Peanut Seed Production

A Guide for Producers of Virginia-Type Peanut Seed
To be successful, peanut seed producers must understand seed quality, know how seed quality is achieved and lost, and understand how they can ensure delivery of high-quality peanut seeds to farmers.

In many respects, the production of peanuts for seed is similar to the production of peanuts for commercial use. With few exceptions, the requirements for disease management, soil amendments, and crop handling are essentially the same, regardless of the intended use of the harvested crop. Like commercial peanut producers, peanut seed producers seek most of all to maximize yield. But because of the specialized use of the seed crop, seed growers must give certain production practices more attention to enhance seed quality. This is particularly true when considering disease management, gypsum application, digging, and curing. In addition, seed growers must follow practices that ensure genetic and crop purity, must handle the crop carefully to avoid quality loss, and must store the seeds in an environment that minimizes deterioration of quality.

**SEEDLOT QUALITY**

Seed quality can be divided into five separate, but related components: genetic purity, crop purity, health, germination, and vigor. Each is important, and each can be affected by management decisions throughout the growing season and during digging, harvest, curing, conditioning, and storage.

**Genetic purity**

The genetic composition of a peanut variety dictates maturity date, disease and insect resistance, peanut quality (appearance as well as protein and oil composition), grade, and many other characteristics. Preserving the genetic integrity of the seed crop is essential and is simply a matter of keeping accurate records, keeping equipment clean, and exercising care when handling the seed.

**Crop purity**

Crop purity refers to the presence of contaminants, including weed seed, nutedge tubers, other crop seed, and inert matter. Weed seed contamination is not a major concern for peanut seed producers. Growers should keep in mind, however, that keeping weeds out of the field in the first place is usually easier than removing weed seeds from the seedlot. Of greater importance is the presence of nutedge tubers, which can be difficult to remove from shelled peanut seeds.

Inert matter includes pods, stems, small stones, skins, and pieces of broken seeds. It is important to harvest peanuts at the correct moisture and at the correct combine settings to reduce the amount of trash and broken kernels collected.

**Seed health**

Seed health is related to seedborne diseases present on or in peanut seeds. Because peanut pods develop underground, they are in constant contact with soilborne pathogens. Some pathogens find their way into the pods and infect the developing seed.

Seedborne diseases are a concern for two reasons. One is the drop in germination caused by pathogens such as fungi. These pathogens are commonly found on peanut seeds and reduce germination by causing seed and seedling rots. However,
growers need not be overly concerned about these diseases because peanut seeds sold in the Virginia-Carolina area are coated with a variety of chemical treatments before planting that either kill seed pathogens or protect the growing seedling long enough for it to become established. Do not plant untreated seed. A list of effective seed treatments can be found in the North Carolina Agricultural Chemicals Manual.

A second, more serious concern associated with seedborne fungi is the transmission through seed stock of such diseases as Cylindrocladium parasiticum (CBR). To develop a better understanding of the significance of seed transmission of CBR, it is important to emphasize that under some circumstances there may be no seed transmission of the disease. This is true if 1) the seeds are produced in clean fields, 2) infested seeds are identified and discarded at the shelling plant, 3) the fungus dies during drying, storage, or following seed treatment, or 4) unfavorable field conditions during that season prevent the disease from forming.

Seed transmission of CBR can occur. A survey of 62 commercial seedlots produced in 1997, which were sampled after conditioning but before the application of seed treatment, showed that an average of 1.3 percent (a range of 0 to 5.6 percent) of the seeds had speckles, which signal the presence of CBR. The speckles are the resting structures (sclerotia) of the fungus C. parasiticum and are how it is transmitted from seed to fields. Speckled seeds were found in at least one subsample of every seedlot. While all speckled seed had viable C. parasiticum at harvest, by planting time only 4 to 5 percent of the speckled seed retained the fungus. This means that most of the sclerotia died during winter seed storage.

To improve our ability to study CBR transmission via seeds, hand-picked, speckled seeds were selected from a commercial shelling operation following conditioning and sorting but before the addition of seed treatment. Our field studies showed that at least some disease was transmitted every year if speckled seeds were planted without seed treatment. Seed treatment cut the transmission rate about in half, and transmission occurred in only 2 of 4 years. Based on our surveys and the results of our field studies, we calculated that from 0 to 60 plants per acre can be infected as a result of planting speckled seed.

To avoid seed transmission of peanut diseases, grow peanuts produced for seed in fields with no CBR. Keep fields on long crop rotations, fumigate them before planting, and scout late in the season to identify these diseases. Harvest only those portions of the field that are free from the disease. No other disease at this time is known to be transmitted on peanut seed at levels high enough to cause concern. Tomato spotted wilt virus (TSWV) is not transmitted by seed.

Germination

Germination is the measure of a seed’s ability to produce a normal seedling when planted in ideal conditions (optimal temperature and moisture plus good aeration). It is this value that is reported on the seed tag and is one of the criteria used to determine if the seedlot meets State Seed Law requirements for sale. It is also the value that farmers often use to calculate yearly seeding rates.

Field conditions are rarely ideal, and the germination test can at times overestimate field emergence. Regardless of its limitations, the seed germination test is the universal standard measure of seed quality.

Freshly harvested peanut seeds are frequently dormant, meaning the seeds will not germinate even if conditions are favorable. Dormancy is a survival mechanism that prevents seeds from germinating at the wrong time. The environment during seed development can influence the level of dormancy. Often seeds produced in hot, dry years will have a “deeper” dormancy, which
means dormancy is harder to break during seed-germination testing. Usually, peanut seed dormancy disappears about 4 months after harvest.

All state seed-testing laboratories follow specific procedures, as outlined in the Rules for Testing Seeds by the Association of Official Seed Analysts (AOSA). The Rules have specific germination test guidelines and offer several options for breaking peanut dormancy; each provides an accurate evaluation of germination potential. If a seedlot-label shows a germination percentage that is much higher than the official regulatory sample, the explanation may be that the seeds in question were labeled based on tests or evaluation criteria that did not follow AOSA Rules. In such cases, a “stop sale” may be issued on the suspect seedlot. It is, therefore, important that peanut seedsmen use germination-testing laboratories that follow AOSA procedures.

Seed vigor

Peanut seedlots with nearly identical germination percentages, planted in nearly identical field conditions, still may have very different emergence rates and final plant stands. This variation in field performance can be attributed to differences in seed vigor. Vigor is the component that determines the potential for rapid and uniform emergence under a wide range of field conditions. No seed, no matter how vigorous, can withstand prolonged periods of adverse conditions at planting. However, a high-vigor seedlot can withstand stress during germination and early seedling development longer than a low-vigor seedlot. Stress could include cool, wet soils; crusting; chemical damage; flooding; or any other environmental condition that places the seed in less than favorable conditions. Low-vigor seeds exhibit many symptoms of deterioration, with delayed germination and emergence among the first noticeable signs, followed by a slower rate of seedling growth and less stress tolerance.

The key to attaining and maintaining excellent germination and vigor potential lies in timing and attention to detail. In addition to traditional production practices of fertilizing and pest management, good seed quality comes from proper digging, combining, and curing of the seed crop. The impact on quality of these practices is discussed below.

PRE-PLANT AND PLANTING DECISIONS

Seed selection

Most peanuts grown for seed in North Carolina and Virginia are grown as a class of Certified Seed. For seed to be eligible for certification, they must meet field and seed standards established by the North Carolina or Virginia Crop Improvement Associations. Consult these organizations for specific requirements about grower eligibility and to arrange for field inspections.

Field selection

Attention to field history and crop rotation is the most efficient way to manage diseases, insects, and weeds. Select fields that do not have a history of soilborne diseases, such as stem rot and CBR. If soil diseases are severe, treat according to recommendations found in the North Carolina Agricultural Chemicals Manual and Peanut Information, AG-331. Long crop rotations and use of cultural practices can reduce the impact of soilborne diseases. If diseases are severe, report the situation to your seedsman.

Equipment tune-up

One way to maximize planting efficiency is to tune your planter. Studies have shown that some pests, thrips in particular, are best managed if plants are spaced uniformly across the field. There is also less TSWV with high plant populations and uniform plantings. Tuning the planter before the first trip to the field can help you achieve uniform seed spacing and planting depth, reduce damage to the planted seed, and minimize down time during the growing season.

Table 1. Gypsum sources and application rates.

<table>
<thead>
<tr>
<th>Source</th>
<th>CaSO₄*</th>
<th>Band (16-18 inches)</th>
<th>Broadcast</th>
</tr>
</thead>
<tbody>
<tr>
<td>USG Ben Franklin</td>
<td>85</td>
<td>600</td>
<td>—</td>
</tr>
<tr>
<td>USG 420 Granular</td>
<td>85</td>
<td>—</td>
<td>1,200</td>
</tr>
<tr>
<td>USG 500</td>
<td>70</td>
<td>—</td>
<td>1,300</td>
</tr>
<tr>
<td>JTM peanut maker</td>
<td>72</td>
<td>—</td>
<td>1,300</td>
</tr>
<tr>
<td>TG Phosphogypsum</td>
<td>50</td>
<td>—</td>
<td>2,000</td>
</tr>
</tbody>
</table>

* Guaranteed analysis percentage in registration with N.C. Department of Agriculture and Consumer Services.
**G R O W I N G   S E A S O N**

**Gypsum application**

Calcium is a critical element in peanut seed development. It is important in the formation of cell walls, in cell function, and in tissue formation; and it is essential for the germination processes. Seedlings produced from seeds with a calcium deficiency exhibit several symptoms, including watery hypocotyls (also known as hypocotyl collar rot) and deformed plumules.

Several reports have indicated that the large, Virginia-type peanut seeds need at least 450 parts per million of calcium within the seed for rapid, normal germination. Few North Carolina and Virginia soils contain enough residual calcium to allow growers to skip application of this critical element. Seed fields require annual applications of gypsum at the right time and in the correct amount. Late June or early July at early bloom is the optimal time, and rates depend on the source (Table 1).

Calcium uptake by the plant is closely related to rainfall, and seeds produced in dry years often exhibit calcium deficiency (Table 2). If seed fields are moisture-stressed during the growing season, evaluate germination and calcium-deficiency symptoms before co-mingling this production with seed from other fields. If seed quality is low, sell these seeds for commercial use, not for seed.

**Boron**

Boron is another element that is critical for sound seed formation and germination. Boron deficiency is often seen at the base of the plumule where tissues appear dark. Another sign of deficiency is a condition known as “hollow heart,” in which the center of the cotyledons appear sunken. Boron can be added pre-plant with herbicide programs, as a component of fertilizers applied to the crop, or as a foliar application in early July. However, on sandy soils, heavy rains can leach pre-plant boron from the peanut plant root zones. In this situation, foliar application may be the best.

**DIGGING AND HARVEST**

Peanuts are indeterminate in growth habit. Therefore, at harvest, seeds on a single plant will be at differing levels of maturity. Seed growers usually report better germination if their seed fields are harvested about 7 days earlier than commercial fields. The decrease in germination observed with later harvests could be related to the environment during seed development, deterioration of pods with a corresponding increase in mechanical damage, or an increase in seed pathogens.

Research at North Carolina State University supports grower observations that germination can decrease if harvest is delayed beyond an optimum digging date (Table 3). However, keep in mind that varieties do respond differently and that growing conditions can dramatically affect seed development and consequently influence optimum digging date. N.C. Cooperative Extension Service will continue to evaluate new varieties as they are released to determine the optimum harvest date for yield and seed quality. Seed growers should consult their county Extension center for information about how new varieties perform in their area.

Studies have shown that immature seeds of many crops are capable of germinating, and this is also true of peanuts. However, germination of immature peanut seeds can be slow, seed vigor often may be low, and seedling survival could be in jeopardy. Thus, seed growers should avoid harvesting too early.

But how early is too early? In a three-year study, germination and vigor (as measured by cell leakage) were evaluated in NC 7 and NC 9 seeds at different maturity levels (Table 4). Cell leakage is generally considered a reliable

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**Table 2. Influence of gypsum and rainfall on seed calcium.**

<table>
<thead>
<tr>
<th>Gypsum Lb/A</th>
<th>Adequate Rainfall</th>
<th>Inadequate Rainfall</th>
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<tr>
<td>0</td>
<td>682</td>
<td>275</td>
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<tr>
<td>200</td>
<td>725</td>
<td>343</td>
</tr>
<tr>
<td>400</td>
<td>848</td>
<td>489</td>
</tr>
<tr>
<td>600</td>
<td>919</td>
<td>469</td>
</tr>
<tr>
<td>800</td>
<td>943</td>
<td>498</td>
</tr>
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</table>

**Table 3. Influence of harvest date (three-year average) on peanut seed germination for four varieties.**

<table>
<thead>
<tr>
<th>Variety</th>
<th>9/21</th>
<th>9/28</th>
<th>10/5</th>
<th>10/12</th>
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<tbody>
<tr>
<td>AT VC 1</td>
<td>86</td>
<td>90</td>
<td>88</td>
<td>88</td>
</tr>
<tr>
<td>NC 7</td>
<td>81</td>
<td>82</td>
<td>87</td>
<td>76</td>
</tr>
<tr>
<td>NC 9</td>
<td>79</td>
<td>84</td>
<td>88</td>
<td>76</td>
</tr>
<tr>
<td>NC-V11</td>
<td>84</td>
<td>80</td>
<td>85</td>
<td>84</td>
</tr>
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</table>
Table 5. Germination at various levels of maturity of NC 9 peanut seeds grown in 1990 and 1992.

<table>
<thead>
<tr>
<th>Maturity Level*</th>
<th>Germination %</th>
<th>1990</th>
<th>1992</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow</td>
<td>90</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>Orange</td>
<td>92</td>
<td>83</td>
<td></td>
</tr>
<tr>
<td>Brown</td>
<td>92</td>
<td>96</td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>91</td>
<td>100</td>
<td></td>
</tr>
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</table>

* Maturity was based on pod mesocarp color using the hull scrape method. Yellow pods were about 40 percent mature, orange pods 60 percent mature, brown pods 95 percent mature, and black pods fully mature.

The germination percentages shown in Table 5 represent the percentage of seeds that successfully germinated under the given conditions. This table highlights the importance of harvesting at the optimal maturity stage to achieve high germination rates.

### Big seeds versus small seeds

Peanut farmers and seed growers often confuse seed size with seed quality. Many think the bigger the seed, the better the seed. Others feel that smaller seeds germinate faster and are therefore better than larger seeds. While it is true that seed size can influence speed of germination, one must be careful to keep seed size in its proper perspective.
Consider this: For the germination process to begin, seed moisture must be around 40 percent. A large seed that weighs 1 gram must take up about 0.6 milliliter of water to begin the germination process. A smaller seed of the same quality weighing only 0.8 gram would need to absorb only 0.4 milliliter before germination could begin. The larger seed will take longer to begin germinating, perhaps as much as 24 hours longer, if moisture at planting is not limiting. If moisture is limiting, it may take several days longer for the larger seed to germinate. It does not mean that the large seed is inferior in quality. It just takes a little longer to hydrate.

Small seeds are often equated with immaturity in indeterminate crops like peanuts. And while it is true that immature seeds tend to be smaller than mature seeds, one cannot assume that discarding the small seed fraction will automatically remove all the immature seeds from the seedlot. A study showed that immature seeds can be found in the large seed portion of the seedlot and that regardless of seed size, maturity is the factor that dictates quality (Table 6). Note that VA-C 92R peanut seeds responded differently in 1993 and 1994. The growing season in 1993 was very dry, and the seed quality of immature seeds (yellow, orange, and brown pods) was very low, regardless of seed size. Seed produced in 1994 developed with little or no stress during the growing season, and germination was much higher.

### Table 6. Percent germination at various levels of maturity and screen sizes of VA-C 92R peanuts harvested in 1993 and 1994.

<table>
<thead>
<tr>
<th>Screen Size</th>
<th>18</th>
<th>20</th>
<th>22</th>
<th>24</th>
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<tbody>
<tr>
<td>Maturity Level</td>
<td>% Germination</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1993</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow</td>
<td>23</td>
<td>30</td>
<td>38</td>
<td>—</td>
</tr>
<tr>
<td>Orange</td>
<td>30</td>
<td>32</td>
<td>41</td>
<td>52</td>
</tr>
<tr>
<td>Brown</td>
<td>38</td>
<td>40</td>
<td>54</td>
<td>52</td>
</tr>
<tr>
<td>Black</td>
<td>—</td>
<td>84</td>
<td>84</td>
<td>88</td>
</tr>
<tr>
<td>1994</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow</td>
<td>70</td>
<td>77</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Orange</td>
<td>77</td>
<td>88</td>
<td>90</td>
<td>—</td>
</tr>
<tr>
<td>Brown</td>
<td>96</td>
<td>98</td>
<td>96</td>
<td>99</td>
</tr>
<tr>
<td>Black</td>
<td>95</td>
<td>100</td>
<td>99</td>
<td>100</td>
</tr>
</tbody>
</table>

Digging and combining

Once peanuts are dug, inverted, and left on top of the soil, environmental elements will influence seed quality. When peanuts are dug, the moisture content of seeds is still fairly high. Seeds from yellow pods (immature) can have as much as 60 percent moisture, while seeds from black pods (mature) usually range from 35 to 40 percent moisture. If temperatures shortly after digging reach 90°F or greater, seeds can suffer physiological heat damage that can reduce germination and vigor. If temperatures drop below freezing shortly after digging and if seed moisture is still above 35 percent, the water inside the seed's cells can freeze, also causing cell damage. Usually, once seed moisture drops below 35 percent, freezing temperatures have little effect on seed quality.

Excessive rainfall after digging can delay combining. Generally, the longer the delay once peanuts have reached safe harvest moisture, the greater the chance of damage to seed quality. However, combining too soon after digging also can harm seed quality. Wet vines are tough, which makes harvesting difficult. Growers often become too aggressive in combining wet vines, and rough

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**Effective Curing**

- Clean the peanuts before placing them in the curing wagon.
- Level the peanuts in the wagon.
- Dry slowly and with as little heat as possible. Heat air no more than 15°F above ambient temperature.
- Turn dryers off when the average seed moisture reaches 10 percent.
- Do not store peanuts in the curing wagons.
handling of this sort can break or bruise the peanut kernels. A good rule of thumb is to harvest peanuts as soon as possible after seed moisture reaches 20 to 25 percent.

**POSTHARVEST HANDLING OF SEEDS**

**Curing**

Peanuts should be cleaned before being placed in the curing wagons. Removing dirt and trash maximizes air flow, which reduces drying time and costs. Curing is most efficient and effective if peanuts are leveled in the trailer.

Seeds can be damaged by overdrying, rapid drying, or drying at high temperatures. Detailed techniques for curing are discussed in *Peanut Information*, AG-331. Producers should take particular care when curing the seed crop because high-quality seed can deteriorate rapidly through improper curing.

**Seed storage**

Once cured, peanut seeds should be stored in a cool, dry environment until delivered to the conditioning plant. Even short periods of poor storage conditions can lower seed quality.

Seed peanuts can be shelled soon after harvest and stored in bulk containers. Again, it is critical to keep seeds dry, cool, and well aerated for quality to be maintained. Airflow should be provided around peanuts to ensure continuous exchange of air in the storage area. Use fans to move cool, dry air into the storage area, particularly in warehouse corners where the flow is blocked.

**SUMMARY**

Production of high-quality peanut seeds requires a high level of management that begins before planting and continues through delivery of seeds to the peanut farmer. Growers must plan all farm operations well in advance to ensure the seed crop has the highest priority. Lastly, producers also must keep two factors in the forefront of all decisions about their crop—namely, disease management and maturity at harvest.

**Tips for SEEDGROWERS**

- The seed crop has priority.
- Keep seed fields and harvested seed genetically pure and weed free.
- Avoid using fields with CBR as seed stock.
- Tune up planting equipment to ensure uniform stands.
- Apply calcium in the correct amount and at the right time.
- Dig peanuts when a majority of the pods are close to maturity.
- Combine as soon as seed moisture reaches 25 percent.
- Cure seed peanuts slowly.

Never store seed in curing wagons.

In memory of

**JACK BAILEY**

**NORTH CAROLINA COOPERATIVE EXTENSION SERVICE**

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