

Texas Peanut Production Guide



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Introduction

Texas ranks second in U.S. peanut production with an annual harvested acreage of 150,000 to 300,000 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 varied over the past several years depending on weather as well as price for peanut and other crops.

Planted peanut acres in Texas for 2004, 2005, and 2006.			
Market Type	2004 Planted Acres	2005 Planted Acres	2006 Planted Acres
Runner	146,024	157,193	90,623
Virginia	45,169	35,731	19,613
Spanish	33,109	47,916	22,407
Valencia	10,375	18,600	12,839
Total	234,677	259,440	145,482
U.S. Total	1,422,164	1,607,896	1,176,640

Additional information in regards to peanut and peanut production can be found at the following website: [**http://peanut.tamu.edu**](http://peanut.tamu.edu)

Agronomic Practices

Crop Rotation

Crop rotation is the key to profitable peanut production. Peanut 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. Crops such as soybean, guar, mung bean, alfalfa and other legume crops should be avoided as possible rotation crops with peanut. 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 may be more easily controlled in the rotation crop. Better weed control leads to reduced foreign material problems at market. Crop rotation will also likely allow rotation of herbicide modes-of-action which will reduce the risk of weed resistance developing within a particular peanut field.

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

Effect of rotation length on peanut yields.			
Rotation Length	Peanut Yield (lb/A)		
	Corn	Soybean	Cotton
1 Year	3457	3360	3150
2 Years	3753	3553	3373
3 Years	4268	3684	4229
Non-rotated peanuts had 3-year average of 2840 lbs/acre. R.A. Flowers, University of Georgia, Unpublished.			

Inoculation with N-Fixing *Rhizobium*

Peanut enter into a symbiotic relationship with *Rhizobium* bacteria--the *Rhizobium* obtains its nutrition from the plant and the plant gains usable nitrogen from the bacteria. This is the nitrogen fixation process. With proper seed inoculation and subsequent nodulation using a **peanut-specific** inoculant, peanut may benefit only marginally from supplemental N fertilizer. Some reports suggests that native *Rhizobium* strains are adequate to nodulate peanut, but Texas soil observations, especially West Texas, suggest that effective *Rhizobium* inoculation and nodulation is essential to approach yield potential. For example, numerous fields in West Texas will show a row of yellow peanut where the inoculant plugged up and was not applied. One can often generally

expect to find perhaps 80-95% fewer nodules where the inoculant was not applied. Typically, 25 to 100 nodules per plant are observed in West Texas.

Surveys indicate that for South and Central Texas plants are apparently nodulated by either native *Rhizobium* or surviving peanut *Rhizobium* from a previous use of inoculant as often indicated by the presence of nodules on the lateral roots (in contrast to high numbers of nodules on the tap root which indicate use of an inoculant). Fields in the Rolling Plains region may or may not be well nodulated if no inoculant is used. Also, in West Texas volunteer peanut the following year exhibit little if any nodulation suggesting that sandy, dry soils, low in organic matter do not support *Rhizobium* carryover to subsequent peanut.

The importance of good *Rhizobium* inoculation and nodulation can not be overemphasized. When good nodulation is achieved, *Rhizobium* inoculation likely has a greater impact on production than a supplemental N fertility program.

Choosing an Inoculant – Several types of peanut-specific inoculants are available. Liquid inoculants are currently the most popular and usually achieve best nodulation. As one moves from seedbox powders to granular to liquid inoculants one increases the number of *Rhizobium* bacteria delivered to the seed. Seedbox inoculants are 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. No increase in nodulation let alone peanut yields has been achieved in West Texas trials using a seedbox powder inoculant.

Hot soil temperature, shallow planting (<1.5"), 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, granular inoculant might be a better choice as suggested in the table below. Granules help buffer the *Rhizobium* from adverse conditions and better ensure survival. West Texas research shows, however, that increasing planting depth and using liquid inoculants is a much better means of achieving good nodulation. Shallow plantings (1"), even in moist soils, can greatly reduce nodulation. The same shallow planting will not significantly affect maturity due to 1-2 days quicker emergence.

Trials from Gaines County (2001-2004) clearly demonstrate the advantage of inoculation for West Texas growers. The use of 1X (standard) rates of liquid and granular inoculant increased yields by 1,660 and 950 lbs./acre, respectively, vs. uninoculated peanut. In addition to higher yields, liquid inoculants also set more nodules per plant than granular inoculants. This suggests that liquid inoculants are the best choice for most production conditions. Double rate inoculant (2X) did not increase nodulation over 1X rates, but did increase yields slightly vs. 1X rate for granular inoculant (but not liquid). The results of seedbox powder inoculant test reveal they did not nodulate the peanut plants and yielded no better than uninoculated peanut.

Four-year averages (2001-2004) for *Rhizobium* inoculant trial results by type, Western Peanut Growers Farm, Gaines County, TX.

Inoculant Type	<i>Rhizobium</i> Rate	August (Nodules/plant)	Grade (%TSMK)	Yield (lb/A)
None	0X	6	75	2710
Liquid	1X	40	77	4370
Liquid	2X	39	77	4320
Granular	1X	22	76	3660
Granular	2X	28	76	3980
Liquid/Granular	1X/1X	39	76	4370
Seedbox	2X	5	75	2680

Each value is the average of several tests and/or similar products.

Recent results also suggest that peanut seeding depth can have a significant effect on *Rhizobium* survivability (Table 4). Many producers in the past have often planted shallow, even in dry soil, then irrigated as quickly as possible in an effort to get peanut up quickly and hopefully gain 2-3 days of maturity.

Effect of seeding depth on nodulation and yield, Gaines County, TX (2003-2004).

Inoculant Type	Seeding Depth (inches)	June (Nodules/plant)	August (Nodules/plant)	Yield (lb/A)
None	1	1	4	3160
None	2	1	6	3140
Liquid Lift	1	3	11	3410
Liquid Lift	2	17	48	4750
Granular Soil Implant	1	8	23	3660
Granular Soil Implant	2	11	29	3920

Peanut were planted into moist soil and irrigated in the first five days after planting.

The 1" depth of seeding, in spite of moist conditions and subsequent irrigation, resulted in significant reduction in nodulation especially for liquid inoculant (over 75%). Results for the 3" depth were similar to the 2" depth. The data suggest that producers should minimize planting into dry soil and shallow planting. When adverse conditions are expected then granular inoculant might be a better choice than liquid due to the buffering of temperature and moisture that granular inoculant may provide.

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 are toxic to *Rhizobium* (e.g., Ridomil 2E). If you use tank mixes consult your

inoculant's company representative or literature to ensure compatibility. Granular inoculants generally avoid this problem.

Common Inoculation Mistakes – The *Rhizobium* inoculant is live bacteria! It must be taken care of to preserve integrity. Here are common mistakes to avoid:

- A. Exposure to temperature, especially above 90 F, and direct sunlight. 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.
- B. If using a liquid inoculant, avoid chlorinated water.
- C. Poor placement of in-furrow granular or liquid inoculant. Ensure that drop hoses in particular (many need to be lengthened a few inches) and nozzles direct inoculum to the seed rather than shoot at it from 6" or more away. Be sure granular drop hoses are not clogged with dirt, spider webs, etc. Use an appropriate flow regulator orifice disc, not a fan type tip, to better shoot a solid stream of inoculant into the furrow. Proper placement of inoculant in the furrow may be more important than which inoculant you use.
- D. Low rates of inoculum; calibrate granular and liquid inoculants to ensure adequate rates.
- E. Shallow planting (<1.5", especially 1.0"). Death of inoculum and reduced nodulation may also occur when little soil is dug back over the seed even if planted 1.5" or deeper.
- F. Incompatibility with other seed, fertilizer, or chemical treatments (if unsure, consult your inoculant's company representative).
- G. Placing large amounts of N fertilizer near the seed will greatly curtail nodulation.
- H. Using old, expired inoculum.

Crop Scouting: Examine Roots for Nodulation – Successful nodulation is expected, but is not guaranteed. Early season scouting of nodulation is advised for two reasons: 1) assess early nodulation in advance of decisions about whether to apply mid-season N (and if so, how much); 2) early identification of any field that might not have nodulated adequately so that supplemental N may be applied to help achieve yield potential.

Five to six weeks after planting use a shovel to dig (don't pull) plants to evaluate nodulation. If nodulation is judged poor, little can be done to increase nodulation. Ask why nodulation may be poor (see the above mistakes). Minimal or nonexistent *Rhizobium* nodulation points toward the need for supplemental N to achieve desired yields thus fertilizer N should be considered. Annually as many as 25% of fields in West Texas are undernodulated, or worse, may have only a few nodules per plant. Poorer nodulation appeared to be somewhat correlated with caliche soils, where pH > 8.0 may curtail *Rhizobium* effectiveness.

Nodule mass later in the season may be more important than number of 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 black, gray, or greenish inside.

Because of the importance of good *Rhizobium* nodulation on peanut production we suggest that early-season scouting of nodulation should be part of a comprehensive crop scouting program for peanut. If adequate nodulation is not achieved then a response is needed to avert possible economic losses.

The following guideline for West Texas rates nodulation levels at 5 to 6 weeks after planting. If early nodulation is good, you can expect it to continue to increase toward peak nodulation (usually August), but if early nodulation is poor it probably isn't going to improve.

Early season <i>Rhizobium</i> nodulation rating for peanut in West TX.		
Early-Season Nodulation Rating	Nodules/Plant	Management Consideration
Excellent	>20	N response doubtful (likely excellent late-season nodulation)
Very Good	16-20	Reduce mid-season N (likely good late-season nodulation)
Good	11-15	Consider some reduction in mid-season N (will produce good crop)
Fair	6-10	Will likely benefit from mid-season N program (try to determine why inoculant program was not more effective)
Poor	1-5	N fertility program is most likely essential (most likely background <i>Rhizobium</i> , try to determine problems with inoculant program)
None	0-1	Field will require N fertilizer (try to determine what went wrong with inoculant program)

Soil Fertility and Plant Nutrition

A major benefit of an effective crop rotation program is that peanut respond better to residual soil fertility than to direct fertilizer applications. For this reason, the fertilization practices for the crop immediately preceding peanut 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 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.

Suggested rates of limestone ^a		
Soil pH Range	Soil Texture	
	Sand and Loamy Sand	Sandy Loam and Loam
	(tons/A)	
6.0 to 6.4 ^b	1 ^c	1
5.6 to 5.9	1	1.5
Below 5.6	2	3
^a Use dolomitic limestone if low magnesium levels are indicated by soil test. ^b For soils with a pH greater than 6.4 and high calcium levels but low-to-medium magnesium levels, consider broadcasting 150 lb/A of potassium magnesium sulfate. ^c For very sandy soils with a pH of 6.0 or more, gypsum is suggested if the soil calcium level is low.		

- 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.
- E. Peanut are efficient legumes that synthesize their own nitrogen through association with specific *rhizobium* soil bacteria that are already present in many peanut soils. However, if peanut 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 peanut.

Nitrogen, Phosphorus and Potassium - One of the major benefits of producing peanut, or any legume, is that the crop requires little nitrogen fertilizer. Texas research on response of peanut to nitrogen fertilizer reveals that, in general, no response is observed in South and Central Texas provided the crop is properly nodulated. Several experiments in West Texas have looked at starter nitrogen, preplant nitrogen, and midseason nitrogen applications. Although in some tests small yield increases 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. 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 under-fertilizing 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 - 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. Pod rot is common in fields low in calcium and high in sodium. Supplying calcium (through products like gypsum or lime) 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). Applications of limestone are not recommended for soils with pH levels of 6.0 or greater. As mentioned earlier increasing the pH through the use of limestone can lead to problems with other plant nutrients. Calcium contained in gypsum is relatively water soluble and enters into the 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, calcium applications may be needed. However, one may want to consider the amount of calcium that is being applied through irrigation water before applying additional calcium. 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. Research in Texas has not shown a benefit in peanut yields or grade with the use of liquid calcium products. Gypsum also may be beneficial in situations where irrigation water contains a high amount of sodium (however, in many cases peanut production may not be recommended for these fields).

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 even if soil test indicates

micronutrient levels are adequate. Late-season foliar applications of micronutrient fertilizers seldom result in economical 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 fertilizer even though the soil test zinc levels are high. This can occur because high soil phosphorus levels reduce zinc solubility. 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 costs with traditional zinc sulfate at 2 to 4 pounds of zinc per acre to determine the most economical option. Foliar applications should be considered only in salvage situations.

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, thus foliar spray applications are recommended to correct deficiencies. 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 sources include both inorganic and chelated forms. 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 since iron will not translocate within the plant. For young peanut, 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 pounds 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. Even small amounts of boron above the sufficiency threshold 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 is cause for concern as boron could accumulate, leading to boron toxicity in peanut (this has been observed in some irrigation water analysis surveys). Many soil tests in West Texas recommend boron for peanut, but unless boron levels in irrigation water are known, use caution in applying boron fertilizer unless plant deficiencies are confirmed.

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

Variety Selection

First consult with shellers on market acceptance and seed availability of peanut varieties before making any planting decisions. Use high quality seed of a recommended variety and check for splits and immature kernels. Plant at the recommended plant population based on a given row spacing and seed count. 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. Runner and Virginia varieties should be planted by May 15, while Spanish should be sewn by June 1 in West Texas while planting dates may be slightly later in Central and South Texas. Growers in these areas should also consider that very early and very late planted fields have increased risk to tomato spotted wilt virus. Prepare seed beds carefully to assure proper 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, reduce the potential for herbicide damage, and delayed germination due to additional cooling of the soil. Variety selection is one of the most important decisions a grower will make during the season. 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, improved oil quality (high oleic acid/linoleic acid ratio), early-maturity, and other quality issues. 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. In addition, all four market-types are produced within the state. 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 as well suited for another.

Nine commercial runner varieties were grown in Texas in 2006. The runner market types comprising the largest percentage of acreage were Flavor Runner 458, Tamrun OL 02, and Tamrun OL 01 (all of these varieties are high oleic). Tamspar 90, OLin, and Spanco are current Spanish varieties that are grown in Texas. In addition, AT9899-14 (a small seeded runner type) has been planted for the Spanish market. There are several Virginia varieties planted in Texas with NC7, Gregory, and Jupiter planted on over 90% of the acres in 2006. Valencia market-types are the least planted acres of peanut with Valencia C and A still making up the bulk of those acres. 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.

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 were popular varieties in the past. These have been replaced with Tamrun OL 02. Tamrun OL07 is a new variety that could potentially be planted in central Texas. There has also been some limited production of NemaTam (tolerant to root-knot nematode).

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 varying incidence of the virus and yields across the region have been very good. Tamrun 96 and Georgia Green were popular varieties in the past. These varieties have produced high yields and grades and possess appreciable tolerance or resistance to TSWV. In recent years many of the acres planted to these varieties have been replaced by Tamrun OL 01 and OL 02. Tamrun OL07 is a new variety that has showed considerable promise in this region.

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*) and Sclerotinia is present and can be moderate to severe in some fields. Due to low disease pressure Flavorrunner 458 is a very popular variety. In fields that have not been properly rotated and have a history of moderate to severe pod rot problems; Tamrun OL 02 may be a good choice. This variety, released primarily because of its tolerance to TSWV and high oleic traits, also tends to suffer less loss from soil born disease problems. Varieties with high oleic traits dominate this region. In addition, this region also produces Spanish, Virginia, and Valencia market-types as well.

Characteristics of Runner Varieties

Flavorranner 458 - Mycogen and Hershey Food Corporations release, 1997. It is similar to Florunner (still the standard by which other varieties are judged) in growth habit, maturity, pod characteristics, and other agronomic characteristics. However, Flavorranner 458 is also high oleic. Flavorranner 458 has performed well in high yielding environments with excellent grade characteristics. Flavorranner 458 will be susceptible to most diseases affecting peanut.

Tamrun OL 02 - Texas A&M University release, 2002. Similar to Tamrun 96 with high oleic trait. Seed size is smaller and incident of hard seed is lower than Tamrun OL 01. Sugar content is lower than Tamrun OL 01 and Flavorranner 458. Disease resistance has been near equal to Tamrun 96.

Tamrun OL 01 - Texas A&M University release, 2001. Similar to Tamrun 96 with high oleic trait. Pods and seed are much larger than Florunner and a little larger than Tamrun 96 and Tamrun OL 02. Disease resistance has been near equal to Tamrun 96. Tamrun OL 01 does have higher sugar content than most peanut and has produced hard seed in some situations.

Tamrun OL07 – Texas A&M University release, 2006. Medium to late maturing high oleic runner peanut. Has improved disease resistance compared to Tamrun OL 01 and OL 02, and Flavorranner 458. Yield similar to these varieties in disease free situations, but significantly higher in the presences of tomato spotted wilt virus or Sclerotinia blight. Seed size is larger than Tamrun OL 02 but smaller than Tamrun OL 01.

Characteristics of Spanish Varieties

AT9899-14 – AgraTech line in production since 2004. This small-seeded high oleic runner variety has a small compact vine with growth habit similar to a runner variety. Maturity will be later than the other Spanish varieties. Under typical production fields yields have been lower than Tamspan 90 in on-farm field trials.

Tamspan 90 - Texas A&M University release, 1990. Typical Spanish growth habit. Resistant to pod rot and Sclerotinia blight. Excellent yield potential that responds well to irrigation.

OLin - Texas A&M University release, 2002. High oleic Spanish variety that was derived from a cross with Tamspan 90 and a high O/L parent. Disease package similar to Tamspan 90, however, yields have typically been 5 to 10% less than Tamspan 90 in West Texas.

Spanco - Oklahoma State University and USDA-ARS release, 1981. Good yield potential and responds to irrigation. Does not possess the pod rot or Sclerotinia resistance found in Tamspan 90.

Tamnut OL06 – Texas A&M University release, 2006. This variety has a typical Spanish-type growth habit with high oleic characteristics. This variety has show equivalent or better yield than Tamspan 90 and similar disease tolerance. The variety was released due to seed size similar to ‘Florunner’ variety but with maturity similar to Tamspan 90.

Characteristics of Virginia Varieties

Brantley – North Carolina State University release, 2005. Brantley is a high oleic variety derived from NC7. Therefore, it has similar growth and disease tolerance characteristics to NC7. Recent studies have indicated that Brantley will produce a high percentage of jumbo pods and extra larger kernels.

Gregory – North Carolina State University release, 1994. Large seeded variety similar in maturity to NC7. Has growth habit intermediate between runner and bunch types. It is susceptible to most diseases and insect pest, but offers best resistance to tomato spotted wilt virus of currently available Virginia cultivars. This variety is popular because it produces a very high percentage of extra large kernels and jumbo pods.

Jupiter – Oklahoma State University release, 2000. Large seeded Virginia-type peanut with a bunch type growth habit and plant size similar to NC7. The main stem of Jupiter is slightly more apparent and foliage is lighter green compared to NC7. Yield has been lower than other Virginia varieties in recent on-farm variety trials.

NC7 - North Carolina State University release, 1978. NC7 has a growth habit intermediate between runner and bunch. NC7 historically graded higher and had a larger percentage of extra large kernels than other varieties. While NC7 may possess moderate resistance to early leafspot, it is very susceptible to other disease problems. Current seed stocks appear to contain several off-types and recent trials have indicated a lower yield and percentage of extra large kernels.

Characteristics of Valencia Varieties

Genetex 136 – Harper and Wilson release, 2001. Large-seeded, large-podded Valencia variety that may contract at a premium due to these traits. Yields have been comparable to other Valencia varieties with grades potentially lower due to large shell.

Valencia A – New Mexico State University release, 1971. Has typical bunch-type growth habit. Has a high percentage of 3 and 4 seeded pods.

Valencia C – New Mexico State University release, 1979. Has typical bunch-type growth habit. Was originally selected for its high percentage of 3 and 4 seeded pods. Typically emerges 1 – 3 days later than Valencia A, but may mature slightly quicker. Has a larger seed and higher percentage of sound, mature kernels than Valencia A. Is currently the most widely planted Valencia variety in Texas.

Plant Growth and Development

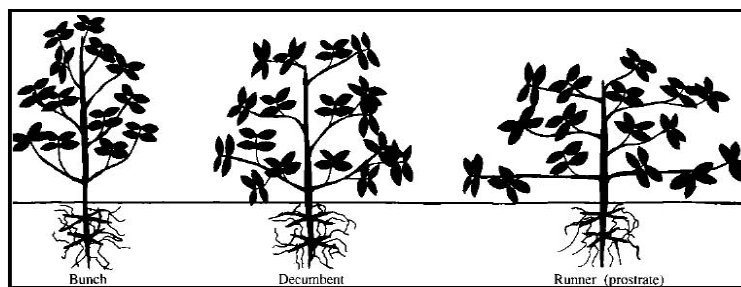
Germination and Seedling Development

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 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

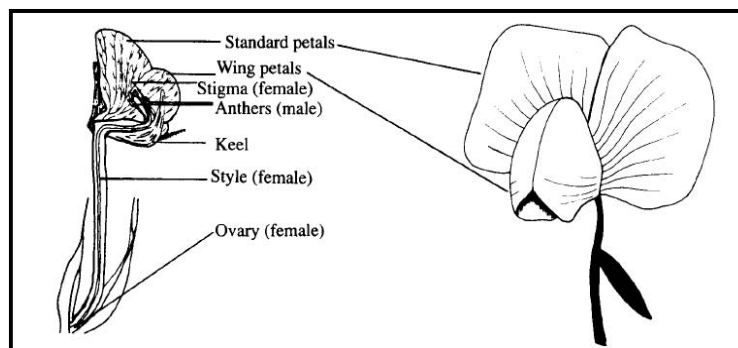
stem. Additional branches arise from nodes on the main and lateral stems. The growth habit of peanut is described as bunch, decumbent or runner. Spanish and Valencia market types are classified as “bunch,” with their upright growth habit and flowering on the main stem and lateral branches. Most Virginia 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.



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

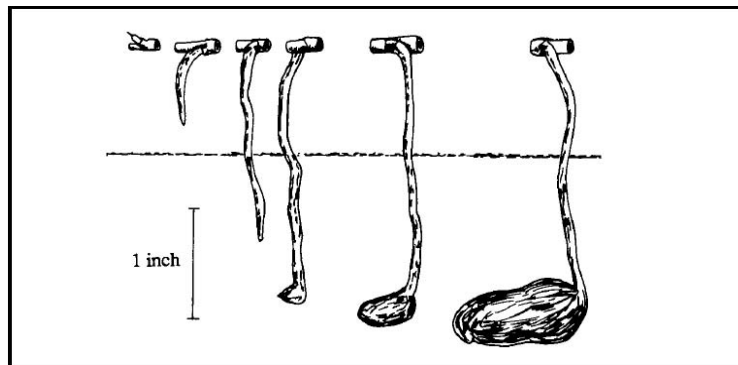
Bloom

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.



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.



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. Over-mature 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.

Relationship Between Harvest, Yield and Grade		
Digging time	Yield Loss (lb/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 peanut acreage has steadily increased. Irrigation ensures a stable supply of high yielding, good quality, aflatoxin-free peanuts. Total seasonal water requirement for maximum peanut yield is 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 can be subject to water shortfalls. In addition, peanuts do not tolerate water quality problems as well as cotton, and this has become evident in low rainfall seasons.

Irrigation Water Quality

Salinity is a problem throughout many areas of Texas. As water quality becomes marginal and cropping patterns change, some areas may experience injury and reduced yields from salinity. 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 and types of salts present in irrigation water. 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 mixture of salts that include 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, roots are unable to absorb water and plant show signs of stress. Foliar applications of salty water commonly cause marginal leaf burn and in severe cases can lead to premature defoliation that creates yield and quality loss. Sodium hazard is caused by high sodium levels that can be toxic to plants and can damage medium and fine-textured soils. When the soil sodium level 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 by a laboratory. Total soluble salts analysis measures salinity hazard by estimating the combined effects of all different salts in the water. It is measured as 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. For additional information on critical levels of salts in irrigation water see the publication, Irrigation Water Quality ([http://peanut.tamu.edu/pdfs/WaterQuality\(b\)-02.pdf](http://peanut.tamu.edu/pdfs/WaterQuality(b)-02.pdf)).

Water Quality, Yield Relationships

The critical level of boron in irrigation water for cotton and grain sorghum is 3 ppm. Preliminary survey studies 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 EC threshold 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. For additional information on the effects of irrigation quality on peanut yields and grades see the publication, Influence of Irrigation Water Quality on Peanut Production in the Texas High Plains (<http://peanut.tamu.edu/pdfs/InfluenceWaterQuality.pdf>)

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)	10
Boron	0.75 ppm = 0.075 meq/L
Chloride	400-500 ppm = 11-14 meq/L
Sodium	400-500 ppm = 17-21 meq/L
M.L. McFarland, R.G. Lemon and C. Stichler. 2003. Irrigation water quality. Texas Cooperative Extension.	

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 the different developmental stages. In general, water use is low in the early season, but is at its peak during the reproductive period. Consumption then starts to decline as pods begin to mature. Specifically, water use can be categorized as follows:

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.

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 a question of when, how long, and how bad. Even with irrigation, extreme 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. Optimum temperature for peanut growth and

development is about 86 degrees F. Very high temperatures slow down crop growth rate. Even in conditions of adequate water, temperatures above 95 degrees F can impair crop development. 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 deeper soil moisture is adequate.

In-Season Irrigation Management

Every producer has his own ideas and methods for watering peanut; 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) high efficiency systems have been developed and are widely used. Many growers use different variations of this system. Some farmers drag socks or hoses in circular rows, others drag hoses across 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. However, results with LEPA may be field and soil type dependent.

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 can actually use. Consequently, stored water in the 2- to 3-

foot soil 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. Two 0.75 inch applications each week total 1.5 inches, emphasizes the need for entering the peak season with a full soil profile of water when possible. The High Plains PET weather station location nearest your farms location will provides daily water use for that production area.

Uniform moisture that can be maintained with two irrigation applications per week helps to ensure adequate soil moisture and high relative humidity in the plant canopy. Peanut 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 in late August to early September the amount of irrigation water can be slightly reduced. However, any reductions in irrigation should be based on crop maturity and rainfall. Changing from a twice-a-week irrigation schedule to a once-a-week 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 let the crop show visible signs of stress in the morning hours. During the maturation period, the plants will mobilize nutrients and food reserves to kernel developing. Plant water use during maturation is moderate compared to the critical bloom, peg and pod development periods. 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:

- A. 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.
- B. Use high quality, weed-free seed. Bar-ready seed is available from shellers and has had nutsedge tubers removed.
- C. Peanut seed that has low germination or low seedling vigor has shown more susceptibility to herbicide injury.
- D. Clean all tillage and harvesting equipment before moving to the next field, or from weedy to clean areas within a field.
- E. Use cultivation or burn down herbicides to remove initial weed flushes prior to planting to ensure a weed-free seedbed.
- F. 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 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. 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 (Pendimethalin), Sonalan (Ethalfluralin)] for full-season weed management. Proper incorporation is critical for successful performance with preplant incorporated herbicides. When herbicides are preplant surface or preemergence applied a rainfall or irrigation is needed for activation. The dinitroanilines require a minimum of 0.75 inches of irrigation water with 1 inch or more better for proper incorporation. Care should be taken to ensure proper application rate of the dinitroaniline herbicides. Excessive rates can lead to peanut injury and reduced yields.

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 dirtying 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 Outlook. Preemergence applications of Dual Magnum or Outlook 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 immediately after the application is needed to properly activate the herbicide. Postemergence applications of Basagran have provided good control of yellow nutsedge; however, repeat applications most likely will be needed for adequate control. **Dual Magnum, Outlook, and Basagran 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 all of 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. 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 Outlook applied preplant incorporated or preemergence can provide early season eclipta suppression. If these materials are applied postemergence, they will not control eclipta that has already emerged, but will provide some residual control of eclipta that has not yet emerged. Strongarm and Valor applied preemergence provide good to excellent control of eclipta. Postemergence options for eclipta include Cobra, Storm, and Ultra Blazer. 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, Outlook, and Valor 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, Cobra, Cadre, Ultra 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 Outlook. Strongarm or Valor applied preemergence provide good control of annual morningglory species. Ultra Blazer, Pursuit, Storm and Cobra 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.

Herbicide Resistant Weeds

The International Survey of Herbicide Resistant Weeds reports that 311 resistant biotypes, 183 species (110 dicots and 73 monocots) and over 270,000 fields have herbicide resistant weeds (<http://www.weedscience.org/in.asp>). In Texas, there are 6 weed biotypes (including barnyardgrass, Palmer amaranth, and johnsongrass) that have been reported to have herbicide resistance, and several other types are currently suspected. In peanut, where crop rotation, tillage, and the use of different herbicide “modes of action” (see publication entitled “Herbicides: How They Work and the Symptoms They Cause” at <http://peanut.tamu.edu/pdfs/TAMUSymptomology99.pdf>) are likely, resistance is often considered less likely when compared to crop monocultures grown in reduced tillage environments that rely on a single herbicide to control weeds

over the course on several consecutive growing season. Kochia resistance to Ally and Johnsongrass resistance to Pursuit and Accent have been reported in Texas. Because Pursuit and Cadre (another ALS inhibiting herbicide) are important herbicides in peanut weed management, rotating peanut to other crops where ALS herbicides are used (Staple and Envoke in cotton; Accent and Beacon in corn, etc.) must be considered in resistance management strategies. Peanut growers are encouraged to consider the following management strategies to prevent/delay the development of herbicide resistant weeds: 1) do not rely on a single herbicide or multiple herbicides with the same “mode of action” to control weeds in a single growing season and over seasons. Rather, use herbicides with different “modes of action”, 2) use tillage, at least once in a while, to help break up weed cycles. No weed has ever been reported that has developed resistance to tillage, 3) use herbicides at their recommended rates. Reduced herbicide rates may select for biotypes with a greater degree of herbicide tolerance, and 4) scout fields for weeds that are no longer controlled by herbicides. If you find a field where several different weed species were not successfully controlled, it is unlikely that weed resistance is the problem, but rather environmental conditions or application error may be the cause of the general weed control failure across several weed species. Consult your local County Agent or Specialist for further information.

Preplant Incorporated Products		
Weeds Controlled	Product Rate/Acre	Remarks
Annual grasses small seeded annual broadleaf weeds	Prowl 3.3 EC 1.2 to 2.4 pts	Apply up to 60 days prior to planting and incorporate within 7 days after application.
	Prowl H ₂ O 1 to 2 pts	Apply up to 60 days prior to planting and incorporate.
	Sonalan HFP 1.5 to 2.5 pts	Incorporate within 48 hours after application. See label for specific rates based on soil type.
	Treflan HFP (Trifluralin) 1 pt	Incorporate immediately after application.
Yellow nutsedge annual grasses small annual seeded broadleaf weeds	Dual Magnum 0.8 to 1.33 pts	Does not adequately control Texas panicum. Injury may occur following use if incorporated too deeply, or very high rainfall conditions move the herbicide into the germination zone.
	Outlook 12 to 21 fl oz	Does not adequately control Texas panicum. Rate dependent on soil texture and organic matter.
Yellow and purple nutsedge annual broadleaf weeds	Pursuit DG 1.44 oz	Shallow incorporation (1 to 2 inches deep) preferable. 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/A, per season. 18-month rotation restriction for cotton and grain sorghum.

Preemergence Products		
Weeds Controlled	Product Rate/Acre	Remarks
Yellow and purple nutsedge annual broadleaf weeds	Pursuit DG 1.44 oz	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/A per season. 18-month rotation restriction for cotton and grain sorghum.
Yellow nutsedge annual grasses small seeded annual broadleaf weeds	Dual Magnum 0.8 to 1.33 pts	Preemergence application is less effective than preplant incorporated treatment for yellow nutsedge control. Does not adequately control Texas panicum.
	Outlook 12 to 21 fl oz	Preemergence application is less effective than preplant incorporated treatment for yellow nutsedge control. Does not adequately control Texas panicum. Rate dependent on soil texture and organic matter.
Annual broadleaf weeds yellow and purple nutsedge	Strongarm 84WG 0.45 oz	Apply preemergence no less than 5 days after planting through at-cracking stage. Do not apply Strongarm to soils with pH of 7.2 or greater.
Annual grasses small seeded broadleaf weeds	Prowl H ₂ O 1 to 2 pts	Apply at planting or up to 2 days after planting and before peanut emergence. To prevent decreased peanut pegging, adequate incorporation must be achieved by applying minimum of 0.75 inches of overhead irrigation or rainfall within 48 hours of application
Annual broadleaf weeds	Valor SX 2 to 3 oz	May be applied to peanuts prior to planting or preemergence. Preemergence applications must be made within 2 days after planting and prior to peanut emergence. Applications made after ground crack or peanut emergence may result in severe peanut injury. Do not irrigate when peanuts are cracking. Do not use on Perry or NC 10C varieties. Proper tank/hose clean out is important to avoid crop injury.

At-Crack Products		
Weeds Controlled	Product Rate/Acre	Remarks
Annual grasses annual broadleaf weeds yellow nutsedge	Gramoxone Inteon 8 to 16 fl oz	To control or suppress small (1-6") emerged annual grass and broadleaf weeds in peanuts at ground crack. Make no more than 2 applications per season and do not apply a total of more than 16.0 fl oz/A per season. A second application may be made up to 28 days after ground crack. Crop foliage sprayed will be injured in the form of bronzing and crinkling but the crop will recover and develop normally. Do not apply by air. Yield reductions have been noted in south Texas when Gramoxone was applied 28 days after ground crack.

Postemergence Products		
Weeds Controlled	Product Rate/Acre	Remarks
Yellow and purple nutsedge annual broadleaf weeds	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. Will provide residual control when activated by rainfall, irrigation or shallow cultivation. 18-month rotation restriction for cotton and grain sorghum.
Yellow and purple nutsedge annual broadleaf weeds	Cadre DG 1.44 oz or Cadre 2AS 4 fl 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 application. Cadre may cause some peanut yellowing and/or reduced vine growth, but yields are unaffected. 18-month rotation restriction for cotton and grain sorghum. Best results with Cadre have been with 0.72 oz/A applied 2 to 3 weeks apart with the initial application approximately 3 to 4 weeks after planting (depending on weed size).
Annual broadleaf weeds	Ultra Blazer 1.0 to 1.5 pts	Treat when broadleaf weeds are small (2 to 6 leaves) and actively growing for best results. Copperleaf should be less than 4 inches tall and eclipta should be less than 2 inches tall. Ultra 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/A). Do not apply within 75 days of harvest. Ultra Blazer will cause spotting and bronzing of contacted peanut foliage.
Yellow nutsedge annual broadleaf weeds	Basagran 1.0 to 2.0 pts	Treat when broadleaf weeds are small and actively growing. For yellow nutsedge, use 2.0 pts/A and apply when nutsedge is 6 to 8 inches tall. Always use 1 to 2 pts/A 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 nonionic surfactant (1 qt/100 gallons spray solution) or crop oil concentrate (1 to 2 pts/A).
Annual broadleaf weeds	Cobra 12.5 fl oz	Apply postemergence to control emerged broadleaf weeds after the peanuts have at least 6 true leaves. Check label for specific weed sizes in your area. Do not apply more than 12.5 fl oz/A per application. A sequential application may be made after 14 days following the initial application. Do not apply more than 25 fl oz/A per season.

Postemergence Products (continued)		
Annual broadleaf weed silverleaf nightshade horsenettle	2,4-DB 175 0.9 to 1.8 pts or 2,4-DB 200 0.8 to 1.6 pts	Use the low rate on morningglory and cocklebur up to 3 inches in size. For silverleaf nightshade and horsenettle 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. 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 annual grasses small seeded annual broadleaves	Dual Magnum 0.8 to 1.33 pt	Use as a supplement to preplant incorporated treatments. Must be activated by rainfall or irrigation (0.75 inch minimum). Will not control emerged grasses and broadleaf weeds; however, it will effectively control emerged yellow nutsedge. Best control when nutsedge is less than 8 in. tall. If nutsedge is taller, need to add Basaqr to provide top kill.
Yellow nutsedge annual grasses small seeded annual broadleaves	Outlook 12 to 21 fl oz	Use as a supplement to preplant incorporated treatments. Must be activated by rainfall or irrigation. Will not control emerged grasses and broadleaf weeds; however, will control emerged yellow nutsedge. May also be used in a split application using 1/2 to 2/3 the maximum rate initially and the remaining 1/2 to 1/3 in sequential application.
Annual grasses Bermudagrass Rhizome johnsongrass	Select 2EC Arrow 2EC 8.0 to 16 fl oz or Poast Plus 1.5 to 2.25 pts	Treat when grasses are actively growing. See label for height restrictions and specific rate recommendations. Use crop oil concentrate at 1qt/A rate. Do not apply to peanuts within 40 days of harvest. Avoid contact with corn, sorghum and small grains. Apply to actively growing bermudagrass before runners (stolons) exceed 6 inches in length and rhizome johnsongrass that is 10 to 24 inches tall. A second application is usually necessary for best results with both bermudagrass and rhizome johnsongrass.

Postemergence – directed		
Weeds Controlled	Product Rate/Acre	Remarks
Annual broadleaf weeds	Aim EC 1 to 2 fl oz	Weed control is optimized when the product is applied to actively growing weeds up to 4 inches in height. Since Aim EC is a contact herbicide, thorough spray coverage is essential (will not control annual grasses). Maximum total seasonal use is 6.1 fl oz/A

Products, Formulations and Common Names of Herbicides		
Product	Formulation	Common name
Aim	2.0 lb/gallon	carfentrazone
Arrow	2.0 lb/gallon	clethodim
Basagran®	4 lb/gallon	bentazon
Ultra Blazer®	2 lb/gallon	acifluorfen
2,4-DB®	1.75 lb/gallon 2.0 lb/gallon	2,4-DB
Cadre		Imazapic
Cadre DG®	one soluble packet contains 0.125 lb. active ingredient	imazapic
Cobra	2.0 lb/gallon	lactofen
Dual Magnum®	7.62 lb/gallon	s-metolachlor
Gramoxone Inteon	2.0 lb cation/gallon	Cation paraquat
Outlook	6.0 lb/gallon	Dimethenomid - P
Poast Plus®	1.0 lb/gallon	sethoxydim
Prowl 3.3EC®	3.3 lb/gallon	pendimethalin
Prowl H ₂ O	3.8 lb/gallon	
Pursuit DG®	one soluble packet contains 0.125 lb active ingredient	imazethapyr
Select 2EC®	2 lb/gallon	clethodim
Sonalan HFP®	3 lb/gallon	ethalfluralin
Storm®	2.67 lb/gallon - bentazon 1.33 lb/gallon - acifluorfen	bentazon-acifluorfen
Strongarm®	84% active ingredient	diclosulam
Treflan HFP®	4 lb/gallon	trifluralin
Valor SX	51 WDG	flumioxazin

Weed/Herbicide Response Ratings

Weed control research involves searching for methods 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, herbicide usage, and the introduction of new herbicides. Changes in soil texture, slope of fields, the time and amount of rainfall or irrigation, soil or air temperature, spray additive, rate of herbicide, time of application, size of weeds and crop condition, 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. Read and follow all label directions before applying any product.

Weed/Herbicide Response Ratings												
Preplant Incorporated	Texas panicum	Yellow Nutsedge	Purple Nutsedge	Barnyard-grass	Crab-grass	Signal-grass	Eclipta	Pigweed	Sun-flower	Yellowtop	Copper-leaf	Morning-glories
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
Outlook	P	G	P	F/G	G	F	F/G	G	G	G	P/F	F
Preemergence												
Dual	P	F/G	P	F/G	F/G	P	F/G	G	F	F	F	P
Frontier	P	FP/F	P	F/G	F/G	P	F/G	G	F	F	F	P
Pursuit	P	F/G	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
Valor	P	P	P	P	P	P	P/F	E	E	E	G/E	E
At-Crack												
Gramoxone Inteon	F	P	P	F	F	F	E	E	E	E	E	E

Weed/Herbicide Response Ratings

Postemergence	Texas panicum	Yellow Nut- sedge	Purple Nut- sedge	Barnyard- grass	Crab- grass	Signal- grass	Eclipta	Pig- weed	Sun- flower	Yellow- top	Copper- leaf	Morning- glories	Bermuda- grass	Johnson- grass
Basagran	P	F/G	P	P	P	P	E	P	P	P	P	P	P	P
Blazer	P	P	P	P	P	P	E	E	G	G	G	F/G	P	P
2,4-DB	P	P	P	P	P	P	P	F	G	G	P	G	P	P
Cadre	G	G/E	G/E	E	E	E	F	G	E	E	F	G/E	P	F
Dual	P	F/G	P	P	P	P	P	P	P	P	P	P	P	
Outlook	P	F	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	F	F
Select (Arrow)	E	P	P	E	E	E	P	P	P	P	P	P	F/G	G/E
Pursuit	P	G	E	P	P	P	P	E	G	G	P	G	P	P
Storm	P	F	P	P	P	P	G	F	F	F	F	G	P	P
Cobra	P	P	P	P	P	P	E	E	G	G	G	G	P	P
Postemergence-directed														
Aim	P	P	P	P	P	P	G	G	G	G	G	G/E	P	P



Palmer Amaranth



Russian Thistle



Silverleaf Nightshade



Ivyleaf Morningglory



Golden Crownbeard



Copperleaf



Yellow Nutsedge



Purple Nutsedge



Prairie Sunflower



Eclipta



Johnsongrass



Texas Panicum

Disease and Nematode Management

All peanut producers experience loss annually from one or more diseases. Refer to the Peanut Disease Atlas (B-1201) for more information in identifying particular diseases (the atlas can be found at http://peanut.tamu.edu/plant_pathology_resources). Peanut diseases often can be controlled or minimized with appropriate preventative practices. Potential economic benefit of these control suggestions is dependent on each grower's ability to adapt them to his production system and prevailing environmental conditions. Foliar fungicides may be applied with ground or air equipment in spray formulations. Chemigation is permitted on several fungicide labels. Any method that evenly deposits the fungicide on the entire target area is satisfactory. Apply in a band with a ground rig in early season to reduce costs. With aerial application, equipment must be properly adjusted and operated. Flagging, marking, or GPS positioning insures even distribution and correct swath widths. Stop application if temperatures are above 90° F. and relative humidity is below 45 percent to avoid spray droplets drying before hitting target plants.

Seed and Seedling Diseases

Seeds and seedlings are vulnerable to various pathogens on the seed surface, in seed skins, inside the seeds, in crop debris and in soil. High quality seeds are less likely to have seed and seedling diseases. Peanut seeds are relatively fragile and short lived compared to most other crop seeds and seed quality is influenced by many factors. Contributions to seed quality start more than 12 months before planting when the seed crop is initiated. Seed crop production factors that contribute to high quality seed include:

- A. Seed production where the growing season consistently allows full crop maturity.
- B. No Sclerotinia blight or CBR in the seed field; minimal levels of other plant diseases (including nematodes), weeds, animal damage, and insect problems.
- C. Adequate soil calcium in the peg and pod development zone that supplies the calcium needs of developing kernels.
- D. No severe stress from drought or heat (stress retards Ca uptake).
- E. Mature pods when vines were dug.
- F. No freeze injury after digging.
- G. Good harvest conditions (no extended delays due to rain, moderate temperatures, moderate relative humidity, moderate seed moisture).

Seed crop, postharvest, and planting season factors for high quality seed include:

- A. Drying after harvest, if any, is slow (usually with forced air only).
- B. During transfer, storage and handling, the pods are handled gently and proper storage climate is maintained.
- C. Seeds are gently shelled shortly before planting and fungicide seed treatment is applied prior to planting.

- D. Representative samples are tested for % germination and vigor to confirm high seed quality.
- E. Seed bags are distributed with gentle handling for immediate planting and the grower avoids short-term storage at high temperatures or in full sun.
- F. Seeds are planted in a rotated field with site/soil prepared for planting.
- G. Warm soil temperature (average 70° F or more at a 2-inch depth at 7 a.m. for 3 consecutive days) and moisture allow rapid germination (seedling diseases increase with planting in dry soil, often with long delays before irrigation reaches some parts of a field).
- H. Planters are adjusted for seed size, target seeding rate and appropriate planting depth for the site and soil type.
- I. Planting dates are reasonable (seedling diseases increase with late planting because of high soil temperatures and increased time lapse between shelling/treating and planting).
- J. Herbicide(s) are applied correctly.
- K. Soil insects do not attack seeds and seedlings.
- L. Postplant rainfall, irrigation, and temperatures are conducive to rapid germination and emergence.

Foliar Fungal Diseases

Early Leaf Spot and Late Leaf Spot - Combine chemical and cultural practices for more consistent control. Rotation with other crops reduces over wintering populations of leaf spot fungi in the soil and makes chemical disease control more effective and profitable. Use of shorter spray intervals and maximum rates of fungicides may be warranted when disease pressure is greatest, or weather conditions favor disease development. Early detection of leaf spot requires close observation. Be aware that different fungicides perform in different ways under varying weather and irrigation conditions. Always read and follow labels carefully. Chemical control methods include:

Irrigated peanut off the Cap Rock, Central Texas, and South Texas: Spanish and Valencia types - begin fungicide applications 35 to 40 days after planting and continue at recommended intervals until 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 given above if late leaf spot occurs during the early stage of plant development.

Irrigated peanut above the Cap Rock: Due to less rainfall and much lower relative humidity experienced in peanut fields above the Cap Rock, leaf spot pressure is lower, and foliar fungicides may not be profitable in some seasons. Where a 3 or 4 year rotation is used, leaf spot related losses are usually negligible, however pepper spot (*Leptosphaerulina* leaf spot) may result in yield reductions. This disease typically presents a problem between about July 15 and September 15 when a favorable environment has developed within a full canopy. Pepper spot is characterized by canopy yellowing, and is more severe in shallow soils with a high pH soils. Consequently, growers should consider a maximum of three foliar fungicide applications

to control pepper spot. Fungicide timing is critical in managing this disease. Initial applications should be made in early August and repeated on a 14 day interval. One of the multipurpose fungicides (labeled for foliar and soilborne pathogens) used for pod rotting diseases at this time is sufficient for both problems. For dryland peanuts, follow the same recommendations as for irrigated peanuts if rainfall is sufficient for continuous plant growth and disease development. However, in years of low rainfall and low humidity, fungicide applications should begin at first evidence of either leaf spot disease, or when rains or dews favor disease development. Continue applications at suggested intervals as long as environmental conditions are conducive for leaf spot development. Dew formation is most consistent in the fall, beginning in September, but may occur anytime.

Rust - The occurrence of peanut rust is usually geographically limited and sporadic except in South Texas where it occurs annually. The fungus has not been observed to over winter in Texas, and each year spores apparently blow 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. At the first sign of rust in fields or nearby fields, apply fungicides highly effective against rust at shortest intervals.

Web Blotch - Spanish and Valencia market type peanuts are more susceptible to web blotch than runner and Virginia types. However, runner types in West Texas can have problems with this disease. Several foliar fungicides used to control other foliar diseases (ie leaf spot, or rust) also effectively control web blotch.

Stem, Pod, and Peg Fungal Diseases

Positive disease identification is necessary to ensure maximum economic returns from chemicals. Signs and symptoms can be similar for two or more soilborne diseases, and effective fungicides may differ greatly for cost.

Southern Blight - Southern blight, caused by the soilborne fungus *Sclerotium rolfsii*, has coarse, initially persistent white fungus strands that develop at a moderate rate on all plant parts and on the soil surface, often in a flat-fan pattern. Nearby plant tissue becomes desiccated due to digestion by the fungus, and the mycelium disintegrates gradually over several days or weeks. On this white fungus growth, mostly-round sclerotia (seed-like long-term survival structures) age from white to tan to black and are almost never found inside stems, pods, or seeds. Southern blight is favored by warm weather. Control methods include:

- A. Rotate to avoid peanut after peanut if possible. Peanut after peanut should have crop residue buried with a mold-board plow deep enough to avoid bringing it back up during land preparation and cultivation. There may be no advantage in burying residue from non-peanut crops.

- B. Plant irrigated peanuts on a raised bed at least 4 inches high. Plant dryland peanuts on a slightly raised bed.
- C. Use a variety with partial resistance if available.
- D. Avoid very high seeding rates in problem fields. Early development of a dense canopy retains humidity that favors the southern blight fungus.
- E. Do not throw soil onto peanut plants during cultivation.
- F. Control foliar diseases with fungicides to prevent leaf shed. Leaf litter at the crown is a nutrition source for the southern blight fungus.
- G. Several fungicides can contribute to southern blight control. Multiple applications as preventative treatments in problem fields are suggested rather than single applications or rescue treatments after southern blight injury has occurred.

Sclerotinia Blight - Sclerotinia blight, caused by the soilborne and seedborne fungus *Sclerotinia minor*, has been increasing in importance in Texas peanuts since 1981. Recently, additional outbreaks of the disease have occurred, in counties with no previous history of the disease. Sclerotinia blight is characterized in early stages by non-persistent small white tufts of cottony-like fungal growth at leaf axils on the stems near the ground line. The fungus spreads rapidly during cool (65-70° F) wet weather. Later stages of the disease show up as bleaching and severe shredding of the stem accompanied by the production of many small, black, irregular-shaped sclerotia (seed-like long-term survival structures) that resemble mouse droppings in size, shape and color. Sclerotia also form inside stems, pods, and occasionally, seeds. Confusion of this disease with southern blight, caused by the fungus *Sclerotium rolfsii*, can be costly because chemicals that control southern blight have little if any effect on *S. minor*. Sulfur applied as a foliar fungicide may significantly increase the severity of Sclerotinia blight. The Sclerotinia fungus can be seedborne, so infested fields should not be used for seed production. Some seed treatment fungicides can reduce seed transmission. Equipment-related movement of infested soil and crop residue (diggers, combines, vehicles) can spread the fungus. Sclerotia may also survive the digestive processes of cattle and migratory birds. Contributions to control include:

- A. Multi-year rotation with non-hosts (for example, small grains) with deep burial of crop residue.
- B. Keep soil moisture below field capacity for the final 45 days to allow soil temperature increases during daylight hours.
- C. Plant early in south Texas to avoid disease-conducive cool fall temperatures.
- D. Use Spanish varieties because of more open plant canopies (Tamspan 90 has lower losses than other Spanish varieties); among runners, Tamrun OL 01 and Tamrun OL 02 have lower disease ratings than most other varieties, perhaps because their fewer stems and more open crown area are less favorable to *S. minor*; among Virginias, Perry is more resistant than others.
- E. Three fungicides are labeled for Sclerotinia blight control. Rovral, on the market the longest, must be applied by ground in large volumes of water (40-60 GPA) for maximum effectiveness, but control is sometimes not adequate. Omega (labeled in 2001) and Endura (labeled in 2004) provide more control than Rovral.

Botrytis Blight - Botrytis blight is caused by a species of the fungus Botrytis. It has been observed statewide, but has only been a significant peanut problem in far West Texas. Symptoms may closely resemble Sclerotinia blight (both produce delicate white mycelium and sclerotia), so a laboratory diagnosis is suggested for proper identification. With time in the field, *Botrytis* produces conidia on mycelium and lesions, while *Sclerotinia minor* does not. No fungicide label currently mentions control of the *Botrytis* fungus on peanut. Thiophanate-methyl is labeled for three other foliar diseases and is effective against Botrytis blight in other cropping systems. The more expensive Sclerotinia blight control chemicals, Omega 500 and Endura are also very effective.

Pythium and Rhizoctonia Diseases - Diseases caused by these two groups of fungi can occur alone or together. *Pythium* fungi contribute to seed rot, seedling disease, root rot, wilting, stunting, plant death, and pod rot (pod breakdown). Symptoms of *Pythium* infection may include a wet black decay sometimes covered with a loose white fungus mat; sloughing outer root layer, and greasy dark brown-black pod lesions. *Rhizoctonia* fungi cause disease on seed, seedlings, roots, lower stems, pods, pegs, limbs, and leaves. Symptoms of *Rhizoctonia* infection may include sunken red-brown dry-textured lesions on the hypocotyl (stem below cotyledons), stem (girdled seedlings), and limbs, and dry dull-surfaced light/dark brown pod lesions. Pod rots are poorly understood and difficult to control. Soil nutrition, physical soil factors, and soil fauna (insects, nematodes, mites) can be involved. Large-seeded varieties tend to have more pod rots than small seeded varieties. Cultural practices should be addressed rather than managing the problem solely with fungicides. Cultural recommendations helpful for Rhizoctonia and Pythium pod rot control include:

- A. Avoid sites and soil types with known histories of these diseases.
- B. Rotate with unrelated crops; if possible, summer fallow during rotation; use small grains as a winter cover crop (terminate and leave in place for wind protection or turn under deeply with other crop residue in the spring).
- C. Avoid excessive fertilizer, especially unneeded K and Mg.
- D. Plant on a raised bed.
- E. Improve drainage in low areas.
- F. Avoid excessive irrigation.
- G. Where salinity is a problem, check for and break up hard pans to allow leaching of salts by rains and irrigation.
- H. Apply gypsum (a water-soluble calcium source) at flowering/pegging, especially in areas where sodium salts accumulate in the soil from low quality irrigation water; large seeded varieties often require more calcium than small seeded varieties.

Aspergillus Crown Rot - Aspergillus crown rot (black mold), caused by the fungus *Aspergillus niger*, affects peanut production throughout Texas. This ubiquitous fungus is seedborne and soilborne. 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. Infected tissues are covered with black masses of fluffy fungal growth (with dusty black spores) just below the ground line. A good rotation program, high seed quality, seed

treatments, no late planting, good planting moisture, and adequate early season irrigations reduce losses.

Diplodia Collar Rot - *Diplodia* collar rot, caused by *Lasiodiplodia theobromae* (*Diplodia gossypina*) may occur where soil and stem temperatures are high due to insufficient irrigation, skips, non-lapped canopies, or defoliation by foliar diseases, insects, or hail. The fungus survives well on crop debris in the soil, and causes disease on several plants following heat stress or wounding. Symptoms include yellow, wilted, or dead plants in patches, blackened limb cankers, and pod lesions. The fungus may be seedborne. Black fungal fruiting structures develop on limb lesions in contact with soil. Reports from Virginia indicate that Virginia market type varieties are more susceptible to collar rot than runner varieties.

Cylindrocladium black rot - *Cylindrocladium* black rot (CBR) is caused by the soilborne and seedborne fungus *Cylindrocladium parasiticum*. It was diagnosed in west Texas peanuts for the first time in 2004 in one field planted with seed produced in a southeastern state with a history of CBR. No symptoms were seen in 2005 in the region. Symptoms are black decay of roots, lower stem, pods, and pegs that causes plants to yellow and die. Low soil moisture during fallow and deep soil freezing reduce fungus populations in soil. Control strategies include long rotations with non-host crops, sanitation of equipment leaving infested fields, pre-plant seed-bed injections with a fumigant, use of pathogen-free seeds, certain fungicide seed treatments for suspect seed, in-furrow at-plant fungicides, and partially resistant varieties. Infested fields should not be used for seed production.

Black Hull - Black hull, caused by the soilborne fungus *Thielaviopsis basicola*, is a peanut pod disease with big implications for the in-shell market. The fungus can cause disease on and increase its population on a large number of plants including cotton (black root rot), several weeds, most other legumes, sweet potato, several other vegetable crops, and many ornamentals. It is favored on peanut in West Texas and New Mexico by high soil pH and late season cool wet conditions. Control suggestions include:

- A. Use a 3-4 year rotation with non-hosts (small grains).
- B. Avoid sites with high pH and histories of black hull or black root rot in cotton.
- C. Plant on raised beds to increase drainage in the pod zone and allow daily heating.
- D. Select a runner variety with partial resistance and avoid highly susceptible varieties.
- E. Thiophanate-methyl fungicide has been reported to reduce incidence, but current labels do not list this disease.

Aflatoxin (Segregation III) - Aflatoxins are highly toxic chemical compounds produced in peanut seeds by the fungi *Aspergillus flavus* and *A. parasiticus* following periods of field stress or high storage moisture. Similar problems in corn and cotton seeds are primarily associated with *A. flavus*. Aflatoxins may accumulate before digging in drought stressed dryland peanuts, especially where pods are injured by insects or other agents. Segregation III peanuts are usually associated with pre-harvest drought

conditions of kernel moisture below 25% and high soil temperatures (80 to 100° F). Aflatoxins can further increase during harvest, curing and storage if drying conditions are poor, kernel moisture is high for extended periods, or the storage site has high relative humidity (seldom in Texas) and facilities that leak during rains. Large-seeded Virginia varieties appear more prone to aflatoxin development than spanish or runners under South Texas conditions. Problem loads can only be pressed for oil. Management options include:

- A. Avoid drought-prone sandy fields.
- B. Manage insect and nematode problems to minimize pod damage.
- C. Irrigate adequately to minimize drought stress.
- D. Reduce seeding rates in dryland fields to conserve soil moisture.
- E. Harvest drought stressed fields and sections of fields separately from better fields to avoid mixing with loads that are non-Seg. III.
- F. Adjust combines to prevent pod damage and transport high moisture peanuts in vented trucks and trailers to prevent heating; force air through the truck or trailer and dry as soon as possible.
- G. A non-aflatoxin producing strain of *A. flavus* is available as a biological control treatment to peanut producers (Afla-Guard, Circle One Global, Inc., Cuthbert, GA). This 'good' fungus competes with the aflatoxin-producing strains, thereby reducing aflatoxin accumulations in peanuts. A related product is labeled for application to cotton preceding a corn crop to reduce aflatoxin in corn.

Nematode Diseases

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 in Texas. Root knot is diagnosed based on 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, 1500 Research Parkway, Suite A130, Texas A&M University Research Park, College Station, TX 77845. The current fee is \$30.00 per sample. Nematode sample forms are available from this address and online at <http://plantpathology.tamu.edu/extension/tpddl/forms.asp>. A control program should include:

- A. Rotation with crops resistant to the nematodes damaging peanuts.
- B. Late maturing varieties have more potential for damage than short-season Spanish market types.
- C. NemaTam runner variety has resistance to peanut root knot.
- D. Consider a nematicide when plant parasitic nematodes have previously limited production.

Use caution when selecting a nematicide, soil moisture is extremely critical for optimum control. Telone II works best when placed in the ground 10 to 12 inches with a

moldboard plow at rates of 6-12 gal./ac. Excessive soil moisture and cold temperatures limit movement of the fumigant in the soil, thus reducing 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.

Virus Diseases

Spotted Wilt - Yield loss from spotted wilt, caused by *Tomato spotted wilt virus* (TSWV), occurs in South and Central Texas. Yield losses may exceed 50% in susceptible varieties in certain years. Tobacco thrips and western flower thrips are vectors (carriers). *Impatiens necrotic spot virus* (INSV) is related to TSWV and is also vectored by western flower thrips. INSV problems in peanut to date have been very low compared to TSWV. Typical early season spotted wilt symptoms include ring spotting of leaves and stunted plant growth, but late season symptoms of spotted wilt often do not. Older plants that become infected with TSWV often simply yellow, wilt, and quickly die. This is accompanied by brown streaking within the vascular system and deterioration of roots. Avoid overwatering 4 to 6 weeks before digging problem fields because excess moisture accelerates secondary decay of TSWV-infected roots. TSWV has a large host range. The virus is not seedborne in any crop or weed. However, infested tobacco thrips may over winter in some soils. Western flower thrips can actively feed on various plants throughout most of the year and may spread the virus during the winter among weeds, various native annuals and perennials, susceptible vegetable crops, and ornamentals. Green bean and pepper can be a bridge for TSWV in fall and spring. Spinach and potato can harbor TSWV through the winter in South Texas. Periodic off-season rains allow more non-crop vegetation (wildflowers, cool season weeds) that helps maintain and increase thrips and the virus. Seasons preceded by such rains usually have increased risk for the peanut crop. However, if rains stop by late-winter or early-spring, cool season vegetation may dry down and thrips may disperse well before the first peanuts are planted, thereby avoiding high spotted wilt incidence in peanut. On the other hand, numerous rains in May-June 2004 supported heavy non-crop vegetation that dried down and forced thrips migrations before peanut planting was finished, and late planted peanuts had severe spotted wilt. Peanuts planted in the proximity of TSWV crop hosts (spinach, potato, green bean, pepper) and early planted peanut fields often have increased risk. Very early and very late planted fields usually have increased risk. Careful planting date and field site selections may allow growers to miss peak thrips migrations from other crops and non-crop areas in some years. Large thrips populations from nearby cotton production may increase spread of TSWV in peanut. There is some evidence that cotton can be a weak TSWV host with no long-term symptoms. Movement of virus-infected thrips into and within peanut fields is very important. Two cultural practices and variety canopy traits may affect thrips migration/landing behavior. A high seeding rate decreases spotted wilt. The twin-row planting pattern decreases spotted wilt. Both practices accelerate ground cover (lapping) and after lapping, produce a flatter peanut canopy with less prominent main stems compared to low seeding rates and single row planting pattern. It's interesting that varieties with partial TSWV field resistance planted at the same seeding

rate and row pattern have less prominent main stems compared to more susceptible varieties. Our hypothesis is that canopy shape can influence thrips behavior enough to reduce spotted wilt. Work is ongoing to explain this phenomenon and use it for improved spotted wilt control strategies. Peanut varieties planted in areas at risk for spotted wilt should have some field resistance. Resistant peanut varieties have fewer infected plants and those infected plants have milder symptoms than more susceptible peanut varieties under the same conditions. Efforts continue with plant breeders to develop superior multiple-disease-resistant varieties for Texas growers. Variety options for partial TSWV resistance in 2006 include Tamrun OL 01, Tamrun OL 02, Georgia Green, and Tamspar 90.

Abiotic Problems

Ozone - Temporary high concentrations of ozone can cause “atmospheric scorch” on peanut leaflets. Nitrogen dioxide and hydrocarbons emitted from automobiles, industrial combustion, oil refineries and other sources react with sunlight to form ozone. Lightning during electrical storms produces ozone which can damage the surface of peanut leaflets. A scorched area appears primarily on the upper leaf surface of the youngest peanut leaflets. Pepper spot caused by a species of the fungus *Leptosphaerulina* may develop in these scorched leaves. Regular use of a foliar fungicide helps minimize injury by this weak pathogen in damaged tissue.

Salts - Low peanut yields, marginal leaflet burn, 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 leaflet. Pod rot often increases when sodium (Na), potassium (K), and perhaps other cations accumulate in soil in the fruiting zone. Excess cations compete with calcium for position on soil particles and allow the Ca to move below the pod zone. Calcium is a nutrient absorbed in large quantities by the developing pods and essential for high kernel quality. Calcium deficiency in pods may 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 runoff after rainfall and irrigation and increase flushing of sodium from soil.

Boron - Boron is required in very small amounts for peanut kernel quality. However, toxicity is a problem in some soils in West Texas, decreasing plant growth and yields. Yield decrease occurs with few foliar symptoms (reduced canopy size). Soil and irrigation water should be tested at least annually in areas at risk for high Boron. Test results should be considered when selecting fields for planting.

Alkalinity - Alkaline (high pH) soils are a challenge for optimal peanut production. Canopy symptoms may include yellowing and reduced leaflet and canopy size. Supplementation may be necessary for minor elements that are less available at high pH. Nodulation and nodule activity should be monitored because some fields may need Bradyrhizobium inoculant every time peanut is planted. Nitrogen fertilizer may be needed if nodule numbers and activity are not high.

Peanut seed treatment fungicides labeled in Texas in 2006^a

			Seed decay, damping off, soil-borne pathogens								Seed-borne
Fungicide	Fungicide group ^b	Formulation	<i>Rhizoctonia</i>	<i>Fusarium</i>	<i>Aspergillus niger</i>	<i>Pythium</i>	<i>Rhizopus</i>	<i>Penicillium</i>	<i>CBR</i>	<i>Sclerotium rolfsii</i>	<i>Sclerotinia</i> ^c
azoxystrobin + fludioxonil + mefenoxam	11 + 12 + 4	Dynasty PD	✓		✓ ^d	✓			✓	✓	
<i>Bacillus subtilis</i> GB03	---	Kodiak Concentrate Biological ^e	✓	✓	✓						
captan	M4	Captan 400, 4000 F	✓	✓	✓	✓	✓				
captan + PCNB + carboxin	M4 + 14 + 7	Vitavax PC	✓		✓		✓				
captan + trifloxystrobin + metalaxyl	M4 + 11 + 4	Trilex Optimum	✓	✓	✓	✓	✓				
EBDC (mancozeb, maneb)	M3	Numerous	✓	✓	✓	✓	✓				
fludioxonil	12	Maxim 4FS	✓	✓	✓			✓			
fludioxonil + mefenoxam	12 + 4	Maxim XL	✓	✓	✓	✓ ^f		✓			✓
Mefenoxam ^g	4	Apron XL LS				✓					
metalaxyl ^g	4	Allegiance-FL, -LS, 50WP				✓					
PCNB + metalaxyl + <i>Bacillus subtilis</i> GB03	14 + ---	System3	✓			✓					
Thiram	M3	Thiram 50WP Dyed, 42-S Thiram	✓	✓	✓	✓	✓				
trifloxystrobin	11	Trilex									

^aSeed suppliers usually select and apply seed treatment fungicides. ^bAvoid exclusive use of one fungicide group (as seed treatment, soil fungicide, and foliar fungicide) for groups 4 (high risk), 7 (medium risk), 11 (high risk), or 12 (low to medium risk) to minimize problems with fungicide 'resistance.' Product labels have specific instructions. See also website <http://www.frac.info/frac/index.htm>. ^cSeedborne *Sclerotinia minor* only, not soilborne inoculum.

^dSuppression only. ^eAlso for improvement of nodulation. ^fAdd Apron XL LS for *Pythium* control. ^gFor combination with a broad spectrum fungicide.

Peanut foliar fungicides labeled for use in Texas^a

Fungicide (active ingredient)	Fungicide group ^b	Formulation	Leaf spot	Rust	Web blotch	Pepper spot	Interval (days)	Hay for livestock	PHI ^c (days)
azoxystrobin	11	Abound F	✓	✓	✓		10-14	Yes	14
<i>Bacillus subtilis</i> QST713	---	Serenade, ASO, MAX, Serenade AS	✓ ^d				7-14	Yes	4 hr
boscalid	7	Endura	✓		✓		14	No	14
chlorothalonil; chlorothalonil + sulfur ^e ; chlorothalonil + propiconazole	M5; M5+M2; M5+3	Bravo Weather Stik, Bravo Ultrex, Bravo S, Chloronil 720, Echo 720, Echo 90DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, etc.; Tilt Bravo SE, Tilt/Bravo, etc.	✓	✓ ^f	✓	✓ ^g	14 ^h	No	14
Copper	M1	numerous	✓				10-14	Yes	1
flutolanil + propiconazole	7+3	Artisan	✓				21-30	No	40
mancozeb; mancozeb + copper	M3; M3+M1	numerous	✓	✓	✓		3-7,7- 10,7-14	No	14
propiconazole; propiconazole + chlorothalonil	3; 3+M5	Tilt; Tilt + chlorothalonil	✓	✓			10-14	No	14
propiconazole + trifloxystrobin	3+11	Stratego	✓	✓	✓		10-14	Yes	14
prothioconazole + tebuconazole	3	Provost	✓	✓	✓	✓	14	No	14
pyraclostrobin	11	Headline	✓	✓	✓	✓	14-21	No	14
Sulfur ^e	M2	numerous	✓	✓			7-24	Yes	1
tebuconazole	3	Folicur 3.6 F, Orius 3.6 F	✓	✓	✓	✓	14	No	14
thiophanate-methyl; thiophanate-methyl + mancozeb	1; 1+M3	numerous	✓	✓	✓		7-14	No for mixture	14

^aSeveral products are also labeled for control of soil borne fungi. ^bAvoid exclusive use of products in groups 1 (high risk), 3 (medium risk), 7 (medium risk), or 11 (high risk) to minimize problems with fungicide 'resistance.' Product labels have specific instructions. See also website <http://www.frac.info/frac/index.htm>.

^cPre-harvest interval (minimum days from last application until harvest). ^dTank mix with copper fungicide. ^eSulfur may increase an existing Sclerotinia blight problem. ^fRust not mentioned on Tilt Bravo SE or Tilt/Bravo labels. ^gOnly Chloronil 720 and Bravo Ultrex are labeled for pepperspot. ^hTilt/Bravo label states 10-14 d interval.

Peanut soil fungicides labeled for use in Texas in 2006^a

Fungicide (active ingredient)	Fungicide group^b	Formulation	Southern blight	Sclerotinia blight	Pythium seedling, pod rot	Rhizoctonia seed, seedling, pod, peg, limb rot	CBR	Aspergillus crown rot	Rotation restriction?	Hay for livestock	PHI^c
azoxystrobin	11	Abound F	C		C, S	C	S	C	Yes	Yes	14
<i>Bacillus subtilis</i> QST713	--- ^d	Serenade ASO		? ^e					No	Yes	4 hr
boscalid	7	Endura	S	C					Yes	No	14
chlorpyrifos	---	Lorsban 15G	S						No	No	21
copper	M1	Copper- Count-N	C		C	C			No	Yes	12 hr
ethoprop	---	Mocap 15G, Mocap 15G Lock 'n Load	C						No	Yes	Peg
fluazinam	29	Omega 500		C					Yes	No	30
flutolanil	7	Moncut 70 DF	C			C			Yes	No?	40
flutolanil + propiconazole	7 + 3	Artisan	C			C			Yes	No	40
iprodione	2	Rovral, 4F, 75WG		C ^f					Yes	No	10
mefenoxam	4	Ridomil Gold EC, GR, SL			C				Yes	No?	Yes ^g
metam sodium	---	Metam CLR 42% Booklet; Metam KLR 54%; Metam Sodium	C ^h	C ^h	C ^h	C ^h	C ^h				
PCNB	14	numerous	C ⁱ			C ⁱ			Yes	No	Yes ^j
PCNB + mefanoxam	14 + 4	Ridomil Gold PC GR	S		C	C			Yes	No	75
Propiconazole ^k	3	Tilt	C						Yes	No	14,21

Peanut soil fungicides labeled for use in Texas in 2006¹ (continued)

Fungicide (active ingredient)	Fungicide group ²	Formulation	Southern blight	Sclerotinia blight	Pythium seedling, pod rot	Rhizoctonia seed, seedling, pod, peg, limb rot	CBR	Aspergillus crown rot	Rotation restriction?	Hay for livestock	PHI ³
Prothioconazole + Tebuconazole	3	Provost	C			C			Yes	No	14
pyraclostrobin	11	Headline	C	S		C	S		Yes	No	14
tebuconazole	3	Folicur 3.6F; Orius 3.6F	C			C			Yes	No	14
thiophanate- methyl ^k	1	numerous				C			Yes	No?	14
trifloxystrobin + propiconazole	3 + 11	Stratego				C			Yes	Yes	14

^aSeveral products are also labeled for control of foliar fungi. C = Control, S = Suppression.

^bAvoid exclusive use of products in groups 1 (high risk), 3 (medium risk), 4 (high risk), 7 (medium risk), or 11 (high risk) to minimize problems with fungicide 'resistance.' Product labels have specific instructions. See also website <http://www.frac.info/frac/index.htm>.

^cPre-harvest interval; minimum days (or hours or growth stage at last application) from last application until harvest.

^dBiological, insecticide or fumigant with some efficacy on certain fungi.

^eSclerotinia blight of peanut is caused mostly by *Sclerotinia minor*; Serenade ASO is labeled for *Sclerotinia sclerotiorum*, a related large-sclerotia species on vegetables, ornamentals, and weeds but rarely on peanut.

^fMinimum 40 gal water/A by ground; Rovral by ground only; Rovral 45, 75WG for ground application or chemigation.

^gNo application after early pegging, pegging, or early pod set.

^hWill only control pests that are in the fumigation zone at the time of treatment.

ⁱThis disease not listed on label of some formulations.

^jAt planting only or some formulations allow use at pegging.

^kMay be used with other active ingredient.

Peanut nematocides labeled for use in Texas in 2006	
1	Abamectin
2	Acetamiprid
3	Admethion
4	Admethion
5	Admethion
6	Admethion
7	Admethion
8	Admethion
9	Admethion
10	Admethion
11	Admethion
12	Admethion
13	Admethion
14	Admethion
15	Admethion
16	Admethion
17	Admethion
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89	Admethion
90	Admethion
91	Admethion
92	Admethion
93	Admethion
94	Admethion
95	Admethion
96	Admethion
97	Admethion
98	Admethion
99	Admethion
100	Admethion

		Timing					
Nematicide	Formulation	Preplant	Planting	Pegging	Rotation restriction	Hay for livestock	PHI ^a (days)
<i>Fumigant nematicides</i>							
chloropicrin	Chlor-O-Pic	✓			No	Yes	---
dichloropropene	Telone II	✓			No	Yes	---
dichloropropene + chloropicrin	Telone C-35, C-17	✓			No	Yes	---
metam-sodium	numerous	✓			No	Yes	---
<i>Contact nematicides</i>							
aldicarb	Temik 15G, 15G Lock 'n Load, 15G CP Lock 'n Load, 15G CP		✓		Yes	No	90
ethoprop	Mocap 15G, 15G Lock 'n Load	✓	✓	✓	No	Yes	Peg
	Mocap EC	✓	✓		No	Yes	---

^aPreharvest interval (minimum days from last application until harvest).



Botrytis blight



Sclerotinia blight



**Botrytis (top)
S. sclerotiorum (bottom)**



Southern blight



Pythium Pod Rot



Rhizoctonia Pod Rot



Limb Rot



Leaf Spot



Spotted Wilt



Verticillium Wilt



Cotton Root Rot



Genetic Variation

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 do not 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. Scouting for white grubs should be started during field preparation, if high populations are present one should monitor for potential damage thru stand establishment. High population levels at planting are not indicative of economic damage occurring. While a more frequent pest in South Texas, white grubs are much less common in other peanut producing regions. White grub infestations may be more likely following high residue grass crops. 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 grub larvae are generally whitish to grayish in color, have a tan to black head, and often have a dark area near the end of the abdomen. The key field identification characteristic is that they curl into a "C-shape" when disturbed. 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 transmitting tomato spotted wilt virus between plants. 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 when adult

thrips carrying the virus fly into a field, feed on peanut plants, and thereby transmit the virus to uninfected plants. 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.

- A. 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.
- B. 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.
- C. Foliar-applied insecticides for thrips control are not recommended. Research results 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 resulting 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.

Insecticides for Thrips Control			
Insecticide	Product Rate/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 ^a	6.7 lbs		Apply in a band and water with center pivot system. May be applied at pegging.
Orthene 75S	3/4 lbs	14	Apply two applications at 10-day intervals.
Thimet 20G ^b	5 lbs	90	Apply at planting in furrow.
^a Do not use in combination with Basagran.			
^b 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. Inspect fields at least weekly 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, and with a minimum of five sample sites in any field. Select sites away from field borders. Examine the soil surface for feeding damage, silken 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 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:

Lesser Cornstalk Borer Treatment Levels		
Growth Stage	Dryland	Irrigated
Before Initial Pegging	5%	10%
After Initial Pegging	10%	15%

Insecticides for Lesser Cornstalk Borer Control			
Insecticide	Product Rate/1000 ft of row	Days to Harvest	Grazing and Hay Use
Lorsban15G ^a	7 1/2-15 oz	21	No
^a 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, yellowstriped 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.

Insecticides for Foliage-Feeding Insect Control				
Insect	Insecticide	Product Rate/Acre	Days to Harvest	Grazing and Hay Use
Armyworm (various species), cutworm, corn earworm, grasshopper	Asana XL ^a	5.8 – 9.6 fl oz	21	No
	Karate Z ^b	0.96 – 1.92 fl oz	14	Yes
	Lannate L	1 – 2 pt	21	No
	Orthene 75S ^c	1 – 1 1/3 lb	14	No
	Sevin 80S ^b	1 1/4 - 2 1/2 lb		Yes
	Steward	9.2 – 11.3 fl oz	0	Yes
	Tracer	2 – 3 fl oz	14	Yes
^a Do not exceed 0.15 lb. of actual insecticide per acre per season. Resistance may develop. ^b See label for specific rates. ^c For grasshopper control, use 1/3 – 2/3 lb/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 is no apparent relationship between infestation sites and soil type, topography or proximity to field borders. Do not limit inspection to a specific portion of the field. There currently are no insecticides labeled for borrowing bug 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.

Insecticides for Spider Mite and Southern Corn Rootworm Control				
Insect	Insecticide	Product Rate/Acre	Days to Harvest	Grazing and Hay Use
Spider mite	Danitol	10.66 – 16 oz	14	No
	Comite ^a	2 pt	14	No
	Omite 30WS ^b	3 – 4 lb	14	No
Southern corn rootworm ^b	Lorsban 15G ^c	7.5 – 15 oz/1000 ft row	21	No
^a Comite – Do not make more than one application per season. ^b 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. ^c Has been observed to have erratic control when used as a rescue treatment. Apply granules in a 14- 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.				

Videos describing Integrated Pest Management principles and scouting techniques for peanuts can be viewed at: <http://lubbock.tamu.edu/ipm/peanut>. Also available at the website are photographic images of most peanut insect pests discussed here.



Spider mites



Spider mite damage



Spider mite webbing



Thrips Damage



Southern Corn Root



Root Worm Damage



**Lesser Cornstalk Borer
Silken Tubes**



**Burrowing Bug
Nymphs**



Burrowing Bug

Application Techniques

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.

- A. 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.
- B. 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:

$$\frac{\text{Total Volume of Tank}}{\text{Total Operating Time}} = \frac{500}{90} = 5.6 \text{ gal/hr}$$

Now that the total gallons per hour are 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. The formula to calculate banded rate is:

$$\frac{\text{Broadcast rate (12 oz/A) x Band width (12 inches)}}{\text{Row width (36 inches)}} = \text{Banded rate per acre (4 oz/A banded)}$$

Precautions

- A. Read the label on each pesticide container before use. Carefully follow all restrictions concerning use of plant materials as animal feed.
- B. Always keep pesticides in original containers.
- C. Dispose of empty containers according to label specifications.
- D. 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.
- E. Please follow Worker Protection Standards Regulations (WPS) per label instructions for proper treatment and reentry restrictions.

Points of Application

- A. Restrict insecticide use to actual need, based on field inspections.
- B. Direct hollow cone nozzles to cover plants thoroughly for foliage-feeding insect control.
- C. 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.
- D. Periodically check the calibration during the season.
- E. 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.
- F. Maintain accurate, detailed records of pesticide use.

References

Beasley, J. P. 1990. Peanut growth and development. The Cooperative Extension Service, The University of Georgia. SB 23-3.

Additional information in regards to peanut production can be found at:
<http://peanut.tamu.edu>



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