12. ORGANIC PEANUT PRODUCTION

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INTRODUCTION

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 peanut produced using conventional technologies (synthetic pesticides and fertilizers). However, demand for organically-produced peanut 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, in most instances impacts of insects and nematodes, and in some cases in-season diseases, are not catastrophic but can reduce yield substantially. In contrast, the need to plant seed that is not treated with effective fungicides and the difficultly in controlling grassy weeds can result in complete crop failure. Growers interested in producing peanut using 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 carries through all processing steps. This can be a major constraint to organic adoption because current shellers in the Virginia-Carolina region are too large to invest in transitioning their plants to a relatively small volume of peanut 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.

The North Carolina Agricultural Foundation has provided funding to develop elements of an organic peanut value chain in North Carolina. This project includes efforts to increase efficiency of production, determine consumer demand and potential farmer involvement, and establish a pilot project with selected certified organic growers in the state. The current goal is to assist growers in producing certified organic peanut for the in-shell trade. Depending on success in this approach, a cooperative among producers of certified organic peanut could lead to shelling of peanut for additional markets.

Our goal in this chapter is to provide information on requirements for certified organic production, basic agronomic practices required for certified organic production of peanut, challenges with pest management in certified organic production, and estimated cost of certified organic production.

TERMS AND REQUIREMENTS FOR CERTIFIED ORGANIC PRODUCTION

The following indicates requirements for certification as organic production by the USDA:

> The National Organic Program (NOP) develops the rules and regulations for the production, handling, labeling, and enforcement of all USDA organic products. This process, referred to as rulemaking, involves input from the National Organic Standards Board (a Federal Advisory Committee made up of fifteen members of the public) and the public. The NOP also maintains a Handbook that includes guidance, instructions, policy memos, and other documents that communicate the organic standards.
> **www.ams.usda.gov/rules-regulations/organic**
>
> USDA organic products have strict production and labeling requirements. Organic products must meet the following requirements: produced without excluded

methods, (e.g., genetic engineering, ionizing radiation, or sewage sludge); produced using allowed substances; and overseen by a USDA National Organic Program-authorized certifying agent, following all USDA organic regulations.
www.ams.usda.gov/rules-regulations/organic/labeling

To be considered organic all inputs used must be in compliance with the Organic Materials Review Institute (OMRI). Your local Cooperative Extension agent can also assist you with questions on certification and benefits and challenges of organic peanut production.
www.ams.usda.gov/grades-standards/organic-standards
www.omri.org/omri-lists

GENERAL AGRONOMIC PRACTICES

Variety Selection

Variety selection most likely will vary little in organic and conventional production systems. One of the major focal points of the breeding program at North Carolina State University is development and release of varieties that express field tolerance or resistance to pathogens and tomato spotted wilt. The strengths and weakness of varieties to diseases are provided in chapter 6, "Peanut Disease Management." These characteristics are important to consider in both conventional and organic systems. It is important to note that growers might plant Spanish, Valencia, or runner market types, and possibly Virginia market type varieties not commonly grown in North Carolina, in their organic production systems. If that is the case, make a strong effort to know the susceptibility of these varieties to pathogens commonly found in North Carolina.

Crop Rotation and Sequence

Crop rotation serves as the foundation of successful peanut production in North Carolina for conventional production systems (see chapter 3, "Peanut Production Practices," and chapter 6, "Disease Management," for more details). Principles of good rotation for peanut also hold true for organic production. Rotations to non-hosts reduce populations of disease-causing fungi and nematodes and can minimize the negative impact of these pathogens on peanut health and productivity. This practice is especially critical in organic production due to the absence or limited efficacy of fungicides, nematicides, and seed treatments that are OMRI-approved for disease control. Long rotations are necessary to suppress diseases, especially those caused by soilborne plant pathogens. Corn, cotton, small grains, and other grasses typically are the best rotation crops for reducing pathogen infestations. However, some grain and grass species are not good rotations for nematode suppression. Soils should be assayed before planting for potential nematode problems, and infested areas should be avoided.

Crop rotation does not have a major impact on most insects that affect peanut. However, crop diversity can impact insect pests on farms and subsequent movement from crop to crop. See chapter 5, "Peanut Insect and Mite Management," for discussions of spider mites and other arthropods that are mobile.

Weed control in previous crops can have a major impact on weeds in both organic and conventional production systems (see chapter 4, "Peanut Weed Management"). However, there are no salvage treatments in organic production systems for weeds, and farmers should avoid fields with moderate to heavy weed pressure. It is necessary to ensure weeds that were controlled relatively well in previous crops do not grow and reproduce after these crops are harvested. Fields should be tilled as needed after harvest to keep weeds from reproducing late in the summer or early in the fall. Managing the soil seedbank is a critical component of organic crop production.

Tillage System

Reduced tillage systems are used by approximately 20 percent of peanut growers in North Carolina. While conservation tillage has been adopted more widely in other row crops, the requirement of digging pods and vine inversion is often more challenging in reduced tillage systems. In these systems peanuts are often grown in seedbeds with residue from the previous crop or in a desiccated cover crop. Pod loss is often greater when peanuts are dug in fields that are flat and not tilled without new rows prepared in spring. This is also the case for organic production systems. A second major challenge in reduced tillage in organic systems is controlling weeds prior to planting but before peanuts emerge. There is simply no way to control winter vegetation and emerged summer weeds without synthetic herbicides. Although reduced tillage often results in fewer weeds emerging with the crop, and high residue cover crops such as cereal rye can suppress weeds to a great degree, these approaches are generally not completely effective and would interfere with the multiple cultivations with a tine weeder that are needed during the first month of the season (see the next section on weed management). Soils in reduced tillage, especially if seedbeds are flat, often warm more slowly in spring. These soils often hold more soil water, resulting in cooler soils that impact stand establishment, especially when pathogens are present that affect seed and seedlings. Higher seeding rates are required to obtain adequate stands. While cover crops can suppress weeds, timing of planting peanut in late May often decreases biomass available for weed suppression. Leaf spot, stem rot, and tomato spotted wilt can be suppressed in reduced tillage, but challenges with stand establishment and early season weed control far outweigh potential benefits.

Soil Fertility and Plant Nutrition

Soil fertility in conventional production systems is often addressed in the crop preceding peanut, although growers are encouraged to sample soils frequently for nutrients to obtain timely recommendations and to adjust soil pH to optimum levels (see chapter 3, "Peanut Production Practices"). However, more and more growers in conventional production systems are applying remedial amounts of fertilizer to make sure peanut do not lack essential nutrients. Addressing fertility in organic production systems can be more challenging than in traditional production systems. This challenge is due to sources of fertilizer that are OMRI approved and the rate of mineralization of these fertilizers in some cases. For this reason, farmers should consider applying adequate amounts of fertilizer in the previous crop to meet the demands of the following peanut crop.

OMRI-approved inoculants that contain *Bradyrhizobia* bacteria essential for biological nitrogen fixation (BNF) are available for peanut. It is very important to apply adequate amounts of inoculant to seed or in the seed furrow at planting to ensure adequate infection of roots for BNF (see chapter 3 on peanut production for more details). This is especially the case if organic peanuts are planted in fields without a history of peanut production. In these fields there is no backup in the form of native *Bradyrhizobia* species. Synthetic nitrogen fertilizer can be applied quickly if inoculant fails in conventional production systems, and much of the yield potential can be realized when ammonium sulfate is applied after an inoculant failure. This fertilization effect is not the case in organic production systems.

Supplemental calcium as calcium sulfate or gypsum is applied to Virginia market types to ensure adequate kernel development. OMRI-approved gypsum sources are available and should be applied at pegging. OMRI-approved formulations of manganese and boron are also available. These micronutrients are often needed to optimize peanut yield. Growers are also cautioned that use of poultry or swine litter, even from many years ago, can result in levels of zinc that are yield limiting. Fields should be avoided if zinc levels exceed NCDA&CS indices of 250.

Digging Pods and Inverting Vines

Digging peanut and inverting vines will be similar in organic production systems compared with traditional production systems in most instances. However, more weeds, especially annual grasses, are likely to be present in organic systems than in conventional systems, and this can increase pod loss during digging and vine inversion. Weeds above the canopy can be mowed within two weeks of digging, but it is important to track rows precisely so that peanut rows can be clearly seen for effective digging. Rapid and haphazard mowing can make tracking rows extremely difficult. To prevent pod loss in the digging process, the implement must be positioned within just a few inches of optimum tracking.

Farmers might experience greater pod shed due to less effective fungicides for leaf spot in organic systems compared with conventional systems. In some fields peanut will need to be dug prior to optimum pod maturity to prevent excessive yield loss. The balance between pod loss from defoliation caused by leaf spot disease and not allowing enough time for peanut to reach full maturity is discussed in more detail in chapter 3, “Peanut Production Practices,” and chapter 6, “Peanut Disease Management.”

WEED MANAGEMENT

DO NOT attempt to grow peanuts in fields with moderate to high levels of weeds, especially if annual or perennial grasses, common ragweed, nutsedge, and Palmer amaranth are present. Grasses are particularly hard to manage because of their fibrous root system, which makes them difficult to remove by hand or by hoeing and causes greater pod shed during digging and vine inversion.

While heavy residue cover crops, in particular cereal rye, can suppress weeds, conventional tillage systems that allow frequent cultivation within the first month of the season have proven to be the most effective approach to organic peanut production. In these systems fields are weed-free at the time of planting peanut at a depth of 3 inches. Cultivation with a tine weeder should begin no later than three days after planting even though peanuts have not emerged. This operation will kill young seedlings below the soil surface, especially grasses. At least five more cultivations at weekly intervals are recommended using a spring-loaded tine weeder. The root system of peanuts planted at a depth of 3 inches will be anchored relatively well, and while some damage of foliage will occur and some plants will be occasionally removed from soil by tines, intensive cultivation in this manner is the only way to minimize weed interference and prevent a weed-control failure. Cultivators with sweeps can also be used as peanut plants grow larger. Soil from these cultivators can be deposited around the base of each plant to bury and suppress weeds in the peanut drill. This approach to weed control is the direct opposite of what is recommended in conventional production systems with respect to cultivation. In conventional systems, in-season cultivation is discouraged because of movement of soil that may contain pathogens onto peanut plants. Cultivation also brings soil to the surface that has not been treated with herbicide. Nonetheless, an aggressive approach to in-season cultivation with a tine weeder that covers the entire row is absolutely critical for success in organic peanut production. The value of weed control from these operations outweighs the negative impact of increased infection by pathogens.

Some weeds will need to be removed by hand in organic production systems. This practice is also true of conventional production systems when herbicides are not completely effective, especially when herbicide-resistant biotypes are present. In organic production, however, timeliness of weed removal by hand is needed not only to avoid interference with yield by weeds but also to minimize damage to peanut plants when physically removing weeds by hand or with implements.

There are currently no OMRI-approved chemicals that control weeds effectively in peanut.

INSECT MANAGEMENT

Thrips, southern corn rootworm, caterpillars, leaf hoppers, and spider mites can be suppressed in conventional tillage systems with insecticides. There are a few OMRI-approved insecticide options to control foliar feeding insects on an "as needed" basis, but there are no preventive, at-plant products. Products that contain spinosads, neem extract (azadirachtin), *Bacillus thuringiensis*, insecticidal soaps, and pyrethrins are available as nontraditional products for insect management. Growers should adjust cultural practices to a certain degree to minimize the likelihood of an infestation and the impact of insects (see chapter 5, "Peanut Insect and Mite Management"). However, sometimes a practice that minimizes the impact of one insect on peanut can increase the potential for another insect to damage peanut. For example, planting as late as possible in May minimizes injury potential from thrips in some years and can lower incidence of tomato spotted wilt compared with earlier plantings. Planting later in May increases potential from southern corn rootworm. In light, sandy soils, however, which pose a low risk from rootworms, this later planting may be a viable option to suppress early season thrips damage.

Unlike the catastrophic nature of a failure in stand establishment and early season weed control in organic peanut, yield loss from insects is often more incremental and generally will not result in complete yield loss. However, the presence of numerous arthropods that affect yield individually can ultimately result in yield losses that approach 15 to 20 percent. Maintaining good plant health will always make the plants more tolerant of insect feeding and less likely to suffer yield loss.

Unfortunately, the search for host plant resistance to insects in peanuts has not been productive, and varieties currently grown in North Carolina do not offer adequate resistance to insects to be considered a control strategy. While thrips vector tomato spotted wilt virus and variety selection can have a major impact on expression of tomato spotted wilt in peanut, resistance is not associated with impacts on thrips but is related to physiological effects of the virus within the peanut plant. Likewise, variety selection can impact damage from southern corn rootworm but is not related directly to resistance to feeding by the insect. Less pod scarring from southern corn rootworm occurs with some varieties because the resistant variety requires less time to reach optimum maturity and possesses hulls that are more fully developed when larvae begin feeding on pods. See both the Southern Corn Rootworm index and the Tomato Spotted Wilt Virus index in chapter 5, "Insect and Mite Management," for more information on management of these pests.

Several OMRI-approved insecticides are available that are effective in controlling leaf hoppers, thrips, and caterpillars. Although insecticidal soaps can suppress spider mites, they require excellent coverage. And under the hot, dry conditions that create spider mite outbreaks, these products may cause severe phytotoxicity. However, while any and all of these insect pests can injure peanut, they often do not occur at populations that result in serious yield reductions, and an overall organic production program can help preserve beneficial organisms that help limit pest populations.

DISEASE AND NEMATODE MANAGEMENT

Seedling diseases may be the greatest threat to organic peanut production because they can result in almost complete stand failure depending on weather and soil conditions at planting. This threat is the case even in conventional production systems when seed is not treated with fungicides. Several OMRI-approved products are available to suppress seedling pathogens, but these products are often less effective than the synthetic seed treatments in conventional production systems that are described in chapter 6, "Peanut Disease Management."

As stated in the introduction to this chapter, failure to establish an adequate stand and ineffective weed control are considered the most yield-limiting challenges in organic peanut production. For this reason, farmers are encouraged to plant peanut as late as possible within the effective planting window (late May) and increase the seeding rate by 50 to 75 percent compared with seeding rates used in conventional production systems where synthetic fungicides are applied to seed before planting. Soil is warmer in late May compared with early and mid-May, and this warmth most often results in more rapid emergence of peanut. The longer peanut seed and seedlings remain in soil prior to emergence, the more likely it is that soil-borne pathogens will cause seeds to rot. Pathogens also cause seedlings to die before and after emergence.

With the exception of systemic insecticides that suppress thrips, cultural practices that are effective in reducing tomato spotted wilt are the same for conventional and organic production. Planting at a seeding rate that ensures four to five plants per foot and in May can reduce incidence of tomato spotted wilt.

Most Virginia market type peanut varieties grown in North Carolina express resistance to one or more diseases typically found in peanut fields. Varieties available for both conventional and organic producers are much more effective at withstanding disease than varieties grown a decade or more ago. However, current varieties are not immune to disease. And in conventional production systems, there is concern that these varieties are less effective in withstanding disease now than when they were first adopted by growers.

Several OMRI-approved fungicides (usually copper and sulfur compounds) are available that can be used in peanut. These fungicides are not as effective as synthetic fungicides used to control leaf spot and require more frequent applications at shorter intervals. These products are strictly surface protectants and must be applied in advance of infection. Good coverage is essential. There are no OMRI-approved fungicides for control of diseases caused by soilborne pathogens (stem rot and Sclerotinia blight). Biological control products are only marginally effective against soil-borne pathogens and nematodes. As mentioned above, rotation is critical for maximizing the potential benefits of other disease control tactics. Yield most likely will be lower in organic production systems than in conventional production systems due to less effective management options for economically important diseases.

CURRENT RESEARCH IN NORTH CAROLINA

Research supported through the North Carolina Agricultural Foundation is currently underway. Trials on research stations that simulate organic production have demonstrated differences in yield between peanut grown at higher seeding rates without synthetic fungicide applied to seed, without insecticides, and with copper fungicide to control leaf spot compared with traditional production systems that include planting at normal seeding rates with fungicide-treated seed, acephate applied within three weeks after emergence to control thrips, insecticide applied at pegging to control southern corn rootworm, and synthetic fungicides designed to control leaf spot and stem rot. These experiments are being conducted in fields where weeds are controlled with synthetic herbicides and fertilizers used in conventional production systems are applied. Yield in the simulated organic system was approximately 20 percent lower than yield in the conventional system. Yield most likely would be even lower due to weed interference and possible fertility issues in the organic system. These studies will shed light on yield potential in organic peanut compared with conventional peanut with respect to disease and insect control.

The project also includes participation with two organic growers who are trying to incorporate peanut into their established organic production systems. Both growers are experienced organic producers. One of these growers has a substantial amount of organically-produced tobacco and sweetpotato. Unfortunately, this grower was unable to produce an organic peanut crop despite a dedicated effort to do so. In 2017, a field was prepared in a manner that would have created the best opportunity for success for organic production. However, the night after planting, a 4-inch rainfall event occurred. Although this did not result in a stand failure, it did prevent cultivation for several weeks, especially when a second significant rainfall event occurred within the next 10 days. This situation underscores the challenges with weed control and how unavoidable weather conditions can result in complete weed control failures in organic systems. In conventional systems, weeds could have been easily controlled with synthetic herbicides. In 2018, a second weed-control failure occurred with the same farmer. However, the failure was not due to weather conditions after planting but rainfall after seedbed preparation but before planting. This allowed weeds to escape and required re-establishment of seedbeds. By the time the field dried out adequately for primary tillage, planting would have occurred well into June. Yield potential for peanut in North Carolina decreases substantially after May. A third attempt will be made in 2019 with this grower to produce organic peanut. The limitation in tools that allow weeds to be controlled quickly without tillage pose a major challenge to organic peanut production, and as growers consider this approach and marketing opportunities, they will need to be aware that a higher frequency of failure will occur compared with traditional production systems, at least with weed management tools currently available in peanut. There is an old adage among farmers that, "a dry year will scare you to death, but a wet year will kill you." That phrase was coined during a time when few herbicides were available and most weed control in peanut was achieved through cultivation and hoeing. Researchers involved with organic peanut in Georgia indicated that they have had more success in dry years than during years with average or above-average rainfall. In fact, most organic peanuts are grown in New Mexico under arid conditions with irrigation. In that system, water can be managed in a way that does not interfere with weed control operations. Likewise, dry conditions and low humidity strongly suppress the activity of many plant pathogens. In North Carolina, the challenge of timely weed control with cultivation and hoeing will exist for organically-produced peanut because rain can be unpredictable and abundant in May and June.

The graduate student involved in this project is also conducting consumer surveys and surveys of organic growers without experience with peanut, traditional peanut growers who might be interested in expanding their operation to include organic peanut, and small, specialty shops that cater to consumers who prefer organically-certified food. Results from these surveys will help determine the feasibility of further development of a value chain for organic peanut in North Carolina.

The actual price the market is willing to pay for organic peanut is unknown. A complete and precise budget is also unknown. However, the budget found in Table 1 is most likely an accurate estimate. One major assumption in the budget is price for farmer stock peanut ($0.46 per pound). This price is roughly twice the price of conventionally-produced Virginia market type peanut.

Table 12-1. Estimated Enterprise Budget for Certified Organic Peanut Production

Item	Quantity or Unit	Price per Unit	Total per Acre ($)	Your Farm
1. GROSS RECEIPTS[1]	2,500 lb	0.46	1,150.00	
Total receipts			1,150.00	
2. VARIABLE COSTS				
Seed	200 lb	0.85	170.00	
Inoculant	1.00 acre	6.00	6.00	
Fertilizer (prorated)[2]	1.00 acre	40.00	40.00	
Lime (prorated)	0.33 ton	46.00	15.18	
Gypsum (spread)	0.60 ton	47.50	28.50	
Hand weeding[3]	1.00 acre	22.92	22.92	
Insecticides	1.00 acre	74.71	74.71	
Fungicides[4]	1.00 acre	180.00	180.00	
Scouting	1.00 acre	16.00	16.00	
Organic certification fee[5]	1.00 acre	32.00	32.00	
Hauling	1.25 ton	12.00 ton	14.97	
Drying	1.25 ton	45.00 ton	56.14	
State Check-off Fee	1.25 ton	3.00 ton	3.75	
National Assessment	1,150.00 acre	0.095%	10.93	
Crop insurance	1.00 acre	30.00	30.00	
Tractor/Machinery[6]	1.00 acre	103.44	103.44	
Labor[7]	9.02	11.27	103.37	
Interest on Operating Capital	376.60	6.0%	22.60	
Total Net Variable Costs			930.51	
3. INCOME ABOVE VARIABLE COSTS			**219.49**	
4. FIXED COSTS				
Machinery	1.00 acre	147.59	147.59	
Total Fixed Costs			**147.59**	
5. TOTAL COSTS			**1,078.10**	
6. NET RETURNS TO LAND, RISK, & MANAGEMENT			**71.90**	

(continued)

Please note: This budget is for planning purposes only. It does not include land rent.

[1]Peanut price was set at twice the price for conventionally produced peanut.

[2]No nitrogen application is considered, but we assume that P and K levels are maintained with a previous crop for which the cost is estimated to be $40.00 an acre.

[3]Hand weeding is hand labor paid at $11.46 an hour for two hours an acre.

[4]Fungicide cost includes eight passes with a copper-containing, OMRI-approved product.

[5]The organic certification fee includes the cost of maintaining records as well as the annual assessment to stay certified.

[6]Equipment cost assumes eight passes with a cultivator at a total equipment cost of $66.96 and two hours of equipment operator labor and could also be included in the cost of weed control.

[7]This is labor that is operating equipment in the field.