# 3. PEANUT PRODUCTION PRACTICES

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Successful production of quality peanuts requires growers to plan an effective production and marketing program and to implement that program on a timely basis during the season. Each cultural practice and marketing decision must be effectively integrated into the total farm management plan to produce optimum profits from the whole farm. In recent years, yields have increased significantly, with several records set since 2011. Many factors have contributed to high yields. These include improved genetics, production of peanut in soils that are adapted to peanut production, long rotations that minimize the impact of disease, availability of plant protection products for virtually all pests, better equipment and technology, and skilled farmers and support staff who manage peanut production extremely well. In North Carolina, weather conditions can have a major impact on yield, given that only 15% of acreage is irrigated. With good weather conditions, 2 tons per acre is the new average yield, and there have been yields that exceed 5,000 lb per acre in North Carolina.

## STAND ESTABLISHMENT

Soil temperatures need to be above 65°F for germination to proceed at an acceptable rate. Large-seeded Virginia market type peanuts planted under favorable moisture and temperature conditions will show beginning radicle (root) growth in about 60 hours. If conditions are ideal, sprouting young seedlings should be visible in 7 days for smaller-seeded varieties like Bailey and in 10 days for larger-seeded varieties like Emery.

Peanuts should not be planted until the soil temperature at a 4-in. depth is 65°F or above at noon for three days. Favorable weather for peanut germination should also be forecast for the next 72 hours after planting. The soil should be moist enough for rapid water absorption by the seed. The planter should firm the seedbed to promote good soil-to-seed contact. Growers should establish at least four plants per ft of row, regardless of variety. This goal generally means setting the planter to deliver five seeds per ft of row. Peanuts can emerge from depths as low as 3 in. With good seed quality and seed treated with fungicide for protection from soilborne pathogens, peanuts can emerge under less-than-ideal conditions. In some years, peanuts planted in mid-May will emerge as quickly as peanuts planted in late April or early May.

## VARIETY SELECTION

Yield and quality are two major factors that influence variety selection. Growers with significant disease history may need to choose a variety with disease tolerance or resistance. Planting at least three varieties with differing maturity dates will permit efficient use of limited harvesting and curing capacities. Planting varieties with different genetic pedigrees reduces the risk of crop failure due to adverse weather or unexpected disease epidemics. In recent years, Bailey II has rapidly become the most dominant variety in North Carolina. As with Bailey, there is concern that heavy reliance on one variety will increase risk, which is often minimized by planting a group of varieties on each farm.

The selection of a variety should be based on more than one year's data. Performance of our most popular peanut varieties from reports prepared by Maria Balota's Peanut Variety and Quality Evaluation (PVQE) program is presented in Table 3-1. (Jacob Forehand is now the director of PVQE.) Varietal characteristics are listed in Table 3-2. Disease reaction of varieties can be found in Chapter 6, "Peanut Disease Management." Additional information on performance of peanut varieties can be found in Chapter 13, "Variety Development." Yield response of Bailey II, Emery, and NC 20 is discussed in Chapter 14.

***Table 3-1. Percentages of Extra-Large Kernels (ELK), Sound Mature Kernels (SMK), Total Kernels, Pod Yield, and Financial Return for the Major Virginia Market Type Varieties***

| Variety | % FP | % ELK | % SMK | Total Kernels (%) | Yield (lb/acre) | Financial Return ($/acre) |
|---|---|---|---|---|---|---|
| Bailey II | 93 | 47 | 65 | 73 | 4,961 | 914 |
| Emery | 88 | 49 | 65 | 72 | 4,832 | 874 |
| Sullivan | 88 | 43 | 63 | 72 | 4,648 | 822 |
| Walton | 88 | 42 | 64 | 72 | 5,000 | 890 |

*Data from Balota (former PVQE director) et al. from all trials in the PVQE testing program 2018–2020. Financial return is calculated using the loan rate price.

***Table 3-2. Varietal Characteristics***

| Factors | Bailey II | Emery | Sullivan | Walton |
|---|---|---|---|---|
| Growth habit (R = runner; SR = semi-runner) | SR | SR | R | SR |
| Heat unit requirement | 2,650 | 2,650 | 2,650 | 2,700 |
| Comparative days to optimum maturity | 0 | 0 | 0 | +4 |
| Seed per lb | 600 | 535 | 575 | 600 |
| Need for calcium (M = moderate; H = high) | M | H | M | M |

**Heat unit requirement** = degree day accumulation (56°F base and a 95°F ceiling) required to reach optimum maturity, assuming adequate soil moisture for sustained growth and development. In comparative days to optimum maturity, **–** = optimum maturity for the variety occurs prior to 0; **+** = optimum maturity for the variety occurs after 0.

## VARIETY CHARACTERISTICS

**Bailey II** iis a large-seeded Virginia market type peanut with resistance to several key peanut diseases. This variety offers tolerance to cylindrocladium black rot (CBR), sclerotinia blight, tomato spotted wilt virus (TSWV), and stem rot. Seed size for Bailey II is small compared to all other Virginia market types.

**Emery** is a large-seeded, high oleic variety that offers resistance to several key diseases in peanuts. Vine growth is intermediate between Bailey and Sullivan. Pods and kernels of Emery are larger than Bailey.

**NC 20** is a large-seeded, high oleic variety that has a disease resistance package similar to Bailey II. Pod size is larger than Bailey II and similar to Sullivan.

**Sullivan** is a large-seeded Virginia market type that possesses the high oleic trait and offers some resistance to some key diseases found in peanuts in North Carolina. This variety does not have excessive vine growth like Bailey and has produced high yields in many trials. Pod size is larger than Bailey but not as large as Wynne.

## SELECTING AND MANAGING SOIL RESOURCES

Peanuts are best adapted to well-drained, sandy loam soils, such as Norfolk, Orangeburg, and Goldsboro. These soils are loose, friable, and easily tilled, with a moderately deep rooting zone for easy penetration by air, water, and roots. A balanced supply of nutrients is needed. Soil pH should be in the range of 5.8 to 6.2. Peanuts grown in favorable soil conditions are healthier and more able to withstand climatic and biotic stresses.

### *Crop Rotation*

A long crop rotation program is essential for efficient peanut production. The peanut plant responds to both the harmful and beneficial effects of other crops grown in the same field. Research shows that long rotations are best for maintaining peanut yields and quality. Benefits and potential problems associated with crops typically found within peanut-based cropping systems can be found in Chapter 6. Research conducted at the Peanut Belt Research Station has demonstrated the benefits of long rotations with corn and cotton.

In recent years, there has been interest in crop yields, especially grains, when transitioning out of traditional peanut rotations. Results indicate that corn, cotton, soybeans, and wheat are not affected by rotation to the extent that peanuts are affected. Sweetpotato is a good rotation crop for peanuts, while some decreases in peanut yield have been observed when peanuts follow sage. Growers should plant corn, cotton, or grain sorghum for at least one year after sage before planting peanuts. A recent experiment found that for every increase in years when cotton separated peanuts and soybeans in the rotation, peanut yield increased by about 6%. The yield of peanuts after four years of cotton was 6,010 lb per acre. When soybeans preceded peanuts in four, three, or two years, peanut yields decreased to 4,440, 5,030, or 5,500 lb per acre, respectively. When only one of the four preceding years was planted in soybeans, peanut yield was 5,670 lb per acre.

## FERTILIZING PEANUTS

### *Lime*

Peanuts grow best on soils limed to a pH of 5.8 to 6.2, if other essential elements are in balance and available to the plant. Dolomitic limestone is the desired liming material because it provides both calcium and magnesium. Strongly acidic soils reduce the efficient uptake and use of most nutrients and may enhance the uptake of zinc to potentially toxic levels. The efficiency of nitrogen fixation is reduced in acid soils. Molybdenum is an essential element in biological nitrogen fixation, and it can be limiting at low soil pH. Soils too high in pH are not desirable because some elements are less available to the peanut plant, and the incidence of sclerotinia blight may be greater. Manganese deficiency is often observed in fields that are overlimed. Some research has demonstrated that higher rates of calcium sulfate (gypsum or land plaster) can reduce peanut yield when soil pH in the pegging zone is relatively low (Table 3-3).

Collecting a soil sample correctly is important. In most cases, the average pH for the field is used to determine how much lime to apply to increase soil pH. The recommendation is to lime for an average pH of 6.2 when the average pH for the field is determined. This will decrease the likelihood of having portions of the field that are below a pH of 5.8. Table 3-3 demonstrates that not only does a pH of less than 5.8 result in lower yields but also that yields can decline even more when gypsum is applied to soils with a low pH. For example, when soil pH is increased from 5.6 to 6.0, peanut yield increased by 6%. When gypsum was applied at the recommended rate (referred to as the 1.0× rate in the table) to soil at pH 5.6, the yield was 26% lower, compared with soils with a pH of 6.0.

***Table 3-3. Peanut Response to Soil pH and Gypsum Rate[a]***

| Approximate Soil pH | Peanut Yield Relative to Gypsum Rate | | |
|---|---|---|---|
| | 0 | 0.5× | 1.0× |
| | Percent of Maximum Yield | | |
| 4.5 | 42 f | 55 e | 55 e |
| 5.2 | 55 e | 56 e | 59 e |
| 5.6 | 78 c | 78 c | 69 d |
| 6.0 | 84 b | 97 a | 95 a |

[a]Means followed by the same letter are not significantly different at $p = 0.10$. Data are pooled over three years.

These results remind us that soil pH should be maintained at about 6.0 and that gypsum should be applied at rates that do not exceed those currently recommended for Virginia market type peanuts. Increased broiler production in North Carolina and use of manure as a fertilizer source have increased concern about micronutrient toxicity. Several peanut fields have exhibited severe and yield-limiting zinc toxicities. These toxicities are increased in fields with low pH because zinc is more available at a lower pH. Maintaining soil pH at about 6.0 is important for minimizing the adverse effects of zinc, and growers are cautioned not to overload fields with high levels of waste products. Micronutrient levels can build up quickly. Peanuts generally are able to tolerate a zinc index of 250. However, zinc toxicity can occur with lower index values if the soil pH is low.

*Nitrogen*

Roots of peanuts can be infected by *Bradyrhizobium* bacteria. Nodules form on the roots at the infection sites. Within these nodules, the bacteria can convert atmospheric nitrogen into a nitrogen form that can be used by plants through a process called biological nitrogen fixation. This symbiotic relationship provides sufficient nitrogen for peanut production if the roots are properly nodulated. Growers should inoculate their peanut seed or fields to ensure that adequate levels of *Bradyrhizobium* bacteria are present in each field. The data in Table 3-4, which come from multiple locations and years, indicate the possible response of peanuts to inoculant applied in the seed furrow.

While peanut response to rotation is often predictable, the response to inoculant and rotation combinations is less predictable. Peanuts should be inoculated in all years regardless of the previous rotation history to minimize risk and maintain satisfactory yield. The economic value of inoculation was demonstrated in trials with Virginia market type varieties in North Carolina, South Carolina, and Virginia from 1999 to 2017 (Table 3-4). Assuming a commercial inoculant cost of $8 per acre, the economic return in new peanut fields at $535 per ton was 51 times higher than the cost of the inoculant. A fivefold increase in economic return over inoculant cost was noted in fields with a recent history of peanut production.

Generally, a peanut plant with 15 nodules on the taproot by 40 days after emergence has adequate nodulation. Often, foliar symptoms of nitrogen deficiency will be apparent by this time if nodulation is not effective. Later in the season, the plant will need more than 100 nodules for optimum growth, development, and yield. If fewer than 15 nodules are noted 40 days after emergence, especially if peanut foliage is yellow, growers should consider application of ammonium sulfate.

Commercial inoculants can be added to the seed or put into the furrow with the seed at planting. In-furrow inoculants are available in either granular or liquid form. When inoculants are applied directly in the seed furrow, either as a spray or granular, it is essential that the product reach the bottom of the seed furrow because infection occurs as the root system develops. Some growers have had difficulty obtaining nodulation because soil moved in the seed furrow after seed drop but before the inoculant spray or granules entered the seed furrow. Delivering granular or in-furrow sprays above seed placement will compromise the effectiveness of systemic insecticides and fungicides.

***Table 3-4. Peanut Yield Response and Economic Return at a Price of $535 per Ton in Fields without a History of Peanuts versus Fields with Frequent Plantings of Peanuts***

| | **New Peanut Fields** | | **Fields with a Recent History of Peanuts** | |
|---|---|---|---|---|
| **Inoculant Use** | **Yield (lb per acre)** | **Economic return ($ per acre)** | **Yield (lb per acre)** | **Economic return ($ per acre)** |
| No Inoculant | 3,460 | 5 | 4,280 | 227 |
| Inoculant | 4,660 | 323 | 4,450 | 268 |
| Difference | 1,200 | 318 | 170 | 41 |
| Number of Trials | 52 | 52 | 43 | 43 |
| Years | 1999 – 2017 | | 1999 – 2017 | |

In addition, shallow plantings along with in-furrow spray inoculants have performed poorly under hot and dry soil conditions. Since peanuts are capable of emerging from depths of at least 3 in., it is advisable to plant deeply to protect sprayed inoculant from breakdown caused by high temperatures. Direct applications of nitrogen to peanuts are not generally needed; application of nitrogen fertilizers can increase yield, but only when peanuts are not nodulating and nitrogen deficiency is obvious. Research indicates that 90 to 120 lb of actual nitrogen per acre as a single application may be needed to obtain yields similar to adequately nodulating peanuts when a true nitrogen deficiency exists. Economic return on investment of inoculant and various rates of ammonium sulfate are compared in Table 3-5 at a peanut price of $560 per ton and fertilizer cost of 29 cents per lb of ammonium sulfate. While a rate of 90 lb of nitrogen is the most economically effective, in some trials 120 lb of nitrogen were needed when late-season rainfall was excessive. Lower rates also may be effective but perform inconsistently.

Research also suggests that ammonium sulfate is a more effective source of nitrogen than ammonium nitrate. Split applications may be more efficient than a single application. Best results are obtained when applications are made early in the season. Peanuts grown on deep, sandy soils often respond to nitrogen fertilization and may lap middles more quickly, even when inoculation is adequate. Rapid canopy closure results in cooler soil temperatures in the pegging zone. When soils have high temperatures, pegs cannot survive. Deciding whether to broadcast the suggested rate of ammonium sulfate can be challenging when the deficiency is sporadic and the failure is incomplete. Table 3-6 is designed to help you determine the economic return if only a percentage of the field has a nitrogen deficiency. There are also times when the deficiency may not be obvious until later in the growing cycle. Table 3-7 is designed to help you determine what rate of ammonium sulfate to apply based on the range of days after planting relative to when the deficiency becomes apparent. Less nitrogen is needed when the deficiency becomes noticeable later in the growing cycle than if the symptoms are observed earlier in the season.

***Table 3-5. Peanut Response from 14 Trials to Inoculation and Ammonium Sulfate at 571 lb/acre (120 lb actual N/acre) Applied when Nitrogen Deficiency Is First Visible***

| Inoculant | Ammonium Sulfate | Pod Yield (lb/acre) | Net Return ($/acre) |
|---|---|---|---|
| No | No | 3,530 c | 20 c |
| Yes | No | 4,850 a | 353 a |
| No | Yes | 4,550 b | 271 b |

Means followed by the same letter are not significantly different at $p < 0.05$.

***Table 3-6. Peanut Response to Ammonium Sulfate (AMS) Applied in Mid-June to Early July and Estimates of Financial Return on Broadcast Applications to Correct a Nitrogen (N) Deficiency***

| Percent of Field that is N Deficient | Rows with N Deficiency (8 Planter Units) | Yield Based on Research | Actual Pounds not Realized due to N Deficiency | Value of Peanuts not Realized at a Price of 25 cents/lb | Financial Return from a Broadcast Application of AMS at 500 lb/acre at a Cost of 29 cents/lb ($145/acre) |
|---|---|---|---|---|---|
| 12 | 1 | 4,420 | 122 | 31 | -114 |
| 23 | 2 | 4,306 | 245 | 61 | -84 |
| 38 | 3 | 4,148 | 367 | 92 | -53 |
| 50 | 4 | 4,062 | 490 | 123 | -22 |
| 63 | 5 | 3,940 | 612 | 153 | 8 |
| 75 | 6 | 3,818 | 734 | 184 | 39 |
| 88 | 7 | 3,696 | 856 | 214 | 69 |
| 100 | 8 | 3,574 | 978 | 245 | 100 |

In some years, excessive rain can cause peanuts to yellow, and growers may consider applying nitrogen to address this issue. In most cases, peanut nodulation will become active after fields dry. Unless nodulation is very poor, there is no value in applying nitrogen in this situation.

***Table 3-7. Ammonium Sulfate Rate Needed Relative to When a Nitrogen Deficiency is Observed***

| Days after Planting | Ammonium Sulfate Rate (lb/acre) |
|---|---|
| 70 or less | 500 |
| 71 to 100 | 400 |
| 101 to 130 | 300 |
| More than 130 | 200 |

On sandy fields with little to no nitrogen from the previous crop, growers often apply a modest amount of nitrogen to soil to enhance early-season growth. This practice has limited value in fields that have some nitrogen remaining from previous crops. The "starter" fertilizer is generally broadcast with preplant fertilizer, although a separate application can be made early in the season. Growers need to use caution when applying products in furrow. We do not recommend applying fertilizer in the seed furrow at planting. Some products with fertilizer and other growth enhancers are available, although a limited number of growers are convinced of their value. Small-plot research in North Carolina has shown little to no value in these applications in terms of yield. Before applying them on a large scale, we suggest making sure there is information available on how these products affect stand establishment. Peanut seed is expensive, and there is a limited time for replanting if a stand is not established..

Contributions from nitrogen fixation by peanuts to succeeding crops is marginal at best under climatic conditions in the mid-Atlantic and southeastern regions of the United States. Small grain crops planted immediately after peanuts receive some nitrogen in this manner. However, the actual amount of nitrogen available is difficult to quantify. Growers should not expect appreciable amounts of nitrogen fixed by peanuts to be available for corn, cotton, and other nonleguminous crops.

*Potassium and Phosphorus*

The most efficient and easiest way to supply potassium is to apply it to the crop before peanuts. This practice usually increases the yield of the preceding crop and allows the potassium to leach into the area where the peanut root system obtains most of its nutrients. However, if NCDA&CS soil test recommendations indicate that potassium and phosphorus are needed, the appropriate levels of these nutrients should be applied.

Many growers and researchers feel that high levels of soil potassium in the fruiting zone (the upper 2 or 3 in. of soil) result in more pod rot and interfere with the uptake of calcium by pegs and pods, which then results in a higher percentage of "pops" and calcium deficiency in the seeds. If the potassium level is high in the fruiting zone, a higher rate of gypsum may be needed. However, research shows that when soil pH is below the recommended level, application of higher rates of gypsum can adversely affect yield.

Most of the peanut soils in North Carolina have adequate levels of phosphorus for good peanut production. After a medium or higher level of phosphorus is achieved, it remains stable over a number of years. The addition of fertilizer with phosphorus to peanuts is generally not needed if it is applied to other crops in the rotation. However, soil testing is the only way to be sure.

Soil index values for potassium are provided in Table 3-8. Previous research indicates that the critical level of potassium for peanuts is a potassium index value of about 20.

***Table 3-8. Potash Recommendations for Peanuts as Related to Potassium Soil Test Index (K-I), Agronomic Division—NCDA&CS****

| Soil Test K-I | Potash ($K_2O$) lb/acre |
|---|---|
| 0 | 150 |
| 10 | 120 |
| 20 | 90 |
| 30 | 70 |
| 40 | 40 |
| 50 | 30 |
| 60 | 10 |
| 70 | 0 |

*From *Crop Fertilization Based on North Carolina Soil Tests*, based on Equation 15 for calculating rates of fertilizer.

### *Calcium*

Calcium must be available for both vegetative and pod growth. Calcium moves upward in the peanut plant but does not move downward. Thus, calcium does not move to the peg and pod and developing kernels through roots. The peg and developing pod absorb calcium directly from soil, so it must be readily available in the soil.

Adequate soil calcium is usually available for good plant growth but not for pod development for high quality peanuts. It is important to provide calcium in the fruiting zone through gypsum applications. Gypsum should be applied to all Virginia market types, regardless of the soil characteristics or soil nutrient levels. The calcium supplied through the gypsum application is relatively water-soluble (compared to other calcium sources) and more readily available for uptake by peanut pegs and pods. Each pod must absorb adequate calcium to develop normally.

Gypsum product materials vary in their elemental calcium content. Studies show that all forms of gypsum effectively supply needed calcium when used at rates that provide equivalent calcium levels uniformly in the fruiting zone. General recommendations for application rates are shown in Table 3-9.

***Table 3-9. Gypsum Sources and Application Rates***

| Source | % $CaSO_4$* | Application Rate (lb/acre) | |
|---|---|---|---|
| | | Band (16 – 18 in.) | Broadcast |
| USG Ben Franklin | 85 | 600 | — |
| USG 420 Granular | 83 | — | 1,215 |
| USG 500 | 70 | — | 1,300 |
| Super Gyp 85 | 85 | — | 1,200 |
| TG Phosphogypsum | 50 | — | 2,000 |
| Agri Gypsum | 60 | — | 1,800 |
| Gyp Soil | 85 | — | 1,200 |
| Gyp Master | 68 | — | 1,500 |

*Guaranteed analysis percentage in registration with NCDA&CS.

The use of gypsum on large-seeded peanuts is very effective in improving peanut seed quality and grades. Some research data indicate that high rates of gypsum may control or reduce the pod rot disease complex. Gypsum should not be broadcast before land preparation or before planting because too much rain may leach the calcium below the fruiting zone.

Best results are obtained when gypsum is applied in late June or early July. The availability of calcium supplied by gypsum application is also influenced by the amount of rainfall. Moisture is needed to make gypsum soluble and calcium available to the peanut fruit. In unusually dry years, peanuts may show symptoms of calcium deficiency, even when the recommended rates of gypsum are applied.

Increasingly, there are questions concerning the need to apply gypsum as supplemental calcium to peanuts. Sometimes peanuts do not respond to supplemental calcium. Sometimes peanuts respond well to half the amount given in Table 3-9. The interactions of environmental conditions, seed size, soil series, native fertility, and soil moisture are unpredictable. However, for a consistent response over a wide range of soil characteristics and weather conditions, the full rate of gypsum is recommended for Virginia market types.

Growers are encouraged to evaluate peanut response to gypsum on their own farms before avoiding gypsum or reducing rates below those presented in Table 3-9. Data from 12 trials (Table 3-10) indicate that gypsum at rates below those recommended in Table 3-9 can, in some cases, be effective. However, for consistent response across all environments, we recommend the 1.0× rate presented in Table 3-9. While soil tests from samples collected in the pegging zone are reliable for deciding if calcium should be applied to runner market types, soil test results are not reliable for determining calcium needs of large-seeded Virginia market types.

***Table 3-10. Pod Yield Following Application of Gypsum at 0.5 and 1 Times (×) the Recommended Use Rate for Virginia Market Types***

| Pod Yield (lb/acre) | No. of Trials | Pod Yield (lb/acre) | | |
|---|---|---|---|---|
| | | No Gypsum | 0.5× Gypsum | 1.0× Gypsum |
| Actual yield | 12 | 3,970 | 4,510 | 4,590 |
| Increase in yield over no-gypsum control | — | — | 540 | 620 |

Excessive rainfall can occur during June and July after gypsum has been applied. If rainfall greater than 5 in. occurs over a short period of time within a few weeks after gypsum is applied, growers should consider applying a rate of 0.5 times the normal use rate. This will ensure that sufficient calcium is in soil during the entire period of reproductive growth. When growers cannot work in the fields to apply gypsum on time due to wet soils, gypsum still must be applied, even if the application is delayed until early to mid-August. Although liquid calcium products are available, they are not a substitute for gypsum.

There is also a question of whether the gypsum rate needs to be increased for extremely large-seeded Virginia market type varieties, such as Wynne. Results from previous research indicated that an application of gypsum 1.5 times the recommended rate did not increase pod yield over the normal use rate in most experiments. While the data did indicate that a large-seeded variety was more responsive to gypsum than a smaller-seeded variety, there was no advantage to applying gypsum at rates that exceed those rates listed in Table 3-9.

In recent years, runner market type varieties referred to as "jumbo runners" have become more popular. For these varieties, growers should apply at least half the rate recommended for Virginia market types (Table 3-9).

Liquid formulations of calcium do not provide adequate calcium for pod and kernel nutrition for Virginia market types at the rates currently marketed. For example, the amount of a 12% calcium liquid product needed to provide the equivalent rate of calcium per acre compared to USG 500 is provided in Table 3-11.

***Table 3-11. Amount of Liquid Product Needed to Provide Equivalent Amounts of Elemental Calcium per Acre***

| Source | Amount of Product Needed to Supply the Equivalent Amount of Calcium per Acre |
|---|---|
| USG 500 (gypsum, 21% calcium) | 1,300 lb |
| Liquid (12% calcium, 11.9 lb calcium per gal) | 23 gal |

*Manganese and Boron*

Two other elements often found to be deficient in peanuts are manganese and boron. Manganese deficiency usually occurs when the soil is overlimed. Increasing the soil pH reduces the plant's uptake of manganese. The symptom of manganese deficiency is interveinal chlorosis. A deficiency can be corrected by a foliar application of manganese sulfate. The usual practice is to apply 3.5 to 4.0 lb per acre of dry material when the deficiency is observed.

Boron plays an important role in kernel quality and flavor. Boron deficiency may occur in peanuts that are produced from deep, sandy soils. Deficient kernels are referred to as having "hollow hearts." Since the inner surfaces of the cotyledons are depressed and darkened, they are graded as damaged kernels. A general recommendation is to apply 0.5 lb of actual boron per acre as a foliar spray in early July. Several formulations of boron are available. Some growers apply boron with their preplant-incorporated herbicides, and others have boron added to their fertilizers.

***Table 3-12. Amount of Formulated Product Needed to Provide Equivalent Amounts of Elemental Boron per Acre***

| Source | Amount Needed to Supply 0.5 lb Boron per Acre |
|---|---|
| Boric acid | 3.0 lb |
| Disodium octaborate (Solubor, 17.5% boron) | 2.8 lb |
| Liquid (9.0% boron) | 2.2 qt |

Growers are advised to make sure boron and manganese sources provide sufficient elemental boron. Several liquid boron and manganese formulations are available. Although liquid sources are more convenient to use than some dry products, some liquid products contain only a fraction of the needed boron or manganese. The amount of formulated product needed to supply 0.5 lb of elemental boron per acre is shown in Table 3-12. Similarly, the amount of formulated manganese product needed to supply 1.0 lb of manganese per acre or two applications of 0.5 lb of manganese spaced 10 to 14 days apart is shown in Table 3-13. Lower rates of boron or manganese are often applied for "maintenance." Growers should make sure the product they purchase supplies the amount of boron or manganese needed by the plant.

***Table 3-13. Amount of Formulated Manganese Products Needed to Provide Equivalent Amounts of Elemental Manganese per Acre***

| Source | Amount Needed to Supply 1.0 lb Manganese per Acre |
|---|---|
| Manganese sulfate (Techmangum, 27% manganese) | 3.7 lb |
| Manganese sulfate (8% manganese) | 1.2 gal |

The percentage of the element (in this case, manganese or boron) or the weight of the element per unit volume of product can be used to determine the amount of liquid product needed to correct a nutrient deficiency. For example, if 1 lb of manganese is needed per acre, the following formulas can be used to determine the amount of 8% water-soluble manganese product needed per acre.

**Step 1.** Calculate the weight of manganese per gal by multiplying the percentage of manganese in product in lb by the total weight of product in lb per gal:

**% manganese in liquid product × lb of total weight of product per gal = lb manganese per gal**

**Step 2.** Calculate the gal of manganese product per acre by dividing the desired amount of manganese in lb per acre by the weight of the manganese per gal:

**Example:**
**Step 1.**

**0.08 × 10.5 lb total weight of product per gal = 0.84 lb manganese sulfate per gal**

**Step 2.**

**0.84 lb manganese sulfate per gal × 1.0 lb manganese sulfate desired = 0.84 gal liquid manganese product**

*Zinc Toxicity*

In fields that have been treated with animal waste, there is the potential for elevated levels of zinc. Peanuts are very susceptible to zinc, especially when soil pH is low. The previous recommendation was that peanuts should not be planted in fields when the zinc concentration exceeds 250 on an NCDA&CS soil report. This recommendation is considered very conservative. In recent years, research has shown that peanuts can be planted in fields when the zinc index is 1,000 or less if soil pH is at least 6.5. Research is underway to fine-tune this recommendation. Keep in mind that if the average zinc index value is 1,000 and that number represents the entire field, there may be areas in the field that have higher levels of zinc. Some areas may also have lower pH levels. Areas in fields with low pH and high zinc create greater risk of zinc toxicity. As the soil pH decreases, the form of zinc in soil is more readily absorbed by peanut roots.

## LAND PREPARATION

Historically, peanut growers have planted into conventionally prepared seedbeds to obtain a smooth, uniform, residue-free surface for planting. The effectiveness of burial of old crop residue and weed seed in the long-term suppression of soilborne pathogens and short-term suppression of some weed problems was noted when the moldboard plow was used. However, only 6% of acres were treated this way, based on a 2019 survey in North Carolina (Table 3-14), in part because newer plant-protection products are very effective. There is also a growing trend toward reduced-tillage crop production in North Carolina, and some growers are successfully using this practice for peanuts. There has also been a significant decrease in the number of growers using secondary tillage. Changes in tillage systems over the past decade are presented in Table 3-14.

There is concern about the stratification of nutrients in reduced-tillage systems. For example, repeated applications of potassium in reduced-tillage cotton may result in excessive amounts of this nutrient in the pegging zone when peanuts are planted in a reduced-tillage system. Growers are encouraged to test soils for excessive potassium levels and incorporate this nutrient with tillage, as needed.

***Table 3-14. Percentage of Farmers Using Certain Tillage Practices on at Least a Portion of Their Farms***

| Tillage | 1998 | 2004 | 2009 | 2014 | 2019 | 2024 |
|---|---|---|---|---|---|---|
| Disk | 90 | 78 | 71 | 75 | 79 | 75 |
| Chisel | 25 | 23 | 27 | 12 | 21 | 11 |
| Moldboard plow | 58 | 17 | 7 | 5 | 6 | 7 |
| Field cultivate | 75 | 55 | 42 | 44 | 53 | 41 |
| Rip and bed | 49 | 39 | 40 | 55 | 48 | 42 |
| Bed | 44 | 35 | 32 | 25 | 35 | 33 |
| Reduced tillage | 10 | 23 | 41 | 20 | 31 | 23 |

Many peanut growers bed their peanut fields in the fall or the spring. Many growers prefer planting on raised beds rather than flat planting. The beds often lead to faster germination and early growth, provide drainage, and may reduce pod losses during digging. While reduced-tillage systems can be as successful as conventional-tillage systems, reduced-tillage systems often produce less consistent yields than conventional-tillage systems. However, most peanut production has shifted to sandy soils that respond more favorably to reduced-tillage systems.

Given concern about digging losses on finer-textured soils, it is recommended that beds be established in the fall with a grass cover crop with peanuts strip-tilled into previously prepared beds. Previous research demonstrated that wheat, cereal (cover crop), rye, oats, and triticale can serve equally well as wheat when used as a cover crop grown in the winter and spring prior to planting peanuts, if peanuts are strip-tilled.

A risk advisory index has been developed to assist growers in assessing if the risk of peanut yield in reduced-tillage systems is lower than yield in conventional-tillage systems (Table 3-15). Research suggests that prior cropping history generally does not affect peanut response to tillage. However, peanuts are often more responsive to tillage systems, primarily because of the digging requirement. The risk advisory index has been modified from the initial version. A positive value indicates that yield was higher with conventional tillage than with reduced tillage. Diversity in soil series across fields creates a challenge in using the index. For example, some fields in the coastal plain of North Carolina contain Norfolk, Goldsboro, and Rains series throughout the landscape. An example of research results used to create the risk tool is presented in Table 3-16. Trials at Lewiston-Woodville on relatively coarse-textured soil and at Rocky Mount on soil that is more fine-textured have been conducted for over two decades. The experiments were designed to determine if crop yield was affected by the interaction of reduced tillage (continuous strip tillage) versus conventional tillage (disk, field cultivate, rip, and bed) with rotation sequence (long or short rotations relative to peanut). Peanut yield was lower when the number of years between peanut plantings was fewer (data not presented). This was expected because pathogen and nematode populations can increase when peanuts are planted more frequently. However, response to tillage system was similar in almost all cases, regardless of rotation sequence. When averaged over years and rotation sequences, corn yield was greater in strip till compared with conventional till on the coarse-textured soil at Lewiston-Woodville. No difference in yield was noted on the fine-textured soil at Rocky Mount for this crop. Cotton yield was similar on both soils, regardless of tillage system. Peanut yield was similar at Lewiston-Woodville for both tillage systems. This was expected because pod loss during digging and vine inversion would not be excessive because of the coarse nature of soils in this field. In contrast, peanut yield was substantially lower at Rocky Mount on the finer-textured soil when peanut was planted in strip tillage compared with conventional tillage. Similar results have been observed on fine-textured soils in other experiments.

Since 1998, the number of growers moldboard-plowing peanut fields has decreased dramatically (Table 3-14). This field operation is time-consuming and expensive and leaves soil vulnerable to wind and water erosion. During 2022 and 2023, some growers experienced financial deductions due to kernel damage from burrower bugs. The peanut market-grade designation increases from Seg 1 to Seg 2 if damage exceeds 2% from this pest. More information on this soil insect is found in Chapter 5. Currently, the only effective method to suppress burrower bugs is moldboard plowing. Damage has been sporadic, however, and moldboard plowing on a broad scale at current infestation levels is not advised as a preventive method of protection from this insect pest.

***Table 3-15. Advisory Index for Determining the Risk of Peanut Yield in Reduced-Tillage Systems Being Lower Than Yield in Conventional-Tillage Systems***

| Category | Scoring Criteria | Your Score |
|---|---|---|
| **Soil series**<br>Pod loss on finer-textured soils, such as those on the Roanoke and Craven series, is often greater than on coarser-textured soils, such as Conetoe and Wanda series, regardless of tillage system. Difficulty in digging can increase when these soils become hard if rainfall is limited in the fall. | Roanoke and Craven — 40 points<br>Goldsboro and Lynchburg — 20 points<br>Norfolk — 10 points<br>Conetoe and Wanda — 0 points | **Soil series**<br>**Your score:** |
| **Tillage intensity**<br>Peanut response to reduced-tillage systems is invariably correlated with the degree of tillage. Efficient digging can be difficult when peanuts are planted in flat ground in reduced-tillage systems. Although fields may appear to be flat and uniformly level, often fields are more rugged than they appear, and setting up the digger to match unforeseen contours in the field can be difficult. Strip tillage into flat ground is a better alternative than no tillage into flat ground, although digging peanuts planted on flat ground can be more challenging regardless of the tillage system. Strip tillage into preformed beds often results in yields approaching those of conventional tillage. | No tillage into flat ground — 35 points<br>Strip tillage into flat ground — 10 points<br>Strip tillage into stale seedbeds — 0 points | **Tillage intensity**<br>**Your score:** |
| **Risk of yield being lower in reduced tillage than in conventional tillage** | 35 or less — low risk<br>40 to 50 — moderate risk<br>55 or more — high risk | **Total index value**<br>**Your score:** |

***Table 3-16. Crop Yield Response to Continuous Conventional and Strip Tillage from 1999 through 2023.****

| Series | Crop | Conventional till | Strip till | Number of years |
|---|---|---|---|---|
| **Lewiston-Woodville (1999–2023) Norfolk and Goldsboro series** | Corn (bu/acre) | 119 | 124* | 12 |
| | Cotton (lb lint/acre) | 823 | 816 | 15 |
| | Peanut (lb/acre) | 3917 | 3899 | 9 |
| | Wheat (bu/acre) | 52 | 54 | 1 |
| | Soybean (bu/acre) | 35 | 35 | 1 |
| **Rocky Mount (2000–2023) Lynchburg, Rains, and Goldsboro series** | Corn (bu/acre) | 147 | 150 | 6 |
| | Cotton (lb lint/acre) | 904 | 901 | 11 |
| | Peanut (lb/acre) | 3871 | 3147* | 9 |
| | Wheat (bu/acre) | 76 | 82 | 1 |
| | Soybean (bu/acre) | 54 | 62* | 1 |

*Significance at $p < 0.05$. Data are pooled over years and rotation sequences.

## PLANTING

Varieties grown in North Carolina may require as many as 160 days for full pod maturity, depending upon soil moisture and temperature. Along with yield and market grades, planting date can affect disease and insect development (see Chapters 5 and 6). Less damage from thrips and a lower incidence of TSWV have been associated with later plantings. Peanut yields are often the highest when the peanuts are planted in mid-May. However, in some years, peanuts planted later can produce a high yield. Conditions in the fall, especially night temperatures, can have a great effect on yield when they prevent peanut pods from reaching optimum maturity.

Table 3-17 provides data for the variety Bailey during 2019 and Bailey II and Walton in 2020 exposed to four or five planting dates when peanuts were dug at optimum maturity based on pod mesocarp color. When averaged over planting dates in 2020, pod yield for Bailey II was 3,581 lb per acre, compared with 3,483 lb per acre for Walton. These results reflect growing conditions that enabled peanuts in 2019 to produce a high yield because of the warmer temperatures throughout much of the growing season, and especially in September and October. In contrast, cooler temperatures in September and October of 2020 most likely prevented later-planted peanuts from reaching optimum maturity. In 2021, Emery yielded more than Bailey II, Sullivan, and Walton. Bailey II and Sullivan yielded the same. Sullivan and Walton also yielded the same, while Walton yielded less than Emery.

***Table 3-17. Influence of Planting Date on Peanut Yield During 2020–2024****

| Planting Date | 2020 Bailey II | 2021 Bailey II | 2022 Bailey II | 2023 Bailey II | 2024 Bailey II |
|---|---|---|---|---|---|
| Early May | 4,117 a | 3,788 a | 5,429 a | 3,651 a | 4,621 a |
| Mid-May | 4,098 a | 3,233 abc | 4,467 b | 3,574 a | 4,751 a |
| Early June | 3,704 b | 3,467 ab | 4,173 bc | 2,770 b | 4,504 a |
| Mid-June | 3,053 c | 3,089 bc | 3,833 c | 2,580 b | 3,463 b |
| Late June | 1,633 d | 2,607 c | 1,740 d | 1,628 c | 1,376 c |

*Means within a year followed by the same letter are not statistically different at $p < 0.05$.

*Seeding Rates and Twin Rows*

Table 3-18 provides the conversion of seed per ft of row to lb per acre necessary to establish the desired plant population for a given variety. Germination percentage is not considered in this conversion, although it should be considered when planning planting. Row spacing also affects seed planted per acre and cost of production. The same in-row population is needed for row spacings of 30, 36, and 38 in. Table 3-19 shows the number of seed required to achieve a desirable plant population for 30- and 36-in. rows.

In the southeastern U.S., less TSWV has been associated with twin-row plantings than with single rows. Similar results have been observed in North Carolina. Higher plant populations and closer row spacings often result in fewer symptoms of virus. Seeding peanuts in narrow rows or at extremely high seeding rates has not increased yield over twin-row plantings that establish a plant population of five plants per ft of row (sum of both twin rows). Although higher seeding rates are needed and higher rates of in-furrow insecticide and inoculant are required, twin rows tend to produce a greater taproot crop rather than a limb crop. This tendency can improve uniformity of harvested peanuts. In a dry season when peanut vines do not lap, twin rows can result in higher yields. One of the detriments of twin-row plantings, especially with the higher plant populations, is excessive vine growth, which can make digging more difficult.

Research in North Carolina in recent years has shown no yield advantage to twin-row plantings compared with single-row plantings. However, some growers with sandy fields experience lapping of rows more quickly with twin-row plantings, and they tend to have cooler soil conditions for initial pegging, which prevents loss of the earliest pegs.

***Table 3-18. Approximate Pounds of Peanut Seed Required per Acre to Provide 3, 4, and 5 Seeds per Foot of Row on 36-in. Rows***

| Variety | Seed/lb | Pounds per Acre (36-in. rows) | | |
|---|---|---|---|---|
| | | 3 Seeds/ft | 4 Seeds/ft | 5 Seeds/ft |
| Bailey | 600 | 73 | 97 | 121 |
| Emery | 535 | 82 | 109 | 136 |
| Sullivan | 575 | 76 | 101 | 126 |
| NC 20 | 575 | 76 | 101 | 126 |
| Runner market types | 725 | 60 | 80 | 100 |
| Spanish and Valencia market types | 800 | 49 | 65 | 81 |

***Table 3-19. Relationship Between In-row Plant Density (Seed per Linear Foot of Row) and Total Number of Seed per Acre on 30-in. and 36-in. Rows***

| Seed per Linear Ft | 30-in. Rows | 36-in. Rows |
|---|---|---|
| 4 | 69,696 | 58,080 |
| 5 | 87,120 | 72,150 |
| 6 | 104,544 | 87,126 |

## IRRIGATION

Having adequate water available throughout the peanut life cycle is important for optimal plant growth and development. Drought or flood can have tremendously negative effects on peanut yields and quality. Likewise, pest infestation and severity of pest damage are influenced by available water, either from rainfall or irrigation. Understanding how environmental conditions and, in particular, irrigation, affect pest complexes is important in developing appropriate management strategies. Although less than 20% of North Carolina peanut acreage is irrigated, irrigation is a powerful production tool. Irrigation minimizes risk and enhances consistency of yield. In addition, irrigation improves consistency of pesticide performance and, in many ways, the predictability of pest complexes. The major production and pest management practices employed in North Carolina peanut production are listed in Table 3-20, with comments on how irrigation or ample rainfall affects efforts to manage pests or supply peanuts with adequate nutrition.

Research supported by the North Carolina Peanut Growers Association has been conducted to determine the feasibility of subsurface drip irrigation. Though there are many associated logistical issues, data collected at Lewiston-Woodville in corn, cotton, and peanuts indicate that this approach to irrigation is feasible. Data for corn, cotton, and peanut yields since 2001 are presented in Table 3-21. As expected, corn yield was affected by irrigation more than cotton or peanut yield. Peanut yield was maintained more effectively than cotton in dry years without irrigation. These data provide a good indication of yield under growing conditions where water is not limited relative to dry-land production for these crops.

***Table 3-20. Impact of Irrigation on Production and Pest Management Strategies***

| Production or Pest Management Practice | Benefits of Irrigation or Optimum Rainfall |
|---|---|
| **Land preparation** | Helps in establishment of seedbeds, either conventional or reduced tillage. |
| **Seed germination** | Ensures germination of seed when existing soil moisture is marginal for complete stand establishment. |
| **Weed management** | Irrigation or adequate rainfall activates preemergence herbicides and minimizes plant stress. Less moisture stress often enhances control by postemergence herbicides and enables peanuts to recover more rapidly from herbicide damage. |
| **Insect management** | Important for activation of in-furrow insecticides. Improves plant growth and root establishment, which is important in absorption of in-furrow insecticides. Improves peanut recovery from early-season insect damage and insecticide phytotoxicity. Increases likelihood of southern corn rootworm survival and subsequent damage to pods but can protect against damage from lesser cornstalk borer. Minimizes potential damage from corn earworms and armyworms by establishment of a dense canopy that can withstand damage from feeding. Reduces the likelihood of spider mite damage by keeping spider mite populations low. |
| **Disease management** | Wet conditions early in the season can favor infection of peanut by CBR but can minimize potential for crown rot. Irrigation increases likelihood of having a favorable microclimate for development of many foliar and soilborne pathogens. A dense canopy that is supplemented by irrigation increases humidity within the canopy and minimizes airflow, all of which favor pathogen and disease development. Symptoms associated with TSWV in peanuts are often more pronounced when peanuts are growing under dry and especially hot conditions. Timely irrigation will reduce plant stress and possibly enable plants to withstand TSWV, diplodia collar rot, and charcoal rot more effectively than nonirrigated, water-stressed plants. |
| **Pod maturation** | Irrigation provides buffers against extremes in moisture and reduces stress (heat and drought), which allows normal flower production and kernel development. Maturation is more predictable and generally earlier. Limited rainfall during reproductive growth often causes delays in maturation and establishment of "multiple crops" or "split crops" on the same plant. Sufficient rainfall is critical for complete kernel development and pod fill. Limited soil moisture during flowering can reduce pegging. Irrigation modeling programs often include soil temperature as a trigger for irrigation during pegging. |
| **Supplemental calcium** | Kernels need adequate calcium to become mature and completely developed. Irrigation buffers against drought, which reduces calcium concentration in soil water and mass flow movement into developing pegs. |
| **Digging** | Supplying soil water reduces hardness of soil, which improves digging efficiency and minimizes pod loss during the digging process. |

***Table 3-21. Yield of Corn, Cotton, and Peanut Total Water During the Cropping Cycle in Dry-Land Production Versus Subsurface Drip Irrigation from 2001 to 2024 in North Carolina.****

| Crop | Year | Crop Yield | |
|---|---|---|---|
| | | Rain only | Rain plus subsurface drip irrigation |
| **Corn (bu/acre)** | 2008 | 96 | 146* |
| | 2009 | 62 | 148* |
| | 2010 | 64 | 155* |
| | 2011 | 64 | 101* |
| | 2013 | 137 | 131 |
| | 2018 | 130 | 157 |
| | 2019 | 54 | 179* |
| | 2020 | 107 | 147* |
| | 2021 | 158 | 149 |
| | Average | 97 | 145* |
| **Cotton (lb lint/acre)** | 2001 | 800 | 1,020* |
| | 2002 | 460 | 900* |
| | 2003 | 840 | 850 |
| | 2004 | 920 | 1,010 |
| | 2005 | 850 | 1,300* |
| | 2006 | 810 | 860 |
| | 2007 | 470 | 1,020* |
| | 2008 | 390 | 840* |
| | 2011 | 480 | 800* |
| | 2012 | 1,370 | 1,450 |
| | 2013 | 1,430 | 1,490 |
| | 2014 | 1,299 | 1,236 |
| | 2015 | 330 | 862* |
| | 2016 | 459 | 1,029* |
| | 2022 | 727 | 761 |
| | 2023 | 579 | 923* |
| | Average | 763 | 1,021* |

***Table 3-21. Yield of Corn, Cotton, and Peanut Total Water During the Cropping Cycle in Dry-Land Production Versus Subsurface Drip Irrigation from 2001 to 2024 in North Carolina.* (continued)***

| Crop | Year | Crop Yield | |
|---|---|---|---|
| | | Rain only | Rain plus subsurface drip irrigation |
| **Peanut (lb/acre)** | 2001 | 2,350 | 3,400* |
| | 2002 | 2,020 | 2,960* |
| | 2003 | 3,020 | 3,210 |
| | 2004 | 2,660 | 2,830 |
| | 2010 | 2,540 | 3,880* |
| | 2011 | 3,440 | 4,040* |
| | 2012 | 5,100 | 4,910 |
| | 2017 | 3,673 | 5,072* |
| | 2022 | 3,875 | 4,660 |
| | 2023 | 3,276 | 4,796* |
| | 2024 | 5,104 | 5,913* |
| | Average | 3,369 | 4,152* |

*Indicates significance at $p < 0.05$.

Relative differences in the response of corn, cotton, and peanuts to subsurface drip irrigation on a sandy coastal plain soil at Lewiston-Woodville are presented in Table 3-21. Although subsurface drip irrigation is not used in North Carolina on significant acreage, these data represent crop response to irrigation in general, including overhead sprinkler irrigation. Corn yield increased substantially in 6 of 9 years when this crop was irrigated. Cotton yield was greater under irrigation in 9 of 16 years, while peanuts responded favorably to irrigation in 6 of 10 years.

In some areas of the state, salt concentration can be elevated in dry years. Growers are encouraged to monitor salt concentration frequently, especially in the counties where the source of irrigation is the Albemarle Sound or Chowan River system.

## DETERMINING MATURITY

Maturity affects flavor, grade, milling quality, and shelf life. Not only do mature peanuts have the quality characteristics that the consumer desires, but they are also worth more to the producer. However, the indeterminate fruiting pattern of peanuts makes it difficult to determine when optimum maturity occurs. The fruiting pattern can vary considerably from year to year, primarily because of the weather; therefore, each field should be checked before digging begins.

The hull-scrape method, currently the most objective method for gauging maturity, requires the use of a peanut profile board, which is available at county Extension centers. A version of the peanut profile board was developed for Virginia market types grown in the Virginia-Carolinas region (Figure 3-1). It is important to follow a specific maturity prediction method to achieve maximum dollar value for peanuts. Expression of the high oleic trait is lower in immature kernels compared to kernels that are older and more fully developed. To ensure the benefits and uniformity of high oleic expression in the cultivars Emery, Sullivan, and Wynne, digging peanuts as close as possible to optimum maturity is advised.

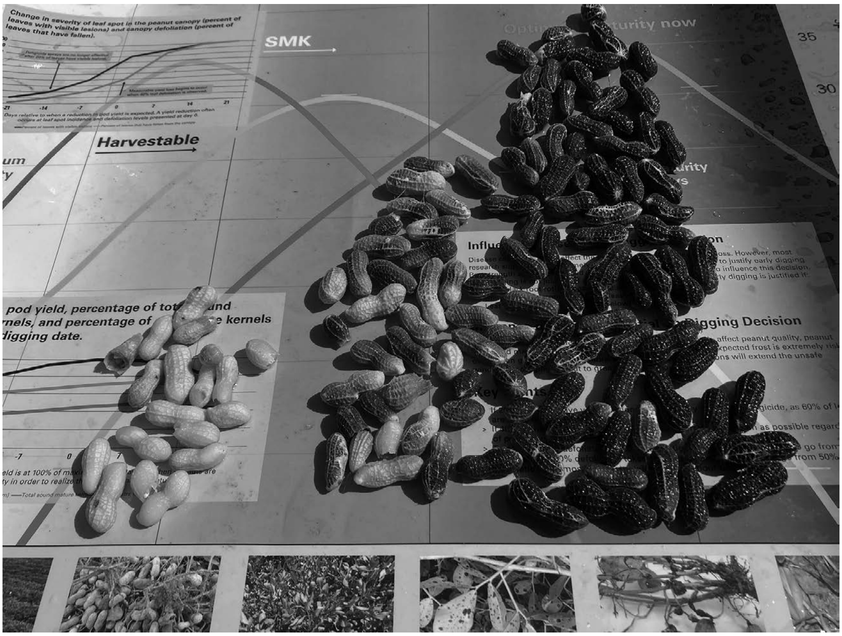


**Figure 3-1. The peanut profile board shown above was developed for Virginia market types. Photo by David Jordan**

Heat units, or growing degree days (GDDs), can be a means of determining maturity. One GDD (base 56°F) accumulates when the average daily high and low temperature is 57°F. A ceiling of 95°F is used, because temperatures above 95°F can cause plant stress. If the average daily high and low temperature is 76°F, for example, then 20 GDDs accumulate for that day. Research has shown that 2,650 to 2,700 GDDs are needed for Virginia market types to mature, if soil moisture is not limiting. Average heat unit accumulation for 2009 to 2018 compared to data from 2018, 2019, and 2020 are presented in Figure 3-2 to contrast the major differences in growing seasons. Peanuts planted in early to mid-June of 2019 were able to yield relatively well, in part due to the higher-than-normal accumulation of heat units from August 16 through October 15. In 2020, however, yield was negatively affected because of the cooler temperatures in September and October and nights with temperatures in the mid-to-high 40°F range (Figure 3-3). Pod maturation generally ceases in the fall when night temperatures are in the mid-to-high 40°F range for two nights in a row. Although day temperatures may increase considerably, the plant seldom recovers from the cooler nighttime temperatures; this scenario occurred in the northern portion of the North Carolina coastal plain during 2020 in late September and again in early October. Many peanuts that were not mature by late September matured at a very slow pace for the remainder of the fall.

Research during 2016 and 2017 compared yields of Bailey, Wynne, and Sullivan planted in mid-May and dug September 10 and 20, and October 1 and 10. Maturity of these varieties varied little when comparing pod mesocarp color, and there was no

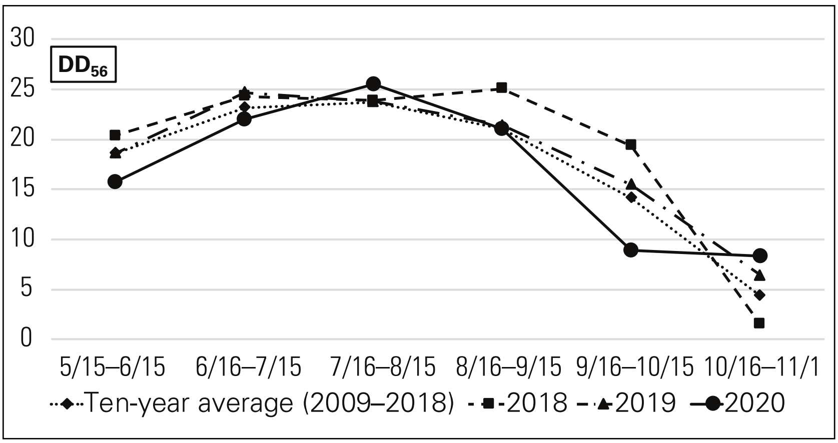


**Figure 3-2. Heat unit accumulation ($DD_{56}$) at Lewiston-Woodville, NC. Source: David Jordan**

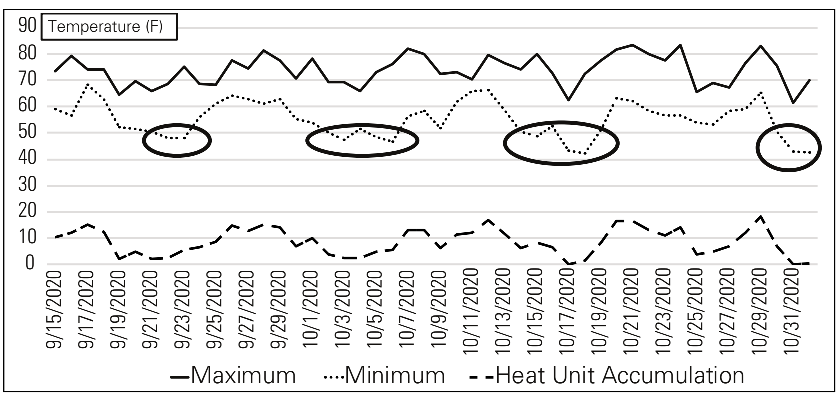


**Figure 3-3. Maximum and minimum air temperatures and heat unit accumulation, September 15 to November 1, 2020, Lewiston-Woodville, NC.**

interaction between variety and digging date. When averaged over varieties, delaying digging from September 10 to September 20 resulted in a substantial yield increase.

In digging trials at Lewiston-Woodville in 2021, yields of the varieties Bailey II, Emery, and Sullivan were similar across four digging dates beginning in early September and continuing through mid-October. The optimum digging date for all varieties was October 5 compared with yields dug September 8 and 23 or October 15. Optimum maturity for the variety Walton occurred several days to a week after Bailey II, Emery, and Sullivan.

A slight decrease was noted when peanuts were dug October 1, with a more substantial loss observed on October 10. Percentages of extra-large kernels and total sound mature kernels increased when peanuts were dug September 20 or later compared with digging on September 10. Data from six years of research at Lewiston-Woodville with the variety Bailey also demonstrate the value of waiting until peanuts are at optimum pod maturity before digging. Yield increased from 4,070 lb per acre to 5,345 lb per acre over a 28-day period from September 7 to October 5. At a selling price of $500 per ton or 25 cents per lb, each day that digging is delayed until optimum maturity results in an increase in economic value of $11 per acre (increase in yield of 45 lb per acre per day). In 2020, peanut yield was higher when peanuts were dug on October 5 compared with digging on September 11 or September 23.

At harvest, growers should follow the weather forecast closely and not dig peanuts when freezing temperatures are expected. It is also important to have adequate harvesting and curing equipment so that the peanut crop can be handled within a reasonable period of time. At least four days (96 hours), and in many cases more than four days, are needed between the time of digging and frost to allow sufficient drying to prevent freeze damage. Peanut frost advisories are available from the North Carolina State Climate Office (products.climate.ncsu.edu/ag/peanut-frost/). Digging and harvesting the 2020 peanut crop was a major challenge. As we moved into late October, the risk of freeze damage (Seg 2 peanuts) increased dramatically. The risk was compounded by fog and heavy dew that slowed drying of pods and vines and kept fields wet in some areas, which caused significant delays in digging. Although it is expensive because of subsequent drying costs, it is possible to pick peanuts within the first few days after digging if a frost or freeze is imminent. After three days, vines become too tough to thresh, and harvesting must be delayed.

Digging and harvest capacity for growers are important to consider. The speed at which growers can plant peanuts is not the same as the time and labor it takes to dig, combine, dry, and haul peanuts. Most crops require a one-step process to harvest, whereas peanuts require two stages. Soil conditions during digging must be ideal to effectively remove peanuts from the soil and invert vines. Growers need to realistically determine the amount of time these operations will require.

With digging, it is estimated that with four-row equipment and six-row equipment, 30 and 40 acres, respectively, can be dug per day if growers dig for 10 hours driving at 3 mph with no interruptions. A six-row self-propelled combine can harvest 20 acres in a day driving at 1.5 mph, while four-row and six-row pull-type combines can harvest 15 to 20 acres in a day, respectively. Weather conditions can have a tremendous effect on the number of hours peanuts can be dug and combined in a given day, and the estimates provided here relative to time represent a best-case scenario.

In research conducted at Lewiston-Woodville during 2018, each increase in ground speed of 1 mph above 2 mph resulted in a loss of about 225 lb per acre when a KMC digger was used. Growers can determine whether a higher loss from digging more rapidly is acceptable if the increased speed allows greater acreage to be covered, especially if poor weather conditions are expected or a frost is in the forecast. In 2020 research, there was no difference in yield when comparing digging speeds between 2 mph and 4 mph. However, in 2021 research, yield loss was substantial when the ground speed for digging was increased from 2 mph to 4 mph.

The decision to dig prior to optimum pod maturity rather than risk experiencing greater disease while peanuts continue to mature can be stressful. When diseases are controlled well during the season, there is greater flexibility in deciding when to dig. The threshold for early digging is high and is discussed in more detail in Chapter 6. Peanuts should be dug when 40% to 50% leaf defoliation occurs, regardless of pod maturity. In the new peanut profile, we provide information on when digging prior to optimum maturity is advised based on plant health, disease severity, and disease incidence. We also provide information on when additional fungicide applications are warranted based on the percentage of lesions in the canopy. Generally, after 25% of leaves in the canopy have visible lesions, the fungicide chlorothalonil is no longer effective. However, fungicides with curative activity can decrease canopy defoliation and subsequent pod shed, even though at 25% incidence (visible lesions) at least 60% of leaves are already infected. You can view the profile information in *Determining Peanut Pod Maturity and Estimating the Optimum Digging Date* at content.ces.ncsu.edu/determining-peanut-pod-maturity-and-estimating-the-optimum-digging-date. Laminated, full-size versions of the profile chart are available at your local Cooperative Extension center.

A Peanut Digging Evaluation Tool is available at peanut.ces.ncsu.edu/peanut-digging-evaluation-tool/ on the NC State Extension Peanut Portal. This Microsoft Excel tool allows practitioners to observe the potential financial return gained from the day when fields are sampled relative to when optimum pod maturity is expected.

## RUNNER MARKET TYPES

There is some demand for runner market type peanut production in North Carolina. Part of this interest is related to market demand and sheller operations in the region. Runner production is also appealing to some growers because of potential savings in production of runners compared with Virginia market type peanuts (about 110 lb of seed for runners versus 125 to 160 lb of seed for Virginia market types and lower requirements for supplemental calcium by runner market types). Yield response to Virginia, Runner, Spanish, and Valencia market types planted from 2017 to 2021 are provided in Table 3-22. Each variety was dug at optimum maturity. Yields of runner and Virginia market types are often similar and exceed yields of Spanish and Valencia market types. Additional information on yield response of peanut varieties can be found in Chapter 14.

***Table 3-22. Yield of Virginia, Runner, Spanish, and Valencia Market Types Grown in North Carolina During 2017 – 2021 when Dug as Close to Optimum Maturity as Possible***

| Variety | Market Type | Fatty Acid Profile | Breeding Program and State | Yield (lb/acre) | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | 2017 | 2018 | 2019 | 2020 | 2021 |
| Bailey II | Virginia | High oleic | NC State, NC | | | 6,670 ab | 3,768 a | 3,987 abc |
| Bailey | Virginia | Normal | NC State, NC | 3,811 ab | 4,380 ab | 5,908 be | | |
| Sullivan | Virginia | High oleic | NC State, NC | 4,636 a | 4,623 a | 6,116 abc | 4,202 a | 3,660 c |
| Emery | Virginia | High oleic | NC State, NC | 4,538 a | 4,395 ab | 6,370 abc | 4,046 a | 4,573 a |
| Walton | Virginia | High oleic | Virginia Tech, VA, and University of Florida, FL | | | | 3,818 a | 3,710 c |
| VENUS | Virginia | High oleic | USDA–ARS, OK | 3,642 ab | 4,005 ab | | | |
| Contender | Virginia | High oleic | ESDA-ARS, OK | | | 4,601 d | | |
| TUFRunner 297 | Runner | High oleic | University of Florida, FL | | | | 4,230 a | 4,154 abc |
| TUFRunner 511 | Runner | High oleic | University of Florida, FL | | | | 4,186 a | 4,492 ab |
| Florida 07 | Runner | High oleic | University of Florida, FL | 3,896 ab | 4,041 ab | | | |
| FloRun 331 | Runner | High oleic | University of Florida, FL | 3,651 ab | 4,591 a | 6,751 a | | |
| TifNV-High O/L | Runner | High oleic | USDA-ARS, GA | | | | | 3,904 bc |
| Lariat | Runner | High oleic | USDA–ARS, OK | 4,008 ab | 4,595 a | 5,622 c | | |
| Olé | Spanish | High oleic | USDA–ARS, OK | 3,890 ab | 3,883 b | 6,261 abc | | |
| NuMex 01 | Valencia | High oleic | New Mexico State University, NM | 3,242 bc | 3,041 c | | 2,210 b | |
| NuMex 02 | Valencia | High oleic | New Mexico State University, NM | | | 3,159 e | | |
| OLin | Spanish | High oleic | Texas A&M University, TX | | | | 2,200 b | |

Means within a year followed by the same letter are not significantly different at $p < 0.05$ based on Fisher's Least Significant Difference (LSD) test.

## PLANT GROWTH REGULATORS

Apogee, Kudos WDG, Kudos OD, and Cryova (prohexadione calcium) are registered for use in peanuts. Research has demonstrated that prohexadione calcium improves row definition, which can lead to increased efficiency in the digging and inversion process. Prohexadione calcium should be applied when 50% of vines from adjacent rows are touching. Sequential applications (7.2 oz per acre followed by 7.2 oz per acre) spaced two to three weeks apart are generally needed. Include crop oil concentrate and ammonium sulfate with prohexadione calcium. Depending upon growing conditions, soil fertility, frequency of rainfall and irrigation, and variety selection, row visibility obtained in mid-August may not be sufficient through digging. Research suggests that in addition to increased row visibility, prohexadione calcium minimizes pod shed and pod loss during digging and harvesting operations. While prohexadione calcium always improves row visibility, this characteristic has not always translated into yield increases. Many growers use GPS tracking during the digging operation, which can decrease pod loss substantially. Reduced digging losses and improved pod retention have been associated with yield increases after prohexadione calcium.

A vast amount of small-plot research has been conducted in North Carolina to determine peanut response to prohexadione calcium. In recent years, most results from those experiments have shown no yield advantage to using prohexadione calcium. Yet, at least 50% of growers in North Carolina apply the products Apogee, Kudos, or Cryova at least once to Virginia market types. In several recent peer-reviewed articles, significant responses to prohexadione calcium were observed in large-scale trials compared with small-plot research.

The morphological or growth habit of Sullivan is different from that of Bailey II in that its foliage is less robust than Bailey II's growth habit. This characteristic may minimize the need for prohexadione calcium in terms of row visibility. However, many growers are applying prohexadione calcium to Sullivan when 50% of vines from adjacent rows are touching. Unlike Bailey II, Sullivan does not always require a second application two to three weeks later.

Two applications of Apogee, Kudos WDG, Kudos OD, or Cryova are often needed to achieve adequate row definition and visibility at digging. In some cases, increases in yield occur when these plant growth regulators are applied, compared with nontreated peanuts.. However, under dry conditions later in the season, do not apply this plant growth regulator. It is unlikely that prohexadione calcium will contribute to row visibility, and we have observed yield loss when applications are made to peanuts that are experiencing drought stress late in the season. In Chapter 14, yield data from on-farm trials demonstrate the potential negative impact of prohexadione calcium applied when peanuts are under drought stress.

There is concern about peanut injury when the oil-based formulation Kudos OD is applied with other products. This topic is discussed in Chapter 10.

## ORGANIC PEANUT PRODUCTION

Producing peanuts that meet certified organic criteria set by the USDA with restrictions set by the Organic Materials Review Institute (OMRI) can be challenging compared with producing peanuts with conventional technologies (synthetic pesticides and fertilizers). However, demand for organically produced peanuts is strong, and markets are available.

The two major production-oriented challenges with the organic approach to production are obtaining adequate plant stands and effectively controlling weeds. While disease, insect, and nematode control can be difficult to achieve, the effects of insects and nematodes and in some cases in-season diseases are not catastrophic, although they can reduce yield substantially. However, the requirement to plant seed that is not treated with effective fungicides and the difficulty in controlling grassy weeds can result in complete crop failure. Growers interested in producing peanuts with organic principles should plant when soil conditions favor rapid emergence of seedlings. Fields with low infestations of weeds should be selected.

Challenges also exist from a post-harvest perspective. The certification process does not end in the field but continues through all processing steps. A major constraint of organic processing is that current shellers in the Virginia-Carolinas region are too large to invest in transitioning their facilities to handle a relatively small volume of peanuts for organic certification. For example, Hampton Farms markets several products that are certified organic, but all production is in New Mexico because of shelling and processing logistics and certification requirements at the post-harvest level.

A comprehensive chapter on organic peanut production in North Carolina can be found in NC State Extension publication AG-660, *North Carolina Organic Commodities Production Guide* (content.ces.ncsu.edu/north-carolina-organic-commodities-production-guide).

## ADDITIONAL EDUCATIONAL MATERIALS

The NC State Extension Peanut Portal (peanut.ces.ncsu.edu) contains information that can be used to make decisions about peanut production and pest management. There is also an archive of educational videos and screencasts (PowerPoint presentations with voiceover) for the peanut production course at NC State. Contact David Jordan (David_Jordan@ncsu.edu) for access to these resources.