Texas Agricultural Extension Service
THE TEXAS A&M UNIVERSITY SYSTEM

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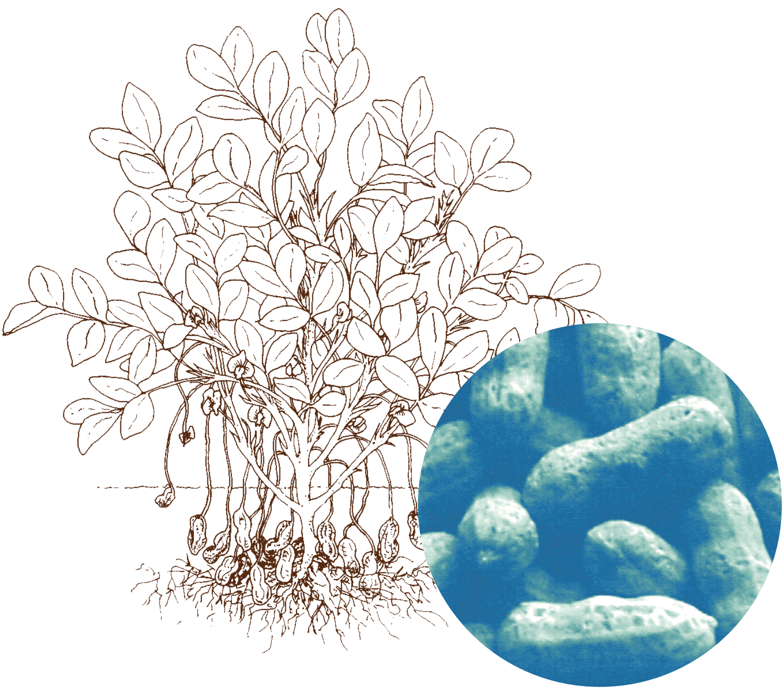
Texas Peanut Production Guide



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The Texas A&M University System

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Introduction

Texas ranks second in U.S. peanut production with an annual planted acreage of 320,000 to 370,000 acres. Texas possesses the soils, irrigation, climate and producer interest needed for the production of all four peanut market types runner, Virginia, Spanish and Valencia. Each market type has different end-use qualities and manufacturer applications.

Production has been similar over the past few years (Table 1). Texas produces considerable acreage of additional (contract) peanuts, primarily in the western region of the state. Additional peanuts generally account for about 50 percent of total statewide production.

Table 1. Peanut Production in Texas, 1999

Market Type	Harvested Acres	Production (tons)	% of Total Production	% of Total Harvested Acres
Runner	271,140	363,233	79	79
Virginia	37,147	68,324	15	11
Spanish	31,704	21,859	5	9
Valencia	2,802	3,991	1	1
Total	342,793	457,407		

Agronomic Practices

Crop Rotation

Crop rotation is the key to profitable peanut production. Peanuts should be planted in the same field only 1 year out of 3 or, in the best case, 1 year out of 4. There are numerous advantages to crop rotation, including improved soil fertility, reduced disease and nematode problems and more manageable weed control systems. Recommended rotational crops include, but are not limited to corn, grain and forage sorghums, grass sod, small grains, sesame and cotton. Longer rotations result in greater benefits, especially when dealing with disease and nematode problems. More efficient weed control occurs because many weeds difficult to control in the peanut crop are easily controlled in the rotation crop. Better weed control leads to reduced foreign material problems at market.

With proper rotation and in-season management, excellent yields can be attained. However, without crop rotation, peanuts will not be a profitable commodity.

Table 2. Effect of Rotation Length on Peanut Yields

	Crop (yield in lbs./acre)		
Rotation Length	**Corn**	**Soybean**	**Cotton**
1 Year	3,457	3,360	3,150
2 Years	3,753	3,553	3,373
3 Years	4,268	3,684	4,229

Nonrotated peanuts had 3-year average of 2,840 lbs./acre.
R.A. Flowers, University of Georgia, Unpublished.

Inoculation with *Rhizobia*

Peanuts grow in a symbiotic relationship with *rhizobium* bacteria—the *rhizobia* obtain nutrition from the plant and the plant gains usable nitrogen from the bacteria. This is the nitrogen fixation process. With proper seed inoculation using a peanut-specific inoculant, a peanut crop requires little supplemental nitrogen fertilizer. Some reports suggests that native *rhizobium* strains are adequate to nodulate peanuts. However, in western Texas, soil observations suggest that effective *rhizobium* inoculation and nodulation are essential to reach yield potential. For example, in 1999 in one West Texas field, plants averaged 12 nodules in one row of peanuts where inoculant mistakenly was not applied. In adjacent inoculated rows, there were 40 to 170 nodules per plant. Typically, 25 to 100 nodules per plant are observed. Also, in West Texas, volunteer peanuts the following year exhibited little if any nodulation, which suggests that sandy, dry soils low in organic matter do not support *rhizobium* carryover to subsequent peanut crops.

Choosing an Inoculant

Several types of peanut-specific inoculants are available. Moving across the spectrum of inoculants from seedbox powders to granular to liquid to the new "frozen" concentrate (a liquid delivered in frozen form to preserve integrity), the number of *rhizobium* bacteria delivered to the seed increases. Farmers should factor in costs of inoculant, particularly the cost per numbers of *rhizobia*. Liquid inoculants are currently the most popular and usually promote good nodulation. Seedbox treatments are most prone to failure as many do not have a sticker to adhere the inoculum to the seed, and should be used only if other options are not available. Hot soil temperature and low soil moisture can kill *rhizobia* and deplete the population available for developing peanut seedlings. For these conditions (including delayed irrigation for several days) or where adverse conditions are anticipated such as acidity or very high pH, inoculant companies suggest granular inoculant. Granules help buffer *rhizobia* from adverse conditions and help ensure survival.

Also, with increased use of liquid inoculants, the issue of compatibility of inoculum with seed, fertilizer, and other chemical treatments exists. In general, insecticides are more toxic than fungicides, which are more toxic than herbicides. Tank mixes of some chemicals (e.g., Ridomil 2E) are toxic to *rhizobia*. If tank mixes are used, consult the inoculant's company representative or literature to ensure compatibility. Granular inoculants generally do not have a compatability problem.

Common Inoculation Mistakes

Rhizobium inoculant is a live bacteria! It must be cared for to preserve integrity. Avoid the following common mistakes. Do not expose to temperature above 90 degrees F. Do not store inoculant in a building where it can get hot in the afternoon. Do not keep inoculant in the pickup cab once in the field. This reduces *rhizobium* numbers. If using a liquid inoculant, avoid chlorinated water. Make sure that the granular or liquid inoculant is placed in the seed furrow and check hoses for obstructions such as dirt, spider webs, etc. Always calibrate the granular boxes or liquid delivery system to ensure proper rates. Consult pesticide labels for any incompatibility with pesticide treatments. Do not place large amounts of nitrogen fertilizer near the seed because it will greatly curtail nodulation. Do not use old, expired inoculum.

Crop Scouting: Examine Roots for Nodulation

Four to 6 weeks after planting use a shovel to dig (don't pull) plants to evaluate nodulation. Nodule mass is more important than number of nodules. Slice open several nodules. Active nodules are pink to dark red inside. If nodules are white inside they are not yet active so check again in another week for reddish color. Older, inactive nodules are gray or greenish inside. If nodulation is judged poor, little can be done to increase nodulation. Determine why nodulation may be poor (see the above mistakes). Minimal or nonexistant *rhizobium* nodulation indicates supplemental nitrogen is needed to achieve desired yields, thus nitrogen fertilizer should be considered. Poor nodulation appears to be somewhat correlated with caliche soils, where pH greater than 8.0 may curtail *rhizobium* effectiveness.

Soil Fertility and Plant Nutrition

A major benefit of an effective crop rotation program is that peanuts respond better to residual soil fertility than to direct fertilizer applications. For this reason, the fertilization practices for the crop immediately preceding peanuts are extremely important. A uniform, high fertility level must be developed throughout the root zone. This is best achieved by fertilizing the previous crop. If a soil test indicates the need for fertilizer, apply it before preparing the land. The primary tillage operations will distribute the fertilizer throughout the root zone.

The following practices will ensure a strong fertility program:

A. Where soils are low in pH, soil test in the fall and apply sufficient lime to raise soil pH to 6.0 to 6.5. Do not over-lime a pH higher than 7.5 because this reduces the plant's ability to absorb other nutrients, especially micronutrients. In addition, this pH range is optimum for effective *rhizobium* nodulation and nitrogen fixation.

B. Use a balanced fertility program based on soil testing that maintains adequate levels of phosphorus, potassium, calcium, magnesium and micronutrients.

C. Avoid high levels of potassium fertilizer in the upper 4 inches of soil. This can lead to increased incidence of unfilled pods (pops) and pod rot that will affect peanut quality and yield. This may be of particular concern in West Texas cotton/peanut rotations where soil potassium is already high.

D. Monitor the pegging and fruiting zone for calcium. A lack of calcium can lead to empty pods and darkened plumules in seed (concealed damage), poor germination and potentially increased risk of aflatoxin when soil conditions are favorable for *Aspergillus flavus* mold development. Adequate calcium must be available in the pegging zone during seed and pod development (see Table 3).

E. Peanuts are efficient legumes that synthesize their own nitrogen requirements through association with specific *rhizobium* soil bacteria that are already present in many peanut soils. However, if peanuts have not been grown in a specific soil during the past 4 or 5 years, the crop should be inoculated at planting with a peanut-specific commercial inoculant. In West Texas, *rhizobium* inoculation is strongly recommended for every peanut crop.

F. Soil test and accumulate a history of soil nutrient levels in your cropping systems. Tracking your field's fertility history can help avoid overlooking potential soil fertility problems that can lead to reduced yields and inferior quality peanuts.

Table 3. Suggested Rates of Limestone[1] (tons/acre)

Soil pH range	Soil Texture	
	Sand and loamy sands	Sandy loams and loams
6.0 to 6.4[2]	1[3]	1
5.6 to 5.9	1	1 1/2
Below 5.6	2	3

[1]Use dolomitic limestone if low magnesium levels are indicated by soil test.

[2]For soils with a pH greater than 6.4 and high calcium levels but low-to-medium magnesium levels, consider applying 150 lbs. per acre of potassium magnesium sulfate broadcast.

[3]For very sandy soils with a pH of 6.0 or more, gypsum is suggested if the soil calcium level is low.

Nitrogen, Phosphorus and Potassium

One of the major benefits of producing peanuts, or any legume, is that the crop requires little nitrogen fertilizer. Texas research on response of peanuts to nitrogen fertilizer reveals that, in general, no response is observed in South and Central Texas provided the crop is properly nodulated. In West Texas several experiments have looked at starter nitrogen, preplant nitrogen, and midseason nitrogen applications. Although in some tests small yield increases may have been observed for large nitrogen applications, there has been no consistent trend toward higher yields with nitrogen additions. Soil nitrate levels (including subsoil nitrate) and degree of *rhizobium* nodulation may affect nitrogen results, but these two factors have not been evaluated in experiments. Starter nitrogen rates up to 30 pounds nitrogen per acre should not negatively influence nodule formation. The practice of putting out nitrogen in small increments through the center pivot is now being evaluated. Late-season nitrogen applications should be avoided to discourage soil-borne diseases and delayed maturity, particularly in West Texas.

For the most efficient use of phosphorus and potassium fertilizers, apply them to the previous crop or before land preparation, and thoroughly incorporate them into the root zone. Always follow soil test recommendations to avoid over- or underfertilizing the crop. This is especially important for potassium, because high levels in the pegging zone have been found to interfere with calcium uptake and to increase the incidence of pod rotting organisms such as *Pythium* and *Rhizoctonia*.

Calcium

In runner and Virginia type peanuts calcium is by far the most critical nutrient for achieving high yields and grades. Low levels of calcium cause several serious production problems, including unfilled pods (pops), darkened plumules in the seed and poor germination. In fields low in calcium and high in sodium, a condition called pod rot is common. Supplying gypsum or a liquid form of calcium can help alleviate these problems.

Calcium must be available for both vegetative and pod development. Calcium moves upward in the plant in the xylem tissues. It does not move downward in the phloem. Therefore, calcium is not transported from leaves to pegs and to the developing pods. Pegs and pods absorb calcium directly from the soil solution, therefore calcium must be readily available in the pegging zone. Foliar applied calcium treatments do not correct calcium deficiencies.

On soils with pH 6.0 or greater, calcium fertilization is accomplished with agricultural gypsum ($CaSO_4$) or calcium in liquid form. Calcium contained in gypsum and certain liquid calcium products is relatively water soluble and enters into soil solution. Experience in Texas indicates that a soil test level of 600 ppm calcium is adequate for peanut production. If soil calcium levels are less than 600 ppm, or if irrigation water is saline, gypsum applications may be needed. In West Texas, gypsum is prohibitively expensive due to transportation costs, but all West Texas soils test high in calcium. The effect on peanut yield and quality of liquid calcium products applied midseason through the pivot is unknown.

Gypsum should not be applied during land preparation or before planting because it can be leached below the pegging zone. Best results have been obtained when gypsum is applied at initial flowering. Banded applications over the row (12- to 16-inch band) of 600 pounds gypsum per acre and broadcast applications of 1,500 pounds per acre have proven to be adequate. Rainfall or irrigation after application is needed to move the gypsum into the pod development zone.

Micronutrients

Micronutrients include zinc, iron, manganese, copper, boron and molybdenum. As soil pH increases, micronutrient availability decreases. Therefore, high pH soils are more prone to micronutrient problems. Late-season foliar applications of micronutrient fertilizers seldom result in economic returns.

Zinc—Do not band zinc near seed since stand losses can occur. If soils are acid, a zinc application may not be necessary since zinc response on acid soils is seldom observed. Alkaline soils with a high soil phosphorus-to-zinc ratio may require zinc even though the zinc tests are high. Deficiency symptoms include interveinal chlorosis of the youngest leaflets and, in severe situations, stunted plants and slow development of new leaves. If soil-applied zinc fertilizer products are used, consider highly soluble zinc sulfate monohydrate. Chelated zinc forms are also available, but compare their costs to traditional zinc sulfate at 2 to 4 pounds zinc per acre.

Iron—A deficiency of available iron in soils above pH 7.0 can cause severe chlorosis or yellowing of leaves and reduction in yield. Generally, soil applications of iron materials are ineffective or uneconomical and foliar spray applications are suggested. Applications may need to be repeated at 10-day intervals if problems are severe. Symptoms will be observed in the youngest leaflets, which are chlorotic to pale green and develop interveinal chlorosis. Foliar iron chelates can be quite expensive. For foliar iron applications adequate results may be achieved by using 1 pound of iron sulfate per 5 gallons of water per acre. Use a surfactant or sticker in the spray, and ensure that nozzles produce a fine spray. For young peanuts apply 5 to 10 gallons per acre and increase to 10 to 15 gallons per acre with subsequent applications. Ground spray rigs achieve better placement of iron on the plants than aerial spray, but consider costs and timeliness of application.

Manganese—Deficiencies have been documented in South Texas. Manganese deficiency symptomology is similar to iron and zinc. Problem fields can be treated with foliar sprays of manganese products.

Copper—Deficiencies are often mistaken for other problems. Initial symptoms include wilting of upper leaves, followed by chlorosis and leaf scorching. Dead, brown tissue develops from the leaf margins and progresses inward until the petiole drops. Flower production can be reduced, resulting in significant yield reductions. Soil applications of copper are the preferred method for managing deficient fields. However, foliar spray treatments of copper sulfate or similar copper-containing materials applied at early bloom correct problem fields. Foliar fungicides containing copper also may correct the problem. Excessive amounts of copper can cause loss of root growth.

Boron—Fortunately boron deficiency problems are rare in Texas. The most significant symptom is deterioration of the central portion of the kernel producing a dark brown colored cavity known as "hollow heart." This causes the kernel to be graded as "internal damage" and drastically lowers the selling price. If the problem is identified as a boron deficiency, apply 1/2 to 3/4 pound of elemental boron per acre in the fertilizer. Do not make further applications without a soil test. Boron often creates problems because the range from boron deficiency to boron toxicity is narrow compared to other nutrients. In small amounts boron can be very toxic and injurious to plants and indiscriminate use reduces yields drastically. Check boron levels in the irrigation water before applying. Amounts greater than 0.75 ppm are cause for concern as boron could accumulate, leading to boron toxicity in peanuts. Many soil tests in West Texas recommend boron for peanuts, but unless boron levels in irrigation water are known, use caution in applying boron fertilizer apart from visible plant deficiency.

Molybdenum—Deficiencies usually do not occur unless soils are highly acid. Adding limestone to raise soil pH usually corrects the problem.

Variety Selection

Use high quality seed of a recommended variety. Plant at the recommended plant population based on a given row spacing and seed count. Consult with shellers on market acceptance of peanut varieties.

Plant peanuts as soon as soil conditions are favorable for rapid germination and development. Late planting dates generally reduce yield and quality and increase the risk of freeze damage and late season drought to peanuts. In West Texas, runner and Virginia varieties should be planted by May 15, while Spanish should be sewn by June 1.

Prepare seed beds carefully to assure seed germination and emergence. Adjust planting depths to soil type, temperature, moisture conditions and planting date. If soils are extremely dry, pre-irrigate fields to obtain favorable soil moisture, rather than dry-planting and then irrigating. This will ensure optimum stand establishment and reduce the potential for herbicide damage.

Variety selection is one of the most important decisions a grower will make during the season. There have been numerous varietal releases during the past 5 years and growers have more runner market types available than ever before. Commercial varieties have been released that possess various degrees of tolerance or resistance to numerous diseases. Also older peanut varieties that were once tolerant to specific diseases may now be susceptible. With increased emphasis on host plant resistance, the number and specificity of varieties will continue to increase. The Texas A&M breeding program is addressing several production issues such as tomato spotted wilt virus (TSWV), root knot nematode, sclerotinia blight and improved oil quality (high oleic acid/linoleic acid ratio).

Texas is much different than other peanut producing states because the state can be divided into three primary production regions—south, central and west regions. The key factors (soils, climate, disease, irrigation, etc.) impacting production in these areas vary considerably and as a consequence the best varietal choices for one area may not be well suited for another.

About 10 commercial runner varieties are grown in Texas. In 1999, the runner market types comprising the largest percentage of acreage were Florunner, Flavor Runner 458, Tamrun 96, Georgia Green and Tamrun 88. The west Texas region was planted heavily to high oleic varieties in 2000, and this trend is expected to continue.

Most Virginias in Texas are contract additionals, and NC-7 has been the preference of shellers for several years because of its high percentage of extra large kernels. However, several other Virginia varieties possessing greater yield potential are being evaluated to determine adaptability to the west region.

Spanish varieties currently produced are Tamspan 90 and Spanco. A high oleic Spanish variety developed by the Texas A&M University peanut breeding program should be available in 2002.

Several factors must be considered when deciding on variety. First, it is extremely important to evaluate varieties based on regional performance. Certainly, yield and grade attributes must be given top priority, but disease tolerance, growth habit, maturity, and seed quality and availability should also be considered. The “perfect variety” possessing all the necessary traits for Texas’ diverse environments does not exist, so it makes good sense to plant a couple of different varieties to reduce the production risk.

West Texas

The west Texas region can be characterized as a high-yielding environment that uses center pivot irrigation and has low disease pressure. The semiarid climate does not favor foliar disease development in most years; however, the soil-borne, pod rot complex (*Rhizoctonia* and *Pythium*) is present and can be moderate to severe in some fields. Traditional runner types such as Florunner and Tamrun 88 have performed very well in the region. However, in 2000, much of the acreage was planted to Flavor Runner 458 and other high oleic varieties such as AT 1-1, AT 201 and Sunoleic 97R. In fields that have not been properly rotated and have a history of moderate to severe pod rot problems, Tamrun 96 may be a good choice. This variety, released primarily because of its tolerance to TSWV, also tends to suffer less loss from pod rot problems.

Central Texas

The central Texas area is a traditional production region and experiences most problems associated with peanut production (southern blight, pod rot complex, limb rot, leaf spot, root knot nematode, sclerotinia blight). Also, TSWV became a problem in some portions of the region in 1996. Tamrun 96 and Georgia Green have become very popular over the past 2 years. Tamrun 96 has performed very well under disease and nondisease conditions. Tamrun 96 has a robust growth habit, producing very large vines, especially in comparison to Georgia Green, which develops a smaller canopy than other runner types.

South Texas

The south Texas region is a traditional area that has experienced various levels of TSWV over the past 15 years. The past few seasons have been characterized by reduced incidence of the virus and yields across the region have been very good. GK7 was a popular choice in the past, but Tamrun 96, Georgia Green, and AT 108 have gained rapid favor with producers. These varieties have produced high yields and grades and possess appreciable tolerance or resistance to TSWV. Tamrun 96 will show visible symptoms of TSWV, but the variety remains sturdy. To prevent loss during the harvest season to the influences of hurricanes or other inclement weather, it is a good policy to select varieties that are sturdy and that have a secure peg attachment. Caution should be taken with AT 108. The variety does not possess strong tolerance to TSWV.

Characteristics of Runner Varieties

Florunner—University of Florida release, 1969. Has had insurmountable influence on the peanut industry. Continues to be the standard of performance in west Texas. Produces high yields and excellent grades. Is being replaced by newer, more disease resistant varieties in most other peanut growing regions. Most varieties will be compared in growth habit and maturity to Florunner.

Georgia Green—University of Georgia release, 1995. Has resistance to TSWV and southern blight (*Sclerotium rolfsii*). Maturity similar to Florunner. Vine growth is less than other runner market types and does not show prominent main stem as do typical runner types. Small seeded runner variety, about 825 seed per pound. Web blotch (*Didymella arachidicola*) was found on this variety in 1998 in south Texas and the Rolling Plains production regions. Good variety for central and south Texas. Shows excellent response when planted in twin rows.

Tamrun 96—Texas A&M University release, 1996. Good tolerance to TSWV. Maturity similar to Florunner. Tamrun 96 has performed better than most varieties in fields having sclerotinia blight (*Sclerotinia minor*) problems and has some tolerance to southern blight (*Sclerotium rolfsii*). Very robust vine growth, especially on more fertile peanut soils. Tamrun 96 has performed very well across all Texas production regions, but especially in central and southern areas. Tamrun 96 also is a good choice for fields with pod rot problems in West Texas. Very sturdy vine and peg attachment.

Virugard—AgraTech Seeds release, 1997. Possesses tolerance to TSWV. Runner x Virginia cross. Appears to be 7 to 10 days earlier than Florunner. Has a Virginia growth habit, does not show prominent main stem, very large kernel size. Late-season micronutrient deficiencies observed similar to AT 120. Growers should be aware of the earliness in this variety to prevent losses from over-mature pods. Pepper spot (L*eptosphaerulina crassiasca*) was found on this variety in 1998 in Texas. Late-season foliar fungicide applications may be warranted to maintain healthy vines.

Florida MDR 98—Most recent release from University of Florida."MDR" stands for multiple disease resistance. MDR 98 has tolerance to late leafspot (*Cercosporidium personatum*), southern blight (*Sclerotium rolfsii*), TSWV and rust (*Puccinia arachidis*). Most of the disease resistance derived from Southern Runner, one of the parents. Like Southern Runner, matures later than all other commercial runner varieties (2 to 3 weeks). Classified as a midoleic variety with about 65 percent oleic acid. The late maturity of this variety makes it questionable for Texas.

Georgia Bold—University of Georgia release, 1997. Larger kernel size than Florunner and has performed very well in Texas variety trials. Possesses moderate tolerance to TSWV. Similar maturity and growth habit to Florunner. Does not resemble Georgia Green in canopy development or kernel size.

GK 7—AgraTech Seeds release, 1984. Agronomic characteristics similar to Florunner. Develops prominent main stem. Some tolerance to TSWV.

AT 108—AgraTech Seeds release, 1994. Similar to GK 7 in growth characteristics. Main stem is not as prominent as GK 7. Seed size similar to GK 7, but has higher percentage of jumbo runner grade. Matures earlier than GK 7.

AT 120—AgraTech Seeds release, 1994. Early maturing runner, depending on conditions may be 7 to 10 days earlier than Florunner. Growth habit is runner plant type, with Spanish flowering habit—it flowers on the main stem. Generally produces high yields and earliness in west Texas. Develops excellent "root crop." Initiates cutout at about 120 days after planting and shows more micronutrient deficiency in new growth than other varieties. Growers should be aware of the early maturity and dig accordingly to avoid losses from over-mature pods. Pepper spot (*Leptosphaerulina crassiasca*) was found on this variety in 1998. Late-season foliar fungicide applications may help maintain healthy vines. Black hull (*Thielaviopsis basicola*) has been found on this variety in west Texas. Potential problems could occur if this variety is planted in cotton fields with a history of black root rot.

Tamrun 88—Texas A&M University release, 1988. Very similar to Florunner in most agronomic characteristics. Emergence is more uniform and stand establishment more rapid than any other runner type grown in Texas—good characteristic for west Texas. Extremely susceptible to TSWV. Produces excellent yields and grades in west Texas.

Okrun—Oklahoma State University and USDA-ARS release, 1986. Agronomic characteristics similar to Florunner. Slightly more resistant to leaf spot and pod rot.

High Oleic Varieties

Flavor Runner 458—Mycogen release. High oleic variety. Similar to Florunner in agronomic characteristics. Performance in west Texas has been very good with high yields and grades. Slow emergence has been observed with this variety.

GK 7 High Oleic—AgraTech Seeds release in 1997. High oleic variety with agronomic characteristics similar to GK 7. GK 7 has very prominent main stem, which aids in row identification.

Sunoleic 97R—University of Florida release to replace Sunoleic 95R. High oleic variety has about 80 percent oleic and 2 to 3 percent linoleic fatty acids, based on total fat/oil content. Yields higher than Sunoleic 95R. Does not have as much pod splitting as Sunoleic 95R. Yielded very well in central and west Texas in 1997. Susceptible to TSWV.

AT 1-1—AgraTech Seeds release, 1999. Has growth habit similar to AT-120 and also flowers on the main stem. Some tolerance to TSWV. Appears to be about 5 to 7 days earlier than other runner varieties. Poor yield and grades in 2000 variety trails.

AT 201—AgraTech Seeds release, 1999. Similar to GK 7 in maturity. Showed good early-season vigor in variety tests conducted in 2000. Tolerant to TSWV.

Characteristics of Virginia Varieties

NC7—Largest seeded variety released in 1978 by North Carolina State University. NC7 has a growth habit intermediate between runner and bunch. NC7 generally grades higher and has a larger percentage of extra large kernels than other varieties. Possesses moderate resistance to early leafspot, but very susceptible to sclerotinia blight. Current seed stocks contain several off-types.

NC 12C—Large seeded variety similar in maturity and plant type to NC7. Possesses moderate level of resistance to early leafspot, but very susceptible to sclerotinia blight. NC 12C has a thin hull so it should be harvested carefully to avoid excessive loose shelled kernels. In Texas variety trials, has outyielded NC7.

Gregory—Large seeded variety similar in maturity to NC7. Has growth habit intermediate between runner and bunch types. This variety produces a very high percentage of extra large kernels, and has a higher calcium requirement than NC7.

VA-98R—Has a runner growth habit and is 3 to 5 days earlier than NC7. Extra large kernels are lower than NC7. Has very good yield potential

VC-2—AgraTech Seeds release, 2000. High oleic variety. Similar to NC7 in maturity. Has shown tolerance to TSWV.

Characteristics of Spanish Varieties

Tamspan 90—Texas A&M University release, 1990. Typical Spanish growth habit. Resistant to *pythium* pod rot and sclerotinia blight. Excellent yield potential. Responds well to irrigation and twin row planting patterns.

Spanco—Oklahoma State University and USDA-ARS release, 1981. Good yield potential, but does not possess the pythium pod rot or sclerotinia resistance found in Tamspan 90. Responds to irrigation and twin row planting patterns.

Plant Growth and Development

Germination and Seedling Development

The peanut seed consists of two cotyledons (also called seed leaves) and an embryo. The embryo comprises the plumule, hypocotyl and primary root. The plumule eventually becomes the stems and leaves of the plant, and the hypocotyl is the white, fleshy stem located between the cotyledons and the primary root. As the seed imbibes water, there is a resumption in metabolic activity, the seed begins to swell, and cell division and elongation occur. As the embryo grows, the testa (seed coat) ruptures and the seedling emerges.

The minimum and maximum temperature requirements for peanut seed germination are not well defined. Research has shown that seed will germinate under a wide range of circumstances (consider volunteer peanuts); however, under field conditions the minimum average soil temperature should be 65 degrees F at the 4-inch depth, with a favorable weather forecast. This ensures rapid, uniform emergence and reduces the risk associated with stand loss from the seedling disease complex.

The seedling uses food reserves from the cotyledons during the initial stages of growth. Under most situations, peanuts should reach the ground cracking stage 7 to 14 days after planting, depending upon soil temperature. The growth rate of the hypocotyl determines how quickly the shoot will emerge from the soil. Most current commercial varieties show little difference in emergence rates and/or seedling vigor. A final plant density of three to four plants per row foot is adequate.

Plant Development

As the plant grows, the root develops very rapidly in comparison to the shoot. By 10 days after planting, root growth can reach 12 inches. By 60 days, roots can extend 35 to 40 inches deep. Late season measurements have found peanut roots down to 6 to 7 feet. Roots grow at a rate of about 1 inch per day as long as soil moisture is adequate.

The hypocotyl pushes the plumule upward causing “ground cracking.” After emergence, the plumule is called a shoot and consists of a main stem and two cotyledonary lateral branches. At emergence the main stem has at least four immature leaves and the cotyledonary lateral branches have one or two leaves also. The seedling develops slowly showing as few as eight to 10 fully expanded leaves 3 to 4 weeks after planting.

Leaves are attached to the main stem at nodes. There is a distinct pattern by which these leaves are attached. There are five leaves for every two rotations around the main stem, with the first and fifth leaves located one above the other. Leaves attached to the cotyledonary laterals and other lateral branches are two-ranked, so there is one leaf at each node, alternately occurring on opposite sides of the stem. Peanut leaves have four leaflets per leaf, making them a tetrafoliate. The leaflets are elliptical in shape and have a prominent midvein.

The main stem and cotyledonary laterals determine the basic branching pattern of the shoot. The main stem develops first and in runner type plants the cotyledonary laterals eventually become longer than the main stem. Additional branches arise from nodes on the main and lateral stems.

The growth habit of peanut is described as bunch, decumbent or runner. Spanish and Valencia market types are classified as “bunch,” with their upright growth habit and flowering on the main stem and lateral branches. Most Virginia and runner market types are considered to have a prostrate (flat) growth habit and do not flower on the main stem. Decumbent varieties have an intermediate growth habit between a runner and bunch. Several Virginia varieties are classified as decumbent.

Peanuts are indeterminate in both vegetative and reproductive development (similar to cotton). This means that the plant is producing new leaves and stems at the same time that it is flowering, pegging and developing pods.

Consequently, developing pods compete with vegetative components for carbohydrates and nutrients. Once a heavy pod-set has been established, the appearance of flowers is greatly reduced.

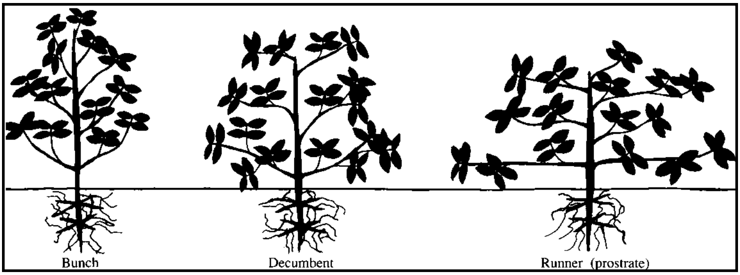

Figure 1. Peanut growth habit is bunch (left), decumbent (center) or runner (right).

Bloom

About 30 days after emergence, peanut plants begin to produce flowers. Flower numbers will continue to increase until the plant reaches peak bloom at about 60 to 70 days after emergence, and then flower development will begin to decline. High temperature, moisture stress and low humidity can have a severe impact on the flowering response, limiting the number of flowers produced and reducing flower pollination. Ultimately, this can result in reduced yield and delayed pod set. However, the peanut plant can compensate to some extent by initiating a large flush of flowers when favorable environmental conditions return.

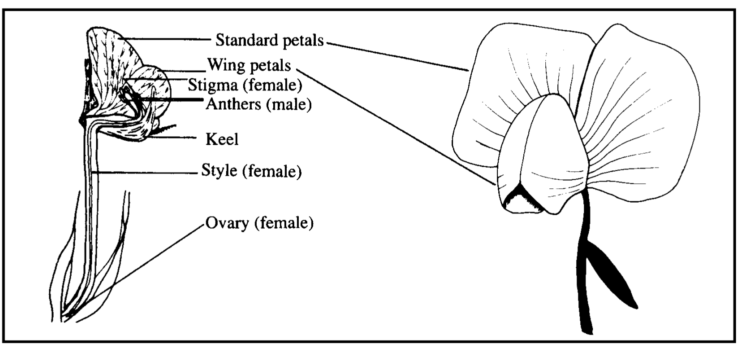

Figure 2. The peanut flower.

Peanut flowers are borne in leaf axils on primary and secondary branches. Several flowers can originate from each node, however, only about 15 to 20 percent will produce a harvestable pod. The peanut flower is a perfect flower (male and female structures present in the same flower) and is self-pollinated. It has a showy yellow bloom and when it first emerges, the petals are folded together. The early morning of the following day the petals unfold and pollen is shed. Fertilization takes place in 3 to 6 hours. The fertilized ovary begins to elongate and grows downward from the node to the soil. This specialized structure, called a peg, becomes visible about 7 days after fertilization. The sharp-pointed peg enters the soil about 10 to 14 days after pollination. The developing pod is located in the tip of the peg. Once in the soil, it begins to enlarge and forms the pod and kernels. It is interesting to note that the pod will not begin growth until the peg is in the presence of darkness. Because several flowers can develop from each node, several pegs and pods can be found originating from a single node. The indeterminate fruiting habit of the peanut means the plant will have pods of varying maturity. Consequently, peanut harvest determinations are based on the presence of 70 to 80 percent mature pods.

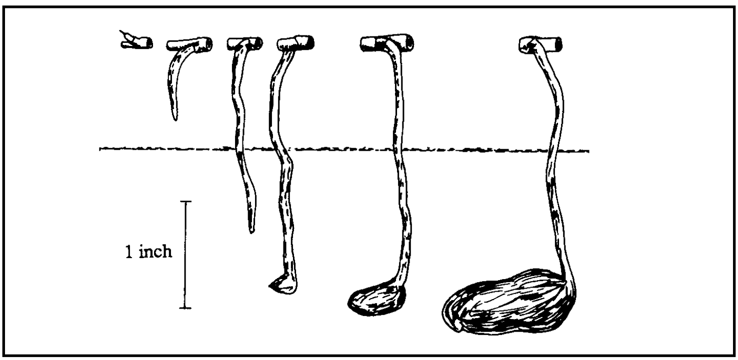

Figure 3. Peg growth and development.

Pod and Kernel Development

During the early stages of pod development, the tissue is soft and watery. As the pod develops, the hull and kernels begin to differentiate. The cell layer just below the outer cell layer of the pod changes from white to yellow to orange to brown to black as it matures, providing a color indication of optimum harvest date. The inner pod tissue separates from the seed and darkens as the seed grows and presses against the hard layer of the hull. This is indicated by the dark brown to black veination on the inside of the hull.

Pods attain full size about 3 to 4 weeks after the peg enters the soil. Although the pod has reached full size, kernel development has barely begun. Mature, harvestable pods require 60 to 80 days of development. In Texas, a mature crop can be produced in 130 to 140 days in south Texas, 140 to 150 days in central Texas, and 150 to 170 days in west Texas. Temperature (both day and nighttime) interacts with variety, planting date, seasonal moisture, etc., in controlling development of the crop. However, the controlling factor in all plant development is temperature.

Maturity and Harvest Determination

As pods mature, the inside portions become brown to black, while immature pods retain a fresh, white appearance. The cellular layer just below the outer layer of the pod undergoes several color changes during the maturation phase. This cellular layer is called the mesocarp. It changes in color from white to yellow to orange to brown and finally black as the pod matures. This color distinction can be used to estimate crop maturity with the “hull scrape” method. Hold the pod with the beak pointing down and away from you, and with a pocket knife scrape away the outer hull in the area from the middle of the pod to the peg attachment point. This region of the pod is known as the saddle. Pods should be moist when the color determinations are made. To get an accurate representation of the field, collect three adjacent plants (about 1 foot of row) from three to five locations in the field. As with all field assessments (soil and plant tissue testing, insect and disease scouting, etc.), the results are only as good as the collection procedure, so collect an adequate sample.

Determining the optimum digging time is a crucial decision for a grower! Using the calendar to predict digging dates is a good way to lose yield, grade and money. There is no substitute for scouting fields and observing pod development, especially late in the season. The optimum time to dig a peanut crop is when it has reached its peak yield and grade. If dug too early or late, yield and crop quality will be sacrificed. Because of the indeterminate fruiting habit of the peanut, each plant will have pods of varying maturity. Consequently, the risk of losing early-set mature pods versus later-set immature pods must be considered, and a compromise must be achieved. Runner types should be dug at 70 to 80 percent maturity, Virginia types at 60 to 70 percent and Spanish and Valencia at 75 to 80 percent maturity.

Peanuts may gain from 300 to 500 pounds per acre in yield and one to two grade points during the 10- to 14-day period preceding optimum digging time. Conversely, similar yield and grade losses can occur if digging time is delayed 1 to 2 weeks. Overmature and diseased plants (pod rot complex, leaf spot, southern blight, sclerotinia blight, rust, etc.) have weakened peg attachments, resulting in significant pod loss during digging and combining.

Table 4. Relationship Between Harvest, Yield and Grade

Digging time	Yield loss (lbs./A)	Grade (Total Sound Mature Kernels)%
14 days early	740	73.9
7 days early	250	74.2
optimum	——	75.0
7 days late	500	75.6
14 days late	540	——

Irrigation Management

Irrigation is the key to current and future peanut production in Texas. Since 1996, Texas irrigated acreage has steadily increased. Irrigation ensures a stable supply of high yielding, good quality, aflatoxin-free peanuts. The total seasonal water requirement for maximum peanut yields is approximately 24 to 28 inches. Water can be a scarce commodity; consequently, producers must consider system capacity as a guide in determining suitable acreage for planting. It is best to plant less acreage and irrigate adequately, than to plant larger acreages that are subject to water shortfalls. In addition, peanuts do not tolerate water quality problems as well as cotton, and this becomes evident in low rainfall seasons.

Irrigation Water Quality

Salinity has become a problem throughout many areas of Texas. As water quality becomes marginal and cropping patterns change, some areas may experience injury and reduced yields. Each crop has its own susceptibility range to marginal quality water. Peanuts are not very tolerant, so it is imperative that water quality be assessed before determining where to plant peanuts.

Water quality is determined by the total amounts of salts and types of salts present in the water. A salt is a combination of two elements or ions, one has a positive charge (sodium) and the other has a negative charge (chloride). Water may contain a variety of salts including sodium chloride, sodium sulfate, calcium chloride, calcium sulfate, magnesium chloride, etc.

Salty irrigation water can cause two major problems in crop production: salinity hazard and sodium hazard. Salts compete with plants for water. Even if a saline soil is water saturated, the roots are unable to absorb the water and plants will show signs of stress. Foliar applications of salty water commonly cause marginal leaf burn and in severe cases can lead to premature defoliation and yield and quality loss.

Sodium hazard is caused by high levels of sodium that can be toxic to plants and can damage medium and fine-textured soils. When the sodium level in a soil becomes high, the soil will lose its structure, become dense and form hard crusts on the surface. To evaluate water quality, a water sample should be analyzed for total soluble salts, sodium hazard and toxic ions.

Total soluble salts analysis measures salinity hazard by estimating the combined effects of all the different salts in the water. It is measured as the electrical conductivity (EC) of the water. Salty water carries an electrical current better than pure water, and EC increases as the amount of salt increases.

Sodium hazard is based on a calculation of the sodium adsorption ratio (SAR). This measurement is important to determine if sodium levels are high enough to damage the soil or if the concentration is great enough to reduce plant growth. Sometimes a factor called the exchangeable sodium percentage may be listed or discussed on a water test; however, this is actually a measurement of soil salinity, not water quality.

Toxic ions include elements like chloride, sulfate, sodium and boron. Sometimes, even though the salt level is not excessive, one or more of these elements may become toxic to plants. Many plants are particularly sensitive to boron. In general, it is best to request a water analysis that lists the concentrations of all major cations (calcium, magnesium, sodium, potassium) and anions (chloride, sulfate, nitrate, boron) so that the levels of all elements can be thoroughly evaluated.

Water Quality, Yield Relationships

The critical level of boron in irrigation water for cotton and grain sorghum is 3 ppm. Preliminary survey studies conducted over the past 2 years indicate that peanuts are much more susceptible to high boron concentrations. Boron levels greater than 0.75 ppm in water can cause severe yield reductions. This concentration should be viewed as the critical threshold level for irrigation systems used for peanuts.

Also, the sodium adsorption ratio (SAR) has been found to correlate with reduced peanut yields. The critical SAR value for cotton, grain sorghum and corn is 10. However, peanuts are much more sensitive to SAR values in the range of 5 to 7. Yield reductions associated with this range indicate that the critical threshold level for peanuts is much lower.

Water Quality, Grade Relationships

Peanut grades can be reduced with increasing chlorides and total soluble salt (EC) concentrations in irrigation water. Study results point to a critical threshold for EC of 2,100 to 2,500 umhos/cm and 400 ppm chloride. Grade reductions associated with increasing salinity may be related to reduced calcium uptake by kernels caused by antagonistic interactions with sodium, chloride, magnesium and potassium.

Table 5. Critical Values for Salts in Irrigation Water for Peanuts

Measurement	Critical Value for Peanuts
Total Dissolved Salts (EC)	2100 umhos/cm = 2.1 mmhos/cm = 1344 ppm
Sodium Adsorption Ratio (SAR)	5-to-7
Boron	0.75 ppm
Chloride	400 ppm
Sodium	400 ppm

R.G. Lemon and M.L. McFarland, Texas Agricultural Extension Service, College Station, TX

Irrigation and Water Use

The growing season for peanuts can be divided into three distinct phases—prebloom/bloom, pegging/pod set and kernel fill/maturity. Water use will vary with these developmental stages. In general, water use is low in the early season, but during the reproductive period water consumption is at its peak. Consumption declines as pods begin to mature. Specifically, water use can be categorized as follows:

Table 6. Plant Development and Water Use	
Stage of Development	**Water Use**
Germination and seedling establishment	very high
Vegetative growth	low to moderate
Flowering and pegging	very high
Pod development	very high
Kernel development	high
Maturity	moderate

Research conducted in Georgia demonstrated how moisture stress at various periods during the season can affect production.

Table 7. Effect of Moisture Stress on Yield	
Stress Period (days after planting)	**Yield (lbs./A)**
30 to 65	3,960
65 to 100	2,900
100 to 135	4,120
Optimum moisture	4,540

C.K. Kvien, Coastal Plain Experiment Station, Tifton, Georgia, 1987-1988.

During the bloom period, water stress can delay formation of flowers, or under extreme conditions flowering can be completely inhibited. In Texas, it's not a matter of if there will be extreme heat and moisture stress, it's just a question of when and for how long a duration. Even with irrigation, these climatic factors can be very difficult to overcome.

Peanuts are of tropical ancestry and do well at moderately warm temperatures. Temperature has a direct influence on growth and development of the crop through its effects on photosynthesis and flower set. The optimum temperature for peanut growth and development is about 86 degrees F.

Very high temperatures slow down the crop growth rate. Even in conditions of adequate water, temperatures above 95 degrees F can impair development of the crop. Research has shown that photosynthetic activity can be reduced by as much as 25 percent at temperatures above 100 degrees F.

Peanuts have a higher rate of flower and fruit set and better pod development at temperatures less than 90 degrees F. High temperatures, occurring both day and night, can reduce flower set. Research has shown that the optimum temperature for flowering and peg set ranges between 68 degrees F to 80 degrees F. An exposed sandy soil can get very, very hot, thus affecting flower set. High temperatures reduce the number of flowers produced, and when coupled with low humidity, flowers may not pollinate well. Under hot and dry conditions, flower structures may not develop properly, resulting in poor fertilization. Fortunately, the peanut plant can compensate by developing a large flush of flowers when the environmental conditions become more favorable. Crop canopy closure reduces temperatures and increases humidity in the canopy, creating a more favorable environment for flowering, pegging and pod development. Also, as plants become older they become less sensitive to stress.

After bloom, peg penetration into the soil requires adequate moisture. Once active pegging and pod formation have begun, it is recommended that the pegging zone be kept moist, even if adequate moisture is present in the soil profile. A moist pegging zone aids the uptake of calcium by the pods. Failure of pegs to penetrate soil and develop pods can result from low relative humidity and high soil temperatures. Therefore, it is extremely important to supply additional moisture during pegging, even if soil moisture is adequate.

In-Season Irrigation Management

Every producer has his own ideas about and methods for watering a crop; often what works in one field may not work well in another, or what works for one producer may not work for another. Considerable research has been done, especially in the High Plains, evaluating different methods for conserving and delivering water to crops. Low Energy Precision Application (LEPA) systems have been developed and are widely used.

Many growers use different variations of this system. Some farmers drag socks or tubes in circular rows, others drag tubes on straight rows, still others use the bubble-mode for delivering irrigation water. Research has shown that optimum peanut yields can be attained with LEPA on circular rows using drag socks in alternate furrows, at a water application rate equal to 75 percent of the recorded cotton evapotranspiration rate.

Peanuts require about 1.5 to 2.0 inches of water per week, especially between early July and mid-August. This time period coincides with peak bloom, peg and pod set. Once full canopy development has been achieved, water use is similar to pan evaporation, indicating that water use ranges from 0.25 to 0.40 inch per day (depending upon weather conditions).

Water use by peanuts will peak in late July through August. If 0.75 inch of water is applied twice weekly, this will not supply as much water as the plants actually use. Consequently, stored water in the 2- to 3-foot depths will be used by the plants. During August, transpiration and evaporation will often range between 0.25 and 0.35 inch per day, depending on weather conditions. This amounts to 1.75 to 2.45 inches of water per week. As stated previously, two 0.75 inch applications each week total 1.5 inches, which emphasizes the need for entering the season with a full profile of water when possible.

Uniform moisture that can be maintained with two irrigation applications per week helps to ensure adequate soil moisture and high relative humidity in the canopy. The peanut plant flowers in response to elevated humidity and pod set is enhanced by elevated humidity and moist surface soils. Consequently, yield is positively affected by an extended period of high humidity during the critical 45 to 90 days after emergence. Holding humidity high during this 45-day period in the growth cycle not only increases yield, but promotes a uniform early pod set, resulting in early maturity and harvest. Also, it creates less exposure to pod-rotting diseases. The pegging zone should be kept moist even though adequate moisture may be available deeper in the profile.

After kernels begin to fill (late August to early September) the amount of irrigation water can be slightly reduced. However, any reductions in irrigation will be based on crop maturity and rainfall. Changing from a twice-a-week to a once-a-week irrigation schedule helps stop blooming. Lower relative humidity in the canopy moves the crop into a maturation phase and reduces susceptibility to pod rot organisms. A good rule of thumb to help gauge the last 30 to 40 days of the season is to not the let the crop show visible signs of stress in the morning hours. During the maturation period, the plants will be mobilizing nutrients and food reserves to the developing kernels. In addition, plant water use during maturation is moderate compared to the critical bloom, peg and pod development periods. Try to avoid large fluctuations in pod zone moisture to prevent hull splitting, which leads to increased loose shelled kernels. Loose shelled kernels correlate highly with aflatoxin problems.

Weed Management

Weeds in peanuts can be managed by using cultural, mechanical, physical and chemical means. A combination approach provides the most successful results. Considerations for cultural and mechanical weed control include:

- Remove spotty infestations by hand hoeing or spot spraying to prevent spreading weed seed, rhizomes, tubers or roots. This is particularly important for perennial weed species.
- Use high quality, weed-free seed. Bar-ready seed is available from shellers and has had nutsedge tubers removed.
- Clean all tillage and harvesting equipment before moving to the next field, or from weedy to clean areas within a field.

- Use cultivation or burn down herbicides to remove initial weed flushes prior to planting to ensure a weed-free seedbed.
- Keep turn rows, fence rows, bar ditches and other areas adjacent to fields clean.
- Practice crop rotation.

Weed management is critical to peanut production from both yield and quality perspectives. Weeds reduce grower profits in several ways. Weed/crop competition for sunlight, water and nutrients can significantly lower yields. Weeds also disrupt digging and harvesting operations and cause pods to be stripped from vines, making them unharvestable. In addition, weed problems can lower grades because plant fragments and fruits are classified as foreign material contamination.

Research indicates that if peanuts are kept weed-free for 4 to 6 weeks, then yield reductions from weeds will be minimized. Therefore, it is most important to use a preplant incorporated dinitroaniline herbicide (Treflan [Trifluralin], Prowl, Sonalan) for full-season weed management. Care should be taken to ensure proper application rate of the dinitroaniline herbicides. Excessive rates can lead to peanut injury and reduced yields. Do not use cotton rates.

Cultivation

Because of their growth habit, peanuts are not well-suited for conventional cultivation methods. Movement of soil onto peanuts can cause several problems. The lower nodes of the lowest lateral branches will be covered with soil, which inhibits normal flower, peg and pod set and reduces production. Soil thrown to the crown and lateral portions of the peanut plant creates favorable conditions for southern blight and other diseases. Plow sweeps should be operated flat and shallow to remove weeds without dirting the plants and pruning lateral roots.

Management of Selected Weed Species

Nutsedge Complex—Yellow and purple nutsedge can often be major problems in peanuts. Both nutsedge species will be similar in appearance, however, control measures may be quite different. Therefore, proper identification is critical to successful control. The easiest way to identify yellow and purple nutsedge is late in the season when the seed head has developed. The seed head of yellow nutsedge will have a yellow coloration, while those of purple nutsedge will have a purple color—hence the names. There are some characteristics that can be used to identify the two species earlier in the season, however, experience with both species is often needed to detect these subtle differences. First, the tubers of purple nutsedge will be connected in chains, while the tubers of yellow nutsedge are not connected. The leaf tips of yellow nutsedge will come to a sharp point and often start to die back. Leaf tips of purple nutsedge will be more rounded. Purple nutsedge will often have darker green appearance than yellow nutsedge. Finally, tubers of yellow nutsedge will have a sweet smell, while tubers of purple nutsedge will smell bitter.

Both species are perennial weeds that are mainly introduced into new fields through tubers. Plant peanut seed that is free of weed seed and tubers. Bar-ready seed contains few if any nutsedge tubers. Also, equipment should be thoroughly cleaned of any nutsedge plants when moving from field to field.

Fortunately, with the introduction of new herbicides, there are control options available for both yellow and purple nutsedge. Good control of yellow nutsedge can be obtained with preplant incorporated applications of Dual Magnum or Frontier. Preemergence applications of Dual Magnum or Frontier will provide some control of yellow nutsedge, but are not as effective as preplant incorporated treatments. Most growers in Texas prefer to make postemergence applications of these materials after the peanuts have emerged. This method reduces any potential injury from the herbicides; however, timely rainfall or irrigation shortly after application is needed to activate the herbicide. Postemergence applications of Basagran or Tough have provided good control of yellow nutsedge; however, repeat applications probably will be needed for adequate control. **Dual Magnum, Frontier, Basagran and Tough do not control purple nutsedge.**

Pursuit applied preplant incorporated, preemergence or postemergence (only postemergence applications are labeled for west Texas) and Strongarm applied preemergence will provide fair to good control of yellow nutsedge and excellent control of purple nutsedge. Cadre applied postemergence will provide excellent control of both yellow and purple nutsedge. Adequate and timely irrigation will improve control with these products.

Eclipta—Eclipta can be a problem in north, central and south Texas regions, especially in low lying and wet areas of fields. Also, fields irrigated from holding ponds and reservoirs generally have more eclipta problems. It is recognizable by its long, narrow leaves attached directly to the stem, and very small white flowers. Recognizing eclipta in the field early is key to its management. Unfortunately, once eclipta gets 4 to 6 inches tall it becomes very difficult to control. Eclipta often germinates late in the season, after residual herbicides have dissipated and after postemergence treatments have been made. Consequently, it can get established late in the season. Dual Magnum or Frontier applied preplant incorporated or preemergence can provide early season eclipta control. If these materials are applied postemergence, they will not control eclipta that has already emerged, but will provide residual control of eclipta that has not yet emerged. Strongarm applied preemergence provides excellent control of eclipta.

Postemergence options for eclipta include Basagran, Blazer, Storm and Tough. Best results are obtained when applied to eclipta that is less than 2 inches tall. Cadre provides some control, but the application must be made to very small eclipta.

Pigweed—The foundation for good pigweed control is using a dinitroaniline herbicide. When used at the appropriate rate and properly incorporated, Treflan, Prowl and Sonalan provide good to excellent pigweed control. Because incorporation methods vary across the state, use a method that provides a uniform distribution of the herbicide into the top 1 to 2 inches of the soil. If soil conditions are dry and large clods are present before and after application, herbicide performance will be reduced. Although the double-pass method is recommended (the second incorporation should be made at an angle to the first) a single-pass can be effective when the soil is of good tilth and moisture. Strongarm, Dual Magnum and Frontier have good activity on pigweed, but are usually not used as stand-alone treatments. Therefore, these materials are usually considered as improving the effectiveness of the dinitroaniline herbicide.

Pigweed escapes can be effectively controlled if the weeds are treated when small. Pursuit, Cadre, Blazer, Storm, and 2,4-DB have good activity on small pigweeds.

Morningglory—Dinitroaniline herbicides do not provide effective morningglory control, nor do preemergence materials such as Dual Magnum and Frontier. Strongarm applied preemergence provides good control of annual morningglory species.

Blazer, Pursuit and Storm provide fair to good control of morningglory, but weed size is very important—the smaller the better. Cadre applied early-postemergence to small morningglories (3 inches tall) provides good to excellent control, and 2,4-DB provides good to excellent control of morningglories of larger size.

Table 8. Preplant Soil Incorporated Products

Weeds Controlled	Product and Rate/Acre	Remarks
Annual grasses and small seeded broadleaf weeds such as pigweed, barnyardgrass, goose-grass, Texas panicum, seedling johnsongrass, fall panicum, broadleaf signalgrass	Prowl 3.3 EC 1.2 to 2.4 pts	Incorporate within 7 days after application.
	Sonalan HFP 1.5 to 2 pts. on coarse soils 2.0 to 2.5 pts. on medium soils	Incorporate within 48 hours after application.
	Treflan HFP (Trifluralin) 1.0 pt.	Incorporate immediately after application.
Yellow nutsedge, barn-yardgrass, crabgrass, fall panicum, broadleaf signalgrass, pigweed, carpetweed	Dual Magnum 0.8 to 1.33 pts.	Does not adequately con-trol Texas panicum. Injury may occur following use if it is incorporated too deeply, or very high rain-fall conditions move the herbicide into the germi-nation zone.
	Frontier 6.0 20 to 32 oz.	Does not adequately con-trol Texas panicum.
Yellow and purple nut-sedge, devil's-claw, pigweed, teaweed, spurge, sunflower, annual morningglory, seedling johnsongrass	Pursuit DG 1.44 oz.	Shallow incorporation (1 to 2 inches deep) preferable. May be tank-mixed with Prowl, Sonalan, Treflan and Dual Magnum. **Not labeled for preplant incorporated or pre-emergence applications in West Texas, wait until late-cracking when most of the peanuts have emerged.**

Table 8. Preplant Soil Incorporated Products (continued)		
Weeds Controlled	**Product and Rate/Acre**	**Remarks**
Yellow and purple nut-sedge, devils claw, pigweed, teaweed, spurge, sunflower, annual morningglory, seedling johnsongrass **(continued)**		Do not apply more than 1.44 oz. Pursuit 70 DG per acre, per season. 18-month rotation restriction for cotton and sorghum. .

Table 9. Preemergence Products

Weeds Controlled	Product and Rate/Acre	Remarks
Yellow and purple nutsedge, devils claw, pigweed, teaweed, spurge, sunflower, annual morningglory, seedling johnsongrass	Pursuit DG 1.44 oz.	Premergence applications depend on rainfall or irrigation for activation. Preemergence applications are less consistent than preplant incorporated treatments. Not labeled for preplant incorporated or preemergence applications in West Texas, wait until late-cracking when most of the peanuts have emerged. Do not apply more than 1.44 oz. Pursuit 70 DG per acre per season. 18-month rotation restriction for cotton and sorghum.
Yellow nutsedge, barnyardgrass, crabgrass, fall panicum, broadleaf signalgrass, pigweed, carpetweed	Dual Magnum 0.8 to 1.33 pts.	Either rainfall or irrigation is needed for effective results from preemergence applications. A preemergence application is less effective than a preplant incorporated treatment for yellow nutsedge control. Does not adequately control Texas panicum.

Table 9. Preemergence Products (continued)		
Weeds Controlled	**Product and Rate/Acre**	**Remarks**
Yellow nutsedge, barnyardgrass, crabgrass, fall panicum, broadleaf signalgrass, pigweed, carpetweed **(continued)**	Frontier 6.0 Outlook 20 to 32 oz.	Either rainfall or irrigation is needed for effective results from preemergence applications. A preemergence application is less effective than a preplant incorporated treatment for yellow nutsedge control. Does not adequately control Texas panicum.
Cocklebur, lambsquarter, common ragweed, devil's-claw, prairie sunflower, common sunflower, golden crownbeard, morningglory, pigweed, teaweed, spurred anoda, tropic croton, velvetleaf, eclipta, copperleaf, yellow and purple nutsedge, smartweed	Strongarm 84WG 0.45 oz.	Apply at rate of 0.45 oz. as a preemergence application from no less than 5 days after planting through at-cracking stage. Do not apply Strongarm to soils with pH of 7.2 or greater.

Table 10. Postemergence Products		
Weeds Controlled	**Product and Rate/Acre**	**Remarks**
Yellow and purple nutsedge, devils claw, pigweed, cocklebur, teaweed, spurge, annual morningglory, seedling johnsongrass	Pursuit DG 1.44 oz	Apply to actively growing weeds less than 3 inches tall to be most effective. Always use a nonionic surfactant (1 qt./100 gallons of spray solution) or crop oil concentrate (1 qt./acre). Addition of nitrogen fertilizer (28 % N, 32 % N, ammonium sulfate) may improve control. May be tankmixed with 2,4-DB for broader spectrum weed control. Will provide residual control when activated by rainfall, irrigation or shallow cultivation. 18-month rotation restriction for cotton and sorghum.
Yellow and purple nutsedge, devils claw, pigweed, cocklebur, teaweed, spurge, annual morningglory, seedling johnsongrass, prairie sunflower, golden crownbeard, yellow top, pie melon, shining tickseed, Russian thistle, sicklepod	Cadre DG 1.44 oz.	Apply to actively growing weeds less than 4 inches tall to be most effective. Always use a nonionic surfactant (1 qt./100 gallons of spray solution) or crop oil concentrate (1 qt./acre). Addition of nitrogen fertilizer (28 % N, 32 % N, ammonium sulfate) may improve control. Will provide residual control when activated by rainfall, irrigation or shallow cultivation. Peanuts should be emerged before making

Table 10. Postemergence Products (continued)		
Weeds Controlled	**Product and Rate/Acre**	**Remarks**
Yellow and purple nutsedge, devils claw, pigweed, cocklebur, teaweed, spurge, annual morningglory, seedling johnsongrass, prairie sunflower, golden crownbeard, yellow top, pie melon, shining tickseed, Russian thistle, sicklepod **(continued)**		application. Cadre may cause some peanut yellowing and/or reduced vine growth, but yields are unaffected. 18-month rotation restriction for cotton and sorghum.
Buffalobur, cocklebur, common ragweed, groundcherry, lambsquarter, purslane, morningglory, pigweed, tropic croton, prostrate spurge, carpetweed, black nightshade, spiny cucumber, smellmelon, Texas gourd, copperleaf, eclipta, golden crownbeard	Blazer Ultra Blazer 1.0 to 1.5 pts.	Treat when broadleaf weeds are small (2 to 6 leaves) and actively growing for best results. Consult label for specific weed problems. Copperleaf should be less than 4 inches tall and eclipta should be less than 2 inches tall. Blazer is a contact herbicide; therefore, good coverage is essential. Always use nonionic surfactant (1 qt./100 gallons spray solution) or crop oil concentrate (1 to 2 pts./acre). Do not apply within 75 days of harvest. Blazer will cause spotting and bronzing of contacted peanut leaves.

Table 10. Postemergence Products (continued)

Weeds Controlled	Product and Rate/Acre	Remarks
Balloonvine, coffee senna, common ragweed, dayflower, devil's-claw, Pennsylvania smartweed, teaweed, spurred anoda, tropic croton, velvetleaf, wild sunflower, cocklebur, yellow nutsedge, eclipta	Basagran 1.0 to 2.0 pts.	Treat when broadleaf weeds are small and actively growing. Consult label for specific weed problems. For yellow nutsedge, use 2.0 pts./acre and apply when nutsedge is 6 to 8 inches tall. Always use 1 to 2 pts./acre crop oil concentrate. Peanuts are tolerant at any growth stage.
See Blazer and Basagran weed lists.	Storm (premix of Blazer and Basagran) 1.5 pts.	Treat when broadleaf weeds are small and actively growing. Consult label for specific weed problems. Always use non-ionic surfactant (1 qt./100 gallons spray solution) or crop oil concentrate (1 to 2 pts./acre).
Cocklebur, eclipta, copperleaf, ragweed, velvetleaf	Tough 3.75 EC 2.0 to 3.0 pts.	Treat when broadleaf weeds are small and actively growing. Tough can be tankmixed with 2,4-DB for improved weed control. Tough does not provide adequate control of palmer pigweed. Eclipta should be less than 2 inches tall and copperleaf less than 4 inches tall.

Table 10. Postemergence Products (continued)

Weeds Controlled	Product and Rate/Acre	Remarks
Morningglory, cocklebur, pigweed, velvetleaf, pie melon, silverleaf night-shade	2,4-DB 1.75 0.9 to 1.8 pts. 2,4-DB 200 0.8 to 1.6 pts	Treat when broadleaf weeds are small and actively growing. Use the low rate on morningglory and cocklebur up to 12 inches in size. For silverleaf nightshade suppression use higher rate. Crop oil concentrate increases effectiveness, especially on hard-to-control weeds; however, this treatment causes the peanut canopy to lay down for a few days. Can be tank mixed with other compounds for enhanced weed control. Do not make more than two applications during the season. Do not allow herbicide to drift to susceptible crops such as cotton. Do not apply within 30 days before harvest.
Yellow nutsedge, goose-grass, barnyardgrass, crabgrass, fall panicum, broadleaf signalgrass, pigweed	Dual Magnum 0.8 to 1.33 pts.	Use as a supplement to preplant incorporated treatments. Must be activated by rainfall or irrigation. Dual Magnum will not control emerged grasses and broadleaf weeds; however, it will effectively control emerged yellow nutsedge.

Table 10. Postemergence Products (continued)		
Weeds Controlled	**Product and Rate/Acre**	**Remarks**
Yellow nutsedge, goose-grass, barnyardgrass, crabgrass, fall panicum, broadleaf signalgrass, pigweed **(continued)**	Frontier 6.0 Outlook 20 to 32 oz.	Use as a supplement to preplant incorporated treatments. Must be activated by rainfall or irrigation. Dual Magnum will not control emerged grasses and broadleaf weeds; however, will effectively control emerged yellow nutsedge.
Annual grasses including barnyardgrass, broadleaf signalgrass, fall panicum, goosegrass, seedling johnsongrass, Texas panicum	Select 2EC 8.0 to 16 oz. Poast Plus 1.5 to 2.25 pts.	Treat when grasses are actively growing. See label for height restrictions. Use crop oil concentrate at 1qt./acre rate. Do not apply to peanuts within 40 days of harvest. Avoid contact with corn, sorghum and small grains.
Bermudagrass	Select 2EC 8 to 16 oz.	Apply to actively growing bermudagrass before runners (stolons) exceed 6 inches. A second application of 12 oz. is usually necessary for good control. The second application should be made when regrowth is 4 inches in length. Use crop oil concentrate at 1qt./acre rate. Avoid contact with corn, sorghum and small grains.

Table 10. Postemergence Products (continued)

Weeds Controlled	Product and Rate/Acre	Remarks
Bermudagrass **(continued)**	Poast Plus 2.25 pts.	Apply to actively growing bermudagrass before runners (stolons) exceed 6 inches. A second application of 1.5 pts. is usually necessary for good control. The second application should be made when regrowth is 4 inches in length. Use crop oil concentrate at 1qt./acre rate. Avoid contact with corn, sorghum and small grains.
Rhizome johnsongrass	Select 2EC 8 to 16 oz.	Apply to actively growing johnsongrass that is 15 to 25 inches tall. A second application of 12 oz. may be needed when new plants or regrowth are 6 to 12 inches tall. Use crop oil concentrate at 1qt./acre rate. Avoid contact with corn, sorghum and small grains.
	Poast Plus 1.5 to 2.25 pts.	Apply to actively growing johnsongrass that is 15 to 25 inches tall. A second application of 1.5 pts. may be needed when regrowth or new plants are 6 to 12 inches tall. Use crop oil concentrate at 1qt./acre rate. Avoid contact with corn, sorghum and small grains.

Table 11. Products, Formulations and Common Names of Herbicides		
Product	**Formulation**	**Common name**
Basagran®	4 lbs./gallon	bentazon
Ultra Blazer®	2 lbs./gallon	acifluorfen
2,4-DB®	1.75 lbs./gallon 2.0 lbs./gallon	2,4-DB
Cadre DG®	one soluble packet contains 0.125 lbs. active ingredient	imazapic
Dual Magnum®	7.62 lbs./gallon	s-metolachlor
Frontier 6.0®	6 lbs./gallon	dimethenamid
Poast Plus®	1.0 lb./gallon	sethoxydim
Prowl 3.3EC®	3.3 lbs./gallon	pendimethalin
Pursuit DG®	one soluble packet contains 0.125 lb. active ingredient	imazethapyr
Select 2EC®	2 lbs./gallon	clethodim
Sonalan HFP®	3 lbs./gallon	ethalfluralin
Storm®	2.67 lbs./gallon - bentazon 1.33 lbs./gallon - acifluorfen	bentazon-acifluorfen
Strongarm®	84 % active ingredient	diclosulam
Tough 3.75 EC®	3.75 lbs./gallon	pyridate
Treflan HFP®	4 lbs./gallon	trifluralin

Weed/Herbicide Response Ratings

Weed control research involves searching for methods and products to eliminate competition to the crop. Weed species in fields are constantly changing because of control of competing weeds; the introduction of new weeds in an area; changing cropping patterns, and herbicide usage rotations and the introduction of new herbicides.

Weed control with herbicides can also be frustrating. Changes in soil texture, slope of fields, the time and amount of rainfall or irrigation, soil or air temperature, amount and type of surfactant, rate of herbicide, time of application, size of weeds and crop condition at time of herbicide application, are just a few of the variables that alter the results of a herbicide application. The following information is the result of years of intensive research in Texas.

The ratings of each of the herbicides are a summary of test plots across Texas. Excellent (E) control is classified as greater than 90 percent control, Good (G) is from 80 to 90 percent, Fair (F) is 70 to 80 percent and Poor (P) is less than 70 percent control; I is Inconsistent. Before applying any product read and follow the label directions.

Table 12. Weed/Herbicide Response Ratings

Preplant Incorporated	Texas panicum	Yellow Nutsedge	Purple Nutsedge	Barnyard-grass	Crabgrass	Signal-grass	Eclipta	Pigweed	Sunflower	Yellowtop	Copper-leaf	Morningglories
Prowl	E	P	P	E	E	E	P	G/E	F	G	F	P
Treflan	E	P	P	E	E	E	P	G/E	F	G	F	P
Sonalan	E	P	P	E	E	E	P	G/E	F	G	F	P
Pursuit	P	F/G	F/G	G/E	F	F	P	E	E	G	F/G	F
Dual	P	F/G	P	F/G	G	F	F/G	G	G	G	P/F	F
Frontier	P	G	P	F/G	G	F	F/G	G	G	G	P/F	F

Pre-emergence	Texas panicum	Yellow Nutsedge	Purple Nutsedge	Barnyard-grass	Crabgrass	Signal-grass	Eclipta	Pigweed	Sunflower	Yellowtop	Copper-leaf	Morningglories
Dual	P	F/G	P	F/G	F/G	P	F/G	G	F	F	F	P
Frontier	P	F	P	F/G	F/G	P	F/G	G	F	F	F	P
Pursuit	P	P/F	F/G	P	P	P	P	G/E	F	P	P	F
Strongarm	P	F/G	F/G	P	P	P	E	E	E	E	F/G	F/G

Table 12. Weed/Herbicide Response Ratings (continued)

Post emergence	Texas panicum	Yellow Nutsedge	Purple Nutsedge	Barnyard-grass	Crab-grass	Signal-grass	Eclipta	Pigweed	Sunflower	Yellowtop	Copper-leaf	Sickel-pod	Morning-glories	Bermuda-grass	Johnson-grass
Basagran	P	F/G	P	P	P	P	E	P	P	P	P	P	P	P	P
Blazer	P	P	P	P	P	P	E	E	G	G	G	P	F/G	P	P
2,4-DB	P	P	P	P	P	P	P	F	G	G	P	G	G	P	P
Cadre	G	G/E	G/E	E	E	E	F	G	E	E	F	E	G/E	P	F
Dual	P	F/G	P	P	P	P	P	P	P	P	P	P	P	P	
Frontier	P	F	P	P	P	P	P	P	P	P	P	P	P	P	P
Poast Plus	G/E	P	P	E	E	E	P	P	P	P	P	P	P	F	F
Select	E	P	P	E	E	E	P	P	P	P	P	P	P	F/G	G/E
Pursuit	P	G	E	P	P	P	P	E	G	G	P	P	G	P	P
Storm	P	F	P	P	P	P	G	F	F	F	F	P	G	P	P
Tough	P	G	P	P	P	P	E	P	P	P	G	F	P	P	P

Disease and Nematode Management

All peanut producers experience crop loss from one or more diseases annually. Refer to the Peanut Disease Atlas (B-1201), available from your county Extension agent for help with disease diagnosis. Diseases can be controlled by using appropriate preventative practices. Control suggestions made in this publication have been well documented in field tests over a period of years and have been shown to produce economic benefit when appropriately applied. Potential economic benefit depends on each grower's ability to adapt controls to his production system and prevailing environmental conditions.

Seed Rot and Seedling Disease Control

Plant high quality seed treated with a seed protectant fungicide (Table 13). Seedling disease is less severe when soil temperatures average 70 degrees F or more at a 2-inch depth at 7 a.m. for 3 consecutive days.

Foliar Disease Control

Early Leaf Spot and Late Leaf Spot

Combine chemical (Table 14) and cultural practices for more consistent control. Rotation with other crops reduces overwintering populations of leaf spot fungi in the soil and makes chemical disease control more effective and profitable. Shorter application intervals and maximum rates of chemicals become necessary when disease pressure is greatest and weather conditions favor additional infection. Early detection of leaf spot requires close observation. Be aware that different fungicides perform in different ways under varying weather conditions. Always read and follow label directions carefully.

Chemical control methods for irrigated peanuts:

Spanish and Valencia types—Begin fungicide applications 35 to 40 days after planting and continue at recommended intervals until 20 to 21 days before harvest, depending on the fungicide used, weather conditions and disease development.

Runner and Virginia types—Begin applications 50 to 55 days after planting. Follow the Spanish recommendations above if late leaf spot occurs during the early stage of plant development.

Chemical control methods for dryland peanuts:

Follow the recommendations for irrigated peanuts if rainfall is sufficient for continuous plant growth and disease development. In years of low rainfall and low humidity, begin fungicide applications at first evidence of either leaf spot disease or when rains or dew favor disease development. Continue applications at suggested intervals through periods suitable for leaf spot development. Dew formation is most consistent in the fall, beginning in September, but may occur anytime.

Rust

Peanut rust usually occurs sporadically in a geographically limited area except in South Texas where it occurs annually. The fungus has not been observed to overwinter in Texas, and each year spores must be blown in from the Caribbean area. Rust is typically found in South Texas peanuts in mid-July. Once established, rust can develop rapidly during humid wet weather. Late planted peanuts in South Texas are most vulnerable because rust spores produced in nearby early planted fields are carried on prevailing winds to other fields. Apply fungicides effective against rust (Table 14) at shortest intervals at the first sign of rust in fields or in nearby fields.

Web Blotch

Spanish and Valencia market type peanuts are more susceptible than runner and Virginia types to web blotch. However, runner types in West Texas can experience severe damage from this disease. Several foliar fungicides are effective (Table 14).

Application Methods

Foliar fungicides may be applied with ground or air equipment in spray formulations. Use any method that evenly deposits the protective fungicide on the entire leaf surface. Use three hollow-cone nozzles per row spaced for optimum coverage. Make the first three applications in a band with ground equipment to control foliar diseases and reduce early season cost. If a three-nozzle arrangement is used (one nozzle at the top and two on the sides), plug the side nozzles for the first application and use only the top one. Use two nozzles on larger peanuts 10 to 14 days later by plugging the top one and using the two side nozzles. For the third and subsequent applications, use all three nozzles even though this may damage some vines. Ground spray equipment should apply the suggested amount of fungicide in 10 to 25 gallons of water per acre, depending on vine size. Careful use of ground equipment has little or no adverse effect on yield. When applying fungicides by air, use at least 5 gallons of water per acre. Demonstrations under field conditions show that foliar fungicides applied through sprinkler irrigation systems give control equal to those applied by air and ground equipment. Continuous agitation of fungicide-water combinations to prevent fungicide settling is required when the center pivot system circles. This is not a problem with side-roll injection systems.

Aerial application of foliar fungicides provides good control when equipment is properly adjusted and operated. Adequate flagging, marking or positioning with global positioning systems ensures even distribution and avoids swath widths that are too wide. Stop application if temperatures are above 90 degrees F and relative humidity is below 45 percent to avoid spray droplets drying before hitting target plants. A visible blanket of spray mixture will appear behind the aircraft when the 5-gallon per acre rate is used.

Control of Pod, Peg and Stem Fungal Diseases

Southern Blight

Cultural methods for control of southern blight include:

1. Rotate crops to avoid peanuts following peanuts.
2. If peanuts follow peanuts in successive years, bury crop residue with a moldboard plow deep enough to avoid bringing residue back up during land preparation and cultivation. There may be no advantage in burying residue from nonpeanut crops.
3. Plant on a raised bed. Plant dryland peanuts on a slightly raised bed and irrigated peanuts on a bed at least 4 inches high.
4. Avoid high seeding rates. Early development of a dense canopy retains humidity that favors the southern blight fungus.
5. Do not throw soil onto peanut plants during cultivation.
6. Control foliar diseases with fungicides to prevent leaf shed. Fallen leaves are a food source for the southern blight fungus.
7. Dig when mature.

Chemical control of southern blight is possible with Folicur, Abound, Tilt, Montero or PCNB when used correctly (Table 15). Multiple applications of Folicur, Tilt, Montero or Abound as preventative treatments in problem fields are suggested rather than single applications or rescue treatments after southern blight damage has occurred. Consider these characteristics when selecting a chemical. Fungicides may be labeled for application through sprinkler irrigation systems in Texas and show acceptable levels of control when used in this manner. Producers must be aware of strict regulations that exist regarding “chemigation” as it relates to the potential for water contamination.

Positive disease identification is necessary to get economic returns from chemicals. For example, all five previously mentioned products are effective against the southern blight fungus but only Abound helps control the Pythium pod rot fungus (Table 15).

Sclerotinia Blight

Sclerotinia blight, caused by the fungus *Sclerotinia minor*, was observed for the first time in Texas peanuts in 1981. Additional outbreaks of the disease have been identified in numerous Texas counties. The disease is characterized in early stages by small white tufts of cottonlike growth on the stems near the ground line at leaf axils. The fungus spreads rapidly. Later stages of the disease show up as severe stem shredding, almost as if the stems had exploded, accompanied by the production of many small, black, irregular-shaped sclerotia that are approximately the size, shape and color of mouse droppings. The distinguishing field diagnostic symptom is rapid plant death, accompanied by stem shredding. At first glance, this disease may be confused with southern blight, caused by the fungus *Sclerotium rolfsii*. This mistake can be devastating because chemicals that control southern blight have no effect on the Sclerotinia fungus. Research from several states has shown the Sclerotinia fungus can be seed-borne. The sclerotia may also be spread by diggers, combines or vehicles carrying infested soil or crop residue. Research at Stephenville has shown that sulfur (applied as a foliar fungicide) significantly increases the severity of Sclerotinia blight.

The only fully labeled product for Sclerotinia blight control is Rovral (Table 15). Rovral applied by ground requires large volumes of water (40 to 60 gallons per acre) to obtain maximum effectiveness. A multiyear rotation, in conjunction with deep burial of crop residue, is also helpful. Sclerotinia blight is more severe on runner than Spanish varieties, supposedly because of quicker, more complete ground cover with the runner types. Tamspan 90 has significantly more resistance to the fungus than other available Spanish and runner varieties (Table 17). Keep soil moisture below field capacity for the final 45 days to allow soil temperature to increase and help control the organism. Plant early where possible to avoid cool fall temperatures conducive to the disease.

Botrytis Blight

Botrytis blight is caused by a species of the fungus *Botrytis*. It has only been a significant problem in far West Texas. Since symptoms so closely resemble Sclerotinia blight, a lab diagnosis is necessary. Benlate, labeled for web blotch control in peanut, is effective against Botrytis blight.

Pythium and Rhizoctonia Diseases

Diseases caused by these two groups of fungi can occur alone but more often occur together. Pythium fungi cause pod rot and root rot. *Rhizoctonia fungi* cause disease on pods, pegs, limbs, leaves and roots. Pod rots are difficult to control and cultural practices should be adjusted before considering a fungicide (Table 15). Cultural recommendations for southern blight control are helpful for Rhizoctonia and Pythium pod rot control.

- Avoid excessive irrigation.
- Rotate with unrelated crops. If possible, summer fallow during rotation. Use small grains as a winter cover crop. Turn this under deeply with other crop residue in the spring. Plant on a raised bed.
- Improve drainage in low areas. Where salinity is a problem, check for and break up hard pans to allow leaching of salts.
- Apply gypsum (a calcium source) at pegging, especially in areas where sodium salts accumulate in the soil from low quality irrigation water. Large seeded Virginia type peanuts require more calcium than runner and Spanish types.
- Avoid excessive fertilizer.

Black Mold

Black mold caused by the fungus *Aspergillus niger* is a threat to peanut production throughout Texas. Low quality seeds, late plantings and drought and high soil temperature stress for the first few weeks after planting have been associated with a high disease incidence. The fungus attacks the crown or collar area near the soil line and may girdle and kill the plant at any stage from seedling to harvest. The black, slightly fluffy fungus growth on lesions located just below the ground line is the best field diagnostic symptom. There are no adequate control recommendations. A good rotation program, avoiding late planting and frequent, light, early season irrigations reduce losses.

Diplodia Collar Rot

Rotating with nonrelated crops lowers populations of this fungal organism in the soil. *Diplodia* has been less severe in plots where leaf spot was controlled with fungicides and where soil temperatures were reduced by irrigation and vine shading. Plant small grain rotation crops in problem fields and turn them under to achieve initial decomposition before planting.

Biological Control of Soil-borne Fungi

Certain fungal species in the genus *Trichoderma* feed on mycelium and sclerotia of *Sclerotinia minor, Sclerotium rolfsii* and *Rhizoctonia* spp. All peanut fields in Texas tested to date have natural populations of *Trichoderma*. For several years, tests have been conducted in Texas using corn meal to stimulate *Trichoderma* development as a way to control the major soil-borne disease fungi. When yellow corn meal is applied to fields in the presence of moist surface soil, *Trichoderma* builds up very rapidly over 5 to 10 days. The resulting high *Trichoderma* population can destroy vast amounts of *Sclerotinia, Sclerotium* and *Rhizoctonia*. This enhanced, natural biological control process is almost identical to the processes that occur when crop rotation is practiced. The level of control with corn meal is influenced by organic matter source, soil moisture, temperature and pesticides used. Seasonal applications of certain fungicides may inhibit *Trichoderma*. Testing will continue to determine the rates and application methods that will give consistent, economical control.

Nematode Control

Several kinds of plant parasitic nematodes may cause damage but "root knot" caused by the peanut root knot nematode *Meloidogyne arenaria* is normally the most severe. Root knot is easily diagnosed from galls on roots and usually also on pegs and pods. Other nematodes require soil and laboratory analysis of plant samples for identification. The best time to sample is at or near harvest. Send a soil sample representative of damaged areas, along with peanut pods if available, to: Texas Plant Disease Diagnostic Laboratory, Texas Agricultural Extension Service, College Station, Texas 77843. There is a $20 per sample fee. Nematode sample forms are available at county Extension offices (Form D-827). Rotate with crops resistant to the nematodes damaging peanuts as a control program. Consider a nematicide when plant parasitic nematodes have previously limited production.

Late maturing varieties have more potential for damage than short-season Spanish market types.

Use caution when selecting a nematicide (Table 16) since soil moisture is extremely critical for optimum control. Telone II at rates of 6 to 12 gallons per acre works best when placed 10 to 12 inches in the ground with a moldboard plow. Excessive soil moisture and cold temperatures limit movement of the fumigant in the soil, reducing its effectiveness and possibly causing plant stunting. This fumigant will cause fewer problems when applied at least 10 to 14 days before planting. Granular contact nematicides work best with good soil moisture conditions.

Aflatoxin (Segregation III)

Aflatoxin is a chemical compound produced by the fungi *Aspergillus flavus* and *A. parasiticus*. Aflatoxin may accumulate before digging in drought stressed dryland peanuts. Reduce seeding rates in dryland fields to conserve soil moisture. Some soils have a higher population of the fungus than others. If peanuts from a field consistently have this condition, consider rotating with other crops. Irrigate if possible because peanuts under drought stress are more susceptible to field infection by *Aspergillus* sp. Segregation III peanuts are usually associated with preharvest drought conditions of kernel moisture below 25 percent and high soil temperatures (80 to 100 degrees F). Pod injury from insects or other agents favor infection by these fungi.

Aflatoxin may also accumulate during harvest and curing if drying conditions are less than ideal. Use inverting diggers to keep pods off the soil surface while curing within the windrow. Adjust combines to prevent pod damage and transport peanuts in vented trucks and trailers to prevent heating. Force air through the truck or trailer and dry as soon as possible.

Aflatoxin may also accumulate during storage in regions with high humidity or in facilities that leak during rains.

Varietal Characteristics Relative to Disease Development

Peanut varieties differ in their susceptibility to disease organisms (Table 17). Tamspan 90 is less susceptible than other varieties to Pythium pod rot. Although runner and Spanish peanuts are both affected by Pythium pod rot and southern blight, runner types suffer the most damage. Give runner types extra consideration when chemical treatments are required.

Both Spanish and runner peanuts can be heavily damaged by root knot nematodes; however, the extra 30 days needed to mature the runner type magnifies their damage potential. Split applications of nematicide may be necessary for runner varieties. With the longer growing season needed for runner peanuts and their partial resistance to early leaf spot, late leaf spot often is the predominant foliage disease. Early leaf spot affects both types but is usually worse on Spanish varieties. Spanish varieties are also more susceptible to web blotch. Large-seeded Virginia varieties appear more prone to aflatoxin development than Spanish or runners under South Texas conditions. Where Sclerotinia blight is a problem, Spanish peanut varieties, particularly Tamspan 90, can often be grown without chemical control. Runner types are much more susceptible to the fungus.

Consider all these factors when planning a chemical control program.

Virus Diseases

Spotted Wilt

Yield loss from spotted wilt, caused by tomato spotted wilt virus (TSWV), occurs in Southwest and Central Texas. Yield losses may exceed 50 percent in susceptible varieties. Tobacco thrips and western flower thrips are vectors (carriers).

Impatiens necrotic spot virus (INSV) was detected in peanut in Southwest Texas in 1998 and 1999 as single INSV infections and double infections with TSWV. INSV is related to TSWV, but western flower thrips are more efficient vectors of INSV than are tobacco thrips. The plant host lists are similar and symptoms are probably identical for TSWV and INSV.

TSWV and INSV overwintering sites are not completely understood. Both viruses have large host ranges. Infested tobacco thrips may overwinter in some soils. Western flower thrips can be active throughout the year and may spread one or both viruses during the winter among weeds and susceptible vegetable crops. Spinach and potato can harbor TSWV through the winter in South Texas. TSWV is not known to be seed-borne in any crop or weed.

Typical early season spotted wilt symptoms include ring spotting of leaves and stunted plant growth; these symptoms usually are not seen in late season spotted wilt. Older plants that become infected with TSWV and apparently with INSV often simply turn yellow, wilt and quickly die. Plants also show signs of brown streaking within the vascular system and deterioration of roots. TSWV can be detected in the crown area of most plants in fields exhibiting these symptoms in Southwest and Central Texas. INSV was detected sporadically in Southwest Texas in 1999.

Risk of spotted wilt is reduced by use of varieties with some level of resistance. Resistant peanut varieties have fewer infected plants and those infected plants have milder symptoms than more susceptible peanut varieties under the same conditions. Spotted wilt epidemics are driven by two factors. The first is how much virus is brought into the field by thrips. This varies widely from year to year (fall rains usually increase risk for the following season) and from field to field. Peanuts planted in the proximity of TSWV hosts (spinach, potato, spring green bean) and early planted peanut fields may have increased risk. Very early and very late planted fields usually have increased risk. Careful planting date and field selections may allow growers to miss some thrips migrations in some years. The second and more important factor is how fast the virus spreads from peanut plant to peanut plant. Large thrips populations from nearby cotton production may increase spread. The only thing known to slow down this type of spread is to increase the level of variety resistance.

Anything that can be done to enhance overall plant health may prolong plant life and increase the chance of making a crop in spite of the virus. It is especially important to avoid over watering 4 to 6 weeks before digging infested fields. This does not control the virus, but helps keep infected plants alive.

Efforts to develop superior resistant varieties for Texas growers (Table 17) continue. Variety options for partial TSWV resistance in 1999 include Tamrun 96, Georgia Green, AT-108, ViruGard, Georgia Bold, Florida MDR-98, and Tamspan 90. Georgia Green may not be resistant to INSV.

TSWV-susceptible varieties such as Tamrun 88, Tamrun 98, AT-127 or Florunner increase the risk of spotted wilt wherever they are planted and, because the virus spreads, even in nearby fields of more resistant peanuts.

Insecticides have not provided spotted wilt control. Consult an Extension entomologist for specific insect control information.

Atmospheric Scorch - Ozone

Nitrogen dioxide and hydrocarbons emitted from automobiles, industrial combustion, oil refineries and other sources react with sunlight to form ozone. Electrical storms produce ozone that can be brought down from the upper atmosphere by strong down drafts. The result on peanuts is a scorched appearance primarily on the upper leaf surface of the youngest leaves. Pepper spot caused by a species of the fungus *Leptosphaerulina* often invades these scorched leaves and enhances the damage. Regular use of a foliar fungicide helps prevent these secondary infections in damaged tissue.

Salt and Boron Damage

Low peanut yields and severe pod rots are potential problems in soils with a high sodium adsorption ratio (SAR). The foliar symptoms that develop after irrigation with saline irrigation water vary from a brown marginal leaflet burn to death of the leaf. Pod rot often increases when sodium and potassium cations accumulate in the fruiting zone. Sodium and potassium apparently compete for position on soil particles with calcium, a nutrient absorbed in large quantities by the developing pods. Calcium deficiency can be associated with increased susceptibility to pod rot fungi. Supplements of gypsum (land plaster) can decrease pod rot under high SAR conditions. Water infiltration into soil is decreased in soils with high SAR. Furrow diking can reduce rainfall and irrigation runoff and increase flushing of sodium from soil.

Boron toxicity is a problem in some soils in West Texas, decreasing plant growth and yields. The most common symptom is a yield decrease with little detectable foliage reduction.

Soil and irrigation water should be tested at least annually in areas at risk for high SAR or boron. Test results should be considered when selecting fields for planting.

Table 13. Peanut Seed Treatment Fungicides[1]

Fungicide	Formulation	Seed decay and damping off					
		Rhizoctonia	Fusarium	Aspergillus	Pythium	Rhizopus	Sclerotinia[2]
Bacillus subtilis GBO3	Kodiak Concentrate Biological[3]	✔	✔	✔			
captan	Captan 30-DD, 400	✔	✔	✔	✔	✔	
captan + PCNB + carboxin	Vitavax PC	✔		✔		✔	
fludioxonil	Maxim 4FS	✔	✔	✔		✔	
EBDC (mancozeb, maneb)	numerous	✔	✔	✔	✔	✔	
metalaxyl	Allegiance-FL				✔		
mefenoxam	Apron XL LS				✔		
PCNB	RTU-PCNB	✔	✔				
PCNB + metalaxyl + Bacillus subtilis GBO3	System 3	✔			✔		
thiophanate-methyl	Tops 90			✔			✔
thiram	Thiram 50WP, 42-S	✔	✔	✔	✔	✔	

[1]Most commonly used products are Vitavax PC + Topsin, Thiram, PCNB, and Vitavax PC alone. Seed suppliers usually determine seed treatment fungicide.

[2]Seed-borne Sclerotinia only, not soil-borne inoculum.

[3]Also for improvement of nodulation.

Table 14. Peanut Foliar Fungicides Labeled for Use in Texas

Fungicide	Formulation	Early or late leaf spots	Rust	Web blotch	Interval (days)	Hay for livestock	PHI[1] (days)
azoxystrobin	Abound F[2]	✔	✔	✔	10-14	No	50
chlorothalonil; chlorothalonil + copper, sulfur[3], or propiconazole	numerous, or tank mixture	✔	✔[4]	✔	10-14	No	14
copper, copper + zinc	numerous	✔			7-14, 10-14	Yes	0
flutolanil + propiconazole	Montero[2]	✔			21-30	Yes[5]	40
mancozeb, mancozeb + copper	numerous	✔	✔		3-7, 7-14	No	14
benzimidazole (benomyl or thiophanate-methyl) + mancozeb, etc.	Benlate, Benlate SP, Topsin M WSB[2], or Topsin M 70W[2] + mancozeb, etc. tank mixture		✔	✔	7-14	No	14
propiconazole	Tilt[2]	✔			10-14	Yes[5]	14
propiconazole + chlorothalonil	Tilt Bravo	✔		✔	10-14	No	14
sulfur[3]	numerous	✔	✔		7	Yes	0
tebuconazole	Folicur 3.6 F[2,6]	✔	✔	✔	10-14	No	14
trifloxystrobin + propiconazole	Stratego[2]	✔	✔	✔	10-14	Yes[5]	14

[1]Preharvest interval (minimum days from last application until harvest)
[2]May also be used to control certain soil-borne fungi.
[3]Sulfur may increase a Sclerotinia blight problem.
[4]Rust not mentioned on Tilt (as tank mixture) or Tilt/Bravo labels.
[5]Do not feed green vines to livestock or graze livestock in treated area.
[6]Also labeled for pepper spot disease control.

Table 15. Peanut Soil Fungicides Labeled for Use in Texas

Fungicide	Formulation	Southern blight[1]	Sclerotinia blight	Pythium seedling, pod rot	Rhizoctonia seed, seedling, pod, peg, limb rot	Black hull	Rotation restriction	Hay for livestock	PHI[2]
azoxystrobin	Abound F[3]	✔		✔	✔		No	No	50
iprodione	Rovral, 4F, WG		✔				Yes	No	10
benomyl + mancozeb	Benlate, SP + mancozeb, etc.[3]					✔	No	No	14
thiophanate-methyl + mancozeb	Topsin M WSB, 70W + mancozeb, etc.[3]				✔		No	No	14
mefenoxam	Ridomil Gold EC, GR, WSP			✔			Yes	Yes	0
flutolanil + propiconazole	Montero[3]	✔			✔		Yes	Yes[4]	40
PCNB	numerous	✔			✔		Yes	No	45
PCNB + metalaxyl	Ridomil PC 11 G	✔		✔	✔		Yes	No	75
propiconazole	Tilt[3]	✔					Yes	No	21
trifloxystrobin + propiconazole	Stratego[3]				✔		Yes	Yes[4]	14
tebuconazole	Folicur 3.6 F[3]	✔			✔		Yes	No	14

[1]Granular insecticide labels for chlorpyrifos (Lorsban 15G) and ethoprop (Mocap 10G, Mocap 10G Lock ‘n Load) claim enhances southern blight control.
[2]Preharvest interval (minimum days from last application until harvest).
[3]May also be used to control certain foliar pathogens.
[4]Do not feed green vines to livestock or graze livestock in treated area.

Table 16. Peanut Nematicides Labeled for Use in Texas

	Formulation	Timing			Rotation restriction	Hay for livestock	PHI[1]
		Preplant	Planting	Pegging			
Fumigant nematicides							
chloropicrin	Chlor-O-Pic	✔			No	Yes	
dichloropropene	Telone II	✔[2]			No	Yes	
dichloropropene + chloropicrin	Telone C-35, C-17	✔			No	Yes	
metam-sodium	numerous	✔			No	Yes	
Contact nematicides							
aldicarb	Temik 15G, Lock ‘n Load, CP		✔	✔[3,4]	Yes	No	90
ethoprop	Mocap 10G,10G Lock ‘n Load, EC	✔	✔	✔[4,5]	No	Yes	
fenamiphos	Nemacur 3, 15G		✔		Yes	No	

[1]Preharvest interval (minimum days from last application until harvest).
[2]Demonstration work shows that maximum rates and placement depths result in excellent control of root knot nematodes.
[3]Split Temik 15G application for pegging is permitted under Texas SLN Label 78-0013.
[4]Temik 15G at plant + Mocap 10G at pegging is sometimes superior to Temik 15G + Temik 15G.
[5]Only Mocap 10G formulations are labeled for use at pegging.

Table 17. Reactions of Texas Peanut Varieties To Plant Diseases[1]

Variety	Early leaf spot	Late leaf spot	Rust	Spotted wilt	Pythium pod rot	Web blotch	Southern blight	Sclerotinia blight	Pepper spot	Black hull	Root knot
Runner market types											
Florunner	S	HS	S	S	HS	R	HS	S	S	S	HS
AT-120	S	S	S	R	S	–	S	S	HS	HS	HS
Tamrun 88	S	HS	HS	HS	HS	S	HS	S	S	S	HS
Georgia Green	S	S	S	R	S	–	S	S	S	S	HS
Tamrun 96	S	S	S	R	S	–	R	S	S	R	S
Coan	S	HS	S	S	HS	R	HS	S	S	S	R
Flavor Runner 458	S	HS	S	S	HS	–	HS	S	S	S	HS
SunOleic 97R	S	HS	S	S	HS	–	HS	S	S	S	HS
AT-108	S	HS	S	R	S	–	HS	S	S	S	HS
ViruGard	S	S	S	HR	HS	–	HS	S	HS	S	HS
GK-7	S	HS	S	R	HS	–	HS	S	S	S	HS
Georgia Runner	S	HS	S	S	S	–	HS	S	S	S	HS
Tamrun 98	S	S	S	S	S	S	S	R	S	S	HS
Florida MDR-98	S	R	S	R	S	–	R	S	S	S	HS
Georgia Bold	S	S	S	R	S	–	S	S	S	S	HS

Table 17. Reactions of Texas Peanut Varieties To Plant Diseases[1] (continued)

Variety	Early leaf spot	Late leaf spot	Rust	Spotted wilt	Pythium pod rot	Web blotch	Southern blight	Sclerotinia blight	Pepper spot	Black hull	Root knot
Spanish market types											
Tamspan 90	HS	HS	S	R	R	S	S	R	S	–	HS
Spanco	HS	HS	S	S	HS	S	S	S	S	–	HS
Pronto	HS	HS	S	S	S	HS	S	S	S	–	HS
Virginia market types											
NC-7	S	S	S	–	S	S	S	S	S	S	HS
Valencia market types											
Valencia	S	S	–	–	S	S	S	S	S	HS	HS

[1]Ratings are: HS=highly susceptible, S=susceptible, R=resistant, HR=highly resistant and "—" unknown due to insufficient testing.

Insect Management

To achieve effective, economical insect control, insecticide applications should be based on field inspections of pest populations. Use chemicals only if economically damaging populations of insects develop. Knowing when not to make an application is as important as knowing when to make one. Beneficial insect parasites and predators should be protected.

White Grubs

White grub, the immature stage of the June beetle, recently has caused considerable concern for peanut producers in south Texas counties. White grubs feed on the secondary or feeder roots of the plant, leaving the tap root intact. Plants appear to die of drought stress because there are no hair roots left to draw water. The beetle larvae don't travel far horizontally but they do move a great deal vertically within the soil moisture profile. White grub populations are usually found in pockets within a field.

To locate damaging populations, sift 1 row foot of soil to a depth of 12 inches at each site. Make at least one inspection site per 5 acres. Randomly select sites throughout the field. White grubs cannot be effectively controlled with approved insecticides. Growers experiencing heavy numbers of white grubs within fields should dig infested areas early to avoid segregation III problems.

Thrips

Thrips feed primarily in terminal leaf clusters between folds of young leaflets by rasping the tender leaf surface and sucking plant juices. This results in dwarfing and malformation of leaves, causing a condition called pouts. Injury usually occurs during the first month after plant emergence. Systemic insecticides applied at planting control some thrips, but generally do not increase yields.

Thrips/Spotted Wilt Disease

Thrips are very small insects that have recently obtained the status of a pest insect in south and central Texas by vectoring tomato spotted wilt virus. The resulting disease is caused by a virus that may be transferred from diseased plants to healthy plants by thrips.

Spotted wilt disease is spread in two different ways within a peanut field. Primary spread is caused by adult thrips infected with the virus that fly into a field, feeding on peanut plants and transmitting the virus. Primary spread cannot be controlled with insecticides. Other than selecting a tolerant peanut variety, the best method of control is to delay planting until soils are warm. Peanuts planted in March and April require a longer growing season since seedlings in cool soils grow slowly and are more susceptible to damage from spotted wilt disease. Primary spread usually occurs in early planted peanuts and again when these fields are dug and thrips carrying the spotted wilt virus fly to neighboring fields. Thrips are carried, to a large extent, by wind; therefore, it is important to plant late peanuts upwind from earlier planted fields.

Secondary spread occurs when immature thrips develop on virus-infected plants then mature to the adult stage and feed on other peanut plants within the same field. The virus can only be acquired by immature thrips feeding on infected plants. As the thrips mature they move to other plants nearby thus spreading the virus from plant to plant.

Limiting the Spread of Tomato Spotted Wilt Virus

Several important factors must be considered when planning a peanut production system to minimize losses due to spotted wilt disease.

- Plant peanuts from May 20 to June 19. Surveys conducted in the early 1990s show that peanuts planted within this time frame had less spotted wilt and produced higher yields than earlier or later planted peanuts.

- Insecticide use favors outbreaks of secondary pests such as spider mites, foliage feeding caterpillars and especially the silverleaf whitefly. Spider mite control is erratic with approved pesticides. Foliar-applied insecticides destroy beneficial insects that feed on these pests, resulting in increased numbers.

- Foliar-applied insecticides for thrips control are not recommended. Test plots show that foliar-applied insecticides provide erratic thrips control and only marginally affect the spread of spotted wilt. Certain peanut fields may be seriously affected by spotted wilt even though precautions on planting dates, etc., were observed. All peanut fields should be monitored in order to determine if spotted wilt is spreading within the field. Some fields may require an insecticide treatment based on the following procedure.

Monitoring Tomato Spotted Wilt Spread

Monitoring spread of spotted wilt helps determine how the disease is progressing during the growing season. To monitor, use permanent flags to mark four rows in a field, each 100 feet in length. Each row should be located near the middle of each quadrant of the field and examined weekly. When a plant is found that appears to be infected with spotted wilt, insert a red or orange wire flag into the ground beside the plant. Repeat this procedure each week, adding flags when new plants exhibit symptoms of spotted wilt. Do not remove flags until field scouting is over for the year. By comparing the total number of plants within the 100-foot sections to the number of infected plants based on the total number of flags, the percentage of infected plants can be determined.

Insecticides for thrips control as a treatment for tomato spotted wilt control are not suggested. The dangers of secondary pest outbreaks are very real, and these pests may be more damaging than tomato spotted wilt. However, if severe cases of tomato spotted wilt infection appear imminent, several insecticides are labeled for thrips control.

Granular systemic insecticides are preferred over foliar insecticides because they are ecologically selective and less harmful to beneficial insects on the foliage. Foliar-applied insecticides create worm or spider mite flare-ups more often than granular insecticides.

Granular materials are hazardous when wet; in-season use of these materials under irrigation systems requiring extensive labor and movement within the field may expose workers to unacceptable risks. Granular materials must be followed by either a substantial rainfall or irrigation to become activated.

Table 18. Insecticides for Thrips Control

Insecticide	Rate per acre	Days to harvest	Remarks
Temik 15G	7 lbs.	90	Apply in a band and water with center pivot system. May be applied through peg initiation.
Di-Syston 15G	9-10 lbs		Apply in a band and water with center pivot system. May be applied at pegging. *
Orthene 75S	3/4 lb.	14	Apply two applications at 10-day intervals.
Thimet 20G	5 lbs.	90	Apply at planting in furrow. **

* Do **not** use in combination with Basagran.
** Phytotoxicity could be experienced.

Lesser Cornstalk Borer

The lesser cornstalk borer is an important insect pest of Texas peanuts. This small, slender larva is primarily a subterranean feeder, living beneath the soil surface in a silken tube. Late-planted peanuts are particularly susceptible to damage in the seedling stage, which often results in reduced plant stands. Worms injure mature plants by feeding on pegs, pods, stems and roots. Pegs are cut off below the ground surface and developing nuts are hollowed out. Stems and roots are scarred and may be girdled.

The lesser cornstalk borer is usually more harmful to peanuts grown under dryland conditions and during drought years. Prolonged rainfall and irrigation contribute to larval mortality. Proper timing and adequate water applied at each irrigation may reduce larval populations. Keeping land free of volunteer peanuts, weeds and grasses several weeks before planting helps reduce pest populations during early season.

Frequently inspect fields to determine when to treat for lesser cornstalk borer. In this way, insecticide applications can be timed precisely and unnecessary treatments avoided. If the producer is unable to make field checks regularly, he should employ competent commercial field scouts for the season.

How to Make Inspections

Begin field checks when plants emerge and continue inspections at least once a week. Select field check locations at random, with one location for each 5 acres in a field with a minimum of five sample sites in any field. Select sites away from field borders. Examine soil surface for feeding damage, larval tubes and larvae. Later in the season, also examine pegs and peanuts. To obtain a percent infestation figure, divide the total number of plants inspected into the number of infested plants found. Do not use dead larvae, old larval tubes or plant damage to derive an infestation level.

Example

Five infested plants in a total of 50 plants examined would be a 10 percent infestation. If several larvae are found on a single plant, it is counted as one infested plant.

When to Begin Control

Yield or quality losses do not occur until certain infestation levels are reached. Treatment of infestations lower than those indicated in Table 19 probably would not be profitable. In addition to the cost of the insecticide, the producer could destroy beneficial insects and cause problems with certain foliage feeders and spider mites.

Treatment levels for lesser cornstalk borer in both dryland and irrigated peanuts are as follows:

	Dryland	Irrigated
Before initial pegging	5 percent	10 percent
After initial pegging	10 percent	15 percent

Table 19. Insecticides and Rates for Lesser Cornstalk Borer Control

Insecticide	Rate	Days to harvest	Grazing and hay use
	Irrigated		
Lorsban15G *	7 1/2-15 oz/1,000 ft of row	21	No
	Dryland		
Lorsban15G *	7 1/2-15 oz/1,000 ft of row	See Remarks	No

Remarks - Granular Insecticides

* Lorsban 15G: Apply granules in a 14- to 18-inch uniform band over the row. If applications are made when plant size permits incorporation, mix granules thoroughly into the top 1 inch to 2 inches of soil. Follow application of granules with 1 to 2 acre-inches of water within 24 hours. Granular insecticides are activated by moisture. Granular insecticides applied under drought conditions may not be as effective as when applied to moist soils.

Foliage-feeding Insects

Foliage-feeding insects include the corn earworm, velvetbean caterpillar, armyworm and grasshopper. Although the peanut plant tolerates foliage loss, extensive feeding damage may lower yields in both dryland and irrigated fields. The plant is most susceptible to insect foliage damage at 60 to 90 days of age. Make inspections before applying insecticides to determine if economically damaging numbers of worms are present. If chemical control measures become necessary, apply when worms are small. Runner type peanuts have more foliage area than Spanish types and can tolerate greater foliage loss before yield reductions occur. Dryland Spanish peanut can tolerate three to five medium-to-large larvae per linear row foot before yield losses occur. Irrigated Spanish peanuts can tolerate approximately six to eight medium-to-large larvae per linear row foot before significant yield losses occur.

Table 20. Insects Causing Foliage Damage

Insect	Insecticide	Rate per acre	Days to harvest	Grazing and hay use
Armyworm, cutworm, corn earworm, grasshopper	Asana XL	5.8 - 9.6 fl ozs.,	21	No
	Orthene 75S	1 - 1 1/3 lb. (see remarks)	14	No
	Lannate L	1 - 2 pts	21	No
	Sevin 80S	1 1/4 - 1 lbs.	0	Yes
Velvetbean caterpillar, green cloverworm	Asana XL	2.9 - 5.8 fl. ozs.,	21	No
	Orthene 75S	1 - 1 1/3 lb. (see remarks)	14	No
	Lannate L	2 - 4 pts.	21	No
	Sevin 80S	1 1/4 lbs.	0	Yes

Remarks

Asana - Do not exceed 0.15 lb. of actual insecticide per acre per season. Resistance may develop.

Orthene - For grasshopper control, use 1/3 - 2/3 lb. per acre.

Burrowing Bug

Burrowing bugs are soil-inhabiting insects that feed on young or maturing peanuts. Their feeding produces a light-to-dark brown mottling of the kernels that lowers the quality grade of the crop.

Adult burrowing bugs migrate into peanut fields around midsummer. They are attracted to lights in great numbers. Careful monitoring of light traps can provide useful information as to when to intensify field inspection efforts.

Burrowing bugs establish colonies soon after infesting a field. Apply insecticides when adults are detected, because immature burrowing bugs are less easily controlled. Burrowing bugs can be detected by frequent field checks. Select check locations at random, with one location for each 15 acres in a field and a minimum of five sample sites in any field. Carefully sift through 3 row feet of soil per location to a depth of 4 inches. There are no apparent relationships between infestation sites and soil type, topography or proximity to field borders. Do not limit inspection to a specific portion of the field.

Consider insecticide applications only after formed pods are present on plants. Early season infestations in which burrowing bugs feed on seedling cotyledons often do not give rise to infestation later in the season.

Table 21. Insecticides and Rates for Burrowing Bug Control

Insecticide	Rate per acre	Days to harvest	Grazing and hay use
Lorsban 15G *	13.3 lbs.	21	No

* Has been observed to have erratic control.

Miscellaneous Pests

Leafhoppers and the red-necked peanut worm are frequently found on peanuts. These insects are almost always present but rarely pose any threat to peanut production. Control of leafhoppers and red-necked peanut worms is not suggested.

Other peanut pests include spider mites, silverleaf whiteflies, cutworms, webworms, wireworms, corn rootworms, leaf miners, flea beetles, stink bugs and lygus bugs. If high numbers of these pests develop, apply insecticides before extensive damage occurs.

The southern corn rootworm may become more of a problem in wet soil with a high clay content. In some areas of the state, certain spider mite species in peanuts have become highly resistant to most organophosphate insecticides and cannot be controlled with registered materials in most cases. Natural populations of beneficial organisms usually control spider mites effectively. However, frequent application or misuse of many insecticides and/or pesticides can destroy beneficial organisms, thus favoring spider mite population increases and development of insecticide resistance. Sulfur applications for leaf disease suppress spider mite populations but will not control mites when populations reach economically damaging levels.

Table 22. Insecticides and Rates Controlling Spider Mites and Southern Corn Rootworms

Insect	Insecticide	Rate per acre	Days to harvest	Grazing and hay use
Spider mite	Danitol	10.66 - 16 oz.	14	No
	Comite	2 pts.	14	No
	Omite	3 - 4 lbs.	14	No
Southern corn rootworm	Lorsban 15G*	7 1/2- 15 oz./1,000 row ft.	21	No

Remarks: Has been observed to have erratic control when used as a rescue treatment.

Granular insecticides

Apply granules in a 14-inch to 18-inch uniform band over the row. If application is made when plant size permits incorporation, mix granules into the top 1 inch to 2 inches of soil. Follow application of granules with 1 to 2 acre-inches of water within 24 hours.

Sprayable insecticides

Comite – Do not make more than one application per season.

Omite – Premix with small amount of water to form a slurry before adding to spray tank. Do not make more than two applications per season.

Field Applications

Chemigation—(Refer to B-1652, 1990 Chemigation Workbook, for in-depth chemigation procedures). Before using this technique, consult the pesticide label for restrictions and special instructions. Important note: Always use pressure-sensitive check valves in the injector system to prevent contamination of ground water.

Stationary systems (handlines and siderolls)—Calculate the acreage covered in each irrigation set by multiplying the row length by the row width (in feet) by the number of rows per set and divide this figure by 43,560. The amount of pesticide required per set equals the acreage covered in each set, multiplied by the desired rate per acre of the pesticide.

Place the amount of pesticide required per set in the injector. Before allowing the material to pass into the irrigation water, allow time for sufficient water pressure to build and activate all nozzles.

Consult the product's label for information on timing the injection in relation to total operating time per set. For some products, it is important to inject at the beginning of the set. For other products, it is equally important to inject near the end of the set.

Moving systems (center pivots)—Determine the total area to be covered and the operating time. Place the total amount of pesticide needed for the field in the injector tank with sufficient water to fill the tank. Divide the total volume of the tank (in gallons) by the total operating time (in hours) to give the gallons per hour at which the injector meter should be set.

Example

A 500-gallon injector tank is to be used for a total of 90 hours operating time. Calculate the total gallons per hour by the following method:

$$\frac{\text{Total volume of tank (500 gallons)}}{\text{Total operating time (90 hours)}} = \frac{500}{90} = 5.6 \text{ gal per hour}$$

Now that the total gallons per hour is known, consult the injector pump operation manual for proper meter setting. Once the system is operating, monitor the draw-down of the tank at hourly intervals for 3 to 4 hours to determine if the injector system is working properly.

Band Applications

Band applications place pesticides in a specific part of the row, thus reducing the amount of pesticide applied in direct proportion to the ratio of the band width and row width. Failure to reduce suggested broadcast rates by this ratio results in over-concentration of the pesticide in the banded area and may cause plant burn.

Example

The suggested broadcast rate of an insecticide is 12 ounces per acre. The insecticide label states that application of the material in a 12-inch band is effective before pegging. With a 36-inch row width, the actual amount of material applied is reduced to 4 ounces per acre.

Formula

$$\frac{\text{Broadcast rate (oz./acre) x [Band width (inches)]}}{\text{row width (inches)}} = \text{Banded rate per acre}$$

Formula used with example above:

$$\frac{\text{Broadcast rate (12 oz./acre) x [Band width (12 inches)]}}{\text{row width (36 inches)}} = \text{4 oz/acre banded}$$

Precautions

- Read the label on each pesticide container before use. Carefully follow all restrictions concerning use of plant materials as animal feed.
- Always keep pesticides in original containers.
- Dispose of empty containers according to label specifications.

- Improper use of insecticides can result in poor insect control as well as crop condemnation. When using approved insecticides, do not exceed recommended maximum dosage levels, and be sure to allow the proper time between the last application and harvest. Using materials without proper label clearance, or exceeding approved tolerance limits, can result in crop condemnation.
- Please follow Worker Protection Standards Regulations (WPS) per label instructions for proper treatment and re-entry restrictions.

Points of Application

- Restrict insecticide use to actual need, based on field inspections.
- Direct hollow cone nozzles to cover plants thoroughly for foliage-feeding insect control.
- Nozzle size, number of nozzles, ground speed and pressure influence the rate of chemical output per acre. Calibrate the sprayer accurately to ensure application of recommended amounts of insecticide.
- Periodically check the calibration during the season.
- Apply insecticide sprays when weather conditions will not cause drift to adjacent fields or crops. If showers occur and insecticides are washed off plants within 12 to 24 hours of application, the field may need to be treated again.
- Maintain accurate, detailed records of pesticide use.

References

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