2011 PEANUT PRODUCTION GUIDE FOR OKLAHOMA

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PEANUT PRODUCTION GUIDE FOR OKLAHOMA – 2011

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I. THE PEANUT INDUSTRY

Peanut production in Oklahoma started in the 1930s and early 1940s. Initially, the need for oil during World War II encouraged the expansion of peanut production. In 1940, there were 82,000 acres of peanuts planted. The high mark for plantings came seven years later when Oklahoma farmers planted 325,000 acres of peanuts.

Planted acres have been reduced significantly since the 2002 Farm Bill, which eliminated the Quota Marketing system. In 2000, 97,000 acres of peanuts were planted in Oklahoma, but that has declined to around 20,000 acres in 2010. In the early years, 750 pounds of pods per acre was considered a good yield. Today, Oklahoma's yield averages from 3,000 to 3,400 pounds per acre. The peanut crop produced each year is typically extremely good quality. Peanuts are grown in more than 12 of the state's 77 counties.

Worldwide, more than 40 million acres of peanuts are planted each year. Of this, the U.S. plants less than two million acres, making the U.S. acreage less than 5 percent of the world's peanut plantings. However, while world yields are only around 800 to 900 pounds per acre, U.S. yields average 2,500 to 2,600 pounds per acre, resulting in 10 to 12 percent of total world production.

II. MARKET TYPE AND VARIETY SELECTION

The availability of irrigation is a critical factor in choosing a market type of peanut. Runner market types of peanuts require more water than Spanish varieties. In recent years, Oklahoma producers have increased their production of varieties. Oklahoma currently produces 23 percent Spanish varieties, 37 percent Runners, and 26 percent Virginia varieties. Runners require a longer growing season — around 160 days compared to 140 to 145 days for Spanish varieties. Planting both Spanish and Runner varieties may offer acceptable yield and return potential, while spreading planting and harvest times, thus reducing risk.

Recently, the majority of breeding efforts have been spent on development of high oleic fatty acid varieties. Oleic acid is a monounsaturated fatty acid credited with benefiting the cardiovascular system, as well as warding off spoilage and off-flavor in stored peanut products. Most shellers prefer the high oleic acid trait when purchasing.

Variety selection should be based on the characteristics that best fit a particular farming operation. Variety selection should be based on expected maturity which will determine 1) when the crop is ready for harvest; 2) disease resistance (particularly Sclerotinia blight reaction); and 3) yield and quality (grade) potential. The selection of a variety should be based on more than one year's performance. See Table 1 for long-term variety performance.

DIFFERENT MARKET TYPES

Runner

Runners have become the dominant type due to the introduction in the early 1970s of a new runner variety, Florunner, which was responsible for a spectacular increase in peanut yields. Runners have rapidly gained wide acceptance because of the attractive, uniform kernel size. A large percentage of the runners grown are used for peanut butter.

Virginia

Virginias have the largest kernels and account for most of the peanuts roasted and processed in the shell. When shelled, the larger kernels are sold as snack peanuts.

Spanish

Spanish-type peanuts have smaller kernels covered with a reddish-brown skin. They are used predominantly in peanut candies, with significant quantities used for snack nuts and peanut butter. They have a higher oil content than the other types of peanuts, which is advantageous when crushing for oil.

Valencia

Valencias usually have three or more small kernels to a pod and are covered in a bright-red skin. They are very sweet peanuts and are usually roasted and sold in the shell. They are also excellent for fresh use as boiled peanuts.

RUNNER VARIETY DESCRIPTIONS

Tamrun OL07 (high oleic)

Tamrun OL07 is a runner market-type peanut cultivar with high O/L ratio. It was released in 2006 by Texas A&M. It is a cross among Tamrun 96, breeding line Tx901639-3, and SunOleic 95R. Tamrun OL07 is more resistant to Sclerontinia than Tamrun OL01 and probably posses the greatest amount of resistance in currently available varieties. Yields are similar or slightly higher than Tamrun OL02.

SW Runner

Released in 1998, SW Runner has erect growth and open canopy.

Good disease resistance, especially Sclerotinia. Small seed is the problem with this variety.

Tamrun OL 02 (high oleic)

Released in 2002, Tamrun OL02 is a high oleic Runner market-type. This variety will be similar to Tamrun 96. Tamrun OL02 has some tolerance to Sclerotinia. This variety developed from Tamrun 96 parentage. Maturity is the same as Tamrun 96.

Flavor Runner 458

Flavor Runner 458 was released by Mycogen company in 1996 as another high oleic variety. The plant growth habit is prostrate with an alternate branching pattern. Flavor Runner 458 is similar to Floruner in regards to pod and seed color, seedling vigor, hull thickness, seed size, and disease and insect resistance. This variety has a history of performing better on heavier textured soil in Oklahoma.

VIRGINIA VARIETY DESCRIPTIONS

Brantley (high oleic)

Developed by the North Carolina Agricultural Research Service (ARS), North Carolina State University (NCSU) and USDA ARS, Brantley is a large-seeded variety with high-oleic oil content, essentially derived from NC 7. In yield tests, it was similar to NC 7, except for having a higher content of extra large kernels. It should be considered susceptible to early leaf spot, Sclerotinia blight and TSWV.

Jupiter

Jupiter released by OSU and ARS in 2000. Susceptible to Sclerotinia blight, but generally has higher tolerance to Sclerotinia blight compared with NC-7. Jupiter tends to have large percentages of Virginia-pods, ELK, and TMSK to NC-7. Maturity is earlier than most Virginia varieties.

Perry

Perry (released in 2000): is a large-seeded peanut with partial resistance to CBR and some tolerance of Sclerotinia blight. It is characterized by a semi-runner growth habit. Perry is susceptible to tomato spotted wilt virus. It matures fairly late. This variety has good resistance to Sclerotinia blight and web blotch. It has a spreading runner growth habit.

SPANISH VARIETY DESCRIPTIONS

Tamnut OL06 (high oleic)

Tamnut OL06 is a large seeded, Spanish type peanut that has the high O/L genes. This variety was released by Texas A&M in 2006. It is a cross between Tamspan 90 and a Florida high oleic breeding line. Yield should be slightly higher than Tamspan90. Yield potential in Oklahoma has been good during the last two growing seasons.

Spanco

Spanco was released by the USDA and the Oklahoma Agricultural Experiment Station in 1981. Spanco originates from a cross between Chico and Comet, and is a high yielding, early-maturing, Spanish-type peanut with erect growth habit. Spanco does not mature as early as Pronto, but it is 10 to 14 days earlier than other previously grown varieties. Spanco should be provided a growing season similar to other Spanish varieties to obtain its maximum potential.

Tamspan 90

Tamspan 90 is a typical Spanish type peanut with vegetative growth, plant form, rate of growth, foliage density, and main stem height. The foliage is slightly darker green than that of Starr. Most pods have two seeds, but the percentage of three-seed pods is greater in Tamspan compared to other Spanish varieties. Seeds are round and tan. Under Sclerotinia blight disease pressure, the frequency of visibly diseased plants is low. Days from infestation until disease symptom appearance is high, and yield is high. In the absence of Sclerotinia blight, yields of Tamspan 90 have been equal to or better than other Spanish varieties. Where Sclerotinia blight is a serious problem, the yields of Tamspan 90 have been significantly higher than other Spanish varieties. Tamspan 90 exhibits less pod rot disease than other varieties. Some indications of reduced infection by Rhizoctonia have been observed.

Pronto

A large-seeded Spanish variety, Pronto has a growth habit typical of Spanish varieties, except that it exhibits more yellow-green color than other Spanish cultivars. Pronto matures three to four weeks earlier than Florunner, and it has yields and grades similar to Spanco.

Olin (high oleic)

Named in honor of long-time peanut breeder Olin Smith, it's a high-oleic Spanish cross between Tamspan 90 and UF 435 Spanish. This is a high oleic Spanish variety with good yield and seed size.

AT 98-99-14 (high oleic)

AT 98-99-14 is marketed as a Spanish peanut. It has a spreading growth habit. Released by Golden Peanut Company. This variety has performed well in Oklahoma in 2006 and 2007. Has large seed size for a Spanish variety. Maturity is similar to Flavorunner 458.Spreading growth habit.

B. VARIETY PERFORMANCE TESTS OF SPANISH, RUNNER, AND VIRGINIA VARIETIES

Variety performance tests are conducted each year by Oklahoma State University. These tests compare varieties currently available with new varieties becoming available in yield, grade, and susceptibility to disease. These tests are conducted at various locations across the state to determine performance under different environmental and soil conditions.

Table 1. Peanut yields and grades from Beckham County variety tests in 2007-2010 and 4 year average.

Variety or line	*Yield (lb/A)*	*Grade (% TSMK)*	*Yield (lb/A)*	*Grade (% TSMK)*	*Yield (lb/A)*	*Grade (% TSMK)*	*Yield (lb/A)*	*Grade (% TSMK)*	*Yield (lb/A)*	*Grade (% TSMK)*
	- - - - 2007 - - - -		*- - - - 2008 - - - -*		*- - - - 2009 - - - -*		*- - - - 2010 - - - -*		*- - - - 4 yr Avg. - - - -*	
Runner[1]										
GA-09B	na	na	na	na	na	na	5359	70.4	5359	70
Tamrun OL 07	5838	74	5710	76	4229	74.0	5064	71.2	5210	74
Red River Runner	5229	77	5928	79	4461	78.2	5223	73.7	5210	77
SW Runner	4473	74	5899	74	na	na	na	na	5186	74
Tamrun OL 02	3147	71	5463	74	4657	73.9	5846	71.7	4778	73
Flavorunner 458	4443	74	5107	78	4352	76.3	4866	75.0	4692	76
LSD 0.05	1825	2	781	3	ns	1.5	ns	ns		
Spanish[1]										
ARSOK-S1	4046	74	5619	73	4138	71.9	5501	69.9	4826	72
Tamnut 06	4029	73	5961	71	3939	70.6	5374	67.1	4826	70
AT 98-99-14	4000	75	6141	73	4320	73.4	4411	69.2	4718	73
Spanco	3740	76	5616	69	3684	74.3	4683	74.8	4431	74
Tamspan 90	3323	74	5140	72	3576	72.2	5271	67.5	4328	71
GA 04S	3766	71	5147	65		na	na		3839	68.7
	4251	68								
OLin	2998	74	4828	71	3530	72.1	4206	67.3	3891	71
Pronto	2886	77	4672	73	3521	75.6	3970	72.7	3762	74
LSD 0.05	577	2	502	2	502	1.4	706	4.3		
Virginia[1]										
Gregory	4866	69	5173	70	3975	70.3	na	na	4671	70
Brantley	4433	72	4599	71	4068	74.2	4642	66.3	4436	71
Jupiter	4409	73	5470	69	4034	70.8	3528	65.3	4360	70
Champs	na	na	na	na	na	na	4030	68.6	4030	69
GA-08V	na	na	na	na	na	na	3800	65.7	3800	66
LSD 0.05	ns	1	ns	ns	ns	ns	ns	3		

[1] Market type.

[2] % TSMK = Percent total sound mature kernels.

[3] Data was not available because variety was not included in the table.

Table 2. Peanut yields and grades from Caddo County variety tests in 2006-2009 and 4 year average.

Variety or line	*Yield (lb/A)*	*Grade (% TSMK)*	*Yield (lb/A)*	*Grade (% TSMK)*	*Yield (lb/A)*	*Grade (% TSMK)*	*Yield (lb/A)*	*Grade (% TSMK)*	*Yield (lb/A)*	*Grade (% TSMK)*
	- - - - 2007 - - - -		*- - - - 2008 - - - -*		*- - - - 2009 - - - -*		*- - - - 2010 - - - -*		*- - - - 4 yr Avg. - - - -*	
Runner[1]										
GA-09B	na	na	na	na	na	na	4559	69.6	4559	70
Red River Runner	2831	72	3764	74	4068	65.2	4519	71.7	3796	71
Tamrun OL 02	2323	68	3311	68	3717	60.7	4770	68.1	3530	66
Tamrun OL 07	2278	68	3416	68	3480	61.4	4218	68.9	3348	67
Flavorunner 458	2355	69	2882	69	3063	63.2	4116	69.4	3104	68
SW Runner	2355	70	3812	71	na	na	na	na	3084	70
LSD 0.05	374	2	352	3	779	ns	452	1.9		
Spanish[1]										
Spanco	2314	70	3539	67	3467	64.7	4527	67.4	3462	67
ARSOK-S1	2350	68	3420	69	3354	64.0	4516	65.1	3410	66
AT 98-99-14	2804	70	3224	65	3006	65.8	3989	65.8	3256	67
Tamnut 06	2246	64	3608	69	2937	63.8	3881	64.2	3168	65
Tamspan 90	1938	65	3278	67	3002	63.3	4120	65.5	3084	65
Pronto	1788	72	3184	66	3093	59.6	3532	69.1	2899	67
OLin	1593	68	3325	70	3118	65.2	3441	63.4	2869	67
GA 04S	1661	63	2556	62	na	na	3089	63.7	2435	63
LSD 0.05	521	4	477	3	414	ns	459	1.7		
Virginia[1]										
GA-08V	na	na	na	na	na	na	5224	68.0	5224	68
Champs	na	na	na	na	na	na	3599	62.7	3599	63
Jupiter	1892	64	3122	67	3536	63.2	4596	64.2	3286	65
Brantley	1974	68	2820	66	3292	64.1	4080	64.3	3042	66
Gregory	2242	65	2653	68	3542	63.3	na	na	2812	66
LSD 0.05	455	3	ns	ns	ns	ns	706	1.3		

[1] Market type.
[2] % TSMK = Percent total sound mature kernels.
[3] Data was not available because variety was not included in given year.

Table 3. Peanut yields and grades from Custer County variety tests in 2008-2010 and 2 year average.

Variety or line	Yield (lb/A)	Grade (% TSMK)	Yield (lb/A)	Grade (% TSMK)	Yield (lb/A)	Grade (% TSMK)	Yield (lb/A)	Grade (% TSMK)
	- - - - 2008 - - - -		- - - - 2009 - - - -		- - - - 2010 - - - -		- - - - 3 yr Avg. - - - -	
Runner[1]								
Tamrun OL 07	7402	61	6716	68.2	7162	68.4	7093	66
GA-09B	na	na		na	na		6679	68.5
6679	69							
Flavorunner 458	6360	66	6135	66.0	7184	70.0	6560	67
Red River Runner	6309	65	6530	72.4	6552	69.4	6464	69
Tamrun OL 02	5340	59	6559	68.9	6933	67.2	6277	65
LSD 0.05	1456	4	735	3.8	ns	ns		
Spanish[1]								
AT 98-99-14	5833	68	7743	70.3	6803	64.9	6793	68
ARSOK-S1	5612	68	7106	68.4	5982	64.4	6233	67
Tamnut 06	5981	65	6312	67.5	5852	65.3	6048	66
Spanco	4879	70	6240	65.8	6647	67.6	5922	68
OLin	5961	70	6248	69.9	5427	65.3	5879	68
Tamspan 90	5122	67		5550	68.0		6244	64.3
5639	66							
Pronto	4824	71	6047	68.5	5329	66.5	5400	69
LSD 0.05	907	2	976	ns	598	2.5		
Virginia[1]								
GA-08V	na	na	na	na	7148	65.1	7148	65
Jupiter	6236	63	6636	65.9	6701	67.3	6524	65
Brantley	5242	66	7050	66.4	6077	66.4	6123	66
Gregory	5485	61	6443	67.5	na	na	5964	64
Champs	na	na	na	na	5844	64.7	5844	65
LSD 0.05	ns	ns	435	ns	ns	ns		

[1] Market type.
[2] % TSMK = Percent total sound mature kernels.
[3] Data was not available because variety was not included in given year.

Table 4. Disease reaction of peanut varieties and advanced breeding lines adapted for production in Oklahoma[1]

Market Type	*Variety[2]*	*Early leaf spot*	*Web blotch*	*Southern blight*	*Sclerotinia blight*	*Pod Rot*	*Limb rot*	*TSWV*
Spanish	Tamspan 90	S	S	R	R	MR	MS	MS
	Spanco	S	S	S	MR	MR	MS	S
	Pronto	S	S	S	MR	MR	MS	S
	Olin	S	S	S	MR	MR	MS	S
	AT-98-99-14	S	S	S	MS	MS	S	S
	Georgia 04S	MS	MR	S	MS	MS	S	MR
	Tamnut OL06	S	S	S	R	R	MS	S
Runner	**Georgia 09B**	MS	MR	S	MS	S	S	MR
	Okrun	MS	MR	S	S	MS	S	S
	Red River Runner	MS	MR	S	MR	MS	S	MR
	Tamrun 96	MS	MR	MR	MR	MR	MS	MR
	Tamrun OL02	MS	MR	S	MR	MR	S	MR
	Tamrun OL07	MS	MR	S	MR	R	S	MR
	Georgia Green	MS	MR	S	MS	MS	S	MR
	Flavor Runner 458	MS	MR	S	S	MS	S	S
	Georgia 03L	MS	MR	S	MR	S	S	MR
	Georgia 02C	MS	MR	S	MS	MR	S	MR
Virginia	**Georgia 08V**	MS	MS	S	S	S	S	MR
	Jupiter	S	MS	S	MR	S	S	S
	Brantley	S	MS	S	S	S	S	S
	Perry	MS	MR	S	MS	S	S	S

1 S=susceptible, MS=moderately susceptible, MR=moderately resistant, R= resistant. None of the varieties have complete resistance to any of the diseases and the ratings reflect relative levels of partial resistance (differences between varieties) that may vary with environment. For diseases on which fungicides have proven beneficial, an R (resistant) rating suggests that a fungicide program for that disease would not be beneficial. All varieties are susceptible to root-knot and root-lesion nematodes.

2 Varieties or lines in bold are High O/L.

III. PRODUCTION PRACTICES FOR SPANISH AND RUNNER TYPE PEANUTS

A. Crop Rotation

Rotation of peanut with grass crops or cotton is essential. Benefits of rotations include soil moisture improvement, disease and weed control, and nutrient availability. Peanut fields rotated with other crops typically have fewer problems with foliar and soil-borne diseases, weeds, and soil insects.

Continuously growing peanuts on the same land does not allow for a rest period so disease cycles can be broken. In a three-year rotation, a peanut crop follows two years of corn, grain sorghum, another grass crop, or cotton, which is best for keeping diseases at a low level compared to growing continuous peanuts. These crops respond well to fertilization and leave residual fertilizer in the soil that benefits peanut growth and development. Rotations with grass crops are effective for controlling root knot nematodes but are ineffective for controlling root lesion nematodes. Two year rotations, a peanut crop followed by another crop, is often not long enough to break pest cycles. At least two years between peanut crops is preferred.

Cotton is a good rotation crop with peanuts, but may pose mechanical problems in how the taproot and stalks are handled. To allow maximum decomposition, cotton roots should be ripped up and shredded in the fall before peanuts are planted the following spring.

Several factors limit crop rotation with peanuts. These factors include the distance separating fields where peanuts might be grown, the limited or no irrigation potential of possible fields, and the unavailability of additional land.

B. Soil Selection

Peanuts perform best in sandy, sandy loam, or loamy-sand soils. Fine textured soils (typically considered as heavy, tight, black, or gumbo) are not recommended for peanuts. Several reasons exist why peanuts prefers sandy soils: 1) well drained soil does not lead to pod discoloration caused by organic matter or iron oxides, 2) the peg is able to penetrate the soil, 3) pod size is reduced in fine textured soils, and 4) harvesting is easier in coarse textured soils.

One disadvantage of sandy soils for peanut production is the low water-holding capacity of these soils. Sandy soils tend to dry out very quickly.

C. Planting Requirements

Weather Conditions and Peanut Stands

Southwest weather conditions change rapidly; and a cold front can cause soil temperatures to drop below acceptable levels for peanuts. When combined with cold rain, the results can be disastrous and may even require replanting. Follow weather reports and avoid planting before a cold front.

Knowing the soil texture of different fields helps decide which fields to plant first. Sandy soils tend to warm more quickly than finer textured soils, which have some clay or loam. This difference relates to the water-holding capacity of the soil types. Sand holds less moisture because of its coarse texture. Soils with some clay or loam have a finer texture that has a higher water-holding capacity. Moisture resists temperature change. Sandy soils have less moisture and tend to warm more rapidly than finer-textured soils with higher moisture content.

Water uptake is the first step in germination of peanut seed. Seeds require a moisture level greater than 35 percent for germination. Soil moisture must be available to permit germination to occur. Seeds that take up cold water during germination may perform poorly.

The standard recommended planting dates for Oklahoma peanuts are May 1 through June 15 for runners and May 1 to May 30 for Spanish varieties. They have proven to be reliable, and planting close to these dates usually results in greater success.

Favorable soil temperature is also necessary for germination. Peanut seed will actually germinate over a wide temperature range (41 F to 104 F). Germination will be quick within a range of 77 F to 86 F. The optimum temperature for rapid germination and seedling development is 86 F to 91 F.

Planting should not commence until the soil temperature is 65 F at a 4-inch depth, measured at 7 a.m. for three consecutive days. This is rarely before May 1 in Oklahoma. The Mesonet is an excellent source to identify what the soil temperature is in your area. You may find this information at: http://www.mesonet.ou.edu/public/current.html.

High seed prices justify extra care at planting time to avoid replanting. Desirable stands for Spanish varieties are five to six plants per row foot. For runner varieties, it is desirable to have about four plants per row foot. There should be a few skips greater than 6 inches in length. Rotary hoeing may help plants emerge through a soil crust.

Peanut seeds are living organisms and should be handled with care. Exposure to excessive temperature and humidity can damage quality. Seed should not be left setting in the sun for extended periods of time. Only seed that can be planted in about half a day of planting should be carried to the field at any given time. Avoid dropping and throwing seed sacks because peanut seed coats are very fragile. Stirring seed in the hopper boxes should also be minimized, as this may damage sensitive seed coats and may reduce the stand.

D. Temperature Range for Peanut Seed Germination

The following information serves as a guide to germination expectations for peanuts:

Temperature range for germination — 41 F to 104 F
Temperature range for quick germination — 77 F to 86 F
Temperature range for optimum germination — 86 F to 91 F

E. Seed Inoculation

Oklahoma research shows that moderate but consistent yield increases can be obtained even on old peanut land with certain types of peanut seed inoculants. Studies have indicated yield increases of approximately 5 percent even on old peanut ground. Nitrogen is typically not a concern with peanut production, since they are legumes and manufacture an adequate amount of nitrogen for their own needs. The plant supplies the bacteria with an environment and nutrients in which to survive and multiply. In turn, the bacteria convert atmospheric nitrogen into a form that can be used by the plant through a process called nitrogen fixation. In order for nitrogen fixation to occur, *Rhizobium* bacteria must be present in the soil. Sometimes soils contain and adequate amount of *Rhizobium* bacteria, however, it is a risk not worth taking. In most cases, application of an inoculant calculates to less than 3 percent of your production costs so it is a wise investment. With proper seed inoculation using peanut-specific inoculants, you increase your chances of having good nodulation. Typically, 25 to 100 nodules per plant are observed.

Inoculants can be applied to the seed (liquid), in a hopper-box mixture (powder) or directly into the ground (liquid or granular) with an in-furrow application. Liquid inoculants are currently the most popular. Powder inoculants should not be used if other sources of inoculant are available. Powder inoculants may not perform as well when compared with liquid and granular types, especially if an additive is not used to adhere the inoculum to the seed. Producers should consider the following when making inoculant choices:

1. The cost of inoculant per number of *Rhizobium* bacteria.
2. Consider how it will be applied and whether any preparation of the product is needed.
3. Compatibility with seed, fertilizer, and other chemical treatments. As a general rule of thumb, insecticides are more toxic than fungicides, which are more toxic than herbicides.

Extreme importance should be used when handling and storing inoculants since it is a live bacteria. Inoculants should be stored in a cool (less than 90 F), dry area and never exposed to sunlight. As with any other product, always read and follow label directions. Four to six weeks after planting, plants may be dug up and evaluated for nodulation.

F. Seeding Rates and Row Spacing

1. Spanish Varieties

For irrigated Spanish peanuts, sufficient seed should be planted to obtain about four to five plants per foot of row. Dryland Spanish peanuts can be produced in eastern Oklahoma, which has more dependable rainfall than southwest Oklahoma. Low yields and low quality can occur as a result of excessive heat and inadequate rainfall. Dryland Spanish seeding rates should be reduced below the seeding rate for irrigated Spanish.

2. Runner Varieties

Sufficient seed should be planted to obtain about four plants per foot of row. Using seed with 80 percent germination would necessitate planting five plants per foot of row.

The row spacing used will be determined by the type of planting and harvesting equipment available. However, current research data indicate that peanuts planted in narrow rows will yield more than peanuts planted in wider rows.

Peanuts-General Recommended Population (peants/row ft)

		36" Row (seed/ft)			
Variety	*Seed (no./lb)*[2]	*4*[3]	*5*	*6*	*Plant Population/acre*[1]
Irrigated Runner	779	75	93	112	65,200 (4.5 plants/ft)
Irrigated Spanish	900	65	81	97	65,600 (4.5 plants/ft)
Dryland Spanish	900	65	NA	NA	43,740 (3 plants/ft)
Virginia	550	97	129	NA	55,935 (3.5 plants/ft)

1 Assumes 90 percent germination and emergence.

2 Seed no./lb shown are averages and actual counts may be greater or less than the counts shown. Adjust seeding rates up or down depending on the exact seed/lb count of seed purchased.

3 Desirable plant populations

- Irrigated runners – four to five plants per row ft.
- Irrigated Spanish – four to five plants per row ft.
- Dryland Spanish – three to four plants per row ft.
- The seeding rate for dryland Spanish may be reduced to as low as 35 pounds per acre which would result in a population of two plants per row foot (assuming 90 percent germination and emergence). This seeding rate is used in southwest Oklahoma where summer rains are unpredictable and high growing season temperatures are expected. Dryland Spanish peanuts are considered risky in all areas of Oklahoma, but above average rainfall with the avoidance of a prolonged summer drought can result in economically acceptable yields and grades.
- Virginias – three to four plants per row foot.

Dryland runner peanuts are not recommended for any area of Oklahoma.

G. Planting Date

1. Spanish Varieties

Because of their shorter growing season and lower water requirement, Spanish peanuts may be planted over a longer period of time than runner varieties. Spanish peanuts may be planted between May 1 and June 15.

2. Runner Varieties

The optimum planting date for runners in Oklahoma is May 1 to May 15. Runners planted during the last two weeks of May perform well if favorable weather conditions are received during the maturing season and an early frost is not received.

The row spacing to be used will be determined to a large extent by the type of planting and harvesting equipment available. Research from the southeast indicates a yield advantage from twin row planting but this is mainly due to reduction in tomato spotted wilt virus, which we do not see widespread in Oklahoma. In Oklahoma peanuts can be grown in 30- to 36-inch rows with similar yields.

H. Prevention of Aflatoxin in Farmer Stock Peanuts

Aflatoxin which results in segregation three peanuts has been a minor problem in the southwest. In any given year, less than 1 percent of the crop has problems in this area.

Production practices that improve the chances that aflatoxin will not become a problem include:

(a) Well irrigated peanuts are usually not susceptible to aflatoxin problems. When drought occurs and kernel moisture drops below 35 percent, peanuts are highly susceptible to fungal infection and aflatoxin is likely to develop.

(b) Excellent pest control will reduce the risk of aflatoxin problems. Healthy plants maintained by good disease control measures will mature more uniformly and be less likely to have a high percentage of immature or over-mature peanuts, which are more likely to be susceptible to fungal infection. Soil insect injury also provides an opportunity for aflatoxin development. The drought conditions that are favorable for soil insects such as lesser cornstalk borer, are also favorable for aflatoxin development.

(c) Combines should be operated to minimize mechanical damage to both shells and kernels. Sound mature peanuts usually are free of aflatoxin, while loose shelled kernels (LSKs) are much more likely to be contaminated with aflatoxin.

(d) Previous crop residue in trailers can be a source of contamination and should be cleaned out before harvest is started.

IV. VIRGINIA PEANUT PRODUCTION

A. General

The Virginia market peanut has special requirements that make its production more difficult than Spanish and runner types. Attention to these special needs can result in success with Virginia-type peanut production.

Virginia peanut production begins with the right soil. The ideal Virginia peanut soil is well-drained, light colored, sand or sandy loam soil. Moist soil rubbed between the index finger and thumb should not ribbon out but should fall apart easily. Pods produced in these soils are bright, shiny, and clean which is a characteristic highly desired by consumers. Some brown colored soils will work, but red soils are unacceptable for producing Virginia peanuts for the in-shell market. Red soils stain the pods, and after roasting the pods become even darker.

B. Seed Characteristics and Variety Selection

The seeds and pods of Virginia-type peanuts are very large. The seed count averages 500 seeds per pound, whereas the runner varieties average around 800 seeds per pound. Most Virginia peanuts are contracted, and the variety grown will be specified. Currently, the varieties being grown in the southwest are Brantely, Perry, and Jupiter. These variety matures in around 130 to 140 days, making it mature earlier than some of the runner varieties. Virginia peanuts are generally lower in seed vigor than runner types, which are lower than Spanish varieties. Growers become concerned when Virginia seedlings do not emerge quickly from the soil, but this is characteristic.

C. Irrigation Requirements

Irrigation water needs to be available to produce high quality Virginia peanuts in Oklahoma. Relying on natural rainfall will result in a disaster in the southwest. Peanuts need 20 to 22 inches of water (properly timed) to produce an acceptable crop. Irrigation must make up the rainfall shortage. Rainfall is usually sufficient to meet the moisture needs of the crop during the germination and early vegetative stages. The maximum susceptibility to drought period is during the flowering and pegging down stage which occurs about 45 to 60 days after planting.

D. Harvesting

Harvesting time for Virginia peanuts does not differ from other varieties and occurs when maximum yield and quality have been reached.

Digging is responsible for most pod loss during harvest. Over-maturity or early defoliation resulting from heavy disease can result in heavy pod loss during digging. Yield losses should be kept at 5 percent or less during the digging operation. Extra care must be exercised in harvesting Virginia peanuts. The peg/pod attachment is not as strong as that of runners or Spanish varieties and rough handling causes excessive pod loss.

V. SOIL FERTILITY

High peanut yields are dependent upon a soil that furnishes adequate levels of essential elements. Peanuts are high in mineral elements and remove considerable quantities of these elements from the soil.

Research shows that peanuts respond poorly to direct fertilization. Adequate phosphorous (P) and potassium (K) application to rotational crops such as corn, grain sorghum, or cotton will usually meet the needs of the peanut crop.

A. Nutrient content of a 3,000 lb yield of nuts.

		Pounds of Nutrients Used				
Yield	*Lbs.*	*N*	*P_2O_5*	*K_2O*	*CaO*	*MgO*
Kernels	2,000	90	20	20	3	5
Hulls	1,000	10	1	15	4	2
Hay	4,000	80	10	80	50	30
Totals		180	31	115	57	37

B. Fertilizer Placement

Fertilizer placement is critical for peanuts. Phosphorus should be placed in the root zone by broadcasting and plow-down. In some instances, the phosphorus may be applied to the side and below the seed at seeding. Do not place fertilizer in direct contact with the seed.

When K fertilizer is needed, apply it in the primary root zone, away from the pegging zone. Potassium in the pegging zone reduces yields and increases the number of empty pods, which are referred to as “pops.” A broadcast, plow-down application of K is best.

C. Fertilizer Recommendation Guide

Apply fertilizer according to the needs indicated by a recent soil test. Use a small amount of nitrogen (N) in starter fertilizer. Additional N is not needed for peanuts. Avoid the application of P and K whenever soil tests indicate these elements are sufficient.

1. Nitrogen Deficiency Symptoms:

Nitrogen deficiency symptoms do not occur frequently. Nitrogen deficiency is observed through varying degrees of plants turning yellow. Young plants not adequately infected with rhizobia may become lighter green than usual. As the plant develops, the lower, older leaves are most affected. Under field conditions, chlorosis (yellowing) may result from lack of root nodulation and ineffective N fixation or from waterlogged soil conditions. Peanuts may turn yellow for reasons other than N deficiency. Determine the correct cause of peanut plant yellowing with care.

2. Nitrogen Recommendation:

Apply 10 to 20 pounds N per acre in starter fertilizer.

In Oklahoma, N applications in excess of 10 to 20 pounds per acre as a starter are not beneficial. Large amounts of N keep the crop vegetative and promote weed growth.

3. Phosphorous Deficiency Symptoms:

Peanut plants deficient in P are typically stunted with reduced leaf size. Leaves may become bluish-green followed by a thickening and a leathery, dull, dark green color. Phosphorous deficiency is not a common problem in Oklahoma peanuts.

4. Phosphorous Recommendation:

P Soil Test Index	*Percent Sufficiency*	*P_2O_5 lbs/A*
0	40	80
11	60	60
21	80	40
41	90	20
65	100	none

Phosphorous deficiencies are easily corrected. Small amounts of phosphorous are removed by the peanut crop; and phosphorous is relatively immobile in the soil. Fertilization normally results in an increase in soil P levels slowly. This buildup can be measured by soil testing. When soil reserves are adequate to produce a crop, additional fertilizer will not provide an economic benefit.

5. Potassium Deficiency Symptoms:

Potassium deficiency is seen as chlorosis (yellowing) of the leaves, beginning at leaf margins. These regions change to reddish-brown, then become scorched in appearance. Leaf margins may curl upward.

6. Potassium Recommendation:

K Soil Test Index	*Percent Sufficiency*	*K_2O lbs/A*
0	40	80
76	60	60
126	75	40
201	90	30
250	100	none

The use of K on peanuts has not produced consistent results. Research shows that peanuts only respond to K on soils that are very low in this nutrient. Removing the hay crop after peanut harvest takes away more K than removing the nut crop only.

Excess K in the fruiting zone can result in a calcium deficiency and peanut "pops." Calcium/potassium ratios should be maintained in the range of 3:1.

7. Calcium Deficiency Symptoms and Recommendation:

Calcium (Ca) must be available to both the plant and the pod. Calcium moves up the plant but does not move down by being absorbed through the roots. After pegs are formed and move into the soil, Ca stops moving through the stems to the pegs. The Ca needs of the developing pod must be met by uptake directly from the surrounding soil.

Calcium does not move through the peg to the pod and developing kernel, so the peg and pod must absorb Ca directly from the soil. In order to develop normally, pods must be surrounded by an adequate Ca supply. Excessive K in the pegging zone may interfere with Ca uptake.

Peanuts require a greater amount of Ca under field conditions. Calcium deficiency is seen as an abnormal fruiting habit. Either one or both kernels may fail to develop or they may only partially develop and shrivel during the drying process. Calcium deficiencies may show up as a darkened plumule or a condition known as "black heart." This is the result of the peanut kernel obtaining an insufficient amount of Ca. The embryo within the kernel dies and becomes blackened. Poor seed germination and seedling abnormalities result from this type of seed.

Extreme deficiency results in lack of pods. If the deficiency is not too extreme, seeds may not develop, leaving only the shells to develop. Calcium may also have some role in pod rot development.

Peanut types vary in sensitivity to a lack of Ca in the fruiting zone. The Ca levels required for the different peanut types must be considered and must be used as a guide for determining whether to make an application of Ca.

The amount of calcium required is partially related to the seed size of the market type planted. For example, Spanish and runner types require less calcium and Virgina types require more. In Oklahoma, soil test levels of 600 pounds of Ca per acre are adequate for both runner and Spanish type peanuts. Large-seeded Virginia types require soil test levels of more than 1,500 pounds of Ca per acre. States that grow the large seeded Virginia types recommend Ca application regardless of soil test levels.

Calcium requirements are met with either **lime or gypsum** application. Soil characteristics determine which to use. Research in Georgia has shown that lime can be used as a calcium source if the soil pH is low (below 6.0).

Lime - Lime should be used if the soil pH needs to be raised to improve crop production. High soil pH slows the rate at which lime dissolves. Lime must be applied ahead of planting time and worked into the soil for soil neutralization. Lime should not be plowed-down but applied after the soil has been turned. It should be concentrated in the upper 3 inches of soil where most of the pod development will occur.

Gypsum - Gypsum can be used if the soil pH is adequate but the soil Ca level is inadequate. Gypsum does not change the soil pH and serves only as a Ca and sulfur source. Gypsum applications are made during peanut flowering; and the application should be made in a band over the row.

Recommended Gypsum Rates to Alleviate Calcium Deficiency in Peanuts.

Calcium Soil Test Index (lb/A)	*Gypsum Needed (lb/A)*
0-150	750
150-300	500
300-450	400
450-600	300
600-750	200
750+	0

Peanut fields that have a calcium deficiency may show symptoms late in the growing season. Excessively green foliage late in the growing season may result from poor seed development. Calcium deficiency will also result in reduced sound mature kernels (SMKs) and ELKs. This results in lower grades and profit potential.

8. Micronutrients

(a) Boron: Severe boron (B) deficiency can cause striking plant symptoms; however, an effect on seeds is more common in Oklahoma peanuts. Boron deficiency causes the peanut seed to exhibit a condition known as "hollow heart." When a seed is split, the inside face of the seed half is depressed in the center and the area may be brown. Only a small amount of boron is required to correct a deficiency, an excess amount results in toxicity. Leaves become yellow and turn brown. They may be shed in severe cases. Following soil test recommendations can help avoid this situation.

Boron is needed to produce top yields and grades on some soils, but it should be applied only when needs have been established through a reliable soil test or internal damage of the peanut kernel has been diagnosed as a boron deficiency.

Do not apply more than one pound of boron per acre. Boron fertilizer has improved peanut yields and quality greatly when the boron soil test was less than 0.25 parts per million (ppm). Peanut quality may be improved by applying boron to soils with a P and K fertilizer and applied as a broadcast, plow-down treatment.

Recommended Fertilizer Rates to Alleviate Boron Deficiency in Peanuts

Boron Soil Test Index (ppm)	*Boron Requirement --------(lbs/A)--------*
0.0-0.25	1.0
0.25-0.50	0.5
0.50+	0.0

(b) Iron: Iron deficiency in peanuts is noted on soils with high pH values. Soil applied iron chelates are effective in correcting the deficiency but other iron sources are not. Apply according to manufacturers' suggestions. Solutions of 1 percent iron sulfate are effective as a foliar application. Foliar

Lime Required to Raise Soil pH to pH 6.8 for Peanuts

Soil Buffer Index	*ECCE* Lime (tons/A)*
6.2	4.2
6.3	3.7
6.4	3.1
6.5	2.5
6.6	1.9
6.7	1.4
6.8	1.2
6.9	1.0
7.0	0.7
7.1	0.5
7.2+	0.0

* Effective Calcium Carbonate Equivalent - Pure calcium carbonate ground fine enough to be 100 percent effective. The rate of ag-lime to apply can be determined from the ECCE requirement using the following formula:

Tons of ag-lime / A = Tons ECCE lime required / %ECCE

applications should be made late in the day when temperatures are low. This may provide temporary response if the deficiency is severe. The iron content of premium fertilizers is too low to be of much value in correcting iron deficiency.

(c) Zinc: Zinc soil test levels less than 0.30 ppm are considered deficient for peanuts. For peanut soils deficient in zinc, 6 to 10 pounds per acre of zinc should be added. Some producers may wish to apply about two pounds of zinc per year until the total suggested amount is applied. The rate of zinc suggested is enough to correct a deficiency for several years. The rate should not be repeated until a new soil test is taken. Both zinc and boron are essential micronutrients, but they are toxic to peanuts when present in large quantities in the soil, irrigation water or fertilizers. Make sure to not over-apply Zn to peanuts.

Zinc Recommendation for Peanuts

Zinc Soil Test Index (ppm)	*Zinc Requirement (lbs/A)*
0.0-0.3	6-10
0.3-0.8	2-5
>0.8	0

D. pH REQUIREMENTS

Peanut yields are best when the soil pH is neutral or between pH 6.5 and 7.2. If soil pH is below 5.8, apply lime to a pH of 6.8, using the soil buffer index reading to determine rate of lime.

IV. INSECT CONTROL

Information on insect pests is divided into two categories: (1) those associated with plant structures at or below the soil surface and (2) foliage feeding pests. For more detailed information on insect pests in peanuts and beneficial species, consult OSU Extension Fact Sheet EPP-7174. Insect pests do not usually pose a serious threat to yields, but growers should watch carefully for occasional outbreaks.

A. SOIL INSECT PESTS

1. Lesser Cornstalk Borer (LCB)

For many Oklahoma peanut growers, the major insect pests is the cornstalk borer. The larvae are reddish-brown with bluish-green bands. They are found beneath the soil surface in tubes or sacs made out of soil particles woven together with silken material. The larvae crawl rapidly or flip about when probed or held in the hand.

The LCB is primarily a subterranean feeder. It may damage or destroy root systems in seedling peanuts, resulting in a reduced stand. The LCB can damage mature plants by feeding on pegs, pods, stems, and roots. Pegs will frequently be cut off below ground level, and the developing nuts may be hollowed out.

Larvae are generally most damaging to peanuts grown in non-irrigated conditions or during a drought. In most years, prolonged rainfall or irrigation appears to significantly reduce populations of this pest.

A thorough field survey for LCB includes checking at least five plants at five different locations in the field. It is important that different locations be sampled because the larvae tend to prefer sandy soils.

After checking at least five plants at five different areas of the field, divide the total number of plants inspected into the number of plants found to be infested with live larvae. This provides the percentage infested.

Treatment for LCB's is suggested when infestations reach the following levels:

FOR IRRIGATED PEANUTS:	If infestation levels exceed 10 percent prior to pegging and 15 percent after pegging.
FOR NON-IRRIGATED PEANUTS:	If infestation levels exceed 8 to 10 percent at any time.

Research in Alabama has developed economic thresholds based on adult LCB counts. Adult LCB counts can be monitored by simply flushing male and female moths from peanut plants. Sampling should be conducted during morning hours using a stick to beat plants from a distance. LCB moths can be distinguished from other species by their unique coloration and distinctive flight pattern.

The Alabama model suggests that an average of one adult per 2.4 to 3.8 meters would justify intensive scouting for larvae. This translates into averaging 2.6 to 4.2 moths for every 10 feet of peanuts flushed. To ensure accuracy, a minimum of 100 feet of row should be sampled. Numbers of adult moths in the sampling can be translated into larval abundance one week later. This model has not been tested in Oklahoma where conditions may not allow such rapid development from the egg to the larval stage.

Aerial application of insecticide is not recommended to control the LCB. The reduced volume and overhead application do not allow adequate coverage of the soil at the base of the plants. Granular insecticides or basal directed sprays are suggested for control of this pest in irrigated peanuts. Granular insecticides are not recommended for non-irrigated peanuts, use drop pipes from the spray boom and two, flat-fan nozzles per row. This allows for good coverage of the soil at the base of the plants. To ensure thorough coverage and penetration to rot/pegging zone, apply a minimum of 20 to 20 gallons of total spray per acre, the highest label rate of insecticide and largest volume of total spray are suggested during extremely hot, dry periods.

2. Granulate Cutworm

During daylight hours, this larva is beneath peanut foliage and must be found by checking at the soil surface. It has mottled bray and tan coloration with many small, dark granules over the body. Larvae may range from one to two inches in length.

This insect seldom damages large acreages of peanuts, but may reach large population densities during August and September. It feeds primarily during nighttime hours on plant foliage, pegs, and pods. This pest reduces yield by clipping pegs and tunneling into pods.

Field checks for granulate cutworms can be performed at the same time sampling is conducted for the LCB. General guidelines for controlling cutworms should be followed.

These are:

- in non-irrigated peanuts, three to five larvae per row foot;
- in irrigated peanuts, six to eight larvae per row foot;
- if granulate cutworms are feeding on pegs or pods, treatment should begin whenever larval numbers exceed two to three larvae per row foot.

B. Foliage Feeding Insects

Foliage feeding insects may cause considerable damage of peanuts if populations reach high numbers. This group of pests includes corn earworms, rednecked peanut worms, armyworms, webworms, and grasshoppers.

Research on these pests has shown that peanuts are extremely tolerant to foliage loss throughout most of the season. Peanuts up to 30 days old have been found capable of tolerating approximately 75 percent defoliation without significant yield reduction. Peanuts 30 to 60 days old can tolerate 35 to 45 percent defoliation. Peanuts 60 to 90 days of age need to be checked the closest. Even moderated defoliation may reduce yields during this crucial period of plant development. When plants are between 60 and 90 days old, defoliation should not be allowed to exceed 15 percent. A guide to making control decision for foliage-feeding worm pests in peanuts at this critical part of the season is: non-irrigated peanuts = three to five larvae per row foot; irrigated peanuts = six to eight larvae per row foot.

Peanuts more than 90 cays old can tolerate more defoliation Research has indicated that after peanuts exceed 100 days of age, defoliation as high as 60 percent will not normally reduce yields.

Most species of pests that feed on peanut foliage are adequately controlled with pesticides. Growers must be aware of the approximate percentage of defoliation these pests are causing.

PEANUT INSECT CONTROL SUGGESTIONS

INSECT AND TIME MOST PREVALENT	*DAMAGE AND/OR INSECT DESCRIPTION*	*INSECTICIDE (MOA GROUP) AND AMOUNT PER ACRE*		*COMMENTS*
Beet armyworm	Striped-green caterpillar, that has a black spot above the second pair of true legs.	Warrior[r] (3)	3.84 oz	14-day waiting period to harvest.
Summer Note: Treatment thresholds[1]		Lannate LV[r] (1A)	1.25-3.0 pt	Do not feed treated vines and do not apply within 21 days of harvest.
		Lannate SP[r] (1A)	.375-1.0 lb	
		Asana XL[r] (3)	5.8-9.6 oz	Do not feed or graze livestock on treated vines. Do not exceed 29 oz per season. 21-day waiting period to harvest.
		Tracer (5)	2.0-3.0 oz	Do not allow grazing of crop residue or harvest of crop residue for hay until 14 days after application. Do not apply within three days of nut harvest. Do not apply more than 9.0 fl oz per acre per crop, or make more than three applications per calendar year.
		Proaxis[r] (3)	3.84 oz	Do not apply within 14 days of harvest. Do not apply more than 0.96 pts per acre per season.
		Prolex[r] (3)	1.54 oz	Do not apply within 14 days of harvest. Do not apply more than 0.38 pts per acre per season.
		Javelin (11B2)	0.25-1.5 lb	No waiting period to harvest. A *Bacillus thuringiensis* (B.t.) product.

Blister beetles July-August	3-striped most common in peanuts.	Sevin XLR+ (1A)	0.5-1.0 qt	14-day waiting period to harvest
Cabbage looper	Looper - large green caterpillar with white stripes – tapers toward head	Lannate LV^r (1A)	1.5-3.0 pt	Large loopers can be difficult to control. See restrictions under beet armyworm comments.
Summer See comments[1]		Lannate SP^r (1A)	0.50-1.0 lb	See restrictions under beet armyworm comments.
		Javelin (11B2)	0.25-1.5 lb	See restrictions under beet armyworm comments.
		Tracer (5)	1.5-3.0 oz	See restrictions under beet armyworm comments.
		Orthene75S (1B)	1.0-1.3 lbs	14 days to digging.
Corn earworm	Caterpillars chew holes in foliage and feed on terminal buds	Sevin XLR+ (1A)	1.0-1.5 qt	14-day waiting period to harvest.
		Lannate LV^r (1A)	0.75-3.0 pt	See restrictions under beet armyworm comments.
Summer See comments[1]		Lannate SP^r (1A)	0.25-1.0 lb	
		Orthene 75S (1B)	1.0-1.3 lbs	14 days to digging.
		Warrior^r (3)	2.56-3.84 oz	14-day waiting period to harvest.
		Tracer (5)	1.5-3.0 oz	See restrictions under beet armyworm comments.
		Danitol^r (3)	10.6-16.0 oz	14 days to digging.
		Asana XL^r (3)	2.9-5.8 oz	See restrictions under beet armyworm comments.
		Javelin (11B2)	0.25-1.5 lb	See restrictions under beet armyworm comments.
		Proaxis^r (3)	2.56-3.84 oz	See restrictions under beet armyworm comments.
		Prolex^r (3)	1.02-1.54 oz	See restrictions under beet armyworm comments.

Granulate Cutworm[1]	Larvae found at soil surface beneath peanut foliage. Mottled gray and tan with many dark granules over surface of the body.	Asana XL[r] (3)	5.8-9.6 oz	See restrictions under beet armyworm comments.
		Sevin XLR+ (1A)	2.0 qt	14 day waiting period to harvest.
		Lannate LV[r] (1A)	1.5-3.0 pt	See restrictions under beet armyworm comments.
		Lannate SP[r] (1A)	0.50-1.0 lb	See restrictions under beet armyworm comments.
		Javelin (11B2)		0.25-1.5 lb
		Proaxis[r] (3)	1.92-3.20 oz	See restrictions under beet armyworm comments.
		Prolex[r] (3)	0.77-1.28 oz	See restrictions under beet armyworm comments.
		Warrior[r] (3)	1.92-3.20 oz	14 day waiting period to harvest.
Fall armyworm	Large striped caterpillar with inverted “y” on front of head.			
		Sevin XLR+ (1A)	1.0-1.5 qt	14-day waiting period to harvest.
Summer[1]		Danitol[r] (3)	10.6-16.0 oz	14-day waiting period to harvest.
		Lannate LV[r] (1A)	0.75-1.5 pt	See restrictions under beet armyworm comments.
		Lannate SP[r] (1A)	0.25-0.50 lb	See restrictions under beet armyworm comments.
		Tracer (5)	2.0-3.0 oz	See restrictions under beet armyworm comments.
		Javelin (11B2)	0.25-1.5 lb	
		Asana XL[r] (3)	9.6 oz	See restrictions under beet armyworm comments.
		Orthene 75S (1B)	1.0-1.3 lb	14 days to digging.
		Proaxis[r] (3)	2.56-3.84 oz	See restrictions under beet armyworm comments.
		Prolex[r] (3)	1.28-2.05 oz	See restrictions under beet armyworm comments.
		Warrior[r] (3)	2.56-3.84 oz	See restrictions under beet armyworm comments.

Grasshoppers Summer	Consume foliage	Warrior^r (3) Orthene 75S (1B) Asana XL^r (3)	2.56-3.84 oz 0.33-0.66 lbs 5.8-9.6 oz	14-day waiting period to harvest. 14-day waiting period to harvest. See restrictions under beet armyworm comments.
Potato Leafhopper Summer	Small hopping or flying wedge-shaped insects– sap feeders, cause yellowing of foliage and brown leaf tips (called “Hopperburn”).	Warrior^r (3)	1.92-3.20 oz	14-day waiting period to harvest.
		Sevin XLR+ (1A) Orthene 75S (1B) Asana XL^r (3)	1.0 qt 1.0-1.3 lb 2.9-5.8 oz	14-day waiting period to harvest. See additional restrictions on previous page. Note. Threshold information from Georgia states treatments should be considered when you find 25 to 30 percent hopperburn and leafhoppers present
		Danitol^r (3) Lannate LV^r (1A) Lannate SP^r (1A) Proaxis^r (3) Prolex^r (3)	6.0-10.6 oz 0.75-3.0 pts 0.25-1.0 lb 1.92-3.20 oz 0.77-1.28 oz	14-day waiting period to harvest. See restrictions under beet armyworm comments. See restrictions under beet armyworm comments. See restrictions under beet armyworm comments. See restrictions under beet armyworm comments.
Lesser cornstalk borer (LCB)	Bluish-green worm; up to 0.66 in long - very active when touched.	Lorsban 15G (1B)	6.8-13.9 lb	Lorsban granular application at pegging using the higher rate in a narrow band over the row and an in-row foliage opener can provide excellent control of LCB’s and good suppression of Southern blight, with rainfall or irrigation following application. Two full rate (2.0 lb) applications per season may be applied. Also, provides suppression of Southern blight. Do not harvest within 21 days after treatment and do not feed treated peanut forage or hay to meat or dairy animals.

Mid-June through September. Economic infestation more common from late July on.	Tunnels nuts and stems, cuts pegs near soil surface.	Warrior^{r} (3)	3.84 oz	
	Begin applicaton when infestation level reaches 8 to 10 percent in dryland peanuts and 15 percent in irrigated peanuts.	Orthene 97 (1B)	4.0-8.0 oz	Do not feed treated forage or hay to lievestock or allow grazing in treated areas.
		Asana XL^{r} (3) (aids in control)	9.6 oz	See restrictions under beet armyworm comments.
		Javelin (11B2)	0.25-1.5 lb	
		Proaxis^{r} (3)	3.84 oz	See restrictions under beet armyworm comments.
		Prolex^{r} (3)	1.54 oz	See restrictions under beet armyworm comments.
Rednecked peanutworm	Small, greenish-white worm with crimson necks. Scar and perforate terminals (buds) destroying or deforming the young leaves and stunting growth.	Sevin XLR+ (1A)	1.0 qt	Research indicates that peanuts can tolerate considerable feeding by peanutworms without reducing yield. Unless populations become quite heavy (80 to 100 percent terminals infested) or infestations occur in combination with other foliage feeders, such as corn earworms, insecticide applications are unwarranted
May to September with heaviest infestations occurring from mid-summer through September.		Asana XL^{r} (3)	2.9-5.8 oz	
		Tracer (5)	1.5-3.0 oz	See restrictions under beet armyworm comments.
		Proaxis^{r} (3)	1.92-3.20 oz	See restrictions under beet armyworm comments.
		Prolex^{r} (3)	0.77-1.28 oz	See restrictions under beet armyworm comments.
		Warrior^{r} (3)	1.92-3.20 oz	14 day waiting period to harvest.

Spider mites				
Summer; during hot dry weather, most common after first of August.	Very small (1/50 inch) damage indicated by reddish brown discoloration of leaves. Mites can be wind or machinery transported to fields. Frequently develop in early summer in weeds, fence/turn rows, and move to peanuts when dry weather hits.	Omite (14)	3.0-5.0 lb	Do not apply within 14 days of harvest. No more than two applications per season. Two or more treatments 5 days apart may be necessary to get control.
		Warrior[r] (3)	3.84 oz	14-day waiting period to harvest.
		Comite (14)	2.0 pt	Apply 20 gal. of finished spray per acre by ground and 5 gal. per acre by air. Do not apply within 14 days of harvest and do not graze or feed livestock on treated area.
Note: See footnote 2 for additional products.		Danitol[r] (3)	10.6-16.0 oz	Do not apply within 14 days of harvest or grazing.
		Proaxis[r] (3)	3.84 oz	See restrictions under beet armyworm comments.
		Prolex[r] (3)	1.54 oz	See restrictions under beet armyworm comments.
Southern corn rootworm	This rootworm is the larva of the spotted cucumber beetles. The larva is yellowish-white with a brown head and somewhat wrinkled body. The larva may reach 0.5 inch in length.	Lorsban15G (1B)	6.8-13.9 lb	Apply in a narrow band over the row during early pegging. (See comments under LCB section.) Rainfall or irrigation is needed following application. Rate based on 36” row spacing.

	Tend to occur most commonly on heavier soils. Damage to shell may appear as a small brown spot on nut. If spots are noted, open nuts and check for larvae.	Thimet^{r} 20G (1B)	3.87-5.28 lb	Apply as a band over the fruiting zone at pegging. Do not graze or feed hay for forage. Rate based on 36” row spacing.
		Warrior^{r} (3)	2.56-3.84 oz	14-day waiting period before harvest.
		Proaxis^{r} (3)	2.56-3.84 oz	See restrictions under beet armyworm comments.
		Prolex^{r} (3)	1.02-1.54 oz	See restrictions under beet armyworm comments.
Thrips	Tiny, slender, insects, most commonly found in terminals—rasp new leaves causes blotching and deformed terminals.	Lannate LV^{r} (1A)	1.5-3.0 pt	Do not feed treated vines.
May through June Check immediately after emergence.		Lannate SP^{r} (1A)	0.5-1.0 lb	21-day waiting period before harvest.
		Sevin XLR+ (1A)	1.0 qt	14-day waiting period to harvest.
		Proaxis^{r} (3)	2.54-3.84 oz	See restrictions under beet armyworm comments.
		Prolex^{r} (3)	1.02-1.54 oz	See restrictions under beet armyworm comments.
		Orthene 75S (1B)	0.5-1.0 lb	Do not feed forage or hay or graze treated areas.
		Orthene 97 (1B)		
		Broadcast	6.0-12.0 oz	
		Banded	3.0-6.0 oz	Note: Research has not been able to show consistent yield increases even with control of heavy thrips populations. Insecticide applications should be restricted to instances where very high populations exist and sever damage, with destruction of terminals, occurring in seedling plants.

		Warrior[r] (3)	2.56-3.84 oz	Do not feed forage or hay or graze treated areas. Do not apply more than 15.36 oz/A/season.
	"AT PLANT APPLICATONS" Granular Insecticide Box applications			See footnote 3.
		Thimet 20G[r] (1B)	3.87-5.28lb	Apply granules evenly in the furrow at planting. Do not graze or feed treated hay or forage. 90 day pre-harvest interval.
		Temik 15G[r] (1A)	7.0-14.0 lb	Apply in seed furrow and cover with soil. Check label for restrictions. 90 day pre-harvest interval.
		Di-Syston 15G[r] (1B)	6.7 lb	Apply as a band on each side of seed furrow at planting. Do not apply directly on the seed. Do not feed treated vines.
		Hopperbox application		Apply as a planter box treatment evenly over seed, alternating 1/3 seed, then 1/3 chemical until box is filled. Do not attempt to mix Othene with seeds by stirring or agitation. This may damage seeds prior to planting. Do not graze or feed treated hay or forage
		Orthene 75S (1B)	4.0 oz	

[r] Restricted use Pesticides.

MOA Group Tables start on page 46 of the handbook.

1 Thresholds: For foliage feeding pests (e.g., corn earworm and armyworms) - the threat of yield reduction due to defoliation exists primarily when plants are from 60 to 90 days old. Check fields frequently durng July and August for earworms, armyworms, etc. and apply insecticides if populations exceed three to five larvae/row ft. in dryland or six to eight larvae/row ft. in irrigated peanuts. For granulate cutworms - if feeding on foliage, use the same guidelines provided above for foliage feeders; however, if cutworms are feeding on pegs or pods, treatment should begin if larval numbers exceed two to three per row ft. in irrigated or dryland peanuts.

2 Additional miticides: Limited control (supperession) has been obtained using either M-pede (potassium salts of fatty acids), Pyrellin(pyrethrins and rotenone) or Saf-T-Side (petroleum oil). The latter two are toxic to fish and should not be used near water. Saf-T-Side should not be used with, before, or after spraying dinitro compounds, or fungicides containing sulfur. Also, do not use with Carbaryl or Dimethoate.

3 Systemics for thrips: Several formulations of this type have been used in Oklahoma with erratic results. Success with these compounds is usually related to thrips pressure, moisture condittions and planting time. Currently, prophylactic use of these compounds in Okalhoma is not recommended. These compounds are presented here only as a guideline to rates and applicaton methods.

DISEASE CONTROL

Peanuts are prone to damage by many diseases. Effective disease control is essential in the production of high-yielding peanuts. Disease management involves the use of diverse control strategies such as crop rotation, resistant varieties, and the use of chemical control when necessary. The use of several control strategies in an integrated disease management program generally results in better and more economical control compared to total dependence on chemical control. However, chemical control is important in peanut production for managing foliar diseases and some soilborne diseases where long crop rotations are not feasible and when resistant varieties are not available. General management strategies for the important peanut diseases are discussed below. This is followed by a listing of chemical controls registered for use on peanuts that are effective in reducing losses from these diseases. The disease reactions of peanut varieties are listed on page 10. Photos of disease damage appear on pages 45 to 47.

SEEDLING DISEASE - Seedling diseases are caused by several soil and seed borne fungi. Seed rot and pre-emergence damping off result in the failure of seedlings to emerge. Post-emergence damping off results in seedling death (blight) after emergence. Cool, wet periods after planting encourage seedling diseases and produce unfavorable soil conditions for plant growth. Other stresses such as cold soil, a poorly prepared seedbed, herbicide injury, excessive rain, and poor quality seed may also contribute to stand failures and should be distinguished from seedling disease.

Control: The goal of seedling disease control is to achieve an adequate stand. Fungicide seed treatments applied by seed dealers effectively control seedling disease in most instances. Cultural practices that also help ensure a good stand include planting high-quality seed in a well-prepared seedbed, in a raised seedbed for improved drainage, at the proper depth, and when soil temperature and moisture are favorable. Where stand establishment is difficult because of a history of severe seedling disease, application of additional fungicide as a planter box or seed furrow treatment may be used to provide additional control of seedling disease. Expect about two to three weeks of protection from these treatments.

NEMATODE DISEASES - Nematodes are microscopic, slender, round worms that live in the soil. Some species feed on the roots of plants and cause damage where populations are high. The northern root-knot and root-lesion are the two most important nematode pests of peanuts in Oklahoma. The peanut root-knot nematode was recently identified in a few fields in southwestern Oklahoma. In fields where these nematodes have reached high populations, yields may be reduced to the extent that a crop cannot be profitably grown. Nematodes reach the highest populations and are most damaging in sandy soils. However, other soil types also may support damaging populations.

Symptoms

Northern root-knot - Root-knot infected plants have a dense, bushy root system with tiny galls (swellings) formed at the points of root branching. Galls may also form on pegs and pods. On sandy soils, plants may be stunted and pale green in color. Stunted plants are usually clustered, resulting in uneven row growth. Yields are reduced from poor plant growth and pod set.

Root-lesion - Plants infected with root-lesion nematode develop brown pin-point spots on pods and pegs. The spots enlarge and turn darker in color leaving a peppered appearance to the pods. High populations reduce plant growth and pod set. Pegs may be weakened so that pods are left in the soil at harvest.

Peanut root-knot - Large galls form on roots and pods, causing extreme swelling and disfiguring of below-ground plant parts. Severely affected plants are stunted and pale green in color. Stunted plants are usually clustered and rows grow unevenly.

Control: Control practices are aimed at reducing nematode populations below damaging levels. Efforts should also be made to avoid introducing nematodes into clean fields with contaminated soil. The type of nematode present and its population level in the soil must be determined before planting for an effective control program. This is because control practices differ depending on the type of nematode present, low populations usually do not threaten yield, and nematode problems cannot be corrected after planting.

Northern root-knot - Root-knot nematode can be effectively managed with crop rotation. Cotton, corn, grain sorghum, and sudan grass are excellent rotational crops for reducing root-knot populations. Rotation is also effective in preventing the development of a root-knot problem. Where damaging levels of root-knot occur and peanuts are to be planted, a suggested nematicide should be applied at planting.

Root-lesion - Crop rotation is not usually effective in the control of this nematode because it can reproduce on many different crops. Nematicide applied at planting and again at pegging where damaging populations of root-lesion nematode are present may be beneficial.

Peanut root-knot - Control strategies are the same as for northern root-knot except that a nematode-resistant variety (NemaTAM) can be planted where peanut root knot is found. ‘NemaTAM’ is not effective against the northern root-knot nematode.

Nematicides - Several nematicides are available which will provide control of both root-knot and root-lesion nematodes for one season. Nematicides must be applied before or at planting. Some nematicide registrations allow a second application at pegging for extended control and for control of root-lesion damage to developing pegs and pods. All nematicides are poisonous and are classified as restricted use pesticides. They should be used with extreme caution.

Nematode sampling - Fields can be checked for symptoms of nematode damage by examining roots and pods during the season. Symptoms of nematode infections are a warning of a potential economic problem. Fields suspected of harboring nematodes should by sampled in an orderly fashion and samples submitted to the OSU Plant Disease Diagnostic Laboratory for analysis. Fields known to be infested should always be sampled before planting peanuts so controls can be applied if populations exceed damaging levels.

Samples can be collected before planting in the spring. However, sampling in the fall, just prior to or at harvest will increase the chances of accurately measuring nematode levels. Root-lesion nematodes can be difficult to detect in soil. Therefore, both roots and soil are needed for this nematode. Entire fields and/or areas where peanut growth was poor may be sampled. If a large field is to be sampled, divide it into smaller, separate units or take samples along a w-shaped pattern to ensure a representative sample. Collect soil from the root zone (2 to10 in. deep); do not include the uppermost one inch of soil. Include fibrous (feeder) roots with the sample. Bulk the soil and/or root samples taken from several places in the field or diseased area in a bucket, mix, and remove 1 quart for analysis. Package the samples in plastic bag to prevent soil from drying out. Keep samples cool and away from direct sunlight, but do not allow them to freeze. Promptly submit samples to the OSU Plant Disease and Insect Diagnostic Laboratory, 125A Noble Research Center, Oklahoma State University, Stillwater, OK 74078; directly or through your County Extension Educator.

LEAF SPOT DISEASES - Early leaf spot is the most common foliar disease. It affects nearly every peanut field in the state. Late leaf spot is less common in Oklahoma, but is more difficult to control than early leaf spot. Web blotch is another important foliar disease in some production areas that is more difficult to control than early leaf spot. Pepper spot is usually of minor importance, but can develop on some varieties late in the season. Control of foliar diseases is essential in the production of a high-yielding crop. Yield losses can exceed 50 percent where foliar diseases are allowed to defoliate plants. Spanish varieties are particularly prone to damage from early leaf spot because they become infected earlier in the season Spanish varieties also are more susceptible to web blotch.

Symptoms

Early leaf spot - On upper leaf surface, spots are circular, brown to dark brown in color, up to 1/3 inch in diameter, and are usually surrounded by a yellow border. Spots are brown on the lower leaf surface. Infected leaves turn yellow and fall to the ground with defoliation beginning in the lower canopy and moving upward. Elongated dark brown spots also develop on stems and pegs where the disease is severe.

Late leaf spot - Symptoms of this disease are very similar to early leaf spot except spots are darker and have a faint or absent yellow border on the upper leaf surface. Spots are black on the lower leaf surface.

Web blotch - Web blotch first appears as large, irregular, olive-green colored webbing on the upper leaf surface. Later, blotches turn brown and extend though to the lower leaf surface.

Pepper spot - Numerous small, dark brown to black spots develop on one side of the leaf. Spots lack yellow borders. Spotted leaves may develop a V-shaped scorch before yellowing and dropping. Similar spots occur on stems.

Control

While crop rotation is useful in delaying the development of foliar diseases, fungicide sprays are required for effective control when weather is favorable for disease development. Fungicides provide from 10 to 14 days protection before weathering and loss of effectiveness occurs. In addition, fungicides only protect healthy foliage from infection and do not cure established disease. Therefore, they must be applied preventively, and repeated applications are required to provide season-long control.

Fungicides should be applied in a sufficient volume of water to achieve thorough coverage. A minimum volume of 15 gal/acre is suggested for ground applications. Some fungicides also may be applied by aircraft (minimum of 5 gal/acre) or by chemigation (check label). Chemigation is the least effective method of application for leaf spot control. For chemigation, the fungicide should be injected into solid-set or side-roll systems during the last 30 minutes of a set. Fungicide can be injected into center-pivot systems during the full irrigation period by using an injector pump. Because there is less fungicide residue left on leaves compared to other methods of application, better disease control with chemigation has been obtained at the highest rates recommended for ground and aerial application.

Spray programs should be started 30 to 45 days after planting. Delaying spray programs until disease appears is risky and resulting disease control may not be satisfactory. Once the first application is made, sprays should be repeated on 14-day intervals or made according to an advisory program until two weeks before anticipated harvest.

Early Leaf Spot Advisory (MESONET) - Daily spray advisories are freely available on the internet to assist growers who spray routinely in the efficient application of fungicides for control of early leaf spot, or to warn growers who do not spray routinely that increased levels of disease are likely to develop. Using the calendar to time sprays is very effective, but unneeded sprays are sometimes applied. The advisory program permits growers to spray only when weather conditions are favorable for disease development. Weather variables are collected from automated weather stations located in each county of the state that make up the *Oklahoma MESONET*. The advisory program identifies and accumulates hours of weather favorable for infection of peanut leaves by the fungus that causes early leaf spot. An infection hour is one hour when the relative humidity is 95 percent or greater and temperature is between 60.8 and 86.7 F. The program can be accessed at http://agweather.mesonet.org by clicking on *Crops*, and then *Peanut Leaf Spot Advisor*. The program can be used by clicking on tabs that produce different products to assist the user in determining the risk for disease and the need for a fungicide application.

Under the *State-Wide Maps* tab (this is the default tab when the *Peanut Leaf Spot Advisor* is first selected), maps show where conditions have been most favorable for disease development for the last 14-days and over the entire season. If the user is considering a fungicide application, he/she might look at the 14-day map to help make that decision. For example, areas of the 14-day map colored in red indicate where recent conditions have been very favorable for leaf spot and areas colored in blue where conditions have not been favorable.

Under the *Local Mesonet Sites* tab, the user enters a nearby MESONET site to obtain a site-specific spray recommendation, or to examine local trends to help in the spray decision. The *Leaf Spot Spray Advisor* is an interactive tool that issues a specific spray recommendation. The user enters the location, planting date, and the date of the previous spray if there has been one. This product accumulates infection hours beginning 30 days after planting if the field has yet to be sprayed, or 10 days after the previous spray. The assumptions are that peanuts 30 days old or older are vulnerable to leaf spot, and that a fungicide spray provides protects the peanuts for a period of 10 days during which time weather is not important. For the first spray, a spray is recommended when 36 infection hours have accumulated beginning 30 days after planting. For the second and all other sprays, a spray is recommended when 36 infection hours have accumulated since the end of the 10-day protection period afforded by the previous spray. Planting date, the 10-day protection period, and the 36-hour threshold are all used to calculate the last effective spray date. The last effective spray date moves forward in time as infection hours accumulate over the season. A spray is recommended when the last effective spray date first passes 30 days after planting (for fields not yet sprayed) or the date of the previous application. The last effective spray date also indicates 1) how near the user is to needing an application, and 2) how far the user might be behind schedule. For example, if the field was previously sprayed on July 15 and the *last effective spray date* is July 14, the field is close to needing another spray. Conversely, if the *last effective spray date* is July 29, the user is two weeks late!

Also under the *Local Mesonet Sites* tab, a *Last 14 Day and Forecast Leaf Spot Hours Graph* is updated each day. This graph shows the accumulation of infection hours over the last 14-days as well as projecting the accumulation of infection hours over the next 3.5 days using the National Weather Service (NWS) 84-hr forecast. This feature is intended to provide advanced warning on the need for a fungicide spray. Other products available show similar information in table form and comparisons of current year accumulation of infection hours to that for previous years.

Use of the advisory program to schedule a season-long spray program often permits a reduction of the number of sprays compared to a 14-day calendar program. The advisory program has been extensively tested in Oklahoma and proven to be effective. However, extending spray intervals beyond 14-days carries some risk. Fields must be monitored to ensure that early leaf spot does not exceed damaging levels and for the presence of other foliar diseases that may not be adequately controlled when using the advisory program.

Advisories should be checked regularly once the peanuts are thirty days old or it has been 10 days since the last spray. Other risk management rules for the advisory program are:

1) If fields cannot be sprayed within three days of exceeding the last effective spray date, spray on a 14-day schedule.
2) Use only highly effective fungicides. If formulations of copper hydroxide, copper sulfate, mancozeb, mancozeb + copper, propiconazole, and propiconazole + flutolanil are used; spray on a 14-day schedule.
3) If levels of early leaf spot exceed 25 percent (leaflets with spots or defoliated), revert to a 14-day schedule.
4) If late leaf spot or web blotch are identified, revert to a 14-day schedule.
5) Be wary of weather forecasts and err on the conservative side if rain is in the forecast.

6) Maintain the spray program until 14 days before anticipated harvest.

AUPnuts Advisory Program - AUPnuts is another spray advisory program that can be used by growers to efficiently time fungicide sprays for foliar disease control. The program was developed in Alabama and has been tested for early leaf spot in Oklahoma and proven to be effective. The program also is effective where late leaf spot is a problem. Its effectiveness against web blotch is unknown. The AUPnuts program is likely to recommend more sprays than the Early Leaf Spot Advisory. Risk management rules described above for the Early Leaf Spot Advisory also must be followed for AUPnuts except for rule 4 (AUPnuts controls late leaf spot) and rule 5 (weather forecasts are part of the AUPnuts program).

The main weather variable used in AuPnuts is a rain event. A rain event is any day with 1/10 of an inch or more of rain and/or irrigation. The program also uses five-day NWS precipitation forecasts which can be obtained from the news media or at the National Weather Service web site (http://www.srh.noaa.gov/oun/). For days when irrigation is planned, substitute 100 percent for the precipitation forecast. Calculate an average precipitation forecast for next five days (add the precipitation forecasts for the next five days and divide by five). A rain gauge (one per field) is the only equipment needed to run AUPnuts. Rules for the AUPnuts advisory program are:

First spray: After emergence, begin counting rain events and spray if:

1) four rain events have been counted since emergence and the average chance of rain for the next five days is 50 percent or greater; or,
2) five rain events have been counted since emergence and the average chance of rain for the next five days is 40 percent or greater; or,
3) six or more rain events have been counted since emergence. If leaf spot is seen (two or more spots per plant), spray immediately.

Note: Spraying peanuts less than 30 days old is not recommended.

Second and all later sprays: Ten days after the previous spray, begin counting rain events and check the five-day forecast daily. Spray if:

1) no rain event has been counted and the average chance of rain for the next five days is 50 percent or greater; or,
2) one rain event has been counted and the average chance of rain for the next five days is 40 percent or greater; or,
3) two rain events have been counted and the average chance of rain for the next five days is 20 percent or greater; or,
4) three rain events have been recorded. Continue the program until 14 days before anticipated harvest.

Fungicide resistance management - The potential for development of resistance in leaf spot fungi is a concern for fungicides belonging to specific mode of action (MOA) groups. MOA groups are designated for each product in the listing of suggested products for disease control (See below). Resistance development can result in loss of effectiveness and disease control failures. Some MOA groups such as Group 1 (e.g. Topsin®) and Group 11 (e.g. Abound®, Headline®, Evito®) can be prone to resistance problems and the rapid loss of fungicide effectiveness has been observed following their use for some crop diseases. Other fungicide groups such as Group 3 (e.g. Folicur®, Tilt®) are intermediate for resistance risk while protective fungicides with multi-site activity (Group M) are not at risk for resistance problems. Group 1 and Group 11 fungicides should always be tank-mixed or applied in alternation with a protective fungicide such as chlorothalonil. The following resistance management guidelines should be followed for at-risk fungicide in Groups 1,3, and 11:

1) Reduce disease pressure through the use of good cultural practices such as crop rotation.
2) Follow label directions and do not use less than the minimum labeled rate.
3) Do not exceed the maximum allowed amount per season. Extending the allowed amount of fungicide in a MOA group with another in the same group will increase the risk of resistance development.
4) Keep the disease pressure low by using an effective spray schedule.
5) Calibrate the sprayer and apply fungicides in an adequate volume of water to ensure good coverage.
6) Avoid using fungicides in the same MOA group all season long. Use alternating sprays or blocks of sprays of these fungicides with protectant fungicides (Group M) or with fungicide in another MOA Group. Alternating or tank-mixing products containing fungicides in the same MOA Group will not help prevent resistance development.

SOILBORNE DISEASES - These diseases generally survive in the soil for long periods and their levels increase with repeated peanut cropping. They are extremely destructive because they often kill plants before harvest. Yield losses are directly proportional to the percentage of plants infected.

ASPERGILLUS CROWN ROT - This disease causes seedling blight and also attacks older plants. Plants growing under hot, drought-stressed conditions are most susceptible. Soil insect feeding also appears to aggravate this disease. Crown rot is usually of minor importance, but occasionally reduces yields.

Symptoms - Seedlings rapidly wilt and die. On older plants, swelling of the stem occurs below the soil line and a dark decay is evident in the crown and roots. Individual branches or entire plants wilt and die. Infected roots and crowns are usually covered with a black powdery mass of fungus growth.

Control - There are no effective controls for this disease except to plant high quality seed treated with fungicide, provide irrigation to reduce drought stress, and control root and stem boring insects when warranted.

SOUTHERN BLIGHT (Stem rot) - This is a widespread disease that usually appears during mid- to late-season. It is most damaging when rows have lapped, temperatures are warm to hot, and soil moisture is high. Southern blight reduces yield by killing plants prior to maturity and by rotting pods.

Symptoms: Brown lesions (dead areas) appear at the base of infected stems. Strands of the fungus (mycelium) cover the stem bases and may grow out over the soil surface if adequate moisture is present. The mycelium is white, coarse, and stringy, and grows in close contact with the plant and soil surface. Affected branches or entire plants may turn pale green and wilt. Eventually entire plants are turn brown and die. Numerous small, uniformly round, seed-like structures (sclerotia) form on the surface of the mycelium. Their color changes from white, to tan, to brown as they mature to resemble mustard seeds. Most of the pods on infected plants are brown and mushy. Usually the mycelium can be found on and around the rotted pods. On sandy soils, the fungus may cause extensive pod rot with no above-ground symptoms.

Control: Southern blight control is based on the use of cultural practices to reduce levels of the fungus in soil or prevent its build-up, and fungicide applications to reduce losses in problem fields. Suggested <u>cultural controls</u> include:

1) Crop rotation with non-host crops such as corn, grain sorghum, cotton, or sudan grass for at least two and preferably three years.
2) Use a moldboard plow to bury crop residue and reduce numbers of sclerotia in the upper soil profile.
3) Avoid throwing dirt against peanut vines during cultivation.
4) Avoid excessive irrigation or frequent irrigations with small amounts of water.

Fungicide applications are suggested for problem fields where the disease has limited yield in the past and long rotations have not been practiced. Preventive applications are most effective. Poor control can be anticipated where fungicide is applied after disease symptoms appear. Most of the fungicides recommended for southern blight also control leaf spots.

SCLEROTINIA BLIGHT - This is a destructive mid-season to late-season disease that is increasing in severity across the state. It is most damaging in the production of irrigated runner varieties. *Sclerotinia* is a very persistent fungus that survives in the soil for many years. Initial infection usually occurs after row closure (lapping) and during prolonged periods of wet and humid conditions when temperatures are in the range of 70 F to 85 F. The shading effect of the plant canopy provides an ideal environment for infection and disease development when moisture from rain or irrigation is provided. The disease has caused yield losses in excess of 50 percent in susceptible varieties.

Symptoms: Symptoms of Sclerotinia blight are often confused with southern blight. Correct identification is essential because this disease is more destructive and the controls are different. Infection begins at the base of stems or where lateral branches contact the soil. Infected stem areas are at first water-soaked and then dry and turn pale white or straw colored as the stems are girdled. The mycelium (mold) of the fungus is white and cottony and can be seen growing at the leading edge of infections when the plant canopy is wet. Infected branches soon turn pale green, wilt, and die. Eventually entire plants die. The fungus forms characteristic black seed-like structures (sclerotia) on and in dead areas of stems and infected pods. Sclerotia are small, irregularly shaped, and look like mouse droppings.

Control: Planting a resistant or partially resistant variety the most economical control for this disease. Unfortunately, varieties with the best resistance are Spanish types (Tamspan 90) or are no longer available (Southwest Runner, Tamrun 96, and Tamrun 98). All of these varieties possess some level of partial resistance, but are not immune to the disease. Under severe conditions (90 percent disease in a susceptible variety, Tamspan 90 has the best resistance (10 to 25 percent disease) while Tamrun OL02 and Georgia Hi O/L are intermediate (30 to 50 percent disease).

Cultural practices should also be used in combination with resistant varieties to help limit disease development and spread. These include:

1) Plant early and harvest as early as possible to avoid favorable late-season weather for disease development.
2) Avoid excessive mechanical damage to vines.
3) Avoid excessive fertilizer and frequent irrigation with small amounts of water which promote rank vine growth and provide an ideal environment for disease development.
4) Avoid spreading the disease to clean fields with soil or plant debris carrying sclerotia. Clean equipment and combines before entering clean fields or work infested fields last. Movement of contaminated peanut hay should be restricted.

Effective <u>fungicides</u> are available for Sclerotinia blight. However, the fungicides for Sclerotinia blight are expensive and growers typically never apply adequate amounts to achieve a high level of disease control. Growers can expect about 40 to 75 percent disease control depending on the rate and number of applications. The first application should be made when the rows lap and conditions become favorable for infection, or at the first sign of disease. Conditions are favorable for infection when the soil temperature stays below 82 F for 24 hours and 1/2 inch of rain or irrigation has been received within the past five days. A fungicide program is beneficial for all currently available varieties except for Tamspan 90. For the moderately resistant varieties, the effects of resistance and fungicide on yield are additive.

VERTICILLIUM WILT - This late-season disease is widespread in the state, but decreasing in importance. However, the disease can cause severe losses in isolated fields. *Verticillium* is a very persistent fungus in soil, but outbreaks of the disease are worse in some years compared to others. The severity of wilt symptoms is increased by high temperature and moisture stress.

Symptoms: Wilt symptoms generally do not appear before flowering and more commonly appear during pod set, although plants are probably infected earlier. Upper leaves turn pale green, curl, and then die from the leaf margins inward. Infected branches or whole plants become stunted, turn yellow, and may wilt and die. Symptoms progress rapidly during drought stress. A tan to brown internal discoloration is apparent when leaf petioles, stems, or tap roots from infected plants are cut.

Control: There are no effective controls for this disease. Contamination of clean fields with soil or debris infested with the fungus should be avoided. Once a field is infested, Verticillium wilt can only be partially controlled by minimizing plant stresses. Partially effective <u>cultural practices</u> include:

1) Long term rotation with non-hosts such as corn, grain sorghum, or sudangrass.
2) Avoid rotations with susceptible crops such as cotton or potatoes.
3) Irrigate to provide adequate soil moisture. However, fields should not be over-watered if Sclerotinia blight is also present in the field.

POD ROT: Pod rot is a complex disorder of peanuts caused by one or more of several soil pathogens. The disease is thought to be influenced by environmental factors, such as pests (soil mites, nematodes, and insects), and soil type making the disease difficult to predict, study, and control. The cause(s) of pod rot may differ between fields. The primary causes are certain strains of fungi *Rhizoctonia* and/or *Pythium* which are commonly found in most soils.

Symptoms: Light brown areas develop on pods and later turn black. A few to nearly all of the pods on a plant may be rotted, or sometimes only pods of a certain age are affected. Pods rotted by *Pythium* are generally black, shiny, and soft while those rotted by *Rhizoctonia* are firm and skeletonized. For *Rhizoctonia* pot rot, the seeds and inner hull are often covered with a tan colored mold. However, both pathogens can be found associated with rotted pods. The kernels of rotted pods are usually destroyed or severely damaged.

Control: Pod rot is difficult to control and an integrated approach should be utilized to reduce damage. <u>Management practices</u> that reduce the severity of pod rot are:

1) Plant resistant varieties such as Tamspan 90 and Tamrun OL02 in problem fields. Avoid planting highly susceptible Virginia varieties.
2) Maintain recommended levels of calcium fertility in the soil.
3) Avoid the excessive use of low quality (salty) irrigation water.
4) Practice crop rotation. Crops thought to be beneficial are corn, grain sorghum, and sudan grass.
5) Preventive fungicide programs for pod rot are expensive and may not provide adequate control. Abound® is effective against *Rhizoctona*, Ridomil® is effective on *Pythium*, and Ridomil PC®, a broad-spectrum fungicide, is effective on both. However, the fungicides generally only provide partial disease control and the reduced levels of pod rot do not always result in increased yield or grade. While other states report successful control of pod rot with applications of gypsum, it has not been effective in Oklahoma.

LIMB ROT - This late-season disease is caused by the fungus *Rhizoctonia* which also causes pod rot. The disease can become severe on irrigated runner varieties during and after periods of extended cool and rainy weather. Mechanical damage to vines also promotes limb rot.

Symptoms: Symptoms of limb rot first appear as brown, elongated, zonate spots on branches that contact the soil. Spots may elongate and cause the limb to wilt under hot conditions. Affected limbs, but usually not entire plants, may be killed. Pegs and pods along infected limbs may rot. Later, affected limbs appear scorched or blackened. This is most evident after digging when the rows are inverted. Under prolonged rainy periods, a white mold may develop on leaves within the plant canopy causing a foliar blight. These leaves eventually turn black.

Control: Cultural and chemical controls can be used to manage limb rot. <u>Cultural practices</u> that help reduce limb rot include:

1) Avoid crop rotation with cotton which aggravates limb rot.

Seedling Disease

Aspergillus crown rot

Root-knot nematode damage

Northern root-knot nematode

Peanut root-knot nematode

Lesion nematode

Early leaf spot

Pepper spot

Web blotch

Southern blight

Sclerotinia blight

Limb rot

Pod rot

Tomato spotted wilt virus

Common Cocklebur

Common Lambsquarters

Devil's-claw

Eclipta

Golden Crownbeard

Hophornbeam Copperleaf

Horsenettle

Horseweed

Ivyleaf Morningglory

Palmer Amaranth

Prickly Sida

Silverleaf Nightshade

Tropic Croton

Waterhemp

Yellow Nutsedge

2) Avoid excessive fertilizer and frequent irrigation with small amounts of water which promote rank vine growth and provide an ideal environment for disease development.
3) The variety Tamspan 90 is partially resistant and may be beneficial.
4) Avoid excessive mechanical injury to vines.

The fungicide Abound is highly effective against limb rot while Folicur®, Moncut®, and Headline® also provide good control. Applications should be made before limb rot becomes a problem and continued during periods favorable for disease development.

TOMATO SPOTTED WILT VIRUS (TSWV) - This virus disease is fairly common in Oklahoma, but has not reached the damaging levels experienced in south Texas and in the southeastern U.S. TSWV infects more than 200 species of plants including economic crops such as peanut, ornamental bedding plants, tomatoes, and peppers; as well as several weed species. The virus is spread by thrips insects. Thrips acquire the virus while feeding on infected plants. In areas where the virus is persistent, winter annual weeds and over-wintering thrips are thought to serve as reservoirs of the virus. Losses are greatest when plants are infected early in their growth. Late season epidemics usually have little impact on yield.

Symptoms: Symptoms are variable and include leaf mottling and distortion; ringspots on new leaflets; plant stunting; and yellowing, wilting, and death of shoots or entire plants.

Control: Thrips control with insecticde is not beneficial for reducing TSWV in peanut. This is probably because thrips are able to infect plants quickly, before insecticide can act to kill them. Planting resistant varieties is the most effective strategy against TSWV.

SUGGESTIONS FOR DISEASE CONTROL IN PEANUTS

DISEASE	*COMMON NAME (MOA GROUP): FORMULATION AND RATE PER ACRE*	*REMARKS*
Seedling diseases	azoxystrobin (11): Abound 2.08F 0.4 to 0.6 fl oz/1000 ft row	Spray in furrow at planting.
	Bacillus subtilis: Kodiak HB 0.3D 2 to 4 oz/cwt seed	Biological seed treatment that can be used in combination with a fungicide seed treatment. Treat seed in planter box.
	carboxin (7) + PCNB (14) + metalaxyl (4):` Prevail 33.1D 4 to 8 oz/cwt seed	Treat seed in planter box.
	flutolanil (7): Moncut 70WG 1.1 lb Convoy 3.6F 25 fl oz	Apply in furrow at planting.
	mefenoxam (4) + PCNB (14): Ridomil Gold PC 10.5G 12.5 to 25 lb	Apply in a 4-inch band at planting.
	PCNB (14): Blocker 4F 2 to 4 pt	Apply in furrow at planting.
Nematodes (northern root-knot, peanut root-knot, root-lesion)	aldicarb (1A): Temik 15G r 15 to 22 oz/1000 ft row - single application	Single application at planting. Apply in a 6 to 12-inch band and incorporate 2 to 4 inches deep.
	or Temik 15G r 11 oz/1000 ft row- split application	Split application. Apply in seed furrow or banded (6 to 12 inches) and incorporate 2 to 4 inches deep. Make second application 45 days after planting in a 12 to 18-inch band over the row, and incorporate immediately. Do not apply within 90 days of harvest.
	dichloropropene: Telone II r 52 to 106 fl oz/1000 ft row	Row fumigation at least seven days before planting. Apply when soil is dry to allow fumigant penetration. Inject through one or two (8 to 12 inches apart) chisels 12 inches deep and seal by packing. Safe to plant when odor is no longer detectable at the fumigation depth.

Leaf spots (early leaf spot, late leaf spot, web blotch, rust)	azoxystrobin (11): Abound 2.08F 18.5 to 24.6 fl oz	Controls leaf spots, southern blight, and limb rot (See southern blight and limb rot below). Apply 60 and 90 days after planting. Apply a non Group 11 fungicide for foliar disease control as needed during other parts of the season.
	boscalid (7): Endura 70WG 6.5 to 10 oz	Apply on 14-day intervals. Also controls Sclerotinia blight at 8 to 10 oz (See Sclerotinia blight below).
	chlorothalonil (M): Bravo, Chloronil, Chlorothalonil, Echo, Equus, or Initiate 6F 1.0 to 1.5 pt Bravo Ultrex, Chlorothalonil, or Equus 82.5DF 0.9 to 1.36 lb Echo 90DF 0.87 to 1.25 lb	Apply on 14-day intervals. Use the high rate when applied alone or the low rate when applied in a tank mixture with another fungicide.
	chlorothalonil (M) + phosphorous acid (33) Catamaran 5.27F 3 to 5.5 pt	Apply on 14-day intervals. Use the high rate (5.5 pt/A) for pod rot (see pod rot below).
	copper hydroxide (M): Kocide 101, Nu-Cop 50DF, Kocide DF, or Champ WG 1.5 to 3 lb Kocide 4.5LF, Champ 4.6F, or Nu-Cop 3L 1 to 2 pt Kocide LF 2 to 4 pt Kocide 2000 or Champ Dry Prill 1 to 2 lb Kocide 3000 or Nu-Cop HB 0.75 to 1.5 lb	Tank mix or alternate with another fungicide on 14-day intervals. Use the high rate when applied alone or the low rate when applied in a tank mixture with another fungicide.
	copper sulfate (M): Cuprofix Ultra 40DF 1 to 2 lb	Tank mix or alternate with another fungicide on 14-day intervals. Use the high rate when applied alone or the low rate when applied in a tank mixture with another fungicide.
	fluoxastrobin (11): Evito 480SC 5.7 fl oz	Controls leaf spots, southern blight, and limb rot (See southern blight and limb rot below). Apply on 14-day intervals. Do not make more than two sequential applications before alternating with a non Group 11 fungicide.

fluoxastrobin (11) + tebuconazone (3): Evito T 4F 6 to 9 fl oz	Also controls southern blight and limb rot at the higher rates (See southern blight and limb rot below). Apply in alternation with chlorothalonil.
mancozeb (M): Dithane, Manzate, or Penncozeb 75DF 1.5 to 2.0 lb Dithane, Manzate, or Penncozeb 4F 1.2 to 1.6 qt	Tank mix or alternate with another fungicide on 14-day intervals. Use the high rate when applied alone or the low rate when applied in a tank mixture with another fungicide. Use a spreader/sticker.
mancozeb (M) + copper (M): Mankocide DF 3 to 4 lb Cuprofix MZ Disperss 2.5 to 4.75 lb	Tank mix or alternate with another fungicide on 14-day intervals. Use the ow rate for tank-mixes and the high rate when applied alone in alternation with another fungicide. Use a spreader/sticker.
propiconazole (3): Tilt, Bumper, Propimax, or Propiconazole 3.6E 2.5 to 4 fl oz	Tank mix the low rate with another fungicide or use the high rate alone on 14-day intervals. Use resistance management strategies.
propiconazole (3) + chlorothalonil (M): Tilt Bravo SE 4.3F 1.5 pt	Contains an equivalent of 2 fl oz Tilt and 1 pt Bravo 6F per acre. Apply on 14-day intervals.
propiconazole (3) + flutolanil (7): Artisan 3.6F 1.6 to 2 pt	Combination of Tilt (0.6 lb/gal) for foliar diseases and Moncut (3 lb/gal) for southern blight and limb rot (See southern blight and limb rot below). Apply at mid season and repeat 4 weeks later. Use resistance management strategies.
propiconazole (3) + trifloxystrobin (11) Stratego 2.08F 7 fl oz	Apply on 14-day intervals. Use resistance management strategies.
prothioconazole (3): Proline 4F 5 to 5.7 fl oz	Controls leaf spots, southern blight, and limb rot (See southern blight and limb rot below). Make up to 4 mid-season applications on 14-day intervals. Use resistance management strategies.

	pyraclostrobin (11): Headline 2.08E 6 to 12 fl oz	Controls foliar diseases, and southern blight and limb rot at high rates (See southern blight and limb rot below). For foliar diseases, use 6 fl oz on 14-day intervals or 9 to 12 fl oz for 21-day intervals. Do not make more than two sequential applications before alternating with a non Group 11 fungicide.
	tebuconazole (3) : Folicur, Monsoon, Muscle, Orius, Tebucon, Tebuconazole, Tebusha, TebuStar, Tebuzol, Toledo, or Uppercut 3.6F 7.2 fl oz	Controls leaf spots, southern blight, and limb rot (See southern blight and limb rot below). Use a spreader/sticker. Make up to 4 mid-season applications beginning 60 days after planting. Use resistance management strategies.
	tetraconazole (3): Eminent 125SL 13 fl oz	Apply on 14-day intervals in alteration with a fungicide from a different mode of action group.
	tetraconazole (3) + chlorothalonil (M): Echo 720/Eminent 125SL Co-Pak 1.45 pt	Equivalent to 1 pt/A Echo 6F and 7.2 fl oz Eminent 1F. Apply the combination on 14-day intervals.
	tebuconazole (3) + trifloxystrobin (11) : Absolute 500SC 4.17F 3.5 fl oz	Apply on 14-day intervals, but do not make more than two consecutive applications before alternating with a non Group 11 fungicide. Use a spreader/sticker.
	thiophanate methyl (1): Topsin or T-Methyl 70W 8 oz Topsin or T-Methyl 4.5F 10 fl oz Thiophanate Methyl 85 WDG 6.4 oz	Apply on 14-day intervals in a tank mixture with chlorothalonil (e.g. Bravo) or mancozeb (e.g Dithane).
Southern blight and limb rot	azoxystrobin (11): Abound 2.08F 18.5 to 24.6 fl oz	Ground sprayer and aerial applications. Controls southern blight, limb rot, and leaf spots (See leaf spots above). Apply 60 and 90 days after planting.
	fluoxastrobin (11): Evito 480SC 4F 5.7 fl oz	Ground sprayer and aerial applications. Controls southern blight, limb rot, and leaf spots (See leaf spots above). Apply on 14-day intervals during mid-season. Do not make more than two consecutive applications before switching to a non Group 11 fungicide.

	fluoxastrobin (11) + tebuconazole (3): Evito T 4F 9 to 11 fl oz	Also controls leaf spots at lower rates (See leaf spots above). Apply in alteration with chlorothalonil.
	flutolanil (7): Moncut 50W 2 to 4 lb Convoy 3.8F 1 to 2 pt	Make ground, aerial, or chemigation application 60 days after planting. Use the higher rates where disease pressure is heavy. A split application may be used by making a second 2-lb application 30 days after the first.
	propiconazole (3) + flutolanil (7): Artisan 3.6F 1.6 to 2 pt	Combination of Tilt (0.6 lb/gal) for foliar diseases (See leaf spots above) and Moncut (3 lb/gal) for southern blight and limb rot. Ground, aerial, or chemigation application. Apply at mid season (60-70 days after planting) and repeat 4 weeks later.
	propiconazole (3) + trifloxystrobin (11): Stratego 2.08F 14 fl oz	Limb rot only. Ground and aerial applications. Apply 60 days after planting and repeat 30 days later. Applications for limb rot will also control leaf spots (See leaf spots above).
	prothioconazole (3) + tebuconazole (3): Provost 3.6F 7 to 8 fl oz	Controls southern blight, limb rot, and leaf spots (See leaf spots above). Make up to 4 mid-season applications by ground sprayer or aircraft on a 14-day schedule beginning 60 days after planting.
	prothioconazole (3): Proline 4F 5.7 fl oz	Controls southern blight, limb rot, and leaf spots (See leaf spots above). Make up to 4 mid-season applications by ground sprayer or aircraft on a 14-day schedule beginning 60 days after planting.
	pyraclostrobin (11): Headline 2.08E 12 to 15 fl oz	Controls southern blight, limb rot, and leaf spots (See leaf spots above). Apply on 14-day intervals by ground sprayer, aircraft, or chemigation. Do not make more than two consecutive applications before alternating with a non Group 11 fungicide.
	tebuconazole (3): Folicur, Monsoon, Muscle, Orius, Tebu, Tebuconazole, Bebusha, TebuStar, Tebuzol Toledo, or Uppercut 3.6F 7.2 fl oz	Controls southern blight, limb rot, and leaf spots (See leaf spots above). Make up to four mid-season applications by ground sprayer or aircraft on a 14-day schedule beginning 60 days after planting. Use a spreader/sticker.
	tebuconazole (3) + trifloxystrobin (11) : Absolute 500SC 4.36F 7 fl oz	*Limb rot only:* Ground and aerial applications. Apply 60 days after planting and repeat 30 days later. Applications for limb rot will also control leaf spots (See leaf spots above).

Pod rot	azoxystrobin (11): Abound 2.08F 18.5 to 24.6 fl oz	Reduces Pythium and Rhizoctonia pod rots when applied as recommended for southern blight and limb rot (See above). Also controls leaf spots (See leaf spots above).
	chlorothalonil (M) + phosphorous acid (33): Catamaran 5.27F 5.5 pt/A	Apply on 14-day intervals. Also controls leaf spot (See leaf spots above).
	mefenoxam or metalaxyl (4): Ridomil Gold 4E or SL 4F 0.5 to 1 pt Twist 2E 1 to 2 pt Metastar 2E 2 to 4 pt	Pythium pod rot only. Apply by chemigation in a minimum of ½ inch water at pegging to early pod set (45 to 60 days after planting).
	Ridomil Gold 2.4G 11.8 lb	Apply in a 12-inch band at pegging to early pod set.
	mefenoxam (4) + PCNB (14): Ridomil Gold PC 10.5G 50 lb	Pythium and Rhizoctonia pod rots. Apply in a 12-inch band at pegging to early pod set (45 to 60 days after planting). Do not apply within 75 days to harvest.
	phosphorous acid (33): Fosphite 3.9L or KPhite 4.4L 1 to 4 qt Fungi-Phite 3.4L 1 to 2.5 qt	Pythium pod rot only. Apply on 2 to 4 week intervals beginning at pegging to early pod set (45 to 60 days after planting by foliar spray (ground or aerial) followed by irrigation, or by chemigation.
Sclerotinia blight	boscalid (7): Endura 70WG 8 to 10 oz	Ground-sprayer, aerial, and chemigation applications. Also controls leaf spots (See leaf spots above). Make first application after row closure when conditions become favorable or at the first sign of disease. Make up to two additional applications on 14 to 21 day intervals. Also controls foliar diseases (see leaf spots above). Do not apply within 14 days of harvest.
	fluazinam (M): Omega 4F 1 to 1.5 pt	Apply by ground sprayer or chemigation. Make the first application at canopy closure, after canopy closure when conditions become favorable, or at the first sign of disease. Make up to two additional applications at three to four week intervals. Do not apply within 30 days of harvest.

[r] Restricted use pesticide
Check labels for feeding and days to harvest restrictions.

For more information on identification and control of peanut diseases, consult the following OSU Extension Fact Sheets available from your county Extension Educator:

EPP-7186	Soilborne Blight Diseases of Peanut
EPP-7187	Viral Diseases of Peanut
EPP-7610	Soil and Plant Sampling for Analysis of Nematode Populations
EPP-7655	Foliar Diseases of Peanut
EPP-7664	Soilborne Diseases of Peanut
EPP-7663	Fungicide Resistance Management

VIII. WEED CONTROL

Major weeds in Oklahoma peanuts include: eclipta, pigweed, water hemp, yellow nutsedge, copperleaf, prickly sida, tropic croton, morningglory, Carolina horsenettle, palmer amaranth, and golden crownbeard. Several of these weeds are shown in the images on pages 48 to 52.

A. CULTIVATION

Heavy weed infestations reduce quality peanut yields and increase harvesting difficulty. In harvested peanuts, foreign material consisting of weed seed or plant parts lower economic returns. Growers rely heavily on herbicides to provide the weed control needed to produce good yields of high quality peanuts, but cultivation can still have a place in weed control systems.

While some growers are able to control weeds without cultivation, some in the southwest cultivate for weed control. Reasons for this vary. Some cultivate because they are unable to control all the problem weeds with herbicides, others because of tradition.

Peanuts are very sensitive to improper cultivation. Precision cultivation requires the use of flat sweeps set to operate just below the soil surface or the use of properly set rolling cultivators. Small weeds are easily and effectively controlled with either of these practices. Both depth and lateral control of the cultivator are critical.

The goal is to control weeds while avoiding throwing soil onto the lower plant limbs. Soil covering the lower leaves and branches creates conditions that are favorable for Southern blight development. These conditions inhibit normal flower, peg, and pod development.

Research and experience have shown that peanuts are quite competitive with weeds if the crop is kept weed-free for the first four to six weeks after planting. A closed peanut plant canopy is effective in competing with weeds.

B. WEED CONTROL WITH HERBICIDES

Successful weed control begins with the use of a preplant incorporated or pre-emergence herbicide for early season weed control. A preplant incorporated herbicide or a pre-emergence herbicide should be used as a foundation weed control program. These herbicides control grasses and small-seeded broadleaf weeds but do not control large-seeded broadleaf weeds. Thoroughly mixing the herbicide with the soil at a controlled depth is important.

Subsequent use of a post emergence herbicide may be necessary to control weeds that emerge later or are not controlled by the early herbicide application. Control with post-emergent herbicides requires precise timing.

C. SUGGESTIONS FOR WEED CONTROL IN PEANUTS.

Preplant or preemergence

Crop, Situation, and Active Chemical Per Broadcast Acre	*Weeds Controlled*	*Material Per Broadcast Acre*	*Formulated Time of Application*	*Method of Application and Precautions*
pendimethalin @ 0.50 to 1 lb/A	Most small-seeded annuals.	**Prowl H_2O** 1.2to 2.4 pt/A	Incorporate in top 1 to 2" of final seedbed. If applied PRE, follow application with at least 0.75" irrigation.	Apply as close to planting as practical.
ethalfluralin @ 0.56 to 1.4 lb/A	Same as above.	**Sonalan** 1.5 to 2.5 pt/A	Same as above.	Same as above.
trifluralin @ 0.5 to 0.75 lb/A	Same as above.	**Treflan** 1.0 to 1.5 pt/A	Same as above.	Same as above.

Application Recommendations for Preplant Treatments

Although Treflan® and Prowl® are labeled for use up to six weeks (or 60 days for Prowl®) prior to planting, poor results are often obtained with early applications of both 1X and 2X rates if extended periods of wet weather occur before planting. For this reason, apply as near to planting as practical.

The following summary is taken from ***Equipment and Methods for Soil Incorporation of Herbicides***, a paper by Bode, Newberg, Butler, and Wax at the American Society of Agricultural Engineers meeting in 1977. Note section on large disks.

Tillage from tandem disk harrows is such that the soil is inverted, and herbicides are mixed deeper in the soil than with any other incorporation tool tested. A single pass with tandem disks results in areas of low concentration, where weed streaking can occur. A second pass will help to level out the areas of high and low concentrations, but there seems to be very little difference whether the second pass is parallel, perpendicular, or at any angle with the first pass.

Large disks with blades spaced 9 inches or wider will not give adequate soil mixing when operated at shallow depths of 4 inches or less. When large disks are operated at a 6-inch depth or more to obtain soil inversion, some of the chemical is incorporated deeper than desired. There is also some loss of horizontal uniformity with the large disk.

Spacing of disk blades and depth of operation seem to be more important than blade diameter in determining the amount of soil mixing. Disks with 7-inch blade spacings gave more uniform incorporation at the desired 2- to 3-inch depth than disks with 9-inch spacings.

The field cultivator also requires two passes to obtain adequate incorporation. Better soil mixing is obtained when sweeps are used at travel speeds of 5 to 7 mph. To avoid areas of low chemical concentration which would result in strips of weeds, the second pass should be at some angle to the first pass rather than parallel to it. The rear row of shanks should not be allowed to operate deeper than the forward rows because untreated soil may be brought to the surface, and weed control would be reduced. A drag harrow mounted behind the cultivator to level the ridges will improve herbicide distribution in the top inch of soil.

Incorporation distribution with the Do-All with field cultivator teeth is similar to that of one pass with the field cultivator followed with a heavy drag harrow. The addition of the ground-driven reel on the Do-All has very little effect on vertical placement of the herbicide but does result in as good a horizontal distribution as can be obtained from two passes with the disks. Under good soil conditions, a single pass with the Do-All having field cultivator teeth + ground reel + drag harrow and properly operated will give adequate soil incorporation. A Do-All having only the ground reel and drag harrow is inadequate.

A single pass with the Roterra gives uniform, shallow mixing of the chemical. There is very little vertical soil mixing. Most of the chemical remains in the top 2 inches when the Roterra is operating to 5-inch depths. Overall, a single incorporation pass with the Roterra provided the most uniform horizontal distribution of all the implements tested if properly operated.

Barrentine and Jordon reported in ***Weeds Today*** that the Triple K will place most of the herbicide in the top 2 inches. It is a good incorporation tool on light and medium textured soils.

Except in the case of rhizome johnsongrass control, where the herbicide needs to be placed 4 inches deep, incorporation in the top 2 inches will control most weeds on the label and avoid excess crop injury.

Preplant or preemergence

Crop, Situation, and Active Chemical Per Broadcast Acre	*Weeds Controlled*	*Material Per Broadcast Acre*	*Formulated Time of Application*	*Method of Application and Precautions*
metolachlor @ 0.8 to 1.3 lb/A	Most small-seeded annuals and yellow nutsedge	**Dual Magnum** 0.8 to 1.33 pt/A	Preplant within seven days before planting and incorporate 1 1/2 to 2" deep **or** immediately after planting with or without incorporation.	If incorporating after planting, do not disturb seed. Incorporation may be helpful under dry soil conditions. **For all Preemergence Herbicides:** Spray in band directly over row. Convert broadcast rate listed to the band used. Plant seed at least 1 1/2" deep.
dimethenamid @ 0.6 to 0.9 lb/A	Most small-seeded annuals. Will reduce competition from yellow nutsedge, prickly sida, copperleaf and other small-seeded broadleaf weeds	**Outlook** 12 to 20 oz/A	May be used preplant surface applied, preplant incorporated, or preemergence.	Outlook may be tank mixed or applied sequentially with several other herbicides. See label.
imazethapyr @ 0.063 lb/A	Morningglory, cocklebur, spotted spurge, yellow nutsedge, ragweed, pigweed, and smartweed.	**Pursuit DG** 1.44 oz/A	Same as Prowl.	

Preplant or preemergence

diclosulam @ 0.016 to 0.024 lb/A	Eclipta, Virginia copperleaf, pigweeds, prickly sida, yellow nutsedge, cocklebur, golden crownbeard, morningglory, tropic croton.	**Strongarm** (1)Apply at 0.3 oz/A rate immediately after planting through at cracking. (2) Apply at 0.45 oz/A from no less than five days after planting through at time of cracking.	Do not use on soils with pH greater than 7.2. Do not use on seed with a warm germination of less than 80 percent germinable seed. For use of this herbicide, cracking is defined as "when soil is displaced by germinating seedlings just prior to emergence." Do not use through any type of irrigation system or by air. Use in combination with a grass herbicide.	Good to excellent control of broad range of broadleaf weeds. If cultivation is required, it should be shallow. Can rotate back to cotton in 12 months after Strongarm use, and 18 months back to corn. The Strongarm label indicates that "When using the 0.3 oz rate, weed control results on eclipta, morningglory, nutsedge, and Virginia copperleaf may be variable and a follow-up treatment with another herbicide may be necessary for full season control."
Flumioxazin @ 0.064 lb/A	Eclipta, pigweeds, prickly sida, spotted spurge, hophornbeam copperleaf, golden crownbeard, morningglories, tropic croton, waterhemp.	**Valor** Apply at 2 oz/A within three days after planting and prior to peanut emergence. **Application after peanuts emerge will result in severe crop damage.**	Use in combination with a grass herbicide. Do not use through any type of irrigation system or by air.	Can rotate to corn, cotton, or wheat after two months. Soybeans can be planted immediately following Valor use. Alfalfa can be planted at 12 months after Valor use.

Postemergence

2,4-DB @ 0.2 lb/A	Common cocklebur, morningglory	**Butyrac, Butoxone** 0.8 pt of 2 lb/gal, 2,4-DB or 1 pt of 1.75 lb/gal 2,4-DB	Overtop, two to 12 weeks after planting.	See label for description. Cutoff is 12 weeks after planting.
bentazon @ 0.75 to 1 lb/A	Common cocklebur, prickly sida, velvetleaf, smartweed, common ragweed.	**Basagran** 1.5 to 2 pt/ac	Overtop to small weeds.	Do not apply to peanuts in stress condition. See label for details.
acifluorfen @ 0.125 to 0.5 lb/A	Pigweed, morningglory, prostrate spurge, hophornbeam, copperleaf, and many other broadleaf weeds.	**Blazer** 0.5 to 2 pt/A For most weeds use 2 pt rate. Refer to label.	Overtop when weeds are in two- to four-leaf stage.	Do not apply within 75 days of harvest. Refer to label for other restrictions and precautions.

imazapic @ 0.063 lb/A	Controls cocklebur, golden crownbeard, morningglory, pigweed, prickly sida, and yellow nutsedge. Observe label restructions on weed sizes.	**Cadre** 4 oz/A Always add a nonionic surfactant of COC.	Apply early postemergence. Activity involves uptake by weed roots and/or foliage and rapid translocation to growing points. Several days may be required before complete death of susceptible weeds. Soil moisture is important for optimum activity. When adequate moisture is present, Cadre will have residual activity on susceptible germinating weeds. Activity on established weeds will depend on species and depth of root system in the soil.	Observe rotation limitations on label. **Rotation is permitted as follows:** Corn - 9 months Wheat - 4 months Soybeans - 9 months Cotton - 18 months (see label for further guidance on cotton) Grain Sorghum - 18 months
imazethapyr @ 0.063 lb/A	Cocklebur, pitted, entireleaf, and ivyleaf morningglories, pigweed, spotted spurge, ragweed, smartweed, and velvetleaf. Suppression of annual grass and johnsongrass.	**Pursuit DG** 1.44 oz/A. Add a nonionic surfactant.	Within first 10 days after weed emergence.	Timing is extremely critical. Weeds must be very small. Can give excellent residual control if rain occurs within five days. **Rotation Restrictions:** Wheat - 4 months Peanuts, peas, field corn - 9.5 months Grain sorghum, cotton - 18 months

bentazon + acifluorfen @ 0.5 to 0.25 lb/A	See Basagran and Blazer comments above.	**Storm** 1.5 pt/A Add 1 pt/A crop oil concentrate.	Over top to small weeds.	See Basagran and Blazer comments above.
lactofen @ 0.125 lb ai/A	Pigweed, morningglory, spurge, hophornbeam copperleaf, and many other broadleaf weeds.	Cobra 8 to 12.5 fl oz/A	Over-the-top to small weeds.	Do not apply within 90 days of harvest. Do not make sequential application within 14 days of first application. Refer to label for other restrictions and precautions.
paraquat @ 0.125 to 0.25 lb/A	Most annual grasses and broadleaf weeds.	**Gramoxone Inteon** 8 to 16 oz/A + surfactant. May be repeated 28 days after first application.	From cracking until 28 days after cracking.	Some crop injury may occur in the form of browning and leaf crinkling but will recover and develop normally. The addition of Basagran to Starfire may reduce peanut foliar burn.
sethoxydim @ 0.2 to 0.3 lb/A	Annual grasses, johnsongrass, bermudagrass	**Poast Plus 1E** 1 to 1.5 pt/A Add 1 qt/A crop oil concentrate. Use 1 pt rate only on small annual grasses. For spot treatment use 1 percent solution of Poast Plus +1 pecent	Best control before annual grasses exceed 14 days after emergence. johnsongrass - 15”-20” bermudagrrass - 1” hight or 6” runner length max **Timing for annual grass control is very critical.**	Most effective grass herbicide on large annual grasses. Apply only under conditions of active growth. Thorough coverage required. Do not cultivate seven days before or after treatment. However, cultivation soon after seven days will be helpful. Repeat treatments may be required if

		crop oil concentrate. Spray to wet, but not to runoff. Rate may be reduced with band application. An alternative or rhizome johnsongrass is to apply 0.75 pt/A under conditions of active growth and repeat if regrowth occurs.		regrowth occurs. If a herbicide is needed for broadleaf weed control, apply Poast Plus first and follow with broadleaf herbicide at least one day later. If broadleaf weeds form canopy over small grass, apply broadleaf herbicide,and wait seven days before applying Poast Plus.
clethodim @ 0.094 to 0.25 lb/A	Annual grasses, bermudagrass, and johnsongrass	**Select 2EC** 6 to 8 oz most annual grasses 8 to 10 oz rhizome johnsongrass. Repeat application with 6 to 8 oz for regrowth. 8 to 16 oz bermudagrass. Repeat application with 6 to 8 oz for regrowth. Add 1 qt/A crop oil concentrate.	Postemergence. Before annual grasses exceed 14 days after emergence. Johnsongrass - 12” to 24” bermudagrass - 3” ht or 6” runner length maximum.	Good control of annual and perennial grasses. Must be actively growing. Tank mix only according to herbicide labels.

IX. SPRAYER CALIBRATION

Calibration is the process of adjusting spray equipment to uniformly apply the desired rate of pesticide. The application rate of a sprayer is determined by:

1. Ground speed of the sprayer.
2. Nozzle flow rate and operating pressure.
3. Effective sprayed width per nozzle.

Measuring Ground Speed

To measure ground speed, stake out a known distance in the field to be sprayed or a field with similar surface conditions. Suggested distances are 200 feet for speeds up to five miles per hour and 300 feet for speeds from five to 10 miles per hour. At the engine throttle setting and gear to be used during spraying, determine the travel time between measured stakes in each direction. To ensure greatest accuracy, sprayer should be at least half full of liquid. Average the two times and use the following chart to determine ground speed.

Ground Speed MPH	*Time for 200 ft. Seconds*	*Time for 300 ft. Seconds*
3	45.5	68.2
3.5	39.0	58.4
4	34.1	51.1
4.5	30.3	45.5
5	27.3	40.9
5.5	24.8	37.1
6	22.7	34.1
6.5	21.0	31.5
7	19.5	29.2
8	17.0	25.5
9	15.1	23.7
10	13.6	20.5

Nozzle Selection

Two commonly used nozzles, the flat-fan and the hollow-cone, are shown in Figure 1. The hollow-cone nozzle produces a cone-shaped pattern, with the spray concentrated in a ring around the outer edge of the pattern. This nozzle is used primarily when plant foliage penetration is essential for effective insect or disease control and when drift is not a major concern.

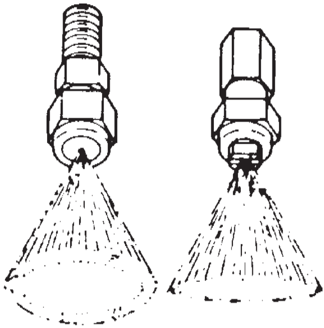


Figure 1. Hollow-cone nozzle (left), regular flat-fan nozzle (right).

At normal operating pressures of 60 to 80 pounds per square inch, these nozzles produce small droplets that readily penetrate plant canopies and cover the underside of the leaves.

The flat-fan nozzle produces a flat oval spray pattern with tapered edges. Its normal operating pressure is 20 to 40 pounds per square inch, resulting in medium to coarse size droplets which are resistant to drift. Because of its tapered edges, adjacent patterns must be overlapped to obtain uniform coverage. This is the preferred nozzle for broadcast spraying most herbicides.

Calibration

The easiest way to calibrate a sprayer is to determine the correct nozzle output for a given set of application conditions using the following formula:

$$GPM = \frac{MPH \times GPA \times W}{5940}$$

GPM = nozzle output in gal./minute
MPH = ground speed of the sprayer
GPA = application rate in gal./ac.
W = effective sprayed width per nozzle in inches

(For broadcast spraying "W" will equal the distance between nozzles. For row-crop spraying, "W" will equal the row spacing divided by the number of nozzles per row.)

5940 is a constant which converts units of measure.

After determining the necessary nozzle output for a particular set of application conditions, it becomes a simple process to collect output from individual nozzles to determine if the sprayer is operating correctly.

Example 1: Apply a fungicide spray over a row of peanuts with a hollow-cone nozzle. Because the peanuts are small, you feel that one nozzle per row will give you adequate coverage. Peanuts are in 36-inch rows. Desired application rate is 10 gallons per acre. Speed is 4 miles per hour. The effective spraying width per nozzle is 36 inches : one nozzle per row or 36 inches. What size nozzles are required?

$$\text{GPM} = \frac{4\ \text{MPH} \times 10\ \text{GPA} \times 36\ \text{in}}{5940} = 0.24\ \text{gal/min.}$$

You will need a hollow-cone nozzle that will deliver 0.24 gpm when operated at a pressure between 60 and 80 psi. A Spraying Systems Tee jet nozzle with a D3 disk and a 25 core would work, as would a Delevan DC3 disk and 25 core.

After installing the selected tip in your sprayer, add some water and operate the sprayer at the required pressure. Collect the output of one nozzle for one minute using a graduated container. If you convert the required output from gallons per minute to ounces per minute by multiplying by 128 (the number of ounces per gallon) you can use a household type measuring pitcher which is graduated in ounces (0.24 gallons per minute x 128 = 31 ounces per minute). **WARNING: Calibrate with water only and do not use the measuring pitcher for other purposes.**

Next, use the graduated container to check the uniformity of output from each nozzle at the same pressure. If the nozzle variation or differences from the maximum to the minimum single nozzle output varies by more than 10 percent, replace all nozzles. (Stainless nozzles should be used for replacement to minimize future wear, as stainless wears more uniformly.)

Example 2: First nozzle output was 31 ounces per minute; maximum was 34 ounces per minute; minimum 29 ounces per minute. Variation or difference = 34 to 30 = 4 oz.

$$\text{Percent deviation} = \frac{4\ \text{oz}}{(34 + 30)/2} = \frac{4}{32} = 12.5\ \text{percent}$$

or greater than 10 percent, change nozzles.

If the amount collected is less than or greater than 31 ounces per minute, adjust the pressure setting until the desired output is achieved. Once the desired output is achieved, add chemical and spray. Maintain the selected ground speed (4 miles per hour) and the proper pressure setting, you will apply 10 gallons per acre. Periodically while spraying, check the output of several nozzles on the boom, as the output will change as the nozzles wear. Make whatever adjustments in pressure are necessary to maintain the desired output. If the pressure required to maintain the desired output moves below the 60 to 80 pounds per square inch range, it is time to replace the nozzles with new ones.

Example 3: Another fungicide application may be applied when the peanuts are larger. Producers might decide that they need two nozzles per row (36-inch rows) directed to give thorough coverage to the plant, and the fungicide being used recommends an application rate of 20 gallons per acre. Speed remains at 4 miles per hour. The effective spraying width per nozzle is 36-inch rows - two nozzles per row or 18 inches. What size nozzle is required?

$$\text{GPM} = \frac{\text{4 MPH x 20 GPA x 18 in.}}{5940} = \text{0.24 gal./min.}$$

The nozzle size is the same as required in Example 1, but two nozzles per row are needed to cover the plants. The same procedure as described in Example 1 should be followed to adjust your sprayer to the desired output. Boom height adjustment is required to provide the correct pattern at the target.

X. PEANUT IRRIGATION

Irrigation is a profitable supplement to normal rainfall during the peanut growing season in Oklahoma. The use of irrigation in peanut production will reduce the possibility of low yields and poor nut quality due to drought stress. In southwestern Oklahoma, irrigation will typically result in increased profits over dryland peanut production in 9 years out of 10.

A. Crop Water Requirements

Well-watered peanuts will use as much as 25 inches of water per season. The effective rainfall in the major peanut growing areas of the state during the season is approximately 10 inches in a normal growing season. This means as much as 15 inches of irrigation water could be required to keep the crop in a well-watered condition.

Table 5. Normal irrigation water requirement by peanuts in Oklahoma.

Month	*South Central Oklahoma*			*Southwestern Oklahoma*		
	ET, (in.)	*Effective Rain, (in.)*	*Irrigation Req., (in.)*	*ET, (in.)*	*Effective Rain, (in.)*	*Irrigation Req., (in.)*
May	0.75	0.75	0.00	0.70	0.70	0.00
June	2.85	2.45	0.00*	2.80	2.40	0.00*
July	6.15	1.60	2.70	6.25	1.60	2.80
August	8.25	1.80	6.45	8.25	1.70	6.55
September	6.50	3.20	3.30	6.10	3.00	3.10
October	1.50	0.95	0.55	1.35	0.65	0.70
Total	26.00	10.75	14.60	25.45	10.05	15.40

*The irrigation requirement assumes a 3-foot deep crop root zone with 4.5 inches of initial stored available water from off-season rainfall.

There are three stages in the peanut life cycle when excess moisture stress will cause a reduction in the quantity or quality of nuts produced. The first stage is germination and emergence. Rainfall is normally sufficient to meet the moisture needs of the crop in this stage. However, if spring rainfall has been insufficient, it may be necessary to apply a pre-plant irrigation to have enough moisture to produce an adequate stand. The second stage, peak flowering and pegging, occurs about 45 to 60 days after planting. This is the period of maximum susceptibility to drought stress for peanuts. The crop will normally require about 0.25 to 0.30 in/day of water at this stage, but the demand may be higher on extremely hot, windy days. At this time the crop must not be allowed to deplete more than half of the stored soil moisture in the root zone or a reduction in the number of fruiting sites and a resulting yield reduction will occur. Pegs will not develop in soil that is too warm or too dry, so adequate irrigation at this stage of growth is critical. Moisture stress while the pods are filling will also result in slower pod growth and smaller pods. During the third stage, nut maturation, the demand for water gradually declines to about 0.10 in/day or less immediately before harvest. Though lesser quantities are required, water is important at this stage to maintain nut quality. Stress at this stage can increase susceptibility of the crop to disease.

During the early vegetative development stage peanuts can experience some degree of drought stress without serious effects. Depleting stored soil moisture in the root zone by more than 50 percent at this stage will slow development somewhat, but will have little effect on the eventual yield of

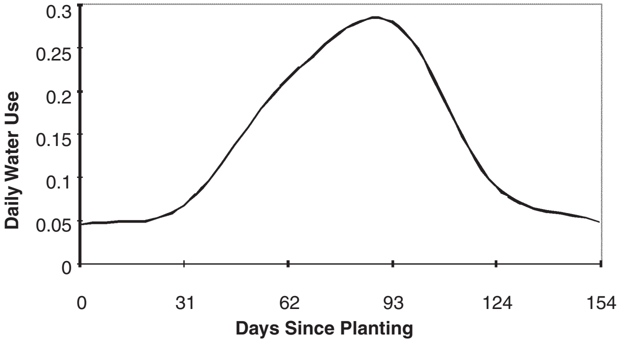


Figure 2. Average daily water use for peanuts throughout the growing season in southern Oklahoma based on 30-year average weather conditions.

the crop. If irrigation water is in short supply, this is the point in the growing season when watering can be reduced. Many growers believe that if the crop is stressed at this stage it will develop a better and deeper root system, enabling it to be more drought tolerant later in the season. To some extent this is true. If the crop is kept well-watered with frequent applications at this point, it may not develop roots deeper than 2 feet or so. Later in the growing season it will not be able to reach stored moisture deeper in the soil because its root system is not extensive enough. If the upper layers of the soil are allowed to be depleted of moisture earlier in the season, the roots will seek out moisture deeper in the soil profile. This assumes that the soil profile was initially well-watered from the surface to deep in the subsoil, as it should be after normal spring rainfall. If the off-season was dry and the stored soil moisture was not replenished to full capacity and the subsoil was depleted of water, this approach will not work. Plant roots will not grow into dry soil. If they encounter a region of dry soil as they develop they will penetrate no further.

B. Irrigation System Design

The required capacity of the irrigation system will depend upon whether the system is meant to supply 100 percent of the crop water needs during prolonged drought, or to supplement the rainfall of a normal year. Economic considerations will be the major factors affecting the grower's decision in this regard. However, the quantity and quality of irrigation water available may be constraints on the system design. Irrigation water may be obtained from lakes, ponds, streams or wells. Where lakes and ponds with limited inflow during the irrigation season are used, 1.5 to 2 acre-feet of water should be stored for each acre-foot of water required. This will account for normal seepage and evaporation losses. The quality of water used for peanut irrigation is important since the crop is moderately sensitive to salinity. Water supplies should be tested for suitability for irrigation use.

The actual capacity of the irrigation system will be determined by the depth and frequency of water application, the hours per day that the system can operate, and the application efficiency of the system. To meet 100 percent of the crop water requirement during the period of peak demand in late July (0.30 in/day) a self-propelled center pivot irrigation system operating 23 hours per day would need a capacity of 7.5 gallons per minute per acre irrigated (gpm/A). A power side roll system operating 20 hours per day would require 9 gpm/A. To supplement normal rainfall during the growing season a self-propelled center pivot system should have a capacity of 5 to 5.5 gpm/A, a side-roll system 6 to 6.5 gpm/A. The higher figure given represents the typical capacity required for the major peanut growing area in the southwestern portion of the state, while the lower figure is for the southeastern part of the state.

The irrigation system must be designed so that the soil infiltration capacity is not exceeded. Applying water at too great a rate will result in standing water on the surface, runoff loss of water and nutrients and soil erosion. In the lighter textured soils preferred for peanut production this is not commonly a concern. On heavier peanut soils the outer end of center pivot irrigation systems may have application rates which temporarily exceed soil infiltration rate. Applying smaller depths of water by keeping the rate of system travel at a higher percentage setting will keep the runoff losses to a minimum. If you don't know the hydraulic properties of your soil, consult your USDA County Soil Survey for information. Surveys are available at your district NRCS office, or the information can be obtained at your OSU County Extension Office.

C. Irrigation System Management

The sandy soils best suited to peanut production have a relatively low water-holding capacity. Though it has been shown that peanuts are capable of extracting water from depths of more than 4 feet, irrigations should replenish only the upper 2 ½ to 3 feet of the root zone, where the majority of the root system is located. This prevents deep drainage losses of irrigation water, and maintains some storage capacity for rainfall. With these constraints, more frequent lighter irrigations are needed than for crops grown on heavier soils.

Table 6. Soil properties affecting irrigation system design and management.

Soil Texture	*Available Water Holding Capacity (inches of water/foot of soil)*	*Infiltration Capacity (inches of water/hour)*
Fine Sand	0.5 – 0.75	6.0 – 20.0
Loamy Fine Sand	0.75 - 1.0	2.0 – 6.0
Fine Sandy Loam	1.0 - 1.25	0.6 – 2.0
Loam	1.25 – 1.5	0.6 – 2.0
Silt Loam	1.5 – 1.75	0.6 – 2.0

The irrigation system should be managed to avoid exceeding the water storage capacity of the soil in the crop root zone. Looking at Table 6, a loamy fine sand soil for example, will store up to 1 inch of water in each foot of soil depth in the root zone. Assuming the crop roots to a depth of about 3 feet, then 3 inches of water are stored in the soil of the root zone. A good irrigation manager will not let more than 50 percent of this water be depleted by the crop before starting the irrigation system. Depleting more water than this will cause yield reductions during most stages of crop growth. Therefore, no more than half of this water, or 1.5 inches, should be used by the crop before irrigation or rainfall replaces it.

The amount of time it takes to use up the allowable amount of water depends on the weather conditions and the stage of crop growth. During the peak growing stage, daily water use can be 0.3 inch/day or more. If the water use rate averages 0.3 inch/day, then it will take five days to deplete the critical amount of water. The irrigation system must be operated long enough to replace the amount of depleted water. If it is operated for a shorter period of time, the depleted water will not be completely replaced. If it is operated too long, some of the water will drain down below the crop root zone and be lost. Over-irrigation not only wastes water, it can also carry nutrients and pesticides out of the root zone where they can no longer improve crop performance and can lead to environmental contamination.

Not all of the water applied through the irrigation system enters the crop root zone. In Oklahoma's hot, windy growing season a large fraction of the water is lost to evaporation and wind drift. The application efficiency of the irrigation system determines how much water has to be pumped to replenish the water deficit. If you are using a side roll system, which typically will have an application efficiency of 70 to 75 percent, then you must pump about 2.0 to 2.15 inches of water to replace an irrigation deficit of 1.5

inches of water. If you have a center pivot with low-drift nozzles which is 80 to 85 percent efficient, then you only need to pump 1.75 – 1.9 inches of water to replace it. It is a good idea to place a rain gauge in the field located at the same height at the peanut canopy to measure how much water you are delivering to the field surface from your sprinkler system. A subsurface drip system with an efficiency of 95 percent would require only 1.6 inches of water to replace a 1.5 inch deficit.

D. Irrigation System Types

Peanuts are most often irrigated with either center pivot or side roll sprinkler systems. Pivots are used in large square fields, most often covering a 125 acre circle out of a quarter section of land. They can be equipped with end guns or corner units which allow them to cover up to 145 acres out of the same area. Usual sprinkler packages on pivots include low-pressure impact sprinklers mounted directly on the pivot line. Application losses on these sprinklers may exceed 25 percent of the applied water in hot, dry, windy conditions encountered in western Oklahoma. Pivots equipped with drop tubes and low-pressure spray nozzles or low-drift nozzles are much more efficient than impact sprinklers. Placing the sprinklers closer to the crop canopy reduces spray evaporation and wind drift. Low-drift nozzles have larger water droplet sizes which are less susceptible to drift and evaporation. Low-drift and spray nozzles are more prone to losses by runoff on low-intake soils. However, since peanuts are seldom grown on such heavy soils this is seldom a concern. Pivot systems are seldom adjusted to apply more than 1.5 inches of water per application, enough to last up to five to seven days. A new 125-acre pivot will cost $35,000-$40,000 depending on the type of sprinkler package it uses.

Side roll systems are best suited to smaller rectangular fields. Individual wheel lines are usually ¼-mile long and can normally irrigate up to 25 acres per line. A larger field will require multiple lines to cover it in time to meet crop water demands. Side roll systems normally operated for two irrigation sets per day, each 10 to 11 hours in length. Impact sprinklers are usually spaced 30 to 40 feet apart on the wheel line, with adjacent sets spaced 40 to 60 feet apart. These systems usually apply 2 to 3 inches of water at each setting, sufficient to last the 7 to 10 days needed to completely cover the field and return to the starting point. A new ¼-mile long side roll system complete with sprinklers and power mover will cost about $8,000-$9,000.

Another irrigation method which has been used successfully on an experimental basis is subsurface drip irrigation. The method has been used only on a limited basis in the commercial production of peanuts. Polyethylene drip tubing is plowed into the field, directly below each peanut row prior to planting, generally at a depth of 12 to 15 inches. If 5/8-inch diameter tubing is used, row lengths are limited to about 600 feet long. If 7/8-inch tubing is used, rows can be up to ¼-mile long. The burial depth of the tubing must be deep enough to avoid interference with peanut harvesting operations, but shallow enough to ensure sufficient capillary rise of the irrigation water to allow proper wetting of the pegging zone. Row positions must be maintained from year-to-year to keep the crop rows located directly over the water supply tubing. Application efficiency of subsurface drip irrigation is very high—95 percent in most cases. Many of the problems associated with high humidity in the peanut canopy from irrigation are reduced or completely eliminated. Initial system costs are quite high, approaching $1,000-$1,200 per acre. The system must be properly maintained by filtering and treating the water to allow reuse of the tubing for several years.

E. Water Quality

The quality of the irrigation water is an important part of the success of an irrigation program. Potential water supplies should be evaluated by the Soil, Water and Forage Analytical Laboratory of the Plant and Soil Sciences Department at OSU before planning irrigation development. Salinity, sodicity, and boron are the most common concerns in irrigating peanuts, or any other crop. Peanuts are moderately sensitive to salinity. Crop yield will generally begin to decline when the electrical conductivity of the irrigation water reaches 2,100 micromhos/cm. The amount of yield loss will depend on the amount of salt leaching that occurs due to rainfall during the growing season. Peanut yield loss begins to occur when the conductivity of the soil reaches 3,200 micromhos/cm and declines by about 3 percent for each 100 micromhos/cm increase of soil salinity above the 3,200 micromho/cm level.

Sodium content of irrigation water is normally a concern not because of direct toxicity to the crop, but because of its effect on the internal drainage of the soil. The clay particles of the soil tend to be dispersed if its sodium level becomes elevated. This will reduce the ability of the soil to absorb and transmit water, preventing it from reaching the roots of the crop. The effect of sodium can be reversed by incorporating calcium in the soil, usually in the form of gypsum.

Boron is an element, occasionally found in irrigation water, which is toxic at extremely low concentrations. Peanuts are classified as a boron-sensitive crop. Peanut yields are affected when the boron concentration in irrigation water reaches the level of 0.75 to 1.0 mg/l. A detailed explanation of irrigation water quality can be read in OSU Extension Fact Sheets PSS-2401 and PSS-2404.

F. Chemigation

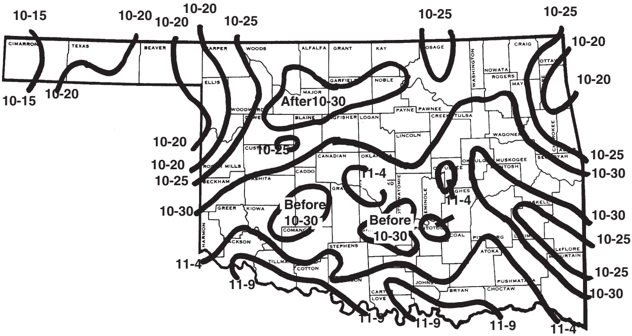
Many growers are interested in chemigation -- the application agricultural chemicals through irrigation systems. Fertilizers, insecticides, herbicides, fungicides, and nematicides are available that are approved for chemigation. There are several important factors to consider when applying chemicals in irrigation water. The system must have a series of check valves and vacuum relief valves to prevent contamination of the water supply due to back-flow of chemicals in case of an unscheduled pump shut down. Any chemicals applied simultaneously must be compatible. Chemical tank agitation and irrigation system flow rate must be adequate to maintain the suspension of wettable powder chemicals. The uniformity of chemical application will be limited to the uniformity of application of the irrigation water. The economics of chemigation compare quite favorably with ground and aerial application methods if several chemical applications per season are required. All of these points should be considered, but safety should be a major consideration. Further details about required safety equipment and calibration of chemigation equipment is available in OSU Extension Fact Sheet F-1717.

G. Summary

A producer must carefully weigh the advantages and disadvantages of a particular irrigation program before coming to any conclusions. The type of system to use and the optimum level of irrigation must be determined from economic constraints. The cost of operating an irrigation system will depend upon the total pressure required to lift the water and apply it to the field, the pumping plant efficiency, the system application efficiency, and the cost of pumping energy. For example, the electric-powered pump of a center-pivot system with the well at the pivot point that has a 30 psi operating pressure at the pump base and a 100-ft lift in the well will use about 20 kWh of electric energy to deliver 1 acre-inch of water if the pump has an excellent operating efficiency. If electric power costs $0.075/kWh, then the energy cost of pumping water would be $1.50/acre-inch. This cost, plus the cost of owning the irrigation equipment, weighed against the value of the increase in yield realized from each unit of water applied will determine what amount of irrigation is profitable. There is a point of diminishing returns for irrigation, just as there is for any other production input. Irrigation for maximum yield may not necessarily result in maximum profit. System maintenance and management are aspects of irrigation that must not be overlooked. An irrigation system must be efficient and must be effectively managed to help a grower produce high quality peanuts and achieve maximum profit.

XI. FIRST FREEZE DATES

Peanuts are susceptible to freeze damage when they are first dug. The map below shows average date of first freeze (32°F) in the fall.



XII. HARVEST MANAGEMENT

Information from harvest management tests have shown the importance of allowing the peanut crop to reach optimum maturity. Peanut yields can be increased by several hundred pounds per acre and grades by several percentage points during the last weeks of the growing season. Over-anxiousness to get the crop harvested can result in severe economic loss.

The chart on the following page reflects the results of a three-year harvest management test conducted at the Caddo Research Station.

XIII. DIGGING AND COMBINING

Peanut handling starts each year with digging and ends with peanut products in the hands of the consumer. Each handling process will either maintain the quality it receives or reduce it.

A. Digging

Start digging when 65 to 70 percent of the peanuts are mature. Immature peanuts are low quality. Also, plants set on peanuts rapidly in

BENEFITS OF DIGGING MATURE PEANUTS
OKLAHOMA

Spanco		
Days after Planting	**Yield lbs/A**	**TSMK %**
115[1]	2200	60
125	2750	61
135	3000	64
145	3055	65
155	3384	67

Okrun		
Days after Planting	**Yield lbs/A**	**TSMK %**
135[1]	2782	63
145	3232	65
155	3322	68
165	3441	71
175	3192	73

[1]Number of days from planting to digging

late season. Delaying digging two weeks can double the profit. Use a digger-invertor and keep it adjusted. Keep blades sharp; blades may need to be changed—hard-surfaced blades last two to three times longer. Dull blades drag root systems, breaking pegs leaving some peanuts underground. Drive slowly (2 $^1/_2$ to 3 mph) and stay on the row, particularly when digging multiple rows. Do not perform “fluffing” or shaking operations unless absolutely necessary.

B. Combining

Cure peanuts in the windrow for three to four days or until the moisture content is between 18 and 24 percent. Combining peanuts at less than 18 percent moisture causes sharp increases in LSK and SS. When peanuts are combined with moisture above 24 percent, more aggressive threshing action is needed to separate pods from vines and physical damage occurs that does not become apparent until after curing. Know the combine and keep it adjusted. Check for and replace broken teeth frequently. Use combine operator manual speed recommendations; 2 $^1/_4$ to 2 $^1/_2$ miles per hour on older combines up to 3 to 3 $^1/_2$ miles per hour on newer models. Use the slowest cylinder speed that will separate pods from vines. Keep cleaning shoe tail board up at Ewe angle or higher. One pod (containing two kernels) per square foot represents a loss of 90 pounds per acre. Check losses before and after combining to separate digging and combining losses. Check losses behind the pickup head, then behind cleaning shoe tailboard to separate combine pickup from cleaning operations. Producers who take pride in their combining ability hold losses near zero.

C. Hauling

The responsibility for peanut quality is the growers until they are unloaded from the trucks or trailers. If trucks or trailers are not unloaded for one to two days, peanuts should be checked for heating and may need to be turned to cool them down.

Peanuts should be hauled in vented trucks or trailers. Venting keeps peanuts from heating and controls mold growth. Freshly harvested peanuts in unvented trucks or trailers can increase in temperature by 20°F or more and can lose 1 to 3 percent in USDA grade value if they are held in unvented trucks or trailers at least one overnight period. Peanuts in vented trucks can cool overnight to a lower temperature than when they were loaded. If mold growth occurs, causing the peanuts to grade Seg. 3, the loss may be 75 percent or more.

Trucks can be vented by covering reinforced stockracks with wire screen with 1/4- or 3/8-inch square openings (hardware cloth). The cost of venting is recovered quickly by the improved value of the loads delivered.

XIV. CURING

Curing of freshly harvested peanuts should begin as soon as possible. Proper curing of peanuts means **slow drying** at **low temperatures**. Air temperature should not exceed 95°F, drying air relative humidity should be greater than 50 percent, and **average moisture removal** should not exceed an **average rate of 1/3- to 1/2-percent per hour**. For 18 percent peanuts dried to 10 percent, drying time should be about 24 hours (1/3 percent per hour). For 25 percent peanuts, drying time should be 30 to 45 hours (1/3 to 1/2 percent per hour).

Research by Texas A&M University determined the increase in SS caused by combining is 1 percent and the average increase in SS during curing is 3 percent. OSU researchers studying the factors causing SS during curing found that **final moisture content** is most important. Overdrying causes sharp increases in SS. The **drying rate** is the second most important factor, with drying rates over 1/2 percent per hour of moisture removal causing higher SS. **Relative humidities** below 50 percent ranked third as a cause of SS. Of the four factors studied, **air temperature** had the least effect on SS.

An OSU field study compared the results of low temperature, controlled-humidity curing with commercial curing at five plants. In 14 wagon load tests, low temperature, controlled-humidity curing reduced SS by 3 percent. These OSU and Texas studies indicate slow, careful curing can be done with no increase in SS. However, low temperature curing required twice as long as commercial curing. The question remains, is it economically feasible or practical to either double the required curing equipment or suffer a 100 percent increase in the time required to cure the crop in order to reduce SS by 3 percent. It is probably not feasible at this time.

Quality factors become more important when curing seed stocks. The high cost of sacks, the low availability of labor during harvest, and the vulnerability of field cured peanuts to damage by weather cause more seed peanuts to be bulk cured. Solar trailers or bags are used where weather conditions (wind, sun, and relative humidity) are favorable; careful use of forced air and very low temperature rise (5° to 10°F), supplemental heat drying is the alternative. Slow and careful curing of seed peanuts in bulk results in seed quality comparable or superior to field cured seedstock.

To maintain maximum quality while bulk curing seed stock peanuts, the following guidelines are offered:

1. The maximum recommended depth for all peanuts during drying is 4 ft. At recommended air flow rates, the complete drying zone depth is greater than 4 ft. Surfaces of drying peanuts must be level for uniform airflow. **Do not exceed 4 ft. depth.**
2. Size heaters to provide from 5 F to a maximum of 15 F temperature rise. Remember that each 1 F rise in air temperature causes a decrease of 2 $^{1}/_{2}$ to 3 percent relative humidity, so a 10 F temperature rise will reduce the relative humidity by 25 percent to 30 percent. Example: 50 F air at 80 percent relative humidity raised 10 F will provide 60 F, 50 percent relative humidity air. (See Table 7 for maximum temperature rise for drying).
3. A humidistat and thermostat can be wired in series so that both control conditions must be met to engage the heater. However, if only one control is to be used, select a thermostat; thermostats are much more reliable than humidistats. Humidistat elements are a serious problem to keep clean and properly calibrated. Humidistat elements should not be mounted in the air-stream and should be protected from dust and vibrations. Dust buildup will cause humidistats to lose their calibration.

Humidistat elements should be cleaned with a camel-hair brush before harvest and several times during harvest. Mount the thermostat bulb sensing elements in the dryer air chamber below the drying floor. Control boxes should be mounted separately to the side of the fan and heater to eliminate vibration damage and shielded from rain and direct sunlight.

4. The heater controls sense the heated drying air conditions so that proper drying conditions are controlled by the temperature rise of the heater. The following table lists recommended temperature rise versus outside air relative humidity values for specific outside air temperatures.
5. Peanuts continue to dry after curing is stopped as moisture migrates from kernels to hulls. Drying should be stopped when moisture content of a probe-collected sample shows about 11 percent. When the peanuts are graded, they should test as near 10 percent as possible. This requires frequent moisture tests in the last stages of curing.
6. Provide a shed to shelter the trailers or wagons during curing. Cover the top of solar trailers and vented hauling trucks and trailers, but leave an air gap between the cover and the peanut surface for free air movement. Check temperature of peanuts if trucks or trailers stand loaded for more than half a day or overnight. **Peanut quality is the producers responsibility until unloaded at commercial drying facilities**.

Table 7. Maximum recommended temperature rise for optimum peanut drying, °F.*

Outside Air	*Outside Air Relative Humidity*				
Temp. °F	*100%*	*90%*	*80%*	*70%*	*60%*
50	15	15	13	10	5
60	15	15	13	10	5
70	15	15	14	10	5
80	15	15	15	10	5
90	5	5	5	5	5

*NOTE: Maximum recommended drying or curing air temperature is 95°F; minimum recommended air relative humidity for drying is 50 percent.

Air Flow for Curing

When peanuts are cured in deep beds, an entrance air velocity of at least 50 feet per minute or 50 cubic feet per minute per square feet should be provided. Most curing trailers and wagons have a bed area of about 100 to 150 square feet. Therefore, at least 5,000 to 7,000 cfm should be provided for each trailer or wagon. Expected pressure drop through 4 feet of peanuts is in the range of 1 to 1 $^1/_2$ inches of water. With expected duct and heater pressure losses, total fan operating pressure will be 1 $^1/_2$ to 2 $^1/_2$ inches of water. Fans should be selected to deliver the required air flow when operating in this range of static pressure. In general one 5 HP, 24-inch diameter fan per trailer, or one 7$^1/_2$ to 10 HP, 24- to 28-inch diameter fan per two trailers should provide adequate airflow. Vaneaxial fans or blowers should have close blade tip clearance (1/8- to 1/4-inch gap) from blower housings for good airflow and static pressure efficiency.

Sizing Gas Heaters

Gas heaters may be sized with the following formula: 1.1 x CFM x °F (desired temperature rise) = BTU/hr.

If a 10°F rise is desired with a fan delivering 6,000 cfm, the proper heater capacity is:

1.1 x 6000 x 10 = 66,000 BTU/hr

A constant-spark electric ignition system is required for low capacity gas heaters. Modulating valves are not required with heater on-off cycling controlled by thermostat/humidistat controls.

Sizing Electric Heaters

Electric heaters may be sized by the following formula: 1/3 x cfm (in thousands) x °F (desired temperature rise) = Kw.

If a 10°F rise is desired with a fan delivering 6,000 cfm, the proper heater capacity is:

1/3 x 6 x 10 = 20 Kw

Tubular heater elements are recommended instead of either finned tubular or open coil elements because of dirty air conditions.

Causes of SS and LSK

Common causes of SS and LSK are:

- Combining with field moisture content less than 18 percent or more than 24 percent.
- Drying less than 10 percent final moisture content.
- Drying more rapidly than 1/2 percent/hr.@b{average} moisture removal.
- Relative humidities less than 50 percent.
- Rough handling after any of the above.

If peanuts are combined with moisture content more than 24 percent, mechanical damage usually becomes apparent as dents are caused in peanuts where mold can form before drying can be completed, as well as showing up as physical peanut hull damage after curing.

Rates of application and waiting periods (the interval from application to time of harvest) are based upon a tolerance for residues of the chemical established by the Environmental Protection Agency. Applying chemicals in excess of the suggested dosage or shortening the waiting period from application to harvest, may result in residues on the crop in excess of the tolerance and is illegal according to federal and state pesticide regulations.

The pesticide information presented in this publication was current with federal and state regulations at the time of printing. The user is responsible for determining that the intended use is consistent with the label of the product being used. Use pesticides safely. Read and follow label directions. The information given herein is for educational purposes only. Reference to commercial products or trade names is made with the understanding that no discrimination is intended and no endorsement by the Cooperative Extension Service is implied.

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