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Chapter 5

CULTURAL PRACTICES

RONALD J. HENNING, ALLEN H. ALLISON, AND LELAND D. TRIPP

Peanut production in the United States is currently concentrated in 3 major geographic areas, the southeast (SE) including Georgia, Florida and Alabama; the southwest (SW) including Texas, Oklahoma, Mississippi, Arkansas and New Mexico; and Virginia-Carolina (VC) which includes Virginia, North and South Carolina (Figure 1). Approximately 50% of the production area is in the SE, 31% in the SW and 18% in the VC area (Henning, 1978).

Currently, about 98% of the SE area is planted to Florunner which is a runner type peanut. The remainder is about equally divided between the spanish type and virginia type. Plantings in the SW are divided mainly between spanish (55%), runner (42%) and valencia (3%). Most of the valencia type peanuts are produced in New Mexico. Almost 100% of the VC area is planted to varieties of the virginia type.

Practices of peanut culture discussed in this chapter are intended to supplement and update where necessary the recommendations given by Sturkie and Buchanan (1973) in their chapter on Cultural Practices, as published in *Peanuts: Culture and Uses*. Included are practices and recommendations on soil and climatic adaptation, fertilization, crop rotation, land preparation, varieties, planting date, row patterns, seed spacing, weed control, irrigation and growth regulation. An in-depth discussion of fertilization, irrigation, weed control, growth regulation, disease control, and insect control is reported elsewhere in this edition, and the reader should refer to the main chapters on these subjects for background research information. Information on the remaining topics is presented from research and extension publications. The material contained in this chapter is intended primarily for those interested in the commercial production of peanuts.

Successful peanut production can be achieved only as each cultural practice is effectively integrated into the total production program. The uneffective implementation of any single practice can seriously reduce crop production potential.

Although peanuts may be produced over a fairly wide range of soil and climatic conditions, maximum production potential will be realized only when such conditions are optimum. Therefore, a careful study of the soil type, temperature range, rainfall amount and distribution pattern should be conducted to determine the suitability of peanuts to a given area.

SOIL AND CLIMATIC REQUIREMENTS

A well drained loamy sand, sandy loam or sandy clay loam soil is best suited for peanuts. Successful production may occur on heavier textured soils, but the risk of pod loss at harvest is greater. Where peanuts must be produced on heavy

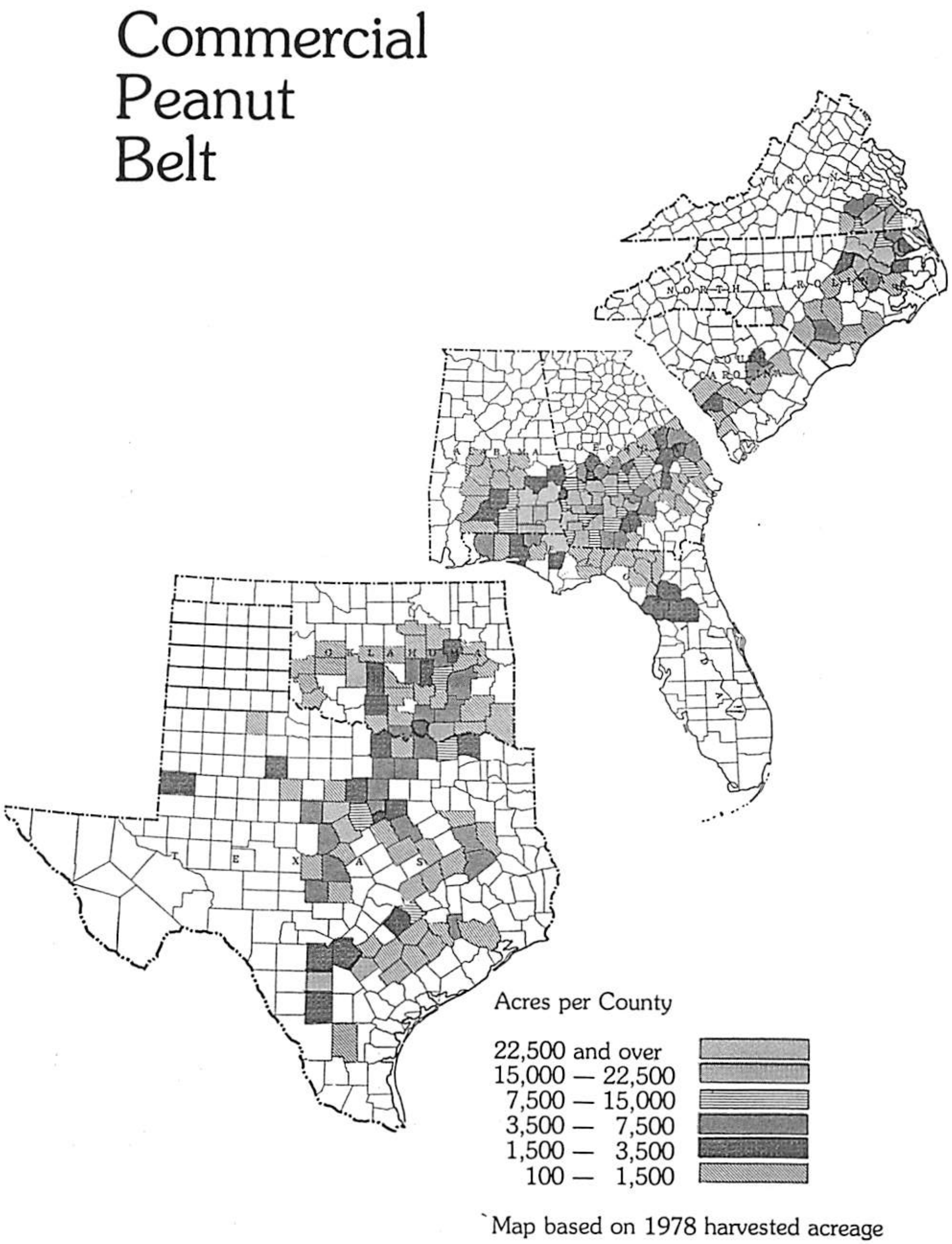

Fig. 1. U. S. Commercial Peanut Belt.

textured soils, runner and spanish are better suited than the virginia type. Avoid planting peanuts in fields with shallow top soil, poorly drained areas or fields subject to excessive erosion.

Climatic conditions such as temperature and rainfall also influence the degree of successful peanut production within a given area. The length of the growing season and the production potential of the crop are greatly influenced by these factors. Peanuts should be planted in warm, moist soils. Planting peanuts in cool, wet soils often results in slow seed germination and seedling emergence, thus increasing the chance for seed rot and seedling diseases. The number of days between the optimum temperature for germination and the first killing frost should be considered when selecting a suitable peanut variety for planting. Certain spanish and valencia market type varieties may require only 95 to 100 days to reach optimum maturity while some runners and virginias may require 140 days or more.

Adequate rainfall during the growing season is essential for maximum yield and quality (Stansell et al., 1976). Distribution of rainfall is as important as the total amount received. Although adequate soil moisture during the entire growing season is desirable, the most critical period occurs during fruiting. Therefore, the area selected for peanuts should have a well drained light to medium textured soil and a minimum 100-day optimum temperature growing season. Failure to meet any of these requirements will reduce production potential. Varieties requiring fewer days to reach maturity should be selected for areas with shorter growing seasons.

CROP ROTATION

Peanuts are extremely sensitive to the effects of other crops grown in the rotation, especially the crop which immediately precedes peanuts. It is best not to plant peanuts in the same field more often than 1 year out of 3. Grass-type crops such as corn, grain sorghum, millet or small grains should be grown immediately preceding peanuts. Maintaining a suitable cropping sequence will: (1) improve fertilizer utilization efficiency, (2) reduce pod yield loss from certain diseases and nematodes, and (3) improve weed control efficiency.

As was pointed out by Sturkie and Buchanan (1973), peanuts respond well to residual soil fertility and only minimally to direct fertilizer applications unless the residual fertility of the soil is low. For this reason special consideration should be given to fertilization of the crops preceding peanuts in the rotation. Crops such as corn, grain sorghum and small grains have generally responded to direct applications of fertilizer. Thus heavy fertilization of these crops will insure maximum yields and build residual soil fertility for the following crop of peanuts. Peanuts, because of their deeper root system, are able to utilize soil nutrients which may have leached below the more shallow root zone of the grass-type crops.

Certain peanut diseases and nematodes can be partially controlled through crop rotation. For example, seedling diseases of peanuts are more damaging where peanuts follow peanuts, cotton, tobacco or soybeans than when peanuts are planted following grass-type crops. Also, leafspot diseases generally appear earlier and are more difficult to control when peanuts follow peanuts more often than 1 year out of 3. The first line of defense against certain soil-borne pathogens such as Southern blight, Cylindrocladium black rot, Pythium, Rhizoctonia and Sclerotenia blight, which may infect peanuts during the fruiting stage, is rotation with grass-type crops.

Root knot, lesion and sting nematodes may also become a serious problem under continuous or short peanut rotations. Including 2 or more years of corn and grain sorghum along with winter small grains in the rotation will relieve the pressure to some degree from root knots, but will have little effect on lesion or sting nematodes. Currently, chemicals offer the most practical control method for lesion and severe root knot infestation.

Crop rotation with emphasis on weed control in the preceding crop will reduce the pressure from weeds in the following crop of peanuts. Deep germinating broadleaf weeds are extremely difficult to control chemically in peanuts but may be effectively controlled with chemicals in grass-type crops preceding peanuts. Effective weed control in these crops will reduce the number of weed seeds remaining in the soil, thus lowering the population pressure for the following peanut crop.

Recommendations from all 3 major peanut areas strongly suggest that, wherever possible, peanuts not be planted following peanuts, soybeans, tobacco or cotton (Boswell, 1975; Henning et al., 1979; Allison, 1981). This practice will likely decrease yields due to increased disease pressure. However, on certain farms the practice of planting peanuts behind some of these crops cannot be avoided. Under such conditions planting as early as practical will aid in reducing some of the risk. This will allow the peanut crop to reach maturity earlier in the season before diseases and nematodes become severe. A more carefully planned leafspot control program may be required in fields which have recently been planted to peanuts. In such fields the control program should begin earlier and the interval between fungicide applications should be reduced, especially during periods of high humidity and rapid plant growth.

Where peanuts must be planted behind cotton or tobacco, the taproots should be ripped up and shredded early in the fall to allow for maximum decomposition prior to land turning. In addition, planting small grains (especially rye) for grazing during the winter may also reduce the disease and nematode hazards in less favorable rotations. Also, in fields which have a history of southern blight or white mold, it may be advisable to utilize recommended chemicals which give additional control.

LAND PREPARATION

The objective of peanut land preparation is 2-fold. These include (1) the complete burial of all crop residue and weed seed as well as applied lime and fertilizer and (2) the formation of a deep, friable, smooth, level but slightly raised seedbed. Such a seed and rootbed will provide for maximum moisture retention, precision planting, efficient seed germination and effective weed and disease control.

These objectives may be accomplished by turning the peanut land to a depth of 15-20 cm (6-8 in) with a moldboard plow equipped with disc coulters or coverboards. These trash burial devices will bury the previous crop litter and weed seed in the bottom of the furrow, thus reducing disease and weed pressure (Sturkie and Buchanan, 1973). (Figure 2).

Fig. 2. Deep turning with a moldboard plow equipped with litter burial device is essential to achieving maximum yields in the SE.

After land turning, final seedbed preparation should be accomplished to leave a completely flat level bed with wheel tracks established. This "bed effect" may be accomplished by "tracking off" the land immediately after turning or by precision use of the power driven rotary tiller as the preplant incorporated (PPI) herbicides are incorporated (Henning et al., 1979). (Figure 3).

Fig. 3. The preparation of a flat, slightly raised seedbed will allow for maximum planting efficiency.

FERTILIZATION

When peanuts follow a heavily fertilized crop in the rotation or when they are planted on soils with high residual fertility, they usually do not respond to a direct application of fertilizer (Sturkie and Buchanan, 1973). Although under such conditions a moderate rate of fertilizer will not usually increase peanut yield, it will serve to maintain the fertility level in soils with clay textured subsoils. A good practice on sandier textured soils is to apply a heavier than normal rate of fertilizer on small grains for grazing immediately preceding peanuts. The small grain crop will hold the plant nutrients making them available for the following peanut crop.

Soil tests should be used to determine fertilizer and lime requirements. A balanced fertility program with particular emphasis on adequate levels of phosphorus, potassium, calcium and magnesium are essential to high yields. Fields which test low in phosphorus and/or potassium should be fertilized with adequate rates of these elements to maintain a medium level. A small amount of nitrogen included with the fertilizer, when peanuts are planted in low fertility soils, may be beneficial.

Fertilizer for peanuts should be broadcast prior to land turning within 4 to 6 weeks of planting. A broadcast application after land turning tends to stimulate early weed growth and may contribute to soil compaction. Heavy rates of fertilizer containing potassium applied to the pegging zone can interfere with the proper uptake of calcium by the developing pegs and pods, resulting in increased risk of peg and pod rots (Hallock and Garren, 1968).

The peanut is a highly efficient legume; thus it can provide its own nitrogen if the correct strains of nitrogen fixation bacteria are present in the soil. These bacteria are usually abundant in most peanut soils if peanuts have been grown during the past 5-6 years. However, in fields which have not been planted to peanuts during the past 5-6 years, a commercially prepared inoculant should be applied in the furrow with the seed at planting (Henning et al., 1979).

Currently, 4 forms of inoculant material are commercially available for peanuts, including granular, powder, liquid and frozen. In the SW and SE areas best results have been obtained from the granular form applied by granule applicator directly into the furrow with the seed. However, in the VC area granular has performed no better than planter box treatments. Also, the granular inoculants were found to be hygroscopic, making application more difficult.

Lime or basic slag should be applied to soils with pH values below 5.8. Rate and kind of lime applied should be based on a soil test. If possible, lime should be applied 3-4 months prior to planting, allowing adequate time for neutralization of the acid soil.

In addition to reducing soil acidity, lime also supplies calcium to the soil. Adequate levels of available calcium are essential to yield and quality of peanuts. A calcium deficiency is expressed primarily as unfilled pods or "pops" and/or a blackened plumule inside the seed halves known as "black heart". In addition to "black heart," a minor calcium deficiency can result in seeds which do not germinate or produce weak or deformed seedlings (Sullivan et al., 1974). A soil calcium deficiency can also increase the incidence of peg and pod rots especially if the potassium level is in the very high range (Hallock and Garren, 1968). (Figure 4).

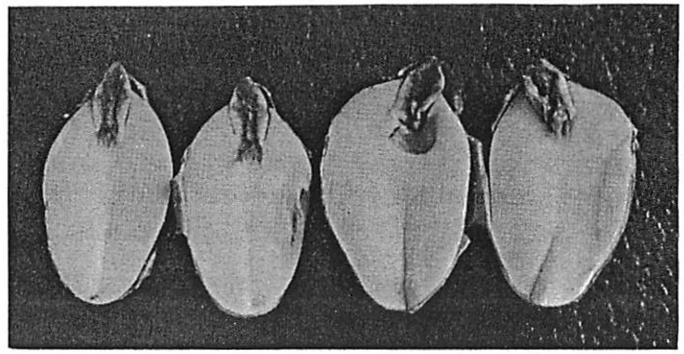

Fig. 4. Calcium deficiency as indicated by the black plumule. "Black heart".

The amount of calcium required by the peanut appears to be partially related to seed size (Walker and Keisling, 1978). The large-seeded virginia type requires a higher concentration of available calcium in the pegging zone than do the smaller-seeded runner and spanish types.

Gypsum (landplaster) in the dry, wet or granular formulation is a readily available source of calcium. When the need for calcium in addition to that received from lime is established through soil testing, gypsum should be applied at the early bloom stage. When the virginia type is produced for seed, a split application of gypsum may improve seed germination and vigor. In such cases the second treatment should be made about 30 days following the early bloom application (Allison, 1981).

Certain micronutrients including zinc, iron, manganese, copper, boron and molybdenum are also essential to peanut production. Boron is probably the micronutrient most often found to be deficient. An adequate level in the soil is essential to normal seed development. A boron deficiency causes "hollow heart," which is an irregular shaped blackened cavity on the inner face of the peanut seeds (Cox and Reid, 1964). This condition is classified as concealed damage at the market place and its presence in a peanut grade sample drastically reduces the value of that load of peanuts. (Figure 5).

Boron deficiency is most common on the light textured soils, especially during a dry season. Field evidence indicates "hollow heart" may be more likely to occur at high yield levels, irrespective of soil type and prevailing moisture conditions. Therefore, boron should be applied prior to the bloom stage to soils testing less than 1.12 kg/ha (1.0 lb/acre) (Henning et al., 1979). Application rate recommendations range from 0.56 to 0.84 kg/ha (0.5 to 0.75 lb/acre). Excess boron may be harmful to peanut yield and quality. Therefore, care should be exercised to apply recommended rates uniformly and rate should not exceed 1.12 kg/ha (1.0 lb/acre).

VARIETY SELECTION

The peanut variety selected for planting will vary depending upon yield performance, cultural requirements of the variety and market availability. The following is a brief description of the most popular varieties which are cur-

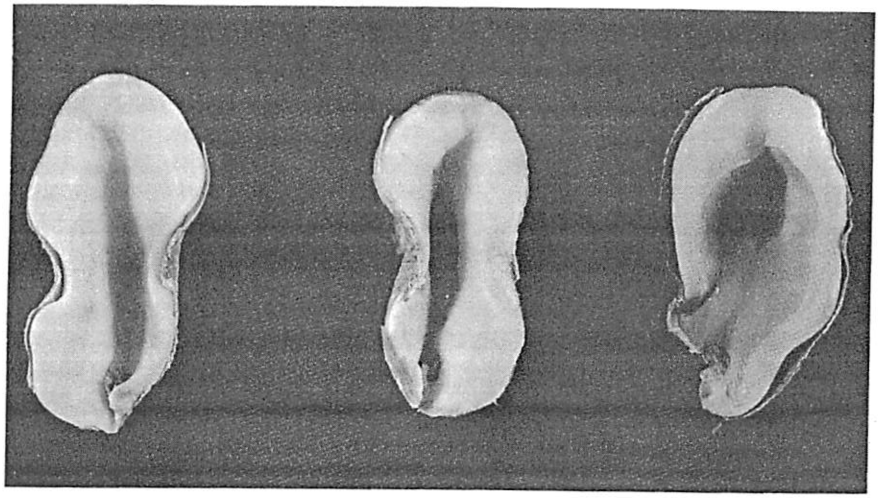

Fig. 5. Boron deficiency as indicated by the irregular shaped sunken cavity. "Hollow heart".

rently planted across the USA peanut belt. For simplicity of discussion, they are divided into 4 market types: virginia, runner, spanish and valencia.

Virginia Market Type

Florigiant, the predominate variety in the VC area, is a virginia type peanut with an ancestry that includes spanish, runner and virginia commercial types. It is closely related to the Early Runner cultivar, as both parents of Florigiant were derived from crosses involving sister lines of Early Runner. Florigiant was released in 1961 by the Florida Agricultural Experiment Station (McGill, 1974).

Plants of Florigiant are spreading in growth habit, small and without the bushy top of the Early Runner cultivar; so ground cover is not as rapid nor complete. Because of its small plant size, a uniform closely-spaced stand of plants is necessary for maximum yields with Florigiant. The taproot and stems are small. The leaf color is somewhat lighter green than that of runner type peanuts.

Florigiant has a prolific fruiting habit, producing up to 4 pegs per node, usually on the first few nodes nearest the main stem. Pods are generally large, uniform, straight and cylindrical, with a few short, thick and crooked pods. Pods may appear slightly dirty because of pubescence on the surface. Pods are set deeper in the soil than those of Early Runner. Seed of Florigiant are typical of virginia type peanuts, being generally elongated and round in cross section. Seedcoats of Florigiant have less red pigment and are slightly lighter in color than other virginia type varieties. The seed of Florigiant are 64% larger than Early Runner.

Early Bunch. A joint Florida-Georgia variety, was developed through hybridization from a 1961 cross and was released in 1977 (Norden et al., 1977). Early Bunch is a high yielding, bunch growing, large-seeded virginia market

type. It matures 5 to 10 days earlier than Florigiant or Florunner, and its foliage is noticeably lighter green in color. It has cleaner pods, and the seeds are darker pink in color and more uniform in shape than those of Florigiant.

Market grade determination shows that the percentage of sound mature kernels of Early Bunch average 1-3% higher than Florigiant. In 5 test locations in Georgia and Florida, the pod yield of Early Bunch was 10% greater than Florigiant and 3% more than Florunner. Early Bunch is best suited to sandy loams under irrigation where adequate amounts of soil calcium are available in the pegging zone.

NC6 is a large-seeded virginia type peanut released in 1976 by the North Carolina Agricultural Experiment Station. It was selected for resistance to the southern corn rootworm (*Diabrotical undecimpunctata howardi* Barber). NC6 has a runner growth habit similar to that of Florigiant, although it tends to be intermediate in growth habit on sandy soils. It is comparable in maturity to Florigiant in North Carolina and Virginia requiring approximately 150 days to mature.

NC6 yielded 15 - 20% more than Florigiant in soils with a high infestation of southern corn rootworm that were not chemically treated for insect control (Campbell et al., 1976). It averaged 85% less rootworm damaged pegs and pods than Florigiant. NC6 has shown moderate resistance to the potato leafhopper (*Empoasca facae* Harris) and is less susceptible to tobacco thrips (*Frankliniella fusca* Hinds) than any other commercial cultivar tested in the Virginia-Carolina peanut belt.

Virginia 81 Bunch (VA 81B), tested as experimental number VA 71-347, is a pure line selection of the cross F 392-8 and GA 119-20. It is a joint release by the Virginia Agricultural Experiment Station and the United States Department of Agriculture.

VA 81B is a high yielding large-seeded virginia type peanut variety adapted to production in Virginia and North Carolina. It is resistant to Sclerotinia blight which is a major disease in Virginia. Yields are significantly higher than Florigiant when grown in fields having Sclerotinia blight. It yields more than Florigiant if grown in twin rows with high plant populations. This is due to its small bunch growth habit with few secondary branches. Fruit are set mostly around the taproot. Maturity is about 10-14 days earlier than Florigiant.

Pod size of VA 81B is about 5% less fancy size than Florigiant with 2-seeded pods the most common. Some single-seeded pods and very few 3-seeded pods also occur. Pods are moderately constricted with moderately pronounced veination and little pod pubescence. Seed are light pink in color and slightly larger than Florigiant with about 10% more extra large kernels. Total meat content is 1-2% higher than Florigiant.

NC7 is a large-seeded virginia type peanut variety released in 1978 by the North Carolina Research Service. This cultivar was selected from a cross of Florida 393 and NC5.

Plants of NC7 have a decumbent or intermediate growth habit similar to NC5 (Wynne and Mozingo, 1979). The cotyledonary lateral branches are approximately 30% shorter than the laterals of Florigiant. The leaves are smaller than Florigiant, being somewhat similar to NC5. The major advantages of this cultivar are its early maturity (10 days earlier than Florigiant), high yields, high percentage of extra large kernels, fancy pods and high total meat. It is also reported to have excellent milling quality and a long shelf life as well as resistance to the southern corn rootworm (Wynne and Mozingo, 1979).

Runner Market Type

Florunner was derived from a cross made in 1960 between Early Runner and Florispan. It was released in 1969 by the Florida Agricultural Experiment Station as a commercial runner type superior to Early Runner in percentage of sound mature seed, flavor, quality and yield. The yield of Florunner averaged 18% greater than Early Runner in Alabama, Florida and Georgia tests from 1965 through 1968 (Norden et al., 1969).

The plant growth habit of Florunner is prostrate with the typical branching pattern of virginia botanical-type cultivars (alternate pairs of reproductive and vegetative nodes on the side branches and no fruiting nodes on the terminal branch). Florunner has the prolific fruiting habit of Early Runner, but the pods are concentrated nearer the central branch or taproot and the foliage is slightly less dense. The seeds mature in approximately 140 days after planting.

The pods of Florunner are more uniform than those of Florispan, but are somewhat larger and thicker than pods of Early Runner. Pods of Florunner are free of the pubescence which often causes soil to cling to pods of certain other varieties during harvest.

Tifrun, a Georgia developed variety, was obtained from a 1967 cross between a farmer variety and Florida breeding line 416. It was released by the University of Georgia and USDA in 1977. Pod yields of Tifrun have been equal to or slightly greater than Florunner; however, its lower SMK grade has made the dollar value per hectare about the same (Hammons and Branch, 1981). This variety has a strong shell that minimizes soil insect damage, mechanical injury, and loose-shelled kernels in harvesting. However, research at the National Peanut Research Laboratory at Dawson, Georgia, indicates the shelling efficiency of Tifrun is less than that of Florunner. Quality evaluations by commercial food scientists indicate little difference between Tifrun and Florunner for dry roasted, cooked, salted or peanut butter products.

Spanish Market Type

Starr, developed by the Texas Agricultural Experiment Station, was the first spanish peanut variety developed from a controlled crossing program (McGill, 1974). It was selected from a cross between Spantex and PI 161317. Foundation seed of Starr was released in 1961, and its popularity grew rapidly in the spanish peanut production areas. By 1970 it was grown on an estimated 77% of the area devoted to spanish peanuts and 35% of the total USA peanut acreage. Starr has medium-size pods with moderate constriction. At maturity the 2 medium-size seed within each pod touch, but generally are not flattened.

Tamnut 74 is a high-yielding, spanish peanut cultivar released cooperatively in 1974 by Agricultural Experiment Stations of Georgia, Oklahoma and Texas (Simpson and Smith, 1974). It has Starr, Spantex and a wild selection parentage. Tamnut 74 has a maturity range of 120 to 130 days. The yield of Tamnut 74 has compared favorably with other commercial spanish cultivars in tests throughout Georgia, Oklahoma and Texas (Hammons and Branch, 1981).

Pronto is a large-seeded spanish type peanut developed by the Oklahoma Agricultural Experiment Station and released in 1980. Pronto is the result of a cross between Chico, an extremely early maturing variety and Comet, a variety with a more determinant growth habit. Pronto carries no known genetic resistance to the normal pathogens and insect pests that attack peanuts. Pronto's greatest advantage over presently grown spanish varieties lies in its ability to yield relatively well and to grade high under short seasons and limited soil moisture.

Valencia Market Type

Valencia A is the primary valencia variety produced in the USA. This variety is produced mainly in New Mexico. It is a descendant of the old Tennessee Red variety and was released in 1971 by the New Mexico Agricultural Experiment Station (Hsi and Finkner, 1972). This variety has averaged 19% higher pod yields and has a greater proportion of 3 and 4 seed pods than the valencia varieties previously produced in eastern New Mexico.

PLANTING

Peanut agronomists across the peanut belt generally recommend peanuts be planted on a flat to slightly raised bed (Harrison et al., 1975; Henning et al., 1979; Allison, 1981). The utilization of properly adjusted disc or sword openers without an opener foot will allow the most precise placement of seed in undisturbed soil. The soil behind the opener should be firmed in place by press wheel action to achieve a level table top finish over the row. If a flat finish is desired over the entire bed, a gentle action pressboard may also be utilized behind the planter. If the peanuts are left in a furrow at planting, soil may be moved onto the lower portion of the peanut plant after emergence. This will increase the chances for damage by soil pathogens and will interfere with normal flowering and fruiting especially for runner and virginia market types which bear their fruit mainly on the cotyledonary lateral branches.

Planting Dates

Research and field experience have shown that earlier plantings generally result in highest yields. The period of April 10 to May 10 is considered optimum for most of the peanut belt (Sturkie and Buchanan, 1973). In the SE, where irrigation is possible, yields of late plantings may be virtually equal to earlier plantings. Unpublished research in Georgia indicates that non-irrigated peanuts planted June 1 or later have fewer blooms per plant, cease blooming earlier and yield 15-20% less than earlier plantings (William and Drexler, 1981, personal communications). If normal yields are to be realized from June plantings, moisture either from rainfall or irrigation during pod fill is critical. In all areas planting should be delayed until the soils at the seed depth have warmed sufficiently for rapid germination and seedling emergence.

Row and Drill Spacing

Peanut spacing studies have been published by researchers across the peanut belt beginning as early as 1931 (McClelland, 1931). Results of these early studies are summarized in detail by Sturkie and Buchanan (1973). These studies conducted prior to the use of herbicides under the mule system of farming showed that highest yields of spanish varieties were realized from plantings 45-60 cm (18-24 in) between rows with plants 15-20 cm (6-8 in) within the row. Cultivars of the runner and virginia types yielded highest when planted with row spacings of 75-90 cm (30-36 in) and with plant spacings of 15-20 cm (6-8 in) in the row (Beattie et al., 1927).

More recent studies have often shown a favorable yield response from peanuts which have a bunch growth characteristic when planted in closer row spacings, but not from the runner and virginia types (Duke and Alexander, 1964; Cox and Reid, 1965; Harrison, 1970). Close row spacings may give the peanut a competitive edge over weeds and offer better opportunities for weed control (Mixon, 1969). Data reported by Buchanan and Hauser (1980) illustrate the benefits of close row spacing on decreased weed competition and increased peanut yields. Yield increases of Florunner peanuts at Headland, Alabama, ranged from 10-30% as row spacings were reduced from 80 cm (32 in) to 40 cm (16 in) and from 20-40% as row spacing was reduced to 20 cm (8 in). Their data indicate that much of the yield increase realized was due to the decreased competition from weeds. Therefore, if weeds were adequately controlled by chemicals, the yield increase due to reduced row width may not be as dramatic nor as consistent.

Recommended within row spacing depends on seed quality, seed size, row spacing and variety. Spacing is expressed as the average number of seed per 30 cm (12 in) of row. In the SE, runner and spanish types are seeded at 4-6 seeds per 30 cm (Henning et al., 1979); whereas VC peanut agronomists recommend that virginia types should average 3-4 seed per 30 cm in each of 2 rows spaced 75-90 cm (30-36 in) apart on a 180 cm (72 in) bed (Allison, 1981). When peanuts are planted in a 4 close row per bed pattern, the number of seed per 30 cm of row should be reduced so that overall seeding rate is not increased by more than 15-20% above that of the 2-row pattern. The SW agronomists recommend a slightly lower seeding rate for runner and spanish, especially for the dryland areas of Texas (Harrison et al., 1975). Four seed per 30 cm of row are recommended for runners and 5-6 for spanish. It is recommended that in the dryland areas these rates be reduced by approximately 30%.

When germination and emergence are insured by irrigation, seeds should be placed 3.75-5.0 cm (1.5-2.0 in) deep. Otherwise, plant 6.25-8.75 cm (2.5-3.5 in) deep in coarse-textured soils and approximately 5.0 cm (2.0 in) deep in medium to fine-textured soils (Henning et al., 1979).

PRINCIPLES OF WEED CONTROL

Weed competition is a major factor that reduces profits in peanut production. Weeds compete with peanuts for moisture, nutrients and sunlight (Swann, 1980). Weeds can also prevent adequate fungicide coverage resulting in inadequate leafspot disease control. Weeds can also cause losses during harvest due to inefficient combine operation. The presence of weed seed and plant parts in harvested peanuts result in higher foreign material and lowered quality, thereby reducing economic return.

Each peanut producer should be familiar with the kinds of weeds present on a field by field basis and plan the control program to fit specific weed problems. Several herbicides are available and may be used as a single treatment or in combination as preplant soil incorporated, at ground cracking or postemergence treatments depending on the diversity and severity of the weed problem. A complete discussion on weed control may be found in chapter 8.

Cultivation continues to be an important weed control tool in fields where inadequate control is achieved from chemicals (Merkle, 1975; Henning et al., 1979). Precision cultivation requires the use of flat sweeps set to skim just beneath the soil surface or the use of carefully adjusted rotary gangs. Positive depth and lateral control of the cultivator is essential to prevent injury to the peanut plant and to avoid shifting soil onto the lower branches. Covering lower leaves and limbs creates conditions favorable for southern blight. Also, normal flower, peg and pod development is seriously inhibited. Peanuts can compete effectively with most broadleaf weeds if the crop is maintained weed free for 4-6 weeks after planting or until a complete canopy of peanuts is formed (Swann, 1980). Cracking stage mixtures and early season postemergence herbicide applications are the most effective means of controlling broadleaf weeds. Applications containing a contact herbicide should be made before the weeds grow beyond the 2-leaf stage. After true leaves emerge the weeds are much more difficult to control.

GROWTH REGULATORS

The use of chemical growth regulators on peanuts to suppress vegetative growth, achieve higher yield and improve fruit quality has met with varying degrees of success. Growth regulators have been used most successfully on fruits, ornamentals and vegetables (Whittner, 1971). Leguminous crops such as peanuts and soybeans have not shown the economic response to growth regulators as have non-legumes.

Most peanut varieties grown in the United States produce more vegetative growth than is needed for maximum fruit yield. Excessive vine growth of peanuts under optimum growing conditions has been related to disease and harvesting problems. Also, a probable potential exists for increasing yields by retarding vegetative growth resulting in better utilization of the photosynthate during the fruiting stage (Bauman and Norden, 1971).

Kylar, a water soluble powder, is the only plant growth regulator currently labeled by the Environmental Protection Agency (EPA) for use on peanuts. Although peanut yield may be increased by the use of Kylar 85, the most consistent response has been in reducing vine growth. Kylar does not reduce leaf area or leaf number, but instead it reduces the length of the internodes thus producing a more compact plant with 15-20% less vegetative growth (Brown and Ethredge, 1974; Daughtry et al., 1975).

Kylar continues to be recommended mainly where excessive vine growth is expected to be a problem. This will be most likely when peanuts are grown under irrigation on soils of high residual fertility. In such cases the timely use of Kylar 85 to reduce vine growth will result in more efficient application of leafspot fungicide, improved digger-shaker and combine efficiency.

According to EPA approved label, Kylar 85 may be applied from the time the peanuts are 30 cm (12 in) across until within 30 days of harvest. One application of 1.20 kg/ha (1 lb/acre) of formulation (85% ai) in a minimum of 37.84 l (10 gal) of water by ground sprayer or 18.92 l (5 gal) by aerial sprayer is suggested when plants are 30-60 cm (12-24 in) across. If regrowth occurs, an additional 0.56 kg/ha (0.5 lb/acre) should be applied. Kylar 85 may also be applied in split application. Three applications at 28-day intervals of 0.56 kg/ha (0.5 lb/acre) or 6 applications at 14-day intervals of 0.28 kg/ha (0.25 lb/acre) are the suggested combination. Reasoning behind the split applications is that a continuous retardation of vegetative growth during the fruiting period may result in more pods being set as a result of more efficient distribution of the photosynthate (Bauman and Norden, 1971).

Kylar 85 should not be applied to peanuts under drought stress. Under such conditions treatment should be delayed until 48 hours following stress relieving rainfall. Since Kylar 85 is very soluble in water, it should not be applied within 6 hours of expected rainfall.

IRRIGATION

Irrigation has become an important cultural practice for many USA peanut producers. Research has shown that timely irrigation can substantially increase yield and quality of peanuts (Sneed and Martin, 1969; Sturkie and Buchanan, 1973; Stansell et al., 1976). The best response to irrigation is obtained by a carefully programmed watering schedule used in combination with all other recommended production and harvesting practices (Samples, 1981). Irrigation does not assure record yields, but is protection against crop losses when water is the limiting factor. Improper scheduling or application rates can result in little or no yield response and in some cases a yield reduction may occur.

Total seasonal water requirements for maximum yield response ranges from 50-70 cm (20-28 in) in the SW and from 45-60 cm (18-24 in) in the SE (Keese et al., 1975; Samples, 1981). The total amount will vary depending upon prevailing climatic conditions.

Daily water requirement varies with variety and stage of plant development. Generally, water requirement increases with plant age, reaching a peak at about 70 days after planting for spanish and 85 and 100 days for runner and virginia types, respectively (Stansell et al., 1976). There is a general decline in daily water requirement after the peak is reached continuing until harvest.

Optimum moisture may be beneficial during the entire growing season if it occurs naturally. However, full season irrigation has often resulted in reduced yields compared to fewer, more timely applications. In the SE, research indicates that the most critical period in terms of pod yield and grade response occurs during the 60-70 day period following the onset of flowering and fruiting (Stansell, 1981, personal correspondence). For most peanut varieties this period extends from approximately 35 to 105 days after planting. Extended drought during this period can reduce peanut yield by as much as 20-30% (Stansell et al., 1976). North Carolina research indicates that the major response of peanuts to irrigation is during the nut enlargement stage of growth,

which is generally during the months of August and September (Sneed and Martin, 1969). They report that June drought has little effect on final yield if soil moisture is adequate during August and September.

Adequate available water in the surface 60 cm (24 in) of soil is required for maximum yields of high quality peanuts (Samples, 1981). Most peanut soils at field capacity will hold about 3.1 cm (1.25 in) of water per 30 cm of depth or 6.2 cm (2.5 in) in 60 cm (24 in). Highest peanut yields occur when available soil moisture is not allowed to deplete below 50% of field capacity (Keese et al., 1975; Samples, 1981). Therefore a single irrigation of at least 3.1 cm (1.25 in) will be required to bring a 60 cm root zone back to field capacity after it has been depleted to 50%. During peak water use periods of 0.6-0.7 cm (0.24-0.28 in) per day, peanuts should receive approximately 3.0-3.5 cm (1.2-1.4 in) of water from rainfall or as supplemental irrigation every 5 days. Irrigation intervals may be lengthened to 7-10 days during periods of lower daily water requirements.

Moisture content of the soil may be monitored through the use of instruments such as tensiometers or resistance meters (Samples, 1981). These instruments have sensors which when placed at varying depths in the soil profile will reflect the average moisture content of that zone. Irrigation should begin before the soil moisture is depleted below 50% of field capacity. If temperature is excessive, normal flowering and pegging may be inhibited (Gregory et al., 1973; Dryer et al., 1981) and therefore irrigation interval may need to be altered until such conditions are changed to favor fruiting. Field observations in Georgia during 1977 and 1981 indicate that excessive vine growth may result when irrigation is continued during periods when other environmental conditions such as temperature may not be favorable for fruit set. The reader should refer to chapter 7 on irrigation and water use for more in-depth information.

Cultural practices outlined in this chapter represent in a general way the cultural requirements of peanuts. Methods of meeting these requirements differ slightly in the different producing areas. Peanut agronomists within each area should be consulted for more in-depth and concise recommendations.

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Chapter 6

LIMING, FERTILIZATION, AND MINERAL NUTRITION

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The nutritional needs of the peanut must be satisfied to attain maximum yields. These needs require that an adequate supply of every essential element is available throughout the growing season and that toxic conditions are eliminated. Assuming sufficient air and water are present, the management of proper mineral nutrition is achieved primarily by liming and fertilization. Prediction of the requirement of these practices and the quantities of materials needed may be by soil testing and plant analysis procedures and with knowledge of prior management. Recent research, especially that within the last decade, on liming and fertilization is reviewed in the following sections.

LIME

Walker (1975) cited an 1895 USDA bulletin as evidence of the early recognition of the need for liming peanuts. Duggar and Funchess (1911), working between 1906 and 1910 in central and southern Alabama, found an average yield increase of 24% from liming 11 field experiments. In spite of these positive responses, Rogers (1948) noted inconsistent yield responses to liming and stated that none of the southeastern states stressed the need for liming peanuts as late as 1940.

It was not until the comprehensive studies at the North Carolina Agricultural Experiment Station during the 1940's that the stage was set for rationalizing the yield responses to lime (Burkhart and Collins, 1942; Brady and Colwell, 1945; Colwell and Brady, 1945; Middleton et al., 1945; Reed and Brady, 1948). It soon became clear that the primary response to lime is the effect it has on available soil Ca in the pegging zone (Rogers, 1948; Reed and Brady, 1948). Adding lime in the row at planting (Colwell and Brady, 1945) or adding it in the fall and turning before planting (Sullivan et al., 1974) results in ineffective lime use; it fails to concentrate the lime in the top 7 to 9 cm of soils where Ca is needed for fruit development. However, if lime is added in a manner to ensure that fine lime is in the pegging zone during fruit development, yield responses have been shown to be consistent with available Ca levels (Rogers, 1948; Reed and Brady, 1948; Hartzog and Adams, 1973; Adams and Hartzog, 1980). Rogers (1948) concluded that the yield response to lime was because a Ca deficiency was corrected (Figure 1). Reed and Brady (1948) reached the same conclusion because topdressed gypsum at bloom and preplant broadcast lime produced the same yield response on 3 very acid soils (Figure 1). Adams and Hartzog (1980) in Alabama directly compared lime and gypsum in 16 experiments on farmers' fields and validated the earlier results (see Figure