrin XP II)	18 + 3
	oxamyl (Vydate)	1A
	pyrethroids	3
Thrips (At-Planting)	aldicarb	1A
	Bacillus thuringiensis (Bt toxin expressed by ThryvOn varieties)	11A
	imidacloprid	4A
	thiamethoxam	4A
	thiamethoxam + abamectin	4A + 6
	imidacloprid + thiodicarb	4A + 1A
	imidacloprid + clothianidin + thiodicarb (AERIS/Poncho/VOTiVO)	4A + 1A
Thrips (Postemergence)	acephate (Orthene, and others)	1B
	cyantraniliprole (Exirel)	28
	dicrotophos (Bidrin)	1B
	dimethoate (Dimethoate)	1B

Insect Control on Peanuts

R. L. Brandenburg and D. Reisig, Entomology and Plant Pathology

Table 5-6A. Insect Control on Peanuts: Seasonal Control of Thrips and Leafhoppers

Insect	Insecticide and Formulation	Amount of Formulation Per Acre	Precautions and Remarks
Thrips at Planting	acephate (Orthene 97) (generics available)	0.75 to 1.0 lb	Apply as in-furrow spray in 3 to 5 gallons of water per acre. State (24c) label must be in possession at time of application.
	phorate (Thimet)	5.0 lb	
	imidacloprid (Admire Pro)	7.0 to10.5 fl oz	In furrow spray during planting, directed on or below seed.
	Vydate C-LV	34 to 68 fl oz	Apply in a 7-inch band immediately behind the planter in a minimum of 10 gallons of water per acre. Incorporate the band application at least 2 inches into the soil either by placing it in-furrow or by using mechanical means. Higher rate used for severe infestations of nematodes.
	aldicarb (AgLogic 15GG & AgLogic 15G)	7.0 lb	Apply granules in the seed furrow and cover with 1 inch or more of soil. May provide suppression of nematodes when applied according to specific label directions.
Thrips foliar postemergence	acephate (Orthene) 97 (generics available)	0.375 to 0.75 lb	Do not feed or graze livestock on treated vines. Apply 10 to 50 gallons spray solution per acre to foliage. Do not apply more than 4.125 pounds per acre (4 pounds a.i. per acre) per season.
	beta-cyfluthrin (Baythroid XL)	2.8 oz	
	bifenthrin (Brigade)	2.1 to 6.4 fl oz	Pre-harvest interval of 14 days.
	spinetoram (Radiant SC)	1.5 to 3.0 fl oz	Suppression only. See 2(ee) recommendation.

Table 5-6B. Insect Control on Peanuts: Control of Specific Pests

Insect	Insecticide and Formulation	Amount of Formulation Per Acre	Precautions and Remarks
Beet Armyworm	*Bacillus thuringiensis* (Xentari)	0.5 to 2.0 lb	Apply to small caterpillars. Use highest rate for larger worms or high populations; 0-day harvest restriction.
	methomyl (Lannate LV)	1.25 to 3.0 pt	Apply broadcast in sufficient water for good coverage when worms are small. Do not apply within 21 days of harvest. See fall armyworm for additional restrictions.
	methoxyfenozide + spinetoram (Intrepid Edge)	4.0 to 8.0 fl oz	Application rate varies with timing. Lower rates appropriate for light infestations, smaller larvae or small plants.
	indoxacarb (Steward)	9.2 to 11.3 oz	Do not apply more than 45 ounces per acre per crop. 14-day preharvest interval.
	spinosad (Blackhawk)	1.7 to 3.3 fl oz	Do not apply more than 12.4 fluid ounces per season or make more than three applications. 3-day preharvest interval.
	bifenthrin (Brigade)	2.1 to 6.4 fl oz	Pre-harvest interval of 14 days.
	chlorantraniliprole (Prevathon)	14.0 to 20.0 fl oz	Make no more than 4 applications per crop per year.
Corn Earworm, Southern Armyworm, Green Cloverworm, Velvetbean Caterpillar	acephate (Orthene) 97 (generics available)	0.75 to 1.0 lb	Do not feed or graze livestock on acephate-treated vines. Do not apply within 14 days of harvest (digging).
	Bacillus thuringiensis (Dipel DF) (Dipel ES) (Xentari)	 0.5 to 2.0 lb 1.0 to 2.0 pt 0.5 to 2.0 lb	For velvetbean caterpillar control only. Apply to small caterpillars and use highest rate for larger worms or high populations; 0-day harvest restriction. Xentari also controls southern armyworm.
	esfenvalerate (Asana XL)	2.9 to 5.8 oz	Do not feed Asana-treated vines or graze livestock on treated plants.
	fenpropathrin (Danitol) 2.4 EC	10.67 to 16.0 fl oz	Do not exceed 2.67 pints per acre per season. Use 10 to 50 gallons per acre by ground and 5 to 10 gallons per acre by air. Repeat no more often than every 7 days. Do not apply within 14 days of digging and do not feed or graze vines within 14 days of last application.
	indoxacarb (Steward)	9.2 to 11.3 oz	Do not apply more than 45 ounces per acre per crop. 14-day preharvest interval. For corn earworm.
	lambda-cyhalothrin (Karate Z)	1.28 to 1.92 oz	Do not feed or graze livestock on Karate-treated plants.
	methomyl (Lannate LV)	0.75 to 3.0 pt	Apply to foliage when four or more worms are present per foot of row and preferably when worms are small. Do not apply methomyl within 21 days of harvest. Do not feed methomyl-treated vines to livestock. Use minimum of 3 gallons of water for aerial application.
	methoxyfenozide + spinetoram (Intrepid Edge)	4.0 to 8.0 fl oz	Application rate varies with timing. Lower rates appropriate for light infestations, smaller larvae or small plants.
	spinosad (Blackhawk)	2.0 to 3.0 fl oz	Do not apply more than 9 fluid ounces per season or make more than three applications. 3-day preharvest interval.
	bifenthrin (Brigade)	2.1 to 6.4 fl oz	Pre-harvest interval of 14 days.
	chlorantraniliprole+ lambda-cyhalothrin (Besiege)	6.0 to 10.0 fl oz	Pre-harvest interval of 14 days. Do not exceed a total of 31 fluid ounces of Besiege per acre per year.
	chlorantraniliprole (Prevathon)	14.0 to 20.0 fl oz	Make no more than 4 applications per crop per year.
	cyantraniliprole (Exirel)	10.0 to 20.5 fl oz	Pre-harvest interval of 14 days.

Table 5-6B. Insect Control on Peanuts: Control of Specific Pests

Insect	Insecticide and Formulation	Amount of Formulation Per Acre	Precautions and Remarks
Budworm, Tobacco	cyantraniliprole (Exirel)	10.0 to 20.5 fl oz	Pre-harvest interval of 14 days.
Cutworm	esfenvalerate (Asana XL)	5.8 to 9.6 oz	Do not feed treated vines to livestock.
	indoxacarb (Steward)	9.2 to 11.3 oz	Do not apply more than 45 ounces per acre per crop. 14-day preharvest interval.
	lambda-cyhalothrin (Karate Z)	0.96 to 1.6 oz	Do not use treated vines or hay for animal feed.
	methomyl (Lannate LV)	1.5 to 3.0 pt	Do not apply within 21 days of harvest. Do not feed treated vines to livestock.
	bifenthrin (Brigade)	2.1 to 6.4 fl oz	Pre-harvest interval of 14 days.
	chlorantraniliprole + lambda-cyhalothrin (Besiege)	5.0 to 8.0 fl oz	Pre-harvest interval of 14 days. Do not exceed a total of 31 fluid ounces of Besiege per acre per year.
	cyantraniliprole (Exirel)	10.0 to 20.5 fl oz	Pre-harvest interval of 14 days.
Fall Armyworm	acephate (Orthene) 97 (generics available)	0.75 to 1.0 lb	Do not apply within 14 days of harvest (digging). Do not feed or graze livestock on vines treated with acephate. Apply 10 to 50 gallons spray solution per acre. Do not apply more than 4.13 pounds per acre (4 pounds a.i. per acre per season).
	fenpropathrin (Danitol) 2.4 EC	10 2/3 to 16.0 fl oz	Do not exceed 2.67 pints per acre per season. Repeat no more often than every 7 days. Do not apply within 14 days of digging and do not feed or graze vines within 14 days of last application.
	indoxacarb (Steward)	9.2 to 11.3 oz	Do not apply more than 45 ounces per acre per crop. 14-day preharvest interval.
	lambda-cyhalothrin (Karate Z)	1.28 to 1.92 oz	
	methomyl (Lannate LV)	0.75 to 1.5 pt	Effective against all sizes of worms. Use minimum of 3 gallons of water for aerial application. Do not apply within 21 days of harvest. Do not feed methomyl-treated vines to livestock.
	methoxyfenozide + spinetoram (Intrepid Edge)	4.0 to 8.0 fl oz	Application rate varies with timing. Lower rates appropriate for light infestations, smaller larvae or small plants.
	spinosad (Blackhawk)	1.7 to 3.3 fl oz	Do not apply more than 12.4 fluid ounces per season or make more than three applications. 3-day preharvest interval.
	bifenthrin (Brigade)	2.1 to 6.4 fl oz	Pre-harvest interval of 14 days.
	chlorantraniliprole + lambda-cyhalothrin (Besiege)	6.0 to 10.0 fl oz	Pre-harvest interval of 14 days. Do not exceed a total of 31 fluid ounces of Besiege per acre per year.
	chlorantraniliprole (Prevathon)	14.0 to 20.0 fl oz	Make no more than 4 applications per crop per year.
	cyantraniliprole (Exirel)	10.0 to 20.5 fl oz	Pre-harvest interval of 14 days.
Leafhoppers	acephate (Orthene) 97 (generics available)	0.75 to 1.0 lb	See remarks under Thrips.
	esfenvalerate (Asana XL)	2.9 to 5.8 oz	Do not feed livestock Asana-treated vines or graze livestock on treated plants.
	fenpropathrin (Danitol) 2.4 EC	6.0 to 10.67 fl oz	Do not exceed 2 2/3 pints per acre per season. Repeat no more often than every 7 days. Do not apply within 14 days of digging and do not feed or graze vines within 14 days of last application.
	chlorantraniliprole + lambda-cyhalothrin (Besiege)	6.0 to 10.0 fl oz	
	lambda-cyhalothrin (Karate Z)	0.96 to 1.6 oz	Do not use treated vines or hay for animal feed.
	methomyl (Lannate LV) bifenthrin (Brigade)	0.75 to 3.0 pt 2.1 to 6.4 fl oz	Do not apply within 21 days of harvest. Do not use treated vines as feed. Pre-harvest interval of 14 days.
Lesser Cornstalk Borer	chlorantraniliprole + lambda-cyhalothrin (Besiege)	10.0 fl oz	Pre-harvest interval 14 days. Do not exceed a total of 31 fluid ounces of Besiege per acre per year.
	chlorantraniliprole (Prevathon)	14.0 to 20.0 fl oz	See 2 (ee) Label recommendation.
	cyantraniliprole (Exirel)	13.5 to 20.5 fl oz	Pre-harvest interval of 14 days.
Southern Corn Rootworm	No currently recommended products		
Spider Mite	propargite (Comite) 73 L	2.0 pt	Apply in at least 25 gallons of water per acre. Spider mite outbreaks are less likely to develop if foliar insecticides are not used during July and August and copper fungicides are used for Cercospora leafspot. Do not apply propargite within 14 days of harvest.
	fenpropathrin (Danitol) 2.4 EC	10.67 to 16.0 fl oz	Do not exceed 2.67 pints (42 2/3 fluid ounces) per acre per season. Use 10 to 50 gallons per acre by ground and 5 to 10 gallons per acre by air. Repeat no more often than every 7 days. Do not apply within 14 days of digging and do not feed or graze vines within 14 days of last application.
	bifenthrin (Brigade)	5.1 to 6.4 fl oz	Pre-harvest interval of 14 days. Can flare mites if used mid-season.[1]
	fenpyroximate (Portal)	1.0 to 2.0 pints	Allow 14 days between applications, No more than 2 applications and 4 pints per year. PHI 1 day. Supplemental label.

Insect Control in Soybeans

D. D. Reisig and A. S. Huseth, Entomology and Plant Pathology

Table 5-7. Insect Control on Soybeans

Insect	Insecticide and Formulation	per Acre: Amount of Formulation	per Acre: Active (lb)	Acres/gal (lb)	Preharvest Interval (PHI) (Days)	Precautions and Remarks
Bean Leaf Beetle	acephate, MOA 1B (Orthene) 97 S	0.75 to 1 lb	0.75 to 1	1.25 to 1	14	Treat when defoliation reaches threshold levels or buildup is obvious. Threshold is 30% prebloom defoliation or 15% defoliation 2 weeks prior to bloom through podfill. Pod skinning by this insect can be a concern in soybeans grown for seed. Selected pyrethroids will suppress bean leaf beetle. Resistance can quickly develop if chemistries are not rotated. **In the premixed products listed, the effective chemistries are in MOAs 3 and 1B.**
	beta-cyfluthrin, MOA 3 (Baythroid XL) 1.0 EC	2.8 fl oz	0.022	45.7	45	
	bifenthrin, MOA 3 (Brigade, Discipline, Sniper, and others) 2 EC	4 to 6.4 fl oz	0.062 to 0.10	32 to 20	30	
	chlorantraniliprole, MOA 28 + lambda-cyhalothrin, MOA 3 (Besiege) 1.25 SC	5 to 8 fl oz	See label	25.6 to 16	21	
	chlorantraniliprole, MOA 28 + bifenthrin, MOA 3 (Elevest) 2.22 SC	4.8 to 9.6 fl oz	See label	26.7 to 13.3	18	
	cyfluthrin, MOA 3 (Tombstone) 2 E	1.6 to 2.8 fl oz	0.025 to 0.04	80 to 45.7	45	
	diflubenzuron, MOA 15 + lambda-cyhalothrin, MOA 3 (DoubleTake) 3 SC	4 fl oz	See label	32	30	
	imidacloprid, MOA 4A + cyfluthrin, MOA 3 (Leverage 360) 3.0 SE	2.8 fl oz	See label	45.7	45	
	lambda-cyhalothrin, MOA 3 (Lambda-cyhalothrin, Silencer) 1.0 EC (Warrior II) 2.08 CS	1.92 to 3.2 fl oz 0.96 to 1.6 fl oz	0.015 to 0.025 0.015 to 0.025	66.7 to 40 133.3 to 80	30 30	
	lambda-cyhalothrin, MOA 3 + thiamethoxam, MOA 4A (Endigo ZC) 2.06 SE	4 to 4.5 fl oz	See label	32 to 28.4	30	
Beet Armyworm	chlorantraniliprole, MOA 28 (Prevathon) 0.43 SC (Vantacor) 5 SC	 14 to 20 fl oz 1.2 to 1.7 oz	 0.047 to 0.067 0.047 to 0.067	 9.1 to 64 9.1 to 6.4	 1 1	Ground application only for larger caterpillars. Control of large armyworms can be difficult. Chlorantraniliprole, indoxacarb, methoxyfenozide, spinetoram, and spinosad are the superior products.
	chlorantraniliprole, MOA 28 + lambda-cyhalothrin, MOA 3 (Besiege) 1.25 SC	9 fl oz	See label	14.2	21	
	chlorantraniliprole, MOA 28 + bifenthrin, MOA 3 (Elevest) 2.22 SC	4.8 to 9.6 fl oz	See label	26.7 to 13.3	18	
	indoxacarb, MOA 22 (Steward) 1.25 EC	5.6 to 11.3 fl oz	0.06 to 0.11	22.9 to 11.3	21	
	methomyl, MOA 1A (Lannate) 2.4 LV (Lannate) 90 SP	1.5 pt 0.5 lb	0.45 0.45	5.3 2	14 14	
	methoxyfenozide, MOA 18A (Intrepid) 2 F	4 to 8 fl oz	0.06 to 0.12	32 to 16	14 (grain) 7 (hay)	
	methoxyfenozide, MOA 18A + spinetoram, MOA 5 (Intrepid Edge) 3F	4.0 to 6.4 oz	See label	32 to 20	28	
	spinosad, MOA 5 (Blackhawk) 4 SC	1.7 to 2.2 fl oz	0.04 to 0.05	75.3 to 58.2	28	
Corn Earworm	emamectin benzoate, MOA 6 (Denim) 0.16 EC	8 to 12 fl oz	0.01 to 0.015	16 to 10.7	21	Treat when earworm numbers exceed threshold as determined by scouting. Be sure caterpillars are present and 3/8 to 1/2 inch in size when treatment is applied. Use low rates for light infestations. Use higher rates by air. If using Heligen/Surtivo, best results are achieved when larvae are 1/8 to 1/4 inch in size. Use modified threshold of 1 to 3 larvae of this size in 15 sweeps. Do not use when more than 3 larvae (1/2-inch long or larger) are present in 15 sweeps. Product takes 4 to 6 days to cause death. Note that, while chlorantraniliprole (MOA 28 in Besiege, Elevest, Prevathon, and Vantacor) is effective, its use should be limited in soybean for resistance management reasons. Use one of the other products listed here. Go to this Extension web page for an online threshold calculator: ces.ncsu.edu/wp-content/uploads/2017/08/CEW-calculator-v0.006.html At $10.00 per bushel, the plant compensates due to the low caterpillar levels needed to reach threshold at $10.00 and above.
	Nuclear Polyhedrosis /Virus ABA-NPV-U, MOA 31 (Heligen/Surtivo)	1.28 to 1.6 fl oz	See label	100 to 80	0	
	indoxacarb, MOA 22 (Steward) 1.25 EC	5.6 to 11.3 fl oz	0.06 to 0.11	22.9 to 11.3	21	
	methoxyfenozide, MOA 18A + spinetoram, MOA 5 (Intrepid Edge) 3F	4.0 to 6.4 oz	See label	32 to 20	28	
	spinosad, MOA 5 (Blackhawk) 4 SC	1.7 to 2.2 fl oz	0.04 to 0.05	75.3 to 58.2	28	
Grasshopper	acephate, MOA 1B (Orthene) 97)	0.25 to 0.5 lb	0.25 to 0.5	4 to 2	14	Apply by air or ground uniformly over foliage as a broadcast treatment. Early morning treatment is preferred. Use higher rates for heavy infestations. Diflubenzuron is not effective to control adult grasshoppers. See label for additional instructions and suggestions.
	pyrethroids, MOA 3 and pyrethroid combinations	See label	See label	See label	See label	
	diflubenzuron, MOA 15 (Dimilin) 2L, 25W	2 fl oz 0.25 lb	0.06 0.06	64 8	21	

Table 5-7. Insect Control on Soybeans

Insect	Insecticide and Formulation	per Acre: Amount of Formulation	per Acre: Active (lb)	Acres/gal (lb)	Preharvest Interval (PHI) (Days)	Precautions and Remarks
Green Cloverworm	*Bacillus thuringiensis*, MOA 11A (Various)				0	Treat when defoliation reaches threshold. This insect is seldom an economic pest. See label of specific *Bt* products. Thresholds are listed under bean leaf beetle.
	beta-cyfluthrin, MOA 3 (Baythroid XL) 1.0 EC	1.6 to 2.8 fl oz	0.0125 to 0.022	80 to 45.7	45	
	chlorantraniliprole, MOA 28 (Prevathon) 0.43 SC (Vantacor) 5 SC	14 to 20 fl oz 1.2 to 1.7 oz	0.047 to 0.067 0.047 to 0.067	9.1 to 64 9.1 to 6.4	1 1	
	chlorantraniliprole, MOA 28 + lambda-cyhalothrin, MOA 3 (Besiege) 1.25 SC	5 to 8 fl oz	See label	25.6 to 16	21	
	chlorantraniliprole, MOA 28 + bifenthrin, MOA 3 (Elevest) 2.22 SC	4.8 to 9.6 fl oz	See label	26.7 to 13.3	18	
	cyfluthrin, MOA 3 (Tombstone) 2E	1.6 to 2.8 fl oz	0.025 to 0.04	80 to 45.7	45	
	esfenvalerate, MOA 3 (Asana XL) 0.66 EC	5.8 to 9.6 fl oz	0.03 to 0.05	22.1 to 13.3	21	
	gamma-cyhalothrin, MOA 3 (Declare) 1.25 EC	1.54 fl oz	0.015	83.1	21	
	indoxacarb, MOA 22 (Steward) 1.25 EC	8 to 11.3 fl oz	0.08 to 0.11	16 to 11.3	21	
	lambda-cyhalothrin, MOA 3 (Lambda-cyhalothrin, Silencer) 1.0 EC (Warrior II) 2.08 CS	1.92 to 3.2 fl oz 0.96 to 1.6 fl oz	0.015 to 0.025 0.015 to 0.025	66.7 to 40 133.3 to 80	30 30	
	lambda-cyhalothrin, MOA 3 + thiamethoxam, MOA 4A (Endigo ZC) 2.06 SE	3.5 to 4 fl oz	See label	36.6 to 32	30	
	methoxyfenozide, MOA 18A + spinetoram, MOA 5 (Intrepid Edge) 3F	4.0 to 6.4 oz	See label	32 to 20	28	
	spinosad, MOA 5 (Blackhawk) 4 SC	1.1 to 2.2 fl oz	0.025 to 0.05	116.4 to 58.2	28	
	zeta-cypermethrin, MOA 3 (Mustang Maxx) 0.8 EC	2.8 to 4 fl oz	0.0175 to 0.025	45.7 to 32	21	
	zeta-cypermethrin, MOA 3 + bifenthrin, MOA 3 (Hero) 1.24 EC	10.3 fl oz	0.033 + 0.066	12.4	30	
Kudzu Bug	acephate, MOA 1B (Orthene) 97 S	1 lb	1	1	14	Bifenthrin is the superior product (MOA 3).
	bifenthrin, MOA 3 (Brigade, Discipline, Sniper, and others) 2 EC	4 to 6.4 fl oz	0.062 to 0.10	32 to 20	30	
	bifenthrin, MOA 3 + imidacloprid, MOA 4A (Brigadier) 2 E (Swagger) 1 F	6.1 fl oz 12.2 fl oz	See label See label	21 to 10.5	7 18	
	gamma-cyhalothrin, MOA 3 (Declare) 1.25 EC	1.54 fl oz	0.015	83.1	21	
	lambda-cyhalothrin, MOA 3 (Lambda-cyhalothrin, Silencer) 1.0 EC (Warrior II) 2.08 CS	3.84 fl oz 1.92 fl oz	0.03 0.03	33.3 to 66.7	30 30	
	lambda-cyhalothrin, MOA 3 + thiamethoxam, MOA 4A (Endigo ZC) 2.06 SE	3.5 to 4.5 fl oz	See label	36.6 to 28.4	30	
	zeta-cypermethrin, MOA 3 (Mustang Maxx) 0.8 EC	4 fl oz	0.025	32	21	
	zeta-cypermethrin, MOA 3 + bifenthrin, MOA 3 (Hero) 1.24 EC	6.4 to 10.3 fl oz	See label	20 to 12.4	30	
Soybean Looper	emamectin benzoate, MOA 6 (Denim) 0.16 EC	8 to 12 fl oz	0.01 to 0.015	16 to 10.7	21	Treat when thresholds are reached or when buildup is obvious. Threshold is 15% defoliation in soybeans 2 weeks prior to flowering but can be increased to 20% during R6 when growing conditions are ideal. Ground application is superior. **Insecticide resistance is developing in soybean looper and has been documented in the Blacklands for MOA 3, 18A, and 28;** insecticides work best on small caterpillars. The most consistent insecticides in Blacklands are those containing MOA 5 (Intrepid Edge and Radiant), MOA 6 (Denim) and MOA 22 (Steward). Finally, using pyrethroids (MOA 3) earlier in the season can make soybean looper populations higher later in the season, even when tank mixed with other insecticides (MOA 18A and 28).
	indoxacarb, MOA 22 (Steward) 1.25 EC	5.6 to 11.3 fl oz	0.06 to 0.11	22.9 to 11.3	21	
	methoxyfenozide, MOA 18A (Intrepid) 2F	4 to 8 fl oz	0.06 to 0.12	32 to 16	7 (hay) 14 (grain)	
	spinetoram, MOA 5 (Radiant) 1 SC	2 to 4 fl oz	0.016 to 0.12	64 to 32	7 (hay) 14 (grain)	
	spinosad, MOA 5 (Blackhawk) 4 SC	1.1 to 2.2 fl oz	0.025 to 0.05	116.4 to 58.2	28	
	spinosad, MOA 5 + gamma-cyhalothrin, MOA 3 (Consero)	2 to 3 fl oz	See label	64 to 42.7	See label	

Table 5-7. Insect Control on Soybeans

Insect	Insecticide and Formulation	per Acre: Amount of Formulation	per Acre: Active (lb)	Acres/gal (lb)	Preharvest Interval (PHI) (Days)	Precautions and Remarks
Spider Mite	bifenthrin, MOA 3 (Brigade, Discipline, Sniper, and others) 2 EC	5.12 to 6.4 fl oz	0.08 to 0.10	25 to 20	18	Miticides registered on soybean often provide erratic control. Two applications may be needed for high populations. The only true miticidal product listed is etoxazole, which has activity on the immature mites.
	etoxazole, MOA 10B (Zeal) SC	2 to 6 fl oz	0.045 to 0.135	64 to 21		
Stink Bug (Brown, Brown Marmorated, Green, and Southern Green)	acephate, MOA 1B (Orthene) 97 S	0.5 to 1 lb	0.5 to 1	2 to 1	14	Treat when bug numbers exceed threshold. Go to soybeans.ces.ncsu.edu/stink-bug-economic-threshold-calculator for a threshold table. Acephate and the highest rates of pyrethroids are preferred for brown stink bug, with bifenthrin the preferred pyrethroid for this species. Stink bugs are often late-season pests so be aware of the preharvest interval of insecticides. **In the premixed products listed, the effective chemistries are in MOAs 3 and 1B.**
	bifenthrin, MOA 3 (Brigade, Discipline, Sniper, and others) 2 EC	2.1 to 6.4 fl oz	0.033 to 0.10	61 to 20	30	
	cyfluthrin, MOA 3 (Tombstone) 2E	1.6 to 2.8 fl oz	0.025 to 0.04	80 to 45.7	45	
	diflubenzuron, MOA 15 + lambda-cyhalothrin, MOA 3 (DoubleTake) 3 SC	4 fl oz	See label	32	30	
	gamma-cyhalothrin, MOA 3 (Declare) 1.25 EC	1.54 fl oz	0.015	83.1	21	
	imidacloprid, MOA 4A + cyfluthrin, MOA 3 (Leverage 360) 3.0 SE	2.8 fl oz	See label	45.7	45	
	lambda-cyhalothrin, MOA 3 (Lambda-cyhalothrin, Silencer) 1.0 EC (Warrior II) 2.08 CS	1.92 to 3.2 fl oz 0.96 to 1.6 fl oz	0.015 to 0.025 0.015 to 0.025	66.7 to 40 133.3 to 80	30 30	
	lambda-cyhalothrin, MOA 3 + thiamethoxam, MOA 4A (Endigo ZC) 2.06 SE	4 to 4.5 fl oz	See label	32 to 28.4	30	
	zeta-cypermethrin, MOA 3 (Mustang Maxx) 0.8 EC	4 fl oz	0.025	32	21	
	zeta-cypermethrin, MOA 3 + bifenthrin, MOA 3 (Hero) 1.24 EC	10.3 fl oz	0.033 to 0.066	12.4	21	
Velvetbean Caterpillar	*Bacillus thuringiensis*, MOA 11A (various)		—		0	See specific labels for use rates.
	pyrethroids, MOA 3					
	chlorantraniliprole, MOA 28 (Prevathon) 0.43 SC (Vantacor) 5 SC	14 to 20 fl oz 1.2 to 1.7 oz	0.047 to 0.067 0.047 to 0.067	9.1 to 64 9.1 to 6.4	1 1	
	chlorantraniliprole, MOA 28 + lambda-cyhalothrin, MOA 3 (Besiege) 1.25 SC	5 to 9 fl oz	See label	25.6 to 14.2	21	
	chlorantraniliprole, MOA 28 + bifenthrin, MOA 3 (Elevest) 2.22 SC	4.8 to 9.6 fl oz	See label	26.7 to 13.3	18	
	diflubenzuron, MOA 15 (Dimilin) 2L	2 to 4 fl oz	0.06 to 0.125	64 to 32	21	
	methoxyfenozide, MOA 18A (Intrepid) 2F	4 to 8 fl oz	0.06 to 0.12	32 to 16	7 (hay) 14 (grain)	
	methoxyfenozide, MOA 18A + spinetoram, MOA 5 (Intrepid Edge) 3F	4.0 to 6.4 oz	See label	32 to 20	28	
	spinetoram, MOA 5 (Radiant) 1 SC	2 to 4 fl oz	0.016 to 0.12	64 to 32	7 (hay) 14 (grain)	
	spinosad, MOA 5 (Blackhawk) 4 SC	1.1 to 2.2 fl oz	0.025 to 0.05	116.4 to 58.2	28	
Grape Colaspis, Blister Beetle, Japanese Beetle, Mexican Bean Beetle, Spotted Cucumber Beetle, Threecornered Alfalfa Hopper	acephate, MOA 1B (Orthene) 97 S	0.75 to 1 lb	0.75 to 1	1.25 to 1	14	These insects are rarely pests; exercise care in determining if a problem exists. Do not spray Mexican bean beetle when many eggs and pupae are present; wait 4 to 5 days. Thrips have never been demonstrated to reduce soybean yields in North Carolina. Threecornered alfalfa hopper girdle mainstems when plants are below 10 inches tall and petioles when plants are larger. Treatments for threecornered alfalfa hopper only impact yield when applied to seedling soybeans.
	pyrethroids, MOA 3 combinations	(see corn earworm above for rates)				

CAUTION: Always use pesticides according to label directions. Be mindful of reducing the impact of pesticides on wildlife and groundwater.

Insect Control on Flue-Cured and Burley Tobacco

C. Sorenson and M. Favre, Entomology and Plant Pathology; M. C. Vann, Crop and Soil Sciences

The Insect Resistance Action Committee (**IRAC**) has grouped insecticides sharing the same mode of action (**MOA**) into categories. The categories are listed following insecticide and formulation names. To minimize the likelihood of resistance development, avoid successive treatment with insecticides having the same MOA. The Organic Materials Registry Institute (**OMRI**) lists products acceptable for use in organic production. These products are identified in the Precautions and Remarks section.

Sanitation is important in controlling greenhouse pests. Keep all trash and equipment out of and away from the greenhouse. Growing plants other than tobacco can introduce difficult-to-control pests. Leaving the empty greenhouses open during cold periods and closed during the summer can help reduce insect pests.

In general, information is provided for the commonly used formulations of active ingredients available in multiple formulations. Carefully check the label of the product you plan to use in the event that it differs from those listed. The label is the law! Residues of some pesticides are a concern for purchasers. Growers are encouraged to discuss insecticide options with their purchasers before treating to reduce potential residue concerns.

Flue-Cured and Burley Tobacco — Greenhouse

Table 5-8A. Insect Control on Flue-Cured and Burley Tobacco in Greenhouses

Insect	Insecticide, Formulation[1] and IRAC Group	Amount of Formulation	Restricted Entry Interval (REI) (hours)	Preharvest Interval (PHI) (days)	Precautions and Remarks
Green peach aphid	acephate, IRAC 1B (Orthene) 97	**Rate per 1,000 sq ft** 0.33 tbsp (0.5 lb/acre)	24	3	There are many formulations of acephate. Apply in 3 gallons water per 1,000 sq ft. Even and thorough coverage is necessary for good control. Do not use more than 4 1/8 lb/acre Orthene (4 lb AI/acre). This includes greenhouse, transplant water, soil, and foliar applications.
	imidacloprid, IRAC 4A (Admire Pro 4.6 lb/gal)	**Rate per 1,000 plants** 0.6 fl oz	12	14	**Only apply imidacloprid to control aphids in the greenhouse if tobacco will be transplanted within a week.** This application replaces tray drench applications for field control of aphids and flea beetles described below. There are many other formulations of imidacloprid**.**
	thiamethoxam, IRAC 4A (Platinum) 75 SG (Platinum) SC	**Rate per 1,000 plants** 0.17 to 0.43 oz 0.5 to 1.3 fl oz	12	None given	**Only apply thiamethoxam to control aphids in the greenhouse if tobacco will be transplanted within a week.** This application replaces tray drench applications for field control of aphids and flea beetles described below.
Tobacco flea beetle	acephate, IRAC 1B (Orthene) 97	**Rate per 1,000 sq ft** 0.33 tbsp (0.5 lb/acre)	24	3	There are many formulations of acephate. Apply in 3 gallons water per 1,000 square feet. Even and thorough coverage is necessary for good control. Do not use more than 4 1/8 lb/acre Orthene (4 lb AI/acre). This includes greenhouse, transplant water, soil, and foliar applications.
	cyantraniliprole, IRAC 28 (Verimark) SC	**Rate per acre equivalent** 10 to 13.5 fl oz	4	None given	Verimark can be applied as a greenhouse tray drench prior to transplant. Applications earlier than one week before transplant have not been tested for efficacy. If Verimark is used to control insects in the greenhouse, it should not be reapplied prior to transplant.
	imidacloprid, IRAC 4A (Admire Pro 4.6 lb/gal 4.6 lb/gal)	**Rate per 1,000 plants** 0.6 fl oz	12	14	**Only apply imidacloprid to control aphids in the greenhouse if tobacco will be transplanted within a week.** This application replaces tray drench applications for field control of aphids and flea beetles described below. There are many other formulations of imidacloprid**.**
	thiamethoxam, IRAC 4A (Platinum) 75 SG (Platinum) SC	**Rate per 1,000 plants** 0.27 to 0.43 oz 0.8 to 1.3 fl oz	12	None given	**Only apply thiamethoxam to control aphids in the greenhouse if tobacco will be transplanted within a week.** This application replaces tray drench applications for field control of aphids and flea beetles described below.
Slugs or snails	hydrated or air-slaked lime		—	—	Apply lime in a band 3 to 4 inches wide around margins of beds.
	iron phosphate bait (Sluggo)	0.5 to 1 lb		0	**OMRI** listed. TO AVOID PLANT INJURY, DO NOT PUT BAIT ON PLANTS.

[1] Some insecticides are available in several formulations. Those listed are generally the most commonly used or available. Other formulations may or may not be suitable for use on tobacco or for a specific pest. Check labels carefully.

Flue-Cured and Burley Tobacco — Field

Table 5-8B. Insect Control on Flue-Cured and Burley Tobacco in the Field

Insect	Insecticide, Formulation[1] and IRAC Group	Amount of Formulation Per Acre	Restricted Entry Interval (REI) (hours)	Preharvest Interval (PHI) (days)	Precautions and Remarks
Green peach aphid — GREENHOUSE OR TRANSPLANT WATER APPLICATIONS Aphids are primarily pre topping pests. Greenhouse or transplant treatments may provide control through topping, and additional foliar treatments are not typically needed. Post topping, aphids are most common on suckers or regrowth. Sucker management via contact materials or hand removal is often sufficient to control post topping aphid populations. The threshold for green peach aphids in the field is 10% of plants scouted with 50 or more aphids on the upper leaves. Organically acceptable aphid control materials are generally less effective than conventional materials, so aphid control in organic production should be initiated upon first aphid appearance, and treatment should continue on 7- to 10-day intervals until topping. **Data on specific organic aphid controls are limited.** Organic tobacco with aphid populations should be topped as early as feasible. Post topping sucker control is very important for aphid control in organic tobacco.	acephate, IRAC 1B (Orthene) 97	0.75 lb	24 If significant foliar contact will occur, gloves must be worn for 14 days after treatment.	3	**TRANSPLANT WATER APPLICATION**. Apply in a minimum of 100 gallons of transplant water/acre. To avoid plant injury, do not exceed 0.75 pound a.i. acephate per acre. **SUPPRESSION ONLY** but may not provide suppression through topping. Continue to scout plants post transplant. Do not use more than 4 1/8 lb/acre Orthene (4 lb AI/acre). This includes greenhouse, transplant water, soil, and foliar applications.
	acephate + bifenthrin, IRAC 1B + IRAC 3 (Acenthrin)	16 oz	24	3	**TRANSPLANT WATER APPLICATION**. Apply in a minimum of 100 gallons of transplant water/acre. To avoid plant injury, do not exceed 0.75 pound a.i. acephate per acre. **SUPPRESSION ONLY** but may not provide suppression through topping. Continue to scout plants post transplant. Do not use more than 4 lb acephate/acre). This includes greenhouse, transplant water, soil, and foliar applications. Bifenthrin provides more protection against soil pests such as wireworms than acephate alone.
	imidacloprid, IRAC 4A (Admire Pro 4.6 lb/gal)	**Rate per 1,000 plants** 0.6 fl oz	12	14	**TRANSPLANT WATER APPLICATION**. Rate is per 1,000 plants and should be converted for transplant water applications based on plant population. Proper calibration of application equipment is essential for effective transplant water applications. A metered or pressurized application system is recommended. Several concentrations of imidacloprid (1.6F, 2F, 4F, and 4.6F) are available. Carefully read the label to determine the correct rate for target pests.
	imidacloprid, IRAC 4A (Admire Pro 4.6 lb/gal)	**Rate per 1,000 plants** 0.5 fl oz	12	14	**GREENHOUSE TRAY DRENCH APPLICATION**. Rate is per 1,000 plants. Apply no more than 5 days before transplanting. Immediately after application, wash the material off the plants onto the potting soil. The lowest label rate is sufficient for aphid and flea beetle management. See below for recommendations for areas with high incidence of Tomato Spotted Wilt Virus (TSWV). Several concentrations of imidacloprid (1.6F, 2F, 4F, and 4.6F) are available. Carefully read the label to determine the correct rate for target pests.
	thiamethoxam, IRAC 4A (Platinum) 75 SG (Platinum) SC	**Rate per 1,000 plants** 0.17 oz 0.5 fl oz	12	None given	**TRANSPLANT WATER APPLICATION**. Use lower label rate for aphids. Rate is per 1,000 plants and should be converted for transplant water applications based on plant population. Proper calibration of application equipment is essential for effective transplant water applications. A metered or pressurized application system is recommended. Make only one application of thiamethoxam per season. Thiamethoxam is also the active ingredient in Actara.
	thiamethoxam, IRAC 4A (Platinum) 75 SG (Platinum) SC	**Rate per 1,000 plants** 0.17 oz 0.5 fl oz	12	None given	**GREENHOUSE TRAY DRENCH APPLICATION**. Use lower label rate for aphids. Rate is per 1,000 plants. Apply no more than 5 days before transplant. Immediately after application, wash the material off the plants onto the potting soil OR apply in transplant water.
	chlorantraniliprole + thiamethoxam, IRAC 28 + IRAC 4A (Durivo)	**Rate per 1,000 plants** 0.6 to 1.6 fl oz	12	None given	**TRANSPLANT WATER APPLICATION.** Apply no more than 0.2 pound chlorantraniliprole per acre per crop, which includes applications of Coragen, Besiege, and Durivo.
Green peach aphid — FIELD FOLIAR APPLICATIONS	acephate, IRAC 1B (Orthene) 97	0.5 lb	24 If significant foliar contact will occur, gloves must be worn for 14 days after treatment.	3	Use at least 25 gallons per acre at 60 PSI. Using hollow cone or small solid cone nozzles, cover entire plant with spray. If control 4 days after treatment is not adequate, choose another MOA for subsequent applications. Do not use more than 4 1/8 lb/acre Orthene (4 lb AI/acre). This includes greenhouse, transplant water, soil, and foliar applications. Tobacco purchasers are concerned about residues of some pesticides in cured leaf. Use caution in making applications of acephate and Group 3 (pyrethroid) insecticides. Select other materials when available.
	acephate + bifenthrin, IRAC 1B + IRAC 3 (Acenthrin)	8 to 12 oz	24	Layby	Make no more than 2 foliar applications per season. Note long pre harvest interval associated with the inclusion of bifenthrin. Tobacco purchasers are concerned about residues of some pesticides in cured leaf. Use caution in making applications of acephate and Group 3 (pyrethroid) insecticides. Select other materials when available.

Table 5-8B. Insect Control on Flue-Cured and Burley Tobacco in the Field

Insect	Insecticide, Formulation[1] and IRAC Group	Amount of Formulation Per Acre	Restricted Entry Interval (REI) (hours)	Preharvest Interval (PHI) (days)	Precautions and Remarks
Green peach aphid — FIELD FOLIAR APPLICATIONS (continued)	acetamiprid, IRAC 4A (Assail) 30 SG	1.5 to 4 oz	12	7	Make no more than 4 applications of acetamiprid per season, and do not apply more than once every 7 days. Avoid using only Group 4A insecticides as foliar field applications for aphids on plants which were treated in the greenhouse with imidacloprid or thiamethoxam.
	imidacloprid, IRAC 4A (Admire Pro 4.6 lb/gal)	0.7 to 1.4 fl oz	12	14	Avoid using only Group 4A insecticides as foliar field applications for aphids on plants which were treated in the greenhouse with imidacloprid or thiamethoxam. Several concentrations of imidacloprid (1.6F, 2F, 4F, and 4.6F) are available. Carefully read the label to determine the correct rate for target pests.
	imidacloprid, IRAC 4A (several products) 2F	1.6 to 3.2 fl oz			
	thiamethoxam, IRAC 4A (Actara)	2 to 3 oz	12	14	Make only one application of thiamethoxam per season. Thiamethoxam is also the active ingredient in Platinum.
	pymetrozine, IRAC 9B (Fulfill) 50 WG	2.75 oz	12	14	Make no more than 2 applications of pymetrozine per year.
	lambda-cyhalothrin, IRAC 3A (Warrior II with Zeon Technology)	0.96 to 1.92 fl oz	24	40	NOTE LONG PREHARVEST INTERVAL. Tobacco purchasers are concerned about residues of some pesticides in cured leaf. Use caution in making applications of acephate and Group 3 (pyrethroid) insecticides. Select other materials when available.
	pyrethrins IRAC 3 (Pyganic) 1.4 EC	16 to 64 fl oz	12	0	Pyganic should be buffered to pH 5.5 to 7. **OMRI** listed. Limited data. Harvest once spray has dried.
	pyrethrins IRAC 3 (Pyganic) 5.0 EC	4.5 to 15.61 fl oz			
	azadirachtin, IRAC UN (Aza Direct)	1 to 2 pt	4	0	Optimal pH range 5.5 to 6.5. **OMRI** listed. Limited data.
	rosemary and peppermint oil (Ecotec Plus)	1to 4 pt	0	0	Rate for 100 gal spray volume. **OMRI** listed. Limited data.
Tobacco flea beetle — GREENHOUSE OR TRANSPLANT WATER APPLICATIONS Greenhouse or transplant treatments may provide control through topping, and additional foliar treatments are not typically needed. The threshold for foliar treatments on small, recently planted tobacco is 4 beetles per plant. Flea beetle populations may increase near harvest and require management if populations exceed 60 beetles per fully grown plant. Good coverage is required for effective flea beetle control in large plants. Use appropriate equipment and sufficient water volume to achieve coverage from the base to the top of the plant.	acephate, IRAC 1B (Orthene) 97	0.75 lb	24 If significant foliar contact will occur, gloves must be worn for 14 days after treatment.	3	**TRANSPLANT WATER APPLICATION**. Apply in a minimum of 100 gallons of transplant water/acre. To avoid plant injury, do not exceed 0.75 pound a.i. acephate per acre. **SUPPRESSION ONLY** but may not provide suppression through topping. Continue to scout plants post transplant. Do not use more than 4 1/8 lb/acre Orthene (4 lb AI/acre). This includes greenhouse, transplant water, soil, and foliar applications.
	acephate + bifenthrin, IRAC 1B + IRAC 3 (Acenthrin)	16 oz	24	3	**TRANSPLANT WATER APPLICATION**. Apply in a minimum of 100 gallons of transplant water/acre. To avoid plant injury, do not exceed 1.0pound a.i. acephate per acre. **SUPPRESSION ONLY** but may not provide suppression through topping. Continue to scout plants post transplant. Do not use more than 4 lb acephate/acre, nor more than 2 lb of bifenthrin/acre. This includes greenhouse, transplant water, soil, and foliar applications. Bifenthrin provides more protection against soil pests such as wireworms than acephate alone.
	imidacloprid, IRAC 4A (Admire Pro 4.6 lb/gal)	**Rate per 1,000 plants** 0.6 fl oz	12	14	**TRANSPLANT WATER APPLICATION**. Proper calibration of application equipment is essential for effective transplant water applications. A metered or pressurized application system is recommended. Several concentrations of imidacloprid (1.6F, 2F, 4F, and 4.6F) are available. Carefully read the label to determine the correct rate for target pests.
	imidacloprid, IRAC 4A (Admire Pro 4.6 lb/gal)	**Rate per 1,000 plants** 0.5 fl oz	12	14	**GREENHOUSE TRAY DRENCH APPLICATION**. Rate is per 1,000 plants. Apply no more than 5 days before transplanting. Immediately after application, wash the material off the plants onto the potting soil. The lowest label rate is sufficient for aphid and flea beetle management. See below for recommendations for areas with high incidence of Tomato Spotted Wilt Virus (TSWV). Several concentrations of imidacloprid (1.6F, 2F, 4F, and 4.6F) are available. Carefully read the label to determine the correct rate for target pests.
	thiamethoxam, IRAC 4A (Platinum) 75 SG (Platinum) SC	**Rate per 1,000 plants** 0.27 oz 0.8 fl oz	12	None given	**TRANSPLANT WATER APPLICATION**. Use lower label rate for aphids. Rate is per 1,000 plants and should be converted for transplant water applications based on plant population. Proper calibration of application equipment is essential for effective transplant water applications. A metered or pressurized application system is recommended.
	thiamethoxam, IRAC 4A (Platinum) 75 SG (Platinum) SC	**Rate per 1,000 plants** 0.27 oz 0.827 oz	12	None given	**GREENHOUSE TRAY DRENCH APPLICATION**. Use lower label rate for aphids. Rate is per 1,000 plants. Apply no more than 5 days before transplant. Immediately after application, wash the material off the plants onto the potting soil OR apply in transplant water.

Table 5-8B. Insect Control on Flue-Cured and Burley Tobacco in the Field

Insect	Insecticide, Formulation[1] and IRAC Group	Amount of Formulation Per Acre	Restricted Entry Interval (REI) (hours)	Preharvest Interval (PHI) (days)	Precautions and Remarks
Tobacco flea beetle — GREENHOUSE OR TRANSPLANT WATER APPLICATIONS (continued)	chlorantraniliprole + thiamethoxam, IRAC 28 + IRAC 4A (Durivo)	**Rate per 1,000 plants** 1.0 to 1.6 fl oz	12	None given	**TRANSPLANT WATER APPLICATION.** Apply no more than 0.2 pound chlorantraniliprole per acre per crop, which includes applications of Coragen, Besiege, and Durivo.
	cyantraniliprole, IRAC 28 (Verimark) SC	10 to 13.5 fl oz	4	None given	**GREENHOUSE TRAY DRENCH APPLICATION.** Rate is per acre. Use plant density to calculate greenhouse application rate.
Tobacco flea beetle — FIELD FOLIAR APPLICATIONS	acephate, IRAC 1B (Orthene) 97	0.5 lb	24 If significant foliar contact will occur, gloves must be worn for 14 days after treatment.	3	Use at least 25 gallons per acre at 60 PSI. Using hollow cone or small solid cone nozzles cover entire plant with spray. If control 4 days after treatment is not adequate, choose another MOA for subsequent applications. Do not use more than 4 1/8 lb/acre Orthene (4 lb AI/acre). This includes greenhouse, transplant water, soil, and foliar applications. Tobacco purchasers are concerned about residues of some pesticides in cured leaf. Use caution in making applications of acephate and Group 3 (pyrethroid) insecticides. Select other materials when available.
	acephate + bifenthrin, IRAC 1B + IRAC 3 (Acenthrin)	8 to 12 oz	24	3	Make no more than 2 foliar applications per season. Tobacco purchasers are concerned about residues of some pesticides in cured leaf. Use caution in making applications of acephate and Group 3 (pyrethroid) insecticides. Select other materials when available.
	lambda-cyhalothrin, IRAC 3A (Warrior II with Zeon Technology)	0.96 to 1.92 fl oz	24	40	NOTE LONG PREHARVEST INTERVAL. Tobacco purchasers are concerned about residues of some pesticides in cured leaf. Use caution in making applications of acephate and Group 3 (pyrethroid) insecticides. Select other materials when available.
	acetamiprid, IRAC 4A (Assail) 30 SG	2.5 to 4 oz	12	7	Make no more than 4 applications of acetamiprid per season, and do not apply more than once every 7 days. Avoid using only Group 4A materials for season-long control of insects with more than 1 generation. Following treatments of Group 4A materials, rotate to a different MOA before making additional applications of a Group 4A material.
	imidacloprid, IRAC 4A (Admire Pro 4.6 lb/gal)	1.4 fl oz	12	14	Avoid using only Group 4A insecticides as foliar field applications for aphids on plants which were treated in the greenhouse with imidacloprid or thiamethoxam. Several concentrations of imidacloprid (2F, 4F, and 4.6F) are available. Carefully read the label to determine the correct rate for target pests.
	imidacloprid, IRAC 4A (several products) 2F	1.6 to 3.2 fl oz			
	thiamethoxam, IRAC 4A (Actara)	2 to 3 oz	12	14	Make only 1 application of thiamethoxam per season. Thiamethoxam is also the active ingredient in Platinum.
	spinosad, IRAC 5 (Blackhawk)	1.6 to 3.2 oz	4	3	Tobacco flea beetles are not listed on the Blackhawk label, but other flea beetle species are, and the active ingredient is very effective against flea beetles. Although spinosad is a naturally derived active ingredient, Blackhawk is not OMRI listed.
	cyantraniliprole, IRAC 28 (Exirel)	13.5 to 20.5 fl oz	12	7	There is limited data on efficacy of cyantraniliprole as a foliar treatment in tobacco.
	indoxacarb IRAC 22A (Steward EC)	9.2 to 11.3 fl az	12	14	There is limited data on the efficacy of indoxacarb for flea beetles late in the season in North Carolina. Do not apply more than 45 fl oz per acre calendar year.
Armyworm Armyworms are typically most common late in the growing season. Preventative treatment is not recommended.	lambda-cyhalothrin, IRAC 3A (Warrior II with Zeon Technology)	0.96 to 1.92 fl oz	24	40	NOTE LONG PREHARVEST INTERVAL. Tobacco purchasers are concerned about residues of some pesticides in cured leaf. Use caution in making applications of acephate and Group 3 (pyrethroid) insecticides. Select other materials when available.
	spinosad, IRAC 5 (Blackhawk)	1.6 to 3.2 oz	4	3	Although spinosad is a naturally derived active ingredient, Blackhawk is not OMRI listed.
	chlorantraniliprole, IRAC 28 (Coragen)	3.5 to 7 fl oz	4	1	Field foliar application only. Transplant applications will not have sufficient longevity to affect armyworm populations. Make no more than 4 applications per season (with at least 3 days between applications) and apply no more than 15.4 fl oz per season.

Table 5-8B. Insect Control on Flue-Cured and Burley Tobacco in the Field

Insect	Insecticide, Formulation[1] and IRAC Group	Amount of Formulation Per Acre	Restricted Entry Interval (REI) (hours)	Preharvest Interval (PHI) (days)	Precautions and Remarks
Budworm The threshold for tobacco budworm is 10% infested plants. This threshold is very conservative, and budworms should not be treated unless infestations exceed 10%. Coverage is important for budworm management. Use 1 to 3 full cone nozzles 6 to 12 inches above bud and a minimum of 25 gallons water per acre.	acephate, IRAC 1B (Orthene) 97	0.75 lb	24	3	There are many formulations of acephate. Do not use more than 4 1/8 lb/acre Orthene (4 lb AI/acre). This includes greenhouse, transplant water, soil, and foliar applications. Acephate has some activity against tobacco budworms, but other products are more effective. Tobacco purchasers are concerned about residues of some pesticides in cured leaf. Use caution in making applications of acephate and Group 3 (pyrethroid) insecticides. Select other materials when available.
	acephate + bifenthrin, IRAC 1B + IRAC 3 (Acenthrin)	6 to 16 oz	24	3	Make no more than 2 foliar applications per season. Tobacco purchasers are concerned about residues of some pesticides in cured leaf. Use caution in making applications of acephate and Group 3 (pyrethroid) insecticides. Select other materials when available.
	chlorantraniliprole, IRAC 28 (Coragen)	5.0 to 7.5 fl oz	4	1	**TRANSPLANT WATER APPLICATION.** Rate is per acre. Transplant applications of Coragen may suppress tobacco budworm populations for 4 to 7 weeks. Proper calibration of application equipment is essential for effective transplant water applications. A metered or pressurized application system is recommended. Apply no more than 15.4 fluid ounces of Coragen or more than 0.2 pound chlorantraniliprole per acre per crop, which includes applications of Coragen, Besiege, and Durivo.
	chlorantraniliprole, IRAC 28 (Coragen)	3.5 to 7.5 fl oz	4	1	**FIELD FOLIAR APPLICATION.** Make no more than 4 applications per season (with at least 3 days between applications) and apply no more than 15.4 fluid ounces of Coragen or more than 0.2 pound chlorantraniliprole per acre per crop, which includes applications of Coragen, Besiege, and Durivo. Some purchasers may have concerns about chlorantraniliprole residues, particularly if used later in the growing season. Discuss chlorantraniliprole usage with purchaser prior to making applications.
	chlorantraniliprole + thiamethoxam, IRAC 28 + IRAC 4A (Durivo)	**Rate per 1,000 plants** 1.6 fl oz	12	None given	**TRANSPLANT WATER APPLICATION.** Transplant applications of Durivo may suppress tobacco budworm populations for 4 to 7 weeks. Proper calibration of application equipment is essential for effective transplant water applications. A metered or pressurized application system is recommended. Apply no more than 0.2 pound chlorantraniliprole per acre per crop, which includes applications of Coragen, Besiege, and Durivo.
	emamectin benzoate, IRAC 6 (Denim)	8 to 12 fl oz	12	14	Do not apply more than 36 fl oz of Denim per year.
	cyantraniliprole, IRAC 28 (Exirel)	10 to 20.5 fl oz	12	7	There is limited data on efficacy of cyantraniliprole as a foliar treatment in tobacco.
	lambda-cyhalothrin, IRAC 3A (Warrior II with Zeon Technology)	0.96 to 1.92 fl oz	24	40	To avoid build-up of resistance, rotate use of this product with other insecticides. NOTE THE LONG PREHARVEST USE RESTRICTION. Tobacco purchasers are concerned about residues of some pesticides in cured leaf. Use caution in making applications of acephate and Group 3 (pyrethroid) insecticides. Select other materials when available.
	lambda-cyhalothrin + chlorantraniliprole IRAC 3 + 28 (Besiege)	5.0 to 10.0 fl oz	24	40	NOTE THE LONG PREHARVEST USE RESTRICTION. Apply no more than 0.2 pound chlorantraniliprole per acre per crop, which includes applications of Coragen, Besiege, and Durivo. Tobacco purchasers are concerned about residues of some pesticides in cured leaf. Use caution in making applications of acephate and Group 3 (pyrethroid) insecticides. Select other materials when available.
	lambda-cyhalothrin + thiamethoxam, IRAC 3 + 4A (Endigo) ZC	4.0 to 4.5 fl oz	24	40	NOTE THE LONG PREHARVEST USE RESTRICTION. Apply no more than 0.2 pound chlorantraniliprole per acre per crop, which includes applications of Coragen, Besiege, and Durivo. Tobacco purchasers are concerned about residues of some pesticides in cured leaf. Use caution in making applications of acephate and Group 3 (pyrethroid) insecticides. Select other materials when available.
	spinosad, IRAC 5 (Blackhawk)	1.6 to 3.2 oz	4	3	Although spinosad is a naturally derived active ingredient, Blackhawk is <u>not</u> OMRI listed.
	indoxacarb IRAC 22A (Steward EC)	6.7 to 11.3 fl oz	12	14	No more than 4 applications per season at no less than 5-day intervals. Don't apply more than 45 fl oz per acre per calendar year.
	Bacillus thuringiensis, IRAC 11 (DiPel DF)	0.5 to 1 lb	4	0	There are many *Bt* formulations, including Agree, Biobit, Condor, Crymax, Deliver, Dipel, Javelin, and Lepinox. Highest labeled rates are generally needed for budworm control. DiPel DF and many other *Bt* formulations are **OMRI** listed, but not all *Bt* formulations are **OMRI** listed. Carefully read the label to determine if a material is acceptable for use on organically certified plants. DiPel 10G formulation is intended to be applied as a bait directly to buds and can be more effective against tobacco budworm than sprayable formulations.
	Bacillus thuringiensis, IRAC 11 (DiPel 10G)	5 to 10 lb			
	Helicoverpa zea nucleopolyhedrovirus ABA-NPV-U IRAC 31 (Heligen)	1.2 to 2.4 fl oz	4	0	Most effective on small larvae (under 0.5 in.); start application when first small caterpillars are observed. More than one application may be needed if large populations are present or if reinfestation occurs. Most effective at 7.0 pH. Heligen is only effective against tobacco budworm and corn earworm.
	GS-omega/kappa-Hxtx-Hv1a IRAC 32 (Spear-Lep)	1 to 2 pt	4	0	Spear-Lep is intended to be combined with a *Bt* product to improve control. Non-ionic surfactant (0.125% v/v) recommended by manufacturer. Data on Spear-Lep performance in tobacco is limited.

Table 5-8B. Insect Control on Flue-Cured and Burley Tobacco in the Field

Insect	Insecticide, Formulation[1] and IRAC Group	Amount of Formulation Per Acre	Restricted Entry Interval (REI) (hours)	Preharvest Interval (PHI) (days)	Precautions and Remarks
Cutworm Preventative insecticide applications are not recommended for cutworms because they are infrequent pests and rescue materials are effective. Scout fields in the first 4 weeks following transplant for cutworm injury and treat if 10% of plants are clipped. Cutworm treatments should be applied in a directed spray over rows in the late afternoon or at dusk, when cutworms are most likely to be active.	acephate, IRAC 1B (Orthene) 97	0.75 lb	24	3	There are many formulations of acephate. Do not use more than 4 1/8 lb/acre Orthene (4 lb AI/acre). This includes greenhouse, transplant water, soil, and foliar applications. Tobacco purchasers are concerned about residues of some pesticides in cured leaf. Use caution in making applications of acephate and Group 3 (pyrethroid) insecticides. Select other materials when available.
	acephate + bifenthrin, IRAC 1B + IRAC 3 (Acenthrin)	6 to 16 oz	24	Layby	Make no more than 2 foliar applications per season. Note long pre harvest interval associated with the inclusion of bifenthrin. Tobacco purchasers are concerned about residues of some pesticides in cured leaf. Use caution in making applications of acephate and Group 3 (pyrethroid) insecticides. Select other materials when available.
	lambda-cyhalothrin, IRAC 3A (Warrior II with Zeon Technology)	0.96 to 1.92 fl oz	24	40	NOTE LONG PREHARVEST INTERVAL.
	lambda-cyhalothrin + chlorantraniliprole IRAC 3 + 28 (Besiege)	5.0 to 10.0 fl oz	24	40	NOTE LONG PREHARVEST USE RESTRICTION. Apply no more than 15.4 fluid ounces of Coragen or more than 0.2 pound chlorantraniliprole per acre per crop, which includes applications of Coragen, Besiege, and Durivo. Some purchasers may have concerns about chlorantraniliprole residues, particularly if used later in the growing season. Discuss chlorantraniliprole usage with purchaser prior to making applications.
	chlorantraniliprole, IRAC 28 (Coragen)	3.5 to 7.5 fl oz	4	1	Make no more than 4 applications per season (with at least 3 days between applications). Apply no more than 15.4 fluid ounces of Coragen or more than 0.2 pound chlorantraniliprole per acre per crop, which includes applications of Coragen, Besiege, and Durivo. Some purchasers may have concerns about chlorantraniliprole residues, particularly if used later in the growing season. Discuss chlorantraniliprole usage with purchaser prior to making applications.
	chlorpyrifos, IRAC 1B (Lorsban 4E)	2 pt	24		Apply as preplant broadcast 24 to 48 hours before bedding and transplanting. Incorporate to a depth of 2 to 4 inches. Do not apply more than once per season. Application restrictions from industry have been announced, consult with leaf buyers prior to application.
Grasshopper	acephate, IRAC 1B (Orthene) 97	0.25 to 0.5 lb	24	3	Nymphs (young) are more easily controlled than adults. There are many formulations of acephate. Do not use more than 4 1/8 lb/acre Orthene (4 lb AI/acre). This includes greenhouse, transplant water, soil, and foliar applications. Tobacco purchasers are concerned about residues of some pesticides in cured leaf. Use caution in making applications of acephate and Group 3 (pyrethroid) insecticides. Select other materials when available.
	acephate + bifenthrin, IRAC 1B + IRAC 3 (Acenthrin)	6 to 16 oz	24	Layby	Make no more than 2 foliar applications per season. Note long preharvest interval associated with the inclusion of bifenthrin. Tobacco purchasers are concerned about residues of some pesticides in cured leaf. Use caution in making applications of acephate and Group 3 (pyrethroid) insecticides. Select other materials when available.
Hornworm Treat for hornworms when 5 or more larvae longer than 1 inch and without cocoons are found per 50 plants. Hornworm larvae with cocoons should be considered 1/5 of a larva when counting. If treatment is necessary during harvesting, be certain to follow all labeled preharvest intervals.	acephate, IRAC 1B (Orthene) 97	0.5 lb	24	3	There are many formulations of acephate. Do not use more than 4 1/8 lb/acre Orthene (4 lb AI/acre). This includes greenhouse, transplant water, soil, and foliar applications. Some purchasers may have concerns about acephate residues, particularly if used later in the growing season. Discuss acephate usage with purchaser prior to making applications.
	acephate + bifenthrin, IRAC 1B + IRAC 3 (Acenthrin)	6 to 16 oz	24	Layby	Make no more than 2 foliar applications per season. Note long preharvest interval associated with the inclusion of bifenthrin. Tobacco purchasers are concerned about residues of some pesticides in cured leaf. Use caution in making applications of acephate and Group 3 (pyrethroid) insecticides. Select other materials when available.
	chlorantraniliprole, IRAC 28 (Coragen)	3.5 to 5 fl oz	4	1	FIELD FOLIAR APPLICATION**.** Because they are not frequent pests before topping, transplant water applications of Coragen for hornworms alone are not recommended. Make no more than 4 applications per season (with at least 3 days between applications). Apply no more than 15.4 fluid ounces of Coragen or more than 0.2 pound chlorantraniliprole per acre per crop, which includes applications of Coragen, Besiege, and Durivo. Lower label rates of Coragen are likely sufficient for hornworms. Some purchasers may have concerns about chlorantraniliprole residues, particularly if used later in the growing season. Discuss chlorantraniliprole usage with purchaser prior to making applications.
	cyantraniliprole, IRAC 28 (Exirel)	13.5 to 20.5 fl oz	12	7	
	emamectin benzoate, IRAC 6 (Denim)	8 to 12 fl oz	12	14	Do not apply more than 36 fl oz of Denim per year.
	lambda-cyhalothrin + thiamethoxam, IRAC 3 + 4A (Endigo) ZC	4.0 to 4.5 fl oz	24	40	NOTE THE LONG PREHARVEST USE RESTRICTION. Apply no more than 0.2 pound chlorantraniliprole per acre per crop, which includes applications of Coragen, Besiege, and Durivo. Tobacco purchasers are concerned about residues of some pesticides in cured leaf. Use caution in making applications of acephate and Group 3 (pyrethroid) insecticides. Select other materials when available.

Table 5-8B. Insect Control on Flue-Cured and Burley Tobacco in the Field

Insect	Insecticide, Formulation[1] and IRAC Group	Amount of Formulation Per Acre	Restricted Entry Interval (REI) (hours)	Preharvest Interval (PHI) (days)	Precautions and Remarks
Hornworm (continued)	lambda-cyhalothrin + chlorantraniliprole IRAC 3 + 28 (Besiege)	5.0 to 10.0 fl oz	24	40	NOTE THE LONG PREHARVEST USE RESTRICTION. Apply no more than 0.2 pound chlorantraniliprole per acre per crop, which includes applications of Coragen, Besiege, and Durivo. Tobacco purchasers are concerned about residues of some pesticides in cured leaf. Use caution in making applications of acephate and Group 3 (pyrethroid) insecticides. Select other materials when available.
	indoxacarb IRAC 22A (Steward EC)	6.7 to 11.3 fl oz	12	14	No more than 4 applications per season at no less than 5-day intervals. Don't apply more than 45 fl oz per acre per calendar year.
	spinosad, IRAC 5 (Blackhawk)	1.6 to 3.2 oz	4	3	While spinosad is a naturally derived active ingredient, Blackhawk is not OMRI listed.
	Bacillus thuringiensis, IRAC 11 (Dipel DF)	0.5 to 1 lb	4	0	There are many *Bt* formulations, including Agree, Biobit, Condor, Crymax, Deliver, Dipel, Javelin, and Lepinox. Highest labeled rates are generally needed for budworm control. DiPel DF and many but not all *Bt* formulations are **OMRI** listed. Carefully read the label to determine if a material is acceptable for use on organically certified plants.
	GS-omega/kappa-Hxtx-Hv1a IRAC 32 (Spear-Lep)	1 to 2 pt	4	0	Spear-Lep is intended to be combined with a *Bt* product to improve control. Non-ionic surfactant (0.125% v/v) recommended by manufacturer. Data on Spear-Lep performance in tobacco is limited.
Japanese beetle Infestations may be spotty within fields and do not typically require treatment.	acephate, IRAC 1B (Orthene) 97	0.75 lb	24	3	There are many formulations of acephate. Do not use more than 4 1/8 lb/acre Orthene (4 lb AI/acre). This includes greenhouse, transplant water, soil, and foliar applications. Tobacco purchasers are concerned about residues of some pesticides in cured leaf. Use caution in making applications of acephate and Group 3 (pyrethroid) insecticides. Select other materials when available.
	acephate + bifenthrin, IRAC 1B + IRAC 3 (Acenthrin)	6 to 16 oz	24	Layby	Make no more than 2 foliar applications per season. Note long preharvest interval associated with the inclusion of bifenthrin. Tobacco purchasers are concerned about residues of some pesticides in cured leaf. Use caution in making applications of acephate and Group 3 (pyrethroid) insecticides. Select other materials when available.
	lambda-cyhalothrin + chlorantraniliprole IRAC 3 + 28 (Besiege)	5.0 to 10.0 fl oz	24	40	NOTE THE LONG PREHARVEST USE RESTRICTION. Apply no more than 0.2 pound chlorantraniliprole per acre per crop, which includes applications of Coragen, Besiege, and Durivo. Tobacco purchasers are concerned about residues of some pesticides in cured leaf. Use caution in making applications of acephate and Group 3 (pyrethroid) insecticides. Select other materials when available.
	lambda-cyhalothrin + thiamethoxam, IRAC 3 + 4A (Endigo) ZC	4.0 to 4.5 fl oz	24	40	NOTE THE LONG PREHARVEST USE RESTRICTION. Apply no more than 0.2 pound chlorantraniliprole per acre per crop, which includes applications of Coragen, Besiege, and Durivo. Tobacco purchasers are concerned about residues of some pesticides in cured leaf. Use caution in making applications of acephate and Group 3 (pyrethroid) insecticides. Select other materials when available.
	imidacloprid, IRAC 4A (Admire Pro 4.6 lb/gal)	1.4 fl oz	12	14	**FIELD FOLIAR APPLICATION.** Avoid using only Group 4A materials for season-long control of insects with more than 1 generation. Following treatments of Group 4A materials, rotate to a different MOA before making additional applications of a Group 4A material.
	imidacloprid, IRAC 4A (several products) 2F	3.2 fl oz			
	thiamethoxam, IRAC 4A (Actara)	2 to 3 oz	12	14	**Make only one application of thiamethoxam per season. Thiamethoxam is also the active ingredient in Platinum.**
Slug Slugs are only potential pests in the greenhouse and shortly following transplant. They do not present a risk to larger plants.	iron phosphate bait (Sluggo)	20 to 44 lb	0		**OMRI** listed. TO AVOID PLANT INJURY, DO NOT PUT BAIT ON PLANTS.
	metaldehyde bait (Deadline Bullets)	10 to 20 lb	12		Apply at dusk to soil surface between rows and around margins of field. DO NOT PUT BAIT ON PLANTS.
Stink bug Stink bugs rarely cause economic damage to tobacco and rarely require treatment.	acephate, MOA 1B (Orthene) 97	0.5 to 0.75 lb	24	3	There are many formulations of acephate. Do not use more than 4 1/8 lb/acre Orthene (4 lb AI/acre). This includes greenhouse, transplant water, soil, and foliar applications. Tobacco purchasers are concerned about residues of some pesticides in cured leaf. Use caution in making applications of acephate and Group 3 (pyrethroid) insecticides. Select other materials when available.
	acephate + bifenthrin, IRAC 1B + IRAC 3 (Acenthrin)	6 to 16 oz	24	Layby	Make no more than 2 foliar applications per season. Note long pre harvest interval associated with the inclusion of bifenthrin. Tobacco purchasers are concerned about residues of some pesticides in cured leaf. Use caution in making applications of acephate and Group 3 (pyrethroid) insecticides. Select other materials when available.
	bifenthrin, IRAC 3 (Capture LFR)	3.4 to 8.5 fl oz	12	Do not apply after Layby	**FIELD FOLIAR APPLICATION.** NOTE THE LONG PREHARVEST USE RESTRICTION. Tobacco purchasers are concerned about residues of some pesticides in cured leaf. Use caution in making applications of acephate and Group 3 (pyrethroid) insecticides. Select other materials when available.

Table 5-8B. Insect Control on Flue-Cured and Burley Tobacco in the Field

Insect	Insecticide, Formulation[1] and IRAC Group	Amount of Formulation Per Acre	Restricted Entry Interval (REI) (hours)	Preharvest Interval (PHI) (days)	Precautions and Remarks
Stink bug (continued)	bifenthrin + imidacloprid, IRAC 3, 4A \Brigadier	3.8 to 6.4 fl oz	12	Do not apply after Layby	**FIELD FOLIAR APPLICATION.** NOTE THE LONG PREHARVEST USE RESTRICTION. Tobacco purchasers are concerned about residues of some pesticides in cured leaf. Use caution in making applications of acephate and Group 3 (pyrethroid) insecticides. Select other materials when available.
	lambda-cyhalothrin, IRAC 3A (Warrior II with Zeon Technology)	0.96 to 1.92 fl oz	24	40	To avoid build-up of resistance, rotate use of this product with other modes of action. NOTE THE LONG PREHARVEST USE RESTRICTION. Tobacco purchasers are concerned about residues of some pesticides in cured leaf. Use caution in making applications of acephate and Group 3 (pyrethroid) insecticides. Select other materials when available.
	lambda-cyhalothrin + chlorantraniliprole IRAC 3 + 28 (Besiege)	5.0 to 10.0 fl oz	24	40	NOTE THE LONG PREHARVEST USE RESTRICTION. Apply no more than 0.2 pound chlorantraniliprole per acre per crop, which includes applications of Coragen, Besiege, and Durivo. Tobacco purchasers are concerned about residues of some pesticides in cured leaf. Use caution in making applications of acephate and Group 3 (pyrethroid) insecticides. Select other materials when available.
Tomato spotted wilt virus (TSWV) suppression The materials below act on the thrips vector of TSWV. In addition to these materials, applications of acibenzolar-S-methyl (Actigard 50WG) timed to predicted thrips flights are also effective at suppressing TSWV. Consult the TSWV and Thrips Risk Forecasting Tool (https://legacy.climate.ncsu.edu/thripshttps://legacy.climate.ncsu.edu/thrips) for recommendation on timing Actigard applications. Refer to the North Carolina Flue Guide Tobacco Production Guide for Actigard application recommendations.	chlorantraniliprole + thiamethoxam, IRAC 28 + IRAC 4A (Durivo)	**Rate per 1,000 plants** 1.0 - 1.6 fl oz	12	None given	**TRANSPLANT WATER APPLICATION.** Proper calibration of application equipment is essential for effective transplant water applications. A metered or pressurized application system is recommended. Apply no more than 0.2 pound chlorantraniliprole per acre per crop, which includes applications of Coragen, Besiege, and Durivo. Thiamethoxam may be less effective at suppressing TSWV than imidacloprid.
	imidacloprid, IRAC 4A (Admire Pro 4.6 lb/gal)	**Rate per 1,000 plants** 0.8 to 1.2 fl oz	12	14	**TRANSPLANT WATER APPLICATION**. Rate is per 1,000 plants and should be converted for transplant water applications based on plant population. Proper calibration of application equipment is essential for effective transplant water applications. A metered or pressurized application system is recommended. Several concentrations of imidacloprid (1.6F, 2F, 4F, and 4.6F) are available. Carefully read the label to determine the correct rate for target pests. Imidacloprid may be more effective at suppressing TSWV than thiamethoxam.
	imidacloprid, IRAC 4A (Admire Pro 4.6 lb/gal)	**Rate per 1,000 plants** 0.6 to 1.2 fl oz	12	14	**GREENHOUSE TRAY DRENCH APPLICATION**. Rate is per 1,000 plants. Apply no more than 5 days before transplanting. Immediately after application, wash the material off the plants onto the potting soil. Several concentrations of imidacloprid (1.6F, 2F, 4F, and 4.6F) are available. Carefully read the label to determine the correct rate for target pests.
	thiamethoxam, IRAC 4A (Platinum) 75 SG (Platinum) SC	**Rate per 1,000 plants** 0.27 to 0.43 oz 0.8 to 1.3 fl oz	12	None given	**TRANSPLANT WATER APPLICATION**. Rate is per 1,000 plants and should be converted for transplant water applications based on plant population. Proper calibration of application equipment is essential for effective transplant water applications. A metered or pressurized application system is recommended. Thiamethoxam may be less effective at suppressing TSWV than imidacloprid.
	thiamethoxam, IRAC 4A (Platinum) 75 SG (Platinum) SC	**Rate per 1,000 plants** 0.27 to 0.43 oz 0.8 to 1.3 fl oz	12	None given	**GREENHOUSE TRAY DRENCH APPLICATION**. Use lower label rate for aphids. Rate is per 1,000 plants. Apply no more than 5 days before transplant. Immediately after application, wash the material off the plants onto the potting soil OR apply in transplant water. Thiamethoxam may be less effective at suppressing TSWV than imidacloprid.
Vegetable weevil	acephate, IRAC 1B (Orthene) 97	0.5 to 0.75 lb	24	3	Treat plants in late afternoon for best control. Spray a band over center of row using a good volume of water. Do not use more than 4 1/8 lb/acre Orthene (4 lb AI/acre). This includes greenhouse, transplant water, soil, and foliar applications. Tobacco purchasers are concerned about residues of some pesticides in cured leaf. Use caution in making applications of acephate and Group 3 (pyrethroid) insecticides. Select other materials when available.
	acephate + bifenthrin, IRAC 1B + IRAC 3 (Acenthrin)	6 to 16 oz	24	Layby	Make no more than 2 foliar applications per season. Note long preharvest interval associated with the inclusion of bifenthrin. Tobacco purchasers are concerned about residues of some pesticides in cured leaf. Use caution in making applications of acephate and Group 3 (pyrethroid) insecticides. Select other materials when available.
	lambda-cyhalothrin, IRAC 3A (Warrior II with Zeon Technology)	0.96 to 1.92 fl oz	24	40	NOTE THE LONG PREHARVEST USE RESTRICTION. Tobacco purchasers are concerned about residues of some pesticides in cured leaf. Use caution in making applications of acephate and Group 3 (pyrethroid) insecticides. Select other materials when available.
	lambda-cyhalothrin + chlorantraniliprole IRAC 3 + 28 (Besiege)	5.0 to 10.0 fl oz	24	40	NOTE THE LONG PREHARVEST USE RESTRICTION. Apply no more than 0.2 pounds of chlorantraniliprole per acre per crop, which includes applications of Coragen, Besiege, and Durivo. Tobacco purchasers are concerned about residues of some pesticides in cured leaf. Use caution in making applications of acephate and Group 3 (pyrethroid) insecticides. Select other materials when available.

Table 5-8B. Insect Control on Flue-Cured and Burley Tobacco in the Field

Insect	Insecticide, Formulation[1] and IRAC Group	Amount of Formulation Per Acre	Restricted Entry Interval (REI) (hours)	Preharvest Interval (PHI) (days)	Precautions and Remarks
Wireworm Wireworm treatments should be applied pretransplant in fields with a history of significant damage. If fields do not have a history of wireworm injury, greenhouse tray drench or transplant water treatments of imidacloprid or thiamethoxam will also suppress wireworm damage if they are present.	acephate + bifenthrin, IRAC 1B + IRAC 3 (Acenthrin)	16 oz	24	3	**TRANSPLANT WATER APPLICATION**. Apply in a minimum of 100 gallons of transplant water/acre. To avoid plant injury, do not exceed 0.75 pound a.i. acephate per acre. **SUPPRESSION ONLY** but may not provide suppression through topping. Continue to scout plants post transplant. Do not use more than 4 lb acephate/acre). This includes greenhouse, transplant water, soil, and foliar applications. Bifenthrin provides more protection against soil pests such as wireworms than acephate alone.
	bifenthrin + imidacloprid, IRAC 3, 4A (Brigadier)	21.75 to 25.5 fl oz	12	Do not apply after Layby	**TRANSPLANT WATER APPLICATION**. Use as described above for transplant water treatments for imidacloprid. Brigadier is not intended for greenhouse use. Data on wireworm control are limited.
	bifenthrin, IRAC 3 (Capture LFR)	3.4 to 8.5 fl oz	12	Do not apply after Layby	Apply as a pretransplant soil treatment and incorporate into 4 inches of soil OR apply in transplant water at 3.4 to 8.5 fluid ounces per acre. Data on wireworm control are limited.
	chlorantraniliprole + thiamethoxam, IRAC 28 + IRAC 4A (Durivo)	**Rate per 1,000 plants** 1.6 fl oz	12	None given	**TRANSPLANT WATER APPLICATION.** Proper calibration of application equipment is essential for effective transplant water applications. A metered or pressurized application system is recommended. Apply no more than 0.2 pounds of chlorantraniliprole per acre per crop, which includes applications of Coragen, Besiege, and Durivo. Data on wireworm control are limited.
	imidacloprid, IRAC 4A (Admire Pro 4.6 lb/gal)	**Rate per 1,000 plants 0.6 to** 1.2 fl oz	12	14	**GREENHOUSE TRAY DRENCH APPLICATION**. Rate is per 1,000 plants. Apply no more than 5 days before transplanting. Immediately after application, wash the material off the plants onto the potting soil. Several concentrations of imidacloprid (1.6F, 2F, 4F, and 4.6F) are available. Carefully read the label to determine the correct rate for target pests. Data on wireworm control are limited.
	thiamethoxam, IRAC 4A (Platinum) 75 SG (Platinum) SC	**Rate per 1,000 plants** 0.43 oz 1.3 fl oz	12	None given	**GREENHOUSE TRAY DRENCH APPLICATION**. Use lower label rate for aphids. Rate is per 1,000 plants. Apply no more than 5 days before transplant. Immediately after application, wash the material off the plants onto the potting soil OR apply in transplant water. Data on wireworm control are limited.
	chlorpyrifos, IRAC 1B (Lorsban 4E)	2 pt	24		Apply as preplant broadcast 24 to 48 hours before bedding and transplanting. Incorporate to a depth of 2 to 4 inches. Do not apply more than once per season. Application restrictions from industry have been announced, consult with leaf buyers prior to application.

[1] Some insecticides are available in several formulations. Those listed are generally the most commonly used or are readily available. Other formulations may or may not be suitable for use on tobacco or a specific pest. Check labels carefully.

More production information is available at tobacco.ces.ncsu.edu.

Insect Control for Commercial Vegetables

J. F. Walgenbach, G. G. Kennedy, and A. S. Huseth, Entomology and Plant Pathology

Read the pesticide label before application. High pressure (200 psi) and high volume (50 gallons per acre) aid in vegetable insect control. Ground sprays with airblast sprayers or sprayers with hollow cone drop nozzles are suggested. Incorporate several methods of control for best results. In recent years, the number of generic products has increased significantly. For brevity, these generic products typically are not listed within each section. The trade names listed are intended to aid in identification of products and are neither intended to promote use of specific trade names nor to discourage use of generic products. A list of active ingredients and generic brand names appears in a separate table at the end of this section.

The Insecticide Resistance Action Committee (IRAC) classifies insecticides based on their mode of action (MOA), with insecticides in the same MOA having the same mode of action. Effective insecticide resistance management involves the use of alternations, rotations, or sequences of different insecticide MOA classes. To prevent the development of resistance, it is important not to apply insecticides with the same MOA to successive generations of the same insect.

Table 5-9. Insect Control for Commercial Vegetables

CROP Insect	Insecticide, Mode of Action Code, and Formulation	Amount of Formulation Per Acre	Restricted Entry Interval (REI)	Pre harvest Interval (PHI) (Days)	Precautions and Remarks
Asparagus					
Aphid	dimethoate 400, MOA 1B	1 pt	48 hrs	180	Do not exceed 2 pints per acre per year.
	malathion, MOA 1B (various) 57 EC	1.5 toto 2 pt	12 hrs	1	Aphid colonies appear by early September.
	pymetrozine, MOA 9B (Fulfill) 50 WDG	2.75 oz	12 hrs	180	For aphid control on ferns after harvest.
	acetamiprid (Assail) 30 SG	2.5 to 3.0 oz	12 hrs	1	Do not make more than 2 applications per calendar year.
Asparagus beetle, Japanese beetle, Grasshopper	carbaryl, MOA 1A (Sevin) 50 WP (Sevin) 80 S (Sevin) XLR Plus	 2 to 4 lb 1.25 to 2.5 lb 1 to 2 qt	12 hrs	1	Low rate to be used on seedlings or spears. Do not apply more often than once every 3 days. With established beetle populations, 3 consecutive weekly sprays are required. Manage beetles and grasshoppers in the fall. The use of carbamates may result in aphid buildup.
	acetamiprid (Assail) 30 SG	2.5 to 3.0 oz	12	1	Do not make more than 2 applications per calendar year.
	dimethoate 400, MOA 1B	1 pt	48 hrs	180	Do not exceed 5 pints per acre per year.
	malathion, MOA 1B (various) 57 EC	2 pt	12 hrs	1	Apply as needed.
	methomyl, MOA 1A (Lannate) 2.4 LV	1.5 pt	48 hrs	1	Leave a row on edge of field near overwintering sites of asparagus beetles fern out. This will attract and hold beetles for that directed insecticide spray (trap and destroy).
	pyrethroid, MOA 3A				See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
	spinetoram, MOA 5 (Radiant) 1 SC	4 to 8 fl oz	4 hrs	60	For asparagus beetle only. This use is only for asparagus ferns; do not apply within 60 days of spear harvest.
Beet armyworm, Cutworm, Yellowstriped armyworm	*Bacillus thuringiensis,* MOA 11A (Dipel) DF	0.5 to1 lb	4 hrs	0	
	chlorantraniliprole, MOA 28 (Coragen) 1.67SC	3.5 to 7.5 fl oz	4 hrs	1	
	cyantraniliprole, MOA 28 (Exirel) 0.83EC	7 to 13.5 fl oz	12 hrs	1	Do not make applications within 25 ft of water sources.
	methomyl, MOA 1A (Lannate) 2.4 LV (Lannate) 90 SP	 1.5 to 3 pt 0.5 to 1 lb	48 hrs	1	
	spinetoram, MOA 5 (Radiant) 1 SC	4 to 8 fl oz	4 hrs	60	This use is only for asparagus ferns; do not apply within 60 days of spear harvest.
	spinosad, MOA 5 (Entrust 2SC)	4 to 6 fl oz	4 hrs	60	This use is only for asparagus ferns; do not apply within 60 days of spear harvest. OMRI listed.
Beans (Snap, Lima, Pole)					
Aphid	acetamiprid MOA 4A (Assail) 30SG	2.5 to 5.3 oz	12 hrs	7	Do not make more than 3 applications per calendar year.
	dimethoate 4 EC, MOA 1B	0.5 to 1 pt	48 hrs	0	On foliage as needed.
	imidacloprid, Soil treatment (Admire Pro) 4.6 F (various) 2F	 7 to 10.5 fl oz 16 to 24 fl oz	12 hrs	 21	See label for soil application instructions. Also controls leafhoppers and thrips.
	Foliar treatment Admire Pro 4.6 F (various) 2 F	1.2 fl oz 2.8 fl oz	12 hrs	7	
	Sulfoxaflor, MOA 4C (Transform) 50 WG	0.75 to 1.0 oz	24 hrs	7	
	flupyradifurone (Sivanto Prime) 1.67	7 to 14 fl oz	4 hrs	7	
	spirotetramat, MOA 23 (Movento) 2 SC	4 to 5 fl oz	24 hrs	1 (succulent) 7 (dried)	

Table 5-9. Insect Control for Commercial Vegetables

CROP Insect	Insecticide, Mode of Action Code, and Formulation	Amount of Formulation Per Acre	Restricted Entry Interval (REI)	Pre harvest Interval (PHI) (Days)	Precautions and Remarks
Beans (Snap, Lima, Pole) (continued)					
Thrips	acephate, MOA 1B (Orthene) 97 PE	0.5 to 1 lb	24 hrs	14	Lima beans may be treated and harvested the same day. Do not apply more than 2 pounds a.i. per acre per season.
	acetamiprid MOA 4A (Assail) 30SG	2.5 to 5.3 oz	12 hrs	7	
	pyrethroid, MOA 3A		12 hrs		Not effective against western flower thrips. See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
	methomyl, MOA 1A (Lannate) 90 SP (Lannate) 2.4 LV	0.5 lb 1.5 pt	48 hrs	1	
	novaluron MOA 15 (Rimon) 0.83 EC	12 fl oz	12 hrs	1	Effective against immature thrips only.
	spinetoram, MOA 5 (Radiant) 1 SC	5 to 6 fl oz	4 hrs	3 (succulent); 28 (dried)	Do not apply more than 28 fluid ounces per acre per season on succulent beans or more than 12 fluid ounces on dried beans.
	spinosad, MOA 5 (Blackhawk)	2.5 to 3.3 oz	4 hrs	3 (succulent); 28 (dried	Do not apply more than 20 ounces per acre per season on succulent beans or more than 8.3 ounces on dried beans.
Corn earworm, European corn borer, Lesser cornstalk borer, Looper	chlorantraniliprole, MOA 28 (Coragen) 1.67 SC (Vantacor) 5 SC	3.5 to 7.5 fl oz 1.2 to 2.5 fl oz	4 hrs	1	
	cyantraniliprole, MOA 28 (Exirel) SE	10 to 20.5 fl oz	12 hrs	1 (succulent) 7 (dried)	
	methoxyfenozide, MOA 18 (Intrepid) 2F	4 to 16 fl oz	4 hrs	7	Use lower rates for early season applications to young crops and higher rates for mid- to late-season applications and heavier infestations. Do not apply more than 16 fl oz per acre per season.
	novaluron MOA 15 (Rimon) 0.83 EC	6 to 12 fl oz	12 hrs	1	
	spinetoram, MOA 5 (Radiant) 1 SC	4.5 to 6 fl oz	4 hrs	3 (succulent); 28 (dried)	Do not apply more than 28 fluid ounces per acre per season on succulent beans or more than 12 fluid ounces on dried beans.
	spinosad, MOA 5 (Blackhawk)	2.22 to 3.3 oz	4 hrs	3 (succulent); 28 (dried	Do not apply more than 20 ounces per acre per season on succulent beans or more than 8.3 ounces on dried beans.
	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
Cowpea curculio	Lambda-cyhalothrin, MOA 3A + chlorantraniliprole, MOA 28 (Besiege) ZC	6 to 10 fl oz	24 hrs	7 (succulent) 21 (dried)	
	bifenthrin, MOA 3A + chlorantraniliprole, MOA 28 (Elevest) SC	5.6 to 9.6 fl oz	12 hrs	3 (succulent0 14 (dired)	
	pyrethroid, MOA 3A				See table 5-9B for a list of registered pyrethroids and pre-harvest intervals. Control may be poor in areas where resistant populations occur, primarily in the Gulf Coast areas. Addition of piperonyl-butoxide-synergist (Exponent) may improve control of pyrethroids.
Cucumber beetle, Bean leaf beetle, Japanese beetle, Cutworm	carbaryl, MOA 1A (Sevin) 50 WP 80 S XLR Plus	4 lb 2.5 lb 1 qt	12 hrs	3 (succulent) 21 (dried)	
	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
Grasshopper	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
Leafminer	cyromazine, MOA 17 (Trigard) 75 WP	2.66 oz	12 hrs	7	
	spinetoram, MOA 5 (Radiant) 1 SC	4 to 8 fl oz	4 hrs	3 (succulent); 28 (dried)	Do not apply more than 28 fluid ounces per acre per season on succulent beans or more than 12 fluid ounces on dried beans.
	spinosad, MOA 5 (Blackhawk)	2.5 to 3.3 oz	4 hrs	3 (succulent); 28 (dried)	Do not apply more than 20 ounces per acre per season on succulent beans or more than 8.3 ounces on dried beans.
Lygus bug	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
	acetamiprid MOA 4A (Assail) 30 SG	2.5 to 5.3 oz	12 hrs	7	
	sulfoxaflor, MOA 4C (Transform) CA	1.5 to 2.25 oz	24 hrs	7	
	dimethoate, MOA 1B (Dimethoate) 4 EC	1 pt	48 hrs	7	Do not apply if bees are visiting area to be treated when crops or weeds are in bloom.
Mexican bean beetle	acetamiprid MOA 4A (Assail) 30SG	2.5 to 5.3 oz	12 hrs	7	See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
	carbaryl, MOA 1A (Sevin) 50 WP (Sevin) 80 S (Sevin) XLR Plus	1 to 2 lb 0.625 to 1.25 lb 1 qt	12 hrs	3 (succulent) 21 (dry)	On foliage as needed. Use low rate on young plants.
	novaluron MOA 15 (Rimon) 0.83 EC	9 to 12 oz	12 hrs	1	Controls immature stages only.

Table 5-9. Insect Control for Commercial Vegetables

CROP Insect	Insecticide, Mode of Action Code, and Formulation	Amount of Formulation Per Acre	Restricted Entry Interval (REI)	Pre harvest Interval (PHI) (Days)	Precautions and Remarks
Beans (Snap, Lima, Pole) (continued)					
Potato leafhopper	acetamiprid MOA 4A (Assail) 30SG	2.5 to 5.3 oz	12 hrs	7	
	carbaryl, MOA 1A (Sevin) 50 WP (Sevin) 80 S (Sevin) XLR Plus	 4 lb 2.5 lb 1 qt	12 hrs	3 (succulent) 21 (dry)	On foliage as needed.
	dimethoate 4 EC, MOA 1B	0.5 to 1 pt	48 hrs	7	
	methomyl, MOA 1A (Lannate) 90 SP (Lannate) 2.4 L	 0.5 lb 1.5 to 3 pt	48 hrs	 1 (0.5 lb) 3 (>0.5 lb)	Do not graze before 3 days or use for hay before 7 days.
	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and their reentry and pre-harvest intervals.
Seedcorn maggot, Wireworm	Use seed pretreated with insecticide for seedcorn maggot control.				Seed can be purchased pretreated. Pretreated seed will not control wireworms.
	bifenthrin MOA 3A (Empower) 1.15G	3.5 to 8.7 lb	9 days	9	Apply preplant broadcast incorporated in the top 1 to 3 inches of soil.
	chlorpyrifos MOA 1B (Lorsban) 4E	2 pts	24 hrs		Can be applied preplant broadcast incorporated in the top 1 to 3 inches of soil, or at planting as a T-band application. For at planting application, apply 1.8 fluid ounces per 1,000 feet of row at 30-inch row spacing. Apply the spray in a 3- to 5-inch wide band over the row behind the planting shoe and in front of the press wheel to achieve shallow incorporation. Do not make more than 1 application per year or apply more than 1 pound ai per acre.
	phorate, MOA 1B (Thimet) 20G	4.5 to 7.0 oz/ 1,000 ft row	12 hrs	60	Drill granules to the side of seed at planting. Avoid contact with seed.
Spider mites	abamectin, MOA 6 (Agri-Mek) 0.7SC	 1.75 to 3.5 fl oz	12 hrs	7	Do not allow leaves to be used as livestock feed.
	bifenazate MOA 20D (Acramite) 4 SC	16 to 24 fl oz	12 hrs	3	
	acequinocyl MOA 20B (Kanemite) 15 SC	 31 fl oz	 12 hrs	7	
	fenpyroximate MOA 21A (Portal) 0.4 EC	 2 pt	 12 hrs	1	For use on snap bean only. Effective against early instars.
Stink bug, Kudzu bug	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
	naled, MOA 1B (Dibrom) 8 EC	1.5 pt/100 gal water	48 hrs	1	
Whiteflies	acetamiprid MOA 4A (Assail) 30 SG	 4.0 to 5.3 oz	12 hrs	7	
	buprofezin, MOA 16 (Courier) 40 SC	9 to 13.6 fl oz	12 hrs	14	For use on snap beans only.
	fenazaquin, MOA 21A (Magister) 1.7	32 to 36 fl oz	12 hrs	7	Do not make more than 1 application per year.
	flupyradifurone, MOA 4D (Sivanto Prime) 1.67	10.5 to 14 fl oz	4 hrs	7	
	imidacloprid, MOA 4A Soil treatment (Admire Pro) 4.6 F (various) 2 F	 7 to 10.5 fl oz 16 to 24 fl oz	12 hrs	 21	See label for soil application instructions.
	Foliar treatment (Admire Pro) 4.6 F (various) 1.6 F	 1.2 fl oz 3.5 fl oz	12 hrs	 7	
	spirotetramat, MOA 23 (Movento)	4 to 5 fl oz	24 hrs	1 (succulent) 7 (dry)	
Beet					
Aphid	flonicamid, MOA 29 (Beleaf) 50SG	2 to 2.8 oz	12 hrs	3	Begin applications before populations begin to build and before damage is evident. Use higher rates for high populations or dense foliage.
	flupyradifurone, MOA 4D (Sivanto Prime) 200 SL	7.0 to 14 fl oz	4 hrs	7	Do not exceed 28 fl oz per acre per season.
	imidacloprid, MOA 4A Soil treatment (Admire Pro) 4.6 F (various) 2 F	 4.4 to 10.5 fl oz 10 to 24 fl oz	12 hrs	 21	See label for soil application instructions. Will also control flea beetle. Do not exceed 1 application per season.
	Foliar treatment (Admire Pro) 4.6 F (various) 1.6 F	 1.2 fl oz 3.5 fl oz	12 hrs	 7	
	thiamethoxam, MOA 4A (Platinum) 75 SG	1.7 to 4 oz	12 hrs	30	Soil application only. Platinum may be applied to direct-seeded crops in-furrow at seed or transplant depth, post seeding or transplant as a drench, or through drip irrigation. Do not exceed 3.67 fl oz per acre per season of Platinum. Check label for plant-back restrictions for a number of crops. Will also control flea beetle.
	(Actara) 25 WDG	1.5 to 3 oz	12 hrs	7	Foliar application. Do not exceed 4 oz per acre per season. Will also control flea beetle.

Table 5-9. Insect Control for Commercial Vegetables

CROP Insect	Insecticide, Mode of Action Code, and Formulation	Amount of Formulation Per Acre	Restricted Entry Interval (REI)	Pre harvest Interval (PHI) (Days)	Precautions and Remarks
Beet (continued)					
Armyworm, Beet webworm	chlorantraniliprole MOA 28 (Coragen) 1.67 SC (Vantacor) 5 SC	 3.5 to 7.5 fl oz 1.2 to 2.5 fl oz	4 hrs	1	
	indoxacarb MOA 22B (Avaunt eVo) 30 DG	3.5 to 6 oz	12 hrs	7	Do not use adjuvants with Avaunt eVo.
	methoxyfenozide MOA 18 (Intrepid) 2F	6 to 16 fl oz	4 hrs	1	Apply at egg hatch or first sign of feeding.
	spinetoram, MOA 5 (Radiant) 1 SC	6 to 8 fl oz	4 hrs	7	Do not apply more than 32 fluid ounces per acre per season.
	spinosad, MOA 5 (Blackhawk)	1.7 to 3.3 oz	4 hrs	3	
Blister beetle, Flea beetle	carbaryl, MOA 1A (Sevin) 50 WP 80 S XLR	 3 lb 1.875 lb 1 qt	12 hrs	7	
	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
Leafminer	spinetoram, MOA 5 (Radiant) 1 SC	6 to 10 fl oz	4 hrs	7	Control will be improved with addition of a spray adjuvant.
Broccoli, Brussels Sprouts, Cabbage, Cauliflower, Kohlrabi					
Aphid	Where whitefly resistance is an issue (or any other insect with a high potential for resistance to Group 4A MOA insecticides), a foliar-applied Group 4A insecticide program and a soil-applied Group 4A program should not be used in the same season. Also, if using a foliar-applied program, avoid using a block of more than 3 consecutive applications of any products belonging to Group 4A insecticides.				
	acetamiprid, MOA 4A (Assail) 30 SG	2 to 4 oz	12 hrs	7	
	afidopyropen, MOA 9D (Versys) 0.83 DC	 1.5 fl oz	 12	 0	Do not make more than 2 sequential applications before using a different mode of action.
	clothianidin, MOA 4A (Belay) 50WD	4.8 to 6.4 oz (soil) 1.6 to 2.1 oz (foliar)	12 hrs	21 (soil) 7 (foliar)	Soil application at planting only.
	cyantraniliprole, MOA 28 (Exirel) SE	 13.5 to 20.5 fl oz	12 hrs	1	Will suppress aphids when applied for lepidopteran larvae.
	dimethoate 4 EC, MOA 1B	0.5 to 1 pt	48 hrs	7	Not for use on cabbage.
	flonicamid, MOA 29 (Beleaf) 50SG	2 to 2.8 oz	12 hrs	0	
	flupyradifurone, MOA 4D (Sivanto Prime) 1.67	7.0 to 14.0 fl oz	4 hrs	1	
	imidacloprid, MOA 4A Soil treatment (Admire Pro) 4.6 F (various) 2 F	 4.4 to 10.5 fl oz 10 to 24 fl oz	12 hrs	 21	Do not follow soil applications of Admire with foliar applications of any neonicotinoid insecticide. Use only one application method. See label for soil application instructions.
	Foliar treatment (Admire Pro) 4.6 F (various) 1.6 F	 1.3 fl oz 3.75 fl oz	12 hrs	 7	Imidacloprid also controls whiteflies. Not effective against flea beetle.
	pymetrozine, MOA 9B (Fulfill) 50 WDG	2.75 oz	12 hrs	7	
	pyrifluquinazon, MOA 9B PQZ 1.87EC	 2.4 to 3.2 fl oz	 12 hrs	 1	See label for rotational crop restrictions. Do not exceed 4.8 fl oz per acre per crop cycle.
	spirotetramat, MOA 23 (Movento) 2 SC	4 to 5 fl oz	24 hrs	1	Do not exceed 10 fluid ounces per season. Requires surfactant.
	sulfoxaflor, MOA 4C Closer 2SC	 1.0 to 2.0 fl oz	12 hrs	3	
	thiamethoxam MOA 4A Soil treatment (Platinum) 75SG Foliar treatment (Actara) 25WDG	 1.66 to 3.67 oz 1.5 to 3.0 oz	 12 hrs	 30 0	Platinum may be applied to direct-seeded crops in-furrow at seed or transplant depth, postseeding or transplant as a drench, or through drip irrigation. Do not exceed 3.67 ounces per acre per season. Thiamethoxam also controls whiteflies and certain thrips species.
	sulfoxaflor, MOA 4C Closer 2SC	 1.0 to 2.0 fl oz	12 hrs	3	

Table 5-9. Insect Control for Commercial Vegetables

CROP Insect	Insecticide, Mode of Action Code, and Formulation	Amount of Formulation Per Acre	Restricted Entry Interval (REI)	Pre harvest Interval (PHI) (Days)	Precautions and Remarks
Broccoli, Brussels Sprouts, Cabbage, Cauliflower, Kohlrabi (continued)					
Diamondback moth, Cabbage looper, Imported cabbageworm, Corn earworm, Cross-striped cabbageworm, Cabbage webworm, Armyworms	**Insecticide-resistant populations of diamondback may not be controlled with some registered insecticides. To manage resistance, avoid transplants from Georgia and Florida, and avoid applying more than 2 sequential applications of insecticides with the same mode of action (MOA) before switching to another MOA. After two applications, rotate to an insecticide with a different mode of action. Do not allow populations to reach high densities before treatments are initiated. Thorough spray coverage is important for achieving effective control and can be improved by the use of a wetting agent. Use of pyrethroid insecticides destroys natural enemies and aggravates diamondback moth infestations.**				
	Bacillus thuringiensis, MOA 11A (Dipel) DF (Javelin) WG (Xentari) DF	 0.5 to 2 lb 0.5 to 1 lb 0.5 to 2 lb	4 hrs	0	On foliage every 7 days. On summer or fall plantings, during periods when eggs and larvae are present. This usually occurs when true leaves appear; on other plantings, it may occur later. A spreader-sticker will be helpful. **Not effective against Cabbage Webworm**
	chlorantraniliprole, MOA 28 (Coragen) 1.67 SC cyclaniliprole, MOA 28 (Harvanta) 50 SL	3.5 to 7.5 fl oz 10.9 to 16.4 fl oz	4 hrs 4 hrs	3	Foliar or drip soil application. See label for soil application instructions.
	cyantraniliprole, MOA 28 (Verimark) 1,67SC (Exirel) 0.83SE	5 to 10 fl oz 7 to 17 fl oz	4 hrs 12 hrs	NA 1	Verimark is for soil application only. Apply at planting only. See label for application options. Higher rates will suppress aphids. Exirel is for foliar application only. Use higher rates for cabbage looper.
	emamectin benzoate, MOA 6 (Proclaim) 5 WDG	3.2 to 4.8 oz	12 hrs	7	
	indoxacarb, MOA 22B (Avaunt eVo) 30 WDG	2.5 to 3.5 oz	12 hrs	3	Add a wetting agent to improve spray. Do not apply more than 14 ounces (0.26 pound a.i.) per acre per crop. The minimum interval between sprays is 3 days.
	methoxyfenozide, MOA 18 (Intrepid) 2F	4 to 16 fl oz	4 hrs	7	Use lower rates for early season applications to young crops and higher rates for mid- to late-season applications and heavier infestations. For suppression only against diamondback moth. Do not apply more than 16 fl oz per acre per season.
	novaluron, MOA 15 (Rimon) 0.83 EC	6 to 12 fl oz	12 hrs	7	Use lower rates when targeting eggs or small larvae, and use higher rates when larvae are large. Make no more than 3 applications or 24 fluid ounces per acre per season.
	spinetoram, MOA 5 (Radiant) 1 SC	5 to 10 fl oz	4 hrs	1	
	methomyl MOA 1A (Lannate) 2.4 LV	1.5-3 pts	48 hrs	See remarks	PHI varies with crop – check label: Cabbage 1 day, broccoli, brussels sprouts, and cauliflower 3 days. Recommended in a rotational scheme for diamondback moth when multiple modes of action are required over the course of a season.
	naled, MOA 1B (Dibrom) 8 EC	1 to 2 pts	48 hrs	1	Do not apply within 25 ft of bodies of water (lakes, rivers, streams, ponds, marshes, etc.) where wind is blowing or gusting towards these areas. Recommended in a rotational scheme for diamondback moth when multiple modes of action are required over the course of a season.
	tolfenpyrad, MOA 21A (Torac) 1.29 EC	17 to 21 fl oz	12 hrs	1	Do not make more than 2 applications per crop, or 4 applications per year. Recommended in a rotational scheme for diamondback moth when multiple modes of action are required over the course of a season.
Flea beetle	acetamiprid, MOA 4A (Assail) 30 SG	2 to 3 oz	12 hrs	7	
	clothianidin, MOA 4A (Belay) 50WDG	4.8 to 6.4 oz (soil) 1.6 to 2.1 oz (foliar)	12 hrs	NA 7 (foliar)	Soil applications may only be made at planting.
	cyantraniliprole, MOA 28 (Verimark) 1,67SC (Exirel) 0.83SE	6.75 to 13.5 fl oz 13.5 to 20.5 fl oz	4 hrs 12 hrs	1 1	Verimark is for at planting soil application only. See label for application options. Exirel is for foliar application only.
	dinotefuran, MOA 4A Foliar treatment (Venom) 70 SG (Scorpion) 35SL Soil treatment (Venom) 70 SG (Scorpion) 35SL	 1 to 4 oz 2 to 7 fl oz 5 to 6 oz 9 to 10.5 fl oz	12 hrs	 1 21	See label for soil application options. Do not combine soil and foliar applications; choose one method.
	pyrethroid MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
Harlequin bug, stink bug	clothianidin, MOA 4A (Belay) 50WDG	4.8 to 6.4 oz (soil) 1.6 to 2.1 oz (foliar)	12 hrs	NA 7 (foliar)	Soil application at planting only.
	dinotefuran, MOA 4A (Venom) 70 SG (Scorpion) 35 SL	 1 to 4 oz 2 to 7 fl oz	12 hrs	1	Do not exceed 6 ounces of Venom per season.
	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.

Table 5-9. Insect Control for Commercial Vegetables

CROP Insect	Insecticide, Mode of Action Code, and Formulation	Amount of Formulation Per Acre	Restricted Entry Interval (REI)	Pre harvest Interval (PHI) (Days)	Precautions and Remarks
Broccoli, Brussels Sprouts, Cabbage, Cauliflower, Kohlrabi (continued)					
Yellowmargined leaf beetle	pyrethroid, MOA 3A		12 hrs		Applications need to be made at the first sign of infestation and before head formation. Problems are most common in spring and fall months along the gulf coast areas.
	spinetoram, MOA 5 (Radiant) SC	5 to 10 fl oz	4 hrs	1	Early application before head formation is important.
Root maggot	cyantraniliprole MOA 28 (Verimark) 1.67 SC	10 to 13.5 fl oz	4	—	Apply to soil at planting as an in-furrow spray, transplant tray drench, transplant water, hill drench, surface band, or soil shank.
	diazinon, MOA 1B (Diazinon 50 W) 50 WP	0.25 to 0.5 lb/ 50 gal	4 days	—	Transplant water: Apply in transplant water or drench water at 4 to 6 ounces per plant at transplanting.
	bifenthrin, MOA 3A (Capture) LFR	3.4 to 6.8 fl oz	12	—	Apply as a 5-7 inch band over the open seed or transplant furrow, or in furrow with the transplant. May be applied through transplant water.
	tolfenpyrad, MOA 21A (Torac) 1.29EC	21 fl oz		1	Apply to soil at planting as in-furrow spray or suface band.
Thrips	acetamiprid , MOA 4A (Assail) 30 SG	4.0 oz	12 hrs	7	Efficacy will vary depending on thrips species.
	dimethoate 4 EC, MOA 1B	0.5 to 1 pt	48 hrs	7	
	imidacloprid, MOA 4A (Admire Pro) 4.6F (various) 2F (various) 1.6 F	1.3 fl oz 3.0 fl oz 3.75 fl oz	12 hrs	7	Check label for rates for other formulations. Foliar applications only.
	methomyl, MOA 1A (Lannate) 2.4 LV	1.5 pt	48 hrs	3 (1 cabbage)	
	novaluron, MOA 15 (Rimon) 0.83 EC	6 to 12 fl oz	12 hrs	7	Make no more than 2 applications, or 24 fluid ounces, per acre per season.
	spinetoram, MOA 5 (Radiant) 1 SC	6 to 10 fl oz	4 hrs	1	
Whitefly	acetamiprid, MOA 4A (Assail) 30 SG	2.5 to 4.0 oz	12 hrs	7	Use a spreader stick to improve control.
	afidopyropen, MOA 9D (Versys) 0.83 DC	5 to 7	12	0	Do not make more than 2 sequential applications before using a different mode of action. Do not exceed 28 fl oz per acre per season.
	cyantraniliprole, MOA 28 Verimark 1.67 SC Exirel 0.83 SE	6.75 to 13.5 fl oz 13.5 to 20.5 fl oz	4 12	NA 1	Verimark is for soil application only. May take 1 to 3 days to fully protect plants. Exirel is for foliar application only.
	dinotefuran, MOA 4A Foliar treatment (Venom) 70 SG (Scorpion) 35SL Soil treatment (Venom) 70 SG (Scorpion) 35SL	 1 to 4 oz 2 to 7 fl oz 5 to 6 oz 9 to 10.5 fl oz	12 hrs	 1 21	Do not follow soil applications with foliar applications of any neonicotinoid insecticide. Use only 1 application method. Do not apply more than 6 ounces per acre per season using foliar applications, or 12 ounces per acre per season using soil applications. Soil applications may be applied by (1) a narrow band below or above the seed line at planting; (2) a post-seeding or transplant drench with sufficient water to ensure incorporation to the root zone or (3) through drip irrigation.
	flupyradifurone, MOA 4D (Sivanto Prime) 1.67 Foliar treatment Soil treatment	 10.5 to 14.0 fl oz 21 to 28 fl oz	4 hrs	 1 21	See label for soil application options.
	spiromesifen, MOA 23 (Oberon) 2 SC	7 to 8.5 fl oz	12 hrs	1414	Do not exceed 22.44 fluid ounces per acre per season.
	spirotetramat, MOA 23 (Movento) 2 SC	4 to 5 fl oz	24 hrs	1	Do not exceed 10 fluid ounces per season. Requires surfactant.
	pyrifluquinazon, MOA 9B PQZ 1.87EC	2.4 to 3.2 fl oz	12 hrs	1	See label for rotational crop restrictions. Do not exceed 4.8 fl oz per acre per crop cycle.
	pyriproxyfen, MOA 7C (Knack) 0.86EC	8 to 10 fl oz	12 hrs	7	Only treat whole fields, and do not plant any crop other than those that Knack is registered on within 30 days after the last application. Will not control adults.
Carrot					
Aphid, Leafhopper	imidacloprid, MOA 4A Soil treatment (Admire Pro) 4.6 F (various) 2 F	4.4 to 10.5 fl oz 10 to 24 fl oz	12 hrs	21	Must be applied to the soil. May be applied via chemigation into the root zone through low-pressure drip, trickle, micro-sprinkler, or equivalent equipment; in-furrow spray or shanked-in 1 to 2 inches below seed depth during planting; or in a narrow band (2 inches or fewer) 1 to 2 inches directly below the eventual seed row in a bedding operation 14 or fewer days before planting. Higher rates provide longer lasting control. See label for information on approved application methods and rate per 100 row feet for different row spacing.
	Foliar treatment (Admire Pro) 4.6 F (various) 1.6 F	1.2 fl oz 3.5 fl oz	12 hrs	7	
	thiamethoxam, MOA 4A (Platinum) 75 SG	1.66 to 3.67 oz	12 hrs	30	Platinum may be applied to direct-seeded crops in-furrow at seeding, immediately after seeding with sufficient water to ensure incorporation into the root zone, or through trickle irrigation.

Table 5-9. Insect Control for Commercial Vegetables

CROP Insect	Insecticide, Mode of Action Code, and Formulation	Amount of Formulation Per Acre	Restricted Entry Interval (REI)	Pre harvest Interval (PHI) (Days)	Precautions and Remarks
Carrot (continued)					
Aphid, Leafhopper (continued)	(Actara) 25 WDG	1.5 to 3 oz	12 hrs	7	Actara is applied to foliage. Do not exceed 4 ounces Actara per acre per season.
	flonicamid, MOA 29 (Beleaf) 50SG	2 to 2.8 fl oz	12 hrs	3	
	flupyradifurone, MOA 4D (Sivanto Prime) 1.67	7.0 to 10.5 fl oz	4 hrs	7	
	cyantraniliprole, MOA 28 (Exirel) 0.83 SE	13.5 to 20.5 fl oz	12 hrs	1	
Armyworm, Parsleyworm	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
	carbaryl, MOA 1A (Sevin) 80 S (Sevin) XLR Plus	 1.25 lb 1 qt	12 hrs	7	On foliage as needed.
	chlorantraniliprole, MOA 28 (Coragen) 1.67 SC	3.5 to 7.5 fl oz	4 hrs	1	Coragen may be used for foliar or drip chemigation.
	cyantraniliprole, MOA 28 (Exirel) 0.83 SE	13.5 to 20.5 fl oz	12 hrs	1	
	emamectin benzoate, MOA 6 (Proclaim) 5 SG	3.2 to 4.8 fl oz	12 hrs	7	
	methomyl, MOA 1A (Lannate) 2.4 LV (Lannate) 90 SP	 0.75 to 1.5 pt 0.25 to 0.5 lb	48 hrs	1	
	methoxyfenozide, MOA 18 (Intrepid) 2 F	4 to 10 fl oz	4 hrs	1	Use higher rates against large larvae.
	spinetoram, MOA 5 (Radiant) 1 SC	6 to 8 fl oz	4 hrs	3	Radiant will not control leafhoppers. Do not make more than 4 applications per year.
Leafminer	spinetoram, MOA 5 (Radiant) 1 SC	6 to 8 fl oz	4 hrs	3	
	chlorantraniliprole, MOA 28 (Coragen) 1.67 SC	 3.5 to 7.5 fl oz	4 hrs	1	Coragen may be used for foliar or drip chemigation.
	cyantraniliprole, MOA 28 (Exirel) 0.83 SE	13.5 to 20.5 fl oz	12 hrs	1	
Wireworm	diazinon, MOA 1B (Diazinon) (AG 500)	4 qt	3 days	—	Broadcast and incorporate preplant.
Celery					
Aphid, Leafhopper, Flea beetle	afidopyropen, MOA 9D (Versys) DC	1.5 fl oz	12 hrs	0	Do not make more than 2 sequential applications before using a different mode of action. Will not control flea beetle.
	imidacloprid, MOA 4A (Admire Pro) 4.6 F (various) 2 F	 7 to 10.5 fl oz 16 to 24 fl oz	12 hrs	21	Apply via chemigation into the root zone, as an in-furrow spray at planting on/or below the seed, or as a post-seeding or transplant drench.
	flonicamid, MOA 29 (Beleaf) 50SG	2 to 2.8 oz	12 hrs	0	Will not control flea beetle
	thiamethoxam, MOA 4A (Actara) 25 WDG	1.5 to 3 oz	12 hrs	7	
	acetamiprid, MOA 4A (Assail) 30 SG	2 to 4 fl oz	12 hrs	7	
	clothianidin, MOA 4A (Belay) 2.13 SC	9 to 12 fl oz 3 to 4 fl oz	4 hrs	21 (soil) 1 (foliar)	
	sulfoxaflor, MOA 4C (Closer) SC	1.5 to 2 fl oz	12 hrs	3	
	flupyradifurone, MOA 4D (Sivanto Prime) 1.67	10.5 to 12.0 fl oz	4 hrs	1	Will not control flea beetle
	pyrifluquinazon, MOA 9B PQZ 1.87EC	 2.4 to 3.2 fl oz	12 hrs	1	See label for rotational crop restrictions. Do not exceed 4.8 fl oz per acre per crop cycle. Will not control flea beetle.
	spirotetramat, MOA 23 (Movento) 2SC	4 to 5 fl oz	24 hrs	3	Do not exceed 10 fluid ounces per season. Not for flea beetle. Requires surfactant.
	cyantraniliprole, MOA 28 (Exirel) 0.83 SE	13.5 to 20.5 fl oz	12 hrs	1	
	cyclaniliprole, MOA 28 (Harvanta) 50 SL	10.9 to 16.4 fl oz	4 hrs	1	
	tolfenpyrad, MOA 21A (Torac) 1.29 EC	17 to 21 fl oz	12 hrs	1	
Armyworm, Corn earworm, Looper	chlorantraniliprole, MOA 28 (Coragen) 1.67 SC	3.5 to 7.5 fl oz	4 hrs	1	Foliar or drip chemigation. Drip chemigation must be applied uniformly to the root zone. See label for instructions.
	cyantraniliprole, MOA 28 (Exirel) 0.83 SE	7 to 13.5 fl oz	12 hrs	1	

Table 5-9. Insect Control for Commercial Vegetables

CROP Insect	Insecticide, Mode of Action Code, and Formulation	Amount of Formulation Per Acre	Restricted Entry Interval (REI)	Pre harvest Interval (PHI) (Days)	Precautions and Remarks
Celery (continued)					
Armyworm, Corn earworm, Looper (continued)	cyclaniliprole, MOA 28 (Harvanta) 50 SL	10.9 to 16.4 fl oz	4 hrs	1	
	emamectin benzoate, MOA 6 (Proclaim) 5 WDG	2.4 to 4.8 oz	12 hrs	7	Do not make more than 2 sequential applications without rotating to another product with a different mode of action.
	indoxacarb, MOA 22B Avaunt eVo	3.5 oz	12 hrs	3	
	methomyl, MOA 1A (Lannate) 2.4 LV	3 pt	48 hrs	7	Methomyl may induce leafminer infestations.
	methoxyfenozide, MOA 18 (Intrepid) 2 F	4 to 10 fl oz	4 hrs	7	For early season applications only to young crop and small plants. For mid- to late-season applications and to heavier infestations and under conditions in which thorough coverage is more difficult. Do not apply more than 16 fluid ounces per application, and do not exceed 64 fluid ounces per season. See Rotational Crop Restrictions on label.
	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
	spinetoram, MOA 5 (Radiant) 1 SC	5 to 10 fl oz	4 hrs	1	Use higher rates for armyworms.
Leafminer	abamectin, MOA 6 (Agri-Mek) 0.15EC	1.75 to 3.5 fl oz	12 hrs	7	
	chlorantraniliprole, MOA 28 (Coragen) 1.67 SC	5 to 7.5 fl oz	4 hrs	1	Foliar or drip chemigation. Drip chemigation must be applied uniformly to the root zone. See label for instructions.
	cyromazine, MOA 17 (Trigard 75WP)	2.66 oz	12 hrs	7	
	spinetoram, MOA 5 (Radiant) 1 SC	6 to 10 fl oz	4 hrs	1	
Collard, Kale, Mustard Greens					
Aphid	acetamiprid, MOA 4A (Assail) 30 SG	2 to 3 oz	12 hrs	7	
	afidopyropen, MOA 9D (Versys) DC	1.5 fl oz	12 hrs	0	Do not make more than 2 sequential applications before using a different mode of action.
	clothianidin, (Belay) 50 WDG	4.8 to 6.4 oz (soil) 1.6 to 2.1 oz (foliar)	12 hrs	7 (foliar)	Soil application at planting only. Foliar applications.
	flonicamid, MOA 29 (Beleaf) 50SG	2 to 2.8 fl oz	12 hrs	0	
	flupyradifurone, MOA 4D (Sivanto Prime) 1.67	10.5 to 144.0 fl oz	4 hrs	1	
	imidacloprid, MOA 4A Soil treatment (Admire Pro) 4.6 F (various) 2 F	4.4 to 10.5 fl oz 10 to 24 fl oz	12 hrs	21	See label for soil application instructions. Admire Pro will also control flea beetle.
	Foliar treatment (Admire Pro) 4.6 F (various) 1.6 F	3.8 fl oz	12 hrs	7	
	pymetrozine, MOA 9B (Fulfill) 50 WDG	2.75 oz	12 hrs	7	
	pyrifluquinazon, MOA 9B PQZ 1.87EC	2.4 to 3.2 fl oz	12 hrs	1	See label for rotational crop restrictions. Do not exceed 4.8 fl oz per acre per crop cycle.
	sulfoxaflor, MOA 4C (Closer) SC	4.25 to 5.75 fl oz	12 hrs	3	
	spirotetramat, MOA 23 (Movento) 2SC	4 to 5 fl oz	24 hrs	1	Do not exceed 10 fluid ounces per season. Requires surfactant.
Diamondback moth, Caterpillars, including Cabbage looper, Imported cabbageworm, Cross-striped cabbageworm, Cabbage webworm, Armyworm	**Insecticide-resistant populations of diamondback may not be controlled with some registered insecticides. To manage resistance, avoid transplants from Georgia and Florida, and avoid applying more than 2 sequential applications of insecticides with the same mode of action (MOA) before switching to another MOA. After two applications, rotate to an insecticide with a different mode of action. Do not allow populations to reach high densities before treatments are initiated. Thorough spray coverage is important for achieving effective control and can be improved by the use of a wetting agent. Use of pyrethroid insecticides destroys natural enemies and aggravates diamondback moth infestations.**				
	Bacillus thuringiensis, MOA 11A (Crymax) WDG (Dipel) 2 X, DF (Dipel) (Xentari) DF	0.5 to 1.5 lb 8 oz 1 pt 0.5 to 2 lb	4 hrs	0	Use a spreader/sticker. OMRI Listed.
	chlorantraniliprole, MOA 28 (Coragen) 1.67 SC	3.5 to 7.55 fl oz	4 hrs	1	Foliar or drip chemigation. Drip chemigation must be applied uniformly to the root zone. See label for instructions.
	cyclaniliprole, MOA 28 (Harvanta) 50 SL	10.9 to 16.4 fl oz	4 hrs	1	
	emamectin benzoate, MOA 6 (Proclaim) 5 WDG	2.4 to 4.8 oz	12 hrs	14	
	flubendiamide, MOA 28 (Belt) 4SC	2 to 2.4 fl oz	12 hrs	1	

Table 5-9. Insect Control for Commercial Vegetables

CROP Insect	Insecticide, Mode of Action Code, and Formulation	Amount of Formulation Per Acre	Restricted Entry Interval (REI)	Pre harvest Interval (PHI) (Days)	Precautions and Remarks
Collard, Kale, Mustard Greens (continued)					
Diamondback moth, Caterpillars, including Cabbage looper, Imported cabbageworm, Cross-striped cabbageworm, Cabbage webworm, Armyworm (continued)	indoxacarb, MOA 22 (Avaunt eVo) 30 WDG	3.5 oz	12 hrs	3	Do not apply Avaunt eVo more than twice to any generation of diamondback moth. After 2 applications, rotate to an insecticide with a different mode of action. Do not make more than 6 applications (4 in GA) or exceed 14 ounces per season per crop.
	spinetoram, MOA 5 (Radiant) 1 SC	5 to 10 fl oz	4 hrs	1	
	methoxyfenozide, MOA 18 (Intrepid) 2 F	4 to 10 fl oz	4 hrs	1	
	methomyl MOA 1A Lannate 2.4 LV	1.5-3 pt	48 hrs	10	PHI varies with crop – check label: Cabbage 1 day, broccoli, brussels sprouts, and cauliflower 3 days. Recommended in a rotational scheme for diamondback moth when multiple modes of action are required over the course of a season.
	naled, MOA 1B (Dibrom) 8 EC	1 to 2 pts	48 hrs	1	Do not apply within 25 ft of bodies of water (lakes, rivers, streams, ponds, marshes, etc.) where wind is blowing or gusting towards these areas. Recommended in a rotational scheme for diamondback moth when multiple modes of action are required over the course of a season.
	tolfenpyrad, MOA 21A (Torac)	21 fl oz	12 hrs	1	Do not make more than 2 applications per crop, or 4 applications per year. Recommended in a rotational scheme for diamondback moth when multiple modes of action are required over the course of a season.
Flea beetle	acetamiprid, MOA 4A (Assail) 30SG	2 to 4 oz	12 hrs	7	
	carbaryl, MOA 1A (Sevin) 50 WP (Sevin) 80 S (Sevin) XLR	3 lb 1.875 lb 1 qt	12 hrs	14	
	dinotefuran, MOA 4A Foliar treatment (Venom) 70 SG (Scorpion) 35SL Soil treatment (Venom) 70 SG (Scorpion) 35SL	 1 to 4 oz 2 to 7 fl oz 5 to 6 oz 9 to 10.5 fl oz	12 hrs	 7 21	Do not follow soil applications with foliar applications. Use only 1 application method. Do not apply more than 6 ounces per acre per season using foliar applications, or 12 ounces per acre per season using soil applications. Soil applications may be applied by (1) a narrow band below or above the seed line at planting; (2) a post-seeding or transplant drench with sufficient water to ensure incorporation to the root zone; or (3) through drip irrigation.
	Pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
Grasshopper	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals. May flare diamondback moth populations.
Harlequin bug, Stink bug, Yellowmargined leaf beetle	clothianidin, MOA 4A (Belay) 50 WDG	4.8 to 6.4 oz (soil); 1.6 to 2.1 oz (foliar)	12 hrs	7 (foliar)	Soil application at planting only.
	Dinotefuran, MOA 4A Foliar treatment (Venom) 70 SG (Scorpion) 35SL Soil treatment (Venom) 70 SG (Scorpion) 35SL	 1 to 4 oz 2 to 7 fl oz 5 to 6 oz 9 to 10.5 fl oz	12 hrs	 7 21	Do not follow soil applications with foliar applications. Use only 1 application method. Do not apply more than 6 ounces per acre per season using foliar applications, or 12 ounces per acre per season using soil applications. Soil applications may be applied by (1) a narrow band below or above the seed line at planting; (2) a post-seeding or transplant drench with sufficient water to ensure incorporation to the root zone; or (3) through drip irrigation.
	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
	thiamethoxam, MOA 4A (Actara) 25WDG	3 to 5.5 oz	12 hrs	7	
	dinotefuran MOA 4A (Venom) 70SG (Scorpion) 35SL	 1 to 4 oz 2 to 7 fl oz	12 hrs	7	Dinotefuran recommendations are for foliar applications.
Root maggot	chlorpyrifos, MOA 1B (Lorsban) 4 EC (Lorsban) 75WDG	 1.6 to 2.75 fl oz 1.1 to 1.8/ 1,000 ft row	24 hrs	—	For direct-seeded crops, apply as a 4-inch band over the row after planting. For transplanted crops, apply as a directed spray immediately after transplanting.
	tolfenpyrad, MOA 21A (Torac)	21 fl oz	12 hrs	1	Read soil application guidelines on label.
	cyantraniliprole, MOA 28 (Verimark)	10 to 13.5 fl oz	4 hrs	at-planting only	

Table 5-9. Insect Control for Commercial Vegetables

CROP Insect	Insecticide, Mode of Action Code, and Formulation	Amount of Formulation Per Acre	Restricted Entry Interval (REI)	Pre harvest Interval (PHI) (Days)	Precautions and Remarks
Collard, Kale, Mustard Greens (continued)					
Whitefly	acetamiprid, MOA 4A (Assail) 30 SG	2.5 to 4.0 oz	12 hrs	7	Apply against adults, before nymphs are present. Use a spreader stick to improve control.
	flupyradifurone, MOA 4D (Sivanto Prime) 1.67	10.5 to 14.0 fl oz	4 hrs	1	Do not make more than 3 applications or apply more than 28 fluid ounces per season.
	pyriproxyfen, MOA 7C (Knack) 0.86 EC	8 to 10 fl oz	12 hrs	7	Do not apply Knack more than twice per season or exceed 0.134 pound per acre per season.
	spiromesifen, MOA 23 (Oberon) 2 SC	7 to 8.5 fl oz	12 hrs	7	Do not make more than 3 applications or apply more than 25.5 fluid ounces per season.
	spirotetramat, MOA 23 (Movento) 2 SC	4 to 5 fl oz	24 hrs	1	Do not exceed 10 fluid ounces per season. Requires surfactant.
	sulfoxaflor, MOA 4C (Closer) SC	4.25 to 5.75 fl oz	12 hrs	3	
Corn, Sweet					
Corn earworm, Fall armyworm, European corn borer	The consistency of pyrethroid insecticides in controlling corn earworm populations has declined in recent years. If reduced efficacy is observed, switch to insecticides with different modes of action.				
	transgenic sweet corn varieties expressing *Bt* protein				Highly effective against European corn borer. Effectiveness against corn earworm will vary among BT traits and there is evidence that resistance in corn earworm to commonly used traits is becoming common. Varieties containing the Vip3A gene (Attribute II or Attribute Plus Series) are still effective at controlling corn earworm. Additional insecticide applications may be required to prevent damage to the ear tips of varieties without the Vi3A gene.
	pyrethroid, MOA 3A		12 hrs		Check label for variety limitations and grazing restrictions. Also, instances of corn earworm resistance to pyrethroids are becoming more prevalent in recent years. To protect ears, begin sprays when tassel shoots first appear, The frequency of sprays will vary depending on location and intensity of earworm populations, ranging from daily to twice weekly in higher elevations. Corn earworms and fall armyworms present in the late whorl stage must be controlled before tassel emergence to prevent migration to ears.
	chlorantraniliprole MOA 28 (Coragen) 1.67 SC	3.5 to 7.5 fl oz	4 hrs	1	Do not apply more than 15.4 oz of Coragen per acre per year.
	bifenthrin, MOA 3A + chlorantraniliprole, MOA 28	5.6 to 9.6 fl oz	12	1	Do not make more than two applications per acre or exceed 0.2 lb [AI] per calendar year.
	lambda-cyhalothrin, MOA 3A + chlorantraniliprole, MOA 28 (Besiege) ZC	6 to 10 fl oz	24 hrs	1	Do not allow livestock to graze in treated areas or harvest treated corn foliage as feed for meat or dairy animals within 1 day after last treatment. Do not feed treated corn fodder or silage to livestock within 21 days of last application.
	methoxyfenozide, MOA 18 + spinetoram, MOA 5 (Intrepid Edge)	8 to 12 fl oz	4 hrs	3	
	methomyl, MOA 1A (Lannate) 90 SP (Lannate) 2.4 LV	4 to 8 oz 0.75 to 1.5 pt	48 hrs	0	Do not use methomyl for European corn borer control.
	indoxacarb, MOA 22BA (Avaunt eVo) 30 WDG	2.5 to 3.5 oz	12 hrs 14 days for hand harvesting	3	For control of fall armyworm and European corn borer in whorl stage only. Do not apply more than 14 ounces Avaunt eVo (0.26 lb a.i.) per acre per crop. Minimum interval between sprays is 3 days. Make no more than 4 applications per season.
	spinetoram, MOA 5 (Radiant) 1 SC	3 to 6 fl oz	4 hrs	1	Do not apply more than 36 ounces per acre per year.
	spinosad, MOA 5 (Blackhawk)	1.7 to 3.3 oz	4 hrs		
Cutworm	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
Sap beetle, Flea beetle, Grasshopper, Japanese beetle, Rootworm beetle	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
	carbaryl, MOA 1A (Sevin) 50 WP (Sevin) 80 S (Sevin) XLR Plus	2 lb 1.25 lb 1 qt	12 hrs	2	Sap beetle infestations usually associated with prior ear damage. Populations build on overmature and damaged fruit and vegetables. Sanitation is important.
Southern corn billbug, Rootworm, Wireworm	*Seed treatments:* clothianidin, MOA 4A (Poncho 600) imidacloprid, MOA 4A (Gaucho 600)	1.13 to 2.26 fl oz per 80,000 seeds 3.6 to 6 oz per cwt seed		—	Seed treatments are applied by commercial seed treaters only. Not for use in hopper bins, slurry mixes, or any other type of on-farm treatment.

Table 5-9. Insect Control for Commercial Vegetables

CROP Insect	Insecticide, Mode of Action Code, and Formulation	Amount of Formulation Per Acre	Restricted Entry Interval (REI)	Pre harvest Interval (PHI) (Days)	Precautions and Remarks
Corn, Sweet (continued)					
Southern corn billbug, Rootworm, Wireworm (continued)	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
	chlorpyrifos, MOA 1B (Lorsban) 4 E	4 pt	24 hrs	0	Preplant incorporation treatment. For postemergence treatment use 2 to 3 pints.
	terbufos, MOA 1B (Counter) 15 G	6 oz per 1,000 ft of row for any row spacing		60	Apply in a 7-inch band over the row of seedling corn plants when billbugs or damage are observed, usually in the 1- to 6-leaf stage. Lightly incorporate into soil.
Stink bug	pyrethroids, MOA 3A				See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
	methomyl, MOA 1A (Lannate) 90SP	0.5 lb	48 hrs	0	Certain hybrid varieties of sweet corn are susceptible to methomyl injury.
Cucurbit Crops (Cucumber, Cantaloupe, Pumpkin, Squash, Watermelon)					
Insecticide applications in cucurbits should be made in late evening to protect pollinating insects. Refer to the section of this chapter on Reducing the Risk of Pesticide Poisoning to Honey Bees for more information about protecting pollinators.					
Aphid	Where whitefly resistance is an issue (or any other insect with a high potential for resistance to Group 4A MOA insecticides), a foliar-applied Group 4A insecticide program and a soil-applied Group 4A program should not be used in the same season. Also, if using a foliar-applied program, avoid using a block of more than 3 consecutive applications of any products belonging to Group 4A insecticides.				
	acetamiprid MOA 4A (Assail) 30SG	2.5 to 4.0 oz	12 hrs	0	Do not exceed 0.5 pound per acre per season.
	afidopyropen, MOA 9D (Sefina) DC	3	12	0	Do not make more than 2 sequential applications before using a different mode of action.
	clothianidin, MOA 4A (Belay) 50 WDG	4.8 to 6.4 oz (soil) 1.6 to 2.1 oz (foliar)	12 hrs	7 (foliar)	Soil application at planting only. See label for application options. Do not use an adjuvant with foliar applications.
	cyantraniliprole MOA 28 (Verimark) 1.67 SC	6.75 to 13.5 fl oz	4 hrs	1	Applied to the soil at planting or later via drip irrigation system. See label for application options.
	flonicamid, MOA 29 (Beleaf) 50 SG	2 to 2.8 oz	12 hrs	0	Begin applications before populations begin to increase and before damage is evident.
	flupyradifurone, MOA 4D (Sivanto Prime) 1.67 Soil application	21 to 28 fl oz	4 hrs	21	Soil applications through drip irrigation, injected below the seed level at planting, or drench at transplanting.
	Foliar application 7 to 14 fl oz		1	DO NOT make foliar applications of Sivanto Prime to muskmelon, cantaloupe, or honeydew melon. See label for additional melons to which it should not be applied.	
	imidacloprid, MOA 4A (Admire Pro) 4.6 F	7 to 10.5 fl oz	12 hrs	21	Must be applied to the soil. May be applied preplant; at planting as a post-seeding drench, transplant water drench, or hill drench; subsurface sidedress or by chemigation using low-pressure drip irrigation methods. Will also control cucumber beetles, thrips and whiteflies.
	pymetrozine, MOA 9B (Fulfill) 50 WDG	2.75 oz	12 hrs	0	Apply before aphids reach damaging levels. Do not exceed 5.5 ounces per acre per season.
	sulfoxaflor, MOA 4C (Transform) 50WG	0.75 oz	12 hrs	3	Limit application to times when managed and native pollinators are least active; for instance., 2 hrs before sunset or when temperature is below 50 °F
	pyrifluquinazon, MOA 9B PQZ 1.87EC	2.4 to 3.2 fl oz	12 hrs	1	See label for rotational crop restrictions. Do not exceed 4.8 fl oz of product per acre per crop cycle. See supplemental label for aerial application.
	thiamethoxam, MOA 4A (Platinum) 75 SG (Actara) 25WDG	1.66 to 3.67 oz 1.5 to 3 oz	12 hrs	30 0	Platinum is for soil application and may be applied to direct-seeded crops in-furrow at seed or transplant depth, post seeding or transplant as a drench, or through drip irrigation. Do not exceed 8 ounces per acre per season of Platinum. Check label for plant-back restrictions for a number of crops. Actara is for foliar application only.

Table 5-9. Insect Control for Commercial Vegetables

CROP Insect	Insecticide, Mode of Action Code, and Formulation	Amount of Formulation Per Acre	Restricted Entry Interval (REI)	Pre harvest Interval (PHI) (Days)	Precautions and Remarks
Cucurbit Crops (Cucumber, Cantaloupe, Pumpkin, Squash, Watermelon) (continued)					
Insecticide applications in cucurbits should be made in late evening to protect pollinating insects. Refer to the section of this chapter on Reducing the Risk of Pesticide Poisoning to Honey Bees for more information about protecting pollinators.					
Armyworm, Cabbage looper	*Bacillus thuringiensis,* MOA 11A (Crymax) WDG, (Dipel) 2X (Xentari) DF	 0.5 to 2 lb 0.5 to 2 oz 0.5 to 2 lb	4 hrs	0	On foliage as needed.
	chlorantraniliprole, MOA 28 (Coragen) 1.67 SC	3.5 to 7.5 fl oz	4 hrs	1	Coragen may be used for foliar or drip chemigation.
	cyclaniliprole, MOA 28 (Harvanta) 50SL	10.9 to 16.4 fl oz	4 hrs	1	
	cyantraniliprole, MOA 28 (Verimark) 1,67SC (Exirel) 0.83SE	5 to 13.5 fl oz 7 to 17 fl oz	4 hrs 12 hrs	1 1	Verimark is for soil application only. It may be applied to the soil at planting at 6.75 to 13.5 ounces or via drip chemigation at 5 to 10 fluid ounces. Do not make more than 2 soil or chemigation applications per season. See label for application options. Exirel is for foliar application only. Use higher rates for cabbage looper.
	indoxacarb, MOA 22B (Avaunt eVo) 30WDG		12 hrs		
	methoxyfenozide, MOA 18 (Intrepid) 2 F	4 to 10 fl oz	4 hrs	3	Apply at first sign of infestation, targeting eggs and small larvae.
	novaluron, MOA 15 (Rimon) 0.83EC	 9 to 12 fl oz	12 hrs	 1	Apply when peak population is at egg hatch through second instar.
	spinetoram, MOA 5 (Radiant) 1 SC	5 to 10 fl oz	4 hrs	3	Use the higher rate for heavy infestations or large larvae.
Cucumber beetle	acetamiprid MOA 4A (Assail) 30SG	2.5 to 5.3 oz	12 hrs	0	Do not exceed 0.5 pound per acre per season.
	carbaryl MOA 1A (Sevin) 50 WP (Sevin) 80 S (Sevin) XLR Plus	 2 lb 1.25 lb 1 qt	12 hrs	3	
	clothianidin, MOA 4A (Belay)2.13 Soil treatment Foliar treatment	 9 to 12 fl oz 3 to 4 fl oz	12 hrs	21	Soil application at planting or through chemigation. See label for application options. . Do not spray after the 4th true leaf.
	dinotefuran, MOA 4A Foliar treatment (Venom) 70 SG (Scorpion) 35SL Soil treatment (Scorpion) 35SL	 1 to 4 oz 2 to 7 fl oz 9 to 10.5 fl oz	12 hrs	 1 21	Do not make both a soil and foliar application, use one or the other. Applications made at planting are most effective against cucumber beetle. Will also control whiteflies and squash bug.
	imidacloprid, MOA 4A (Admire Pro) 4.6 F (various) 2F	 7 to 10.5 fl oz 16 to 24 fl oz	12 hrs	21	Must be applied to the soil. May be applied preplant; at planting as a post-seeding drench, transplant water drench, or hill drench; subsurface sidedress or by chemigation using low-pressure drip irrigation methods. Will also control aphids and whiteflies.
	pyrethroid, MOA 3A		12 hrs		See table 5.9B for a list of registered pyrethroids and pre-harvest intervals.
Leafminer	abamectin, MOA 6 (Agri-Mek) 0.7 SC	 1.75 to 3.5 fl oz	12 hrs	7	To avoid illegal residues, Agri-Mek must be mixed with a nonionic activator type wetting, spreading or penetrating spray adjuvant. For resistance management do not make more than 2 sequential applications.
	cyromazine, MOA 17 (Trigard) 75 WS	2.7 oz	12 hrs	0	
	chlorantraniliprole, MOA 28 (Coragen) 1.67 SC	5 to 7.5 fl oz	4 hrs	1	For foliar or soil application or drip chemigation. Drip chemigation must be applied uniformly to the root zone. See label for instructions.
	cyclaniliprole, MOA 28 (Harvanta) 50SL	10.9 to 16.4 fl oz	4 hrs	1	
	spinetoram, MOA 5 (Radiant) 1 SC	6 to 10 fl oz	4 hrs	3	Control may be improved by tank mixing with an adjuvant.
Pickleworm, Melonworm, cutworm	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
	carbaryl, MOA 1A (Sevin) 50 WP (Sevin) 80 S (Sevin) XLR Plus	 2 lb 1.25 lb 1 qt	12 hrs	3	Apply to foliage when worms appear in blossoms. Repeat as needed. Protect pollinators by applying early morning or late evening when pollinators are not active.
	chlorantraniliprole, MOA 28 (Coragen) 1.67 SC	2.5 to 7.5 fl oz	4 hrs	1	For foliar application or drip chemigation. Drip chemigation must be applied uniformly to the root zone. See label for instructions. Use high rate for pickleworm.
	cyantraniliprole, MOA 28 (Verimark) 1,67SC (Exirel) 0.83SE	5 to 10 fl oz 7 to 13.5 fl oz	4 hrs 12 hrs	1 1	Verimark is for drip chemigation only for these pests. Do not make more than 2 chemigation applications. See label for application options. Exirel is for foliar application only.

Table 5-9. Insect Control for Commercial Vegetables

CROP Insect	Insecticide, Mode of Action Code, and Formulation	Amount of Formulation Per Acre	Restricted Entry Interval (REI)	Pre harvest Interval (PHI) (Days)	Precautions and Remarks
Cucurbit Crops (Cucumber, Cantaloupe, Pumpkin, Squash, Watermelon) (continued)					
Insecticide applications in cucurbits should be made in late evening to protect pollinating insects. Refer to the section of this chapter on Reducing the Risk of Pesticide Poisoning to Honey Bees for more information about protecting pollinators.					
Pickleworm, Melonworm, cutworm (continued)	cyclaniliprole, MOA 28 (Harvanta) 50SL	10.9 to 16.4 fl oz	4 hrs	1	
	methoxyfenozide, MOA 18 (Intrepid) 2 F	4 to 10 fl oz	4 hrs	3	
	spinetoram, MOA 5 (Radiant) 1 SC	5 to 10 fl oz	4 hrs	3	
Spider mite	abamectin, MOA 6 (Agri-Mek) 0.7 SC	1.75 to 3.4 fl oz	12 hrs	7	To avoid illegal residues, Agri-Mek must be mixed with a nonionic activator type wetting, spreading or penetrating spray adjuvant. For resistance management, do not make more than 2 sequential applications.
	bifenazate, MOA 20D (Acramite) 50 WS	0.75 to 1.0 lb	12 hrs	3	Do not make more than 1 application per season.
	fenazaquin, MOA 21A (Magister) 1.7	24 to 36 fl oz	12 hrs	3	Do not make more than 1 application per year.
	etoxazole, MOA 10B (Zeal) 72 WSP	2 to 3 oz	12 hrs	7	Does not kill adults. Do not make more than 1 application per season.
	fenpyroximate MOA 21 (Portal) 0.4EC	2 pt	12 hrs	3	Fenpyroximate is only registered on cucumber, not other cucurbits. Do not make more than 2 applications per season.
	spiromesifen, MOA 23 (Oberon) 2 SC	7 to 8.5 fl oz	12 hrs	7	
Squash bug	Squash bug is a common pest of cantaloupe, pumpkin and squash. Although cucumber and watermelon are occasionally reported as hosts of squash bug, rarely do infestations occur.				
	acetamiprid, MOA 4A (Assail) 30 SG	5.3 oz	12 hrs	0	Assail is most effective against newly laid eggs and nymphs.
	clothianidin, MOA 4A (Belay) 2.13	3 to 4fl oz (	12 hrs	21	Do not spray after the 4th true leaf. See label for application restrictions for protection of pollinators.
	flupyradifurone, MOA 4D (Sivanto Prime)	10.5 to 14.0 fl oz	12 hrs	1	Do not apply Sivanto Prime to cantaloupe or honeydew melon. See label for other additional melons to which it should not be applied.
	dinotefuran, MOA 4A Foliar treatment (Venom) 70 SG (Scorpion) 35 SL Soil treatment (Venom) 70 SG (Scorpion) 35 SL	 1 to 4 oz 2 to 7 fl oz 5 to 7.5 oz 9 to 10.5 fl oz	12 hrs	 1 21	Do not make a soil and foliar application – use one or the other. Do not exceed 6 oz (foliar) or 12 oz (soil) of Venom per acre per season. Do not exceed 10.5 fl oz (foliar) or 21 fl oz (soil) of Scorpion per acre per season. See label for application restrictions for protection of pollinators.
	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
Squash vine borer	Squash vine borer only attacks squash and pumpkin and is more common in home gardens as opposed to commercial plantings.				
	acetamiprid, MOA 4A (Assail) 30 SG	5.3 oz	12 hrs	0	
	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
Thrips	methomyl, MOA 1A (Lannate) 2.4 LV (Lannate) 90 SP	 0.75 to 1.5 pt 0.25 to 0.5 lb	48 hrs	0	
	spinetoram, MOA 5 (Radiant) 1 SC	6 to 10 fl oz	4 hrs	3	
Whitefly	acetamiprid, MOA 4A (Assail)	2.5 to 3 oz	12 hrs	0	
	afidopyropen, MOA 9D (Sefina) DC	14 fl oz	12	0	Do not apply more than twice per crop cycle.
	buprofezin, MOA 16 (Courier) 40 SC	9 to 13.6 fl oz	12 hrs	7	Use sufficient water to ensure good coverage. Do not apply more than twice per crop cycle.
	chlorantraniliprole MOA 28 (Coragen) 1.67 SC	5 to 7.5 fl oz	4 hrs	1	For foliar or soil application or drip chemigation. Drip chemigation must be applied uniformly to the root zone. See label for instructions.
	cyantraniliprole, MOA 28 (Verimark) 1,67SC (Exirel) 0.83SE	6.8 to 13.5 fl oz 13.5 to 20.5 fl oz	4 hrs 12 hrs	1 1	Verimark is for soil application only. It may be applied to the soil at planting at 6.75 to 13.5 fl oz, or via drip chemigation 10 fl oz See label for application options. Exirel is for foliar application only. Use an adjuvant for best results.
	dinotefuran, MOA 4A (Venom) 70SG Soil treatment: Foliar treatment	 5 to 7.5 oz 1 to 4 oz	12 hrs	 21 1	Soil applications may be made with irrigation systems, including drip, or overhead irrigation. Do not apply while bees are foraging. Residues may remain toxic to bees up to 38 hrs following treatment.

Table 5-9. Insect Control for Commercial Vegetables

CROP Insect	Insecticide, Mode of Action Code, and Formulation	Amount of Formulation Per Acre	Restricted Entry Interval (REI)	Pre harvest Interval (PHI) (Days)	Precautions and Remarks
Cucurbit Crops (Cucumber, Cantaloupe, Pumpkin, Squash, Watermelon) (continued)					
Insecticide applications in cucurbits should be made in late evening to protect pollinating insects. Refer to the section of this chapter on Reducing the Risk of Pesticide Poisoning to Honey Bees for more information about protecting pollinators.					
Whitefly (continued)	flupyradifurone, MOA 4D (Sivanto Prime) 1.67 Soil treatment: Foliar treatment:	 21 to 28 fl oz 10.5 to 14 fl oz	4 hrs	 21 1	 Soil applications by injection below the seed level at planting, drench at transplanting, or drip irrigation. Do not make foliar applications of Sivanto Prime to muskmelon, cantaloupe, or honeydew melon. See label for additional melons to which it should not be applied.
	imidacloprid, MOA 4A (Admire Pro) 4.6 F (various) 2 F	 7 to 10.5 oz 16 to 24 fl oz	12 hrs	21	Must be applied to the soil. May be applied preplant; at planting; as a post-seeding drench or hill drench; subsurface sidedress; or by chemigation using low pressure drip or trickle irrigation. See label for information on approved application methods. Will also control aphids and cucumber beetles. Will also control wireworms.
	pyriproxyfen, MOA 7C (Knack) 0.86 EC	8 to 10 oz	12 hrs	7	Do not make more than 2 applications per season, and do not make applications closer than 14 days apart.
	pyrifluquinazon, MOA 9B PQZ 1.87EC	 2.4 to 3.2 fl oz	 12 hrs	 1	See label for rotational crop restrictions. Do not exceed 4.8 fl oz per acre per crop cycle.
	spiromesifen, MOA 23 (Oberon) 2 SG	7 to 8.5 fl oz	12 hrs	7	Does not control adults. Apply when colonies first appear and before leaf damage or discoloration. Do not exceed 3 applications per season.
	thiamethoxam, MOA 4A (Platinum) 75 SG (Actara) 25WDG	 1.66 to 3.67 fl oz 3 to 5.5 oz	12 hrs	 30 0	Platinum is for soil application and may be applied to direct-seeded crops in-furrow at seed or transplant depth, postseeding or transplant as a drench, or through drip irrigation. Do not exceed 11 ounces per acre per season of Platinum. Check label for plant-back restrictions for a number of crops. Actara is for foliar application. See label for application restrictions for protection of pollinators.
Wireworm	diazinon, MOA 1B (Diazinon) AG 500	3 to 4 qt	3 days	—	Broadcast on soil just before planting and thoroughly work into upper 4 to 8inches of soil.
	Imidacloprid (MOA 4A (Admire Pro) 4.6F	7 to 10.5 fl oz	12 hrs	21	Soil application only on cucurbits. May be applied preplant; at planting as a post-seeding drench, transplant water drench, or hill drench; subsurface sidedress or by chemigation using low-pressure drip irrigation methods. Will also control cucumber beetles, thrips and whiteflies.
Eggplant					
Aphid	Where whitefly resistance is an issue (or any other insect with a high potential for resistance to Group 4A MOA insecticides), avoid making foliar applications of Group 4A insecticides when a soil-applied Group 4A program is used; for instance., do not make both foliar and soil applications of Group 4A insecticides. Also, if using a foliar-applied program, avoid using a block of more than 3 consecutive applications of any products belonging to Group 4A insecticides.				
	acetamiprid, MOA 4A (Assail) 30 SG	2 to 4 oz	12 hrs	7	Thoroughly cover foliage to effectively control aphids. Do not apply more than once every 7 days, and do not exceed a total of 7 ounces per season.
	afidopyropen, MOA 9D (Sefina) DC	 3	 12 hrs	 0	Do not make more than 2 sequential applications before using a different mode of action.
	flonicamid, MOA 29 (Beleaf) 50 SG	2 to 4.8 oz	12 hrs	0	
	flupyradifurone, MOA 4D (Sivanto Prime) 1.67	7.0 to 12.0 fl oz	4 hrs	1	
	imidacloprid, MOA 4A Soil treatment (Admire Pro) 4.6 F (various) 2 F	 7 to 10.5 oz 16 to 24 fl oz	12 hrs	 21	See label for soil application instructions. For short-term protection of transplants at planting, apply Admire Pro (0.44 ounces per 10,000 plants) not more than 7 days before transplanting by 1) uniformly spraying on transplants, followed immediately by sufficient overhead irrigation to wash product into potting media; or 2) injection into overhead irrigation system with adequate volume to thoroughly saturate soil media.
	Foliar treatment (Admire Pro) 4.6 F (various) 1.6 F	 1.3 to 2.2 fl oz 3.75 fl oz	12 hrs	0	
	pymetrozine, MOA 9B (Fulfill) 50 WDG	2.75 oz	12 hrs	14	Apply before aphids reach damaging levels. Do not exceed 5.5 ounces per acre per season.
	pyrifluquinazon, MOA 9B (PQZ) 1.87EC	 2.4 to 3.2 fl oz	 12 hrs	 1	See label for rotational crop restrictions. Do not exceed 4.8 fl oz per acre per crop cycle.
	spirotetramat, MOA 23 (Movento) 2 SC	4 to 5 fl oz	24 hrs	1	Do not exceed 10 fluid ounces per season. Requires surfactant.
	thiamethoxam, MOA 4A Soil treatment (Platinum) 75 SG Foliar treatment (Actara) 25 WDG	1.66 to 3.67 oz 2 to 3 oz	12 hrs 12 hrs	30 0	Platinum may be applied to direct-seeded crops in-furrow at seed or transplant depth, postseeding or transplant as a drench, or through drip irrigation. Do not exceed 8 ounces per acre per season. Check label for plant-back restrictions for a number of plants. Actara is for foliar application.
Blister beetle	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.

Table 5-9. Insect Control for Commercial Vegetables

CROP Insect	Insecticide, Mode of Action Code, and Formulation	Amount of Formulation Per Acre	Restricted Entry Interval (REI)	Pre harvest Interval (PHI) (Days)	Precautions and Remarks
Eggplant (continued)					
Colorado potato beetle	Resistance to many insecticides is widespread in Colorado potato beetle. To reduce risk of resistance, scout fields and apply insecticides only when needed to prevent damage to the crop. Crop rotation will help prevent damaging Colorado potato beetle infestations. If control failures or reduced levels of control occur with a particular insecticide, do NOT make a second application of the same insecticide at the same or higher rate. If an additional insecticide application is necessary, a different insecticide representing a different MOA class should be used. Do NOT use insecticides belonging to the same class 2 years in a row for Colorado potato beetle control.				
	abamectin, MOA 6 (Agri-Mek) 0.7 SC	1.75 to 3.5 fl oz	12 hrs	7	Apply when adults and small larvae are present but before large larvae appear. For resistance management, use the higher rate.
	acetamiprid, MOA 4A (Assail) 30 SG	2 to 4 oz	12 hrs	7	Do not apply more than once every 7 days and do not exceed 7 ounces of formulation per season.
	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
	chlorantraniliprole, MOA 28 (Coragen) 1.67 SC	3.5 to 7.5 fl oz	4 hrs	1	Foliar or drip chemigation. Drip chemigation must be applied uniformly to the root zone. See label for instructions.
	cyclaniliprole, MOA 28 (Harvanta) 50SL	10.9 to 16.4 fl oz	4 hrs	1	
	dinotefuran, MOA 4A Foliar treatment (Venom) 70 SG (Scorpion) 35SL Soil treatment (Venom) 70 SG (Scorpion) 35SL	 1 to 4 oz 2 to 7 fl oz 5 to 6 oz 9 to 10.5 fl oz	12 hrs 12 hrs	 1 21	Do not follow soil applications with foliar applications on any neonicotinoid insecticide. Use only 1 application method. Do not apply more than 6 ounces per acre per season using foliar applications or 12 ounces per acre per season using soil applications. Soil application may be applied by (1) a narrow band below or above the seed line at planting; (2) a post-seeding or transplant drench with sufficient water to ensure incorporation to the root zone; or (3) drip irrigation.
	imidacloprid, MOA 4A Soil treatment (Admire Pro) 4.6 F (various) 2 F	 7 to 10.5 fl oz 16 to 24 fl oz	12 hrs	 21	See application methods under Aphids, Thrips.
	Foliar treatment (Admire Pro) 4.6 F (various) 1.6 F	 1.3 fl oz 3.75 fl oz	12 hrs	 0	
	novaluron, MOA 15 (Rimon) 0.83 EC	9 to 12 fl oz	12 hrs	1	
	spinetoram, MOA 5 (Radiant) 1 SC	5 to 10 fl oz	4 hrs	1	
	sulfoxaflor, MOA 4C (Closer) 2 SC	1.5 to 2.0 fl oz	12 hrs	1	
	thiamethoxam, MOA 4A (Platinum) 75 SG (Actara) 25 WDG	1.66 to 3.67 oz 2 to 3 oz	12 hrs 12 hrs	30 0	See application methods under Aphids.
Eggplant lace bug	imidacloprid, MOA 4A (Admire Pro) 4.6 F (various) 1.6 F	 1.3 to 2.2 fl oz 3.8 to 6.2 fl oz	12 hrs	 0	
	malathion, MOA 1B (various brands) 57 EC	3 pt	12 hrs	3	
Flea beetle	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
	Carbaryl, MOA 1A (Sevin) 50 WP (Sevin) 80 S (Sevin) XLR Plus	 2 lb 1.25 lb 1 lb	12 hrs	3	
	clothianidin, MOA 4A (Belay) 50WDG	4.6 to 6.8 oz (soil); 1.6 to 2.1 fl oz (foliar)	12 hrs	 7 (foliar)	Soil application at planting only.
	Cyantraniliprole, MOA 28 (Verimark) 1,67SC	6.75 to 13.5 fl oz	4 hrs	1	Verimark for soil application only. Apply at planting or via drip chemigation. See label for application options.
	Dinotefuran, MOA 4A Foliar treatment (Venom) 70 SG (Scorpion) 35SL Soil treatment (Venom) 70 SG (Scorpion) 35SL	 1 to 4 oz 2 to 7 fl oz 5 to 6 oz 9 to 10.5 fl oz	12 hrs 12 hrs	 1 21	Do not follow soil applications with foliar applications on any neonicotinoid insecticide. Use only 1 application method. Do not apply more than 6 ounces per acre per season using foliar applications, or 12 ounces per acre per season using soil applications. Soil application may be applied by (1) a narrow band below or above the seed line at planting; (2) a post-seeding or transplant drench with sufficient water to ensure incorporation to the root zone; or (3) drip irrigation.
	thiamethoxam, MOA 4A (Platinum) 75 SG (Actara) 25 WDG	1.66 to 3.67 oz 2 to 3 oz	12 hrs 12 hrs	30 0	See application methods under Aphids.

Table 5-9. Insect Control for Commercial Vegetables

CROP Insect	Insecticide, Mode of Action Code, and Formulation	Amount of Formulation Per Acre	Restricted Entry Interval (REI)	Pre harvest Interval (PHI) (Days)	Precautions and Remarks
Eggplant (continued)					
Hornworm, European corn borer, Beet army worm, Corn earworm	chlorantraniliprole, MOA 28 (Coragen) 1.67 SC	3.5 to 7.55 fl oz	4 hrs	1	Foliar or drip chemigation. Drip chemigation must be applied uniformly to the root zone. See label for instructions.
	cyantraniliprole, MOA 28 (Verimark) 1,67SC (Exirel) 0.83SE	5 to 10 fl oz 7 to 13.5 fl oz	4 hrs 12 hrs	1 1	Verimark is for soil application only. Applications made at planting or via drip chemigation. See label for application options. Exirel is for foliar application only.
	cyclaniliprole, MOA 28 (Harvanta) 50SL	10.9 to 16.4 fl oz	4 hrs	1	
	indoxacarb, MOA 22B (Avaunt eVo) 30 WDG	2.5 to 3.5 oz	12 hrs	3	Do not apply more than 14 ounces per acre per season.
	methomyl, MOA 1A (Lannate) 2.4 LV	1.5 to 3 pt	48 hrs	5	
	methoxyfenozide, MOA 18 (Intrepid) 2 F	4 to 16 fl oz	4 hrs	1	Apply at rates of 4 to 8 fluid ounces early in season when plants are small. Apply at rates of 8 to 16 ounces to large plants or when infestations are heavy. During periods of continuous moth flights, retreatments at 7 to 14 days may be required. Do not apply more than 16 fluid ounces per application or 64 fluid ounces of Intrepid 2F per acre per season.
	spinetoram, MOA 5 (Radiant) 1 SC	5 to 10 fl oz	4 hrs	1	
	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
Leafminer	abamectin, MOA 6 (Agri-Mek) 0.15 EC	8 to 16 fl oz	12 hrs	7	Use low rates for low to moderate infestations and high rates for severe infestations
	chlorantraniliprole, MOA 28 (Coragen) 1.67 SC	5 to 7.5 fl oz	4 hrs	1	Foliar, soil, or drip chemigation. Drip chemigation must be applied uniformly to the root zone. See label for application instructions.
	oxamyl, MOA 1A (Vydate) 2 L	1 to 2 qt	48 hrs	7	
	spinetoram, MOA 5 (Radiant) 1 SC	5 to 10 fl oz	4 hrs	1	
Stink bug, leaffooted bug	dinotefuran, MOA 4A Foliar treatment (Venom) 70 SG (Scorpion) 35SL Soil treatment (Venom) 70 SG (Scorpion) 35SL	 1 to 4 oz 2 to 7 fl oz 5 to 6 oz 9 to 10.5 fl oz	12 hrs 12 hrs	 1 21	
	pyrethroid MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and preharvest intervals.
	thiamethoxam, MOA 4A (Actara) 25 WDG	3 to 5.5 oz	12 hrs	0	Do not exceed 11 ounces Actara per acre per season.
Spider mite	abamectin, MOA 6 (Agri-Mek) 0.7 SC	1.75 to 3.5 fl oz	12 hrs	7	Use low rates for low to moderate infestations, and high rates for severe infestations.
	acequinocyl, MOA 20B (Kanemite) 15SC	31 fl oz	12 hrs	1	
	bifenazate, MOA 20D (Acramite) 50 WS	0.75 to 1.0 lb	12 hrs	3	Do not make more than 1 application per season.
	fenazaquin, MOA 21A (Magister) 1.7	24 to 36 fl oz	12 hrs	3	Do not make more than 1 application per year.
	etoxazole, MOA 10B (Zeal)	2 to 3 oz	12 hrs	7	Do not make more than 1 Zeal application per season.
	fenpyroximate MOA 21 (Portal) 0.4EC	2 pts	12 hrs	3	Do not make more than 2 applications per season.
	spiromesifen, MOA 23 (Oberon) 2 SG	7 to 8.5 fl oz	12 hrs	7	
Thrips	dinotefuran, MOA 4A Foliar treatment (Venom) 70 SG (Scorpion) 35SL Soil treatment (Venom) 70 SG (Scorpion) 35SL	 1 to 4 oz 2 to 7 fl oz 5 to 6 oz 9 to 10.5 fl oz	12 hrs 12 hrs	 1 21	Will not control western flower thrips, only tobacco thrips, which are common early in the season. See Whitefly for application instructions. Soil applications are more effective against thrips than foliar applications.
	cyantraniliprole, MOA 28 (Verimark) 1,67SC	5 to 10 fl oz	4 hrs	1	Soil applications of Verimark will suppress western flower thrips. Foliar applications of Exirel are less effective.
	cyclaniliprole, MOA 28 (Harvanta) 50SL	10.9 to 16.4 fl oz	4 hrs	1	Foliar applications will help suppress western flower thrips when used in a rotational program.
	imidacloprid, MOA 4A Admire Pro 4.6 F (various) 2 F	7 to 10.5 fl oz 16 to 24 fl oz	12 hrs	21	Will not control western flower thrips, only tobacco thrips, which are common early in the season. See Aphids for application instructions.

Table 5-9. Insect Control for Commercial Vegetables

CROP Insect	Insecticide, Mode of Action Code, and Formulation	Amount of Formulation Per Acre	Restricted Entry Interval (REI)	Pre harvest Interval (PHI) (Days)	Precautions and Remarks
Eggplant (continued)					
Thrips (continued)	methomyl, MOA 1A (Lannate) 2.4	1.5 to 3 pt	48 hrs	3	
	spinetoram, MOA 5 (Radiant) 1 SC	6 to 10 fl oz	4 hrs	1	
	Tolfenpyrad, MOA21A (Torac) 1.29 EC	21 fl oz	12 hrs	1	
Whitefly	acetamiprid, MOA 4A (Assail) 30 SG	2.5 to 4 oz	12 hrs	7	Begin applications when significant populations of adults appear. Do not wait until heavy populations have become established. Do not apply more than once every 7 days and do not exceed 4 applications per season. Do not apply more than 7 ounces per season.
	afidopyropen, MOA 9D (Sefina) DC	14 oz	12 hrs	0	Do not make more than 2 sequential applications before using a different mode of action.
	chlorantraniliprole, MOA 28 (Coragen) 1.67 SC	5 to 7.5 fl oz	12 hrs	1	For foliar or drip chemigation. Drip chemigation must be applied uniformly to the root zone. See label for instructions.
	cyantraniliprole, MOA 28 (Verimark) 1,67SC (Exirel) 0.83SE	6.75 to 13.5 fl oz 13.5 to 20.5 fl oz	4 hrs 12 hrs	1 1	Verimark is for soil application only. Apply at planting or via drip chemigation. See label for application options. Exirel is for foliar application only.
	dinotefuran, MOA 4A Foliar treatment (Venom) 70 SG (Scorpion) 35SL Soil treatment (Venom) 70 SG (Scorpion) 35SL	 1 to 4 oz 2 to 7 fl oz 5 to 6 oz 9 to 10.5 fl oz	12 hrs 12 hrs	 1 21	Use only 1 application method (foliar or soil) of Group 4A insecticides. Soil applications may be applied in a narrow band on the plant row in bedding operations, as a post-seeding or transplant drench, as a side-dress after planting and incorporated 1 or more inches, or through a drip irrigation system.
	flupyradifurone, MOA 4D (Sivanto Prime) 1.67	10.5 to 14.0 fl oz	4 hrs	1	
	imidacloprid, MOA 4A (Admire Pro) 4.6 F (various) 2 F	 7 to 10.5 fl oz 16 to 24 fl oz	12 hrs	21	Do not follow soil applications with applications of other neonicotinoid insecticides (Assail or Venom). See Aphids for application methods and restrictions.
	pyriproxyfen, MOA 7C (Knack) 0.86 EC	8 to 10 fl oz	12 hrs	14	Knack prevents eggs from hatching. It does not kill whitefly adults. Applications should begin when 3 to 5 adults per leaf are present. Do not make more than 2 applications per season, and do not apply a second application within 14 days of the first application. Do not exceed 20 fluid ounces of Knack per acre per season. Check label for plant-back restrictions.
	Pyrifluquinazon, MOA 9B (PQZ) 1.87EC	2.4 to 3.2 fl oz	12 hrs	1	See label for rotational crop restrictions. Do not exceed 4.8 fl oz per acre per crop cycle.
	spirotetramat, MOA 23 (Movento) 2SC	4 to 5 fl oz	24 hrs	1	Do not exceed 10 fl oz per season. Requires surfactant.
	spiromesifen, MOA 23 (Oberon) 2 SC	7 to 8.5 fl oz	12 hrs	7	Do not exceed 3 applications or 25.5 fluid ounces per season.
	thiamethoxam, MOA 4A (Platinum) 75 SG (Actara) 25WDG	1.66 to 3.67 oz 3 to 5.5	12 hrs	30 0	Platinum is for soil applications and may be applied to direct-seeded crops in furrow at seed or transplant depth, at postseeding or transplant as a drench, or through drip irrigation. Do not exceed 11 ounces per acre per season. Check label for plant-back restrictions for a number of plants. Actara is for foliar application.
Hops					
Aphids and leafhoppers	imidacloprid, MOA 4A (Admire) 4.6 F Soil application Foliar applicatoin	 2.8 to 8.4 fl oz 2.8 fl oz	12 hrs	 60 28	Soil applications can be made by drip chemigation, Subsurface side-dress shanked into root-zone, or a hill drench in sufficient water to ensure incorporation into the root zone by irrigation.
	pymetrozine, MOA 9B (Fulfill) 50 WDG	4 to 6 oz	12 hrs	14	For aphids only. Will not control leafhoppers.
	spirotetramat, MOA 23 (Movento) 2 F	5 to 6 fl oz	24 hrs	7	Do not exceed 12.5 fl oz per acre per season. Will also control twospotted spider mite.
	malathion, MOA 1B 5 EC 8 EC	 1 pt 0.63 pt	 12 hrs 12 hrs	 7 7	 May suppress twospotted spider mite.
	pyrethrins, MOA 3A (Pyganic) 1.4 EC (Pyganic) 5 EC	 16 to 64 fl oz 4.5 to 17 fl oz	 12 hrs 12 hrs	 0 0	**OMRI listed.** Pyrethrins degrade very quickly in sunlight. Do not expect residual control.
Japanese beetle	bifenthrin, MOA 3A (Brigade) 2 EC (Brigade) WSB	 3.8 to 6.4 fl oz 9.6 to 16 of oz	 12 hrs 12 hrs	 14 14	 See Table of Generic Insecticides for other bifenthrin products.
	imidacloprid, MOA 4A (Admire) 4.6 F (generics) 2	 2.8 fl oz 6.4 fl oz	 12 hrs 12 hrs	 28 28	

Table 5-9. Insect Control for Commercial Vegetables

CROP Insect	Insecticide, Mode of Action Code, and Formulation	Amount of Formulation Per Acre	Restricted Entry Interval (REI)	Pre harvest Interval (PHI) (Days)	Precautions and Remarks
Hops (continued)					
Armyworms, cutworms, loopers, leafroller, Question mark butterfly	*Bacillus thuringiensis,* MOA 11A (Xentari) DF (Crymax) WDG	 0.5 to 2 lb 0.5 to 2 lb	 4 hrs 4 hrs	 0 0	
	chlorantraniliprole, MOA 28 (Coragen) 1.67 SC	3.5 to 7.5 fl oz	4 hrs	0	Foliar or drip chemigation. Drip chemigation must be applied uniformly to the root zone. See label for instructions.
	spinosad, MOA 5 (Entrust) SC	4 to 6 fl oz	4 hrs	1	**OMRI listed.**
	spinetoram, MOA 5 (Delegate) 25WG	2.5 to 4 oz	4 hrs	1	
Spider mites	abamectin, MOA 6 (Agri-Mek) 0.7 SC	1.75 to 3.5 fl oz	12 hrs	21	Do not exceed 48 fluid ounces per acre per season, or more than 2 sequential applications.
	acequinocyl, MOA 20B (Kanemite) 15 SC	31 fl oz	12 hrs	1	The use of a surfactant/adjuvant with Kanemite on tomatoes is prohibited.
	Bifenazate, MOA 20D (Acramite) 50 WS	0.75 to 1.0 lb	12 hrs	1414	Do not make more than 1 application per season.
	fenazaquin, MOA 21A (Magister) 1.7	24 to 36 fl oz	12 hrs	3	Do not make more than 1 application per year.
	etoxazole, MOA 10B (Zeal) 72 WSP	3 to 4 oz	12 hrs	7	Apply when mites are low because Zeal is primarily an ovicide/ larvicide.
	fenpyroximate MOA 21 (Portal) 0.4EC	2 pts	12 hrs	1515	Do not make more than 2 applications per season.
	hexythiazox, MOA 10A (Savvy) 50 DF	4 to 6 oz	12 hrs	—	May be applied up to burr formation in hop vines. Apply when mites are low, because Savvy is primarily an ovicide, and also sterilizes females.
	Mineral Oil (TriTek) Various brands	1 to 2% soln.	4 hrs	0	**OMRI listed.** TriTek is the only emulsified formulation of oil. All others do not contain an emulsifier
Lettuce					
Aphid	acetamiprid, MOA 4A (Assail) 30 SG	2 to 4 oz	12 hrs	7	Do not apply more than once every 7 days, and do not exceed 4 applications per season.
	afidopyropen, MOA 9D (Versys) DC	1.5 fl oz	12 hrs	0	Do not make more than 2 sequential applications before using a different mode of action.
	clothianidin, MOA 4A (Belay) 2.13 SC	9 to 124 fl oz (soil); 3 to 4 1 fl oz (foliar)	12 hrs	7 (foliar)	Soil application at planting only. Do not incorporate an adjuvant with foliar applications. Do not apply more than 6.4 oz per acre per season.
	dimethoate 4 EC, MOA 1B	0.5 pt	48 hrs	14	
	flonicamid, MOA 29 (Beleaf) 50 SG	2 to 2.8 oz	12 hrs	0	
	flupyradifurone, MOA 4D (Sivanto Prime) 1.67	10.5 to 144.0 fl oz	4 hrs	1	
	imidacloprid, MOA 4A Soil treatment (Admire Pro) 4.6 F (various) 2 F	 4.4 to 10.5 fl oz 10 to 24 fl oz	12 hrs	21	Do not follow soil applications with foliar applications of any neonicotinoid insecticide. See label for soil application instructions.
	Foliar treatment (Admire Pro) 4.6 F (various) 1.6 F	 1.3 fl oz 3.8 fl oz	12 hrs	7	
	pymetrozine, MOA 9B (Fulfill) 50 WDG	2.75 oz	12 hrs	7	Apply before aphids reach damaging levels. Do not exceed 5.5 ounces per acre per season.
	pyrifluquinazon, MOA 9B PQZ 1.87EC	2.4 to 3.2 fl oz	12 hrs	1	See label for rotational crop restrictions. Do not exceed 4.8 fl oz per acre per crop cycle.
	spirotetramat, MOA 23 (Movento) 2SC	4 to 5 fl oz	24 hrs	3	Do not exceed 10 fl oz per season. Requires surfactant.
	thiamethoxam, MOA 4A (Platinum) 75 SG (Actara) 25 WDG	1.66 to 3.67 oz 1.5 to 3 oz	12 hrs 12 hrs	30 7	Do not follow applications of Platinum with foliar applications of any neonicotinoid insecticide. Platinum may be applied to direct-seeded crops in-furrow at the seeding or transplant depth, or as a narrow surface band above the seedling and followed by irrigation. Post seeding, it may be applied as a transplant or through drip irrigation. Actara is applied as a foliar spray.
	tolfenpyrad, MOA 21A (Torac) 1.29 EC	17 to 21 fl oz	12 hrs	1	Do not apply until at least 14 days after plant emergence or after transplanting to allow time for root establishment.

Table 5-9. Insect Control for Commercial Vegetables

CROP Insect	Insecticide, Mode of Action Code, and Formulation	Amount of Formulation Per Acre	Restricted Entry Interval (REI)	Pre harvest Interval (PHI) (Days)	Precautions and Remarks
Lettuce (continued)					
Armyworm, Cabbage looper, Corn earworm	*Bacillus thuringiensis,* MOA 11A (Crymax) WDG (Dipel) DF	 0.5 to 1.5 lb 8 oz	4 hrs	0	Only target small armyworms with Bts.
	chlorantraniliprole, MOA 28 (Coragen) 1.67 SC	3.5 to 7.5 fl oz	4 hrs	1	Foliar or drip chemigation. See label for use instructions.
	cyantraniliprole, MOA 28 (Verimark) 1,67SC (Exirel) 0.83SE	5 to 13.5 fl oz 7 to 17 fl oz	4 hrs 12 hrs	1 1	Verimark is for soil application only. Applications made at planting or via drip chemigation. Use higher rates (>10 fluid ounces) where cabbage looper is a concern. See label for application options. Exirel is for foliar application only. Use higher rates (>13.5 fluid ounces) for cabbage looper.
	cyclaniliprole, MOA 28 (Harvanta) 50 SL	 11 to 16.4 fl oz	4 hrs	1	
	emamectin benzoate, MOA 6 (Proclaim) 5 WDG	3.2 to 4.8 oz	12 hrs	7	Do not make more than 2 sequential applications without rotating to another product with a different mode of action.
	indoxacarb, MOA 22B (Avaunt eVo) 30 WDG	2.5 to 3.5 oz	12 hrs	3	Do not apply more than 14 ounces of Avaunt eVo (0.26 lb a.i.) per acre per crop. The minimum interval between sprays is 3 days.
	methomyl, MOA 1A (Lannate) 90 SP (Lannate) 2.4 LV	 0.5 to 1 lb 1.5 to 3 pts	48 hrs	See Label.	See label for use instructions.
	methoxyfenozide, MOA 18 (Intrepid) 2 F	4 to 10 oz	4 hrs	1	Low rates for early-season applications to young or small plants. For mid- and late-season applications, use 6 to 10 ounces.
	Pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
	spinetoram, MOA 5 (Radiant) 1 SC	5 to 10 fl oz	4 hrs	1	
Leafhopper	buprofezin, MOA 16 (Courier) 40 SC	 9 to 13.6 fl oz	12 hrs	7	Do not apply more than 27.2 fl oz per acre per crop cycle.
	dinotefuran, MOA 4A (Venom) 70 SG	1 to 3 oz (foliar) 5 to 6 oz (soil)	12 hrs	7 21	Do not follow soil applications with foliar applications of any neonicotinoid insecticide. Use only 1 application method. Do not apply more than 6 ounces per acre (foliar) or 12 ounces per acre (soil). Soil applications may be applied by (1) Narrow band below or above the seed line at planting; (2) post seeding or transplant drench with sufficient water to ensure incorporation; or (3) drip irrigation.
	dimethoate 4 EC, MOA 1B	0.5 pt	48 hrs	14	14-day interval for leaf lettuce.
	flupyradifurone, MOA 4D Sivanto Prime 1.67 Foliar treatment Soil treatment (Sivanto) 1.67	 7.0 to 14 fl oz 21 to 28 fl oz	4 hrs	 1 21	Do not apply more than 0.365 lb flupyradifurone per acre per crop per season regardless of application method, product, or formulation. Chemigation via drip, injection below the eventual seed line prior to planting, post-transplant drench following setting and covering, and potting hole drench after transplanting.
	imidacloprid, MOA 4A (various) 1.6 F	3.75 fl oz	12 hrs	7	There is a 12-month plant-back restriction for a number of crops. Check label for restrictions.
	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
	thiamethoxam, MOA 4A (Actara) 25 WDG	1.5 to 3 oz	12 hrs	7	
	tolfenpyrad, MOA 21A (Torac) 1.29 EC	14 to 21 fl oz	12 hrs	1	Do not apply until at least 14 days after plant emergence or after transplanting to allow time for root establishment.
Slugs	iron phosphate (Sluggo)	20 to 44 lb	0 hrs	0	**OMRI listed.** Sluggo should be scattered around the perimeter of the crop to provide a protective barrier for slugs and snails. If slugs are inside the rows, scatter the bait on the soil around the plants and between rows. For smaller plantings use at 0.5 to 1 lb 1,000 square feet.
	metaldehyde (Deadline Bullets)	25 lb	12 hrs	0	Apply in a band to the soil between rows. Do not allow pellets to come into contact with plant parts. Do not exceed 3 applicatoins per season or at intervals shorter than 14 days.
Melon (See Cucurbit Crops)					
Mustard Greens (See Collard, Kale, Mustard Greens)					
Okra					
Aphid	acetamiprid, MOA 4A (Assail) 30 SG	2 to 4 oz	12 hrs	7	Do not apply more than once every 7 days, and do not exceed 4 applications per season.
	Afidopyropen, MOA 9D (Sefina) DC	3	12 hrs	0	Do not make more than 2 sequential applications before using a different mode of action.
	imidacloprid, MOA 4A Soil treatment (Admire Pro) 4.6 F (various) 2 F	 7 to 14 fl oz 16 to 24 fl oz	12 hrs	 21	See label for soil treatment instructions.
	Foliar treatment (Admire Pro) 4.6 F (various) 2 F	 1.3 to 2.2 fl oz 2.5 to 5 fl oz	12 hrs	7	

Table 5-9. Insect Control for Commercial Vegetables

CROP Insect	Insecticide, Mode of Action Code, and Formulation	Amount of Formulation Per Acre	Restricted Entry Interval (REI)	Pre harvest Interval (PHI) (Days)	Precautions and Remarks
Okra (continued)					
Aphid (continued)	flonicamid, MOA 29 (Beleaf) 50 SG	2 to 2.8 oz	12 hrs	0	
	flupyradifurone, MOA 4D (Sivanto Prime) 1.67	7.0 to 12 fl oz	4 hrs	1	
	malathion, MOA 1B (various brands) 8 F (various brands) 25 WP	 1.5 pt 6 lb	12 hrs	1	
	pyrifluquinazon, MOA 9B (PQZ) 1.87EC	 2.4 to 3.2 fl oz	 12 hrs	 1	See label for rotational crop restrictions. Do not exceed 4.8 fl oz per acre per crop cycle.
	spirotetramat, MOA 23 (Movento) 2SC	4 to 5 fl oz	24 hrs	3	Do not exceed 10 fluid ounces per season. Not for flea beetle. Requires surfactant.
	sulfoxaflor, MOA 4C (Closer) 2 SC	1.5 to 2.0 fl oz	12 hrs	7	
	carbaryl, MOA 1A (Sevin) 50 WP (Sevin) 80 S (Sevin) XLR Plus	 4 lb 2.5 lb 2 qt	12 hrs	3	On foliage as needed.
	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
Corn earworm, Tobacco budworm, European corn borer	carbaryl, MOA 1A (Sevin) 50 WP (Sevin) 80 S (Sevin) XLR Plus	 4 lb 2.5 lb 2 qt	12 hrs	3	On foliage as needed.
	chlorantraniliprole, MOA 28 (Coragen) 1.67 SC	3 to 7.5 fl oz	4 hrs	1	Foliar or drip chemigation. Drip chemigation must be applied uniformly to the root zone. See label for instructions.
	cyantraniliprole, MOA 28 (Verimark) 1,67SC (Exirel) 0.83SE	 5 to 10 fl oz 7 to 17 fl oz	 4 hrs 12 hrs	 1 1	Verimark is for soil application only. Applications made at planting or via drip chemigation. See label for application options. Exirel is for foliar application only. Rates >13.5 for loopers only.
	cyclaniliprole, MOA 28 (Harvanta) 50SL	10.9 to 16.4 fl oz	4 hrs	1	Foliar applications will help suppress western flower thrips when used in a rotational program.
	methoxyfenozide, MOA 18 (Intrepid) 2 F	8 to 16 fl oz	4 hrs	1	
	novaluron, MOA 15 (Rimon) 0.83 EC	9 to 12 fl oz	12 hrs	1	
	spinetoram, MOA 5 (Radiant) 1 SC	5 to 10 fl oz	4 hrs	1	For corn earworm only.
	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
Spider mites	bifenazate, MOA 20D (Acramite) 50 WP	0.75 to 1 lb	12 hrs	3	Do not make more than 1 application per season.
	fenpyroximate MOA 21 (Portal) 0.4EC	2 pt	12 hrs	3	Do not make more than 2 applications per season.
Stink bug, leaffooted bug	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
Whitefly	buprofezin, MOA 16 (Courier) 40 SC	9 to 13.6 fl oz	12 hrs	1	
	chlorantraniliprole, MOA 28 (Coragen) 1.67 SC	3.57.5 fl oz	4 hrs	1	Foliar or drip chemigation. Drip chemigation must be applied uniformly to the root zone. See label for instructions.
	cyantraniliprole, MOA 28 (Verimark) 1,67SC (Exirel) 0.83SE	 6.75 to 13.5 fl oz 13.5 to 20.5 fl oz	 4 hrs 12 hrs	 1 1	Apply Verimark to at planting or later via drip irrigation or soil injection. See label for application options. Exirel is for foliar application.
	flupyradifurone, MOA 4D (Sivanto Prime) 1.67	10.5 to 14.0 fl oz	4 hrs	1	
	imidacloprid, MOA 4A Soil treatment (Admire Pro) 4.6 F (various) 2 F Foliar treatment (Admire Pro) 4.6 F (various) 1.6 F	 7 to 14 fl oz 16 to 32 fl oz 1.3 to 2.2 fl oz 3.8 oz	12 hrs 12 hrs	 21 0	See label for soil application instructions.
	pyriproxyfen, MOA 7C (Knack) 0.86 EC	8 to 10 fl oz	12 hrs	1	Do not make more than 2 applications per season.
	spirotetramat, MOA 23 (Movento) 2SC	4 to 5 fl oz	24 hrs	3	Do not exceed 10 fluid ounces per season. Not for flea beetle. Requires surfactant.
Onion					
Armyworm, Cutworm	chlorantraniliprole MOA 28 (Coragen) 1.67 SC (Vantacor) 5 SC	 3.5 to 7.5 fl oz 1.2 to 2.5 fl oz	4 hrs	1	
	cyantraniliprole, MOA 28 (Exirel) SE	 10 to 20.5 fl oz	12 hrs	1 (succulent0 7 (dried)	

Table 5-9. Insect Control for Commercial Vegetables

CROP Insect	Insecticide, Mode of Action Code, and Formulation	Amount of Formulation Per Acre	Restricted Entry Interval (REI)	Pre harvest Interval (PHI) (Days)	Precautions and Remarks
Onion (continued)					
Armyworm, Cutworm (continued)	methoxyfenozide MOA 18 (Intrepid) 2F	4 to 8 fl oz 8 to 12 fl oz	4 hrs	1	For use against lepidopteran pests on green onion only. Use lower rates in early season on small plants; use higher rates in late season and for heavy infestations.
	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
	spinetoram, MOA 5 (Radiant) 1 SC	5 to 10 fl oz	4 hrs	1	Control may be improved by mixing with an adjuvant.
Leafminer	cyromazine, MOA 17 (Trigard) 75 WS	2.66 oz	12 hrs	7	
	spinetoram, MOA 5 (Radiant) 1 SC	6 to 10 fl oz	4 hrs	1	
Onion maggot, Seed corn maggot	Onion seed pre-treated with cyromazine (Trigard) can be used to control onion and seed corn maggot.				
	chlorpyrifos, MOA 1B (Lorsban) 4 E	32 fl oz	24 hrs		For use on green onion only. Apply as a drench over the row at planting or 7 to 10 days after seeding. Do not exceed 1 application per year.
	diazinon, MOA 1B (Diazinon) (AG 500)	2 to 4 qt	3 days		Broadcast just before planting and mix into the top 3 to 4 inches of soil.
	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
Thrips	acetamiprid MOA 4A (Assail) 70 WP	5 to 8 oz	12 hrs	7	Control may be improved by tank mixing with an adjuvant. Do not exceed 4 applications per year.
	methomyl, MOA 1A (Lannate) 2.4 LV	3 pt	48 hrs	7	May be applied by overhead sprinkler chemigation to control thrips. Add a wetting agent to improve coverage.
	spinetoram, MOA 5 (Radiant) 1 SC	6 to 10 fl oz	4 hrs	1	Control may be improved by mixing with an adjuvant.
	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
Pea, English and Snow Pea (Succulent and dried)					
Aphid	acetamiprid MOA 4A (Assail) 30SG	2.5 to 5.3 oz	12 hrs	7	Also controls leafhoppers. Succulent peas only.
	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
	dimethoate, MOA 1B (Dimethoate) 400 (4E)	0.32 pt	48 hrs	0	Do not make more than 1 application per season, and do not feed or graze if a mobile viner is used, or for 21 days if a stationary viner is used. Re-entry interval is 48 hours.
	flupyradifurone, MOA 4D (Sivanto Prime) 1.67	7.0 to 14 fl oz	4 hrs	7	Will also control leafhopper.
	imidacloprid, MOA 4A Soil treatment (Admire Pro) 4.6 F (various) 2 F	 7 to 10.5 fl oz 16 to 24 fl oz	12 hrs	 21	See label for soil application instructions.
	Foliar treatment (Admire Pro) 4.6 F (various) 1.6 F	 1.2 fl oz 3.5 fl oz	12 hrs	 7	
Armyworm, Cloverworm, Cutworm, Looper	chlorantraniliprole MOA 28 (Coragen) 1.67 SC (Vantacor) 5 SC	3.5 to 7.5 fl oz 1.2 to 2.5 fl oz	4 hrs	1	
	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
	spinetoram, MOA 5 (Radiant) 1 SC	4 to 8 fl oz	4 hrs	3 (succulent); 28 (dried)	Not for cutworm.
	spinosad, MOA 5 (Blackhawk)	2.2 to 3.3 oz	4 hrs	3 (succulent); 28 (dried)	
Leafhopper, Lygus bug, Stink bug	methomyl, MOA 1A (Lannate) 2.4 LV	1.5 to 3 pt	48 hrs	1 (pea) 3 (forage)	Apply to foliage as needed.
	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
Seedcorn maggot	See **Beans** for control				
Pea (Cowpea, southernpeas)					
Aphid, Thrips	acetamiprid MOA 4A (Assail) 30 SG	2.5 to 5.3 oz	12 hrs	7	Succulent peas only.
	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
	flupyradifurone, MOA 4D (Sivanto Prime) 1.67	7.0 to 14 fl oz	4 hrs	7	Will not control thrips.
	imidacloprid, MOA 4A Soil treatment (Admire Pro) 4.6 F (various) 2 F	 7 to 10.5 fl oz 16 to 24 fl oz	12 hrs	21	See label for soil application instructions.

Table 5-9. Insect Control for Commercial Vegetables

CROP Insect	Insecticide, Mode of Action Code, and Formulation	Amount of Formulation Per Acre	Restricted Entry Interval (REI)	Pre harvest Interval (PHI) (Days)	Precautions and Remarks
Pea (Cowpea, southernpeas) (continued)					
Aphid, Thrips (continued)	Foliar treatment (Admire Pro) 4.6 F (various) 1.6 F	 1.3 fl oz 3.5 fl oz	12 hrs	 7	
	spinetoram, MOA 5 (Radiant) 1 SC	5 to 8 fl oz	4 hrs	3 (succulent) 28 (dried)	Radiant is not effective against aphids.
	sulfoxaflor, MOA 4C (Transform) 50 WG	0.75 to 1.0 oz	24 hrs	7	
	spinosad, MOA 5 (Blackhawk)	2.2 to 3.3 oz	4 hrs	3 (succulent); 28 (dried)	Blackhawk is not effective against aphids.
Bean leaf beetle	carbaryl, MOA 1A (Sevin) 4 L (Sevin) 80 S	 0.5 to 1 qt 0.625 to 1.25 lb	12 hrs	3 (fresh) 21 (dried)	Do not feed treated foliage to livestock.
	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
Corn earworm, Loopers, European corn borer, Armyworm	chlorantraniliprole MOA 28 (Coragen) 1.67 SC (Vantacor) 5 SC	 3.5 to 7.5 fl oz 1.2 to 2.5 fl oz	4 hrs	1	
	cyantraniliprole, MOA 28 (Exirel) SE	 10 to 20.5 fl oz	12 hrs	1 (succulent) 7 (dried)	
	methoxyfenozide, MOA 18 (Intrepid) 2 F	4 to 16 fl oz	4 hrs	7	Use lower rates on smaller plants and higher rates for mid- to late-season applications, against corn earworm. Do not apply more than 16 fluid ounces per acre per season.
	methomyl, MOA 1A (Lannate) 90SP	0.5 to 1 lb	48 hrs	1	Re-entry interval is 48 hr.
	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
	spinetoram, MOA 5 (Radiant) 1 SC	3 to 8 fl oz	4 hrs	3 (succulent) 28 (dried)	Do not apply more than 18 fl oz (succulent) or 12 fl oz (dried) per acre per season.
Cowpea curculio	pyrethroids, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals. Control may be poor in areas where resistant populations occur, primarily in parts of Alabama and Georgia. In areas where resistance is a problem, pyrethroid insecticides should be used at the highest labeled rate and synergized by tank-mixing with 1 pint piperonyl butoxide synergist per acre. In fields where resistance is a problem, applications every 3 to 5 days may be necessary to maintain control of the cowpea curculio population.
	lambda-cyhalothrin, MOA 3A + chlorantraniliprole, MOA 28 (Besiege) ZC	6 to 10 fl oz	24 hrs	7 (succulent) 21 (dried)	
Stink bug	methomyl, MOA 1A (Lannate) 90SP	0.5 to 1 lb	48 hrs	1	
	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals. Control may be poor in areas where resistant populations occur, primarily in the Gulf Coast areas.
Leafminer	spinetoram, MOA 5 (Radiant) 1 SC	5 to 8 fl oz	4 hrs	3 (succulent); 28 (dried)	
	spinosad, MOA 5 (Blackhawk)	2.5 to 3.3 oz	4 hrs	3 (succulent); 28 (dried)	
Pepper					
Aphid	acetamiprid, MOA 4A (Assail) 70 WP	0.8 to 1.2 oz	12 hrs	7	Do not apply more than once every 7 days and do not exceed 4 applications per season.
	clothianidin, MOA 4A (Belay) 50WDG	4.8 to 6.4 oz (soil) 1.6 to 2.1oz (foliar)	12 hrs	7	Soil application at planting only.
	cyantraniliprole, MOA 28 (Verimark)	6.75 to 13.5 fl oz	4 hrs	1	Apply to soil at planting, as a transplant tray drench, in transplant water or hill drench. After planting may be applied via drip irrigation.
	flonicamid, MOA 29 (Beleaf) 50 SG	2 to 4.8 oz	12 hrs	0	Will not control flea beetle.
	flupyradifurone, MOA 4D (Sivanto Prime) 1.67	7.0 to 144.0 fl oz	4 hrs	1	
	imidacloprid, MOA 4A Soil treatment (Admire Pro) 4.6 F (various) 2 F Foliar treatment (Admire Pro) 4.6 F (various) 1.6 F	 7 to 14 fl oz 16 to 32 fl oz 1.3 fl oz 3.8 fl oz	12 hrs 12 hrs	 21 0	Where whitefly resistance is a concern, do not follow soil applications with foliar applications of any neonicotinoid. See label for soil application instructions. For short-term protection of transplants at planting, apply Admire Pro (0.44 oz/10,000 plants) not more than 7 days before transplanting by 1) uniformly spraying on transplants, followed immediately by sufficient overhead irrigation to wash product into potting media; or 2) injection into overhead irrigation system using adequate volume to thoroughly saturate soil media.
	oxamyl, MOA 1A (Vydate) 2 L	1 to 2 qt	48 hrs	7	
	pymetrozine, MOA 9B (Fulfill) 50 WDG	2.75 oz	12 hrs	0	Apply before aphids reach damaging levels. Do not exceed 5.5 ounces per acre per season. Not for flea beetle.

Table 5-9. Insect Control for Commercial Vegetables

CROP Insect	Insecticide, Mode of Action Code, and Formulation	Amount of Formulation Per Acre	Restricted Entry Interval (REI)	Pre harvest Interval (PHI) (Days)	Precautions and Remarks
Pepper (continued)					
Aphid (continued)	pyrifluquinazon, MOA 9B (PQZ) 1.87EC	2.4 to 3.2 fl oz	12 hrs	1	See label for rotational crop restrictions. Do not exceed 4.8 fl oz per acre per crop cycle.
	spirotetramat, MOA 23 (Movento) 2SC	4 to 5 fl oz	24 hrs	1	Do not exceed 10 fluid ounces per season. Requires surfactant. Will not control flea beetle.
	sulfoxaflor, MOA 4C (Closer) 2 SC	1.5 to 2.0 fl oz	12 hrs	1	
	acephate, MOA 1B (Orthene) 97	8 oz	24 hrs	7	
	sulfoxaflor, MOA 4C (Closer) 2 SC (Transform) WG	 1.5 to 2.0 fl oz 0.75 to 1.0 oz	24 hrs	1	
	tolfenpyrad, MOA 21A (Torac)	17 to 21 fl oz	12 hrs	1	
	thiamethoxam, MOA 4A Soil treatment (Platinum) 75 SG Foliar treatment (Actara) 25 WDG	1.66 to 3.67 oz 2 to 4 oz	12 hrs 12 hrs	30 0	Platinum may be applied to direct-seeded crops in-furrow seeding or transplant depth, post seeding or transplant as a drench, or through drip irrigation. Actara is applied as a foliar spray. Do not exceed 11 ounces per acre per season of Platinum or Actara. Check label for plant-back restrictions for a number of crops.
Armyworm, Corn earworm, Looper, Hornworm, European corn borer	*Bacillus thuringiensis,* MOA 11A (Dipel) DF (Xentari) DF	 0.5 to 1.5 lb 0.5 to 2 lb	4 hrs	0	Not effective against European corn borer.
	chlorantraniliprole, MOA 28 (Coragen) 1.67 SC	3 to 7.5 fl oz	4 hrs	1	Foliar or drip chemigation. Drip chemigation must be applied uniformly to the root zone. See label for instructions.
	cyantraniliprole, MOA 28 (Verimark) 1,67SC (Exirel) 0.83SE	 5 to 10 fl oz 7 to 13.5 fl oz	 4 hrs 12 hrs	 1 1	 Verimark is for soil application only. Applications made at planting or via drip chemigation. See label for application options. Exirel is for foliar application only.
	cyclaniliprole, MOA 28 (Harvanta) 50SL	10.9 to 16.4 fl oz	4 hrs	1	
	emamectin benzoate, MOA 6 (Proclaim) 5 WDG	2.4 to 4.8 oz	12 hrs	7	Apply when larvae are first observed. Additional applications may be necessary to maintain control.
	indoxacarb, MOA 22B (Avaunt eVo) 30 WDG	2.5 to 3.5 oz	12 hrs	3	Use only higher rate for control of armyworm and corn earworm. Do not apply more than 14 ounces of Avaunt eVo (0.26 pound a.i. per acre per crop). Minimum interval between sprays is 5 days.
	methoxyfenozide, MOA 18 (Intrepid) 2 F	4 to 16 fl oz	4 hrs	1	Apply at rates of 4 to 8 fluid ounces early in season when plants are small. Apply at rates of 8 to 16 ounces to large plants or when infestations are heavy. During periods of continuous moth flights re-treatments at 7 to 14 days may be required. Do not apply more than 16 fluid ounces per application or 64 fluid ounces of Intrepid per acre per season.
	novaluron, MOA 15 (Rimon) 0.83 EC	9 to 12 fl oz	12 hrs	1	The use of a surfactant/adjuvant with Rimon is prohibited on pepper.
	spinetoram, MOA 5 (Radiant) 1 SC	5 to 10 fl oz	4 hrs	1	
	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
Blister beetle, Stink bug, Leaffooted bug	dinotefuran, MOA 4A Foliar treatment (Venom) 70 SG (Scorpion) 35SL Soil treatment (Venom) 70 SG (Scorpion) 35SL	 1 to 4 oz 2 to 7 fl oz 5 to 6 oz 9 to 10.5 fl oz	12 hrs	 1 21	Do not combine foliar applications with soil applications, or vice versa. Use only 1 application method.
	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
	thiamethoxam, MOA 4A (Actara) 25WDG	 3 to 5.5 oz	12 hrs	 0	
Leafminer	abamectin, MOA 6 (Agri-Mek) 0.7 SC	 1.75 to 3.5 fl oz	12 hrs	7	
	cyromazine, MOA 17 (Trigard) 75 WP	2.66 oz	12 hrs	0	
	dimethoate 4 EC, MOA 1B	0.5 pt	48 hrs	0	
	spinetoram, MOA 5 (Radiant) 1 SC	6 to 10 fl oz	4 hrs	1	
Pepper maggot	acephate, MOA 1B (Orthene) 97 PE	 0.75 to 1 lb	24 hrs	7	See comments under European corn borer.
	dimethoate 4 EC, MOA 1B	0.5 to 0.67 pt	48 hrs	0	
	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.

Table 5-9. Insect Control for Commercial Vegetables

CROP Insect	Insecticide, Mode of Action Code, and Formulation	Amount of Formulation Per Acre	Restricted Entry Interval (REI)	Pre harvest Interval (PHI) (Days)	Precautions and Remarks
Pepper (continued)					
Pepper weevil	acetamiprid, MOA 4A (Assail) 30 SG	4 oz	12 hrs	7	
	cyclaniliprole, MOA 28 (Harvanta) 50SL	16.4 fl oz	4 hrs	1	
	oxamyl, MOA 1A (Vydate) 2 L	2 to 4 pt	48 hrs	7	
	thiamethoxam, MOA 4A (Actara) 25 WP	3 to 4 oz	12 hrs	0	Do not exceed 8 oz of Actara per acre per season.
	tolfenpyrad, MOA 21A (Torac)	17 to 21 fl oz	12 hrs	1	
	pyrethroid, MOA 3A		12 hrs		See table 5-9B for registered pyrethroids and pre-harvest intervals.
Broad mite	abamectin, MOA 6 (Agri-Mek) 0.7 SC	1.75 to 3.5 fl oz	12 hrs	7	On foliage as needed.
	fenazaquin, MOA 21A (Magister) SC	24 to 36 fl oz	12 hrs	3	Do not make more than one application per season.
	fenpyroximate MOA 21 (Portal) 0.4EC	2 pt	12 hrs	3	Do not make more than 2 applications per season.
	spiromesifen, MOA 23 (Oberon) 2 SG	7 to 8.5 fl oz	12 hrs	7	Do not exceed 3 applications per season.
	spirotetramat MOA 23 (Movento) 2 SC	4 to 5 fl oz	12 hrs	1	
	tolfenpyrad, MOA 21A (Torac)	17 to 21 fl oz	12 hrs	1	
Thrips	dinotefuran, MOA 4A Soil treatment (Venom) 70 SG (Scorpion) 35SL	5 to 6 oz 9 to 10.5 fl oz	12 hrs	21	See label for application instructions and restrictions.
	cyclaniliprole, MOA 28 (Harvanta) 50SL	16.4 fl oz	4 hrs	1	
	flonicamid, MOA 20D (Beleaf) 50 SG	2 to 4.8 fl oz	12 hrs	0	Is an option for insecticide-resistant western flower thrips. Do not exceed 8.4 oz per acre per season.
	imidacloprid, MOA 4A (Admire Pro) 4.6 F (various) 2 F	7 to 14 fl oz 16 to 32 fl oz	12 hrs	21	See Aphids for application instructions. Treating transplants before setting in the field, followed by drip irrigation may suppress incidence of tomato spotted virus. Imidacloprid is ineffective against western flower thrips.
	methomyl, MOA 1A (Lannate) 2.4 LV	1.5 pt	48 hrs	3	
	spinetoram, MOA 5 (Radiant) 1 SC	6 to 10 fl oz	4 hrs	1	Do not exceed 29 fluid ounces per acre per season. Control of thrips may be improved by adding a spray adjuvant. See label for instructions.
	tolfenpyrad, MOA21A (Torac), 1.29 EC	21 fl oz	12 hrs	1	
Potato, Irish					
Aphid	acetamiprid, MOA 4A (Assail) 30 SG	1.5 to 4 oz	12 hrs	7	Do not make more than 4 applications per season. Thorough coverage is important. Assail belongs to the same class of insecticides (neonicotinoid, 4A) as Admire Pro, Belay, and Platinum (soil insecticides), and Provado and Actara, (foliar insecticides). Some Colorado potato beetle populations have developed resistance to this class.
	clothianidin MOA 4A Belay 2.13	2 to 3 fl oz	12 hrs	7	Apply Belay as foliar spray when populations reach a threshold level. Do not apply more than 3 applications. Belay belongs to the same class of insecticides (neonicotinoid, 4A) as Admire Pro, Provado, Actara, and Platinum and some Colorado potato beetle populations have developed resistance to this class.
	flonicamid, MOA 29 (Beleaf) 50 SG	2 to 2.8 oz	12 hrs	7	
	flupyradifurone, MOA 4D (Sivanto Prime) 1.67	7.0 to 12.0 fl oz	4 hrs	1	
	dimethoate 4 EC, MOA 1B	0.5 to 1 pt	48 hrs	0	Do not apply more than 2 pints total per year.
	imidacloprid, MOA 4A (Admire Pro) 4.6F (various) 1.6 F	1.2 fl oz 3.75 fl oz	12 hrs	7	To minimize selection for resistance in Colorado potato beetle, do not use acetamiprid, imidacloprid, or thiamethoxam for aphid control if either of these compounds was applied to the crop for control of Colorado potato beetle. See comments on insecticide rotation under Colorado potato beetle.
	pymetrozine, MOA 9B (Fulfill) 50 WDG	2.75 oz	12 hrs	14	Allow at least 7 days between applications. Do not exceed a total of 5.5 ounces (0.17 lb a.i.) per acre per season.
	thiamethoxam, MOA 4A (Actara) 25 WDG	3 oz	12 hrs	14	To minimize selection for resistance in Colorado potato beetle, do not use imidacloprid or thiamethoxam for aphid control if either of these compounds was applied to the crop for control of Colorado potato beetle.

Table 5-9. Insect Control for Commercial Vegetables

CROP Insect	Insecticide, Mode of Action Code, and Formulation	Amount of Formulation Per Acre	Restricted Entry Interval (REI)	Pre harvest Interval (PHI) (Days)	Precautions and Remarks
Colorado potato beetle	Colorado potato beetle populations in most commercial potato-growing areas have developed resistance to many insecticides. As a result, insecticides that are effective in some areas, or were effective in the past, may no longer provide control in particular areas. Colorado potato beetle readily develops resistance to insecticides. The following practices help to reduce the risk of resistance developing: CROP ROTATION AND INSECTICIDE ROTATION (the use of insecticides representing different modes of action IRAC MOA class number in different years and against different generations of potato beetle within a year) are essential if insecticide resistance is to be managed and the risks of control failures due to resistance minimized. If control failures or reduced levels of control are observed with a particular insecticide, do NOT make a second application of the same insecticide at the same or higher rate. If an additional insecticide application is necessary, a different insecticide representing a different IRAC MOA class number should be used. Because potato beetle adults will move between adjacent and nearby fields from one year to the next, it is important to maintain the same rotation schedule of insecticide MOA classes in adjacent fields and groups of nearby fields. SCOUT FIELDS: All insecticide applications to the potato crop, regardless of the target insect pest, have the potential to increase the resistance of the Colorado potato beetle to insecticides. Unnecessary insecticide applications should be avoided by scouting fields for insect pests and applying insecticides only when potentially damaging insect populations are present. SPOT TREATMENTS: Because overwintered potato beetles invade rotated fields from sources outside the field, potato beetle infestations in rotated fields occur first along field edges early in the season. Limiting insecticide applications to infested portions of the field will provide effective control and reduce costs. Growers are advised to keep accurate records on which insecticides have been applied to their potato crop for control of Colorado potato beetle and on how effective those insecticides were at controlling infestations. This will make choosing an insecticide and maintaining insecticide rotations easier. Monitoring the insecticide resistance status of local populations will also make insecticide selection easier.				
	abamectin, MOA 6 (Agri-Mek) 0.7 SC	1.75 to 3.5 fl oz	12 hrs	14	Apply when adults or small larvae are present but before large larvae appear. Do not exceed 2 applications per season. Apply in at least 20 gallons water per acre.
	acetamiprid, MOA 4A (Assail) 30 SG	1.5 to 4.0 oz	12 hrs	7	Apply when most of the egg masses have hatched and many small but few large larvae are present. An additional application should be used only if defoliation increases. Allow at least 7 days between foliar applications. To minimize selection for resistance, do not use foliar applications of any IRAC MOA class 4A insecticides if any IRAC MOA class 4A insecticides were applied to the crop as soil or seed piece treatments. See comments on insecticide rotation under Colorado potato beetle.
	chlorantraniliprole, MOA 28 (Coragen) 1.67 SC (Vantacor) 5 SC	3.5 to 7.5 oz 1.2 to 2.5 fl oz	4 hrs	14	Do not apply more than 0.2 lb ai ounces chlorantraniliprole per acre per crop season. Treated insects may take several days to die but stop feeding almost immediately after treatment.
	clothianidin MOA 4A (Belay) 2.13	2 to 3 fl oz	12 hrs	7	Apply Belay as foliar spray Apply when adults or small larvae are present but before large larvae appear. Do not apply more than 3 applications. Belay belongs to the same class of insecticides (neonicotinoid) as Admire Pro, Provado, Actara, and Platinum and some Colorado potato beetle populations have developed resistance to this class.
	cyantraniliprole, MOA 28 (Verimark) 1.67SC	6.75 to 13.5 fl oz	4 hrs	NA	Apply in-furrow at planting. Do not apply any other MOA Group 28 insecticide for Colorado potato beetle control following an at-plant application for cyantraniliprole. When applied at 10 to 13.5 fluid ounces per acre will provide control of European corn borer in most years, except possibly in very early planted potatoes.
	dinotefuran, MOA 4A (Venom) 70 SG	1 to 1.5 oz (foliar) 6.5 to 7.5 oz (soil)	12 hrs	7	Soil treatment for preplant, preemergence, or at ground crack application only. To minimize selection for resistance, do not use foliar applications of any IRAC MOA class 4A insecticides if any IRAC MOA class 4A insecticides were applied to the crop as soil or seed piece treatments. See comments on insecticide rotation under Colorado potato beetle.
	imidacloprid seed piece treatment, MOA 4A (Genesis) 240 g/L	0.4 to 0.6 fl oz/100 lb of seed tubers			Resistance has been reported and may reduce efficacy or duration of control. To minimize selection for resistance, do not use foliar applications of any IRAC MOA class 4A insecticides if any of these compounds were applied to the crop as soil or seed piece treatments. See label for specific instructions. For early planted potatoes control may be marginal because of the prolonged time between application and Colorado potato beetle emergence. Limit use to locations where Colorado potato beetles were a problem in the same or adjacent fields during the previous year. Do not apply other IRAC MOA class 4A insecticides to a field if seed pieces were treated with Genesis. See product label for restrictions on rotational crops.
	imidacloprid, MOA 4A Soil treatment (Admire Pro) 4.6 F (various) 2.0 F	0.74 fl oz/ 1,000 ft row	12 hrs	—	Resistance has been reported and may reduce efficacy or duration of control. See comments on insecticide rotation under Colorado potato beetle. Admire Pro applied in-furrow at planting time may provide season-long control. However, for early planted potatoes control may be marginal due to the prolonged time between application and Colorado potato beetle emergence. Use only in potato fields that have a history of potato beetle infestations. If potatoes are rotated to a field adjacent to one planted in potato last year, a barrier treatment may be effective. (See Vegetable IPM Insect Note #45.) Admire Pro may also be applied as a seed treatment. Check label for instructions regarding this use. Check label for restrictions on planting crops following Admire Pro treated potatoes. There have been reports of low levels of resistance to imidacloprid. To minimize selection for resistance, do not use foliar applications of any IRAC MOA class 4A insecticides if any of these compounds were applied to the crop as soil or seed piece treatments. See comments on insecticide rotation under Colorado potato beetle.

Table 5-9. Insect Control for Commercial Vegetables

CROP Insect	Insecticide, Mode of Action Code, and Formulation	Amount of Formulation Per Acre	Restricted Entry Interval (REI)	Pre harvest Interval (PHI) (Days)	Precautions and Remarks
Potato, Irish (continued)					
	Foliar treatment (Admire Pro) 4.6 (various) 1.6 F	 1.3 fl oz 3.75 fl oz	12 hrs	7	Apply when most of the egg masses have hatched and most larvae are small (1/8 to 3/16 in.). An additional application should be made only if defoliation increases. Allow at least 7 days between foliar applications. Do not exceed 5.6 fluid ounces of Admire Pro per field per acre per season. Regardless of formulation, do NOT apply more than a total of 0.31 pound imidacloprid per season. Foliar applications of imidacloprid should not be applied if soil application was used. There have been reports of resistance to imidacloprid. To minimize selection for resistance, do not use foliar applications of any IRAC MOA class 4A insecticides if any of these compounds were applied to the crop as soil or seed piece treatments. See comments on insecticide rotation under Colorado potato beetle.
	imidacloprid cyfluthrin premix, MOA 4A and 3 (Leverage) 2.7 SE	3 to 3.75 fl oz		7	There have been reports of low levels of resistance to imidacloprid. To minimize selection for resistance, do not use foliar applications of any IRAC MOA class 4A insecticides if any of these compounds were applied to the crop as soil or seed piece treatments. See comments on insecticide rotation under Colorado potato beetle. Apply when most of the egg masses have hatched and most larvae are small (1/8 to 3/16 inch). An additional application should be made only if defoliation increases. Leverage will control European corn borer if application coincides with egg hatch and presence of small corn borer larvae. Leverage should not be used in fields treated with Admire Pro.
	novaluron, MOA 15 (Rimon) 0.83 EC	9 to 12 fl oz	12 hrs	14	Novaluron is an insect growth regulator with activity against eggs and larvae. Larvae are killed as they molt to the next stage. Eggs present at the time of application are killed. Adults exposed produce few eggs. Novaluron is most effective if directed against overwintered adults when egg numbers are increasing, and small larvae are just beginning to appear. Do not apply to successive generations of Colorado potato beetle. Do not apply more than 24 fl oz per season.
	spinosad, MOA 5 (Blackhawk) 36WG	1.7 to 3.3 oz		3	Apply when most egg masses have hatched and both small and large larvae are present. Thorough coverage is important. Do not apply more than a total of 0.33 pound a.i. (14.4 ounces of Blackhawk or 21 ounces of Radiant) per crop. Do not apply in consecutive generations of Colorado potato beetle and do not make more than 2 applications per single generation of Colorado potato beetle. Do not make successive applications less than 7 days apart. To minimize the potential for resistance, do NOT use spinosad or spinetoram if either product was applied to a potato crop in the field or an adjacent field within the last year.
	spinetoram, MOA 5 (Radiant) 1 SC	6 to 8 fl oz	4 hrs	7	
	thiamethoxam seed piece treatment, MOA 4A (Cruiser) 5 FS	0.11 to 0.16 fl oz/100 lb			See label for specific instructions. Resistance to neonicotinoid insecticides has been reported and may reduce efficacy or duration of control by thiamethoxam. To minimize selection for resistance, do not use foliar applications of any IRAC MOA class 4A insecticides if any of these compounds were applied to the crop as soil or seed piece treatments. See comments on insecticide rotation under Colorado potato beetle. For early planted potatoes control may be marginal because of the prolonged time between application and Colorado potato beetle emergence. Limit use to locations where Colorado potato beetles were a problem in the same or adjacent fields during the previous year.
	thiamethoxam, MOA 4A (Platinum) 75 SG	1.66 to 2.67 oz	12 hrs	7	Resistance to neonicotinoid insecticides has been reported and may reduce efficacy or duration of control by thiamethoxam. To minimize selection for resistance, do not use foliar applications of any IRAC MOA class 4A insecticides if any of these compounds were applied to the crop as soil or seed piece treatments. See comments on insecticide rotation under Colorado potato beetle. See product label for restrictions on rotational crops. Platinum applied in-furrow at planting time may provide season-long control. For early planted potatoes control may be marginal because of the prolonged time between application and Colorado potato beetle emergence. Limit use to locations where Colorado potato beetles were a problem in the same or adjacent fields in the previous year.
	(Actara) 25 WDG	3 oz	12 hrs	7	Resistance to neonicotinoid insecticides has been reported and may reduce efficacy or duration of control by thiamethoxam. To minimize selection for resistance, do not use foliar applications of any IRAC MOA class 4A insecticides if any of these compounds were applied to the crop as soil or seed piece treatments. See label for rotational restrictions. Actara is applied as foliar spray. Apply when most of the eggs have hatched and most of the larvae are small (1/8 to 3/16 inch). An additional application should be made only if defoliation increases. Allow at least 7 days between applications. Do not make more than 2 applications of Actara per crop per season.

Table 5-9. Insect Control for Commercial Vegetables

CROP Insect	Insecticide, Mode of Action Code, and Formulation	Amount of Formulation Per Acre	Restricted Entry Interval (REI)	Pre harvest Interval (PHI) (Days)	Precautions and Remarks
Potato, Irish (continued)					
Colorado potato beetle (continued)	thiamethoxam, MOA 4A + chlorantraniliprole, MOA 28 Premix (Voliam Flexi)	4 oz		14	Resistance to neonicotinoid insecticides has been reported and may reduce efficacy or duration of control by thiamethoxam. To minimize selection for resistance, do not use foliar applications of any IRAC MOA class 4A insecticides if any of these compounds were applied to the crop as soil or seed piece treatments. See comments on insecticide rotation under Colorado potato beetle. Voliam Flexi is applied as a foliar spray. Apply when most of the eggs have hatched and most of the larvae are small (1/8 to 3/16 inch.). An additional application should be made only if defoliation increases. Allow at least 7 days between applications. Do not exceed 8 ounces of Voliam Flexi. See label for rotational restrictions. Voliam Flexi can be expected to provide control of European corn borer if application is timed correctly. See European corn borer for correct timing.
European corn borer	The Atlantic variety of potato is very tolerant of injury by European corn borer larvae. Consequently, control is not recommended on Atlantic unless more than 30% of the stems are infested. Control on all other varieties is recommended when infestations reach 20% infested stems. Application timing is critical. Scout for eggs and treat when eggs hatch or at the first sign of larvae entering petioles. Several days of cool wet weather will kill larvae and may eliminate the need for insecticide applications. If this occurs, flag additional egg masses and apply insecticide at hatch.				
	pyrethroid, MOA 3A		12 hrs		Apply when threshold is reached (usually during the first half of May). A second application may be needed if the percentage of infested stems increases substantially 7 to 10 days after the first application. Ground applications are usually more effective than aerial applications. See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
	chlorantraniliprole, MOA 28 (Coragen) 1.67 SC (Vantacor) 5 SC	3.5 to 7.5 oz 1.2 to 2.5 fl oz	4 hrs	14	Correct timing of application is important. Apply when threshold is reached (usually during the first half of May) Do not apply more than 0.2 lb ai/acre chlorantraniliprole containing products per crop season.
	thiamethoxam, MOA 4A chlorantraniliprole MOA 28 Premix (Voliam Flexi)	4 oz	12 hrs	14	Voliam Flexi is applied as a foliar spray. Correct timing of application is important for control of European corn borer. Apply when threshold is reached (usually during the first half of May). Voliam Flexi can also be expected to provide control of if most of the potato beetle eggs have hatched and most of the larvae are small (1/8 to 3/16 inch). Voliam Flexi applications targeting European corn borer will select for resistance to neonicotinoid insecticides in, if present. To minimize selection for resistance to Colorado potato beetle, do not use foliar applications of any IRAC MOA class 4A insecticides if any of these compounds were applied to the crop as soil or seed piece treatments. Do not exceed 8 ounces of Voliam Flexi. See label for rotational restrictions.
	indoxacarb, MOA 22B (Avaunt eVo) 30 WDG	3.5 to 6.0 oz	12 hrs	7	Apply when threshold is reached (usually during the first half of May). A second application may be needed if the percentage of infested stems increases substantially 7 to 10 days after the first application. Ground applications are usually more effective than aerial applications. Do not apply more than 24 ounces of Avaunt eVo per acre per crop.
	spinetoram, MOA 5 (Radiant) 1 SC	6 to 8 fl oz	4 hrs	7	Do not apply more than a total of 0.25 pound a.i. (32 fluid ounces product) per crop.
Flea beetle	imidacloprid, MOA 4A Soil treatment (Admire Pro) 4.6 F (various) 2.0 F	0.74 fl oz/ 1,000 ft row	12 hrs	—	If imidacloprid- or thiamethoxam-resistant Colorado potato beetles occur in the field, application of imidacloprid to control flea beetles has the potential to further increase resistance levels. Imidacloprid applied in-furrow at planting time may provide season-long control of flea beetles. However, for early planted potatoes control may be marginal due to the prolonged time between application and crop emergence. Check label for restrictions on planting crops following Admire Pro treated potatoes.
	Foliar treatment (Admire Pro) 4.6 (various) 1.6 F	1.3 fl oz 3.75 fl oz	12 hrs	7	See comments for imidacloprid resistance in Colorado potato beetle.
	thiamethoxam seed piece treatment, MOA 4A (Cruiser) 5 FS	0.11 to 0.16 fl oz/100 lb	12 hrs		See label for specific instructions. For early planted potatoes control may be marginal because of the prolonged time between application and flea beetle emergence. Limit use to locations where Colorado potato beetles were not a problem in the same or adjacent fields during the previous year. To minimize selection for resistance, do not use foliar applications of any IRAC MOA class 4A insecticides if any of these compounds were applied to the crop as soil or seed piece treatments. See comments on insecticide rotation under Colorado potato beetle.
	thiamethoxam, MOA 4A (Platinum) 2 SC	5 to 8 fl oz	12 hrs	7	Platinum applied in-furrow at planting time may provide season-long control. However, for early planted potatoes control may be marginal due to the prolonged time between application and crop emergence. Limit use to locations where Colorado potato beetles were not a problem in the same or adjacent fields during the previous year. See product label for restrictions on rotational crops. See comments for imidacloprid resistance in Colorado potato beetle.
	(Actara) 25 WDG	3 oz	12 hrs	7	Actara is applied as foliar spray. See comments for imidacloprid resistance in Colorado potato beetle.

Table 5-9. Insect Control for Commercial Vegetables

CROP Insect	Insecticide, Mode of Action Code, and Formulation	Amount of Formulation Per Acre	Restricted Entry Interval (REI)	Pre harvest Interval (PHI) (Days)	Precautions and Remarks
Potato, Irish (continued)					
Flea beetle (continued)	thiamethoxam MOA 4A chlorantraniliprole moa 28 (Voliam Flexi)	4 fl oz		14	Do not exceed a total of 8.0 fluid ounces per acre Voliam Flexi or 0.094 lb ai/acre of thiamethoxam-containing products or 0.2 pound ai/acre of chlorantraniliprole-containing products per growing season. If Colorado potato beetles occur in the field, application of Voliam Flexi to control flea beetles has the potential to increase resistance levels. See comments for imidacloprid resistance in Colorado potato beetle.
	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
Leafhopper	carbaryl, MOA 1A (Sevin) 50 WP (Sevin) 80 S (Sevin) XLR Plus	1 to 2 lb 0.625 to 1.25 lb 1 pt	12 hrs	7	On foliage when leafhoppers first appear. Repeat every 10 days as needed. Often a problem in the mountains.
	dimethoate, MOA 1B various – check label for rate, PHI and REI				
	imidacloprid cyfluthrin premix, MOA 4A and 3 (Leverage) 2.7 SE (Leverage) 360	3 to 3.80 fl oz 2.8 fl oz	7	7	There have been reports of low levels of resistance to imidacloprid. To minimize selection for resistance, do not use foliar applications of any IRAC MOA class 4A insecticides if any of these compounds were applied to the crop as soil or seed piece treatments. See comments on insecticide rotation under Colorado potato beetle. Leverage should not be used in fields treated with Admire Pro.
	methomyl, MOA 1A (Lannate) 2.4 LV	1.5 pt	48 hrs	6	
	pyrethroid, MOA				See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
Leafminer	dimethoate 4 EC, MOA 1B various – check k label for rate, PHI and REI				
	chlorantraniliprole, MOA 28 (Coragen) 1.67 SC (Vantacor) 5 SC	3.5 to 7.5 fl oz 1.2 to 2.5 fl oz	4 hrs	14	Foliar or drip chemigation. Drip chemigation must be applied uniformly to the root zone. See label for instructions.
Blister beetle, Leaffooted bug, Plant bug, Stink bug, Vegetable weevil	carbaryl, MOA 1A (Sevin) 50 WP (Sevin) XLR Plus	2 to 4 lb 1 to 2 qt	12 hrs	7	On foliage as needed.
	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
Potato tuberworm	Prevent late-season injury by keeping potatoes covered with soil to prevent damage in storage.				
	chlorantraniliprole, MOA 28 (Coragen) 1.67 SC (Vantacor) 5 SC	3.5 to 7.5 fl oz 1.2 to 2.5 fl oz	4 hrs	14	Do not exceed 4 applications per acre per crop. Do not apply more than 0.2 lb ai/acre chlorantraniliprole containing products per acre per calendar year. Minimum interval between applications is 5 days. Performance is improved if applied via overhead chemigation (see label).
	Cyantraniliprole, MOA 28	7 to 13.5 fl oz	12 hrs	12	Apply as foliar spray. Do not apply more than 0.4 lb ai/acre (including seed treatments) of cyantraniliprole containing products per calendar year. Methylated seed oil (MSO) adjuvant at 1 gal100 gal spray volume (1%v/v) improves control by foliar sprays. Performance is improved if applied via overhead chemigation (see label). Do not apply more than 0.4 lb ai/ acre (including seed treatments) of cyantraniliprole containing products per calendar year.
	methomyl, MOA 1A (Lannate) 2.4 LV	1.5 to 3 pt	48 hrs	6	
	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
Thrips	dimethoate 4 EC, MOA 1B	0.5 pt	48 hrs	0	
	spinetoram, MOA 5 (Radiant) 1 SC	6 to 8 fl oz	4 hrs	7	
	spinosad, MOA 5 (Blackhawk) 36WG	2.25 to 3.5 oz	4 hrs	3	Control may be improved by addition of an adjuvant to the spray mixture.
Wireworm	Planting in fields previously in corn, soybean, or fallow may increase risk of wireworm.				
	bifenthrin, MOA 3A (Capture LFR)	25.5 fl oz			In-furrow at planting.
	clothianidin (Belay) 2.13	12 fl oz	12 hrs		In-furrow at planting.
	ethoprop, MOA 1B (Mocap) 15 G	1.4 lb per 1,000 row ft	48 hrs	90	In-furrow at planting.
	fipronil, MOA 2B (Regent) 4 SC	3.2 fl oz	0 hrs	90	In-furrow at planting. Do NOT use T-banding over the top of a closed furrow.
	phorate, MOA 1B (Thimet) 20 G	Row Treatment: 10 to 20 oz (38 in. row spacing)	12 hrs	90	Can contribute to insecticide-resistance problems with Colorado potato beetle.

Table 5-9. Insect Control for Commercial Vegetables

CROP Insect	Insecticide, Mode of Action Code, and Formulation	Amount of Formulation Per Acre	Restricted Entry Interval (REI)	Pre harvest Interval (PHI) (Days)	Precautions and Remarks
Pumpkin, Squash (see Cucurbit Crops)					
Radish					
Aphid, Flea beetle	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
	flupyradifurone, MOA 4D (Sivanto Prime) 1.67	7.0 to 14 fl oz	4 hrs	7	Will not control flea beetle or leafminer.
	Foliar treatment - imidacloprid (Admire Pro) 4.6 F (various) 2 F	 1.2 fl oz 2.8 fl oz	12 hrs	 7	Will not control leafminer. Do not exceed 1.2 fl oz (4.6F) or 2.8 f. oz (2F) per acre per season.
	flonicamid, MOA 29 (Beleaf) 50 SG	2 to 2.8 oz	12 hrs	3	Will not control flea beetle or leafminer.
	thiamethoxam, MOA 4A (Platinum) 75 SG (Actara) 25 WDG	 1.7 to 2.17 oz 1.5 to 3 oz	12 hrs	 NA 7	See label for soil application instructions.
Root maggot, Wireworm	chlorpyrifos, MOA 1B (Lorsban) 4E	1 fl oz/1,000 linear ft	24 hrs	—	Water-based drench in-furrow planting. Use a minimum of 40 gal of water per acre. Do not exceed 5.5 pts per acre per season.
	diazinon, MOA 1B (AG 500) 50 WP	 2 to 4 qt 4 to 8 lb	3 days		Broadcast just before planting and immediately incorporate into the upper 4 to 8 inches of soil. Do not exceed 4 qt (AG500) or 8 lb (50WP) per acre per season.
Spinach					
Aphid	acetamiprid, MOA 4A (Assail) 30SG	2 to 4 oz	12 hrs	7	Do not apply more than once every 7 days, and do not exceed 5 applications per calendar year
	afidopyropen, MOA 9D (Versys) DC	1.5 fl oz	12 hrs	0	Do not make more than 2 sequential applications before using a different mode of action.
	clothianidin, MOA 4A (Belay) 50 WDG	4.8 to 6.4 oz (soil) 1.6 to 2.1 oz (foliar)	12 hrs	7	Soil application at planting only. Belay must not be applied during bloom. Do not incorporate an adjuvant with foliar applications. Do not exceed 6.4 oz per acre per season.
	cyantraniliprole, MOA 28 (Verimark) 1,67SC	6.75 to 13.5 fl oz	4 hrs	1	Suppression only. Soil applications made at planting only. See label for application options.
	flonicamid, MOA 29 (Beleaf) 50 SG	2 to 2.8 oz	12 hrs	0	
	flupyradifurone, MOA 4D (Sivanto Prime) 1.67	10.5 to 12.0 fl oz	4 hrs	1	
	imidacloprid, MOA 4A Soil treatment (Admire Pro) 4.6 F (various) 2 F	 4.4 to 10.5 fl oz 10 to 24 fl oz	12 hrs	 21	Do not follow soil applications with foliar applications of any neonicotinoid insecticides. See label for soil application instructions.
	Foliar treatment (Admire Pro) 4.6 F (various) 1.6 F	 1.2 fl oz 3.8 fl oz	12 hrs	 7	
	pymetrozine, MOA 9B (Fulfill) 50 WDG	2.75 oz	12 hrs	7	Apply before aphids reach damaging levels. Use sufficient water to ensure good coverage.
	pyrifluquinazon, MOA 9B (PQZ) 1.87EC	2.4 to 3.2 fl oz	12 hrs	1	See label for rotational crop restrictions. Do not exceed 4.8 fl oz per acre per crop cycle.
	spirotetramat, MOA 23 (Movento) 2 SC	4 to 5 fl oz	24 hrs	3	Do not exceed 10 fluid ounces per season. Requires surfactant.
	thiamethoxam, MOA 4A Soil treatment (Platinum) 75 SG Foliar treatment (Actara) 25 WDG	1.7 to 3.7 oz 1.5 to 3 oz	12 hrs 12 hrs	30 7	See label for soil application instructions.
	tolfenpyrad, MOA 21A (Torac) 1.29 EC	17 to 21 fl oz	12 hrs	1	Do not apply until at least 14 days after plant emergence or after transplanting to allow time for root establishment.
Leafminer	chlorantraniliprole, MOA 28 (Coragen) 1.67 SC	5 to 7.5 fl oz	4 hrs	1	Foliar or drip chemigation. Drip chemigation must be applied uniformly to the root zone. See label for instructions.
	cyantraniliprole, MOA 28 (Verimark) 1.67 SC (Exirel) 0.83 SE	 5 to 13.5 fl oz 7 to 17 fl oz	 4 hrs 12 hrs	 N/A 1	Verimark is for soil application only. Applications made at planting or via drip chemigation. Use higher rates (>10 fluid ounces) where cabbage looper is a concern. See label for application options. Exirel is for foliar application only. Use higher rates (>13.5 fluid ounces) for cabbage loopers. Do not apply more than 0.4 lb ai per acre per year of CYAZYPYR or cyantraniliprole containing products.
	cyclaniliprole, MOA 28 (Harvanta) 50SL	16.4 fl oz	4 hrs	1	
	cyromazine, MOA 17 (Trigard) 75 WP	2.66 oz	12 hrs	7	
	spinetoram, MOA 5 (Radiant) 1 SC	6 to 10 fl oz	4 hrs	1	Spray adjuvants may enhance efficacy against leafminers. See label for information on adjuvants.

Table 5-9. Insect Control for Commercial Vegetables

CROP Insect	Insecticide, Mode of Action Code, and Formulation	Amount of Formulation Per Acre	Restricted Entry Interval (REI)	Pre harvest Interval (PHI) (Days)	Precautions and Remarks
Spinach (continued)					
Armyworm, Beet webworm, Corn earworm, Cutworm, Looper	chlorantraniliprole, MOA 28 (Coragen) 1.67 SC	3.5 to 7.5 fl oz	4 hrs	3	
	emamectin benzoate, MOA 6 (Proclaim) 5 WDG	3.2 to 4.8 oz	12 hrs	7	Do not make more than 2 sequential applications without rotating to another product with a different mode of action. Do not apply more than 14.4 oz per acre per calendar year.
	cyclaniliprole, MOA 28 (Harvanta) 50SL	16.4 fl oz	4 hrs	1	
	emamectin benzoate, MOA 6 (Proclaim) 5 SG	2.4 to 4.8 oz	12 hrs	7	
	indoxacarb, MOA 22B (Avaunt eVo) 30 SG	3.5 oz	12 hrs	3	
	methomyl, MOA 1A (Lannate) 90 SP (Lannate) 2.4 LV	 0.5 to 1 lb 1.5 to 3 pts	48 hrs	7	Air temperature should be well above 32ºF. Do not apply to seedlings less than 3 inches in diameter.
	methoxyfenozide, MOA 18 (Intrepid) 2 F	4 to 10 fl oz	4 hrs	1	Use low rates for early-season applications to young or small plants and 6 to 10 oz for mid- to late-season applications.
	spinetoram, MOA 5 (Radiant) 1 SC	5 to 10 fl oz	4 hrs	1	
	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
Squash (see Cucurbit Crops)					
Sweetpotato					
Aphids, Leafhopper, Whitefly	Aphids, leafhoppers, and whiteflies are rarely a problem.				
	acetamiprid, MOA 4A (Assail) 30SG	1.5 to 4 oz	12 hrs	7	Do not make more than 4 applications per season. Do not apply more frequently than once every 7 days. Use 2.5 to 4 ounces for aphids.
	clothianidin, MOA 4A (Belay) 2.13 SC Soil application Foliar application	 9 to 12 fl oz 2 to 3 fl oz	12 hrs	 21 14	Soil application as an in-furrow or sidedress application. For sidedress applications, immediately cover with soil.
	flonicamid, MOA 29 (Beleaf) 50 SG	2 to 2.8 oz	12 hrs	7	
	flupyradifurone, MOA 4D (Sivanto Prime) 1.67	7.0 to 14.0 fl oz	4 hrs	77	For aphids and leafhopper use 7.0 to 10.5 fluid ounces, for whitefly use 10.5 to 14.0 fluid ounces.
	imidacloprid, MOA 4A (Admire Pro) 4.6 F (various) 1.6 F	Foliar: 1.2 fl oz 3.5 fl oz Soil: 4.4 to 10.5 fl oz	12 hrs	 7 60	Two foliar applications may be needed to control heavy populations. Allow 5 to 7 days between applications. The Admire Pro 24C label includes an in-furrow or side dress application 45 days after planting at 4.4 to 10.5 fl oz/acre.
	pymetrozine, MOA 9B (Fulfill) 50 WDG	2.75 to 5.5 oz	12 hrs	14	
	spirotetramat MOA 23 (Movento) 2 SC	4 to 5 fl oz	24 hrs	7	Will not control leafhopper. Requires surfactant.
	thiamethoxam, MOA 4A (Actara) 25 WDG	3 oz		14	Two applications of Actara may be needed to control heavy populations. Allow 7 to 10 days between applications. Do not exceed a total of 6 ounces of Actara per crop per season.
Armyworm, Looper, Corn earworm, Hornworm	Damaging armyworm and earworm infestations may occur in August or September. If significant infestations are present on foliage during harvest, larvae may feed on exposed roots.				
	chlorantraniliprole, MOA 28 (Coragen) 1.67 SC (Vantacor) 5 SC	 3.5 to 7.5 fl oz 1.2 to 2.5 fl oz	4 hrs	1	
	chlorantraniliprole and lambda-cyfluthrin premix, MOA 28 and 3 (Besiege)	6 to 9 fl oz	24 hrs	14	Treat when a combination of moth pests and cucumber beetles are above threshold.
	methoxyfenozide, MOA 18 (Intrepid) 2 F	6 to 10 fl oz	4 hrs	7	
	novaluron, MOA 15 (Rimon) 0.83 EC	9 to 12 fl oz	12 hrs	14	Do not make more than 2 applications per crop per season.
	spinosad MOA 5 (Blackhawk)	2.25 to 3.5 oz	4 hrs	77	
	spinetoram, MOA 5 (Radiant) 1 SC	6 to 8 fl oz	4 hrs	7	
Cucumber beetle(adults), Japanese beetle (adults), Tortoise beetle	Cucumber beetle larvae (*Diabrotica*) are a serious pest of sweetpotato in LA and MS. Controlling adult cucumber beetles in areas with a history of Diabrotica damage can reduce damage to roots. Foliage feeding by beetles rarely causes economic loss, and control is not warranted unless defoliation is severe. Tortoise beetles are frequently present but rarely reach levels requiring treatment. Treat for tortoise beetles only if significant defoliation is observed.				
	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
	carbaryl, MOA 1A XLR Plus	 2 qt	12 hrs	7	Treat for tortoise beetles only if significant defoliation is observed. Tortoise beetles are frequently present but rarely reach levels requiring treatment.

Table 5-9. Insect Control for Commercial Vegetables

CROP Insect	Insecticide, Mode of Action Code, and Formulation	Amount of Formulation Per Acre	Restricted Entry Interval (REI)	Pre harvest Interval (PHI) (Days)	Precautions and Remarks
Sweetpotato (continued)					
Flea beetle, Wireworm, White grub	bifenthrin, MOA 3A (various) 2 EC Soil application: Foliar application:	 9.6 to 19.2 fl oz 2.1 to 6.4 fl oz		21	Apply as broadcast, preplant application to the soil and incorporate 4 to 6 inches prior to bed formation. This use has been demonstrated to control overwintered wireworm populations and reduce damage to roots at harvest. Post-transplant bifenthrin should be directed onto each side of the bed from the drill to the middle of the furrow and incorporated with cultivating equipment set to throw soil toward the drill. The objective is to provide a barrier of treated soil that covers the bed and furrows. Foliar sprays of various insecticides that target adults to prevent egg laying have not been shown to provide any reduction in damage to roots by wireworm larvae at harvest.
	chlorpyrifos, MOA 1B (Lorsban) 15 G (Lorsban) 4 E (Lorsban Advanced)	 13.5 lb 4 pt 4 pt	24 hrs	125 (60 in NC for Lorsban Advanced only)	
	clothianidin MOA 4A (Belay) 2.13 SL	 12 fl oz	12 hrs		
	imidacloprid MOA 4A (Admire Pro) 4.6SC	10.5 fl oz or 0.75 fl oz per 1,000 ft	3 days	60 days (NC, LA) 125 days elsewhere	
	thiamethoxam (Platinum) 75SG	1.66 to 2.67 oz	12 hrs		
Fruit fly (vinegar fly)	pyrethrins, MOA 3A (Pyrenone)	1 gal/100,000 cu ft	12 hrs	—	Postharvest application in storage. Apply as a space fog with a mechanical or thermal generator. Do not make more than 10 applications.
Sweetpotato weevil	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
	phosmet, MOA 1B (Imidan) 70 W	1.33 lb	5 days	7	
Thrips	spinetoram, MOA 5 (Radiant) 1 SC	6 to 8 fl oz	4 hrs	7	
Whitefringed beetle	phosmet, MOA 1B (Imidan) 70 W	1.33 lb	5 days	7	Do not make more than 5 applications per season. Whitefringed beetle adults are active in July and August. Do not plant in fields with a recent history of whitefringed beetles.
Tomato					
Aphid, Flea beetle	acetamiprid, MOA 4A (Assail) 30 SG	2 to 4 oz	12 hrs	7	Do not apply more than once every 7 days, and do not exceed 5 applications per season.
	Afidopyropen, MOA 9D (Sefina) DC	3	12 hrs	0	Will not control flea beetle. Do not make more than 2 sequential applications before using a different mode of action.
	clothianidin, MOA 4A (Belay) 50 WDG	4.8 to 6.4 oz (soil) 1.6 to 2.1 oz (foliar)	12 hrs	7	Soil applications at planting only.
	cyantraniliprole, MOA 28 (Verimark) 1.67 SC	6.75 to 13.5 fl oz	4	1	Soil applications at planting will control flea beetles and suppress aphids. See label for application options.
	dimethoate 4 EC, MOA 1B	0.5 to 1 pt	48 hrs	7	Do not exceed rate with dimethoate as leaf injury may result.
	flonicamid, MOA 29 (Beleaf) 50 SG	2 to 4.8 oz	12 hrs	0	Will not control flea beetle. Foliar and soil applications are permissible. Soil applications should be made via drip chemigation and within 21 days of transplanting.
	flupyradifurone, MOA 4D (Sivanto Prime) 1.67	7.0 to 144 fl oz	4 hrs	1	Will not control flea beetle.
	imidacloprid, MOA 4A Soil treatment (Admire Pro) 4.6 F (various) 2 F	 7 to 10.5 fl oz 16 to 24 fl oz	12 hrs	21	For short-term protection at planting. Admire Pro may also be applied to transplants in the planthouse not more than 7 days before planting at the rate of 0.44 (4.6 F formulation) or 1 ounce (2 F formulation) per 10,000 plants. See label for soil application instructions.
	Foliar treatment (Admire Pro) 4.6 F (various) 1.6 F	 1.2 fl oz 3.75 fl oz	12 hrs	0	
	pymetrozine, MOA 9B (Fulfill) 50 WDG	2.75 oz	12 hrs	0	For aphids only.
	pyrifluquinazon, MOA 9B (PQZ) 1.87EC	2.4 to 3.2 fl oz	12 hrs	1	See label for rotational crop restrictions. Do not exceed 4.8 fl oz per acre per crop cycle.
	spirotetramat, MOA 23 (Movento) 2SC	4 to 5 fl oz	24 hrs	1	Do not exceed 10 fl oz per season. Requires surfactant.
	thiamethoxam, MOA 4A (Platinum) 75 SG	1.66 to 3.67 oz	12 hrs	30	Platinum may be applied to direct-seeded crops in-furrow seeding or transplant depth, post seeding or transplant as a drench, or through drip irrigation. Do not exceed 11 ounces per acre per season. Check label for plant-back restrictions for a number of crops.
	(Actara) 25 WDG	2 to 3 oz	12 hrs	0	Actara is for foliar applications.
	spinetoram, MOA 5 (Radiant) 1 SC	5 to 10 fl oz	4 hrs	1	

Table 5-9. Insect Control for Commercial Vegetables

CROP Insect	Insecticide, Mode of Action Code, and Formulation	Amount of Formulation Per Acre	Restricted Entry Interval (REI)	Pre harvest Interval (PHI) (Days)	Precautions and Remarks
Tomato (continued)					
Colorado potato beetle	acetamiprid, MOA 4A (Assail) 30 SG	1.5 to 2.5 oz	12 hrs	7	
	chlorantraniliprole, MOA 28 (Coragen) 1.67 SC	3.5 to 7.5 fl oz	4 hrs	1	Foliar or drip chemigation. Drip chemigation must be applied uniformly to the root zone. See label for instructions.
	cyantraniliprole, MOA 28 (Verimark) 1,67 SC (Exirel) 0.83 SE	 5 to 10 fl oz 7 to 13.5 fl oz	 4 hrs 12 hrs	 1 1	Apply Verimark to soil via drip irrigation or soil injection. Exirel is for foliar application.
	Dinotefuran, MOA 4A (Venom) 70SG	5 to 7.5 oz (soil)	12 hrs	21	Soil application only for Colorado potato beetle
	imidacloprid, MOA 4A Soil treatment (Admire Pro) 4.6 F (various) 2 F	 7 to 14 fl oz 16 to 24 fl oz	12 hrs	 21	Use Admire Pro for soil or transplant drench treatment and 1.6 F formulation for foliar applications.
	Foliar treatment (Admire Pro) 4.6 F (various) 2 F	1.3 to 2.2 fl oz 2.5 to 5 fl oz	12 hrs	0	
	spinetoram, MOA 5 (Radiant) 1 SC	5 to 10 fl oz	4 hrs	1	
	thiamethoxam, MOA 4A (Platinum) 75 SG	1.66 to 3.67 oz	12 hrs	30	Platinum may be applied to direct-seeded crops in-furrow seeding or transplant depth, post seeding or transplant as a drench, or through drip irrigation. Do not exceed 11 oz per acre per season of Platinum. Check label for plant-back restrictions for a number of crops.
	(Actara) 25 WDG	2 to 3 oz	12 hrs	0	Actara is for foliar applications.
Armyworm, Cabbage looper, Hornworm, Tomato fruitworm, Pinworm	*Bacillus thuringiensis,* MOA 11A (Dipel) DF (Crymax) WDG	 0.5 to 1 lb 0.5 to 1.5 lb	4 hrs	0	Tomato fruitworm resistance to Bt products has become common in recent years.
	pyrethroid, MOA				See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
	chlorantraniliprole, MOA 28 (Coragen) 1.67 SC	3.5 to 7.5 fl oz	4 hrs	1	Foliar or drip chemigation. Drip chemigation must be applied uniformly to the root zone. See label for instructions.
	cyantraniliprole, MOA 28 (Verimark) 1,67SC (Exirel) 0.83SE	5 to 10 fl oz 7 to 13.5 fl oz	4 hrs 12 hrs	1 1	Verimark is for soil application only. Applications made at planting or via drip chemigation after planting. See label for application options. Exirel is for foliar application only.
	cyclaniliprole, MOA 28 (Harvanta) 50SL	16.4 fl oz	4 hrs	1	
	emamectin benzoate, MOA 6 (Proclaim) 5 WDG	2.4 to 4.8 oz	12 hrs	7	
	indoxacarb, MOA 22B (Avaunt eVo) 30 WDG	3.5 to 6 oz	12 hrs	3	Do not apply more than 24 ounces of Avaunt eVo (0.44 lb a.i.) per acre per crop.
	methomyl, MOA 1A (Lannate) 2.4 LV	1.5 to 3 pt	48 hrs	1	Methomyl may induce leafminer infestation.
	methoxyfenozide, MOA 18 (Intrepid) 2 F	4 to 16 fl oz	4 hrs	1	Use low rates (4 to 8 fl oz) for early-season applications to young or small plants and 8 to 16 ounces for mid- and late-season applications. Intrepid provides suppression of pinworm only.
	novaluron, MOA 15 (Rimon) 0.83 EC	9 to12 fl oz	12 hrs	1	Do not make more than 3 applications per season.
	spinetoram, MOA 5 (Radiant) 1 SC	5 to 10 fl oz	4 hrs	1	
Cutworm	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
Leafminer	abamectin, MOA 6 (Agri-Mek) 0.7 SC	 1.75 to 3.5 fl oz	12 hrs	7	Do not make more than 2 sequential applications.
	chlorantraniliprole, MOA 28 (Coragen) 1.67 SC	5 to 7.5 fl oz	4 hrs	1	Foliar or soil chemigation. Drip chemigation must be applied uniformly to the root zone. See label for soil application instructions.
	cyclaniliprole, MOA 28 (Harvanta) 50SL	16.4 fl oz	4 hrs	1	
	cyromazine, MOA 17 (Trigard) 75 WP	2.66 oz	12 hrs	0	See label for plant-back restrictions.
	spinetoram, MOA 5 (Radiant) 1 SC	6 to 8 fl oz	4 hrs	1	Do not exceed 29 fl oz per acre per season.
Spider mite	abamectin, MOA 6 (Agri-Mek) 0.7 SC	 1.75 to 3.5 fl oz	12 hrs	7	Do not make more than 2 sequential applications.
	acequinocyl, MOA 29 (Kanemite) 15 SC	31 fl oz	12 hrs	1	The use of a surfactant/adjuvant with Kanemite on tomatoes is prohibited.
	bifenazate, MOA 20D (Acramite) 50 WS	0.75 to 1.0 lb	12 hrs	3	Do not make more than 1 application per season.

Table 5-9. Insect Control for Commercial Vegetables

CROP Insect	Insecticide, Mode of Action Code, and Formulation	Amount of Formulation Per Acre	Restricted Entry Interval (REI)	Pre harvest Interval (PHI) (Days)	Precautions and Remarks
Tomato (continued)					
Spider mite (continued)	cyflumetofen, MOA 25 (Nealta) 1.67 SC	13.7 fl oz	12 hrs	3	Do not make more than 1 application before using an effective miticide with a different mode of action.
	fenazaquin, MOA 21A (Magister) 1.7 SC	32 to 36 fl oz	12 hrs	3	Do not make more than 1 application per year.
	fenpyroximate MOA 21 (Portal) 0.4EC	2 pts	12 hrs	11	Do not make more than 2 applications per season.
	spiromesifen, MOA 23 (Oberon) 2 SG	7 to 8.5 fl oz	12 hrs	11	Do not exceed 3 applications per season.
Stink bug	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
	dinotefuran, MOA 4A Foliar treatment (Venom) 70 SG (Scorpion) 35 SL Soil treatment (Venom) 70 SG (Scorpion) 35 SL	 1 to 4 oz 2 to 7 fl oz 5 to 6 oz 9 to 10.5 fl oz	12 hrs	 1 21	Do not combine foliar with soil applications, use only 1 method. Soil applications of Venom or Scorpion may be made in a narrow band under the plant row as a post-transplant drench, as a soil-incorporated sidedress after plants are established, or in drip irrigation water. See label for instructions. Read pollinator protection restrictions on the label.
	thiamethoxam, MOA 4A (Actara) 25 WDG	3 to 5.5 oz	12 hrs	0	Do not exceed 11 ounces Actara per acre per season.
Thrips	dimethoate 4 EC, MOA 1B	0.5 to 1 pt	48 hrs	7	
	cyclaniliprole, MOA 28 (Harvanta) 50SL	10.9 to 16.4 fl oz	4 hrs	1	Harvanta will help suppress western flower thrips when used in a rotational program.
	flonicamid MOA 29 (Beleaf) 50 SG	2.4 to 4.8 fl oz	12 hrs	0	Beleaf has shown good activity against insecticide resistant western flower thrips.
	imidacloprid (Admire Pro) 4.6 SC **For Planthouse treatment of transplants**	0.44 fl oz per 10,000 plants	12 hrs	—	For suppression of TSWV, treat transplants in the planthouse not more than 7 days before planting in the field. Transplants should be treated with overhead irrigation immediately after planting to ensure movement of imidacloprid into the soil media. See label for instructions. Only effective against tobacco thrips.
	methomyl, MOA 1A (Lannate) 2.4 LV	1.5 to 3 pt	48 hrs	1	On foliage as needed.
	novaluron, MOA 15 (Rimon) 0.83 EC	9 to12 fl oz	12 hrs	1	Do not make more than 3 applications per season.
	spinetoram, MOA 5 (Radiant) 1 SC	6 to 10 fl oz	4 hrs	1	Will control thrips on foliage, not in flowers.
	tolfenpyrad, MOA 21A (Torac) 1.29 EC	21 oz	12 hrs	1	Do not make more than 2 applications per crop cycle and allow at least 14 days between applications.
Whitefly	For resistance management of whiteflies, do not follow a foliar application of a neonicotinoid (MOA group 4A) with a soil application of any neonicotinoid. Use only 1 method. Locally resistant populations may affect the performance of specific insecticides.				
	acetamiprid, MOA 4A (Assail) 30 SG	2.5 to 4 oz	12 hrs	7	Do not apply more than once every 7 days, and do not exceed 5 applications per season.
	buprofezin, MOA 16 (Courier) 40 SC	9 to 13.6 fl oz	12 hrs	1	Use sufficient water to ensure good coverage. Do not apply more than twice per crop cycle. Allow 28 days between applications.
	chlorantraniliprole, MOA 28 (Coragen) 1.67 SC	5 to 7.5 fl oz	4 hrs	1	Foliar or soil application. Drip chemigation must be applied uniformly to the root zone. See label for soil application instructions.
	cyantraniliprole, MOA 28 (Verimark) 1.67 SC (Exirel) 0.83 SE	6.75 to 13.5 fl oz 13.5 to 20.5 fl oz	4 hrs 12 hrs	1 1	Apply Verimark at planting or later via drip irrigation or soil injection. See label for application options. Exirel is for foliar application.
	dinotefuran MOA 4A Soil treatment (Venom) 70 SG (Scorpion) 35 SL Foliar treatment (Venom) 70 SG (Scorpion) 35 SL	 5 to 6 oz 9 to 10.5 fl oz 1 to 4 oz 2 to 7 fl oz	12 hrs	 21 1	Soil applications of Venom or Scorpion may be made in a narrow band under the plant row as a post transplant drench, as a soil incorporated sidedress after plants are established, or in drip irrigation water. See label for instructions. See the label for pollinator protection restrictions.
	imidacloprid, MOA 4A (Admire Pro) 4.6 F (various) 2 F	16 to 24 fl oz 7 to 10.5 fl oz	12 hrs	21	Apply through a drip irrigation system or as a transplant drench with sufficient water to reach root zone. As a sidedress, apply 2 to 4 inches to the side of the row and incorporate 1 or more in. Residual activity will increase with increasing rates applied. Use higher rate for late-season or continuous infestations. Trickle irrigation applications will also control aphids and stinkbugs.
	flupyradifurone, MOA 4D (Sivanto Prime) 1.67SL Soil treatment Foliar treatment:	 21 to 28 fl oz 10.5 to 14 fl oz	12 hrs	 45 1	Soil applications may be made through drip irrigation, at planting or post-transplant drench,
	pyriproxyfen, MOA 7C (Knack) 0.86 EC	8 to 10 fl oz	12 hrs	1	Do not apply more than 2 applications per growing season, and do not make applications closer than 14 days.
	pyrifluquinazon, MOA 9B (PQZ) 1.87EC	2.4 to 3.2 fl oz	12 hrs	1	See label for rotational crop restrictions. Do not exceed 4.8 fl oz per acre per crop cycle.

Table 5-9. Insect Control for Commercial Vegetables

CROP Insect	Insecticide, Mode of Action Code, and Formulation	Amount of Formulation Per Acre	Restricted Entry Interval (REI)	Pre harvest Interval (PHI) (Days)	Precautions and Remarks
Tomato (continued)					
Whitefly (continued)	spiromesifen, MOA 23 (Oberon) 2 SC	7 to 8.5 fl oz	12 hrs	11	Do not make more than 3 applications per season.
	spirotetramat, MOA 23 (Movento) 2SC	4 to 5 fl oz	24 hrs	1	Do not exceed 10 fluid ounces per season. Requires surfactant.
	thiamethoxam, MOA 4A (Platinum) 75 SG	1.66 to 3.67 oz	12 hrs	30	Platinum may be applied to direct-seeded crops in-furrow seeding or transplant depth, post seeding or transplant as a drench, or through drip irrigation. Do not exceed 11 ounces per acre per season of Platinum. Check label for plant-back restrictions for a number of crops. Actara is for foliar applications.
	(Actara) 25 WDG	3 to 5.5 oz	12 hrs	0	
Wireworm	diazinon, MOA 1B (Diazinon) AG 500 or 50 WP	2 to 4 qt	48 hrs	—	Broadcast before planting and incorporate. Wireworms may be a problem in fields previously in pasture, corn, or soybean.
Turnip					
Aphid, Flea beetle	afidopyropen, MOA 9D (Versys) DC	1.5 fl oz	12 hrs	0	Do not make more than 2 sequential applications before using a different mode of action.
	clothianidin, MOA 4A (Belay) 50 WDG	4.8 to 6.4 oz (soil) 1.6 to 2.1 oz (foliar)	12 hrs	NA 7	Soil application as in in-furrow, sidedress application, seed or transplant drench, or chemigation. See label for application instructions.
	cyantraniliprole, MOA 28 (Verimark) 1,67 SC	7 to 14 fl oz	4 hrs	4	Verimark is for greens only, not root turnips. Verimark is for soil application only. Applications can be made at planting or later via drip chemigation. See label for application options.
	dimethoate 4 EC, MOA 1B	0.5 pt	48 hrs	14	
	flonicamid, MOA 29 (Beleaf) 50 SG	2 to 2.8 oz	12 hrs	0	Will not control flea beetle, for aphids only.
	flupyradifurone, MOA 4D (Sivanto Prime) 1.67	7.0 to 10.5 fl oz	4 hrs	7	Will not control flea beetle.
	imidacloprid, MOA 4A Soil treatment (Admire Pro) 4.6 F (various) 2 F	4.4 to 10.5 fl oz 10 to 24 fl oz	12 hrs	21	See label for soil application instructions. Do not exceed 10.5 fl oz of Admire Pro per acre per season for soil application.
	Foliar treatment (Admire Pro) 4.6 F (various) 1.6 F	1.2 fl oz 2.8 fl oz	12 hrs	7	Do not exceed 3.7 fl oz of Admire Pro per acre per season for foliar application.
	pymetrozine, MOA 9B (Fulfill) 50 WDG	2.75 oz	12 hrs	7	Will not control flea beetle, for aphids only. Do not exceed 5.5 oz per acre per season.
	pyrifluquinazon, MOA 9B (PQZ) 1.87EC	2.4 to 3.2 fl oz	12 hrs	1	See label for rotational crop restrictions. Do not exceed 4.8 fl oz per acre per crop cycle.
	thiamethoxam, MOA 4A (Platinum) 75 SG	1.7 to 4.01 oz	12 hrs	Apply at	Platinum is for soil application and Actara for foliar application.
	(Actara) 25 WDG	1.5 to 3 oz	12 hrs	7	
Harlequin bug, Vegetable weevil, Yellow-margined leaf beetle	clothianidin, MOA 4A (Belay) 50 WDG	4.8 to 6.0 oz (soil) 1.6 to 2.1 oz (foliar)	12 hrs	21	Soil application as in in-furrow, side dress application, seed or transplant drench, or chemigation. See label for application instructions.
	imidacloprid, MOA 4A Soil treatment (Admire Pro) 4.6 F (Various) 2 F Foliar treatment (Admire Pro) 4.6 F (Various) 2 F	4.4 to 10.5 fl oz 10 to 24 fl oz 1.2 fl oz 2.8 fl oz	12 hrs	21 7	Soil applications of imidacloprid will not control harlequin bug past 20 days after application.
	thiamethoxam, MOA 4A (Platinum) 75 SG (Actara) 25 WDG	1.7 to 4.0 oz 1.5 to 3 oz	12 hrs	Apply at plant 7	Platinum is for soil application and Actara for foliar application. .
	pyrethroid, MOA 3A		12 hrs		See table 5-9B for a list of registered pyrethroids and pre-harvest intervals.
	spinetoram, MOA 5 (Radiant) 1 SC	5 to 10 fl oz	4 hrs	3	For yellowmargined leaf beetle only.
Cabbage looper, Diamondback moth	Insecticide-resistant diamondback moth populations, widespread in the Southeast, may not be controlled with some registered insecticides. To manage resistance, avoid transplants from GA and FL, where resistance is common, and avoid the repeated use of the same materials for extended periods of time. Repeated use of pyrethroid insecticides often aggravates diamondback moth problems. Do not allow populations to increase to large densities before treatments are initiated.				
	Bacillus thuringiensis, MOA 11A (Crymax) WDG (Dipel) DF (Xentari) DF	0.5 to 1.5 lb 0.5 to 1.5 lb 0.5 to 1.5 lb	4 hrs	0	On foliage, every 7 days as needed.
	chlorantraniliprole, MOA 28 (Coragen) 1.67 SC (Vantacor) 5 SC	3.5 to 7.55 fl oz	4 hrs	1	For turnip greens or root turnips.
	cyantraniliprole, MOA 28 (Verimark) 1,67 SC (Exirel) 0.83 SE	5 to 10 fl oz 7 to 17 fl oz	4 hrs 12 hrs	1 1	Verimark and Exirel are for greens only, not root turnips. Verimark is for soil application only. Applications made at planting or later via drip chemigation. See label for application options. Exirel is for foliar application only.

Table 5-9. Insect Control for Commercial Vegetables

CROP Insect	Insecticide, Mode of Action Code, and Formulation	Amount of Formulation Per Acre	Restricted Entry Interval (REI)	Pre harvest Interval (PHI) (Days)	Precautions and Remarks
Turnip (continued)					
Cabbage looper, Diamondback moth (continued)	cyclaniliprole, MOA 28 (Harvanta) 50 SL	10.9 to 16.4 fl oz	4 hrs	1	Harvanta is for foliar application only.
	emamectin benzoate, MOA 6 (Proclaim) 5 WDG	2.4 to 4.8 oz	12 hrs	14	Proclaim is for turnip greens only. Do not apply more than 2 sequential applications.
	indoxacarb, MOA 22B (Avaunt eVo) 30 WDG	2.5 to 3.5 oz	12 hrs	3	Avaunt eVo may be applied only to turnip greens, not root turnips.
	spinetoram, MOA 5 (Radiant) 1 SC	5 to 10 fl oz	4 hrs	3	
Root maggot	chlorpyrifos, MOA 1B (Lorsban) 4 E (Lorsban) 75 WDG	4.5 pt/A 1.6 to 2.75 oz fl per 1,000 ft row 3 lb 1.1 to 1.8 oz/1000 ft row	24 hrs	30	Rate per acre is for preplant broadcast incorporated application. Rate per 1000 ft row is for at planting or post plant as a 4-inch ban over the row or directed to the base of the plant immediately after planting transplants.
Watermelon (see Cucurbit Crops)					

Relative Effectiveness of Insecticides and Miticides for Insect and Mite Control on Vegetables

J. F. Walgenbach, Entomology and Plant Pathology, and G. G. Kennedy, Entomology Research

Table 5-9A. Relative Effectiveness of Insecticides and Miticides for Insect and Mite Control on Vegetables

Not all insecticides listed are registered on all vegetable crops. Refer to label before applying to a specific crop. Ratings are based on a consensus of vegetable entomologists in the southeastern United States. Table continued on following page.

(E = very effective; G = effective; F = somewhat effective; I = ineffective or insufficient data)

Chemical class (IRAC)	Common name	Example Product	Flea beetle	Colorado potato beetle*	Cucumber beetles	Corn earworm*	European corn borer	Fall armyworm	Cabbage looper	Imported cabbageworm	Diamondback moth*	Squash vine borer
1A	carbaryl	Sevin	E	F	G	F	G	F	F	G	F	F
	methomyl	Lannate	F	I	I	G	G	G	G	G	G	I
	oxamyl	Vydate	F	F	F	I	I	I	I	I	I	I
1B	malathion	Malathion	G	F	G	F	F	F	F	G	F	F
	chlorpyrifos	Lorsban	I	I	I	F	F	F	F	G	F	I
	acephate	Orthene	I	I	I	F	E	G	F	G	I	I
	diazinon	Diazinon	I	I	I	I	I	I	I	I	I	I
	dibrom	Dibrom	G	–	–	–	–	F	G	G	G	–
	dimethoate	Dimethoate	G	I	F	I	I	I	I	I	I	I
3A	permethrin	Pounce	G	F	G	G	G	F	G	E	F	E
	alpha cypermethrin	Fastac	G	F	G	G	G	G	G	E	F	E
	zeta cypermethrin	Mustang Max	E	F	E	G	E	G	G	E	F	E
	cyfluthrin	Tombstone										
	beta cyfluthrin	Baythroid XL	G	F	G	G	G	F	G	E	F	E
	lambda cyhalothrin	Karate	E	F	E	G	E	G	G	E	F	E
	esfenvalerate	Asana XL	G	G	G	G	G	F	G	E	F	G
	gamma cyhalothrin	Proaxis	E	F	E	G	E	G	G	E	F	E
	fenpropathrin	Danitol	G	I	G	G	G	F	F	E	F	G
	bifenthrin	Brigade	E	F	E	G	G	F	F	E	F	E
4A	imidacloprid	Admire	F	G	E	I	I	I	I	I	I	I
	acetamiprid	Assail	G	E	G	I	I	I	I	I	I	F
	clothianidin	Belay	E	E	G	I	I	I	I	I	I	I
	thiamethoxam	Platinum/Actara	E	G	G	I	I	I	I	I	I	I
	dinotefuran	Venom/Scorpion	E	E	G	I	I	I	I	I	I	I
4C	sulfoxaflor	Closer/Transform	I	I	I	I	I	I	I	I	I	I
4D	flupyradifurone	Sivanto Prime	I	I	I	I	I	I	I	I	I	I
5	spinosad	Blackhawk/Entrust	I	E	I	G	G	G	G	E	G	G
	spinetoram	Radiant	I	E	I	G	E	G	G	E	G	G
6	emamectin benzoate	Proclaim	I	I	I	G	G	G	E	E	E	G
	abamectin	AgriMek	I	E	I	I	I	I	I	I	I	I
7C	pyriproxyfen	Knack/Distance	I	I	I	I	I	I	I	I	I	I
9A	pyrifluquinazon	PQZ	I	I	I	I	I	I	I	I	I	I
9B	pymetrozine	Fulfill	I	I	I	I	I	I	I	I	I	I
9D	afidopyropen	Sefina, Versys	I	I	I	I	I	I	I	I	I	I
10B	etoxazole	Zeal	I	I	I	I	I	I	I	I	I	I
11A	Bt	Dipel, various	I	I	I	F	F	F	G	E	G	F
15	novaluron	Rimon	I	E	I	E	E	E	G	E	F	G
16	buprofezin	Courier	I	I	I	I	I	I	I	I	I	I
17	cyromazine	Trigard	I	G	I	I	I	I	I	I	I	I
18	methoxyfenozide	Intrepid	I	I	I	G	G	E	E	E	F	G
20B	acequinocyl	Kanemite	I	I	I	I	I	I	I	I	I	I
20D	bifenazate	Acramite	I	I	I	I	I	I	I	I	I	I
21A	fenazaquin	Magister	I	I	I	I	I	I	I	I	I	I
	fenpyroximate	Portal	I	I	I	I	I	I	I	I	I	I
	tolfenpyrad	Torac	G	I	I	F	F	F	F	G	G	I
22A	indoxacarb	Avaunt	F	G	F	E	G	G	E	E	G	G
23	spiromesifen	Oberon	I	I	I	I	I	I	I	I	I	I
	spirotetramat	Movento	I	I	I	I	I	I	I	I	I	I
25	cyflumetofen	Nealta	I	I	I	I	I	I	I	I	I	I
28	chlorantraniliprole	Coragen/Vantacor	I	E	I	E	E	E	E	E	E	G
	cyantraniliprole	Verimark/Exirel	G	E	I	E	E	E	E	E	E	G
	cyclaniliprole	Harvanta	F	E	I	E	E	G	G	E	E	G
29	flonicamid	Beleaf	I	I	I	I	I	I	I	I	I	I

Table 5-9A. Relative Effectiveness of Insecticides and Miticides for Insect and Mite Control on Vegetables (continued)
Not all insecticides listed are registered on all vegetable crops. Refer to label before applying to a specific crop. Ratings are based on a consensus of vegetable entomologists in the southeastern United States. Table continued on following page.

(E = excellent; G =good; F =fair; I = ineffective or insufficient data)

Chemical class (IRAC)	Common name	Example Product	Beet armyworm*	Stinkbugs/ Harlequin bug	Squash bug	Aphids*	Tobacco thrips	Western Flower Thrips*	Leafminer	Maggots	Whiteflies*	Cutworms	Wireworms	White grubs	Spider mites*	Broad mites
	carbaryl	Sevin	I	I	I	I	F	I	I	I	I	F	I	I	I	I
1A	methomyl	Lannate	F	G	G	F	E	G	F	I	I	I	I	I	I	I
	oxamyl	Vydate	I	F	F	G	G	I	I	I	I	I	I	I	I	I
	malathion	Malathion	I	F	F	F	F	I	I	F	I	F	I	I	I	I
	chlorpyrifos	Lorsban	I	I	I	I	F	I	I	E	I	G	G	G	I	I
1B	acephate	Orthene	I	I	I	G	G	I	F	I	I	G	I	I	I	I
	diazinon	Diazinon	I	I	I	I	I	I	I	G	I	F	G	F	I	I
	dibrom	Dibrom	F	–	–	G	–	–	–	–	–	–	–	–	F	–
	dimethoate	Dimethoate	I	G	F	E	E	G	G	I	I	I	I	I	I	I
	permethrin	Pounce	I	F	G	F	F	I	F	I	I	G	I	I	I	I
	zeta cypermethrin	Mustang Max	I	G	E	F	F	I	F	I	I	E	I	I	I	I
	cyfluthrin	Tombstone xl	I	F	G	F	F	I	F	I	I	G	I	I	I	I
	beta cyfluthrin	Baythroid XL	I	E	E	F	F	I	F	I	I	E	I	I	I	I
3A	lambda cyhalothrin	Karate, Warrior	I	G	E	F	F	I	F	I	I	E	I	I	I	I
	esfenvalerate	Asana XL	I	F	G	F	F	I	F	I	I	G	I	I	I	I
	gamma cyhalothrin	Proaxis	I	E	E	F	F	I	F	I	I	E	I	I	I	I
	fenpropathrin	Danitol	I	E	E	F	F	I	F	I	I	G	I	I	F	I
	bifenthrin	Brigade	I	E	E	F	G	I	F	F	I	E	G	F	F	I
	imidacloprid	Admire	I	F	G	E	G	I	I	G	G	I	F	G	I	I
	acetamiprid	Assail	I	F	F	E	G	I	I	I	E	I	I	I	I	I
4A	clothianidin	Belay	I	G	G	G	I	I	F	G	F	I	F	G	I	I
	thiamethoxam	Platinum/Actara	I	G	G	E	F	I	F	G	E	I	F	F	I	I
	dinotefuran	Venom/Scorpion	I	G	G	F	G	I	F	I	E	I	I	I	I	I
4C	Sulfoxaflor	Closer/Transform	I	F	F	E	F	I	I	I	F	I	I	I	I	I
4D	flupyradifurone	Sivanto Prime	I	I	G	E	I	I	I	I	G	I	I	E	I	I
5	spinosad	Blackhawk/Entrust	G	I	I	I	E	G	E	I	I	F	I	I	I	I
	spinetoram	Radiant	G	I	I	I	E	G	E	I	I	F	I	I	I	I
6	emamectin benzoate	Proclaim	E	I	I	I	I	I	F	I	I	F	I	I	I	I
	abamectin	AgriMek	I	I	I	I	G	F	E	I	I	I	I	I	E	E
7C	pyriproxyfen	Knack/Distance	I	I	I	I	I	I	I	I	E	I	I	I	I	I
9A	pyrifluquinazon	PQZ	I	I	I	E	I	I	I	I	G	I	I	I	I	I
9B	pymetrozine	Fulfill	I	I	I	E	I	I	I	I	F	I	I	I	I	I
9D	afidopyropen	Sefina, Versys	I	I	I	E	I	I	I	I	F	I	I	I	I	I
10B	etoxazole	Zeal	I	I	I	I	I	I	I	I	I	I	I	I	G	I
11A	Bt	Dipel, various	F	I	I	I	I	I	I	I	I	I	I	I	I	I
15	novaluron	Rimon	E	F	F	I	G	F	G	I	G	I	I	I	I	I
16	buprofezin	Courier	I	I	I	I	I	I	I	I	G	I	I	I	I	I
17	cyromazine	Trigard	I	I	I	I	I	I	E	I	I	I	I	I	I	I
18	methoxyfenozide	Intrepid	E	I	I	I	I	I	I	I	I	I	I	I	I	I
20B	acequinocyl	Kanemite	I	I	I	I	I	I	I	I	I	I	I	I	E	E
20D	bifenazate	Acramite	I	I	I	I	I	I	I	I	I	I	I	I	E	I
21A	fenazaquin	Magister	I	I	I	I	I	I	I	I	F	I	I	I	G	G
	fenpyroximate	Portal	I	I	I	I	I	I	I	I	F	I	I	I	G	G
	tolfenpyrad	Torac	F	I	G	G	F	F	I	I	F	I	I	I	I	G
22A	indoxacarb	Avaunt eVo	E	I	I	I	I	I	F	I	I	F	I	I	I	I
23	spiromesifen	Oberon	I	I	I	I	I	I	I	I	F	I	I	I	G	G
	spirotetramat	Movento	I	I	I	E	I	I	I	I	F	I	I	I	I	F
25	cyflumetofen	Nealta	I	I	I	I	I	I	I	I	I	I	I	I	G	I
28	chlorantraniliprole	Coragen/Vantacor	E	I	I	I	F	I	E	I	E	I	I	I	I	I
	cyantraniliprole	Verimark/Exirel	E	I	I	G	G	F	E	G	E	I	I	I	I	I
	cyclaniliprole	Harvanta	E	I	I	I	G	F	E	I	F	I	I	I	I	I
29	flonicamid	Beleaf	I	I	I	E	G	G	I	I	F	I	I	I	I	I

* Denotes that insecticide-resistant populations may occur in some areas and can affect the performance of insecticides.

Table 5-9A. Relative Effectiveness of Insecticides and Miticides for Insect and Mite Control on Vegetables
Not all insecticides listed are registered on all vegetable crops. Refer to label before applying to a specific crop. Ratings are based on a consensus of vegetable entomologists in the southeastern United States. Table continued on following page.
(E = very effective; G = effective; F = somewhat effective; I = ineffective or insufficient data)

Preharvest Intervals for Pyrethroid Insecticides in Vegetable Crops

Table 5-9B. Preharvest Intervals (in Days) for Pyrethroid Insecticides in Vegetable Crops
See Table 5-9A to compare relative efficacy of these products against specific insect pests. Read the pesticide label for specific rates and application instructions.

		Common Name/Example Product (Restricted Entry Interval – REI)										
Type of Vegetable	Vegetable	alpha cypermethrin Fastac (12 hrs)	beta cyfluthrin Baythroid XL (12 hrs)	bifenthrin Brigade (12 hrs)	cypermethrin Various brands (12 hrs)	cyfluthrin Tombstone (12 hrs)	esfenvalerate Asana XL (12 hrs)	fenpropathrin Danitol (24 hrs)	gamma cyhalothrin Proaxis (24 hrs)	lambda cyhalothrin Karate/Warrior (24 hrs)	permethrin Pounce (12 hrs)	zeta cypermethrin Mustang Max (12 hrs)
	Asparagus	NR	NR	NR	NR	NR	NR	NR	NR	NR	1	NR
Bulb Vegetables	**Onions, Green**	NR	NR	NR	7	NR	NR	NR	NR	NR	NR	7
	Onions, Dry Bulb	NR	NR	NR	7	NR	NR	NR	14	14	1	7
Brassica Leafy Vegetables	**Broccoli, Brussels Sprout, Cabbage, Cauliflower, Kohlrabi**	1	0	7	1	0	3	7	1	1	1	1
	Collard, Mustard Green	1	0	7	1	0	7[†]	NR	NR	NR	1[†]	1
Cereal Corn	**Sweet Corn**	3	0	1	NR	0	1	NR	1	1	1	3
Cucurbits	**Cantaloupe, Watermelon**	1	0	3	NR	0	3	7	NR	1	0	1
	Cucumber, Pumpkin, Summer Squash, Winter Squash	1	0	3	NR	0	3	7	NR	1	0	1
Fruiting Vegetables	**Eggplant, Pepper**	1	7	7	NR	0	7	3	5	5	3	1
	Tomato	1	0	1	NR	7	1	3	5	5	0	1
	Okra	1	NR	7	NR	NR	NR	NR	NR	NR	NR	1
Legumes	**Edible-podded**	1	NR	3	NR	NR	3	NR	7	7	NR	1
	Succulent Shelled Pea and Bean	1		3	NR		3	7	7	7	NR	1
	Dried Shelled Pea and Bean	21	7	14	NR	7	21	NR	21	21	NR	21
Leafy Vegetables, Except Brassica	**Head and Leaf Lettuce**	1	0	7	5[A]	0	7[A]	NR	1	1	1	1
	Spinach	1	0	40	NR	0	NR	NR	NR	NR	1	1
	Celery	1	0	NR	NR	0	NR	NR	NR	NR	3	1
Root and Tuber Vegetables	**Beet, Carrot, Radish. Turnip**	1	0	21	NR	0	7	NR	NR	NR	1	1
	Potato	1	0	21	NR	0	NR	NR	NR	7	14	1
	Sweetpotato	1	0	21	NR	0	NR	NR	NR	7	NR	1

NR Not registered
[A] Head lettuce only
[†] Collard only

Insect Control for Greenhouse Vegetables

J. F. Walgenbach and G. G. Kennedy, Entomology and Plant Pathology

Sound cultural practices, such as sanitation and insect-free transplants, help prevent insect establishment and subsequent damage. Separate plant production houses, use of yellow sticky traps, and timely sprays will help prevent whitefly buildup. Use of *Encarsia* parasites for whitefly and other biological control agents in conjunction with use of pesticides is encouraged. Unless a pesticide label specifically states that a product cannot be used in a greenhouse vegetable crop, the product can be used on those crops for which it is registered. However, pesticides behave differently in the field and the greenhouse, and for many products, information is not available on greenhouse crop phytotoxicity and residue retention. If unsure of the safety of a product to a crop, apply to a small area before treating the entire crop.

Table 5-10. Insect Control for Greenhouse Vegetables

CROP Insect	Insecticide and Formulation	Amount of Formulation	Re Entry Interval	Pre Harvest Interval (PHI) (Days)	Precautions and Remarks
Cucumber					
Aphid	flonicamid, MOA 29 (Beleaf) 50SG	0.065 to 0.1 oz per 1000 sq ft	12 hrs	0	May be applied either to the soil as a drench or drip irrigation for preventive control or sprayed onto plants as a rescue treatment.
	flupyradifurone, MOA 4D (Altus) 1.67 SL		12 hrs	1	
	Foliar application	7 to 14 fl oz per 50 gal			Spray crop to wet, not to drip. Thorough, uniform coverage is required for good control. Use higher rates for whiteflies.
	Soil application	1.4 to 1.9 fl oz per 50 gal			Apply as a soil drench using micro-irrigation, drip irrigation, overhead irrigation or hand-held motorized calibrated equipment. Use sufficient volume to wet potting medium without loss of liquid from the bottom of the container. Irrigate carefully during the next 10 days to avoid loss of product due to leaching.
	imidacloprid, MOA 4A (Admire Pro) 4.6 F	0.6 fl oz/1,000 plants	12 hrs	0	Apply in a minimum of 21 gallons water using soil drenches, micro-irrigation, or drip irrigation. Do not apply to immature plants as phytotoxicity may occur. Make only 1 application per crop per season.
	insecticidal soap (M-Pede) 49 EC	1% to 2% soln.	12 hrs	0	
Cabbage looper	*Bacillus thuringiensis,* MOA 11 (various)	0.5 to 1 lb OR 3 pt/100 gal water	4 hrs	—	
	Cyantraniliprole MOA 28 (Exirel) SE	10 to 20.5 fl oz per acre or per 100 gal	12 hrs	0	For best performance, use an effective adjuvant.
	spinosad, MOA 5 (Entrust) SC	3 fl oz/100 gal	4 hrs	1	Do not make more than 2 consecutive applications. OMRI listed.
Spider mite	insecticidal soap (M-Pede) 49 EC	1% to 2% soln.	12 hrs		Use predatory mites.
	mineral oil (TriTek)	1 to 2 gal/100 gal	4 hrs	0	Begin applications when mite populations are low and repeat at weekly intervals.
	acequinocyl, MOA 20B (Kanemite) 15 SC (Shuttle O) 1.25SC	31 fl oz per 43,560 sq ft or per 100 gal water	12 hrs	1	Will control spider mites and broad mites.
	fenpyroximate, MOA 21A (Akari) 5SC	1 to 2 pts per 100 gal	12 hrs	7	
	chlorfenapyr, MOA 13 (Pylon) 2SC	9.8-13 fl oz/100 gal water or per acre area	12 hrs	0	Do not make more than 2 applications at 5- to 10-day intervals before rotating to an insecticide with a different mode of action.
Whitefly, Leafminer	acetamiprid, MOA 4A (Assail) 30 SG	0.1 oz per 1000 sq ft	12 hrs	0	
	Cyantraniliprole MOA 28 (Exirel) SE	13.5 to 20.5 fl oz per acre or per 100 gal	12 hrs	0	For best performance, use an effective adjuvant.
	flonicamid, MOA 20 (Beleaf) 30 SG	0.065 to 0.1 oz per 1000 sq ft	12 hrs	0	
	flupyradifurone, MOA 4D (Altus) 1.67 SL	—	—	1	See rates and application instructions under aphids.
	imidacloprid, MOA 4A (Admire Pro) 4.6 F	0.6 fl oz/1,000 plants	12 hrs	0	Apply in a minimum of 21 gallons water using soil drenches, micro-irrigation, or drip irrigation. Do not apply to immature plants as phytotoxicity may occur. Make only 1 application per crop per season.
	insecticidal soap (M-Pede) 49 EC	1% to 2% soln.	12 hrs	0	May be used alone or in combination. Acts as an exciter.
	Beauveria bassiana (Botanigard) 22 WP (Mycotrol) WP	1 lb/100 gal water 0.25 lb/20 gal water	4 hrs	0	Apply when whiteflies observed. Repeat in 4- to 5-day intervals.
Lettuce					
Aphid, Leafminer, Whitefly	flupyradifurone, MOA 4D (Altus) 1.67 SL		12 hrs	1	
	Foliar application	7 to 14 fl oz per 50 gal			Spray crop to wet, not to drip. Thorough, uniform coverage is required for good control. Use higher rates for whiteflies.
	Soil application	1.4 to 1.9 fl oz per 50 gal			Apply as a soil drench using micro-irrigation, drip irrigation, overhead irrigation or hand-held motorized calibrated equipment. Use sufficient volume to wet potting medium without loss of liquid from the bottom of the container. Irrigate carefully during the next 10 days to avoid loss of product due to leaching.
	pymetrozine, MOA 9B (Fulfill) 50 WG	0.063 oz per 1000 sq ft	12 hrs	0	Will not control leafminer.

Table 5-10. Insect Control for Greenhouse Vegetables

CROP Insect	Insecticide and Formulation	Amount of Formulation	Re Entry Interval	Pre Harvest Interval (PHI) (Days)	Precautions and Remarks
Lettuce (continued)					
Aphid, Leafminer, Whitefly (continued)	pyrethrins, MOA 3A (Pyganic) 5EC	0.25 to 0.5 fl oz per gal water	12 hrs	0	May be used alone, or tank mixed with a companion insecticide (see label for details).
	malathion, MOA 1B (various) 57 EC 25 WP	 1 qt/100 gal water 4 lb/100 gal water	24 hrs	 14 14	Will not control whitefly.
	insecticidal soap (M-Pede) 49 EC	1% to 2% soln.	12 hrs	0	May be used alone or in combination. Acts as an exciter. Insecticidal soaps can cause phytotoxicity under high temperatures or slow drying conditions. If unsure, apply to a small area before treating the entire crop.
	Beauveria bassiana (Mycotrol WP)	0.25 lb/20 gal water	4 hrs	0	Under high aphid or whitefly pressure, apply at 2- to 5-day intervals.
Cabbage looper	*Bacillus thuringiensis,* MOA 11 (Javelin) WG	0.5 to 1.25/100 gal water	4 hrs	0	
	spinosad, MOA 5 Entrust SC	 3 fl oz/100 gal	 4 hrs	 1	Do not make more than 2 consecutive applications.
Slugs	iron phosphate (Sluggo) iron phosphate + spinosad (Bug-N-Sluggo)	0.5 to 1 lb/1,000 sq ft 0.5 to 1 lb/1,000 sq ft	4 hrs 4 hrs	1 1	Scatter the bait around the perimeter of the greenhouse to provide a protective barrier. If slugs are within the crop, then scatter the bait on the ground around the plants. Do not make more than 3 applications within 21 days. Sluggo will control slugs and snails, while Bug-N-Sluggo will also control earwigs, cutworms, sowbugs and pillbugs. Both are OMRI listed.
Spider mite	insecticidal soap (M-Pede) 49 EC	1% to 2% soln.	12 hrs	0	
	mineral oil (TriTek)	1 to 2 gal/100 gal	4 hrs	0	Begin applications when mite populations are low and repeat at weekly intervals.
Tomato, Pepper					
Aphid	flonicamid, MOA 20 (Beleaf) 50 SG	0.1 oz per 1000 sq ft	12 hrs	0	May be applied to the soil as a drench or drip irrigation for preventive control, or as a spray for rescue treatments. Will also control whiteflies.
	Acetamiprid, MOA 4A (Tristar) 8.5 SL	8.5 oz per 100 gal	12 hrs	3	Do not apply more than two times per crop, and do not apply more than once every 7 days.
	flupyradifurone, MOA 4D (Altus) 1.67 SL Foliar application Soil application	 7 to 14 fl oz per 50 gal 1.4 to 1.9 fl oz per 50 gal	12 hrs	1 (tomato) 3 (pepper)	 Spray crop to wet, not to drip. Thorough, uniform coverage is required for good control. Use higher rates for whiteflies. Apply as a soil drench using micro-irrigation, drip irrigation, overhead irrigation or hand-held motorized calibrated equipment. Use sufficient volume to wet potting medium without loss of liquid from the bottom of the container. Irrigate carefully during the next 10 days to avoid loss of product due to leaching.
	imidacloprid, MOA 4A (Admire Pro) 4.6 F	0.6 fl oz/1,000 plants	12 hrs	0	Apply in a minimum of 16 gallons water. Apply only to plants grown in field-type soils, potting media, or mixtures thereof. Do not apply to plants grown in non-soil medias such as perlite, vermiculite, rock wool or other soil-less media, or plants growing hydroponically. Do not apply to peppers. Do not exceed 1 application per crop. Also controls whiteflies.
	malathion, MOA 1B (various) 10 A 57 EC 25 WP	 1 lb/50,000 cu ft 1 qt/100 gal water 4 lb/100 gal water	12 hrs	 15 hrs 1 1	
	insecticidal soap (M-Pede) 49 EC	1% to 2% soln.	12 hrs	0	May be used alone or in combination. Acts as an exciter.
	Beauveria bassiana (Mycotrol WP)	0.25 lb/20 gal water		0	Apply when whiteflies are observed. Repeat in 4-to 5-day intervals.
Armyworm, Fruitworm, Cabbage looper, Cutworm, Pinworm	*Bacillus thuringiensis*, MOA 11 (Javelin) WG (Agree) WP (Dipel) DF Xentari DF	 0.5 lb to 1.25 lb/100 gal water 1 to 2 lb 0.5 to 1.25 0.5 to 1.5	4 hrs	0	
	chlorfenapyr MOA 13 (Pylon) 2SC	6.5 to 13 fl oz/100 gal water or per acre area	12 hrs	0	Do not make more than 2 applications at 5- to 10-day intervals before rotating to an insecticide with a different mode of action.
	cyantraniliprole, MOA 28 (Exirel) SE	7 to 13.5 fl oz per acre, or per 100 gal	12 hrs	1	
	spinosad, MOA 5 Entrust SC	3 fl oz/100 gal	4 hrs	1	Do not make more than 2 consecutive applications. Do not apply to seedling tomatoes or peppers grown for transplants.
Leafminer	cyantraniliprole, MOA 28 (Exirel) SE	13.5 to 20.5 fl oz per acre, or per 100 gal	12 hrs	1	
	Chlorfenapyr, MOA 13 (Pylon) 2SC	9.8 to 13 fl oz/100 gal water or per acre	12 hrs	0	Do not make more than two applications at 5- to 10-day intervals before rotating to a different mode of action.
	spinosad, MOA 5 (Entrust) SC	10 fl oz/100 gal	4 hrs	1	Do not apply to seedlings grown for transplants.
Slug	metaldehyde (various) bait	Follow label directions	12 hrs		Apply to soil surface around plants. Do not contaminate fruit.
	iron phosphate (Sluggo)	½ teaspoon per 9-inch pot		0	

Table 5-10. Insect Control for Greenhouse Vegetables

CROP Insect	Insecticide and Formulation	Amount of Formulation	Re Entry Interval	Pre Harvest Interval (PHI) (Days)	Precautions and Remarks
Tomato, Pepper (continued)					
Spider mite, broad mite, rust mite	acequinocyl, MOA 20B (Kanemite) 15 SC (Shuttle O) 1.25SC	31 fl oz per 43,560 sq ft or per 100 gal`	12 hrs	1	Will control spider mites, russet mites and broad mites.
	bifenazate (Floramite) SC,	4 to 8 fl oz/100 gal water (1/4 to 1/2 tsp/gal)	12 hrs	3	For use on tomatoes more than 1 inch in diameter at maturity. Not registered on pepper. Not for rust mite.
	mineral oil (TriTek)	1 to 2 gal/100 gal		0	Begin applications when mite populations are low and repeat at weekly intervals.
	chlorfenapyr, MOA 13 (Pylon) 2 SC	9.8 to 13 fl oz/100 gal water or per acre area		0	Do not make more than 2 applications at 5- to 10-day intervals before rotating to an insecticide with a different mode of action.
	cyflumetofen, MOA 25 (Sultan) 1.67SC	13.7 fl oz/100 gal	12 hrs	1	Do not make more than 2 applications.
	fenpyroximate, MOA 21A (Akari) 5 SC	1 to 2 pts per 100 gal	12 hrs	1	
	insecticidal soap (M-Pede) 49 EC	1% to 2% soln.	12 hrs	0	
Thrips, including western flower	*Beauveria bassiana* (Mycotrol WP)	0.25 lb/20 gal water		0	Use screens on intake vents. Apply when whiteflies observed. Repeat in 4- to 5-day intervals.
	chlorfenapyr, MOA 13 (Pylon) 2SC	9.8 to 13 fl oz/100 gal water or per acre area		0	For use on tomatoes more than1 inch in diameter at maturity. Do not make more than 2 applications at 5- to 10-day intervals before rotating to an insecticide with a different mode of action.
	cyantraniliprole, MOA 28 (Exirel) SE	13.5 to 20.5 fl oz per acre, or per 100 gal	12 hrs	1	For foliage-feeding thrips only, not those in flowers.
	flonicamid, MOA 29 (Beleaf) 50 SG	0.1 oz per 1,000 sq ft	12 hrs	0	For use on tomato only.
	spinosad, MOA 5 (Entrust) SC	5.5 fl oz/100 gal	4 hrs	1	Do not make more than 2 consecutive applications, and do not apply more than 6 times in a 12-month period against thrips. Do not apply to seedlings grown for transplants.
Whitefly	*Beauveria bassiana* (BotaniGard) 22 WP (Mycotrol) WP	1 lb/100 gal water 0.25 lb/20 gal water	4 hrs	0	Apply when whiteflies are observed. Repeat in 4- to 5-day intervals.
	buprofezin, MOA 16 (Talus) 40 SC	9 to 13.6 oz/100 gal water or per acre area	12 hrs	1	Insect growth regulator that affects immature stages of whiteflies. Will not kill adults. For use on tomato only.
	cyantraniliprole, MOA 28 (Exirel) 0.83 SE	13.5 to 20.5 fl oz/100 gal water or per acre area	12 hrs	1	
	flonicamid, MOA 29 (Beleaf) 50 SG	0.1 oz per 1,000 sq ft	12 hrs	0	For use on tomato only.
	Flupyradifurone, MOA 4D (Altus) 1.67 SL	—	—	1 (tomato) 3 (pepper)	See rates and application instructions under aphids.
	imidacloprid, MOA 4A (Admire Pro) 4.6 F	0.6 fl oz/1,000 plants	12 hrs	0	Apply in a minimum of 16 gallons water. Apply only to plants grown in field-type soils, potting media, or mixtures thereof. Do not apply to plants grown in non-soil medias such as perlite, vermiculite, rock wool or other soil-less media, or plants growing hydroponically. Do not apply to peppers. Do not exceed 1 application per crop. Also controls aphids.
	acetamiprid, MOA 4A (Tristar) 8.5 SL	1.25 fl oz/1000 plants	12 hrs	1	Apply only to plants growing in rock wool, perlite or other soil-less growing media. Do not apply to crops that have already been treated with imidacloprid, dinotefuran, or another neonicotinoid.
	insecticidal soap (M-Pede) 49 EC	1% to 2% soln.	12 hrs	0	
	pyrethrins and PBO, MOA 3A (Pyganic) 5 EC	0.25 to 0.5 fl oz per gal	12 hrs	0	May be used alone, or tank mixed with a companion insecticide. (See label for details.)
	pyriproxyfen, MOA 7C (Distance) 0.86 EC	6 fl oz/100 gal water	12 hrs	<1	Do not use on tomatoes less than 1 inch in diameter. Insect growth regulator that affects immature stages of whiteflies. Will not kill adults. Do not use on tomatoes more than 1 inch in diameter. Do not apply on non-bell pepper.

Insect Control for Livestock and Poultry

W. Watson, Entomology and Plant Pathology

Table 5-11A. Insect Control for Cattle

Insect	Insecticide and Formulation	Amount of Formulation to Use in Water	Dosage per Animal	Minimum Interval (Days) Between Application and Harvest	Precautions and Remarks
Cattle Grub—(a) Beef and non-lactating dairy animals					Make all grub treatments after heel fly season ends but before Oct. 1.
	doramectin (Dectomax) injectable	—	1 cc/110 lb	35	Not for female dairy cattle over 20 months of age.
	ivermectin injectable pour-on	 — —	 1 cc/110 lb 1 ml/22 lb	 49 48	Not for female dairy cattle of breeding age. For calves older than 12 weeks of age.
	moxidectin (Cydectin) 0.5 PO	—	5 ml/110 lb	0	Not for use on lactating dairy cattle.
Cattle Grub—(b) Dairy animals (also beef and non-lactating dairy animals)	eprinomectin (Eprinex) pour-on	—	1 ml/22 lb	0	
Horn fly—non-lactating dairy animals	abamectin Aim-A Capsule		1 capsule (600 lb)	42	Smart Vet applicator required
Horn Fly—(a) Dairy and beef animals	coumaphos (CoRal) 1 D	—	3 to 6 tbsp	0	Repeat as necessary.
	cyfluthrin (CyLence) 1 PO	—	8ml/400 to 800 lb	0	Follow label instructions.
	cypermethrin D	Dust bag			Forced use
	diflubenzuron oral larvicide (ClariFly)	—	—	—	In feed according to label.
	eprinomectin (Eprinex) pour-on	—	1 ml/22 lb	0	Effective control for 7 days only.
	methoprene (Altocid) liquid	—	5 lb/ton of feed	—	Mixed into liquid feed.
	methoprene mineral mix	—	—	0	Daily in feed according to label.
	moxidectin (Cydectin) 0.5 PO	—	5 ml/100 lb	0	Not for use on lactating dairy cattle.
	permethrin EC or PO	—	—	0	See label for rate and application directions.
	permethrin + diflubenzuron	—	3 ml/110 lb		See label for rate and application directions.
	pyrethrins 0.1 OS + synergist	—	1 to 2 oz	0	Oil sprays will harm skin if not applied properly. Apply oil solutions daily as a mist.
	pyrethrin (Pyganic) 1.4 EC		5 to 14oz/gal	0	Organic.
	tetrachlorvinphos (Rabon) 7.76 oral larvicide	 — —	 70mg/100 lb body wt.	— 	 Daily in feed according to label.
	SELF-APPLICATING DEVICES coumaphos (Co-Ral) permethrin tetrachlorvinphos + dichlorvos (RaVap) 23 EC	 — 5 oz/1 gal oil	 4 qts/13 gal — —	 0	For dairy and beef animals. These devices aid in face fly and louse control. Follow all label instructions. Inspect and charge oilers and dust bags weekly as needed.
	EAR TAGS abamectin (XP820) coumaphos + diazinon (Corathon) cyfluthrin (CyLence Ultra) cypermethrin (Python, Magnum) diazinon (40%) (Patriot, Max 40) diazinon (20%) (Optimizer) lambda-cyhalothrin (Saber) permethrin (GardStar) pirimiphos-methyl (Dominator) zetacypermethrin + abamectin + PBO (Tri-Zap)	—	2/head for optimal control		These devices give season-long fly control. Some tags are not for use on lactating dairy cattle. Some tags are restricted from use on calves under the age of 3 months. Use according to label. Other ear tags are available. Contact Entomology Department, N.C. State University, for current tag list.
Horn Fly—(b) Beef animals	lambda-cyhalothrin Aim-L Capsule abamectin Aim-A Capsule		1 capsule (600 lb) 1 capsule (600 lb)	0 42	Smart Vet applicator required Smart Vet applicator required
	gamma cyhalothrin (Prozap StandGuard) pour-on		10 ml < 600 lb 15 ml > 600 lb		Do not apply more than once in 2 weeks or more than 4 times in 6 months.
	Ivermectin PO	—	1 ml/22 lb	48	Not for female dairy cattle of breeding age. Controls horn flies for up to 28 days.
	tetrachlorvinphos (Rabon) 50 WP	5 oz/5 gal	2 to 4 qt	0	
	SELF-APPLICATING DEVICES tetrachlorvinphos + dichlorvos (RaVap) 23 EC	5 oz/1 gal oil	—	0	For beef only. These devices aid in face fly and louse control.
Lice—(a) Dairy and beef animals	coumaphos (CoRal) 1 D	—	3 to 6 Tbsp		
	coumaphos spray 6.15%	2.5 oz/4 gal	— —	0	Spray thoroughly—wet to skin.
	cyfluthrin (CyLence) 1 PO	—	—	—	Follow label instructions.
	eprinomectin (Eprinex) pour-on	—	1 ml/22 lb	0	Follow label instructions.
	Permethrin EC PO permethrin plus diflubenzuron (Cleanup II Pour on)	See label	 — —	0	Follow label instructions. Spray entire animal, second treatment at 14 to 21 days. Pyrethroid and IGR blend to control all louse life stages. Follow label instructions.
	Pyrethrin + PBO (ULDBP-100)		2 oz/animal		Wet to the skin. Repeat 2 to 3 weeks.

Table 5-11A. Insect Control for Cattle

Insect	Insecticide and Formulation	Amount of Formulation to Use in Water	Dosage per Animal	Minimum Interval (Days) Between Application and Harvest	Precautions and Remarks
Lice—(b) Beef animals	gamma cyhalothrin (Prozap StandGuard) pour-on		10 ml < 600 lb 15 ml > 600 lb		Do not apply more than once in 2 weeks or more than 4 times in 6 months.
	coumaphos 6.15%	 5 oz/4 gal	 —	 0	Spray—wet to skin.
	cypermethrin D	Dust bag			Forced use
	doramectin (Dectomax) injectable pour-on		1ml/110lb 500 mcg/Kg	35 45	Follow label instructions. Not for dairy cattle 20 months or older.
	ivermectin injectable pour-on	 — —	 1 cc/110 lb 1 ml/22 lb	 49 48	Not for female dairy cattle of breeding age. Injection ineffective for control of biting lice. Pour-on controls both biting and sucking lice.
	lambda-cyhalothrin (Saber) 1 PO	—	—	0	Follow label instructions.
	lambda-cyhalothrin Aim-L Capsule	2nd application needed	1 capsule (600 lb)	0	Smart Vet applicator required
	moxidectin (Cydectin) 0.5 PO	—	5 ml/110 lb	0	Not for lactating dairy cattle.
	tetrachlorvinphos (Rabon) 50 WP	5 oz/5 gal	2 to 4 oz	0	Spray thoroughly.
	tetrachlorvinphos + dichlorvos (RaVap) 23 EC	See label	—	0	Do not treat more often than every 10 days. Spray entire animal.
	Note: Self-applicating devices under horn fly aid in louse control.				
Face Fly	cyfluthrin (CyLence) 1 PO	See label	—	—	Follow label instructions.
	cypermethrin D	Dust bag			Forced use
	diflubenzuron oral larvicide (ClariFly)	—	—	—	In feed according to label.
	permethrin EC PO	 See label See label	 — —	0	Follow label instructions.
	pyrethrin (Pyganic) 1.4 EC		5-14oz/gal	0	Organic.
	diflubenzuron oral larvicide (Clarify)	—	—	—	In feed according to label.
	EAR TAGS abamectin (XP820) coumaphos + diazinon (Corathon) cyfluthrin (CyLence Ultra) cypermethrin (Python, Magnum) diazinon (40%) (Patriot, Max40) diazinon (20%) (Optimizer) lambda-cyhalothrin (Saber) permethrin (GardStar) pirimiphos-methyl (Dominator) cypermethrin + abamectin + PBO (Tri-Zap)		2/head for optimal control	 0 0	These devices give season-long fly control or aid in the control of face flies. Some tags are not for use on lactating dairy cattle. Use according to label. Other ear tags are available. Contact Entomology Department, N.C. State University, for current tag list.
	Note: Self-applicating devices under horn fly aid in face fly control.				
Mange	doramectin (Dectomax) injectable pour-on		1ml/110lb 500 mcg/Kg	35 45	Follow label instructions. Not for dairy cattle 20 months or older
	eprinomectin (Eprinex) pour-on	—	1 ml/22 lb	0	Follow label instructions.
	ivermectin injectable pour-on	 — —	 1 cc/110 lb 1 ml/22 lb	 49 48	Not for female dairy cattle of breeding age. Injection ineffective for control of biting lice. Pour-on controls both biting and sucking lice.
	moxidectin (Cydectin) 0.5 PO	—	5 ml/110 lb	0	Not for lactating dairy cattle.
	permethrin EC or PO	See label	—	0	Follow label instructions. Spray entire animal, second treatment at 14 to 21 days.
	coumaphos 6.15%	See label	—	—	
Maggots in Wounds	permethrin 0.5% (Catron IV)	—	—	—	Spray wound directly and thoroughly. Repeat 5 to 7 days until healed.
	pyrethrin + PBO + Dipropyl isocinchomeronate	See label	—	—	
	pyrethrins 0.1 OS plus synergist				May give protection for short periods.
Stable Fly, Horse Fly, Deer Fly	permethrin			0	
Mosquitoes; Dairy and beef animals	coumaphos 6.15%	 5 oz/4 gal	 —	 10	Not for use on lactating dairy animals. Spray animals thoroughly.

Table 5-11A. Insect Control for Cattle

Insect	Insecticide and Formulation	**Amount of Formulation to Use in Water**	Dosage per Animal	**Minimum Interval (Days) Between Application and Harvest**	**Precautions and Remarks**
Ticks—Dairy and beef animals	coumaphos (Co-Ral) fly and tick 6.15%	Spray or backrubber 4 oz/10 gal			Do not use within 14 days of freshening.
	cypermethrin D and zeta-cypermethrin	2 oz/animal			Apply evenly where ticks are found, treat once every 3 days.
	permethrin pour-on, spray or backrubber	See label	—	0	
	phosmet (Prolate/Lintox)	Spray Backrubber	8 oz/15 gal water 8 oz/3.5 gal oil		Do not treat lactating dairy animals.
	tetrachlorvinphos (Rabon) 50 WP	4 lb/50 gal	0.5 to 1 gal	—	Do not treat lactating dairy animals. Treat about every 3 weeks during periods of heavy tick activity. Spray animals thoroughly.
	tetrachlorvinphos + dichlorvos (Rabon + Vapona, RaVap) EC	1 qt/50 gal	—	0	Spray animals completely.
House Fly, Lesser House Fly, Stable Fly, Other Filth Flies—Premises: beef and dairy	cyfluthrin (Tempo Ultra WP)	See label	—	—	Do not apply when animals are present.
	alpha-cypermethrin Fendona CS	See label	2 to 5 oz/1,000 sq ft		Microencapsulated for controlled release.
	deltamethrin (Suspend Polyzone)	0.25 to 1.5 oz/gal	1 pt/10,666-64,000 sq ft	—	Do not apply when animals are present.
	dichlorvos (Vapona) 2 EC or 4 EC	—	—	—	Fog, mist, or surface spray. Remove livestock before treatment.
	lambda-cyhalothrin (Grenade)	See label	—	—	
	permethrin 25 WP or EC	See label	—	—	
	pyrethrins 0.1 OS + synergist	—	—	—	Fog or mist.
	spinosad (Elector) 44.2 PSP	2 oz/10 gal water	See label	Lactating and non-lactating cattle may be present when applied	Do not use more than once each week. Do not make more than 5 consecutive applications.
	tetrachlorvinphos (Rabon) 50 WP	4 lb/25 gal	0.5 to 1 gal/500 sq ft	—	
	tetrachlorvinphos + dichlorvos (RaVap) 23 EC	5 oz/1 gal	1 gal/500 to1,000 sq ft	—	Surface treatment only. DO NOT use as a space spray.
	LARVICIDE cyromazine (Neporex) 2 SG	See label	Spray or dry application: 1 lb/200 sq ft	21	For larval control in manure or animal bedding only.
	pyriproxyfen (NyGuard) 10% IGR	—	4 ml/1500 sq ft		Fog, mist, spray, tank mix. Slow acting insecticide, may work best in combination with adulticides. See label.
	BAIT MIXTURES imidacloprid (QuickBayt) cyantraniliprole (Zyrox, Cyanarox) dinotefuran (Alpine) methomyl (Golden Malrin) nithiazine (QuikStrike) strip				Do not apply baits in areas accessible to animals.

Table 5-11B. Insect Control for Sheep and Goats

Insect	**Insecticide and Formulation**	**Amount of Formulation to Use in Water**	**Dosage per Animal**	**Minimum Interval (Days) Between Application and Harvest**	**Precautions and Remarks**
Lice and Sheep Ked	pyrethrin + PBO permethrin (Gordons Livestock backrubber and pour on) 0.25	See label — —	0.5 to 2.0 oz/100 lb	—	
House Fly, Stable Fly and other filth flies	diflubenzuron oral larvicide (ClariFly)	—	—	—	In feed according to label.
Blow Fly, other maggots in wounds	permethrin 0.5% (Catron IV)	—	—	—	Spray wound directly and thoroughly. Repeat 5 to 7 days until healed.

Table 5-11C. Insect Control for Swine

Insect	Insecticide and Formulation	Amount of Formulation to Use in Water	Dosage per Animal	Minimum Interval (Days) Between Application and Harvest	Precautions and Remarks
Cockroaches, Spiders	cyfluthrin (Tempo Ultra)	See label	—	—	
House Fly, Stable Fly—Premises	alpha-cypermethrin Fendona CS	See label	2 to 5 oz/1,000 sq ft		Microencapsulated for controlled release.
	cyromazine (Neporex) 2 G	See label	Spray or dry application: 1 lb/200 sq ft	21	For larval control only in manure or animal bedding.
	deltamethrin (Suspend Polyzone)	0.25 to 1.5 oz/gal	1 pt/10,666-64,000 sq ft	—	Do not apply when animals are present
	lambda-cyhalothrin (Cyonara 9.7 EC) Lambda Cy 11.4 EC	See Label	—	—	
	Beauveria bassiana (balEnce)	See label	See label	—	Labeled for organic farming.
	pyriproxyfen (NyGuard) 10% IGR	—	4 ml/1500 sq ft		Fog, mist, spray, tank mix. Slow acting insecticide, may work best in combination with adulticides. See label.
Lice	ivermectin injectable pre mix 0.6% (Ivomec only)	—	 1 cc/75 lb 300 g/ton	 18 5	 Continually feed for 7 days. For feeder pigs and finish hogs ONLY.
	permethrin		—	5	Spray entire animal until thoroughly wet.
	phosmet (Prolate/Lintox 11.75%)			1	Retreat in 14 days.
	tetrachlorvinphos (Rabon) 50 WP	7 oz/5 gal	1 to 2 qt	0	
Mange Mite	doramectin (Dectomax) injectable	—	1 cc/ 75 lb	24	
	ivermectin injectable pre mix 0.6% (Ivomec only)	 — —	 1 cc/75 lb 300 g/ton	 18 5	 Continually feed for 7 days. For feeder pigs and finishing hogs ONLY.
	permethrin EC 10 PO (SwineGuard ready to use)	—	 — 3 ml/100 lb	5	Spray entire animal until thoroughly wet. See label for correct rates and treatment intervals.
	phosmet (Prolate/Lintox 11.75%)	2 qt in 50 gal		1 to harvest	Retreat in 14 days
Maggots in Wounds	permethrin 0.5% (Catron IV	—	—	—	Spray wound directly and thoroughly. Repeat 5 to 7 days until healed.
House Fly	diflubenzuron oral larvicide (ClariFly)	—	—	—	In feed according to label.
	tetrachlorvinphos (Rabon oral larvicide)				See label.
	Also see CATTLE		—	—	Treat according to label.

Table 5-11D. Insect Control for Horses

Insect	Insecticide and Formulation	Amount of Formulation to Use in Water	Precautions and Remarks
Bot	ivermectin (Zimecterin, Eqvalan)		Follow all instructions.
	MGK 264, Permethrin, PBO (Prozap War Paint)		Follow all instructions.
Horse Fly, Deer Fly, Mosquito	For materials and control suggestions see CATTLE section.		
House Fly, Stable Fly—Premises	alpha-cypermethrin Fendona CS	See label	2 to 5 oz/1,000 sq ft
	cyromazine (Neporex) 2G	See label	Spray or dry application to stall bedding or muck pile.
	cyromazine (Solitude IGR) 2.1		In feed to control fly larvae in manure.
	dichlorvos (Vapona)		Follow label instructions.
	spinosad (Elector PSP) 44.2 spray	 2oz/10 gal water	Spray thoroughly, prevent runoff. 5,000 to 10,000 sq ft
	lambda-cyhalothrin		
	pyrethrins (Pyranha Insecticide)		
	Beauveria bassiana (balEnce)	See label	Organic labeling.
Horn Fly, Face Fly, House Fly, Stable Fly, Gnats	coumaphos (Co-Ral)		Follow label instructions for horn fly, lice and tick control.
	cypermethrin + synergists (Tri-Tec 14, Endure Roll on)		Follow label instructions.
	dichlorvos (Vapona)		Follow label instructions. Premises only
	diflubenzuron oral larvicide (ClariFly)		Follow label instructions.
	permethrin (Atroban, Permectrin II)		Follow label instructions.
	permethrin + piperonyl butoxide (Flysect-7) Permethrin + diflubenzuron (Clean-up II)		Pour on for fly control. Wipes or ready to use spray.
	pyrethrin + piperonyl butoxide		Follow label instructions.
	pyrethrins (Pyranha Insecticide)		Follow label instructions.
	tetrachlorvinphos (Rabon oral larvicide)		In feed, mixed, or top-dressed for control of fly larvae in manure.
	pyriproxyfen (NyGuard) 10% IGR		Follow label instructions.
	AUTOMATIC SPRAY SYSTEMS resmethrin; natural pyrethrins + piperonyl buxide		Follow label instructions.
	BAIT MIXTURES cyantraniliprole (Zyrox, Cyanarox) dinotefuran (Alpine) imidacloprid (QuickBayt), methomyl (Golden Malrin), nithiazine (QuikStrike) Strip		Do not apply baits in areas accessible to animals.

Table 5-11E. Insect Control for Poultry

Insect	Insecticide and Formulation	Amount of Formulation in Water	Dosage	Precautions and Remarks
Chicken Mite	permethrin	See label	—	Provide easy-to-clean roosts and nests with few hiding places. Apply sprays thoroughly to roosts and cracks in surrounding areas. Repeat application as necessary. Follow labels carefully. Treatment of birds as for northern mite also helps.
Northern Fowl Mite, Lice	permethrin	—	1 gal spray/100 birds	
	tetrachlorvinphos (Rabon) 50 WP	6.5 oz/5 gal	1 gal/100 birds or 1 to 2 gal/1,000 sq ft of litter	Direct on birds. Thorough coverage and feather penetration is essential. Follow labels carefully. Use 100 to 125 psi for good penetration. Apply premises spray as necessary to reduce NFM/lice dislodged from birds.
	tetrachlorvinphos + dichlorvos (RaVap) 23 EC	5 oz/1 gal	1 gal/100 birds; 1 to 2 gal/1,000 sq ft of litter	Direct on birds. Thorough coverage and feather penetration is essential. Follow labels carefully. Use 100 to 125 psi for good penetration. Apply premises spray as necessary to reduce NFM/lice dislodged from birds.
House Fly, Lesser House Fly, Stable Fly, Other Filth Flies—Premises	chlorpyrifos (Durashield) 20 CS	See label		Restricted use insecticide. Surface treatment only. DO NOT use as a space spray.
	cyfluthrin (Tempo Ultra WP)	See label	—	Remove birds from building prior to treatment of interior surfaces.
	alpha-cypermethrin Fendona CS	See label	2 to 5 oz/1,000 sq ft	Microencapsulated for controlled release.
	deltamethrin (Suspend Polyzone)	0.25 to 1.5 oz/gal	1 pt/10,666-64,000 sq ft	Remove birds from building prior to treatment of interior surfaces.
	dichlorvos (Vapona) Concentrate 40.2	—	1 gal /100 gal water dilution	Fog, mist, or surface spray. See label. 1 qt. diluted per 1000 sq. ft.
	bifenthrin DuraFlex CS + Novaluron + Pyriproxyfen	1 oz/gal	1500 sq ft	Premises only. Can be used in occupied or unoccupied buildings. Do not apply directly to animals, feed or water sources.
	lambda cyhalothrin (Lambda Cy) 11.4 EC	See label		
	permethrin	See label	—	
	pyrethrins 0.1 OS + synergist	See label	—	Fog or mist.
	pyriproxyfen (NyGuard) 10% IGR	—	4 ml/1500 sq ft	Fog, mist, spray, tank mix. Slow acting insecticide, may work best in combination with adulticides. See label.
	spinosad (Elector PSP) 44.2 spray	2oz/10 gal water	Spray thoroughly, prevent runoff 5,000 to 10,000 sq ft	
	Beauveria bassiana (balEnce) spray	—	—	Apply as directed. Organic labeling.
	tetrachlorvinphos (Rabon) 50 WP	4 lb/25 gal	0.5 to 1 gal/500 sq ft	
	tetrachlorvinphos + dichlorvos (RaVap) 23EC	5 to 10 oz/1 gal	1 gal/500 to1,000 sq ft	
	tetrachlorvinphos + dichlorvos (RaVap) 23 EC	5 oz/1 gal		Apply larvicide as spot treatment.
	tetrachlorvinphos (Rabon) 50 WP	4 lb/25 gal		Apply larvicide as spot treatment.
	LARVICIDES cyromazine (Neporex) 2 G (Flyzine, Larvadex) 1% premix	 See label	 1 lb/ton of feed	 For use in all poultry. Approved as a manure treatment for broiler breeders and caged layers only. Feed continuously for 4 to 6 weeks.
	BAIT MIXTURES cyantraniliprole (Zyrox, Cyanarox) dinotefuran (Alpine) imidacloprid (QuickBayt) methomyl (Golden Malrin) nithiazine (QuikStrike) bait strip	—		Do not apply baits in areas accessible to poultry.
Northern Fowl Mite	permethrin 2.5%	See label	2.5 oz/gal	No more than 1 gal spray per 100 birds, apply directly to the vent region for thorough coverage.
	spinosad (Elector) PSP 44.1%		3 oz/10 gal water	No more than 1 gal spray per 100 birds, apply directly to the vent region for thorough coverage.
Scaly-Leg Mite	crude petroleum oil	Undiluted	Dip shanks	
Chigger	permethrin	—	See label	Apply day before poultry is put on range. Repeat in 2 to 3 weeks.
Stick-Tight Flea	permethrin	—	See label	May be applied to birds.
	pyriproxyfen	—	—	Follow label directions.
	Vaseline	—	Rub into areas of head where pest is attached	Keep dogs and other animals out of poultry areas. Yards, nesting, and roosting areas should be cleaned frequently.
Bed Bug, Fowl Tick	cyfluthrin (Tempo) 20 WP or 2 L	See label	—	Remove birds prior to treatment. Add acidifier in high alkaline environments (See label)
	Alpha-cypermethrin Fendona CS	See label	2 to 5 oz/1,000 sq ft	Microencapsulated for controlled release.
	lambda-cyhalothrin (Grenade) 9.7 ER	See label	—	
	permethrin	—	—	

Table 5-11E. Insect Control for Poultry

Insect	Insecticide and Formulation	Amount of Formulation in Water	Dosage	Precautions and Remarks
Darkling Beetle (Lesser Mealworm)	Beauveria bassiana balance beetle bait, FBP23	See label	—	Use according to label.
	carbaryl (Sevin) 43 SL 44.1 XLR Plus	 — —	 — —	Limited to building exteriors; see label.
	cyfluthrin (Tempo Ultra 20 WP or 2 L	See label	10 to 20g/gal water	Remove birds prior to treatment. Add acidifier in high alkaline environments (See label)
	Alpha-cypermethrin Fendona CS	See label	2 to 5 oz/1,000 sq ft	Microencapsulated for controlled release.
	spinosad (Elector) PSP 44.1%		2 to 4 oz/5,000 sq ft	
	gamma-cyhalothrin (StandGuard) 5.9 MC	See label		
	tetrachloryinphos (Beetle Shield) 6%		1.5 to 4 oz/100 sq ft	Apply with a duster.
	spinosad (Elector) 44.2 PSP	2 oz/10 gal water	See label	Do not use more than once each week. Do not make more than 5 consecutive applications.
	imidacloprid (Credo SC 43.8, Dominion 4L flowable 42.3	3 fl oz/0.5 to 2 gal water	1 gal/1,000 sq ft	
	lambda-cyhalothrin (Grenade) 9.7 ER	See label		Remove birds prior to treatment.
	permethrin	—	—	
	pyriproxyfen + novaluron (Tekko pro) 1.3 EC	1 fl oz/gal	1 gal/1,000 to 1,500 sq ft	This slow-acting insect growth regulator is most effective when used in combination with other insecticides.
	pyriproxyfen (NyGuard) 10% IGR	—	4 ml/1500 sq ft	Fog, mist, spray, tank mix. This slow-acting insect growth regulator is most effective when used in combination with other insecticides. See label.
	spinosad (Elector PSP) 44.2 spray	See label		
	tetrachlorvinphos (Rabon) 50 WP	 4 lb/50 gal —	 1 to 2 gal/1,000 sq ft 1 lb/100 sq ft	Do not treat houses with birds 6 weeks old or less.
	tetrachlorvinphos + dichlorvos (RaVap) 23 EC	5 to 10 oz/1 gal	1 gal/500 to1,000 sq ft	
	zetacypermethrin (ZetaGard LBT) Granular	50 lb/house	See Label	6-week withdrawal period before slaughter.
Imported Fire Ants	Baiting is the best management practice. See COMMUNITY PEST CONTROL			
Rodents	See ANIMAL DAMAGE CONTROL chapter— Rodenticides			

Community Pest Control

S.E. Crawley, Entomology and Plant Pathology Extension and M. Reiskind, Entomology and Plant Pathology Research

NOTE: Insecticides recommended for use by Certified Applicators only. For rodents, see Animal Damage Control, Chapter 9.

Table 5-12A. Community Pest Control — Mosquito Adults[1]

Read pesticide labels carefully. Some pesticide products are not approved for application to edible plants. Avoid spraying flowering plants when bees are actively foraging.
KEY: Dv 0.9 = 90% of the spray volume droplets are smaller than value given VMD = Volume Median Diameter; um = micrometer

Type of Application	Insecticide and Formulation	Mixing Instructions and Application Equipment	Application Rate at 10 mph	Droplet Size Requirements on Label (*u*m)	Precautions and Remarks
Ground Application	Bifenthrin 7.9L	0.33 to 1.0 fl oz/gal water in backpack or hydraulic sprayer.			Apply at a rate of 1 gallon per 1,000 square feet for thorough coverage of lawns or ornamentals. Spray on vegetated areas of mosquito harborage, avoiding flowering and edible plants.
	Clove oil, Cottonseed oil (Nature-Cide)	1:9 to 1:39 dilution in water.		Outdoors – apply to wet surfaces but not to the point of run-off.	Treat with mist or spray around landscape plants, turf, ground cover, under decks, around building foundations where mosquitoes may rest. Spray on vegetated areas of mosquito harborage, avoiding flowering and edible plants.
	Deltamethrin (Suspend Polyzone)	0.25 to 1.5 fl oz/gal water in backpack or hydraulic sprayer.			Treat with mist or spray around landscape plants, turf, ground cover, under decks, around building foundations where mosquitoes may rest. Spray on vegetated areas of mosquito harborage, avoiding flowering and edible plants.
	Etofenprox (Aqua Zenivex E20)	Apply undiluted or up to 1:4.5 dilution.	Dilution-dependent.	VMD-7-30 *u*m Dx 0.9 < 50 *u*m	For use as a thermal, ULV, or space spray. Do not apply more than 0.18 lb per acre per site per year. Do not make more than 25 applications per site per year. Use higher label rates when dense vegetation is present, not to exceed the highest application rate on the label.
	Lambda-cyhalothrin (Cyonara 9.7, Demand CS, Cyzmic CS)	0.015% to 0.03% a.i. 0.2 to 0.4 fl oz/gal water in backpack or hydraulic sprayer (Demand CS). 0.8 fl oz/gal water in backpack or hydraulic sprayer (Cyonara 9.7, Cyzmic CS).			Treat resting areas on structures as well as surrounding shrubs. Higher volumes applied result in better coverage and, as a rule, will improve control, not to exceed highest application rate on the label. Use to create a mosquito barrier by treating perimeter vegetation, avoiding flowering and edible plants.
	Malathion 96.5% concentrate (Fyfanon ULV)	Use undiluted in aerosol ULV sprayer.	2 to 4.3 fl oz	VMD < 30 *u*m Dv 0.9 < 50 *u*m	Do not spray when wind speed is more than 5 mph.
		Dilute 3.9 to 5.2 gal to 100 gal with No. 2 fuel or diesel oil; use in thermal fog sprayer.			Avoid direct application to vehicles; these insecticides may damage paint. Apply when air temperatures are cool and wind speed is 3 mph or less. Toxic to fish, aquatic invertebrates, and wildlife.
	Naled (Dibrom 8) 62.0% concentrate	0.8 to 1.6 fl oz diluted with water.		VMD < 60 *u*m Dv 0.9 < 115 *u*m	Toxic to fish, aquatic invertebrates, and wildlife. Restricted Use Pesticide. Do not retreat site more than once in 24 hours. No more than 3.75 oz per week and maximum of 180 oz per year. For use only in government-sponsored wide area public pest control programs.
		3 to 5 qt per 100 gal of water using a mist or cold fogger		VMD < 40 *u*m Dv 0.9 < 75 *u*m	Do not directly apply to water or to areas where runoff into water is likely to occur.
	Permethrin 10% to 57%	Apply undiluted or mix with refined mineral or soybean oil to surfaces where adult mosquitoes may land or harborage.	0.31 to 15 oz/ min depending on dilution	VMD = 150 to 300 *u*m	Permethrin 57% is not for use in residential misting systems. 10% is the preferred concentration for misting systems. Products titled “SFR” are formulated for termites (see structural pest section). Do not allow drift onto cropland, poultry ranges or potable water supplies. Do not use on crops used for food or forage.
	Permethrin (Permanone) 10% EC	Dilute 1:20 with water (6.5 fl oz/1 gal of water).			Can be used in home misting systems. Treat surfaces using course wet spray. Do not allow runoff or drift into waterways or storm drains.
	Permethrin (20%) and Piperonyl Butoxide (20%) (Aqua-Reslin)	Dependent upon application method. For low pressure hand sprayers dilute 2.8 oz/1 gal water. For backpack sprayers dilute 1 part Aqua-Reslin to 31 parts water.	0.70 to 17.9 fl oz/ min	VMD < 30 *u*m Dv 0.9 < 50 *u*m	Dilute with water only. Toxic to fish and aquatic invertebrates. Can be used as barrier spray on building foundations (maximum height of 3’) and vegetation around structure but not within 100 feet of lakes and streams. Structural applications to areas other than foundation limited to crack & crevice.
	Permethrin and Piperonyl Butoxide (Permanone 31-66, Biomist 3 + ULV)	Dilute 1 gal to 2.4 gal with light weight oil; use in ULV sprayer. May apply undiluted.	0.5 to 3 fl oz/min 3.1 to 17.4 oz/min	VMD < 30 *u*m Dv 0.9 < 50 *u*m	Do not exceed 25 applications at maximum rate at any site in one year
	Prallethrin (1%), Sumithrin (5%) and Piperonyl Butoxide (5%) (Duet)	Apply undiluted in aerosol ULV sprayer. Do not exceed 1.28 fl oz of Duet per A.	2.5 to 7.5 oz/min	VMD = 8 to 30 *u*m Dv 0.9 < 50*u*m	Do not allow drift onto pastureland, rangeland, or potable water supplies. Ensure application equipment is properly calibrated.

Table 5-12A. Community Pest Control — Mosquito Adults[1]

Read pesticide labels carefully. Some pesticide products are not approved for application to edible plants. Avoid spraying flowering plants when bees are actively foraging.

KEY: Dv 0.9 = 90% of the spray volume droplets are smaller than value given VMD = Volume Median Diameter; um = micrometer

Type of Application	Insecticide and Formulation	Mixing Instructions and Application Equipment	Application Rate at 10 mph	Droplet Size Requirements on Label (*u*m)	Precautions and Remarks
Ground Application (continued)	Rosemary oil, Geraniol, Wintergreen (Essentria IC3)	1 to 3 fl oz of Essentria IC3 per gallon of water.	43 gal	2 gallons per 1,000 square feet	Treat harborage areas such as shrubbery and vegetation where mosquitoes/flies may rest. Repeat as necessary. Spray on vegetated areas of mosquito harborage, avoiding flowering and edible plants.
	Sumithrin and Piperonyl Butoxide (Anvil 10+10 ULV or 2+2 ULV)	Use undiluted or dilute 10+10 formulation with light mineral oil.	1.3 to 18.6 oz/min	VMD < 30 *u*m Dv 0.9 < 50*u*m	
Fixed Wing Aerial Application	Etofenprox (Aqua Zenivex E20)	0.00175 to 0.007 oz (undiluted) per acre.	Varies with dilution	VMD <60 *u*m Dx 0.9 < 100 *u*m	Do not apply at altitudes below 100 feet. Do not apply more than 0.10 lb per acre per site per year. Do not make more than 25 applications per site per year.
	Malathion 96.5% concentrate (Fyfanon ULV)	Use undiluted.	2.6 to 3 fl oz/A	VMD <60 *u*m Dx 0.9 < 100 *u*m	Toxic to fish, aquatic invertebrates, and wildlife. Do not directly apply to water or to areas where runoff into water is likely to occur. Do not retreat a site more than 3 times in any one week except in emergencies. Do not spray by fixed wing aircraft below 100 feet or by helicopter below 75 feet.
	Naled (Dibrom) 87.4% concentrate	Use undiluted.	0.5 to 1 fl oz/A	VMD = 60 *u*m Dv 0.9 < 115*u*m	Toxic to fish, aquatic invertebrates, and wildlife. Do not directly apply to water, except when necessary to target areas where adult mosquitoes are present or to areas where runoff into water is likely to occur. Do not exceed 104 fl oz per year.
		Dilute 50 to 100 fl oz to 100 gal with No. 2 fuel oil or diesel oil.	1 gal/A	VMD = 60 *u*m Dv 0.9 < 115*u*m	Toxic to fish, aquatic invertebrates, and wildlife. Do not directly apply to water, except when necessary to target areas where adult mosquitoes are present or to areas where runoff into water is likely to occur. Do not exceed 104 fl oz per year.
	Permethrin (20%) and Piperonyl Butoxide (20%) (Aqua-Reslin)	Dilute 1 gal with 2 to 12 gal water	2.1 to 9 oz/min depending on dilution	VMD < 60 *u*m Dv 0.9 < 100*u*m	Dilute with water only. Toxic to fish and aquatic invertebrates.
	Prallethrin (1%) and Sumithrin (5%) and Piperonyl Butoxide (5%) (Duet)	Apply undiluted in aerosol ULV sprayer.	0.41 to 1.24 oz/A	VMD = < 60 *u*m	Do not allow drift onto pastureland, rangeland, or potable water supplies.
	Sumithrin and Piperonyl Butoxide (Anvil 10+10)	Use undiluted.	3.8 to 5.7 fl oz/A	VMD < 60 *u*m Dv 0.9 < 80 *u*m	

[1] Avoid direct applications to flowering plants when pollinators are active. Do not allow drift onto adjoining non-target areas. When treating residential properties, cover or remove pet food and water sources, grills, swimming pools and children's toys. Note: Treatment of structures (exterior or interior) requires a P-phase Structural Pest Control License in North Carolina.

Table 5-12B. Community Pest Control — Mosquito Immatures and Other Pests

Pest	Insecticide and Formulation	Mixing Instructions and Application Equipment	Application Rate Per Acre	Precautions and Remarks
Mosquito—Immatures	*Bacillus thuringiensis*, var. *israelensis* (Teknar, Vectobac) 50 WP 2 WP 14.3% aqueous conc. 15% aqueous conc. 1.2% aqueous conc. 0.8% aqueous conc.	Dilute with sufficient water to obtain uniform coverage.	 6 to 12 oz 4 to 16 oz 0.5 to 3 pt. 0.5 to 3 pt. 0.25 to 2 pt. 0.5 to 2 pt.	Only effective against larvae. Can be applied to all breeding habitats, including potable water supplies.
	Bacillus thuringiensis, var. *israelensis* (Summit BTI) briquets 10%			Use one briquet per 100 square feet of surface area regardless of depth.
	Teknar G and CG, Vectobac Granules (1.7% - 2.8% Bt.)	Ready to use (RTU).	—	Apply 4 to 10 pounds per acre with aircraft or ground equipment. Do not apply directly to treated, finished drinking water reservoirs or drinking water receptacles when the water is intended for human consumption.
	Methoprene Altosid Liquid SR-5, SRT-20 (5% and 20% Methoprene) Altosid Briquet (2.1%, 8.6% Methoprene) Altosid Pellets (4.2% Methoprene) Altosid Granules (0.3%, 1.5%, 1.6%, 4.25% Methoprene)	For liquid formulations: Use water sufficient for equipment. Briquets, Pellets, Granules: Ready to use.	0.75 to 1 fl oz/acre for liquid products. —	All products: Apply when larvae are in 2nd, 3rd and 4th instar. Methoprene will not kill pupae or adults. Briquets: Water less than 2 feet; 1 briquet per 100 square feet; deeper or flowing water; 1 briquet per 10 cubic feet. Pellets: 2.5- to 10-pound pellet per acre; use high rate in breeding sites with high organic content. Granules: Target application rate is species and product-dependent. Please see product labels.
	Mineral Oil (BVA 2 Mosquito Larvicide Oil)	Apply undiluted	1 to 5 gal/A	Apply using maximum nozzle height of 4 feet by ground or 10 feet by air.
	Spinosad (Natular G30) Granules	Ready to use.	5 to 20 lb	This product is toxic to aquatic organisms. Non-target aquatic invertebrates may be killed in waters where this pesticide is used.
Midge ("fuzzy bills")	*Bacillus thuringiensis,* var. *israelensis* (Bactimos PT)	Apply uniformly over surface.	22.3 to 26.8 lb/A	Species identification is important to effective control. Treat smaller area first if the species of concern has not been identified.
	Methoprene 20% EC (Strike Midge) 4.25% pellet (Strike Pellets)	 4 to 5 oz/1 million gal wastewater —	 — 5 to 10 lb/A	 For use in wastewater treatment facilities. Uniformly apply at the influent side over a 24-hr period. Apply to natural and manufactured aquatic habitats. High rate recommended for wastewater.
	Spinosad (Natular G30) 2.5% (Granules)	Ready to use.	5 to 20 lb	This product is toxic to aquatic organisms. Non-target aquatic invertebrates may be killed in waters where this pesticide is used.
Tick	Acetamiprid-Permethrin (Transport Mikron)	—	Apply 0.11% concentration of active ingredient to cover 1,000 sq. ft.	Do not apply more than 0.11% finished dilution per 1,000 square feet.
	Alpha-Cypermethrin (Fendona CS)	0.8 to 1.6 fl oz per gal		Apply 0.5 to 1.0 fluid ounce concentrate per 1,000 square feet for most effective control. Apply in a sufficient amount of water to adequately cover the area being treated.
	Bifenthrin (Talstar, Bifen I/T) Bifen L/P Granular 7.9% L	Ready to use 1 fl oz/100 gal water	 100 to 200 lb/A	Do not allow public use of area during treatment. Use 1 gallon per 1,000 square feet.
	Carbaryl (Lesco Sevin SL) 43.0%	1 qt./100 gal	1 qt. (0.75 oz/1000 sq. ft.)	Keep children and pets off treated areas until they have dried.
	Clove oil, Cottonseed Oil (Nature-Cide)	1:9 to 1:39 dilution in water		Outdoors – Apply to wet surfaces but not to the point of run-off. Kills by contact.
	Cyfluthrin (Tempo) 11.8% SC 10% WSP	1.5 to 5.4 oz/100 gal 1 to 3 packs/100 gal	25 gal	
	Deltamethrin (Suspend Polyzone) 4.75T L	0.25 to 1.5 fl oz/gal water	1 to 3 gal/1,000 sq. ft.	Do not allow public use of area during treatment.
	Imidacloprid and Beta-Cyfluthrin (Temprid SC or FX)	0.075% to 0.15% fl oz/gal water		Apply at rate that will not cause drip/run-off from site.
	Permethrin (Permethrin SFR)	1 2/3 fl oz/gal of water	0.4 to 0.8 fl oz/1,000 sq. ft.	Do not allow public use of area during treatment. Apply 1 gallon per 1,000 square feet.
	Rosemary oil, Geraniol, Wintergreen (Essentria IC3)	1 to 8 oz of Essentria IC3 per gallon of water	43 gal	Use 2 finished gallons per 1,000 square feet.

Table 5-12B. Community Pest Control — Mosquito Immatures and Other Pests

Pest	Insecticide and Formulation	Mixing Instructions and Application Equipment	Application Rate Per Acre	Precautions and Remarks
Imported Fire Ants	Acetamiprid-Bifenthrin (Transport Mikron)		Apply 0.11% concentration of active ingredient to cover 1,000 sq. ft.	Do not apply more than 0.11% finished dilution per 1,000 square feet.
	Cyfluthrin (Tempo) 11.8% SC 10% WSP	1.5 to 5.4 oz/100 gal 1 to 3 packs/100 gal	25 gal	
	Deltamethrin (Suspend Polyzone) 4.75T L	0.25 to 1.5 fl oz/gal water	1 to 3 gal/1,000 sq. ft.	Do not allow public use of area during treatment.
	Fipronil (Topchoice Granular) 0.0143%	— —	87 lb	For use on home lawns, golf courses, commercial and recreational turf, and sod farms. One application of 87 pounds of product/acre per year. Restricted-Use Pesticide.
	Hydramethylnon (Amdro, Amdro Pro) B	—	1 to 1.5 lb	Broadcast Treatment: Distribute uniformly on pasture and range grass, lawns, turf, and nonagricultural lands. Mound Treatment: Distribute 5 level tbsp. 3 to 4 feet around base of each mound (do not exceed 1.5 pounds per acre). Cutting/ baling restrictions for pastures with dairy or beef cows.
	Hydramethylnon 0.365% + S-Methoprene 0.25% (Extinguish Plus) B	—	1.5 lb	Broadcast Treatment: Distribute uniformly on pasture and range grass, lawns, turf, and nonagricultural lands. Mount Treatment: Distribute 2 to 5 level tablespoons 3 to 4 feet around base of each mound (do not exceed 1.5 pounds per acre).
	Indoxacarb (Advion Fire Ant Bait) 0.045% Granular Bait 20% WDG	— —	1.5 lb —	For use in outdoor areas on noncroplands. For mound or perimeter treatments (see label for rates).
	Metaflumizone (Siesta) (0.0653%) B	-	1.5 lb	Broadcast uniformly on target area or use 2 to 4 level tablespoons 3 to 4 feet around base of each mound (do not exceed 1.5 pounds per acre).
	Methoprene (Extinguish Professional) 0.5% B	—	1 to 1.5 lb	For use on crop and noncroplands, such as parks, zoos, sports fields, and school grounds.
	Pyriproxyfen (Distance) 0.5% B	—	1 to 1.5 lb	For use in outdoor areas on noncroplands.
	Spinosad (Conserve) 0.15% B	-	4 lb	May require 2 applications per year. (OMRI certified).
	For treatment of individual ant mounds with liquid insecticides, refer to the section on insect control for home lawns.			

Industrial and Household Pests

S.E. Crawley and P. Alder, Extension Entomology and Plant Pathology

For Use by Licensed Pest Management Professionals

Space limitations preclude listing all pesticide formulations and brand names. Other products or formulations may be used. Some products contain a mixture of active ingredients. Read the product label for specific information about the active ingredients, application rates, and detailed instructions on use—particularly approved sites for application.

Mention of pesticides in this section does not imply that chemicals should be the first or only means of pest control. Nonchemical methods, including exclusion, habitat modification, and sanitation, are important to long-term pest management.

Table 5-13. Industrial and Household Pests—For use by licensed pest management professionals only

Pesticide	Boric acid (Niban, Perma-Dust, InTice)		Silicon dioxide (Drione, Tri-Die, Cimexa Dust)	Sodium Tetraborate (Gourmet Liquid Ant Bait, Dominant Ant Bait)		*Bacillus thuringiensis* var. *israelensis* (Vectobac, Teknar)	*Beauveria bassiana* (Aprehend)	Methomyl (Golden Malrin)	Propoxur (Invader)	Dichlorvos (Nuvan)	
Chemical Class[1]	Inorganic					Biological		Carbamate		Organophosphate	
Formulation[2]	**Bait**[3]	**Dust**	**Dust**[4]	**Bait**	**Dust**			**Bait**	**Sprayable**	**Strip**	**Fog/Spray**
Pests											
ANTS	X	X	X	X[7]	X						X
BED BUGS			X		X		X		X	X	X
BEES			X								X
BOOKLICE	X		X						X		
BUGS (TRUE)[6]	X		X						X	X	
CARPET BEETLES					X					X	X
CENTIPEDES	X		X						X		
CLOTHES MOTHS										X	X
CLOVER MITES	X		X						X		
COCKROACHES	X	X	X						X	X	X
CRICKETS	X	X	X								X
EARWIGS	X	X	X						X	X	
FLEAS		X	X		X						X
FLIES	X		X			X[5]		X[6]	X	X	X
HORNETS/WASPS			X								X
LADY BEETLES			X								
MILLIPEDES	X		X						X		X
MOSQUITOES (adults)						X[5]					X
STORED PRODUCT PESTS	X		X						X		X
SCORPIONS			X								
SILVERFISH	X	X	X						X	X	X
SPIDERS									X	X	X
SOWBUGS									X		X
SPRINGTAILS			X								X
TICKS			X								X

1 Alternating uses of insecticides in different chemical classes can help reduce the likelihood of the pests developing resistance to one group or class of compounds.

2 **Formulations:**
Aerosol includes crack and crevice. Bait may be granular, gel, or station. Sprayable may be concentrate or powder, some RTU formulations.

3 Baits may be formulated as solids, dusts or liquids

4 Some formulations of diatomaceous earth and silica gel contain pyrethrins as a flushing agent.

5 Bti is used for mosquito and specific fly larvae only.

6 Not to be used in or around residences or other buildings where children may be present. May also contain an attractant compound.

7 True bugs include boxelder bugs, stink bugs, kudzu bugs, and similar occasional invaders.

Table 5-13 (continued). Industrial and Household Pests—For use by licensed pest management professionals only

Pesticide	Bifenthrin (Bifen I/T, Talstar P)	Cyfluthrin (Tempo Ultra, Ultrashield CS)	Cypermethrin[2] (Demon, Cynoff, Fendona, Talstar Xtra)			Deltamethrin (DeltaDust, DeltaGuard, Suspend, Barricor)			Esfenvalerate (Onslaught)	Etofenprox (Zenprox)	Lambda-cyhalothrin (Demand, 228L)		Permethrin (Flee, Dragnet, Prelude)		Phenothrin (Bedlam, Nyguard Plus[6]	Prallethrin (Alpine Flea and Bed Bug spray)	Pyrethrins and pyrethrum (Kicker, Pyrenone, ULD BP-300)			Sumithrin (Sterifab)
Chemical Class[1]	**Pyrethroids**																			
Formulation[3]	**S, G**	**S**	**D**	**G**	**S**	**D**	**G**	**S**	**S**	**S**	**S**	**G**	**S**	**G**	**S**	**S**	**A[4]**	**S[4]**	**D[4]**	**S**
Pests																				
ANTS	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BED BUGS	X	X				X		X	X	X	X		X		X	X		X	X	X
BEES	X	X	X		X	X		X	X		X		X					X	X	
BOOKLICE		X				X		X					X		X			X		
BUGS (TRUE)[5]	X	X	X		X				X		X		X		X					
CARPET BEETLES		X				X		X	X	X	X		X				X	X		
CENTIPEDES	X	X	X	X	X	X	X	X	X	X	X		X		X					X
CLOTHES MOTHS		X				X		X												
CLOVER MITES		X	X		X		X					X		X	X		X	X		
COCKROACHES	X	X	X		X	X	X	X	X	X	X		X		X		X	X	X	
CRICKETS	X	X	X		X	X		X	X	X	X	X	X	X	X		X	X		
EARWIGS	X	X	X	X	X				X	X	X	X	X	X	X		X	X		
FLEAS	X	X	X	X	X	X		X	X	X	X		X		X		X	X		X
FLIES/GNATS	X	X	X		X			X		X	X		X		X		X	X		
HORNETS/WASPS	X	X	X		X			X	X	X	X				X		X	X		
LADY BEETLES															X					
MILLIPEDES	X	X	X	X	X		X	X	X	X	X	X	X	X						
MOSQUITOES (adults)	X	X	X		X			X	X	X	X						X	X		
STORED PRODUCT																				
PESTS		X						X		X	X		X				X	X		
SCORPIONS	X	X	X	X	X				X			X	X		X		X	X		
SILVERFISH	X	X	X		X			X	X	X	X	X	X		X		X	X		X
SPIDERS	X	X	X	X	X		X	X	X	X	X		X		X		X	X		
SOWBUGS	X	X	X	X	X	X	X	X	X	X	X		X	X	X		X	X		X
SPRINGTAILS	X	X	X		X	X	X	X	X	X	X		X		X		X	X		
TICKS	X	X	X	X	X	X	X	X	X	X	X		X	X	X		X	X		X

[1] Alternating uses of insecticides in different chemical classes can help reduce the likelihood of the pest developing resistance to one class or group of compounds. Many pyrethroids can be tank-mixed with piperonyl butoxide products to enhance insecticidal activity.

[2] Some products use alpha-cypermethrin or zeta-cypermethrin which contain chemical isomers or cypermethrin. Talstar Xtra is a mixture of zeta-cypermethrin and bifenthrin.

[3] **KEY TO FORMULATION SYMBOLS:**
A = aerosol
B = bait (granular or station)
D = dust
G = granular
S = sprayable (concentrate or powder, some RTU formulations)

[4] Some formulations of pyrethrins contain piperonyl butoxide as a synergist.

[5] True bugs include boxelder bugs, stink bugs, kudzu bugs, and similar occasional invaders.

Table 5-13 (continued). Industrial and Household Pests — For use by licensed pest management professionals only

Pesticide	S-Hydroprene (Gentrol)[3]	Methoprene (Altosid, Precor)[3]	Pyriproxyfen (Archer, Ultracide) V[3]	Acetamiprid+Bifenthrin (Transport Mikron)	Dinotefuran (Advance, Alpine)	Imidacloprid (Maxforce, FlyBait, Premise, Temprid[8])	Thiamethoxam (Optiguard)[9]	Clothianidin (Maxforce Impact, Crossfire)	Abamectin (Ascend, Avert, Advance)	Aluminum phosphide (Phostoxin)[5]	Chlorfenapyr (Phantom)[6]	Cyantraniliprole (Zyrox)	Fipronil (Maxforce F, TopChoice, Termidor)[7]	2-Phenyl Propionate (EcoVia EC)	Hydramethylnon (Amdro Pro, MaxForce)	Indoxacarb (Advion, Arilon)	Rosemary Oil (Essentria IC3)	Sulfuryl fluoride (Vikane, Profume, Zythor)[9]
Chemical class[1]	**Insect Growth Regulators**				**Neonicotinoids**				**Other Classes**									
Formulation[2]	**A,S**	**B**	**A,S**	**A,S**	**B,S**	**B,D,S**	**B, S**	**B,S**	**B,S**	**B**	**F**	**S**	**B**	**B,G,S**	**A,S**	**B**	**B,S**	**A**	**F**
Pests																			
ANTS	X	X		X	X	X	X	X[9]		X		X		X	X	X	X	X	
BED BUGS			X	X	X	X	X		X[11]			X			X			X	X
BEES					X	X									X			X	
BOOKLICE						X												X	
BUGS (TRUE)[4]					X	X		X							X			X	
CARPET BEETLES					X	X									X			X	X
CENTIPEDES					X			X							X			X	
CLOTHES MOTHS					X	X													X
CLOVER MITES					X													X	
COCKROACHES	X			X	X	X	X	X	X	X		X		X	X	X	X	X	X
CRICKETS				X	X	X		X				X		X	X		X	X	
EARWIGS					X	X		X				X		X	X			X	
FLEAS			X	X	X	X									X				
FLIES/GNATS				X	X	X	X			X		X	X	X	X			X	
HORNETS/WASPS					X	X						X[10]		X	X			X	
LADY BEETLES					X	X		X				X		X	X			X	
MILLIPEDES					X	X		X				X		X	X		X	X	
MOSQUITOES (adults)		X		X	X	X									X			X	
STORED PRODUCT PESTS	X		X	X	X	X		X			X	X			X			X	X
SCORPIONS					X	X						X							
SILVERFISH					X	X		X				X		X	X			X	
SPIDERS					X	X						X		X	X			X	
SOWBUGS					X	X												X	
SPRINGTAILS					X	X												X	
TICKS				X	X									X				X	

[1] Alternating uses of insecticides in different chemical classes can help reduce the likelihood of the pest developing resistance to one class or group of compounds.

[2] **KEY TO FORMULATION SYMBOLS:**
A = Aerosol (includes Crack & Crevice) B = Bait (granular, gel or station)
D = Dust F = Fumigant
G = Granular S = Sprayable (concentrate or powder, some RTU formulations)

[3] IGR products are not typically effective against adult stage of pests; use with an adulticide to provide quicker control of pest population.

[4] True bugs include boxelder bugs, stink bugs, kudzu bugs, and similar occasional invaders.

[5] Requires an F-Phase Structural Pest Control License and manufacturer-offered product stewardship training.

[6] Chlorfenapyr labeled for indoor use only for these pests or limited spot treatment outdoors.

[7] Termidor liquid formulations are labeled for outdoor use only; use other insecticide products indoors.

[8] Temprid contains both imidacloprid and beta-cyfluthrin.

[9] Optigard not for use against pharaoh ants or carpenter ants.

[10] Phantom is not a knockdown insecticide for pests such as wasps.

[11] Use spray formulation only for bed bugs. Also contains metofluthrin.

ORNAMENTALS

Arthropod Management for Ornamental Plants Grown in Greenhouses

S. D. Frank, Entomology and Plant Pathology

Successful pest management programs use a combination of appropriate pest control tactics. Always follow label precautions when handling or applying pesticides. Make chemical control part of an integrated pest management program that includes monitoring and pest identification along with appropriate cultural, physical, horticultural, and biological controls.

Responsible pesticide use includes resistance management. A system has been developed by the inter-company Insecticide Resistance Action Committee (IRAC; www.irac-online.org) to help you rotate chemicals correctly. Pesticides have been assigned an IRAC classification number based on their mode of action. To rotate properly, choose a product with a different IRAC number for each successive application directed against the same pest. Follow resistance management instructions on the label.

The information in this chart is not a substitute for the label. Pesticide labels and restrictions change frequently. Read and understand all label information before using any pesticide. Do not use pesticides for uses other than those on the label. Check county and state regulations for any local restrictions on the use of products listed here before using them.

Table 5-14. Arthropod Management for Ornamental Plants Grown in Greenhouses

Permitted application sites: G = greenhouse, L = landscape, N = Nursery. (Trade names listed are common examples of products that contain the active ingredient, not an endorsement of a particular product.)

Insect or Mite	Pesticide common name (Example trade name)	Minimum Hours Between Application and Reentry	IRAC Mode of Action Group	Permitted application sites can differ by trade name; see label
Aphid	abamectin (Avid)	12 hr	6	G, L, N
	acephate (Orthene)	24 hr	1B	G, L, N
	acetamiprid (TriStar)	12 hr	4A	G, L, N
	afidopyropen (Ventigra)	12 hr	9D	G, L, N
	azadirachtin (Azatin)	4 hr	18B	G, L, N
	Beauveria bassiana (Botanigard, Naturalis)	4 hr	M	G, L, N
	bifenthrin (Talstar)	12 hr	3	follow label
	Chromobacterium subtsugae (Grandevo PTO)	4 hr	UN	G, L, N
	cyantraniliprole (Mainspring)	4 hr	28	G
	cyfluthrin (Decathlon)	12 hr	3A	G, L, N
	dinotefuran (Safari)	12 hr	4A	G, L, N
	flonicamid (Aria)	12 hr	9B	G, L, N
	fluvalinate (Maverik)	12 hr	3A	G, L, N
	horticultural oil (various)	4 hr		G, L, N
	imidacloprid (Marathon II)	12 hr	4A	G, N
	insecticidal soaps	12 hr	UN	G, N, L
	Isaria fumosorosea (NoFly, Preferal)	4-12 (see label)	UN	follow label
	kinoprene (Enstar II)	4 hr	7A	G
	neem oil (Various)	4 hr	UN	G, L, N
	permethrin (Astro, others)	12 hr	3	follow label
	pymetrozine (Endeavor)	12 hr	9B	G, L, N
	pyriproxyfen (Distance, Fulcrum)	12 hr	7C	G, L, N
	pyrethrins (various)	12 hr	3A	G, L, N
	pyrifluquinazon (Rycar)	12 hr	UN	G
	spinetoram + sulfoxaflor (XXpire)	12 hr	4C + 5	G, L, N
	spirotetramat (Kontos)	24 hr foliar (see exception for drench application)	23	G, N
	thiamethoxam (Flagship)	12 hr	4A	G, L, N
	tolfenpyrad (Hachi-Hachi)	12 hr	21A	G

Table 5-14. Arthropod Management for Ornamental Plants Grown in Greenhouses

Permitted application sites: G = greenhouse, L = landscape, N = Nursery. (Trade names listed are common examples of products that contain the active ingredient, not an endorsement of a particular product.)

Insect or Mite	Pesticide common name (Example trade name)	Minimum Hours Between Application and Reentry	IRAC Mode of Action Group	Permitted application sites can differ by trade name; see label
Broad Mite	abamectin (Avid)	12 hr	6	G, L, N
	bifenthrin (Talstar)	12 hr	3A	G, L, N
	chlorfenapyr (Pylon)	12 hr	13	G
	fenoxycarb (Preclude)	12 hr	7B	G
	fenpyroximate (Akari)	12 hr	21A	G, N
	methiocarb (Mesurol)	24 hr	1A	G, N
	pyridaben (Sanmite)	12 hr	21A	G, L, N
	spiromesifen (Judo)	12 hr	23	G, N
Caterpillar	abamectin (Avid)	12 hr	6	G, L, N
	acephate (Orthene)	24 hr	1B	G, L, N
	acetamiprid (TriStar)	12 hr	4A	G, L, N
	azadirachtin (Azatin)	4 hr	18B	G, L, N
	Bacillus thuringiensis var. kurstaki	4 hr	11B2	follow label
	Beauveria bassiana	12 hr		follow label
	bifenthrin (Talstar)	12 hr	3	follow label
	carbaryl (Sevin)	12 hr	1A	G, L, N
	chlorfenapyr (Pylon)	12 hr	13	G
	Chromobacterium subtsugae (Grandevo PTO)	4 hr	UN	G, L, N
	cyantraniliprole (Mainspring)	4 hr	28	G
	cyfluthrin (Decathlon)	12 hr	3A	G, L, N
	diflubenzuron (Adept)	12 hr	15	G
	fenoxycarb (Preclude)	12 hr	7B	G
	fluvalinate (Mavrik)	12 hr	3A	G, L, N
	insecticidal soaps	12 hr		G, L, N
	methoxyfenozide (Intrepid)	4 hr	18	G, L, N
	novaluron (Pedestal)	12 hr	15	G, N
	permethrin (Astro, others)	12 hr	3	Follow label
	pyrethrins (various)	12 hr	3A	G, L, N
	pyridalyl (Overture)	12 hr	UN	G
	spinetoram + sulfoxaflor (XXpire)	12 hr	4C + 5	G, L, N
	spinosad (Conserve)	4 hr	5	G, L, N
	tolfenpyrad (Hachi-Hachi)	12 hr	21A	G
Cyclamen Mite	abamectin (Avid)	12 hr	6	G, L, N
	chlorfenapyr (Pylon)	12 hr	13	G
	fenpyroximate (Akari)	12 hr	21A	G, N
	pyridaben (Sanmite)	12 hr	21A	G, L, N
	spiromesifen (Judo)	12 hr	23	G, N
Fungus Gnat	acetamiprid (TriStar)	12 hr	4A	G, L, N
	azadirachtin (Azatin)	4 hr	18B	G, L, N
	Bacillus thuringiensis var. israelensis	4 hr	11A1	Follow label
	bifenthrin (Talstar)	12 hr	3	Follow label
	chlorfenapyr (Pylon)	12 hr	13	G
	cyromazine (Citation)	12 hr	17	G, L, N
	cyfluthrin (Decathlon)	12 hr	3A	G, L, N
	diflubenzuron (Adept)	12 hr	15	G
	dinotefuran (Safari)	12 hr	4A	G, L, N
	fluvalinate (Mavrik)	12 hr	3A	G, L, N
	imidacloprid (Marathon)	12 hr	4A	G, N
	insecticidal soaps	12 hr		G, L, N
	kinoprene (Enstar II)	4 hr	7A	G
	permethrin (Astro, others)	12 hr	3	Follow label
	pyriproxyfen (Distance)	12 hr	7C	G, L, N
	Steinernema feltiae (various; beneficial nematode)	0 hr	Biological	G, L, N
Leafminer	abamectin (Avid)	12 hr	6	G, L, N
	acephate (Orthene)	24 hr	1B	G, L, N
	acetamiprid (TriStar)	12 hr	4A	G, L, N
	azadirachtin (Azatin)	4 hr	18B	G, L, N
	cyromazine (Citation)	12 hr	17	G, L, N
	dinotefuran (Safari)	12 hr	4A	G, L, N
	fenoxycarb (Preclude)	12 hr	7B	G
	imidacloprid (Marathon II, others)	12 hr	4A	Follow label
	spinosad (Conserve)	4 hr	5	G, L, N
	thiamethoxam (Flagship)	12 hr	4A	G, L, N

Table 5-14. Arthropod Management for Ornamental Plants Grown in Greenhouses

Permitted application sites: G = greenhouse, L = landscape, N = Nursery. (Trade names listed are common examples of products that contain the active ingredient, not an endorsement of a particular product.)

Insect or Mite	Pesticide common name (Example trade name)	Minimum Hours Between Application and Reentry	IRAC Mode of Action Group	Permitted application sites can differ by trade name; see label
Mealybug	acephate (Orthene)	24 hr	1B	G, L, N
	acetamiprid (TriStar)	12 hr	4A	G, L, N
	afidopyropen (Ventigra)	12 hr	9D	G, L, N
	azadirachtin (Azatin)	4 hr	18B	G, L, N
	Beauveria bassiana	12 hr		Follow label
	bifenthrin (Talstar)	12 hr	3	Follow label
	buprofezin (Talus)	12 hr	16	G, N
	cyfluthrin (Decathlon)	12 hr	3A	G, L, N
	dinotefuran (Safari)	12 hr	4A	G, L, N
	fenoxycarb (Preclude)	12 hr	7B	G
	flonicamid (Aria)	12 hr	9B	G, L, N
	horticultural oil (various)	4 hr		G, L, N
	imidacloprid (Marathon II, others)	12 hr	4A	Follow label
	insecticidal soaps	12 hr		G, L, N
	kinoprene (Enstar II)	4 hr	7A	G
	neem oil (Various)	4 hr	UN	G, L, N
	permethrin (Astro, others)	12 hr	3	Follow label
	pyriproxyfen (Distance)	12 hr	7C	G, L, N
	pyrifluquinazon (Rycar)	12 hr	UN	G
	spinetoram + sulfoxaflor (XXpire)	12 hr	4C + 5	G, L, N
	spirotetramat (Kontos)	24 hr foliar (see exception for drench application)	23	G, N
	pyriproxyfen (Distance)	12 hr	7C	G, L, N
	thiamethoxam (Flagship)	12 hr	4A	G, L, N
Scale (Armored) check label to be sure it lists scale to be treated	acephate (Orthene)	24 hr	1B	G, L, N
	acetamiprid (Tri-Star)	12 hr	4A	G, L, N
	bifenthrin (Talstar)	12 hr	3	Follow label
	buprofezin (Talus)	12 hr	16	G, N
	dinotefuran (Safari)	12 hr	4A	G, L, N
	horticultural oil (various)	4 hr		G, L, N
	kinoprene (Enstar II)	4 hr	7A	G
	thiamethoxam (Flagship)	12 hr	4A	G, L, N
	acephate (Orthene)	24 hr	1B	G, L, N
	acetamiprid (TriStar)	12 hr	4A	G, L, N
	azadirachtin (Azatin)	4 hr	18B	G, L, N
	bifenthrin (Talstar)	12 hr	3	Follow label
	buprofezin (Talus)	12 hr	16	G, N
	cyantraniliprole (Mainspring)	4 hr	28	G
	dinotefuran (Safari)	12 hr	4A	G, L, N
	fenoxycarb (Preclude)	12 hr	7B	G
	flonicamid (Aria)	12 hr	9B	G, L, N
	horticultural oil (various)	4 hr		G, L, N
	imidacloprid (Marathon II, others)	12 hr	4A	Follow label
	kinoprene (Enstar II)	4 hr	7A	G
	neem oil (Various)	4 hr	UN	G, L, N
	pyriproxyfen (Distance)	12 hr	7C	G, L, N
	spirotetramat (Kontos)	24 hr foliar (see exception for drench application)	23	G, N
	thiamethoxam (Flagship)	12 hr	4A	G, N
	tolfenpyrad (Hachi-Hachi)	12 hr	21A	G
Shorefly	acephate (Orthene)	24 hr	1B	G, L, N
	azadirachtin (Azatin)	4 hr	18B	G, L, N
	bifenthrin (Talstar)	12 hr	3	Follow label
	diflubenzuron (Adept)	12 hr	15	G
	imidacloprid (Marathon II, others)	12 hr	4A	Follow label
	kinoprene (Enstar II)	4 hr	7A	G
	pyriproxyfen (Distance)	12 hr	7C	G, L, N
	spinetoram + sulfoxaflor (XXpire)	12 hr	4C + 5	G, L, N
Slugs	iron phosphate (bait)	Follow label	UN	Follow label
	metaldehyde (bait)	Follow label	UN	Follow label
	methiocarb (bait)	Follow label	1A	Follow label
Spider Mites	abamectin (Avid)	12 hr	6	G, L, N
	acephate (Orthene)	24 hr	1B	G, L, N
	acequinocyl (Shuttle)	12 hr	20B	G, N
	azadirachtin (Azatin)	4 hr	18B	G, L, N
	Beauveria bassiana	12 hr		Follow label
	bifenazate (Floramite)	12 hr	UN	G, L, N
	bifenthrin (Talstar)	12 hr	3	Follow label
	chlorfenapyr (Pylon)	12 hr	13	G

Table 5-14. Arthropod Management for Ornamental Plants Grown in Greenhouses

Permitted application sites: G = greenhouse, L = landscape, N = Nursery. (Trade names listed are common examples of products that contain the active ingredient, not an endorsement of a particular product.)

Insect or Mite	Pesticide common name (Example trade name)	Minimum Hours Between Application and Reentry	IRAC Mode of Action Group	Permitted application sites can differ by trade name; see label
Spider Mites (continued)	*Chromobacterium subtsugae* (Grandevo PTO)	4 hr	UN	G, L, N
	clofentezine (Ovation)	12 hr	10A	G, N
	cyflumetofen (Sultan)	12 hr	25	G, L, N
	etoxazole (TetraSan)	12 hr	10B	G, L, N
	fenazaquin (Magus)	12 hr	21A	G, L, N
	fenoxycarb (Preclude)	12 hr	7B	G
	fenpyroximate (Akari)	12 hr	21A	G, N
	hexythiazox (Hexygon)	12 hr	10B	G, L, N
	horticultural oil (various)	4 hr		Follow label
	insecticidal soaps	12 hr		Follow label
	methiocarb (Mesurol)	24 hr	1A	G, N
	pyridaben (Sanmite)	12 hr	21A	G, L, N
	spiromesifen (Judo)	12 hr	23	G, N
Thrips	abamectin (Avid)	12 hr	6	G, L, N
	acephate (Orthene)	24 hr	1B	G, L, N
	acetamiprid (TriStar)	12 hr	4A	G, L, N
	azadirachtin (Azatin)	4 hr	18B	G, L, N
	Beauveria bassiana	12 hr		Follow label
	bifenthrin (Talstar)	12 hr	3	Follow label
	chlorfenapyr (Pylon)	12 hr	13	G
	Chromobacterium subtsugae (Grandevo PTO)	4 hr	UN	G, L, N
	cyantraniliprole (Mainspring)	4 hr	28	G
	cyfluthrin (Decathlon)	12 hr	3A	G, L, N
	dinotefuran (Safari)	12 hr	4A	G, L, N
	flonicamid (Aria)	12 hr	9B	G, L, N
	fluvalinate (Mavrik)	12 hr	3A	G, L, N
	horticultural oil (various)	4 hr		Follow label
	imidacloprid (Marathon II, others)	12 hr	4A	Follow label
	kinoprene (Enstar II)	4 hr	7A	G
	Isaria fumosorosea (NoFly, Preferal)	4-12 (see label)	UN	follow label
	methiocarb (Mesurol)	24 hr	1A	G, N
	novaluron (Pedestal)	12 hr	5	G, N
	pyrethrins (various)	12 hr	3A	G, L, N
	pyridalyl (Overture)	12 hr	UN	G
	spinetoram + sulfoxaflor (XXpire)	12 hr	4C + 5	G, L, N
	spinosad (Conserve)	4 hr	5	G, L, N
	thiamethoxam (Flagship)	12 hr	4A	G, N
	tolfenpyrad (Hachi-Hachi)	12 hr	21A	G
Whitefly	abamectin (Avid)	12 hr	6	G, L, N
	acephate (Orthene)	24 hr	1B	G, L, N
	acetamiprid (TriStar)	12 hr	4A	G, L, N
	afidopyropen (Ventigra)	12 hr	9D	G, L, N
	azadirachtin (Azatin)	4 hr	18B	G, L, N
	Beauveria bassiana	12 hr		Follow label
	bifenthrin (Talstar)	12 hr	3	Follow label
	buprofezin (Talus)	12 hr	16	G, N
	cyantraniliprole (Mainspring)	4 hr	28	G
	cyfluthrin (Decathlon)	12 hr	3A	G, L, N
	dinotefuran (Safari)	12 hr	4A	G, L, N
	fenazaquin (Magus)	12 hr	21A	G, L, N
	fenoxycarb (Preclude)	12 hr	7B	G
	flonicamid (Aria)	12 hr	9B	G, L, N
	fluvalinate (Mavrik)	12 hr	3A	G, L, N
	horticultural oil (various)	4 hr		G, L, N
	imidacloprid (Marathon II, others)	12 hr	4A	Follow label
	insecticidal soaps	12 hr		G, L, N
	kinoprene (Enstar II)	4 hr	7A	G
	neem oil (Various)	4 hr	UN	G, L, N
	novaluron (Pedestal)	12 hr	5	G, N
	permethrin (Astro, others)	12 hr	3	Follow label
	pyridaben (Sanmite)	12 hr	21A	G, L, N
	pyriproxyfen (Distance)	12 hr	7C	G, L, N
	pyrifluquinazon (Rycar)	12 hr	UN	G
	spinetoram + sulfoxaflor (XXpire)	12 hr	4C + 5	G, L, N
	spirotetramat (Kontos)	24 hr foliar (see exception for drench application)	23	G, N
	thiamethoxam (Flagship)	12 hr	4A	G, N
	tolfenpyrad (Hachi-Hachi)	12 hr	21A	G

Arthropod Management for Ornamental Plants Grown in Nurseries or Landscapes

S. D. Frank, Entomology and Plant Pathology

Successful pest management programs use a combination of appropriate pest control tactics. Always follow label precautions when handling or applying pesticides. Make chemical control part of an integrated pest management program that includes monitoring and pest identification along with appropriate cultural, physical, horticultural, and biological controls.

Responsible pesticide use includes resistance management. A system has been developed by the Insecticide Resistance Action Committee (IRAC; www.irac-online.org) to help you rotate chemicals correctly. Pesticides have been assigned an IRAC classification number based on their mode of action. To rotate properly, choose a product with a different IRAC number for each successive application directed against the same pest. Follow resistance management instructions on the label.

The information in this chart is not a substitute for the label. Pesticide labels and restrictions change frequently. The label will provide the most updated information. Read and understand all label information before using any pesticide. Do not use pesticides for uses other than those on the label. Check county and state regulations for any local restrictions on the use of products listed here before using them.

Table 5-15. Arthropod Management for Ornamental Plants Grown in Nurseries or Landscapes

Permitted application sites: G = greenhouse, L = landscape, N = Nursery. (Trade names listed are common examples of products that contain the active ingredient, not an endorsement of a particular product.)

Insect or Mite	Pesticide common name (Example trade name)	Minimum Hours Between Application and Reentry	IRAC Mode of Action Group	Permitted application sites can differ by trade name; see label
Adelgid	acetamiprid (TriStar)	12 hr	4A	G, L, N
	azadirachtin (Azatin)	4 hr	18B	G, L, N
	bifenthrin (Talstar)	12 hr	3	Follow label
	bifenthrin + imidacloprid (Allectus)	12 hr	3 + 4A	L
	bifenthrin + clothianidin (Aloft)	12 hr	4 + 4A	L
	chlorantraniliprole (Acelepryn)	4 hr	28	L
	dinotefuran (Safari)	12 hr	4A	G, L, N
	horticultural oil (various)	4 hr		G, L, N
	imidacloprid (Merit, Marathon, others)	12 hr	4A	Follow label
	insecticidal soap (various)	12 hr		G, L, N
	spirotetramat (Kontos)	24 hr foliar (see exception for drench application)	23	G, N
	thiamethoxam (Flagship)	12 hr	4A	G, N
Aphid	abamectin (Avid)	12 hr	6	G, L, N
	acephate (Orthene)	24 hr	1B	G, L, N
	acetamiprid (TriStar)	12 hr	4A	G, L, N
	afidopyropen (Ventigra)	12 hr	9D	G, L, N
	azadirachtin (Azatin)	4 hr	18B	G, L, N
	bifenthrin + imidacloprid (Allectus)	12 hr	3 + 4A	L
	bifenthrin (Talstar)	12 hr	3	Follow label
	bifenthrin + clothianidin (Aloft)	12 hr	4 + 4A	L
	Beauveria bassiana (BotaniGard)	4 hr		G, L, N
	carbaryl (Sevin)	12 hr	1A	L, N
	clothianidin (Celero, Arena)	12 hr	4A	Follow label
	cyfluthrin (Decathlon)	12 hr	3	G, N
	fluvalinate (Mavrik)	12 hr	3	G, L
	horticultural oil (various)	4 hr		G, L, N
	imidacloprid (Merit, Marathon)	12 hr	4A	Follow label
	neem oil (Triact) 70	4 hr	18B	G, L, N
	permethrin (Astro, Perm-up, others)	12 hr	3	Follow label
	pymetrozine (Endeavor)	12 hr	9B	G, L, N
	pyrethrins (various)	12 hr	3A	G, L, N
	pyriproxyfen (Distance)	12 hr	7C	G, L, N
	insecticidal soap (various)	12 hr Follow label directions		G, L, N
	spinetoram + sulfoxaflor (XXpire)	12 hr	4C + 5	G, L, N
	spirotetramat (Kontos)	24 hr foliar (see exception for drench application)	23	G, N
	thiamethoxam (Flagship)	12 hr	4A	G, N
Armored Scale (such as Juniper scale, Oystershell scale, Pine needle scale, Tea scale, Euonymus scale, White peach scale)	acephate (Orthene)	24 hr	1B	G, L, N
	acetamiprid (TriStar)	12 hr	4A	G, L, N
	afidopyropen (Ventigra)	12 hr	9D	G, L, N
	azadirachtin (Azatin)	4 hr	18B	G, L, N
	bifenthrin (Talstar)	12 hr	3	Follow label
	buprofezin (Talus)	12 hr	16	G, L, N
	carbaryl (Sevin)	Follow label directions	1A	L, N
	dinotefuran (Safari)	12 hr	4A	G, L, N
	horticultural oil (various)	4 hr		G, L, N
	insecticidal soap (various)	Follow label directions 12 hr		G, L, N
	neem oil (Triact) 70	4 hr	18B	G, L, N
	pyriproxyfen (Distance)	12 hr	7C	G, L, N
	spinetoram + sulfoxaflor (XXpire)	12 hr	4C + 5	G, L, N

Table 5-15. Arthropod Management for Ornamental Plants Grown in Nurseries or Landscapes

Permitted application sites: G = greenhouse, L = landscape, N = Nursery. (Trade names listed are common examples of products that contain the active ingredient, not an endorsement of a particular product.)

Insect or Mite	Pesticide common name (Example trade name)	Minimum Hours Between Application and Reentry	IRAC Mode of Action Group	Permitted application sites can differ by trade name; see label
Ambrosia Beetle	bifenthrin (Talstar)	12 hr	3	Follow label
	permethrin (Astro, Perm-up, Permethrin Pro)	12 hr	3	Follow label
Bark Beetles	bifenthrin (Onyx, Talstar)	Follow label directions	3	Follow label
	permethrin (Astro, Perm-up, others	12 hr	3	Follow label
Borers (Clearwing, flatheaded, and roundheaded borers are included in this section. Make sure label specifically lists the type of borer you are trying to control.)	azadirachtin (Azatin)	4 hr	18B	G, L, N
	chlorantraniliprole (Acelepryn)	4 hr	28	L
	cyfluthrin + imidacloprid (Discus)	12 hr	3 + 4A	N
	dinotefuran (Safari)	12 hr	4A	G, L, N
	imidacloprid (Merit, Marathon II, others)	12 hr	4A	Follow label
	bifenthrin (Onyx, Talstar)	Follow local regulations for landscape reentry	3	Follow label
	permethrin (Astro, Perm-up, Permethrin Pro)	12 hr	3	Follow label
Caterpillars (such as armyworm, bagworm, budworm, eastern tent caterpillar, fall webworm, orangestriped oakworm, leafrollers)	abamectin (Avid)	12 hr	6	G, L, N
	acephate (Orthene)	24 hr	1B	G, L, N
	acetamiprid (Tri-Star)	12 hr	4A	G, L, N
	azadirachtin (Azatin)	4 hr	18B	G, L, N
	Bacillus thuringiensis kurstaki (DiPel)	4 hr	11B2	G, L, N
	bifenthrin (Onyx, Talstar)	Follow label directions	3	Follow label
	bifenthrin + imidacloprid (Allectus)	12 hr	3 + 4A	L
	bifenthrin + clothianidin (Aloft)	12 hr	4 + 4A	L
	carbaryl (Sevin)	12 hr	1A	L, N
	chlorantraniliprole (Acelepryn)	4 hr	28	L
	chlorfenapyr (Pylon)	12 hr	13	G
	cyfluthrin (Decathlon)	12 hr	3A	G, L, N
	diflubenzuron (Dimilin)	12 hr	15	L, N
	emamectin benzoate (Arbormectin)	see label	6	L
	indoxacarb (Provaunt)	12 hr	22	L
	insecticidal soap (various)	Follow label directions		G, L, N
	methoxyfenozide (Intrepid)	4 hr	18	G, L, N
	novaluron (Pedestal)	12 hr	15	G, N
	permethrin (Astro, Perm-up, Permethrin Pro)	12 hr	3	Follow label
	spinosad (Conserve SC)	4 hr	5	G, N
	spinetoram + sulfoxaflor (XXpire)	12 hr	4C + 5	G, L, N
	tebufenozide (Confirm)	4 hr	18A	L, N
Eriophyid Mite	abamectin (Avid)	12 hr	6	G, L, N
	fenpyroximate (Akari)	12 hr	21A	G, N
	horticultural oil (various)	4 hr		G, L, N
	spiromesifen (Judo, Forbid)	12 hr	23	G, N
False Spider Mites (such as privet mite)	acequinocyl (Shuttle)	12 hr	20B	G, N
	bifenazate (Floramite)	12 hr	Un	G, N, L
	etoxazole (TetraSan)	12 hr	10B	G, N, L
False Spider Mites (such as privet mite) (controlled)	horticultural oil (various)	4 hr		G, N, L
	insecticidal soaps	12 hr		G, N, L
	spiromesifen (Judo, Forbid)	12 hr	23	follow label
Fungus Gnats	acetamiprid (TriStar)	12 hr	4A	G, L, N
	azadirachtin (Azatin)	4 hr	18B	G, L, N
	Bacillus thuringiensis var. israelensis	4 hr	11A1	Follow label
	bifenthrin (Talstar)	12 hr	3	Follow label
	chlorfenapyr (Pylon)	12 hr	13	G
	cyfluthrin (Decathlon)	12 hr	3A	G, L, N
	cyromazine (Citation)	12 hr	17	G, L, N
	diflubenzuron (Adept)	12 hr	15	G
	dinotefuran (Safari)	12 hr	4A	G, L, N
	fluvalinate (Mavrik)	12 hr	3A	G, L, N
	imidacloprid (Marathon)	12 hr	4A	G, N
	insecticidal soaps	12 hr		G, L, N
	kinoprene (Enstar II)	4 hr	7A	G
	permethrin (Astro, others)	12 hr	3	Follow label
Grasshopper	bifenthrin (Onyx, Talstar)	12 hr	3	Follow label
	carbaryl (Sevin) 5 bait	Follow label directions	1A	Follow label
	cyfluthrin (Decathlon)	Follow label directions	3	G, N
	insecticidal soap (various)	12 hr		G, L, N

Table 5-15. Arthropod Management for Ornamental Plants Grown in Nurseries or Landscapes

Permitted application sites: G = greenhouse, L = landscape, N = Nursery. (Trade names listed are common examples of products that contain the active ingredient, not an endorsement of a particular product.)

Insect or Mite	Pesticide common name (Example trade name)	Minimum Hours Between Application and Reentry	IRAC Mode of Action Group	Permitted application sites can differ by trade name; see label
Lacebugs	abamectin (Avid)	12 hr	6	G, L, N
	acephate (Orthene)	Follow label directions	1A	G, L, N
	azadirachtin (Azatin XL)	4 hr	18B	G, L, N
	Beauveria bassiana (BotaniGard)	4 hr		G, L, N
	bifenthrin (Talstar, Onyx)	12 hr	3	Follow label
	bifenthrin + clothianidin (Aloft)	12 hr	4 + 4A	L
	bifenthrin + imidacloprid (Allectus)	12 hr	3 + 4A	L
	carbaryl (Sevin)	12 hr	1A	L, N
	chlorantraniliprole (Acelepryn)	4 hr	28	L
	Chromobacterium subtsugae (Grandevo PTO)	4 hr	UN	G, L, N
	cyfluthrin + imidacloprid (Discus)	12 hr	3 + 4A	N
	dinotefuran (Safari)	12 hr	4A	G, L, N
	imidacloprid (Merit, Marathon, others)	12 hr	4A	Follow label
	insecticidal soaps	12 hr		G, L, N
	permethrin (Astro, Perm-up, Permethrin Pro)	12 hr	3	Follow label
	soap (Olympic Insecticidal)	Follow label directions 12 hr		Follow label
	spinetoram + sulfoxaflor (XXpire)	12 hr	4C + 5	G, L, N
	thiamethoxam (Flagship)	12 hr	4A	G, N
Leaf feeding beetles (such as cucumber beetle, elm leaf beetle, willow leaf beetle, flea beetles, weevils, Japanese beetles)	acephate (Orthene)	12 hr	1A	G, L, N
	acetamiprid (TriStar)	12 hr	4A	G, L, N
	azadirachtin (Azatin XL)	4 hr	18B	G, L, N
	Beauveria bassiana (BotaniGard)	4 hr		G, L, N
	bifenthrin (Onyx, Talstar)	12 hr	3	Follow label
	bifenthrin + clothianidin (Aloft)	12 hr	4 + 4A	L
	bifenthrin + imidacloprid (Allectus)	12 hr	3 + 4A	L
	carbaryl (Sevin)	12 hr	3	L, N
	chlorantraniliprole (Acelepryn)	4 hr	28	L
	cyfluthrin + imidacloprid (Discus)	12 hr	3 + 4A	N
	dinotefuran (Safari)	12 hr	4A	G, L, N
	horticultural oil (various)	4 hr		G, N, L
	imidacloprid (Merit, Marathon II, others)	12 hr	4A	Follow label
	insecticidal soaps	12 hr		G, L, N
	Isaria fumosorosea (NoFly, Preferal)	4-12 (see label)	UN	Follow label
	spinosad (Conserve SC)	4 hr	5	G, N
	spinetoram + sulfoxaflor (XXpire)	12 hr	4C + 5	G, L, N
	thiamethoxam (Flagship)	12 hr	4A	G, N
Leafhoppers (such as potato leafhopper and sharpshooters)	abamectin (Avid)	12 hr	6	G, L, N
	acephate (Orthene)	Follow label directions	1A	G, L, N
	azadirachtin (Azatin XL)	4 hr	18B	G, L, N
	Beauveria bassiana (BotaniGard)	4 hr		G, L, N
	bifenthrin (Talstar, Onyx)	12 hr	3	Follow label
	bifenthrin + clothianidin (Aloft)	12 hr	4 + 4A	L
	bifenthrin + imidacloprid (Allectus)	12 hr	3 + 4A	L
	carbaryl (Sevin)	12 hr	1A	L, N
	chlorantraniliprole (Acelepryn)	4 hr	28	L
	Chromobacterium subtsugae (Grandevo PTO)	4 hr	UN	G, L, N
	cyfluthrin + imidacloprid (Discus)	12 hr	3 + 4A	N
	dinotefuran (Safari)	12 hr	4A	G, L, N
	horticultural oil (various)	4 hr		G, N, L
	imidacloprid (Merit, Marathon, others)	12 hr	4A	Follow label
	insecticidal soaps	12 hr		G, L, N
	permethrin (Astro, Perm-up, Permethrin Pro)	12 hr	3	Follow label
	soap (Olympic Insecticidal)	Follow label directions 12 hr		Follow label
	spinetoram + sulfoxaflor (XXpire)	12 hr	4C + 5	G, L, N
	spirotetramat (Kontos)	24 hr foliar (see exception for drench application)	23	G, N
	thiamethoxam (Flagship)	12 hr	4A	G, N

Table 5-15. Arthropod Management for Ornamental Plants Grown in Nurseries or Landscapes

Permitted application sites: G = greenhouse, L = landscape, N = Nursery. (Trade names listed are common examples of products that contain the active ingredient, not an endorsement of a particular product.)

Insect or Mite	Pesticide common name (Example trade name)	Minimum Hours Between Application and Reentry	IRAC Mode of Action Group	Permitted application sites can differ by trade name; see label
Leafminers (such as boxwood leafminer, holly leafminer, birch leafminer) Note this includes dipterous, lepidopterous, and coleopteran leafminers. Make sure leafminer to be treated is listed on label.	abamectin (Avid)	Follow label directions	6	G, L, N
	acephate (Orthene)	Follow label directions	1A	G, L, N
	acetamiprid (TriStar)	24 hr	4A	G, L, N
	azadirachtin (Azatin XL)	12 hr	18B	G, L, N
	bifenthrin (Onyx, Talstar)	Follow label directions	3	Follow label
	carbaryl (Sevin)	12 hr	1A	L, N
	chlorantraniliprole (Acelepryn SC)	4 hr	28	L
	clothianidin (Arena)	12 hr	4A	L
	cyfluthrin + imidacloprid (Discus)	12 hr	3 + 4A	N
	cyromazine (Citation)	12 hr	17	G, L, N
	dinotefuran (Safari)	12 hr	4A	G, L, N
	imidacloprid (Merit, Marathon, others)	12 hr	4A	Follow label
	novaluron (Pedestal)	12 hr	15	G, N
	permethrin (Astro, Perm-up, Permethrin Pro)	12 hr	3	Follow label
	pyriproxyfen (Distance)	12 hr	7C	G, L, N
	spinosad (Conserve SC)	4 hr	5	G, N
Mealybugs	acephate (Orthene)	12 hr	1A	G, L, N
	acetamiprid (TriStar)	24 hr	4A	G, L, N
	afidopyropen (Ventigra)	12 hr	9D	G, L, N
	Beauveria bassiana (BotaniGard)	4 hr		G, L, N
	bifenthrin (Onyx, Talstar)	Follow label directions	3	Follow label
	buprofezin (Talus)	12 hr	16	G, N
	carbaryl (Sevin)	Follow label directions	1A	L, N
	clothianidin (Arena, Celero)		4A	L
	cyfluthrin (Decathlon) 20 WP	Follow label directions	3	G, N
	cyfluthrin + imidacloprid (Discus)	12 hr	3 + 4A	N
	dinotefuran (Safari)	12 hr	4A	G, L, N
	fluvalinate (Mavrik) 22.3 F	Follow label directions	3	G, L
	horticultural oil (various)	4 hr		G, L, N
	imidacloprid (Merit, Marathon, others)	12 hr	4A	Follow label
	insecticidal soap (various)	Follow label directions 12 hr		G, L, N
	neem oil (Triact)	4 hr	18B	G, L, N
	permethrin (Astro, Perm-up, Permethrin Pro)	12 hr	3	Follow label
	spinetoram + sulfoxaflor (XXpire)	12 hr	4C + 5	G, L, N
	spirotetramat (Kontos)	24 hr foliar (see exception for drench application)	23	G, N
	thiamethoxam (Flagship)	12 hr	4A	G, N
Plantbugs	bifenthrin (Onyx, Talstar)	Follow label directions	3	Follow label
	cyfluthrin (Decathlon)	Follow label directions	3	G, N
	insecticidal soap (various)	Follow label directions 12 hr		G, L, N
	permethrin (Astro, others)	12 hr	3	Follow label
	spinetoram + sulfoxaflor (XXpire)	12 hr	4C + 5	G, L, N
	thiamethoxam (Flagship)	12 hr	4A	G, N
Psyllid	abamectin (Avid)	Follow label directions	6	G, L, N
	acephate (Orthene)	Follow label directions	1A	G, L, N
	acetamiprid (TriStar)	24 hr	4A	G, L, N
	azadirachtin (Azatin XL)	12 hr	18B	G, L, N
	Beauveria bassiana (BotaniGard)	4 hr		G, L, N
	bifenthrin (Onyx, Talstar)	Follow label directions	3	Follow label
	buprofezin (Talus)	12 hr	16	G, N
	carbaryl (Sevin)	Follow label directions	1A	L, N
	clothianidin (Arena, Celero)		4A	L
	cyfluthrin (Decathlon) 20 WP	Follow label directions	3	G, N
	cyfluthrin + imidacloprid (Discus)	12 hr	3 + 4A	N
	dinotefuran (Safari)	12 hr	4A	G, L, N
	imidacloprid (Merit, Marathon, others)	12 hr	4A	Follow label
	insecticidal soap (various)	12 hr		G, L, N
	neem oil (Triact)	4 hr	18B	G, L, N
	spinosad (Conserve SC)	4 hr	5	G, N
	spirotetramat (Kontos)	24 hr foliar (see exception for drench application)	23	G, N
	thiamethoxam (Flagship)	12 hr	4A	G, N

Table 5-15. Arthropod Management for Ornamental Plants Grown in Nurseries or Landscapes

Permitted application sites: G = greenhouse, L = landscape, N = Nursery. (Trade names listed are common examples of products that contain the active ingredient, not an endorsement of a particular product.)

Insect or Mite	Pesticide common name (Example trade name)	Minimum Hours Between Application and Reentry	IRAC Mode of Action Group	Permitted application sites can differ by trade name; see label
Sawfly	acephate (Orthene)	Follow label directions	1A	G, L, N
	acetamiprid (TriStar)	24 hr	4A	G, L, N
	azadirachtin (Azatin XL)	12 hr	18B	G, L, N
	bifenthrin (Onyx, Talstar)	Follow label directions	3	Follow label
	carbaryl (Sevin)	Follow label directions	1A	L, N
	chlorantraniliprole (Acelepryn SC)	4 hr	28	L
	cyfluthrin (Decathlon) 20WP	Follow label directions	3	G, N
	cyfluthrin + imidacloprid (Discus)	12 hr	3 + 4A	N
	diflubenzuron (Dimilin)	12 hr	15	L, N
	dinotefuran (Safari)	12 hr	4A	G, L, N
	emamectin benzoate (Arbormectin)	see label	6	L
	imidacloprid (Merit, Marathon, others)	12 hr	4A	Follow label
	indoxacarb (Provaunt)	12 hr	22	L
	insecticidal soap (various)	12 hr		G, L, N
	spinetoram + sulfoxaflor (XXpire)	12 hr	4C + 5	G, L, N
	spinosad (Conserve SC)	4 hr	5	G, N
	thiamethoxam (Flagship)	12 hr	4A	G, N
Slug, Snail	iron phosphate (bait)	follow label	UN	Follow label
	metaldehyde + carbaryl (Sevin) bait	Follow label directions	Follow label	Follow Label
	methiocarb (Mesurol)	24 hr	1A	Follow label
Soft Scale (such as fletcher scale, cottony maple scale, wax scale)	acetamiprid (Tri-Star)	12 hr	4A	G, L, N
	acephate (Orthene)	24 hr	1B	G, L, N
	acetamiprid (TriStar)	12 hr	4A	G, L, N
	azadirachtin (Azatin)	4 hr	18B	G, L, N
	bifenthrin (Talstar)	12 hr	3	Follow label
	buprofezin (Talus)	12 hr	16	G, N
	dinotefuran (Safari)	12 hr	4A	G, L, N
	fenoxycarb (Preclude)	12 hr	7B	G
	flonicamid (Aria)	12 hr	9B	G, L, N
	horticultural oil (various)	4 hr		G, L, N
	imidacloprid (Marathon II, others)	12 hr	4A	Follow label
	insecticidal soap (various)	12 hr		G, L, N
	neem oil (Various)	4 hr	UN	G, L, N
	pyriproxyfen (Distance)	12 hr	7C	G, L, N
	spirotetramat (Kontos)	24 hr foliar (see exception for drench application)	23	G, N
	thiamethoxam (Flagship)	12 hr	4A	G, N
Spider Mite (such as twospotted, southern red, and spruce spider mite)	abamectin (Avid)	12 hr	6	G, L, N
	acephate (Orthene)	24 hr	1B	G, L, N
	acequinocyl (Shuttle)	12 hr	20B	G, N
	azadirachtin (Azatin)	4 hr	18B	G, L, N
	Beauveria bassiana	12 hr		Follow label
	bifenazate (Floramite)	12 hr	Un	G, L, N
	bifenthrin (Talstar)	12 hr	3	Follow label
	Chromobacterium subtsugae (Grandevo PTO)	4 hr	UN	G, L, N
	clofentezine (Ovation)	12 hr	10A	G, N
	cyflumetofen (Sultan)	12 hr	25	G, L, N
	etoxazole (TetraSan)	12 hr	10B	G, L, N
	fenazaquin (Magus)	12 hr	21A	G, L, N
	fenpyroximate (Akari)	12 hr	21A	G, N
	hexythiazox (Hexygon)	12 hr	10B	G, L, N
	horticultural oil (various)	4 hr		Follow label
	insecticidal soaps	12 hr		Follow label
	pyridaben (Sanmite)	12 hr	21A	G, L, N
	spiromesifen (Judo)	12 hr	23	Follow label
Spittlebug	acephate (Orthene)	12 hr	1A	G, L, N
	cyfluthrin (Decathlon)	Follow label directions	11B2	G, N
	horticultural oil (various)	4 hr		Follow label
	insecticidal soaps	12 hr		Follow label

Table 5-15. Arthropod Management for Ornamental Plants Grown in Nurseries or Landscapes

Permitted application sites: G = greenhouse, L = landscape, N = Nursery. (Trade names listed are common examples of products that contain the active ingredient, not an endorsement of a particular product.)

Insect or Mite	Pesticide common name (Example trade name)	Minimum Hours Between Application and Reentry	IRAC Mode of Action Group	Permitted application sites can differ by trade name; see label
Thrips	abamectin (Avid)	12 hr	6	G, L, N
	acephate (Orthene)	24 hr	1B	G, L, N
	acetamiprid (TriStar)	12 hr	4A	G, L, N
	azadirachtin (Azatin)	4 hr	18B	G, L, N
	Beauveria bassiana	4 hr		G, L, N
	bifenthrin (Talstar)	Follow label directions	3	Follow label
	chlorfenapyr (Pylon)	12 hr	3A	G, L, N
	Chromobacterium subtsugae (Grandevo PTO)	12 hr	9B	G, L, N
	cyantraniliprole (Mainspring)	12 hr	3A	G, L, N
	cyfluthrin (Decathlon)	4 hr		Follow label
	dinotefuran (Safari)	12 hr	4A	G, L, N
	flonicamid (Aria)	12 hr	9B	G, L, N
	fluvalinate (Mavrik)	12 hr	3A	G, L, N
	horticultural oil (various)	4 hr		Follow label
	imidacloprid (Marathon II, others)	12 hr	4A	Follow label
	Isaria fumosorosea (NoFly, Preferal)	4-12 (see label)	UN	follow label
	methiocarb (Mesurol)	24 hr	1A	G, N
	novaluron (Pedestal)	12 hr	5	G, N
	pyrethrins (various)	12 hr	3A	G, L, N
	spinetoram + sulfoxaflor (XXpire)	12 hr	4C + 5	G, L, N
	spinosad (Conserve SC)	4 hr	4	G, N
	thiamethoxam (Flagship)	12 hr	4A	G, L, N
	tolfenpyrad (Hachi-Hachi)	12 hr	4A	G, N
Whitefly	abamectin (Avid)	12 hr	6	G, L, N
	acephate (Orthene)	24 hr	1B	G, L, N
	acetamiprid (TriStar)	12 hr	4A	G, L, N
	afidopyropen (Ventigra)	12 hr	9D	G, L, N
	azadirachtin (Azatin)	4 hr	18B	G, L, N
	Beauveria bassiana	12 hr		Follow label
	bifenthrin (Talstar)	12 hr	3	Follow label
	buprofezin (Talus)	12 hr	16	G, N
	cyfluthrin (Decathlon)	12 hr	3A	G, L, N
	dinotefuran (Safari)	12 hr	4A	G, L, N
	fenazaquin (Magus)	12 hr	21A	G, L, N
Whitefly (continued)	flonicamid (Aria)	12 hr	9B	G, L, N
	fluvalinate (Mavrik)	12 hr	3A	G, L, N
	horticultural oil (various)	4 hr		G, L, N
	imidacloprid (Marathon II, others)	12 hr	4A	Follow label
	insecticidal soaps	12 hr		G, L, N
	neem oil (Various)	4 hr	UN	G, L, N
	novaluron (Pedestal)	12 hr	5	G, N
	permethrin (Astro, others)	12 hr	3	Follow label
	pyridaben (Sanmite)	12 hr	21A	G, L, N
	pyriproxyfen (Distance)	12 hr	7C	G, L, N
	spinetoram + sulfoxaflor (XXpire)	12 hr	4C + 5	G, L, N
	spirotetramat (Kontos)	24 hr foliar (see exception for drench application)	23	G, N
	thiamethoxam (Flagship)	12 hr	4A	G, N
White Grubs (in containers or landscape plants (not turf) such as oriental and Japanese beetle)	*Beauveria bassiana* (BotaniGard)	4 hr		G, L, N
	chlorantraniliprole (Acelepryn)	4 hr	28	L
	clothianidin (Arena)	12 hr	4A	L
	dinotefuran (Safari)	12 hr	4A	G, L, N
	imidacloprid (Merit, Marathon, others)	12 hr	4A	Follow label
	thiamethoxam (Flagship)	12 hr	4A	G, N

Arthropod Control on Christmas Trees

J. R. Sidebottom, Entomology Forestry

Table 5-16. Arthropod Control on Christmas Trees
**** N.C. label**

Insect or Mite	Insecticide and Formulations	Amount per 100 Gallons of Water	Minimum Interval (Hours) Between Application and Reentry	Precautions and Remarks
Adelgids (Balsam Woolly Adelgid, Cooley, Eastern Spruce Gall)	bifenthrin (Talstar S Select)	20 to 40 fl oz/acre	12	Will also control twig aphids and spider mites but not rust mites.
	bifenthrin 25% (Sniper)	3.9 to 12.8 fl oz/acre	12	Will also control twig aphids and spider mites but not rust mites.
	bifenthrin (OnyxPro)	1.8 to 14.4 fl oz/100 gal	12	
	chlorpyrifos (Lorsban 4E, Nufos 4E, Warhawk - Clearform)	1 qt/acre	24	Do not treat plants under extreme heat or drought stress. Control is achieved only when eggs and crawlers are not present.
	dinotefuran (Safari)	4 to 8 oz/100 gal	12	Do not apply more than 2.7 pounds per acre.
	esfenvalerate (Asana XL)	5.8 to 9.6 fl oz/100 gal	12	Use full rate to control balsam woolly adelgid.
	imidacloprid (Admire Pro)	1.4 to 2.8 fl oz/acre	12	
	insecticidal soap (M-Pede)	1 to 2 gal/100 gal	12	May cause foliage discoloration.
	lambda-cyhalothrin (Silencer or Warrior II)	1.28 to 2.56 fl oz/acre	24	Maximum use 0.96 pints per acre per year.
	petroleum oil (Damoil)	2 to 4 gal/100 gal dormant use 1 to 3 gal/100 gal summer use	4	
	spirotetramat (Movento)	5 to 10 fl oz/acre	24	Maximum use 20 fluid ounces per acre per year. Use adjuvant to increase penetration.
Ants *(Also see "Imported Fire Ant" under Home Lawns table)*	bifenthrin (Talstar S Select)	20 to 40 fl oz/acre	12	
	carbaryl (Sevin SL)	1 qt/acre	12	
	chlorpyrifos (Lorsban 4E, Nufos 4E, Warhawk - Clearform)	1 qt/acre	24	Do not treat plants under extreme heat or drought stress.
	insecticidal soap (M-Pede)	1 to 2 gal/100 gal	12	May cause foliage discoloration.
Aphid (including Balsam Twig Aphid and Cinara Aphid)	abamectin (Ardent 0.15 EC, Avid 0.15 EC, Reaper 0.15 EC)	8 fl oz/100 gal	12	Do not apply more than 16 ounces or less than 8 ounces per acre. To suppress aphids, spray must contact young immatures.
	azadirachtin (Aza-Direct)	1 to 2 pt/acre	4	Under extremely heavy pest pressure up to 3.5 pints may be used.
	Beauveria bassiana (BotaniGard ES)	up to 3 qt/100 gal	4	Spray immediately after mixing.
	bifenthrin (Talstar S Select)	5 to 10 fl oz/acre	12	
	bifenthrin 25% (Sniper)	3.9 to 12.8 fl oz/acre	12	Will also control twig aphid and spider mites but not rust mites.
	bifenthrin (OnyxPro)	1.8 to 14.4 fl oz/100 gal	12	
	carbaryl (Sevin SL)	1 qt/acre	12	
	chlorpyrifos (Lorsban 4E, Nufos 4E, Warhawk - Clearform)	1 qt/acre	24	Do not treat plants under extreme heat or drought stress.
	dimethoate (Dimethoate 4 EC, Dimethoate 400)	1 to 1.5 pt/acre	10 days	
	esfenvalerate (Asana XL)	5.8 to 9.6 fl oz/100 gal	12	
	flupyradifurone (Altus)	7 to 14 fl oz/acre	4	Not for use in bare-ground plantations. May also control balsam woolly adelgid
	imidacloprid (Admire Pro)	1.4 to 2.8 fl oz/acre	12	
	insecticidal soap (M-Pede)	1 to 2 gal/100 gal	12	May cause foliage discoloration.
	lambda-cyhalothrin (Silencer or Warrior II)	1.28 to 2.56 fl oz/acre	24	Maximum use 0.96 pints per acre per year
	mineral oil emulsion (TriTek)	1 to 2 gal/100 gal	4	Maintain agitation until solution is used.
	petroleum oil (Damoil)	2 to 4 gal/100 gal dormant use 1 to 3 gal/100 gal summer use	4	
	pymetrozine (Endeavor)	Up to 10 oz/acre	12	Maximum use 48 ounces per acre per year.
	spirotetramat (Movento)	5 to 10 fl oz/acre	24	Maximum use 20 fluid ounces per acre per year. Use adjuvant to increase penetration.
	thiamethoxam (Flagship 25WG)	2 to 8.5 oz/100 gal or 4 to 17 oz/acre	12	Maximum use 17 ounces per acre per year. Also effective on root aphids.

Table 5-16. Arthropod Control on Christmas Trees
**** N.C. label**

Insect or Mite	Insecticide and Formulations	Amount per 100 Gallons of Water	Minimum Interval (Hours) Between Application and Reentry	Precautions and Remarks
Bagworm	azadirachtin (Aza-Direct)	1 to 2 pt/acre	4	Under extremely heavy pest pressure up to 3.5 pints may be used.
	bifenthrin (Talstar S Select)	5 to 10 fl oz/acre	12	
	carbaryl (Sevin SL)	1 qt/acre	12	
	diflourobenzamide (Dimilin 4L)	1 to 2 fl oz/acre	12	Apply to early instars in mid to late June.
	dimethoate (Dimethoate 4 EC, Dimethoate 400 EC)	1 to 1 1/2 pt/acre	10 days	
	lambda-cyhalothrin (Silencer or Warrior II)	1.28 to 2.56 fl oz/acre	24	Maximum use 0.96 pints per acre per year
	spinosad (Conserve SC)	4 to 16 oz/acre	4	
	tebufenozide (Mimic 2LV)	4 to 8 fl oz/acre	4	Apply to early instar larvae; foliage development should be minimum of 20%. Do not apply more than 16 ounces per acre per year.
Elongate Hemlock Scale and Cryptomeria Scale	bifenthrin 25% (Sniper)	3.9 to 12.8 fl oz/acre	12	Will also control twig aphid and spider mites but not rust mites. Best results when mixed with a systemic.
	buprofezin (Talus 70 DF)	14 oz/acre	12	Do not apply more than 28 pounds per acre.
	dimethoate (Dimethoate 4 EC, Dimethoate 400 EC)	1 to 1 1/2 pt/acre	10 days	Best results when mixed with other materials.
	esfenvalerate (Asana XL)	5.8 to 9.6 fl oz/100 gal	12	Best results when mixed with a systemic.
	dinotefuran (Safari SG)	4 to 8 oz/100 gal	12	Do not apply more than 2.7 pounds per acre.
	mineral oil emulsion (TriTek)	1 to 2 gal/100 gal	4	Maintain agitation until solution is used.
	spirotetramat (Movento)	5 to 10 fl oz/are	24	Maximum use 20 fluid ounces per acre per year. Use adjuvant to increase penetration.
European Pine Shoot Moth	azadirachtin (Aza-Direct)	1 to 2 pt/acre	4	Under extremely heavy pest pressure up to 3.5 pints may be used.
	chlorpyrifos (Lorsban 4E)	1 qt/acre	24	Do not treat plants under extreme heat or drought stress.
	dimethoate (Dimethoate 4 EC, Dimethoate 400 EC)	1 to 1 1/2 pt/acre	10 days	
	phosmet (Imidan 70-W)	1.3 to 1.5 lb/acre	13 days	
Gypsy Moth	azadirachtin (Aza-Direct)	1 to 2 pts/acre	4	Under extremely heavy pest pressure up to 3.5 pints may be used.
	bifenthrin (Talstar S Select)	10 to 20 fl oz/acre	12	
	carbaryl (Sevin SL)	0.75 to 1 qt/acre	12	
	chlorpyrifos (Lorsban 4E Warhawk - Clearform)	1 qt/acre	24	Do not treat plants under extreme heat or drought stress.
	diflourobenzamide (Dimilin 4L)	0.5 to 2 fl oz/acre	12	Apply to early instar and prior to full leaf expansion.
	insecticidal soap (M-Pede)	1 to 2 gal/100 gal	12	May cause foliage discoloration.
	lambda-cyhalothrin (Silencer or Warrior II)	1.28 to 2.56 fl oz/acre	24	Maximum use 0.96 pints per acre per year
	phosmet (Imidan 70-W)	1.3 to 1.5 lb/acre	13 days	
	spinosad (Conserve SC)	4 to 16 fl oz/acre	4	
	spinosad (Blackhawk Naturalyte)	1.1 to 4.4 oz/acre	4	
	tebufenozide (Mimic 2LV)	4 to 8 fl oz/acre	4	Apply to early instar larvae after each foliage flush at approximately 25% foliage expansion. Allow at least 6 hours between application and rainfall to assure thorough spray drying.
Midge (Douglas fir needle midge, pine needle midge)	chlorpyrifos (Lorsban 4E)	1 qt/acre	24	Do not treat plants under extreme heat or drought stress.
	esfenvalerate (Asana XL)	5.8 to 9.6 fl oz/100 gal	12	
	azadirachtin (Aza-Direct)	1 to 2 pt/acre	4	Under extremely heavy pest pressure up to 3.5 pints may be used.
	carbaryl (Sevin SL)	1 qt/acre	12	
Nantucket Pine Tip Moth	diflourobenzamide (Dimilin 4L)	1 to 2 fl oz/acre	12	Apply when second generation instars are present or 70% of first generation pupal cases are empty.
	dimethoate (Dimethoate 4 EC, Dimethoate 400 EC)	1 to 1 1/2 pt/acre	10 days	
	esfenvalerate (Asana XL)	5.8 to 9.6 fl oz/100 gal	12	Apply as needed for control. Spray sufficient gallonage to obtain good coverage of entire tree.
	phosmet (Imidan 70-WSB)	1.3 to 1.5 lb/acre	13 days	
	tebufenozide (Mimic 2LV)	8 fl oz/acre	4	Apply to early instar larvae after each foliage flush at approximately 25% foliage expansion. Allow at least 6 hours between application and rainfall to assure thorough spray drying.

Table 5-16. Arthropod Control on Christmas Trees
**** N.C. label**

Insect or Mite	Insecticide and Formulations	Amount per 100 Gallons of Water	Minimum Interval (Hours) Between Application and Reentry	Precautions and Remarks
Pine Chafer	esfenvalerate (Asana XL)	5.8 to 9.6 fl oz/100 gal	12	
	lambda-cyhalothrin (Silencer or Warrior II)	1.28 to 2.56 fl oz/acre	24	Maximum use 0.96 pints per acre per year
Rosette Bud Mite	dimethoate (various brands)	1.3 pt/100 gal	10 days	
	spirotetramat (Movento)	5 to 10 fl oz/acre	24	Maximum use 20 fluid ounces per acre per year. Use adjuvant to increase penetration.
Rust Mites	abamectin (Ardent 0.15EC, Avid 0.15 EC, Reaper 0.15 EC))	4 fl oz/100 gal	12	
	carbaryl (Sevin SL)	1 qt/acre	12	
	chlorpyrifos (Lorsban 4E, Warhawk - Clearform)	1 qt/acre	24	Do not treat plants under extreme heat or drought stress.
	dimethoate (Dimethoate 4 EC, Dimethoate 400 EC)	1 to 1.5 pt/acre	10 days	
	fenpyroximate (Akari 5SC)	24 fl oz/100 gal	12	Do not apply more than 105 fluid ounces per acre per year.
	insecticidal soap (M-Pede)	1 to 2 gal/100 gal	12	May cause foliage discoloration.
	mineral oil emulsion (TriTek)	1 to 2 gal/100 gal	4	Maintain agitation until solution is used.
	petroleum oil (Damoil)	2 to 4 gal/100 gal dormant use 1 to 3 gal/100 gal summer use	4	
	spirodiclofen (Envidor 2SC)	18 to 24.7 fl oz/acre	12	Make only one application per season.
Sawflies (Redheaded pine, red pine, European pine)	carbaryl (Sevin SL)	1 qt/acre	12	
	chlorpyrifos (Lorsban 4E, Warhawk - Clearform, Chlorpyrifos)	1 qt/acre	24	
	diflourobenzamide (Dimilin 4L)	2 to 4 fl oz/acre	12	Treat prior to egg deposition.
	dinotefuran (Safari SG)	4 to 8 oz/100 gal	12	Do not apply more than 2.7 pounds per acre.
	esfenvalerate (Asana XL)	5.8 to 9.6 fl oz/100 gal	12	
	imidacloprid (Admire Pro)	1.4 to 2.8 fl oz/acre	12	
	insecticidal soap (M-Pede)	1 to 2 gal/100 gal	12	May cause foliage discoloration.
	lambda-cyhalothrin (Silencer or Warrior)	1.28 to 2.56 fl oz/acre	24	Maximum use 0.96 pints per acre per year
	malathion (Malathion 8)	0.4 gal/100 gal	12	
	mineral oil emulsion (TriTek)	1 to 2 gal/100 gal	4	Maintain agitation until solution is used.
	phosmet (Imidan 70-W)	1.3 to 1.5 lb/acre	13 days	
	spinosad (Conserve SC)	4 to 16 fl oz/acre	4	
	spinosad (Blackhawk Naturalyte)	1.1 to 4.4 oz/acre	4	
	thiamethoxam (Flagship 25WP)	2 to 8.5 oz/100 gal or 4 to 17 oz/acre	12	
Scale (Pine needle, pine tortoise, spruce bud, black pine, stripped pine; see also Elongate Hemlock and Cryptomeria Scale)	azadirachtin (Aza-Direct)	1 to 2 pt/acre	4	Under extremely heavy pest pressure up to 3.5 pints may be used.
	carbaryl (Sevin SL)	1 qt/acre	12	Controls crawlers only.
	chlorpyrifos (Lorsban 4E, Nufos 4E, Warhawk - Clearform)	1 qt/acre	24	Do not treat plants under extreme heat and drought stress. Apply when scale crawlers are active.
	dinotefuran (Safari SG)	4 to 8 oz/100 gal	12	Do not apply more than 2.7 pounds per acre.
	insecticidal soap (M-Pede)	1 to 2 gal/100 gal	12	May cause foliage discoloration
	lambda-cyhalothrin (Silencer)	2.58 to 5.12 fl oz/acre	24	Maximum use 1.92 pints per acre per year
	mineral oil emulsion (TriTek)	1 to 2 gal/100 gal	4	Maintain agitation until solution is used.
	petroleum oil (Damoil)	2 to 4 gal/100 gal dormant use 1 to 3 gal/100 gal summer use	4	
	spirotetramat (Movento)	5 to 10 fl oz/are	24	Maximum use 20 ounces per acre per year. Use adjuvant to increase penetration.
	thiamethoxam (Flagship 25WP)	2 to 8.5 oz/100 gal or 4 to 17 oz/acre	12	For soft scales. Maximum use 8 ounces per acre per year
Seed Bugs/Seed Chalcid	esfenvalerate (Asana XL)	9.6 fl oz/100 gal	12	
	lambda-cyhalothrin (Silencer or Warrior)	2.56 fl oz/100 gal	24	For high volume spray. See label for other application methods.
	phosmet (Imidan 70-WSB)	1.3 to 1.5 lb/acre	13 days	
Spider Mite (Spruce spider mites)	abamectin (Ardent 0.15 EC, Avid 0.15 EC, Reaper 0.15 EC)	4 to 8 fl oz/100 gal	12	Do not apply more than 16 fluid ounces or less than 8 ounces per acre.
	azadirachtin (Aza-Direct)	1 to 2 pt/acre	4	Under extremely heavy pest pressure up to 3.5 pints may be used.
	Beauveria bassiana (BotaniGard ES)	up to 3 qt/100 gal	4	Spray immediately after mixing
	bifenazate (Floramite SC)	4 to 8 fl oz/100 gal	12	Add an adjuvant like Silwet L-77 or Sylgard 309 to the Floramite solution. Do not apply more than 32 oz per acre per year.
	bifenthrin (Talstar S Select)	20 to 40 fl oz/acre	12	
	bifenthrin 25% (Sniper)	3.9 to 12.8 fl oz/acre	12	Will also control twig aphid and spider mites but not rust mites.

Table 5-16. Arthropod Control on Christmas Trees
**** N.C. label**

Insect or Mite	Insecticide and Formulations	Amount per 100 Gallons of Water	Minimum Interval (Hours) Between Application and Reentry	Precautions and Remarks
Spider Mite (Spruce spider mites) (continued)	bifenthrin (OnyxPro)	1.8 to 14.4 fl oz/100 gal	12	
	chlorpyrifos (Lorsban 4E, Nufos 4E, Warhawk - Clearform)	1 qt/acre	24	Do not treat plants under extreme heat or drought stress. If eggs are present, reapply in 7 to 10 days to control newly hatched nymphs.
	clofentezine (Apollo SC)	4 to 8 oz/acre	12	Most effective when applied at first sign of mite activity and mite eggs.
	cyflumetofen (Sultan)	13.7 fl oz/100 gal	12	Do not make more than 2 applications per year. Use at least 100 gallons of water per acre and get thorough coverage. Do not tank mix with insect or plant growth regulators or carbamate, organophosphate, or pyrethroid insecticides.
	dimethoate (Dimethoate 4 EC, Dimethoate 400 EC)	1 to 1.5 pt/acre	48	
	disulfoton (Di-Syston 15G)	1 tsp/tree; 20 to 30 lb/acre	48 where rainfall exceeds 25 in/ year	Spread the granules in the root zone of the trees at the dripline and work into the soil or water thoroughly within 48 hours of application. Not for use in bare-ground plantations.
	etoxazole (TetraSan 5 WDG)	28 to 40 oz/100 gal	12	TetraSan kills mite eggs and nymphs but not adult mite. Treated adults will not produce viable eggs. Do not apply more than 40 oz per acre per season.
	fenazaquin (Magister SC, Magus)	24 to 36 fl oz/acre 12 to 24 fl oz/acre	12	Do not exceed 36 fl oz for Magister and 24 fl oz for Magus per acre per year
	fenpyroximate (Akari 5SC)	16 to 24 oz/100 gal	12	Do not apply more than 48 fluid ounces or less than 8 ounces per acre.
	hexythiazox (Savey 50 DF)	2 oz/100 gal	12	Do not make more than one application per year.
	insecticidal soap (M-Pede)	1 to 2 gal/100 gal	12	May cause foliage discoloration.
	mineral oil emulsion (TriTek)	1 to 2 gal/100 gal	4	Maintain agitation until solution is used.
	propargite (Omite 30 WS)	3 to 7.5 lb/acre	7 days	Make no more than three applications per year. Compatibility restrictions.
	spirodiclofen (Envidor 2SC)	18 to 24.7 fl oz/acre	12	Make only one application per season.
Spittlebug	chlorpyrifos (Lorsban 4F)	1 qt/acre	24	Do not treat plants under extreme heat or drought stress.
	esfenvalerate (Asana XL)	5.8 to 9.6 fl oz/100 gal	12	
	lambda-cyhalothrin (Silencer or Warrior)	1.28 to 2.56 fl oz/acre	24	Maximum use 0.96 pints per acre per year
Spruce Needle Miner	chlorpyrifos (Lorsban 4E)	1 qt/acre	24	Do not treat plants under extreme heat or drought stress.
Weevils (pales, northern pine, pitch eating, root collar, white pine)	azadirachtin (Aza-Direct)	1 to 2 pt/acre	4	Under extremely heavy pest pressure up to 3.5 pints may be used.
	chlorpyrifos (Lorsban 4E or Nufos 4E)	3 qt/100 gal	24	Apply as a cut stump drench.
	diflourobenzamide (Dimilin 4L)	4 to 8 fl oz/100 gal	12	Treat prior to egg deposition. Do not exceed 8 ounces per acre per year
	esfenvalerate (Asana XL)	5.8 to 9.6 fl oz/100 gal	12	
	phosmet (Imidan 70-WSP)	1.3 to 1.5 lb/acre	13 days	
White Grubs	chlorpyrifos (Lorsban 4E, Nufos 4E, Warhawk - Clearform)	1 qt/acre	24	Incorporate into the soil if possible.
	imidacloprid (Admire Pro)	7 to 14 fl oz/acre	12	Maximum per season: 14 ounces per acre
	thiamethoxam (Flagship 25WG)	4 to 8.5 fl oz/acre	12	Apply from adult flight through peak hatch of targeted species. Do not exceed 17 ounces per acre per year.
Zimmerman Pine Moth	azadirachtin (Aza-Direct)	1 to 2 pt/acre	4	Under extremely heavy pest pressure up to 3.5 pints may be used.
	dimethoate (Dimethoate 4 EC, Dimethoate 400)	1 to 1 1/2 pt/acre	10 days	
	tebufenozide (Mimic 2LV)	4 to 8 fl oz/acre	4	Apply to early instar larvae; foliage development should be minimum of 20%. Do not apply more than 16 fluid ounces per acre per year.

Commercial Turf Insect Control

R. L. Brandenburg and T. L. Billeisen, Entomology and Plant Pathology

Table 5-17. Insect Control in Commercial Turf

Pest	Insecticide and Formulation	Amount per 1,000 sq ft	Precautions and Remarks
Annual Bluegrass Weevil	bifenthrin (Talstar, Taurus Trio)	0.25 to 0.5 fl oz	Monitor for adults, apply at peak activity. Use GC formulation for golf courses. Repeated use will lead to resistance issues. Be sure to rotate with other active ingredients to avoid resistance.
	chlorantraniliprole (Acelepryn)	.28 fl oz	Apply approximately 7 to 14 days after adult emergence to target larvae.
	cyantraniliprole (Ference)	0.28 fl oz	Monitor for adults, apply at peak activity. Apply approximately 7 to 14 days after adulticide to target larvae.
	indoxacarb (Provaunt) SC	0.28 fl oz	Monitor for adults, apply at peak activity. Apply approximately 7 to 14 days after adulticide to target larvae
	lambda-cyhalothrin (Scimitar, Cyonara)	0.23 fl oz	Monitor for adults, apply at peak activity.
	novaluron (Suprado)	See label	Apply approximately 7 to 14 days after adult emergence to target larvae.
	tetraniliprole (Tetrino)	See label	Apply approximately 7 to 14 days after adult emergence to target larvae.
Ant (also see Imported Fire Ant)	bifenthrin[1] (Talstar)	0.5 to 1 fl oz	Use GC formulation for golf courses.
	carbaryl[1]	1 to 1.5 oz	
	zeta-cypermethrin, bifenthrin, and imidacloprid (Triple Crown)	20 to 35 fl oz/acre	
	clothianidin + bifenthrin (Aloft) GC SC LC SC GC G LC G	 0.27 to 0.54 fl oz 0.27 to 0.54 fl oz 1.8 to 3.6 lb 1.8 to 3.6 lb	
	beta-cyfluthrin (Tempo SC)	0.143 fl oz	Home lawns only.
	cypermethrin[1] (Demon Max) TC	See label	
	deltamethrin (Deltagard G)	2 to 3 lb/1,000 ft	
	dinotefuran (Alucion)	See label	
	fipronil (Top Choice, Taurus G)	2 lb	
	hydramethylnon[1] (Amdro)	See label	
	lambda-cyhalothrin[1] (Scimitar, Cyonara)	See label	Do not make applications within 20 feet of any body of water. No reentry until spray has dried.
Bee and Wasp (Burrowing)	carbaryl[1]	1.5 oz	
	pyrethroids[1] (Deltagard G, Scimitar, Talstar, Tempo)	See label	
Bermudagrass Mite	abamectin (Divanem)	3.125 to 6.25 fl oz/acre	Tank mix with wetting agent and irrigate 0.1 to 0.25 in water post application. Applicator must be in possession of the 2(ee) label recommendation for restricted uses.
Billbug	bifenthrin[1] (Talstar)	0.25 to 0.5 fl oz	Use GC formulation for golf courses.
	chlorantraniliprole (Acelepryn)	0.184 to 0.46 fl oz	
	chlorpyrifos[1] (Dursban)	See label	For use on golf courses; check new label.
	clothianidin (Arena) .5G 50 WDG	 14 to 22 oz 0.15 to 0.22 oz	
	clothianidin + bifenthrin (Aloft) GC SC LC SC GC G LC G	 0.27 to 0.44 fl oz 0.27 to 0.54 fl oz 1.8 to 3.6 lb 1.8 to 3.6 lb	
	deltamethrin (Deltagard G)	2 to 3 lb/1,000 ft	
	dinotefuran (Zylam)	1 oz	
	imidacloprid[1] (Merit)	3 to 4 level tsp	Make application prior to egg hatch.
	lambda-cyhalothrin[1] (Scimitar, Cyonara)	See label	Observe restrictions near water.
	thiamethoxam (Meridian) 0.33 G 25 WG	 60 to 80 lb/acre 12.7 to 17 oz/acre	Optimum control when applied from peak flight of adults to peak of egg hatch. Also suppresses mole crickets and chinch bugs.
	zeta-cypermethrin, bifenthrin, and imidacloprid (Triple Crown)	10 to 20 fl oz/acre	
Chinch Bug	acephate[1] (Orthene)	1.2 to 2.4 oz	
	bifenthrin[1] (Talstar)	0.25 to 0.5 fl oz	Use GC formulation for golf courses.
	carbaryl[1] (Sevin)	2.5 to 3 oz	
	chlorantraniliprole (Acelepryn)	0.184 to 0.46 fl oz	Suppression.
	clothianidin (Arena) .5G 50 WDG	 1.4 to 1.8 lb 0.2 to 0.3 oz	

Table 5-17. Insect Control in Commercial Turf

Pest	Insecticide and Formulation	Amount per 1,000 sq ft	Precautions and Remarks
Chinch Bug (continued)	clothianidin + bifenthrin (Aloft) GC SC LC SC GC G LC G	 0.27 to 0.44 fl oz 0.27 to 0.54 fl oz 1.8 to 3.6 lb 1.8 to 3.6 lb	
	chlorpyrifos[1] (Dursban)	See label	For use on golf courses; check new label.
	beta-cyfluthrin (Tempo SC)	0.2 fl oz	Home lawns only.
	cypermethrin (Demon Max)	0.33 to 0.65 fl oz	
	deltamethrin (Deltagard G)	2 to 3 lb/1,000 ft	
	dinotefuran (Zylam)	1 oz	For suppression.
	lambda-cyhalothrin[1] (Scimitar, Cyonara)	See label	Do not make applications within 20 feet of any body of water. No reentry until spray has dried.
	permethrin[1] (Astro)	0.4 to 0.8 fl oz	
	zeta-cypermethrin, bifenthrin, and imidacloprid (Triple Crown)	20 to 35 fl oz/acre	
Cutworm, Armyworm	acephate[1] (Orthene)	1.2 to 2.4 oz	Commercial and residential turf only.
	azadirachtin[1] (Neemix)	See label	
	bifenthrin[1] (Talstar)	0.18 to 0.25 fl oz	Use GC formulation for golf courses.
	Bt products, various labels	See label	
	carbaryl[1]	0.75 to 1.5 oz	Treat in late afternoon. Apply in adequate water for good coverage but do not flood or water in. Do not cut grass for 1 to 3 days after treatment.
	chlorantraniliprole (Acelepryn)	0.046 to 0.092 fl oz	
	chlorpyrifos[1] (Dursban)	See label	For use on golf courses; check new label.
	clothianidin (Arena) .5G 50 WDG	 1.4 to 1.8 lb 0.2 to 0.3 oz	Cutworms only.
	clothianidin + bifenthrin (Aloft) GC SC LC SC GC G LC G	 0.27 to 0.54 fl oz 0.27 to 0.54 fl oz 1.8 to 3.6 lb 1.8 to 3.6 lb	
	beta-cyfluthrin[1] (Tempo SC)	0.143 fl oz	Home lawns only.
	deltamethrin (Deltagard G)	2 to 3 lb/1,000 ft	
	dinotefuran (Zylam) 20 SG	1 oz	
	entomogenous nematodes[1]	See label	Read and follow special application instructions. Effective only against small cutworms.
	indoxacarb (Provaunt)	0.0625 to 0.25 fl oz	Not labeled for use on sod farms.
	lambda-cyhalothrin[1] (Scimitar, Cyonara)	See label	Do not make applications within 20 feet of any body of water. No reentry until spray has dried.
	spinosad A + D (Conserve SC)	1.25 fl oz	Rate varies with size and species.
	tetraniliprole (Tetrino)	0.367 to 0.735 fl oz	Apply when pest presence first observed or anticipated
	trichlorfon (Dylox)	1.5 to 3 oz	
Earthworm			Usually not a problem. No effective controls available.
Fall Armyworm	acephate[1] (Orthene)	0.5 to 1.2 oz	Water in immediately after application.
	chlorantraniliprole (Acelepryn)	0.046 to 0.092 fl oz	
	chlorpyrifos[1] (Dursban)	See label	For use on golf courses; check new label.
	indoxacarb (Provaunt)	0.0625 to 0.25 fl oz	Not labeled for use on sod farms.
	pyrethroids[1] (Deltagard G, Scimitar, Talstar, Tempo, Cyonara)	See label	
	spinosad A + D (Conserve SC)	1.25 fl oz	Rate varies with size and species.
	tetraniliprole (Tetrino)	0.367 to 0.735 fl oz	Apply when pest presence first observed or anticipated
Grasshopper	acephate[1] (Orthene)	0.5 oz	Do not mow turfgrass for at least 24 hours after application.
	deltamethrin (Deltagard G)	2 to 3 lb/1,000 ft	
	lambda-cyhalothrin[1] (Scimitar, Cyonara)	See label	Do not make applications within 20 feet of any body of water. No reentry until spray has dried.
Ground Pearl	bifenthrin + zeta-cypermethrin (GardenTech Sevin Insect Killer Lawn Granules)	See label	Labeled for ground pearl control but not very effective.
Imported Fire Ant (See www.ncagr.gov/plantindustry/plant/entomology/documents/ncifaquarantine.pdf for latest quarantine areas.)	acephate[1] (Lesco-Fate) (Orthene,)	 See label 1 to 2 tsp/mound	 Distribute uniformly over mound. For best results apply in early morning or late afternoon.
	bifenthrin[1] (Talstar)		Follow label directions.
	clothianidin + bifenthrin (Aloft) GC SC LC SC GC G LC G	See label 0.27 to 0.44 fl oz 0.27 to 0.54 fl oz 1.8 to 3.6 lb 1.8 to 3.6 lb	

Table 5-17. Insect Control in Commercial Turf

Pest	Insecticide and Formulation	Amount per 1,000 sq ft	Precautions and Remarks
Imported Fire Ant (See www.ncagr.gov/plantindustry/plant/entomology/documents/ncifaquarantine.pdf for latest quarantine areas.)	deltamethrin (Deltagard G)	2 to 3 lb	
	fipronil (Topchoice, Chipco Choice, Maxforce FC)	2 lb	Apply as a broadcast.
	fipronil + bifenthrin + lambda-cyhalothrin (Taurus Trio G)	2 lb	Apply as a broadcast. Irrigate prior to treatment.
	hydramethylnon[1] (Amdro) 0.88% bait	— See label	Uniformly broadcast 1 to 1.5 pound of bait per acre with ground equipment on pastures, range grasses, lawns, and nonagricultural lands. Or distribute uniformly 5 level tablespoons of bait 3 to 4 feet around base of each mound. Do not exceed 1.5 pounds per acre.
	imidacloprid + bifenthrin (Allectus)	See label	Rate varies with pest. Different formulations for different sites.
	indoxacarb (Advion) bait	1.5 lb/acre	Bait formulation.
	lambda-cyhalothrin[1] (Scimitar, Cyonara)	See label	
	metaflumizone (Siesta) bait	1.0 to 1.5 lb/acre 2 to 4 tbsp/mound	Do not exceed 4 applications in a one-year period.
	methoprene (Extinguish Pro)	1.5 lb/acre	Mound or broadcast.
	methoprene + hydramethylnon (Extinguish Plus)	1.5 lb/acre	
	pyriproxyfen (Distance, Esteem)	See label	Mound or broadcast.
	spinosad A + D (Conserve SC)	0.1 fl oz/gal/mound	Dilute 0.1 fluid ounce in 1 gallon water. Use 1 to 2 gallons per mound.
Leafhopper, Spittlebug	acephate[1] (Orthene)	1 oz	
	bifenthrin[1] (Talstar)	0.25 to 0.5 fl oz	Use GC formulation for golf courses.
	carbaryl[1]	0.75 to 1.5 oz	
	chlorpyrifos[1] (Dursban)	See label	For use on golf courses; check new label.
	deltamethrin (Deltagard G)	2 to 3 lb	
Millipede	bifenthrin[1] (Talstar)	0.25 to 0.5 fl oz	Use GC formulation for golf courses.
	carbaryl[1] (Sevin)	1.5 to 3 oz 0.75 to 1.5 oz	
	chlorpyrifos[1] (Dursban)	See label	For use on golf courses; check new label.
	cypermethrin (Demon Max)	See label	
	lambda-cyhalothrin[1] (Scimitar, Cyonara)	See label	Do not make applications within 20 ft of any body of water. No reentry until spray has dried.
Mole Cricket	acephate[1] (Orthene Lesco-Fate)	1 to 1.9 oz	Water soil before application. Do not water in.
	bifenthrin[1] (Talstar)	0.5 to 1 fl oz	Use GC formulation for golf course.
	carbaryl[1]	See label	
	beta-cyfluthrin[1] (Tempo SC, Tempo Ultra)	0.2 fl oz	Home lawn use only.
	deltamethrin (Deltagard G)	2 to 3 lb	
	dinotefuran (Zylam)	See label	
	entomogenous nematodes[1]	See label	Various formulations now available. Adequate soil moisture critical for good control.
	fipronil (Chipco Choice) (Top Choice, Fipronil)	12.5 to 25 lb/A 2 lb	Use slit placement equipment. Apply as a broadcast.
	imidacloprid (Merit) 75 WP 0.5G	4 level tsp 1.8 lb	Apply while crickets are less than ½ inch long (June, early July).
	indoxacarb (Advion)	50 to 200 lb/acre	Not for use on sod farms. DO NOT water in after application.
	indoxacarb (Provaunt)	0.275 oz	Two applications 2 to 4 weeks apart work best, following egg hatch.
	lambda-cyhalothrin[1] (Scimitar, Cyonara)	See label	Do not make applications within 20 feet of any body of water. No reentry until spray has dried.
	zeta-cypermethrin, bifenthrin, and imidacloprid	20 to 35 fl oz/acre	
Slug, Snail	beta-cyfluthrin (Tempo SC, Tempo Ultra)	see label	
	methiocarb (Mesurol 75W)	1 lb	Apply late in afternoon.
	metaldehyde (Durham Ornamental)	See label	
Sod Webworm	acephate[1] (Lesco-Fate, Orthene)	0.5 to 1 oz 2.8 lb	Home lawns only. Irrigate immediately.
	azadirachtin[1] (Neemix)	0.5 fl oz	
	Bacillus thuringiensis, various brands	1 to 2 lb/acre	
	bifenthrin[1] (Talstar,)	0.18 to 0.25 fl oz	Use GC formulation for golf courses.
	carbaryl[1]	2.5 to 3 oz	
	chlorantraniliprole (Acelepryn)	0.046 to 0.092 fl oz	
	chlorpyrifos[1] (Dursban)	See label	For use on golf courses; check new label.
	clothianidin (Arena) .5G 50 WDG	14 to 22 oz 0.15 to 0.22 oz	

Table 5-17. Insect Control in Commercial Turf

Pest	Insecticide and Formulation	Amount per 1,000 sq ft	Precautions and Remarks
Sod Webworm (continued)	clothianidin + bifenthrin (Aloft) GC SC LC SC GC G LC G	 0.27 to 0.54 fl oz 0.27 to 0.54 fl oz 1.8 to 3.6 lb 1.8 to 3.6 lb	
	beta-cyfluthrin[1] (Tempo SC, Tempo Ultra)	see label	Irrigate immediately after application. Do not apply to newly seeded stands or bentgrass.
	deltamethrin (Deltagard G)	2 to 3 lb	
	dinotefuran (Zylam)	1 oz	
	indoxacarb (Provaunt)	0.0625 to 0.25 fl oz	Not labeled for use on sod farms.
	lambda-cyhalothrin[1] (Cyonara, Scimitar)	See label	Do not make applications within 20 feet of any body of water. No reentry until spray has dried.
	permethrin[1] (Astro)	0.4 to 0.8 fl oz	
	spinosad A + D (Conserve SC)	1.25 fl oz	Rate varies with size and species.
	tetraniliprole (Tetrino)	0.367 to 0.735 fl oz	Apply when pest presence first observed or anticipated
	trichlorfon[1] (Dylox)	1.5 to 3 oz	
Sowbug, Pillbug	bifenthrin[1] (Talstar)	0.25 to 0.5 fl oz	Use GC formulation for golf courses.
	carbaryl[1] (Sevin)	0.75 to 1.5 oz	
	cypermethrin[1] (Demon Max)	See label	
	deltamethrin (Deltagard G)	2 to 3 lb	
	lambda-cyhalothrin[1] (Cyonara, Scimitar)	See label	Do not make applications within 20 feet of any body of water. No reentry until spray has dried.
Sugarcane Beetle	bifenthrin[1] (Talstar)	0.5 to 1.0 fl oz	Target adults early (Apr-May). Insecticide efficacy significantly reduced for fall population.
White Grub (May beetle, chafers, green June beetle, and others)	B.t. subspecies galleriae (grubGoneG)	100 to 150 lb/acre	
	chlorantraniliprole (Acelepryn)	0.184 to 0.367 fl oz	Optimal control when applied at egg hatch. Use higher rates later in summer.
	clothianidin (Arena) .5G 50 WDG	 14 to 22 oz 0.15 to 0.22 oz	Mole cricket suppression.
	clothianidin + bifenthrin (Aloft) GC SC LC SC GC G LC G	 0.27 to 0.54 fl oz 0.27 to 0.54 fl oz 1.8 to 3.6 lb 1.8 to 3.6 lb	
	dinotefuran (Zylam)	1 oz	
	imidacloprid[1] (Merit)	3 to 4 level tsp	Make application prior to egg hatch. (Offers some suppression of caterpillars.)
	thiamethoxam (Meridian) 0.33 G 25 WG	 60 to 80 lb/acre 12.7 to 17 oz/acre	Optimum control when applied from peak flight of adults to peak of egg hatch. Also suppresses mole crickets and chinch bugs.
	trichlorfon (Dylox)	3.75 oz	Can be used with some success as a rescue treatment in August and September. Apply at egg hatch.
White Grub, Green June Beetle (only)	B.t. subspecies galleriae (grubGoneG)	100 to 150 lb/acre	
	carbaryl[1]	1 to 1.5 oz	
	chlorantraniliprole (Acelepryn)	0.184 to 0.367 fl oz	Optimal control when applied at egg hatch. Use higher rates later in summer.
	chlorpyrifos[1] (Dursban)	See label	For use on golf courses; see new label.
	clothianidin (Arena) .5G 50 WDG	 14 to 22 oz 0.15 to 0.22 oz	Mole cricket suppression.
	clothianidin + bifenthrin (Aloft) GC SC LC SC GC G LC G	 0.27 to 0.54 fl oz 0.27 to 0.54 fl oz 1.8 to 3.6 lb 1.8 to 3.6 lb	
	dinotefuran (Zylam)	1 oz	Apply at egg hatch.
	imidacloprid[1] (Merit)	3 to 4 level tsp	Make application prior to egg hatch. Do not use on sod farms. Offers some suppression of caterpillars.
	thiamethoxam (Meridian) 0.33 G 25 WG	 60 to 80 lb/acre 12.7 to 17 oz/acre	Optimum control when applied from peak flight of adults to peak of egg hatch. Also suppresses mole crickets and chinch bugs.

Table 5-17. Insect Control in Commercial Turf

Pest	Insecticide and Formulation	Amount per 1,000 sq ft	Precautions and Remarks
White Grub (Japanese beetle)	B.t. subspecies galleriae (grubGoneG)	100 to 150 lb/acre	
	carbaryl[1]	3 oz	
	chlorantraniliprole (Acelepryn)	0.184 to 0.367 fl oz	Optimal control when applied at egg hatch. Use higher rates later in summer.
	clothianidin + bifenthrin (Aloft) GC SC LC SC GC G LC G	 0.27 to 0.54 fl oz 0.27 to 0.54 fl oz 1.8 to 3.6 lb 1.8 to 3.6 lb	
	clothianidin (Arena) .5G 50 WDG	 14 to 22 oz 0.15 to 0.22 oz	Mole cricket suppression.
	dinotefuran (Zylam)	1 oz per 1000 sq ft	Can be used with some success as a rescue treatment in August and September. Apply at egg hatch.
	imidacloprid[1] (Merit)	3 to 4 level tsp	Make application prior to egg hatch. (Offers some suppression of caterpillars.)
	tetraniliprole (Tetrino)	See label	
	thiamethoxam (Meridian) 0.33 G 25 WG	 60 to 80 lb/acre 12.7 to 17 oz/acre	Optimum control when applied from peak flight of adults to peak of egg hatch. Also suppresses mole crickets and chinch bugs.
	trichlorfon[1] (Dylox)	3.75 oz	Can be used with some success as a rescue treatment in August and September. Apply at egg hatch.
	zeta-cypermethrin, bifenthrin, and imidacloprid (Triple Crown)	20 to 35 fl oz/acre	
Zoysiagrass mites			No effective controls available. Make sure turf is irrigated and apply lime and fertilizer applications according to soil test recommendations.

Insect Control for Wood and Wood Products

S.E. Crawley and P. Alder, Extension Entomology and Plant Pathology

Space limitations preclude listing all pesticide formulations and brand names. Other products or formulations may be used—but only those products labeled for the intended use. Products labeled for outdoor use only should never be applied indoors. Some insecticides listed here are designated for professional use only; others may have different formulations for professionals and the general public. Read the product label for specific information about the active ingredient, application rates, and detailed instructions on use – particularly approved sites for application.

Mention of pesticides in this section does not imply that chemicals should be the first or only means of pest control. Non-chemical methods, including exclusion, proper sanitation/maintenance, and moisture reduction, are critical to controlling wood-destroying pests.

Table 5-18. Insect Control for Wood and Wood Products

Insect	Insecticide	Formulation[1]	Use[2]	Precautions and Remarks
Carpenter Ant—(a) Indoors	1% 2-Phenethyl Propionate, 0.4% Pyrethrins (EcoPCO AR-X-M)	Aerosol	P	Apply as directed on label.
	Abamectin (Advance 375)	Bait	P	Apply as directed on label.
	Acetamiprid + Bifenthrin (Transport Mikron)	Sprayable	P	Apply as directed on label.
	Avermectin (Advance)	Bait	P	Apply as directed on label.
	Bifenthrin (Ortho) (Talstar Pro)	Aerosol Sprayable, Granule	 G P	Apply as directed on label.
	Boric acid (Niban, InTice)	Bait	P	May be formulated as granular, gel or liquid. Apply as directed on label.
	Chlorfenapyr (Phantom)	Sprayable	P	Apply as directed on label.
	Cyfluthrin (BioAdvanced) (Tempo SC Ultra, Barrico SP)	Sprayable	 G P	Apply as directed on label.
	Cypermethrin (Cynoff, Demon Max)	Sprayable	P	Apply as directed on label.
	Deltamethrin (BioAdvanced, Ortho) (Suspend, D-Foam)	Sprayable, Dust, Foam	 G P	Apply as directed on label. D-Foam is applied to voids where nests may be located.
	Dinotefuran (Alpine)	Foam & Spray	P	Apply as directed on label
	Esfenvalerate (Onslaught)	Sprayable	P	Apply as directed on label.
	Fipronil (Combat) (Maxforce)	Bait	 G P	Bait where you see ant activity. Apply as directed on label.
	Hydramethylnon (Combat) (Amdro)	Granular Bait	 P G	Apply granules where you see ant activity. Apply as directed on label.
	Imidacloprid (Premise 2)	Sprayable	P	Apply as directed on label.
	Imidacloprid + Beta-cyfluthrin (Temprid SC)	Sprayable	P	Apply as directed on label.
	Indoxacarb (Advion, Arilon)	Bait (gel) Sprayable	P	Bait where you see ant activity. Apply as directed on label. Apply as directed on label
	Lambda-cyhalothrin (Demand CS) (Spectracide)	Sprayable, Foam	 P G	Apply as directed on label.
	Permethrin (Permethrin SFR) (Spectracide)	Sprayable	 P G	Apply as directed on label.
	Prallethrin (Ortho) Prallethrin + Lambda-cyhalothrin (Spectracide)	Aerosol Foam	G	Apply to galleries as directed on label.
	Sodium Borate (Boracare, Borathor) (Spectracide, Terminate)	Sprayable, Dust	 P G	Apply as directed on label.
	Thiamethoxam (Optigard Flex Liquid)	Sprayable	P	Apply as foam to wall voids or infested wood.
Carpenter Ant—(b) outdoors	Acetamiprid + Bifenthrin (Transport Mikron)	Sprayable	P	Apply outdoors only as pin stream, spot, crack and crevice, or perimeter spray.
	Abamectin (Advance)	Bait	P	Place bait around perimeter.
	Bifenthrin (Ortho) (Bifen I/T, Talstar)	Sprayable Granule	 G P	Spray or inject into wood.
	Boric acid (Niban)	Bait	P	Place bait granules around perimeter.

Table 5-18. Insect Control for Wood and Wood Products

Insect	Insecticide	Formulation[1]	Use[2]	Precautions and Remarks
Carpenter Ant—(b) outdoors (continued)	Chlorfenapyr (Phantom)	Sprayable	P	Exterior use limited to spot (2 square feet) and crack and crevice treatments at points of entry.
	Cyfluthrin (BioAdvanced) (Tempo SC Ultra)	Sprayable	 G P	Treat exterior of structure following label.
	Cypermethrin (Demon Max, Cynoff EC)	Sprayable	P	Course spray or inject into wood for localized infestations.
	Zeta-cypermethrin (Ortho) (Cynoff)	 Sprayable Dust	 G P	Treat exterior of structure following label
	Deltamethrin (BioAdvanced) (Suspend Polyzone, Barricor SP, D-Foam)	Sprayable, Foam	G, P G P	Apply as directed on label. D-Foam is applied to voids where nests may be located. Treat into and around the nest.
	Dinotefuran (Alpine)	Foam & Spray	P	Apply as directed on label (apply to damaged shrubs, tree stumps and fences.)
	Esfenvalerate (Onslaught Microencapsulated)	Sprayable	P	Apply as directed on label.
	Fipronil (Maxforce Complete, Gel, Termidor, Taurus SC)	Bait, Granule, Powder	P	Apply bait granules in ant foraging areas. Water area after applying granules.
	Imidacloprid + Fipronil (Fuse Foam)	Sprayable Liquid Foam	P	Apply to galleries as directed on label.
	Imidacloprid + Beta-cyfluthrin (Temprid SC)	Sprayable	P	Apply as directed on label.
	Indoxacarb (Arilon, Advion Insect Bait)	Bait (Granular/gel) Sprayable	P	Apply as directed on label
	Lambda-cyhalothrin (Demand) (Spectracide, Terro)	 Sprayable Granular	 P G	Apply as directed on label.
	Permethrin (Dragnet FT)	Sprayable	P	Apply as crack and crevice or spot treatment or paint onto surface. Application by drilling and injecting is also permitted.
	Sodium Borate (Boracare, Borathor) (Spectracide)	Sprayable	P G	Spray, brush on, or inject into wood. For long-term protection, apply a water repellent stain to exterior wood surfaces 2 to 3 weeks after treatment.
Carpenter Bee	Bifenthrin (Ortho) (Bifen I/T, Talstar SFR)	Sprayable	 G P	Apply as a coarse surface spray and into entrance hole. Seal entrance hole.
	Boric acid (Perma-Dust PT 240)	Aerosol	P	Inject into entrance hole or tunnels with wood injector nozzle. Seal entrance hole.
	Carbaryl (Lesco Sevin WP)	Dust, Sprayable	G	Apply liquid as a coarse surface spray and into gallery entrance. Puff into and around entrance holes, using dust applicator. Seal with wood plugs, putty, or stainless-steel wool.
	Chlorfenapyr (Phantom)	Sprayable	P	Apply as directed on label.
	Cyfluthrin (BioAdvanced) (Tempo 20 WP)	Sprayable	 G P	Apply liquid as a surface spray and into entrance hole. Seal entrance hole.
	Cypermethrin (Demon Max, Cyper WP)	Sprayable	P	Course spray or inject into wood. Seal entrance hole.
	Zeta-cypermethrin (Cynoff)	Dust	P	Apply dust formulation directly to galleries. Seal entrance hole.
	Lambda-cyhalothrin (Demand) (Spectracide)	Sprayable	 P G	Spray or inject into wood. Seal holes in wood before injecting. Avoid runoff.
	Deltamethrin (BioAdvanced) (Suspend, D-Foam)	Sprayable, Dust, Foam	 G P	Apply liquid as a coarse surface spray and into gallery entrance. Inject foam or puff into and around entrance holes, using dust applicator. Seal with wood plugs, putty, or stainless-steel or copper wool.
	Imidacloprid (Premise 2) (BioAdvanced)	Sprayable	 P G	Apply to galleries as directed on label. Seal entrance hole.
	Imidacloprid + Beta-cyfluthrin (Temprid SC)	Sprayable		Apply as directed on label.
	Permethrin (Dragnet FT) (Permethrin 3.2)	Sprayable	 P G	Spray or inject into wood. Seal holes in wood before injecting. Avoid runoff.
	Prallethrin + Lambda-cyhalothrin (Spectracide, Hot Shot)	Foam	G	Apply to galleries as directed on label. Seal entrance hole.
	Sodium borate (Boracare, Borathor) (Spectracide)	 Sprayable Dust	 P G	Apply to galleries as directed on label. Seal entrance hole. Apply dust formulation directly to galleries.
Old House Borer	Aluminum phosphide (Phostoxin)	Fumigant	P	For infested furniture, stacked lumber, other wood products. Apply under gas-tight tarpaulins or in sealed chamber. Requires an F-Phase N.C. Structural Pest Control License and manufacturer-offered product stewardship training.
	Bifenthrin (Ortho) (Bifen I/T, Talstar)	Sprayable	 G P	Apply as directed on label.
	Cyfluthrin (BioAdvanced) (Tempo)	Sprayable	 G P	Coarse spray, brush on, or inject into wood. Avoid excessive runoff.
	Cypermethrin (Demon Max, Cyper TC)	Sprayable	P	Apply as directed on label.
	Deltamethrin (Suspend, D-Foam)	Sprayable, Dust, Foam	P	Apply as directed on label.
	Imidacloprid + Cyfluthrin (Temprid SC)	Sprayable	P	Apply as directed on label.
	Permethrin (Dragnet FT) (Permethrin 3.2)	Sprayable	 P G	Apply as directed on label.

Table 5-18. Insect Control for Wood and Wood Products

Insect	Insecticide	Formulation[1]	Use[2]	Precautions and Remarks
Old House Borer (continued)	Sodium Borate (Boracare, Timbor) (Spectracide)	Sprayable Dust	 P G	Spray, brush on, or inject into wood. For permanent protection, a water repellent should be applied to exterior surfaces 2 to 3 weeks after treatment.
	Sulfuryl fluoride (Vikane, Zythor)	Fumigant	P	Apply under gas-tight tarpaulins only. Hold for 20 to 24 hours at temperature above 60ºF. Requires an F-Phase N.C. Structural Pest Control License and manufacturer-offered product stewardship training.
Powderpost Beetle	Aluminum phosphide (Phostoxin)	Fumigant	P	For infested furniture, stacked lumber, other wood products. Apply under gas-tight tarpaulin or in a sealed chamber. Requires an F-Phase N.C. Structural Pest Control License.
	Bifenthrin (Ortho) (Bifen I/T, Talstar)	Sprayable	 G P	Coarse spray, brush on, or inject into wood. Avoid excessive runoff.
	Chlorfenapyr (Phantom)	Sprayable	P	Apply as directed on label.
	Cyfluthrin (Tempo SC Ultra)	Sprayable	P	Apply as directed on label.
	Cypermethrin (Demon Max, Cyper WP) Zeta-cypermethrin (Cynoff)	Sprayable Dust	P P	Coarse spray or inject into wood for localized infestations.
	Deltamethrin (Ortho) (Suspend, D-Foam)	Sprayable, Dust, Foam	 G P	Surface spray or inject foam or dust into galleries.
	Imidacloprid (Premise, Fuse)	Foam	P	Apply to galleries as directed on label.
	Imidacloprid + Beta-cyfluthrin (Temprid SC)	Sprayable	P	Apply as directed on label.
	Lambda-cyhalothrin (Demand Duo) (Spectracide)	Sprayable	 P G	Apply as directed on label.
	Permethrin (Dragnet FT) (Permethrin 3.2)	Sprayable	 P G	Apply as directed on label.
	Sodium borate (Boracare, Timbor) (Spectracide)	Sprayable Dust	 P G	For long-term protection, apply a water repellent to exterior surfaces 2 to 3 weeks after treatment.
	Sulfuryl fluoride (Vikane, Zythor)	Fumigant	P	For infested furniture, stacked lumber, other wood products. Apply under gas-tight tarpaulin. Hold for 20 to 24 hours at a temperature above 60ºF. Requires an F-Phase N.C. Structural Pest Control License and manufacturer-offered product stewardship training.
Termite—Drywood Species (Wood Treatment)	Acetamiprid + Bifenthrin (Transport)	Sprayable	P	Coarse spray or drill and inject wood.
	Aluminum phosphide (Phostoxin)	Fumigant	P	Apply under gas-tight tarpaulins or in sealed chamber. Requires an F-Phase N.C. Structural Pest Control License.
	Bifenthrin (Ortho) (Bifen I/T, Talstar Pro)	Sprayable	 G P	Coarse spray or inject into wood
	Cyfluthrin (BioAdvanced) (Tempo)	Sprayable	 G P	Coarse surface spray or inject wood.
	Lambda-cyhalothrin (Demand) (Spectracide)	Sprayable	 P G	Apply as directed on label. Localized treatments. Spectracide is not recommended as a sole protection against termites.
	Cypermethrin (Demon Max, Cyper WP) Zeta-cypermethrin (Cynoff)	Sprayable Dust	P P	Coarse spray or inject into wood for localized infestations.
	Fipronil (Termidor, Taurus, Navigator SC)	Sprayable, Foam, Dry	P	Coarse surface spray or inject wood.
	Deltamethrin (Suspend, D-Foam)	Sprayable, Dust, Foam	P	Surface spray or inject foam or dust into galleries.
	Dinotefuran (Alpine)	Foam, Spray	P	Apply as directed on label (can be used on infested shrubs, fence posts, utility poles, eMax.)
	Imidacloprid (Premise, Dominion, Fuse)	Sprayable, Foam	 P	Drill or inject or otherwise apply to galleries as directed on label.
	Imidacloprid + Cyfluthrin (Temprid SC)	Sprayable	P	Apply as directed on label.
	Methyl bromide (Meth-O-Gas Q)	Fumigant	P	Apply under gas-tight tarpaulins only. **Regulatory use only.**
	Permethrin (Permethrin SFR)	Sprayable	P G	Coarse spray on wood for localized infestation.
	Sodium borate (Boracare, Timbor)	Sprayable	 P	Coarse surface spray or inject wood.
	Sulfuryl fluoride (Vikane, Zythor)	Fumigant	P	Apply under gas-tight tarpaulins only. Hold for 20 to 24 hours at temperature above 60ºF. Requires an F-Phase N.C. Structural Pest Control License and manufacturer-offered product stewardship training.
	Thiamethoxam (Optiguard)	Sprayable	P	Coarse spray or drill and inject into wood.

Table 5-18. Insect Control for Wood and Wood Products

Insect	Insecticide	Formulation[1]	Use[2]	Precautions and Remarks
Termite—Subterranean Species (Wood treatment)	Acetamiprid + Bifenthrin (Transport)	Sprayable	P	
	Bifenthrin (Bifen I/T, Talstar) (Ortho)	Sprayable	P G	For use only in voids or channels in damaged wood or to cracks and spaces between wooden members of structures.
	Boric acid (Perma-Dust PT 240)	Aerosol	P	Coarse surface spray or inject wood.
	Chlorantraniliprole (Altriset)	Sprayable	P	Coarse spray around or inject into infested poles, trees and stumps (Outdoors).
	Chlorfenapyr (Phantom)	Sprayable	P	Coarse spray or inject into wood.
	Cyfluthrin (Tempo) (BioAdvanced)	Sprayable	P G	Coarse spray, brush on, or inject into wood. Avoid excessive runoff.
	Zeta-cypermethrin (Cynoff)	Dust	P	Inject into wood for localized infestations.
	Lambda-cyhalothrin (Demand) (Spectracide)	Sprayable	P G	Apply as directed on label. Localized treatments. Spectracide is not recommended as a sole protection against termites.
	Deltamethrin (Suspend, D-Foam)	Sprayable, Dust, Foam	P	Coarse surface spray or inject wood with spray, dust or foam.
	Diflubenzuron (Exterra)	Bait	P	Above-ground stations used in conjunction with in-ground baiting systems.
	Dinotefuran (Alpine)	Foam and Spray	P	Apply as directed on label (can be used on infested shrubs, fence posts, utility poles, eMax.).
	Esfenvalerate (Onslaught) (Bengal)	Sprayable	P G	Apply as directed on label. (For use against swarming termites only).
	Fipronil (Termidor, Taurus)	Sprayable, Foam	P	Coarse spray or inject into wood.
	Imidacloprid (Premise)	Sprayable, Gel, Foam	P	Gel and foam formulations may be injected into voids or damaged wood.
	Imidacloprid + Beta-cyfluthrin (Temprid SC)	Sprayable	P	Apply as directed on label.
	Noviflumuron (Recruit IV AG)	Bait	P	Available only as part of the Sentricon in-ground system (see below).
	Permethrin (Permethrin SFR, Dragnet SFR) (Bengal)	Sprayable	P G	Coarse spray, brush on, or inject into wood. Avoid excessive runoff.
	Sodium borate (Boracare, Penetreat) (Spectracide)	Sprayable Dust	P G	Spray, brush on, or inject into wood. For long-term protection, apply a water repellent to exterior wood surfaces 2 to 3 weeks after treatment. Not a replacement for a soil treatment.
Termite—Subterranean Species (Soil treatment)	Acetamiprid + Bifenthrin (Transport)	Sprayable	P	Dig trenches 6 inches wide and at least 4 inches deep along the foundation. Never trench below the top of the footing. Depending upon the depth of footer, rodding may be needed. Dilutions and rates of applications vary among specific products. Vertical barriers usually require about 4 gallons of spray per 10 linear feet for each foot of depth along a foundation. Follow label restrictions on treatment in crawlspaces containing wells or cisterns. Follow instructions if "excavation and backfill" is permitted. Exercise extreme caution when treating crawlspaces. Wear appropriate protective equipment as specified on product label. General (broadcast) treatments of crawlspace soil for termites are prohibited, except as noted on the label. **NOTE:** Most termite infestations require treatment by a W-phase licensed structural pest control operator. Requirements for termite treatments are outlined in 2NCAC 34:.0503, .0505. Apply Premise or BioAdvanced granules to trenches as a spot treatment. BioAdvanced for the general public is available only in granular formations.
	Bifenthrin (Bifen I/T, Talstar) (Ortho)	Sprayable	P G	
	Chlorfenapyr (Phantom)	Sprayable	P	
	Chlorantraniliprole (Altriset)	Sprayable	P	
	Cyfluthrin (BioAdvanced) (Tempo Ultra)	Sprayable	G P	
	Cypermethrin (Demon Max, Cyper TC)	Sprayable	P	Apply as directed on label.
	Lambda-cyhalothrin (Demand CS) (Spectracide)	Sprayable	P G	Apply as directed on label. Localized treatments can be used in conjunction with other treatments such as baits.
	Fipronil (Termidor, Taurus SC, Navigator SC)	Sprayable	P	
	Imidacloprid + Cyfluthrin (Temprid SC)	Sprayable	P	
	Indoxacarb (Arilon)	Sprayable	P	Use for spot or local treatment only (Arilon is not intended as sole protection against termites)
	Permethrin (Dragnet SFR) (Bengal)	Sprayable	P G	
	Diflubenzuron (Labyrinth)	Bait	P	Termite monitoring and baiting program. Available only through manufacturer-authorized pest control companies.
	Hexaflumuron (Shatter) (Terminate)	Bait	P G	Termite monitoring and baiting program. Available only through manufacturer-authorized pest control companies
	Novaluron (Trelona Compressed Termite Bait)	Bait	P	Termite monitoring and baiting program. Available only through manufacturer-authorized pest control companies.
	Noviflumuron (Recruit HD)	Bait	P	Termite monitoring and baiting program. Available only through manufacturer-authorized pest control companies.

[1] Formulation designations: Aerosol = injectable or spray; Dust = dry application; Fumigant = gas in pressurized cylinder or pellets; Foam = injectable foam; Sprayable = liquid concentrate or wettable powder for mixing with water or in a ready-to-use form

[2] Use designations: P = Professional applicator (licensed in structural pest control); G = General public use

INSECT CONTROL FOR HOME USE

Insect Control for the Home Vegetable Garden

S.E. Crawley, Entomology and Plant Pathology

Consumer products are numerous and names change frequently. The insecticides listed below are grouped by the active ingredient. The product label for consumer products identifies the active ingredient; always check the “active ingredients” portion on the front of the label to determine if the product is appropriate for your needs. In addition, refer to the product label for specific application rates, pest lists, pre-harvest intervals and other important directions for use (DFU).

Table 5-19. Insect Control for the Home Vegetable Garden

Commodity	Insect	Insecticide Active ingredient	Minimum Interval (Days) Between Last Application and Harvest (PHI)	Precautions and Remarks
Asparagus	Asparagus beetle, Japanese beetle, Grasshopper, and Aphids	Malathion	1	
		Carbaryl	1	
		Permethrin	3	
		Spinosad	60	Grasshoppers and aphids are not on the label.
		Pyrethrins	0	
Bean	Aphids	Malathion	1	
		Azadirachtin	0	
		Acephate	1	
		Bifenthrin	3	
		Cyfluthrin	7	Post-harvest interval may differ depending on product.
		Insecticidal soap	0	
		Neem Oil	0	
		Pyrethrins	0	
	Corn earworm, Mexican bean beetle, Bean leaf beetle, Flea beetle, Japanese beetle, and Cucumber beetle, Potato leafhopper, Fleahopper, Lygus bug, and Stink bug	Carbaryl	3	PHI is plant stage-dependent.
		Spinosad	3	Will not control Japanese beetles, Cucumber beetles or Stink bugs.
		Bifenthrin	3	
		Cyfluthrin	7	
		Lambda-cyhalothrin	7	21-day PHI for dried beans.
	Spider mite	Bifenthrin	3	
		Malathion	1	
		Insecticidal Soap	0	Apply treatment at first sign of mites and speckled plants.
		Sulfur	0	
	Whitefly	*Beauveria bassiana*	0	
		Bifenthrin	3	
		Insecticidal Soap	0	
		Pyrethrins	0	
		Mineral Oil	0	
Beet	Flea beetle, Beet webworm, and Blister beetle	Carbaryl	3 (14)	On foliage as needed. Fourteen days if tops used; 3 days if tops not used.
Broccoli, Cabbage, Cauliflower, Collards, Brussels Sprouts, Rutabagas	Aphids	Acetamiprid	7	
		Bifenthrin	7	
		Cyfluthrin	3	
		Malathion	7	
		Insecticidal Soap	0	
		Imidacloprid	7	
	Cabbage looper, Imported cabbageworm, and Cutworms	*Bacillus thuringiensis*	0	Start control program when worms are small and treat foliage every 5 to 7 days.
		Carbaryl	3	Will not control cabbage looper. Carbaryl is suggested for cutworms.
		Bifenthrin	7	
		Esfenvalerate	3	
		Lambda-cyhalothrin	1	
		Spinosad	1	
		Imidacloprid	7	
	Flea beetle and thrips	Bifenthrin	7	
		Carbaryl	3	
		Malathion	7	
		Spinosad	1	For thrips only.
		Imidacloprid	7	
	Harlequin bug	Bifenthrin	7	On foliage as needed.
		Lambda-cyhalothrin	1	On foliage as needed.

Table 5-19. Insect Control for the Home Vegetable Garden

Commodity	Insect	Insecticide Active ingredient	Minimum Interval (Days) Between Last Application and Harvest (PHI)	Precautions and Remarks
Carrot	Armyworm, Leafminers, and Leafhoppers	*Bacillus thuringiensis*	0	Will not control leafhoppers.
		Carbaryl	0	On foliage as needed.
		Cyfluthrin	0	
		Pyrethrins	0	
		Zeta-cypermethrin	1	
		Deltamethrin	3	
Cucurbits (including Cantaloupe, Cucumber, Pumpkin, Squash, Watermelon)	Aphid	Cyfluthrin	0	
		Acetamiprid	0	
		Permethrin	0	
		Esfenvalerate	3	
		Malathion	1	
		Insecticidal Soap Mineral Oil	0 0	On foliage as needed.
		Pyrethrins	1	
	Cucumber beetle (spotted and striped) and Squash bug	Bifenthrin	3	
		Pyrethrins	0	
		Acetamiprid	7	
		Carbaryl	7	
		Cyfluthrin	0	
		Permethrin	0	
	Pickleworm, Squash vine borer	Bifenthrin	3	
		Pyrethrins	1	
		Esfenvalerate	3	
		Cyfluthrin	0	
		Spinosad	3	
		Permethrin	0	
	Spider mite	Insecticidal soap	0	On foliage as needed.
		Bifenthrin	3	
Celery	Aphids, Flea beetle, Leafminers, and Fleahoppers	Malathion	7	On foliage as needed.
		Permethrin	3	On foliage as needed.
Corn (Sweet)	Corn earworm, European corn borer, Fall armyworm, and Sap beetle	*Bacillus thuringiensis*	0	Consult specific label. Effective while worms are feeding on the foliage.
		Cyfluthrin	0	
		Esfenvalerate	1	
		Lambda-cyhalothrin	1	
		Permethrin	3	
		Carbaryl	2	
		Spinosad	1	
Eggplant	Aphid, Flea beetle, Whitefly, Lace bug	Acetamiprid	7	
		Bifenthrin	7	Not for whiteflies.
		Lambda-cyhalothrin	5	Not for whiteflies.
		Malathion	3	On foliage as needed.
		Esfenvalerate	7	
		Spinosad	1	
		Esfenvalerate	7	
	Spider mite	Insecticidal soap Horticultural oil	0 0	On foliage as needed.

Table 5-19. Insect Control for the Home Vegetable Garden

Commodity	Insect	Insecticide Active ingredient	Minimum Interval (Days) Between Last Application and Harvest (PHI)	Precautions and Remarks
Lettuce	Aphid, Leafhoppers	Bifenthrin	7	
		Mineral Oil	0	
		Lambda-cyhalothrin	1	
		Malathion	14 (leaves), 7 (head)	Consult label for PHI
		Insecticidal Soap	0	
	Cabbage looper, Corn earworm, and Leafhoppers	*Bacillus thuringiensis*	0	
		Spinosad	1	
		Lambda-cyhalothrin	1	
		Carbaryl	14	
		Pyrethrins	0	
Mustard Greens	Aphid, Flea beetle	Acetamiprid	7	
		Bifenthrin	7	
		Malathion	7	
		Insecticidal Soap	0	
	Various caterpillars, cutworms, armyworms	*Bacillus thuringiensis*	0	Begin foliage treatments early and repeat as necessary.
		Spinosad	1	
		Carbaryl	14	Consult label for specific pest list, typically cutworms and armyworms.
Okra	Aphid and Leafminers	Bifenthrin	7	
		Malathion	1	
		Spinosad	1	Leafminers only.
		Permethrin	1	
	Corn earworm, European corn borer, Flea beetle, and Stink bug	Spinosad	1	
		Bifenthrin	7	
		Cyfluthrin	1	
		Esfenvalerate	1	
		Permethrin	1	
Onion	Onion thrips	Lambda-cyhalothrin	14	
		Malathion	3 (Green)	
		Insecticidal Soap	0	
		Zeta-cypermethrin	7	
Peas	Aphids and Leafminers	Insecticidal Soap	0	
		Zeta-cypermethrin	1 (Succulent), 21 (Dried)	Leafminers only.
		Malathion	3	
		Lamda-cyhalothrin	7	
Pepper	Aphids and Thrips	Acetamiprid	7	
		Malathion	3	
		Insecticidal Soap	0	
	European corn borer, Flea beetle, Tomato fruitworm, Hornworms, and Stink bug	Carbaryl	3	Will not control stink bugs.
		Bifenthrin	7	Excellent control of stink bugs.
		Cyfluthrin	7	
		Esfenvalerate	1	Will not control stink bugs.
		Permethrin	3	
		Spinosad	1	Will not control stink bugs.
Potato, Irish	Aphids	Cyfluthrin	0	
		Esfenvalerate	0	
	European corn borer, Potato tuberworm	*Bacillus thuringiensis*	0	
		Carbaryl	0	Apply when eggs begin to hatch, and every 5 days as needed.
		Esfenvalerate	1	
		Permethrin	3	
	Potato leafhopper, Potato flea beetle, Colorado potato beetle, and Blister beetle	Imidacloprid	21	Apply to the soil immediately at planting for long-term control.
		Bacillus thuringiensis var. *san diego* var. *tenebrionus*	0	For Colorado potato beetle only. Treat when small larvae are present. Not effective against adults or large larvae.
		Carbaryl	0	On foliage as needed. Treat when most Colorado potato beetle eggs have hatched.

Table 5-19. Insect Control for the Home Vegetable Garden

Commodity	Insect	Insecticide Active ingredient	Minimum Interval (Days) Between Last Application and Harvest (PHI)	Precautions and Remarks
Pumpkin—See SQUASH AND PUMPKIN				
Radish	Aphid	Malathion	7	On foliage as needed.
	Flea beetle and Imported cabbageworm	Cyfluthrin	0	
Spinach	Aphids, Thrips, and Leafminers	Acetamiprid	7	
		Permethrin	1	
		Malathion	7	
		insecticidal Soap	0	On foliage as needed.
		Pyrethrins	0	
		Zeta-cypermethrin	1	
	Corn earworm and Loopers	*Bacillus thuringiensis*	0	
		Permethrin	1	
		Spinosad	1	
		Pyrethrins	0	
		Zeta-cypermethrin	1	
Squash and Pumpkin	Aphids	Bifenthrin	3	
		Malathion	1	
		Insecticidal Soap	0	
	Cucumber beetle (spotted and striped), Flea beetle, and Leafhoppers	Esfenvalerate	3	
		Bifenthrin	3	
	Pickleworm	Esfenvalerate	3	
		Spinosad	3	
	Squash bug	Bifenthrin	3	
Tomato	Aphid, Fleabeetle	Acetamiprid	7	
		Bifenthrin	1	
		Malathion	1	
		Insecticidal Soap	0	
	Cutworm (surface type)	Esfenvalerate	1	
	Colorado potato beetle	*Bacillus thuringiensis* var. *san diego* var. *tenebrionus*	0	For Colorado potato beetle only. Treat when small larvae are present. Not effective against adults or older larvae.
		Spinosad	1	
	Spider mite	Insecticidal Soap Horticultural Oil	0 0	On foliage as needed.
	Stink bug	Cyfluthrin	7	Do not make more than 6 applications per season.
		Lambda-cyhalothrin	5	
		Malathion	1	
		Permethrin	7	Do not apply on cherry tomatoes or varieties less than 1 inch in diameter.
	Thrips	Spinosad	1	
		Insecticidal Soap	0	
	Tomato fruitworm, Cabbage looper, Tobacco hornworm	*Bacillus thuringiensis*	0	Treat weekly, if necessary. Begin when fruits are 0.5 inch in diameter. Fruitworms are most serious after August 1.
		Carbaryl	3	
		Cyfluthrin	7	Do not make more than 6 applications per season.
		Esfenvalerate	1	
		Lambda-cyhalothrin	5	
		Permethrin	7	Do not apply on cherry tomatoes or varieties less than 1 inch in diameter.
		Spinosad	1	
	Whitefly	Acetamiprid	7	
		Beauveria bassiana	0	Apply when whiteflies observed. Repeat in 4- to 5-day intervals.
		Malathion	1	
		Pyrethrum products	0	
		Insecticidal Soap	0	
Turnip, Turnip Greens	Aphid, Flea beetle	Bifenthrin	7	
		Malathion	7	On foliage as needed.
		Insecticidal Soap	0	
	Cabbage looper, Imported cabbageworm	*Bacillus thuringiensis*	0	On foliage as needed.
		Spinosad	1	
	Harlequin bug	Pyrethrins	0	Apply as needed.

Control of Household Pests

(Products for Use by the General Public)

P. Alder and M. G. Waldvogel, Entomology and Plant Pathology

Mention of pesticides in this section does not imply that chemicals are or should be the first or only means of control. Nonchemical methods, including exclusion and sanitation, are important to long-term pest management.

Space limitations preclude listing all pesticide formulations and trade names. Other appropriate products or formulations may be used.

Never use products that are not labeled for the intended use. Products labeled for outdoor use only should never be applied indoors. Read the product label for specific pest information about the active ingredient, application rates, and detailed instructions on the product's use.

NOTE: The insecticides listed below are identified by the common name. The brand names of most consumer insecticide products do not identify the specific chemical used, and the formulation or its contents may be changed by the manufacturer. Always check the "Active ingredients" portion of the product label to determine if the product is appropriate for your needs.

Table 5-20. Control of Household Pests−Products for Use by the General Public

Insecticide	Formulation	Precautions and Remarks
Ant (a) Indoors *(For information on carpenter ants, see* Insect Control for Wood and Wood Products*)*		
abamectin (Enforcer)	Bait Station	Place bait stations in areas where ants are active. Keep of out of reach of children and pets. Use dust formulations only in inaccessible areas. Treat ant-traveled areas. Re-treat as effectiveness diminishes. Some products are not suitable for use in residential kitchens or commercial food/feed preparation sites. Read the product label carefully. Remove food from storage areas before treating. Apply products as directed on the label Imiprothrin is usually formulated with other pesticides in these products.
avermectin (Raid)	Bait Station	
bifenthrin (Ortho)	Liquid, Aerosol Spray	
borax/boric acid (Terro)	Dust, Bait Station	
cornmint oil (EcoLogic)	Aerosol Spray, Liquid	
cyfluthrin (BioAdvanced)	Liquid	
cypermethrin (Black Flag, Hot Shot, Ortho, Raid)	Liquid, Aerosol Spray	
dinotefuran (Hot Shot)	Gel Bait, Liquid Bait	
hydramethylnon (Combat, Amdro)	Bait Station	
diatomaceous earth (Hot Shot, Safer Brand)	Dust	
lambda-cyhalothrin (Cutter, Hot Shot, Spectracide)	Liquid, Aerosol Spray	
fipronil (Combat)	Bait Station, Gel Bait	
imiprothrin (Black Flag, Raid)	Aerosol Spray	
indoxacarb (Hot Shot)	Bait Station	
d-limonene (Orange Guard)	Liquid	
mint oil (EcoSmart)	Liquid	
permethrin (Bengal, Hot Shot)	Aerosol Spray	
d-phenothrin (Raid, Ortho)	Liquid	
prallethrin (Black Flag, Hot Shot, Raid, Terro)	Aerosol Spray	
pyrethrins, pyrethrum (Hot Shot, Black Flag, Ortho, Spectracide)	Aerosol Spray	
Ant (b) Outdoors (*Also see* "Ant" *and* "Imported Fire Ant" *under Home Lawns table.*)		
bifenthrin (Ortho)	Granular Insecticide, Aerosol Spray, Liquid, Granular Bait	Apply granular bait around nest. Place bait stations in areas where ants are active. Treat nest and surrounding area. May be applied along building perimeter.
borax (Terro)	Bait Station, Granular Bait, Liquid	
cypermethrin (Black Flag, Hot Shot, Raid, Ortho)	Liquid, Aerosol Spray	Apply chemicals as directed on the label.
dinotefuran (Hot Shot)	Gel Bait, Liquid Bait	
fipronil (Combat)	Bait Station, Gel Bait	
hydramethylnon (Amdro, Combat)	Bait Station, Granular Bait	
indoxacarb (Hot Shot)	Bait Station	
lambda-cyhalothrin (Spectracide, Hot Shot, Cutter)	Liquid, Granular Insecticide, Aerosol Spray	
lemongrass (EcoLogic)	Liquid	
mint oil (EcoSmart)	Liquid	
imiprothrin (Black Flag, Raid)	Liquid	
pyrethrins (Black Flag)	Aerosol Spray	
Bed Bug		
bifenthrin (Ortho)	Aerosol Spray, Liquid	
cypermethrin (Hot Shot, Black Flag, Ortho, Raid)	Liquid, Aerosol Spray	
cyfluthrin (BioAdvanced)	Liquid, Aerosol	
diatomaceous earth (Hot Shot, Safer Brand)	Dust	
dichlorvos (Hot Shot)	Pest Strip	
d-phenothrin (Raid Ortho)	Liquid	
lambda-cyhalothrin (Hot Shot)	Aerosol Spray	
mint oil (EcoSmart)	Liquid	
N-octyl bicycloheptene dicarboximide (Raid)	Aerosol Spray	
pyrethrins (Hot Shot, Black Flag)	Aerosol Spray	
phenoxybenzyl (Enforcer)	Aerosol Spray	
prallethrin (Black Flag, Hot Shot, Raid, Terro)	Aerosol Spray	
silicon dioxide (Hot Shot)	Dust	

Table 5-20. Control of Household Pests−Products for Use by the General Public

Insecticide	Formulation	Precautions and Remarks
Bee (a) Indoors		
bifenthrin (Ortho)	Aerosol Spray	
cypermethrin (Black Flag, Hot Shot, Ortho, Raid)	Aerosol Spray, Liquid	
deltamethrin (Black Flag, Terro)	Liquid, Aerosol Spray, Dust	Apply only for sporadic invaders. If bees are found frequently, locate and remove the nest.
diatomaceous earth (Hot Shot, Safer Brand)	Dust	
d-phenothrin (Raid, Ortho)	Liquid	Apply products as directed on the label.
pyrethrins (Black Flag)	Aerosol Spray	
Bee (b) Outdoors For carpenter bees, see section *Insect control for Wood and Wood Products*		
bifenthrin (Ortho)	Liquid	Apply after dark when insects have returned to nest. Some materials available in pressurized cans that propel an insecticide stream up to 10 feet. Re-treatment may be necessary. Apply products as directed on the label.
carbaryl (Sevin)	Dust, Liquid, Powder	
cypermethrin (Black Flag, Hot Shot, Ortho, Raid)	Aerosol Spray, Liquid	
deltamethrin (Amdro, Black Flag, Spectracide)	Liquid	
lambda-cyhalothrin (Spectracide, Cutter)	Liquid	
d-phenothrin (Raid, Ortho)	Liquid	
Booklouse (psocid) (Indoors and outdoors)		
bifenthrin (Ortho)	Liquid	Apply as a barrier spray along foundation and entry points (doors and windows). Read labels to determine which products are suitable for indoor use. Clean up moisture problems, which may attract insects indoors. Excess moisture may impede product effectiveness.
diatomaceous earth (Safer Brand)	Dust	
deltamethrin (Black Flag)	Liquid	
pyrethrins, pyrethrum (Black Flag)	Aerosol Spray	
Boxelder Bug (Outdoors)		
bifenthrin (Ortho)	Liquid	Harmless insects become nuisances when searching indoors for hibernation sites in the fall. Treat door thresholds, window ledges, and other areas where the insects congregate or may gain entry.
cypermethrin (Black Flag, Hot Shot, Ortho, Raid)	Aerosol Spray, Liquid	
deltamethrin (Black Flag, Terro)	Liquid, Dust	
lambda-cyhalothrin (Spectracide)	Liquid	
d-phenothrin (Raid, Ortho)	Liquid	
Brown Dog Tick (a) Indoors		
bifenthrin (Ortho)	Liquid	
cypermethrin (Black Flag, Hot Shot, Ortho, Raid)	Aerosol Spray, Liquid	
deltamethrin (Black Flag, Terro)	Aerosol Spray, Liquid, Dust	
diatomaceous earth (Safer Brand, Hot Shot)	Dust	
d-phenothrin (Raid, Ortho)	Liquid	
imiprothrin (Black Flag)	Aerosol Spray	
lambda-cyhalothrin (Spectracide, Black Flag)	Aerosol Spray, Liquid	
mint oil (EcoSmart)	Aerosol Spray	
permethrin (Hot Shot, Bengal)	Aerosol Spray	
prallethrin (Black Flag, Hot Shot, Raid, Terro)	Aerosol Spray	
pyrethrins (Black Flag)	Aerosol Spray	
tetramethrin (Raid)	Aerosol Spray	
Brown Dog Tick (b) Outdoors and under buildings		
bifenthrin (Ortho)	Granules, Liquid	
cypermethrin (Black Flag, Hot Shot, Ortho, Raid)	Aerosol Spray, Liquid	
deltamethrin (Black Flag)	Aerosol Spray, Liquid	
lambda-cyhalothrin (Spectracide, Cutter)	Aerosol Spray, Granule, Liquid	
permethrin (Hot Shot, Bengal)	Aerosol Spray	
pyrethrins (Black Flag)	Aerosol Spray	
Carpet Beetle (a) Nonfabric areas and infested areas of carpets only		
cypermethrin (Black Flag, Hot Shot, Ortho, Raid)	Aerosol Spray, Liquid	
diatomaceous earth (PermaGuard, Hot Shot)	Dust	
deltamethrin (Black Flag)	Aerosol Spray, Dust, Liquid	
d-phenothrin (Raid, Ortho)	Liquid	
lambda-cyhalothrin (Spectracide, Hot Shot, Black Flag)	Liquid	
pyrethrins, pyrethrum (Black Flag)	Aerosol Spray	
bifenthrin (Ortho)	Aerosol Spray, Liquid	
pyrethrins (Black Flag)	Aerosol Spray	
Carpet Beetle (b) On fabric		
diatomaceous earth (Hot Shot)	Dust	
pyrethrins, pyrethrum (Black Flag)	Aerosol Spray, Liquid	
Centipede (a) Indoors		
bifenthrin (Ortho)	Liquid	

Table 5-20. Control of Household Pests−Products for Use by the General Public

Insecticide	Formulation	Precautions and Remarks
Centipede (a) Indoors (continued)		
cyfluthrin (Raid, Black Flag, Ace, Combat)	Aerosol Spray	
cypermethrin (Black Flag, Hot Shot, Ortho, Raid)	Aerosol Spray, Liquid	
deltamethrin (Black Flag, Terro)	Aerosol Spray, Dust, Liquid	
diatomaceous earth (Hot Shot, Safer Brand)	Dust	
lambda–cyhalothrin (Spectracide)	Aerosol Spray, Liquid	
imiprothrin (Black Flag, Raid)	Aerosol Spray, Liquid	
permethrin (Bengal, Hot Shot)	Aerosol Spray	
prallethrin (Black Flag, Hot Shot, Raid, Terro)	Aerosol Spray	
pyrethrins (Black Flag)	Aerosol Spray	
Centipede (b) Outdoors		
bifenthrin (Ortho)	Granule, Liquid	Treat infested areas around building foundations, vents, and similar access points. Barrier sprays of 12 to 18 inches along perimeter may be effective.
cypermethrin (Black Flag, Hot Shot, Ortho, Raid)	Aerosol Spray, Liquid	
deltamethrin (Black Flag, Terro)	Aerosol Spray, Liquid, Dust	
diatomaceous earth (Hot Shot)	Dust	
lambda-cyhalothrin (Hot Shot, Spectracide)	Aerosol Spray, Granule, Liquid	
lemongrass oil (EcoLogic)	Liquid	
mint oil (EcoSmart)	Liquid	
pyrethrins (Black Flag)	Aerosol Spray	
Chigger (Red bug) Outdoors		
bifenthrin (Ortho)	Granule, Liquid	Apply to grass, bushes, and weeds in the infested areas. Thoroughly saturate soil, but avoid runoff into ponds, lakes, or other bodies of water. Repeat as needed. Apply labeled repellent products to shoes, ankles, and legs before entering suspected chigger-infested areas.
gamma-cyhalothrin (Spectracide)	Granuar Insecticide, Liquid	
lambda-cyhalothrin (Spectracide, Cutter)	Granule, Liquid	
deltamethrin (Black Flag)	Liquid	
Clothes Moth (a) Nonfabric areas and infested areas of carpet only, See Carpet Beetle		
Clothes Moth (b) On fabric, See Carpet Beetle		
Clothes Moth (c) In storage areas		
dichlorvos (Hot Shot)	Pest Strip	Hang on strip in clothes closets or storage chests up to 1,000 cubic feet in capacity. Not for use in occupied rooms or in closets in occupied rooms. Follow label instructions carefully.
paradichlorobenzene (PDB) naphthalene (Enoz)	Crystals or similar solid	Effective repellents on clean fabric in airtight enclosures. Avoid contact with plastic buttons and zippers.
Clover Mite (a) Indoors		
bifenthrin (Ortho)	Liquid	
cypermethrin (Black Flag, Hot Shot, Ortho, Raid)	Aerosol Spray, Liquid	
deltamethrin (Black Flag, Terro)	Aerosol Spray, Liquid	
lambda-cyhalothrin (Spectracide)	Liquid, Granules	
pyrethrins (Black Flag)	Aerosol Spray	
Clover Mite (b) Outdoors		
bifenthrin (Ortho)	Granular, Liquid	Treat around points of entry, such as foundations, vents, windows, and doors. Maintain a 12-inch wide vegetation-free zone along foundation. Spray 1 to 2 feet high along the foundation wall and a 3- to 5-feet barrier on the grass or landscaped areas around the foundation. Water immediately after applying granules. Apply products as directed on the label.
cypermethrin (Black Flag, Hot Shot, Ortho, Raid	Liquid, Aerosol Spray	
deltamethrin (Black Flag)	Liquid, Aerosol Spray	
diatomaceous earth (Safer Brand)	Dust	
lambda-cyhalothrin (Spectracide, Cutter)	Liquid	
pyrethrins (Black Flag)	Aerosol Spray	
Cockroach (a) Indoors		
abamectin (Enforcer)	Bait Station	Apply sprays along baseboards, under sinks, in cabinets and other infested areas. Remove and cover food, cooking, and eating utensils before spraying cabinets. Do not restock shelves until surface dries completely. Some products are not suitable for use in residential kitchens or commercial food/feed preparation sites. Read the product label carefully
avermectin (Raid)	Bait Station	
bifenthrin (Ortho)	Aerosol Spray, Liquid	
cornmint oil (EcoLogic)	Aerosol Spray, Liquid	
boric acid (Terro)	Bait Station, Dust	
chlorpyrifos (Hot Shot)	Bait Station	
cyfluthrin (Raid, Black Flag, Ace, Combat)	Aerosol Spray	
cypermethrin (Black Flag, Hot Shot, Ortho, Raid)	Aerosol Spray, Liquid	
imiprothrin (Black Flag, Raid)	Aerosol Spray	Imiprothrin is formulated with other pesticides in these products.
diatomaceous earth (Hot Shot, Safer Brand)	Dust	Use diatomaceous earth in the same manner as boric acid powders. Some formulations contain pyrethrins and pyrethrum.
deltamethrin (Black Flag, Terro)	Aerosol Spray, Dust, Liquid	
dinotefuran (Hot Shot)	Gel Bait	Place bait stations in infested areas; follow label instructions. Keep out of reach of children and pets. Sanitation is critical; before using baits, eliminate other food sources. Place bait stations in cabinets under sinks, behind stoves and refrigerators. Slow acting but gives long-lasting control. Force small amounts into all hidden nesting areas with dust applicator. Avoid overapplication and inhalation of dust. Some formulations may contain pyrethrins or pyrethrum. Do not contaminate food preparation or storage sites.
fipronil (Combat)	Bait, Bait Station	
hydramethylnon (Combat, Amdro)	Bait Station	
hydroprene (Raid Plus, Egg Stopper)	Bait Station	Hydroprene is an insect growth regulator and should be used with an adulticide.
imiprothrin (Black Flag, Raid)		
lambda-cyhalothrin (Spectracide, Black Flag)	Liquid, Aerosol Spray	

Table 5-20. Control of Household Pests−Products for Use by the General Public

Insecticide	Formulation	Precautions and Remarks
Cockroach (a) Indoors (continued)		
lemongrass oil (EcoLogic)	Liquid	
mint oil (EcoSmart)	Liquid	
permethrin (Bengal, Hot Shot)	Aerosol Spray	
prallethrin (Black Flag, Hot Shot, Raid, Terro)	Aerosol Spray	
pyrethrins (Black Flag)	Aerosol Spray	
tetramethrin (Raid)	Aerosol Spray	
chlorpyrifos (Hot Shot)	Bait	Apply products as directed on the label.
Cockroach (b) Outdoors		
bifenthrin (Ortho)	Aerosol Spray, Liquid	Some species of cockroaches can live indoors and outdoors. Cockroaches that live outdoors tend to hide under mulch, ivy, and similar cover. Treat groundcover and along foundation walls, patios, and other areas where cockroaches are seen. Certain products cannot be used on or around edible plants. Read product labels for any limitations.
cypermethrin (Black Flag, Hot Shot, Ortho, Raid)	Aerosol Spray. Liquid	
deltamethrin (Black Flag, Terro)	Aerosol Spray, Liquid, Dust	
diatomaceous earth (PermaGuard)	Dust	Apply products as directed on the label.
dinotefuran (Hot Shot)	Gel Bait	
hydramethylnon (Combat, Amdro)	Bait, Granular Insecticide	
lambda-cyhalothrin (Spectracide, Cutter)	Granular Insecticide, Liquid	
lemongrass oil (Orange Guard)	Liquid	
pyrethrins (Black Flag)	Aerosol Spray	
Cricket (Indoors and in crawlspaces)		
boric acid	Granular Bait, Dust	Crickets enter homes through basements and similar areas. Some formulations may be sprinkled along foundation. Read product label before using outdoors. Treat along foundation walls, patios, and other areas where crickets are seen. Apply products as directed on the label. Apply in a light 2- to 4-inch band around foundation. Do not use excessive amounts, and do not apply to foliage of ornamentals or to food crops. Imiprothrin is formulated with other pesticides in these products. Apply products as directed on the label.
Cornmint oil (EcoLogic)	Aerosol Spray, Liquid	
cyfluthrin (BioAdvanced)	Liquid	
cypermethrin (Black Flag, Hot Shot, Ortho, Raid)	Aerosol Spray, Liquid	
deltamethrin (Black Flag, Terro)	Dust, Liquid. Aerosol Spray	
diatomaceous earth (Hot Shot, Safer Brand)	Dust	
hydramethylnon (Amdro, Combat)	Granular Insecticide	
imiprothrin (Raid, Black Flag)	Aerosol Spray	
lambda-cyhalothrin (Spectracide, Black Flag, Cutter)	Aerosol Spray, Granular Insecticide, Liquid	
mint oil (EcoSmart)	Liquid	
permethrin (Bengal, Hot Shot)	Aerosol Spray	
pyrethrins (Hot Shot, Black Flag)	Aerosol Spray	
bifenthrin (Ortho)	Aerosol Spray, Liquid	
prallethrin (Black Flag, Hot Shot, Raid, Terro)	Aerosol Spray	
Earwig (a) Indoors		
bifenthrin (Ortho)	Aerosol Spray, Liquid	
cyfluthrin (BioAdvanced)	Liquid	
cypermethrin (Black Flag, Hot Shot, Ortho, Raid)	Liquid, Aerosol Spray	
diatomaceous earth (Hot Shot, Safer Brand)	Dust	
deltamethrin (Black Flag, Terro)	Liquid, Aerosol Spray	
d-phenothrin (Ortho, Raid)	Liquid	
imiprothrin (Raid, Black Flag)	Aerosol Spray	
lambda-cyhalothrin (Spectracide)	Liquid	
mint oil (EcoSmart)	Liquid	
pyrethrins (Black Flag)	Aerosol Spray	
prallethrin (Black Flag, Hot Shot, Raid, Terro)	Aerosol Spray	
tetramethrin (Raid)	Aerosol Spray	
Earwig (b) Outdoors		
bifenthrin (Ortho)	Aerosol Spray, Liquid	Repeat treatments at 14-day intervals if necessary. Granular formulations are for outdoor use only and must be watered in or applied before rain.
boric acid (Terro)	Granular Bait	
cypermethrin (Black Flag, Hot Shot, Ortho, Raid)	Aerosol Spray, Liquid	
diatomaceous earth (Hot Shot)	Dust	
gamma-cyhalothrin (Spectracide)	Liquid, Granular Insecticide	
lambda-cyhalothrin (Spectracide)	Liquid, Granular Insecticide	
mint oil (EcoSmart)	Liquid	
pyrethrins (Black Flag)	Aerosol Spray	
Flea (a) Indoors		
bifenthrin (Ortho)	Aerosol Spray, Liquid	
boric acid	Dust	Treat pet sleeping quarters and other localized areas, such as under cushions and furniture, as specified on label. Vacuum carpets and furniture before applying; dispose of contents properly. Sprays may be used for general area treatment. Also treat cracks, crevices, and similar areas only. Foggers are only effective when used in conjunction with sprays to other critical areas. Treat infested animals with properly labeled product for lasting control.
cypermethrin (Black Flag, Hot Shot, Ortho, Raid)	Aerosol Spray, Liquid	
deltamethrin (Black Flag)	Aerosol Spray, Liquid	Apply as directed on the label.
Diatomaceous earth (Hot Shot, Safer Brand)	Dust	

Table 5-20. Control of Household Pests−Products for Use by the General Public

Insecticide	Formulation	Precautions and Remarks
Flea (a) Indoors (continued)		
lambda-cyhalothrin (Spectracide)	Aerosol Spray, Liquid	
lemongrass oil (Orange Guard)	Liquid	
mint oil (EcoSmart)	Liquid	
d-phenothrin (Raid, Ortho)	Liquid	
pyrethrins (Hot Shot, Black Flag)	Liquid, Fogger, Aerosol Spray	
tetramethrin (Raid)	Aerosol Spray	
permethrin (Bengalr, Hot Shot)	Aerosol Spray	
prallethrin (Black Flag, Hot Shot, Raid, Terro)	Aerosol Spray	
sumithrin (Enforcer)	Dust	
methoprene (Precor)	Aerosol Spray, Liquid	Insect growth regulators that control immature fleas only. Usually formulated with an adulticide.
Imiprothrin (Black Flag, Raid)	Aerosol Spray	
tetramethrin (Raid)	Aerosol Spray	
phenoxybenzyl (Enforcer)	Aerosol Spray	
Flea (b) Outdoors		
bifenthrin (Ortho)	Aerosol Spray, Liquid	Concentrate on kennels and shaded areas where animals tend to rest or congregate. Apply liquid formulations with sufficient spray volume to saturate soil. Granular formulations must be watered in or applied before rain. Repeat as needed at 4- to 6-week intervals. Apply as directed on the label.
cypermethrin (Black Flag, Hot Shot, Ortho, Raid)	Aerosol Spray, Liquid	
deltamethrin (Black Flag)	Aerosol Spray, Liquid	
gamma-cyhalothrin (Spectracide)	Granular Insecticide, Liquid	
lambda-cyhalothrin (Enforcer, Spectracide, Cutter)	Aerosol Spray, Liquid, Granular Insecticide	
lemongrass oil (Orange Guard)	Liquid	
mint oil (EcoSmart)	Liquid	
permethrin (Bengal, Hot Shot)	Aerosol Spray	
pyrethrins (Black Flag)	Aerosol Spray	
Flies (a) Indoors		
cypermethrin (Black Flag, Hot Shot, Ortho, Raid)	Aerosol Spray, Liquid	
dichlorvos (Hot Shot)	Pest Strip	Strips can only be used in unoccupied areas. Apply as a surface spray to areas or objects (such as garbage cans) infested with flies. Repeat treatments may be necessary. See label before treating areas of vegetation. Sanitation in the area is essential for satisfactory control of flies.
lambda-cyhalothrin (Spectracide)	Aerosol Spray, Liquid	
permethrin (Bengal, Hot Shot)	Aerosol Spray	
prallethrin (Black Flag, Hot Shot, Raid, Terro)	Aerosol Spray	
pyrethrins (Black Flag)	Aerosol Spray, Liquid	
d-phenothrin (Raid, Ortho)	Liquid	
tetramethrin (Raid)	Aerosol Spray	
deltamethrin (Black Flag, Terro)	Aerosol Spray, Liquid	
Flies (b) Outdoors		
cypermethrin (Black Flag, Hot Shot, Ortho, Raid)	Aerosol Spray, Liquid	Apply as a surface spray to areas or objects (such as garbage cans) infested with flies. Repeat treatments may be necessary. See label before treating areas of vegetation. Sanitation in the area is essential for satisfactory control using any of these chemicals but particularly important with baits. Use as directed.
cyfluthrin (BioAdvanced)	Liquid	
deltamethrin (Black Flag, Terro)	Aerosol Spray, Liquid	
imidacloprid (Maxforce)	Bait	
lambda-cyhalothrin (Spectracide)	Aerosol Spray, Liquid	
d-phenothrin (Raid, Ortho)	Liquid	
prallethrin (Black Flag, Hot Shot, Raid, Terro)	Aerosol Spray	
pyrethrins (Black Flag)	Aerosol Spray	
Hornets, Mud Daubers, Wasps, Yellow Jackets (a) Indoors		
bifenthrin (Ortho)	Liquid	
cypermethrin (Black Flag, Hot Shot, Ortho, Raid)	Aerosol Spray, Liquid	
deltamethrin (Black Flag)	Liquid, Aerosol Spray	
prallethrin (Black Flag, Hot Shot, Raid, Terro)	Aerosol Spray	
d-phenothrin (Raid, Ortho)	Liquid	
pyrethrins (Black Flag)	Aerosol Spray	
tetramethrin (Raid)	Aerosol Spray	
Hornets, Mud Daubers, Wasps, Yellow Jackets (b) Nest and adjacent areas		
bifenthrin (Ortho)	Liquid	Apply to nest or opening after dark when insects have returned to nest. Re-treatment may be necessary. Most are packaged in pressurized containers that direct an insecticide stream of up to 10 feet. For yellowjackets and other soil-dwelling wasps, apply chemical to nests in soil.
Carbaryl (Sevin)	Dust, Liquid	
cyfluthrin (BioAdvanced)	Liquid	
cypermethrin (Black Flag, Hot Shot, Ortho, Raid)	Aerosol Spray, Liquid	
deltamethrin (Black Flag)	Aerosol Spray, Liquid	
diatomaceous earth (Safer Brand)	Dust	
lambda-cyhalothrin (Hot Shot)	Liquid	
d-phenothrin (Raid)	Liquid	
prallethrin (Black Flag, Hot Shot, Raid, Terro)	Aerosol	

Table 5-20. Control of Household Pests−Products for Use by the General Public

Insecticide	Formulation	Precautions and Remarks
Lice: body, head, crab (on person)		
ivermectin (Sklice)	Liquid	Shampoo lotions and formulations. Thoroughly treat infested areas of body with lotion. Do not apply near eyes, mouth or other sensitive areas. Wash infested clothing with strong soap and very hot water. Dry clean woolens. Products containing ivermectin, malathion or spinosad are available by prescription only. **Insecticidal treatment of furniture, carpets, or other areas of the home is not needed.**
malathion (Ovide)	Liquid	
permethrin (Nix)	Cream	
pyrethrins (Pyrethrin Lice Treatment M)	Liquid	
spinosad (Natroba)	Liquid	
Millipede (a) Indoors		
bifenthrin (Ortho)	Liquid	
cypermethrin (Black Flag, Hot Shot, Ortho, Raid)	Liquid, Aerosol Spray	
diatomaceous earth (Hot Shot, Safer Brand)	Dust	
imiprothrin (Raid, Black Flag)	Aerosol Spray	
lambda-cyhalothrin (Spectracide)	Liquid	
mint oil (EcoSmart)	Liquid	
deltamethrin (Black Flag, Terro)	Aerosol Spray, Dust	
d-phenothrin (Ortho, Raid)	Liquid	
prallethrin (Black Flag, Hot Shot, Raid, Terro)	Aerosol Spray	
pyrethrins (Black Flag)	Aerosol Spray	
Millipede (b) Outdoors		
bifenthrin (Ortho)	Liquid	Use as barrier treatment along foundation wall, door threshold, window ledges. Some sprays may damage vegetation under hot, humid conditions. Read label precautions. For lawn treatment, apply an insecticide band 10 to 15 feet wide. Apply liquid formulations with sufficient spray volume to saturate soil. Use granular formulations outdoors only; water in or apply before rain. Repeat as needed at 4- to 6-week intervals.
cypermethrin (Black Flag, Hot Shot, Ortho, Raid)	Aerosol Spray, Liquid	
diatomaceous earth (Hot Shot)	Dust	
gamma-cyhalothrin (Spectracide)	Granular Inseticide, Liquid	
lambda-cyhalothrin (Cutter)	Liquid	
mint oil (EcoSmart)	Liquid	
pyrethrins (Black Flag)	Aerosol Spray	
Mosquitoes (a) Indoors		
cypermethrin (Black Flag, Hot Shot, Ortho, Raid)	Aerosol Spray, Liquid	
deltamethrin (Black Flag)	Liquid, Aerosol Spray	
lambda-cyhalothrin (Spectracide)	Aerosol Spray, Granular Insecticide, Liquid	
tetramethrin (Raid)	Aerosol Spray	
permethrin (Bengal, Hot Shot)	Aerosol Spray	
d-phenothrin (Raid, Ortho	Liquid	
prallethrin (Black Flag, Hot Shot, Raid, Terro)	Aerosol Spray	
pyrethrins (Black Flag)	Aerosol Spray	
Mosquitoes (b) Outdoors (See also *Community Pest Control* Section)		
allethrin (Coleman)	Repellent Coil	
Bacillus thuringiensis (*Bti*) (Mosquito Dunks)	Solid	A biopesticide containing bacteria that kill mosquitoes and some biting flies. Place in small ponds, birdbaths, and ornamental pools (not swimming pools). Follow instructions for specifics of application.
bifenthrin (Ortho)	Liquid	Long-term control requires eliminating or cleaning mosquito breeding areas, such as discarded containers, ditches, and other artificial sources of standing water. Spraying nearby vegetation may eliminate some mosquito resting sites, but some formulations may damage vegetation. Aerosols or foggers may be used for temporary relief when winds are insignificant. Use repellents on exposed body areas.
deltamethrin (Black Flag)	Aerosol Spray, Liquid	
cyfluthrin (BioAdvanced)	Liquid	
cypermethrin (Black Flag, Hot Shot, Ortho, Raid)	Aerosol Spray, Liquid	
gamma–cyhalothrin (Spectracide)	Liquid, Granular Insecticide	
lambda-cyhalothrin (Spectracide, Cutter)	Aerosol Spray, Granular Insecticide, Liquid	
permethrin (Bengal, Hot Shot)	Aerosol Spray	
pyrethrins (Black Flag)	Aerosol Spray	
Pantry Pests (Pests in food storage areas)		
cypermethrin (Black Flag, Hot Shot, Ortho, Raid)	Aerosol Spray, Liquid	
deltamethrin (Black Flag)	Liquid, Aerosol Spray	
imiprothrin (Black Flag, Raid)	Aerosol Spray	Imiprothrin is formulated with other pesticides in these products.
lambda-cyhalothrin (Spectracide)	Liquid	
mint oil (EcoSmart)	Liquid	
pyrethrins, pyrethrum (Black Flag)	Aerosol Spray	
bifenthrin (Ortho)	Aerosol Spray, Liquid	
Silverfish		
bifenthrin (Ortho)	Aerosol Spray Liquid	Apply to cracks and crevices, behind and underneath appliances. Spray along baseboards and other areas where silverfish are found.
cyfluthrin (BioAdvanced)	Liquid	
cypermethrin (Black Flag, Hot Shot, Ortho, Raid)	Aerosol Spray, Liquid	
deltamethrin (Black Flag, Terro)	Dust, Liquid, Aerosol Spray	
diatomaceous earth (Hot Shot, Safer Brand)	Dust	

Table 5-20. Control of Household Pests−Products for Use by the General Public

Insecticide	Formulation	Precautions and Remarks
Silverfish (continued)		
d-phenothrin (Ortho, Raid)	Liquid	
hydramethylnon (Amdro, Combat)	Granular Bait	
imiprothrin (Raid, Black Flag)	Aerosol Spray	Imiprothrin is formulated with other pesticides in these products
lambda-cyhalothrin (Spectracide)	Aerosol Spray, Granular Insecticide, Liquid	Follow label directions.
lemongrass oil (Orange Guard)	Liquid	
mint oil (EcoSmart)	Liquid	
deltamethrin (Black Flag)	Aerosol, Liquid	
permethrin (Bengal, Hot Shot)	Aerosol Spray	
prallethrin (Black Flag, Hot Shot, Raid, Terro)	Aerosol Spray	
pyrethrins (Black Flag)	Aerosol Spray	
Sowbugs and Pillbugs (a) Indoors		
bifenthrin (Ortho)	Liquid	Clean up breeding and hiding places and treat thoroughly. Outdoor barrier treatments along foundation and door thresholds are usually sufficient. Some products are not suitable for use in residential kitchens or commercial food/feed preparation sites. Read the product label carefully. Follow label directions.
cypermethrin (Black Flag, Hot Shot, Ortho, Raid)	Aerosol Spray, Liquid	
deltamethrin (Black Flag, Terro)	Dust, Liquid, Aerosol Spray	
lambda-cyhalothrin (Spectracide)	Aerosol Spray, Liquid	
mint oil (EcoSmart)	Liquid	
permethrin (Bengal, Hot Shot)	Aerosol Spray	
pyrethrins (Black Flag)	Aerosol Spray	
Sowbugs and Pillbugs (b) Outdoors		
bifenthrin (Ortho)	Liquid	
cypermethrin (Black Flag, Hot Shot)	Aerosol Spray, Liquid	
deltamethrin (Black Flag, Terro)	Dust, Liquid, Aerosol Spray	
mint oil (EcoSmart)	Liquid	
lambda-cyhalothrin (Spectracide, Cutter)	Aerosol Spray, Granular Insecticide, Liquid	
pyrethrins (Black Flag)	Aerosol Spray	
Spiders (a) Indoors		
bifenthrin (Ortho)	Aerosol Spray, Liquid	Treat infested areas, along baseboards. Use foggers if rooms have been undisturbed for some time and spider populations are extensive. Some products are not suitable for use in residential kitchens or commercial food/feed preparation sites. Read the product label carefully. Imiprothrin is formulated with other pesticides in these products. Follow label directions.
cornmint oil (EcoLogic)	Aerosol Spray, Liquid	
cyfluthrin (BioAdvanced)	Liquid	
cypermethrin (Black Flag, Hot Shot, Ortho, Raid)	Aerosol Spray, Liquid	
d-phenothrin (Ortho, Raid)	Liquid	
imiprothrin (Raid, Black Flag)	Aerosol Spray	
lambda-cyhalothrin (Spectracide, Black Flag)	Aerosol Spray, Liquid	
mint oil (EcoSmart)	Liquid	
deltamethrin (Black Flag, Terro)	Aerosol Spray, Dust, Liquid	
permethrin (Bengal, Hot Shot)	Aerosol Spray	
pyrethrins (Black Flag)	Aerosol Spray	
prallethrin (Black Flag, Hot Shot, Raid, Terro)	Aerosol Spray	
Spiders (b) Outdoors		
bifenthrin (Ortho)	Aerosol Spray, Liquid	Apply as a barrier treatment along foundation. Spray corners of decks, eaves, porches and other areas where spiders tend to build webs. Webbing can be knocked down as an alternative. Exercise caution when spraying in crawlspace. Avoid inhaling spray. Follow label directions.
cypermethrin (Black Flag, Hot Shot, Ortho, Raid)	Liquid, Aerosol Spray	
deltamethrin (Black Flag)	Liquid, Aerosol Spray	
lambda-cyhalothrin (Spectracide, Cutter)	Aerosol Spray, Granular Insecticide, Liquid	
mint oil (EcoSmart)	Aerosol Spray, Liquid	
pyrethrins (Black Flag)	Aerosol Spray	
Springtails (Indoors and outdoors)		
bifenthrin (Ortho)	Liquid	Apply as a barrier spray along foundation and entry points. Some products may be used indoors for temporary relief. Clean up moisture conditions that may attract insects indoors. Excess moisture may impede product effectiveness. Use indoors for temporary relief. Some products are not suitable for use in residential kitchens or commercial food/feed preparation sites. Read the product label carefully. Imiprothrin is formulated with other pesticides in these products. Follow label directions.
deltamethrin (Black Flag)	Aerosol Spray	
imiprothrin (Raid, Black Flag)	Aerosol Spray	
lambda-cyhalothrin (Spectracide)	Granular Insecticide, Liquid	
mint oil (EcoSmart)	Liquid	
pyrethrins, pyrethrum (Black Flag)	Aerosol Spray	
gamma-cyhalothrin (Spectracide)	Liquid, Granular Insecticide	
Stinging Caterpillars See *Trees and Woody Ornamentals* Section		

Table 5-20. Control of Household Pests−Products for Use by the General Public

Insecticide	Formulation	Precautions and Remarks
Stink Bugs (Indoors and outdoors)		
bifenthrin (Ortho)	Liquid	
deltamethrin (Black Flag)	Liquid, Aerosol Spray	
d-phenothrin (Ortho, Raid)	Liquid	
gamma-cyhalothrin (Spectracide)	Liquid, Granular Insecticide	
imiprothrin (Raid, Black Flag)	Aerosol Spray	
lambda-cyhalothrin (Cutter)	Liquid	
Stored Food Pests See Pantry Pests.		
Ticks (Outdoors) See Brown Dog Tick and *Control of Insects on Pets* section		
Wasps, Yellow Jackets See Hornets		

Formulation Designations: Bait may be gel or granular; fogger is a total release aerosol; liquid for mixing with water or ready-to-use; powder for mixing with water.

Insect Control for Home Lawns

R. L. Brandenburg and T. L. Billeisen, Entomology and Plant Pathology

NOTE: Some products are for use only by professionals. Homeowner products are numerous, and names change frequently, so it is not possible to list all homeowner products by brand names. When choosing a product to use at home, look at the label and use this table to compare the name of the active ingredients.

Table 5-21. Insect Control for Home Lawns

Pest	Insecticide and Formulation	Amount per 1,000 Sq Ft	Precautions and Remarks
Ant (Also see Imported Fire Ant)	carbaryl*	See label	Treat mounds and surrounding area or apply broadcast.
	clothianidin + bifenthrin (Aloft LC) G SC	 1.8 to 3.6 lb 0.27 to 0.54 fl oz	Toxic to fish and aquatic invertebrates. Do not apply near or allow runoff to surface waters or intertidal areas.
	hydramethylnon* (Maxforce FC) bait	See label	Do not combine with other pesticides or fertilizers
	pyrethroids* (Advanced Lawn, Bug-B-Gone, Deltagard G, Scimitar, Talstar, Tempo, Wisdom) Some ants are susceptible to fire ant products.	See label	Many pyrethroids are toxic to fish and aquatic invertebrates. Apply these products only as specified on the label.
Armyworm, Fall Armyworm, Cutworm	azadirachtin* (Neemix and)	See label	
	carbaryl*	See label	Apply as a coarse spray in sufficient water for good coverage. Treat when first injury noted. Repeat as needed. Do not water into soil. Do not cut grass for 1 to 3 days after treatment.
	chlorantraniliprole (Acelepryn) G SC	 1.15 to 2.3 lb 0.046 to 0.092 fl oz	Toxic to aquatic invertebrates, oysters and shrimp.
	indoxacarb (Provaunt)	0.046 to 0.092 oz	
	pyrethroids* (Advanced Lawn, Bug-B-Gone, Deltagard G, Scimitar, Talstar, Tempo, Wisdom)	See label	Many pyrethroids are toxic to fish and aquatic invertebrates. Apply these products only as specified on the label.
	spinosad A and D (Conserve SC)	0.25 to 1.25 fl oz	Rate varies with size and species.
	thiamethoxam + lambda-cyhalothrin (Tandem)	See label	Highly toxic to fish and aquatic invertebrates.
	trichlorfon* (Dylox)	1.5 to 3 oz	
	various entomogenous nematode and *B.t.* products	See label	
Bee and Wasp	carbaryl*	6 to 8 oz	Most of these are parasitic on soil pests, especially grubs; therefore, they are beneficial. Sometimes there are so many bees and wasps burrowing in the soil that chemical treatments are necessary to prevent damage or reduce danger from stings. Spot spray ground nest openings. Bee, wasp and hornet sprays in pressurized cans are also effective.
	pyrethroids* (Advanced Lawn, Bug-B-Gone, Deltagard G, Scimitar, Talstar, Tempo, Wisdom)	See label	
Chinch Bug	chlorantraniliprole (Acelepryn) G SC	 1.15 to 2.3 lb 0.184 to 0.46 fl oz	Suppression only. Toxic to aquatic invertebrates, oysters and shrimp.
	clothianidin + bifenthrin (Aloft LC) G SC	 1.8 to 3.6 lb 0.27 to 0.54 fl oz	Toxic to fish and aquatic invertebrates. Do not apply near or allow runoff to surface or intertidal areas.
	dinotefuran (Zylam)	1.0 fl oz	For suppression, make application prior to hatching of first instar nymphs.
	pyrethroids* (Advanced Lawn, Bug-B-Gone, Deltagard G, Scimitar, Talstar, Tempo, Wisdom)	See label	Many pyrethroids are toxic to fish and aquatic invertebrates. Apply these products only as specified on the label.
	thiamethoxam + lambda-cyhalothrin (Tandem)	0.6 fl oz	Apply when insects are first observed. Repeat applications may be necessary. Highly toxic to fish and aquatic invertebrates.
Grub, White (Green June Beetle only)	carbaryl*	1.8 oz	Apply to the soil surface but do not water in.

Table 5-21. Insect Control for Home Lawns

Pest	Insecticide and Formulation	Amount per 1,000 Sq Ft	Precautions and Remarks
Grub, White (Japanese beetle, Southern chafer, European chafer, billbug)	carbaryl*	3.6 oz	
	chlorantraniliprole (Acelepryn) G SC	 1.15 to 2.3 lb 0.184 to 0.46 fl oz	Toxic to aquatic invertebrates, oysters and shrimp.
	clothianidin (Arena) 0.25 G 50 WDG	 1.84 to 3.67 lb 0.14 to 0.29 fl oz	Toxic to fish and aquatic invertebrates. Do not apply near or allow runoff to surface waters or intertidal areas.
	clothianidin + bifenthrin (Aloft LC) G SC	 1.8 to 3.6 lb 0.27 to 0.54 fl oz	Toxic to fish and aquatic invertebrates. Do not apply near or allow runoff to surface waters or intertidal areas.
	dinotefuran (Zylam)	1.0 fl oz	Make application prior to or during peak egg hatch.
	imidacloprid (Advanced Lawn Grub Control, Merit)	See label	
	thiamethoxam (Meridian)	See label	Highly toxic to aquatic invertebrates.
	thiamethoxam + lambda-cyhalothrin (Tandem)	See label	Highly toxic to fish and aquatic invertebrates.
	trichlorfon* (Dylox)	3.75 oz	
	various entomogenous nematodes	See label	Must be *Heterorhabditid* species to be effective.
Imported Fire Ant	acephate* (Ortho Fire Ant Killer)	1 to 2 tsp/ mound	Distribute uniformly over mound. For best results apply in early morning or late afternoon.
	bifenthrin (Talstar)	See label	Apply as a mound treatment or broadcast.
	carbaryl	See label	Use as a mound drench.
	clothianidin + bifenthrin (Aloft LC SC)	2.3 to 3.6 lb	Toxic to fish and aquatic invertebrates. Do not apply near or allow runoff to surface waters or intertidal areas.
	d-limonene (Orange Guard)	See label	Mound treatment. Acceptable to organic growers. May also be used around fruit and vegetable gardens.
	fipronil (Taurus G, Top Choice)	2 lb	Apply as a broadcast.
	fipronil (Maxforce FC) bait	See label	Apply as a mound treatment or broadcast bait.
	fipronil + bifenthrin + lambda-cyhalothrin (Taurus Trio G)	2 lb	Apply as a broadcast. Irrigate prior to treatment.
	hydramethylnon* (Amdro Fire Ant Bait, Amdro Pro, Maxforce FC)	See label	Follow label directions precisely. Use fresh bait. Repeat treatment usually required.
	indoxacarb (Advion)	See label	
	lambda-cyhalothrin (Scimitar, Cyonara)	See label	Apply as a mound treatment or broadcast.
	metaflumizone (Siesta) bait	See label	Mound or broadcast bait.
	methoprene (Extinguish Pro) bait	See label	Mound or broadcast. Follow label directions. Repeat treatments usually required.
	methoprene + hydramethylnon (Extinguish Plus, Amdro) bait	See label	Follow label directions precisely. Repeat treatments usually required. Use fresh bait. Found in broadcast or mound treatment packaging.
	pyriproxyfen (Distance) bait	See label	Mound or broadcast bait.
	spinosad	See label	Acceptable to organic growers. Follow label directions precisely. Repeat treatments usually required. Use fresh bait. May also be used around fruit and vegetable gardens.
Mole Cricket	carbaryl* baits	See label	
	clothianidin + bifenthrin (Aloft LC) G SC	 1.8 to 3.6 lb 0.27 to 0.54 fl oz	Toxic to fish and aquatic invertebrates. Do not apply near or allow runoff to surface waters or intertidal areas. Application should be made during peak adult flight and egg lay.
	dinotefuran (Zylam)	1.0 fl oz	Make application prior to or during peak egg hatch.
	fipronil (Top Choice, Taurus G)	2 lb	Apply as a broadcast.
	imidacloprid (Advanced Lawn Grub Control, Merit)	See label	
	indoxacarb (Advion Insect Granules) bait	See label	
	indoxacarb (Provaunt)	0.275 oz	
	pyrethroids* (Advanced Lawn, Bug-B-Gone, Deltagard G, Scimitar, Talstar, Tempo, Wisdom and others)	See label	Many pyrethroids are toxic to fish and aquatic invertebrates. Apply these products only as specified on the label.
	thiamethoxam + lambda-cyhalothrin (Tandem)	See label	Apply from first egg hatch to peak egg hatch. Highly toxic to fish and aquatic invertebrates.
	various entomogenous nematode products	See labels	Require irrigation.
Slug, Snail	ferric orthophosphate + ferric phosphate + iron phosphate (Natria Snail & Slug)		Apply in late afternoon.
	methiocarb (Mesurol 75 W)	1 lb	Apply in late afternoon.
	metaldehyde (Durham Ornamental)	See label	Apply in late afternoon.
Sod Webworm (also Burrowing Sod Webworm)	carbaryl*		Do not water in sprays. Use 6 gallons water plus the insecticide per 1,000 square feet. Treat in late afternoon. Do not cut grass for 1 to 3 days after treatment. Granules must be watered in.
	dinotefuran (Zylam)	1.0 fl oz	
	pyrethroids* (Advanced Garden, Deltagard G, Scimitar, Talstar, Tempo, Wisdom and others)	See label	Many pyrethroids are toxic to fish and aquatic invertebrates. Apply these products only as specified on the label.
	spinosad A and D (Conserve SC)	0.25 to 1.25 fl oz	Rate varies with size and species.
	thiamethoxam + lambda-cyhalothrin (Tandem)	See label	Highly toxic to fish and aquatic invertebrates.
	trichlorfon* (Dylox)	1.5 to 3 oz	Use sufficient water for good coverage.
	various entomogenous nematode and *B.t.* products	See label	

** Several trade names available. Check label for active ingredient. Always follow label instructions.*

Insect Management in Industrial Hemp

David H Suchoff, Crop & Soil Sciences

Industrial hemp (grain, fiber, and high cannabinoid floral) is a newer crop in North Carolina and throughout much of the United States, and there are limited formally labeled pesticides available. The materials listed in this table have been approved for use in industrial hemp by the US Environmental Protection Agency and the North Carolina Department of Agriculture & Consumer Services. **Materials for which there is data suggesting efficacy in industrial hemp or for the target pest in other crops are listed below. Additional materials are registered for use in industrial hemp in North Carolina, but their efficacy is unknown or not expected based on data for the target pest from other crops. We would not recommend use of these materials at this time, but we have listed them Table 5-22B to assist growers with questions about registered materials.**

In general, information is provided for the commonly used formulations of active ingredients available in multiple formulations. Carefully check the label of the product you plan to use in the event that it differs from those listed. The label is the law!

Residues of some pesticides are a concern for purchasers. Growers are encouraged to discuss insecticide options with their purchasers before treating to reduce potential residue concerns.

The Insect Resistance Action Committee (**IRAC**) has grouped insecticides sharing the same mode of action (**MOA**) into categories. The categories are listed following insecticide and formulation names. To minimize the likelihood of resistance development, avoid successive treatment with insecticides having the same MOA. The Organic Materials Registry Institute (**OMRI**) lists products acceptable for use in organic production. These products are identified in the Precautions and Remarks section.

Pests listed below are currently considered to be pests of industrial hemp. Because our understanding of this system is rapidly expanding, the status of pests included here is subject to change.

Table 5-22A. Insect Management in Industrial Hemp

Insect	Insecticide, Formulation and IRAC Group	Amount of Formulation per acre	Restricted Entry Interval (REI) (hours)	Preharvest Interval (PHI) (days)	Potential efficacy[1] and Precautions and Remarks
Cannabis aphid and other aphids Several aphid species have been identified feeding in industrial hemp, but cannabis aphid (*Phorodon cannabis*) appears to be the most common and potentially significant. Cannabis aphid has been observed in both indoor and outdoor, high cannabinoid floral hemp production.	Azadirachtin, IRAC UN (Aza-Direct and many other formulations)	1 to 3.5 pt	4	0	**F** Many formulations of azadirachtin are available for use in hemp. Check rates on the label of the product you intend to use. These materials likely have similar efficacy against target pests.
Corn earworm and Tobacco budworm Corn earworm (*Helicoverpa zea*) and tobacco budworm (*Chloridea virescens*) may both feed on industrial hemp as caterpillars. Corn earworm appears more common than tobacco budworm, but they may co-occur. Moths of both species strongly prefer flowers, seeds, and fruit and are not a concern in hemp until flowering begins. Control can be difficult because larvae are sheltered within flowers and buds. Corn earworm and tobacco budworm are more significant pests in field grown, high cannabinoid floral hemp and can be excluded from enclosed greenhouses.	*Helicoverpa zea* nucleopolyhedrovirus ABA-NPV-U, IRAC 31 (Heligen)	1.2 to 2.4 fl oz	4	0	**G** Most effective on small larvae (under 0.5 in.); start application when first small caterpillars are observed. More than one application may be needed if large populations are present or if reinfestation occurs. Most effective at 7.0 pH. Effective only against corn earworm (*Helicoverpa zea*) and tobacco budworm (*Chloridea virescens)*. No efficacy expected on other caterpillars.
	Helicoverpa armigera nucleopolyhedrovirus strain BV-0003, IRAC 31 (Helicovex)	0.5 to 2.5 fl oz	4	0	**G** Most effective on small larvae (under 0.5 in.); start application when first small caterpillars are observed. More than one application may be needed if large populations are present or if reinfestation occurs. Most effective at 7.0 pH. Effective only against corn earworm (*Helicoverpa zea*) and tobacco budworm (*Chloridea virescens)*. No efficacy expected on other caterpillars.
	Polyhedral occlusion bodies (OBs) of the nuclear polyhedrosis virus of *Helicoverpa zea* (corn earworm), IRAC 31 (Gemstar LC)	4 to 10 fl oz	4	0	**G** Effective only against corn earworm (*Helicoverpa zea*) and tobacco budworm (*Chloridea virescens)*. No efficacy expected on other caterpillars.
	Bacillus thuringiensis subspecies *kurstaki* strain EG 7841, IRAC 11 (Crymax)	0.5 to 2 lb	4	0	**G**
	Bacillus thuringiensis subspecies *kurstaki* strain SA-11, IRAC 11 (Javelin)	0.5 to 1.5 lb	4	0	**G**
	Bacillus thuringiensis ssp. kurstaki strain EVB-113-19 fermentation solids, spores, and insecticidal toxins, IRAC 11 (Leprotec)	1 to 3.5 pt	4	0	**G**
	GS-omega/kappa-Hxtx-Hv1a, IRAC 32 (Spear-Lep)	1 to 2 pt	4	0	**G** (when tank mixed with *Bt*) Spear-Lep is most effective when tank mixed with a *Bt* containing insecticide.

Table 5-22A. Insect Management in Industrial Hemp

Insect	Insecticide, Formulation and IRAC Group	Amount of Formulation per acre	Restricted Entry Interval (REI) (hours)	Preharvest Interval (PHI) (days)	Potential efficacy[1] and Precautions and Remarks
Foliar feeding caterpillars Recent research suggests that even high rates of leaf feeding does not reduce yield in industrial hemp grown for grain, fiber, or flowers. Foliar feeding may be a concern in very young plants or if populations build in greenhouses. A number of different generalist caterpillar species have been observed feeding in industrial hemp. Correct species identification can aid in selecting the best management tool.	*Bacillus thuringiensis* subspecies *kurstaki* strain EG 7841, IRAC 31 (Crymax) (Agree WG)	 0.5 to 2 lb 0.5 to 2 lb	4	0	**G**
	Chrysodeixis includens nucleopolyhedrovirus isolate #460, IRAC 31 (Chrysogen)	1.2 to 2.4 fl oz	4	0	**G** Effective only against soybean looper (*Chrysodeixis includens*) and cabbage looper (*Trichoplusia ni*). No efficacy expected on other foliar feeding caterpillars.
	GS-omega/kappa-Hxtx-Hv1a, IRAC 32 (Spear-Lep)	1 to 2 pt	4	0	**G** (when tank mixed with *Bt*) Spear-Lep is most effective when tank mixed with a *Bt* containing insecticide.
	Azadirachtin, IRAC UN (Aza-Direct and many other formulations)	1 to 3.5 pt	4	0	**F** Many formulations of azadirachtin are available for use in hemp. Check rates on the label of the product you intend to use. These materials likely have similar efficacy against target pests.
Japanese beetles Recent research suggests that even high rates of leaf feeding does not reduce yield in industrial hemp grown for grain, fiber or flowers. Japanese beetles do not appear to feed on seeds or flowers in hemp, so their feeding is not expected to result in significant damage.	Azadirachtin, IRAC UN (Aza-Direct and many other formulations)	1 to 3.5 pt	4	0	**F** Many formulations of azadirachtin are available for use in hemp. Check rates on the label of the product you intend to use. These materials likely have similar efficacy against target pests.
Russet mites	Hemp russet mites *(Aculops cannabicola*) are tiny, worm-like eriophyid mites that live on the surface of hemp leaves which require magnification to identify. They can occur in both greenhouse and field grown hemp and can reach high densities on leaves. It is not clear how significant a pest hemp russet mites are, and there are no current management criteria. There are currently no known effective management tools for hemp russet mites.				
Twospotted spider mites Twospotted spider mites (*Tetranychus urticae*) are more common on greenhouse grown high cannabinoid floral hemp and rarely reported in field grown plants in North Carolina.	predatory mites (*Phytoseiulus persimilis and others*)	30,000 to 60,000	NA	NA	**VG** Release predatory mites when spider mites are first observed and populations are low. Spider mite populations must be followed closely after predatory mite releases. Consult commercial insectaries for predatory mite release rate and species recommendations. Other predatory mite species may also provide good control of twospotted spider mites in NC industrial hemp.
Red imported fire ants Red imported fire ants have been observed feeding on stalks of small high cannabinoid floral hemp plants throughout the Southeast with this injury apparently contributing to stand loss in some areas. Treating fields with fire ant populations prior to transplant with baits is the most effective means of suppressing populations. Mound drenches and other contact treatments provide only short term suppression.	methoprene, IRAC 7C (Extinguish Professional Fire Ant Bait)	1 to 1.5 lb	4	0	**E** Extinguish can be applied as a mound treatment or broadcast. Extinguish is broadly labeled for use on cropland, although the label does not explicitly include industrial hemp. *Extinguish Plus* is **not** labeled for use on cropland. Read labels carefully. Industrial hemp growers should communicate with their intended purchaser before using Extinguish to ensure it is acceptable.

[1] E - Excellent, VG - Very Good, G - Good, F - Fair, NC – No control, UN – No data at this time

Relative Effectiveness of Insecticides Registered for Use in Industrial Hemp

M. Favre, Entomology and Plant Pathology

(E - Excellent, VG - Very Good, G - Good, F - Fair, NC – No control, UN – No data at this time)

Table 5-22B. Relative Effectiveness of Insecticides Registered for Use in Industrial Hemp

IRAC[1] MOA Group (when determined)	Active ingredient (Formations)	Cannabis aphid and other aphids	Corn earworm and Tobacco budworm	Foliar feeding caterpillars	Japanese beetles	Russet mites	Twospotted spider mites	Red imported fire ants	OMRI Listed?
7C	methoprene, (Extinguish Professional Fire Ant Bait)	NC	NC	NC	NC	NC	NC	E	No
11	*Bacillus thuringiensis* (Crymax) (Javelin) (Leprotec)	NC	G	G	NC	NC	NC	NC	No
31	*Chrysodeixis includens* nucleopolyhedrovirus isolate #460 (Chrysogen)	NC	NC	G[2]	NC	NC	NC	NC	Yes
31	Polyhedral occlusion bodies (OBs) of the nuclear polyhedrosis virus of *Helicoverpa zea* (corn earworm) (Gemstar LC) (Heligen) (Helicovex)	NC	G	G[4]	NC	NC	NC	NC	Yes
32	GS-omega/kappa-Hxtx-Hv1a (Spear-T)	UN	NC	NC	NC	UN	UN	NC	No
	(Spear-Lep)	UN	G	G	UN	UN	UN	NC	NC
UNF	*Isaria fumosorosea* Apopka Strain 97 (Ancora)	UN	NC	NC	NC	UN	UN	NC	Yes
UNE	Neem oil, cold pressed (Debug-ON) (Ecoworks EC)	F	NC	F	F	UN	UN	NC	Yes
UN and UNE	Azadirachtin and Neem oil, cold pressed (Debug Optimo) (Debug Tres) (Debug Turbo)	F	NC	F	F	UN	UN	NC	Yes
UN	azadirachtin (Aza-Direct) (AzaMax) (EcoGarden)	F	NC	F	F	UN	UN	NC	Yes
NA	Capsicum oleoresin extract, Garlic oil, Soybean oil (GH CMT) (Prevasyn)	UN	NC	NC	NC	UN	UN	NC	No
NA	piperonyl butoxide[3] (Exponent) (P.B.O. Concentrate)	NC	NC	NC	NC	NC	NC	NC	No
NA	cinnamaldehyde (Seican)	UN	NC	NC	NC	UN	UN	NC	Yes

[1] Insecticide Resistance Action Committee (IRAC) mode of action (MOA) group. NA – not available.

[2] Effective only against soybean looper (*Chrysodeixis includens*) and cabbage looper (*Trichoplusia ni*). No efficacy expected on other foliar feeding caterpillars.

[3] Piperonyl butoxide is a synergist that improves performance of pyrethrin or pyrethroid insecticides. It is not expected to have activity alone.

[4] Effective only against corn earworm (*Helicoverpa zea*) and tobacco budworm (*Chloridea virescens)*. No efficacy expected on other caterpillars.

More information is available at hemp.ces.ncsu.edu/insect-mite-managementv