Crop Profile for Peanuts in North Carolina

Prepared: April, 1999
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General Production Information

Production Facts:

- North Carolina ranked fifth in the nation in peanut production in 2003.
- North Carolina is the leading producer of Virginia-type peanuts.
- North Carolina produced 7.7 percent of the total U. S. production in 2003.
- In 2003, North Carolina peanut harvested amounted to 320 million pounds from 100,000 acres.
- The average peanut yield in 2003 was 3,200 pounds per acre.
- The value of the peanut crop in North Carolina in 2003 was $67,840,000.

Production Regions

Peanuts are grown in more than 22 North Carolina counties. Most production occurs in nine counties in the northeastern part of the state, although significant production occurs in southeastern North Carolina (Figure 1). Changes in 2002 Federal farm legislation eliminated the quota system and has lead to a market-based system with growers contracting the crop with shellers. In addition to traditional production regions of the state, production has increased in the Central Coastal Plain.

Production Practices

Deep, fine, sandy loam soils with good drainage are preferred for peanut production. Soil pH should be in the range of 5.8 to 6.2, and the soils should be easily tilled and should offer a moderately deep rooting zone for easy penetration by air, water, and roots. Approximately 20 percent of the acreage in North Carolina is produced under conservation tillage. However, yield has been inconsistent in conservation tillage systems, and production in conservation tillage systems most likely will remain at the current

level.

Crop rotation is the most important cultural practice used in peanut production. A long rotation (three years) with two years of grass-type crops has been effective in reducing nematode and soil-borne disease problems and permits better control of weeds. However, rotations of 5 or more years between peanut crops is not uncommon in North Carolina. Varietal selection, based on pest resistance (primarily disease), is also critical for cost-effective production. Many growers prefer planting on raised beds rather than flat planting. Beds often give faster germination and early growth, provide drainage, and may reduce pod losses during harvest. Strip-tillage and no-tillage practices are becoming more popular. Optimal planting dates are between May 1 and May 20. Varieties grown in North Carolina require from 145 to 165 days to reach full maturity. Early planting usually gives higher yields and more mature pods and permits earlier harvesting, but this may make peanuts more susceptible to thrips injury, CBR and tomato spotted wilt virus. Only a small percentage (less than 20 percent) of North Carolina peanuts are grown under irrigation.

The majority of the peanuts grown in North Carolina are the Virginia-type and are targeted primarily for the in-shell market. Across the U. S., differences in climate, soils, production practices, and pests make each of the production regions (Virginia-Carolina, the Southeast, and the Southwest) unique in the appropriate cultural practices for peanut production as well as the pests that attack the crop. The variable cost of producing Virginia market type peanut is approximately $50 per acre and more than the cost for other market types. Practices and data from one U. S. production region must be viewed with caution when attempting to apply them to another production region.

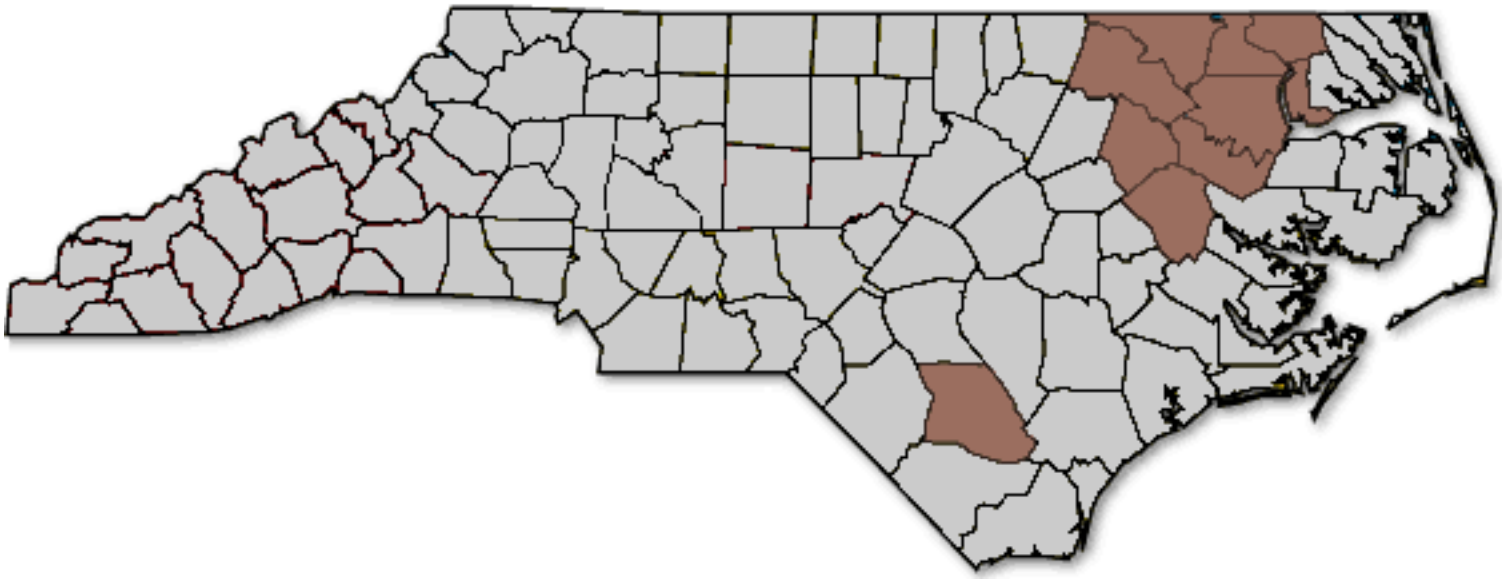

Figure 1. Primary peanut-producing counties in North Carolina, including Martin, Bertie, Halifax, Edgecombe, Chowan, Gates, Hertford, Bladen, Northampton and Pitt counties.

Worker Activities

Growers typically apply an insecticide and an herbicide at planting. Nearly 90% of the soil insecticide is loaded into the spreader with a "lock and load" system that limits exposure to the mix/loader.

Nearly all applicators use ground equipment with enclosed cabs. Larger farms are more likely to have closed cabs.

During the season, a typical farm would make from 8 to 12 pesticide applications per year. A typical applicator could cover about 25 acres per hour. On smaller farms (less than 500 acres), a single individual may make all of the pesticide applications. A large peanut farm may have 2,500 acres of peanuts and other crops, but the operation would be more likely to have several people that drive spray rigs.

When the peanuts reach the flowering stage, nearly all growers make one application of gypsum to provide calcium for the developing peanuts. Most growers apply boron and manganese during flowering.

A few growers cultivate the row middles one time near the beginning of the season.

From 15 to 20% of the North Carolina peanut acreage is irrigated each season using a center pivot system. Sporadically during the season, someone may have to visit the pivot to implement repairs or adjustments. It is not necessary for anyone to enter the field to move irrigation equipment.

About 60% of the North Carolina peanut acreage is formally scouted. Nearly all of the professional scouts are scouting other crops (e.g., cotton) in addition to peanuts. These scouts spend a majority of the day scouting fields or traveling to the next location.

Nearly all peanuts are monitored informally. The grower or an employee will spend 1 to 2 hours per week driving near the fields or walking in the field margins.

About 70% of the North Carolina peanut farms monitor weather instruments to determine when irrigation should be applied or to determine the risk of disease. The grower or a farm employee may spend up to several hours per week visiting weather instruments in or near each field. The monitoring equipment may in the field or at the field margin.

Insect and Mite Pests

Major Pests

Corn Earworms

This lepidopterous pest occurs frequently in the peanut crop during mid to late summer. The threshold is 4 earworms per row foot until September 1 at which time it increases until September 1 at which time it increases to 8 earworms per row foot. After September 15, the threshold increases to 12 earworms per row foot. While several generations can occur, it is the later generations that attack peanuts. Approximately 40% of the acreage in North Carolina was treated in 1995, much less (less than 25%) now. Growers generally control this pest with a single application of a foliar insecticide based upon scouting information. Improved scouting over the past ten years has probably reduced the acreage that is treated for this pest. Scouting and thresholds are adequate. Reduced tillage and twin row production produce modest reductions in the likelihood of an economic infestation of corn earworm. Resistance issues seen in pyrethroid insecticides in cotton, same populations move around. Alternate chemistries are important.

Organophosphate Insecticides:

Foliar

Acephate (Orthene): Not a typical treatment, there are better treatments available for this pest, disrupts beneficial insects. (REI- 24 hours, PHI- 14 days)

Malathion: Very limited use for this pest, there are better treatments available. (REI-12 hours, PHI-0 days)

Carbamate Insecticides:

Carbaryl (Sevin): Very limited use, there are better treatments available, can flare spider mites. (REI-12 hours, PHI- 14 days)

Methomyl (Lannate): Effective, but high toxicity, choice for mixed species (fall armyworm), limited use but sometimes used as a “rescue” cleanup when other products “fail”. (REI- 48 hours, PHI- 21 days)

Pyrethroid Insecticides:

gamma-cyhalothrin (Prolex, Proaxis): New product in 2004, role in marketplace relatively unknown at this time, fish toxicity is an issue for all pyrethroids (REI – 24 hours, PHI – 14 days)

lambda-Cyhalothrin (Karate): Top choice, cost effective, dermal sensitivity can be an issue, fish toxicity is an issue for all pyrethroids. (REI- 24 hours, PHI- 14 days)

Esfenvalerate (Asana): Lower skin sensitivity problems, cost effective. (REI- 12 hours, PHI- 21 days)

Fenpropathrin (*Danitol)*: More of a miticide, only used for earworms when mixed with mites as it is an expensive treatment when used only for caterpillars. (REI- 24 hours, PHI- 14 days)

Other Insecticides:

Indoxacarb (Steward): Primary target will be fall and beet armyworms and is most effective product for beet armyworms. (REI – 12 hours, PHI – 14 days).

Spinosad (Tracer): Limited use, primarily as alternative to conventional insecticide chemistry (REI – 4 hours, PHI – 28 days).

Non-Chemical Pest Management Alternatives:

Twin row and reduced till has very modest effect on reducing levels of infestation. Not reliable for suppressing below threshold levels.

Fall Armyworms

Fall armyworms can and do occur simultaneously with corn earworms, but are generally less common and less destructive. They will sometime still be present in the field at harvest time and may be observed in peanut trailers. Due to their less destructive feeding behavior the threshold is generally about twice that for corn earworms. Fall armyworms are rarely found by themselves and since there are usually mixed populations in the field, the corn earworm threshold is often the default threshold used. Fall armyworms are a little more difficult to control than are corn earworms.

Organophosphate Insecticides:

Foliar

Acephate (Orthene): Not very effective. (REI- 24 hours, PHI- 14 days)

Malathion: Poor effectiveness. (REI-12 hours, PHI- 0 days)

Carbamate Insecticides:

Carbaryl (Sevin): Poor performance, potential to flare spider mites. (REI- 12 hours, PHI- 14 days)

Methomyl (Lannate): Most effective, but higher toxicity, choice for mixed species, limited use but sometimes used as a “rescue” cleanup when others “fail”. (REI- 48 hours, PHI- 21 days)

Pyrethroid Insecticides:

gamma-cyhalothrin (Prolex, proaxis): New product in 2004, role in marketplace relatively unknown at this time, fish toxicity is an issue for all pyrethroids (REI – 24 hours, PHI – 14 days)

lambda-Cyhalothrin (Karate): Reasonable control of this more difficult to control species, cost effective, dermal sensitivity is an issue with some users. (REI- 24 hours, PHI- 14 days)

Esfenvalerate (Asana): Reasonable control of the more difficult to control problem, lower skin sensivity problems, cost effective. (REI- 12 hours, PHI- 21 days)

Fenpropathrin (Danitol): More of a miticide, used only against fall armyworms when mixed with mites as it is an expensive treatment when used only for caterpillars. (REI- 24 hours, PHI- 14 days)

Other Insecticides:

Indoxacarb (Steward): Primary target will be fall and beet armyworms and is most effective product for beet armyworms. (REI – 12 hours, PHI – 14 days).

Spinosad (Tracer): Limited use, primarily as alternative to conventional insecticide chemistry (REI – 4 hours, PHI – 28 days).

Non-Chemical Pest Management Alternatives:

Twin row and reduced till has very modest effect on reducing levels of infestation. Not reliable for suppressing below threshold levels.

Potato Leafhoppers

Potato leafhoppers can also damage peanuts; however, research indicates the economic threshold should be 25% leaf damage. Such levels are not commonly seen, but leafhoppers have been more of a problem in recent years, particularly in fields not treated for rootworms. These tiny insects feed on leaflets and inject a toxin that disrupts photosynthesis. There is limited research available on injury, thresholds and management and the value of rescue treatments is questionable once damage symptoms are obvious. Only a small percentage of fields (<10%) get treated for leafhoppers.

Organophosphate Insecticides:

Acephate (Orthene): Good product, reasonable price. (REI- 24 hours, PHI- 14 days)

Chlorpyrifos (Lorsban): Targeted for southern corn rootworms. Effectiveness results from secondary

benefit. Following application at mid season for leafhoppers effectiveness can be affected by timing. Expensive to use solely for potato leafhopper control and can also flare spider mites. (REI- 12 hours, PHI- 21 days)

Carbamate Insecticides:

Carbaryl (Sevin): Reasonable performance but concern over mid to late season use and flaring of mites. (REI- 12 hours, PHI- 14 days)

Pyrethroid Insecticides:

gamma-cyhalothrin (Prolex, proaxis): New product in 2004, role in marketplace relatively unknown at this time, fish toxicity is an issue for all pyrethroids (REI – 24 hours, PHI – 14 days)

lambda-Cyhalothrin (Karate): Excellent control at low rates, very cost effective, skin sensitivity an issue for some. (REI- 24 hours, PHI- 14 days)

Esfenvalerate (Asana): Excellent control, less skin sensitivity. (REI- 12 hours, PHI- 21 days)

Fenpropathrin (Danitol): Good leafhopper control, but more expensive. Does provide secondary benefit of spider mite control so would be used when both pests are present. (REI- 24 hours, PHI- 14 days)

Non-Chemical Pest Management Alternatives:

Cultural: Slight reductions in leafhopper abundance in reduced tillage systems.

Southern Corn Rootworms

The southern corn rootworm is one of the most troublesome insects for peanut producers. While pests like caterpillars, Diseases, and spider mites can cause severe damage that is often quite obvious above the ground, the rootworms feed below the soil surface and feed directly on the pod. The rootworm beetles lay their eggs at the base of the peanut plants in mid summer and the larvae attack developing pods. Due to the subterranean nature of the pest, “rescue” type treatments are ineffective and growers must rely upon preventive insecticide applications. A southern corn rootworm advisory based on soil type and other factors is available through North Carolina State University to aid growers in making decisions about preventive treatments. Less than 50% of the total acreage is treated and this may decline as production continues to move away from heavier soils in the northeast areas of the state in the southeastern counties.

Organophosphate Insecticides:

Chlorpyrifos (Lorsban, Pilot): Excellent results, flexibility in timing (flowering to pegging), but must still in a prophylactic manner. Use may flare spider mites, but has secondary benefit by providing control of potato leafhopper. (REI- 12 hours, PHI- 21 days)

Ethoprop (Mocap): Seldom used, quite toxic and quite water soluble, average performance, limited availability. (REI- 48 hours, PHI- 45 days)

Phorate (Thimet): Rarely used, average performance. (REI- 48 hours, PHI- 90 days)

Non-Chemical Pest Management Alternatives:

Cultural : Early planting prior to April 25 (soil often too cool, however) helps pods mature before damage occurs, use of early maturing varieties, if available. Evidence that no till reduces rootworm threat.

Thrips

Thrips can be serious pests early in the season if at-planting systemic insecticides are not used, but foliar sprays can be effective. The impact from thrips is due to the stunting of plants early in the season. Thrips can also transmit tomato spotted wilt virus and the increase in incidence of this disease since 2000 has increased the status of thrips as a pest. The economic threshold for thrips is 25% leaf damage. It is very important to follow this guideline closely. Delaying thrips treatment will still provide control but will not provide any real benefits in plant response.

Organophosphate Insecticides:

Acephate (Orthene): Excellent both as foliar and in-furrow, hopper box, cost effective alternative to Temik and is much less toxic. Worker exposure concerns over old 75S formulation. At plant use saves time (includes Di-Syston and Thimet as well). (REI- 24 hours, PHI- 14 days)

Disulfoton (Di-Syston): Mediocre performance seldom used product with concerns over herbicide interactions when used as an at-plant systemic insecticide. (REI- 24 hours, PHI- 0 days)

Malathion: Little use as a foliar treatment, mediocre performance. (REI-12 hours, PHI-0 days)

Phorate (Thimet): Average performance as an at-plant systemic insecticide, some concern over phytotoxicity issues with herbicide interactions. Research indicates Thimet is a useful tool for reducing tomato spotted wilt virus despite its average performance for thrips control. Affect on virus apparently due to mechanisms other than vector control. (REI- 48 hours, PHI- 90 days)

Carbamate Insecticides:

Aldicarb (Temik): Excellent performance, has been the standard for thrips control as an at plant insecticide, highly toxic, additional benefits suppression through nematode suppression, most expensive, at plant insecticide use provides benefits in time savings. (REI- 48 hours, PHI- 90 days)

Carbaryl (Sevin): Mediocre performance, seldom used as a foliar treatment. (REI- 12 hours, PHI-14 days)

Pyrethroid Insecticides:

gamma-cyhalothrin (Prolex, Proaxis): New product in 2004, role in marketplace relatively unknown at this time, fish toxicity is an issue for all pyrethroids (REI – 24 hours, PHI – 14 days)

lambda-Cyhalothrin (Karate): Excellent foliar cleanup treatment, used alone or to supplement at plant insecticides once plants are growing. (REI- 24 hours, PHI- 14 days)

Non-Chemical Pest Management Alternatives:

Cultural: Reduced tillage and twin rows produces modest reductions in thrips damage, as does later planting (not much of an option) due to length of growing season.

Twospotted Spider Mites

This is a pest during hot, dry conditions. Outbreaks often induced by the use of foliar insecticides or fungicides, which reduce the level of natural enemies and pathogens. Infestations often overlooked until serious damage has occurred. Infestations often occur from field edge due to movement in from field borders and adjacent corn fields.

Organophosphate Insecticides:

Malathion: Poor control, not used for mites. (REI- 12 hours, PHI- 0 days)

Propargite (Comite): One of the better products, but narrow spectrum, controls mites only, considered very expensive for use in peanuts and has no ovicidal activity and two sprays often required, relatively easy on beneficial arthropods, timing difficult and is often used late due to the small size of mites, products often tank mixed with a leafspot fungicide and this low volume spray application often leads to failure due to application technique. (REI- 48 hours, PHI- 14 days)

Carbamate Insecticides:

Aldicarb (Temik): Used at mid season, but must have rain to activate (the rain itself is often the best control measure), rarely used for this purpose, 90-day PHI, narrow spectrum for this use, mites only.

(REI- 48 hours, PHI- 90 days)

Pyrethroid Insecticides:

Fenpropathrin (Danitol): Good performance, two sprays often required, timing difficult as per Comite. Application techniques similar to Comite with same tank mix concerns. Danitol does offer late season worm control as an added benefit. Spider mites commonly develop resistance to miticides and the availability of an organophosphate and pyrethroid insecticide important for resistance management. (REI- 24 hours, PHI- 14 days)

Non-Chemical Pest Management Alternatives:

Cultural: Avoid late season foliar insecticides; use leafspot advisory to minimize fungicide use during periods of hot, dry weather, don't mow around fields in mid summer. Irrigation helps reduce mite populations but only available in a small percentage of fields.

Sporadic Pests

Cutworms

Cutworms are rare pests in the Virginia-Carolina area. They can feed on both vines and pods and are much more difficult to detect and control when feeding on pods.

Organophosphate Insecticides:

Acephate (Orthene): Foliar application not a good performer and probably a last choice. (REI- 24 hours, PHI- 14 days)

Methomyl (Lorsban): Spray or granular application will give good control. (REI- 12 hours, PHI- 21 days)

Malathion: Poor control. (REI-12 hours, PHI- 0 days)

Carbamate Insecticides:

Carbaryl (Sevin): Poor performance against this pest. (REI- 12 hours, PHI- 14 days)

Methomyl (Lannate): Good control, relatively toxic product. (REI- 48 hours, PHI- 90 days)

Pyrethroid Insecticides:

gamma-cyhalothrin (Prolex, Proaxis): New product in 2004, role in marketplace relatively unknown at

this time, fish toxicity is an issue for all pyrethroids (REI – 24 hours, PHI – 14 days)

lambda-Cyhalothrin (Karate): Good performance, but only if cutworms on vines. (REI- 24 hours, PHI- 14 days)

Esfenvalerate (Asana): Good performance, but only if cutworms on vines. (REI- 12 hours, PHI- 21 days)

Fenpropathrin (Danitol): Less effective than above. (REI- 24 hours, PHI- 14 days)

Other Insecticides:

Indoxacarb (Steward): Primary target will be fall and beet armyworms and is most effective product for beet armyworms. Limited use for cutworms. (REI – 12 hours, PHI – 14 days).

Non-Chemical Pest Management Alternatives:

Cultural: Current conventional tillage probably helps reduce cutworms, but as growers shift to reduced tillage, cutworms may become more of a problem.

Lesser Cornstalk Borers

The lesser cornstalk borer is another pest of hot, dry conditions. It is generally observed at damaging levels only under severe drought and rarely observed in Virginia and North Carolina. It is difficult to monitor and control. It is usually only found in very sandy soils that would not be treated for southern corn rootworm. This insect may become a more frequent pest as production moves to more sandy, drought-prone soils of southeastern counties.

Organophosphate Insecticides:

Chlorpyrifos (Lorsban): Works well, but lesser cornstalk borers are rare and found only in drought, only product available for control. (REI- 12 hours, PHI- 21 days)

Non-Chemical Pest Management Alternatives:

Irrigation: Fields under irrigation will not be infested with lesser cornstalk borer.

Biological Control: Natural enemies in the field normally keeps cornstalk borers in check except under extreme drought.

Wireworms

Wireworms are very sporadic pests that can attack peanuts at planting or later in the season. They are a rare problem.

Organophosphate Insecticides:

Chlorpyrifos (Lorsban): Good as a curative insecticide, problems usually not found until it is too late for corrective action. (REI- 12 hours, PHI- 21 days)

Ethoprop (Mocap): Less effective than Lorsban. (REI- 48 hours, PHI- 45 days)

Phorate (Thimet): Less effective than Lorsban. (REI- 48 hours, PHI- 90 days)

Non-Chemical Pest Management Alternatives:

Cultural practices: Tillage helps reduce problems as does rotations that avoid following pasture or tobacco.

Insecticide and Miticide Use on Peanuts in North Carolina

Use of Systemic Insecticides

Systemic insecticides are an effective production tool. Over 95 percent of the North Carolina peanut acreage is treated annually with phorate (Thimet), aldicarb (Temik), or acephate (Orthene). This eliminates the need for most foliar insecticides unless caterpillars or mites become a problem in August or September. Systemic insecticides are applied in-furrow at planting as a granular formulation.

Orthene 97 allows the use of acephate as an in-furrow spray. This approach has proven successful and offers an additional option for at-plant thrips management.

When foliar insecticides are used in addition to fungicides, spider mite outbreaks often occur if hot, dry weather, which favors spider mite buildup, persists. The use of systemic insecticides at planting eliminates the need for foliar insecticide treatments for thrips early in the season and for leafhoppers in July, and may decrease the likelihood of mite buildup. The systemic insecticides are not effective against caterpillars, and if peanuts are attacked by caterpillars in August and September, foliar sprays may be needed.

Use of Foliar Insecticides

Only a limited acreage is typically treated with foliar insecticides. Approximately 10% of all peanut acres are treated for thrips with a foliar application and this is only in situations when at plant insecticides were not used or performed poorly. About 30% of all acres are treated for caterpillars as

the threshold of 8 per row foot is commonly used and producers often scout for caterpillars. Foliar sprays can also induce spider mite outbreaks so farmers minimize use of these products. Less than 10% of the acreage is treated for potato leafhoppers or spider mites.

Current Insecticide Recommendations for Peanuts in North Carolina

Current North Carolina Cooperative Extension Service recommendations for insecticide use on peanuts (including information on formulations, application rates, and precautions/limitations) are provided in the following table from the *North Carolina Agricultural Chemicals Manual*:

Table 5-7: Insect Control on Peanuts http://ipm.ncsu.edu/agchem/chptr5/507.pdf

Diseases

Foliar Diseases of Peanuts

Early Leaf Spot, Late Leaf Spot, Web Blotch, Pepper Spot, and Botrytis Blight

Peanut leaf spot is caused by two different fungi: *Cercospora arachidicola* (early leaf spot pathogen) and *Cercosporidium personatum* (late leaf spot pathogen). It is often difficult to distinguish between these two diseases, particularly since symptoms vary depending on the variety grown and the time of the year. Early leaf spot has light-brown lesions, is generally surrounded by a yellow halo, and can be found as early as June 1. Late leaf spot has darker spots, usually lacks a halo, and appears later in the season. The best way to tell these two diseases apart is by observing with a good magnifying glass where spores are being produced. Early leaf spot spores are silvery and hair-like and appear on the spot on the top of the leaf. Late leaf spots are brown and velvety and are formed mostly on spots on the bottom of the leaf. It is important to determine if late leaf spot becomes predominate since some fungicides are not very effective against this disease.

Web blotch (caused by *Phoma arachidicola*) is a sporadic problem that can be very serious. A large (½ inch), circular, dark area forms on the upper surface of the leaf, which dries and cracks as it ages. Severe defoliation often occurs first in portions of a field, but the problem can spread over the entire field in a short time.

Pepper spot (caused by *Leptosphaerulina crassiasca*) is present every year in all fields as very small dark lesions that "pepper" a leaf. Occasionally, lesions will fuse and kill large areas, resulting in a scorch symptom. Pepper spot has been associated with severe vine decline, which sometimes occurs after a

heavy, late-season rain.

Botrytis blight (caused by *Botrytis cinerea*) is most commonly seen at the end of the season when conditions are moist. Symptoms appear first on vines or leaves that have been injured (i.e., by tractor tires or freezing temperatures), killing the tissue. Massive numbers of brown spores can be produced, and black sclerotia can be found on the pods of peanuts. While this disease does not usually cause serious losses, it can be alarming.

Symptoms are sometimes seen on the leaves without symptoms on any other part of the plant. Numerous lesions can appear on the top of the leaf. Spots are about the same size as early leaf spot lesions; however, they are light tan in color with no obvious spores.

Registered Fungicides:

Fungicides that are vulnerable to resistance development in fungi are not recommended after August 15 to insure that a broad-spectrum will be used at the end of the season. Chlorothalonil is the most effective broad-spectrum fungicide for this purpose.

Chlorothalonil (Bravo, Echo, Equus): a broad-spectrum fungicide used for control of early and late leaf spot, web blotch, pepper spot, and leaf scorch. Chlorothalonil is an important tool for resistance management when using strobilurins (Abound, Stratego, Headline) and triazoles (Tilt, Folicur).

Copper fungicides (ManKocide, Tribasic copper, etc.): these fungicides have only a minor role in foliar disease management because they are only partially effective in control of foliar diseases.

Ethylene bisdithiocarbamates (Dithane, Manzate, etc.): like the copper fungicides, these fungicides offer only partial control of foliar diseases.

Propiconazole + chlorothalonil (Tilt/Bravo, EchoPropiMax): this mixture is widely used as the first or second fungicide application of fungicide for foliar disease control.

Propiconazole + trifloxystrobin (Stratego): this mixture was first introduced in 2001 and was found to provide good control of foliar diseases in the first or second fungicide application.

Tebuconazole (Folicur): in addition to good foliar disease control, this fungicide provides good control of certain soilborne diseases (southern stem rot, Rhizoctonia limb rot) and suppression of Cylindrocladium black rot (CBR).

Azoxystrobin (Abound): This strobilurin fungicide provides very good control of leaf spots and web blotch. It also controls stem rot and Rhizoctonia limb rot; the higher range of the labeled rate is most effective. Only two applications of a strobilurin fungicide are recommended per season as a means of managing the risk of fungicide resistance in target fungi.

*Flutolanil + propiconazole (Artisan)***:** The propiconazole portion gives fair control of foliar pathogens. A more effective foliar fungicide should be applied two weeks (or according to advisory) after application of Artisan. The flutolanil portion of this fungicide mixture provides excellent control of southern stem rot and Rhizoctonia limb and pod rot.

*Pyraclostrobin (Headline)***:** This strobilurin fungicide provides excellent control of leaf spots and web blotch and has some activity against southern stem rot and Rhizoctonia limb rot. Only two applications of a strobilurin fungicide are recommended per season as a means of managing the risk of resistance in target fungi.

Bosclalid (Endura): This fungicide provides excellent control of web blotch and good control of leaf spots. However, due to its high cost, the primary use of boscalid is for control of Sclerotinia blight.

Non-Chemical Pest Management Measures:

Crop rotations of three or four years are recommended.

Select varieties with partial resistance and/or reduced susceptibility to disease (Perry for early leaf spot and web blotch).

Phytotoxicity

Phytotoxicity (chemical toxicity), caused by systemic insecticides applied at planting, is often confused with leaf spot. Symptoms usually occur around the margins of the leaflets on the lower-most leaves. In general, spots found before mid-June are phytotoxicity. Herbicide toxicity can also cause leaf spots by burning areas associated with the spray droplets. Symptoms associated with phytotoxicity will not spread or form spores.

Management:

Producers should learn to identify symptoms associated with chemical damage to keep from mistaking these signs for a contagious problem such as leaf spot. They also should avoid practices that lead to these symptoms.

Tomato Spotted Wilt Virus (TSWV)

Tomato spotted wilt virus (TSWV) is found in all peanut counties in North Carolina. Spread is accomplished primarily through infected thrips, which acquire the virus by feeding on infected plants (cultivated or wild plant species). Symptoms on peanuts can be quite variable but usually include one or more of the following: stunting; dead terminal buds; pale yellow or white ring patterns on leaves; purple blotches on the underside of leaves; stunted, small, and malformed growth; undersized pods; and red

seed coats. On some occasions, the whole plant may turn light green, resembling CBR disease/black root rot. Symptomatic plants are usually found scattered throughout a field in clumps of two or three.

Management:

Severity can be reduced by planting the moderately resistant NC-V11 or Gregory and avoiding the very susceptible NC 9 or Perry. All other varieties are susceptible. Early and very late planting should be avoided. Plant density has a marked effect on spotted wilt disease. Stands of 4 plants per foot of row or more are recommended, especially when susceptible cultivars are grown. The virus is transmitted by thrips. Aldicarb (Temik) or phorate (Thimet) applied in furrow reduces the risk of spotted wilt disease compared to no insecticide use. A tomato spotted wilt index developed for use in North Carolina and Virginia allows growers to evaluate relative risks of spotted wilt disease based on their choice of management practices.

Soil-Borne Diseases of Peanuts

Seed and Seedling Rots

Seed and seedling rots can be caused by many fungi. These symptoms may appear: (a) seeds will not germinate (seed rot), (b) seeds will germinate but will not penetrate the soil surface (pre-emergence damping-off), or (c) seeds will die shortly after emergence (postemergence damping-off). The result is a poor stand with skips. Often, the primary problem is either environmental (poor seedbed conditions) or poor seed quality, rather than disease.

Management:

Planting should be done in warm soil (65°F at a 4-inch depth for three consecutive days) because cold soils retard germination and increase the chance for rots. Bedding generally aids soil warming and drainage. Poor drainage can cause waterlogging, a major factor in seed and seedling rots.

Seed and seedling diseases usually can be prevented by using high-quality seed coated with a good chemical seed treatment fungicide. No chemicals are available for postsymptom treatment. Mefenoxam + PCNB (Ridomil Gold PC) or azoxystrobin (Abound) can be applied in furrow at planting time to reduce losses due to this disease complex.

Southern Stem Rot and Rhizoctonia Limb/Pod Rot

Southern stem rot or white mold (*Sclerotium rolfsii*) is found in all peanut-producing counties of North Carolina. Limbs with southern stem rot normally have white, stringy fungus growth, yellow to brown birdshot-sized balls (sclerotia) on the lower stems, and leaf litter. These sclerotia distinguish southern stem rot from other soil-borne diseases.

The disease is most active during the hottest part of the season, especially following rain, and causes wilting and sometimes death. Fields with heavy vine growth and excess moisture are most prone to the development of southern stem rot.

Rhizoctonia limb rot (*Rhizoctonia* spp.) is sometimes confused with southern stem rot. While both affect the stems, Rhizoctonia limb rot does not produce the white stringy growth or brown sclerotia. Lesions are usually found on the bottom of stems (touching the soil). Dead areas have a purple border and sometimes several rings (a target pattern within the diseased area). This disease often causes a serious pod rot, the most destructive phase of the disease. Like stem rot, this disease is most common in moist fields or where vines are thick, and irrigated fields are attacked most severely.

Long rotations are preferable because both fungi can live for a number of years in the absence of a host. Both fungi have very broad host ranges, requiring care in selection of rotation crops. If these diseases have been serious problems in a field, then peanuts should be rotated with corn, small grains, or cotton.

Registered Fungicides:

Azoxystrobin (Abound): this fungicide provides good control of stem and pod rots and also controls foliar pathogens. Higher rates than are needed for foliar disease control may be required for heavy infestations or conditions very favorable for disease development.

Carboxin (Vitavax): continues to be widely used as a peanut seed treatment against fungi, but it is no longer applied for control of stem and pod rot in the field.

Flutolanil + propiconazole (various names): The flutolanil portion of this mixture is highly effective against southern stem rot and Rhizoctonia limb and pod rot. The propiconazole portion gives fair control of foliar diseases. A more effective foliar fungicide should be applied two weeks (or according to advisory) after application of Artisan.*Flutolanil (Moncut)*: not used due to cost and narrow spectrum of activity.

PCNB (Terraclor): not used due to the availability of less expensive and more effective products.

Mefenoxam + PCNB (Ridomil Gold PC): not used due to availability of more effective products.

Propiconazole + trifloxystrobin (Stratego): used only for foliar disease control due to the need for higher rates and greater cost compared to tebuconazole and azoxystrobin.

Pyraclostrobin (Headline): This fungicide gives some suppression of southern stem rot and Rhizoctonia limb rot at the rates applied for foliar disease control.

Tebuconazole (Folicur): widely used throughout region due to favorable cost and good efficacy against foliar diseases, southern stem rot, and Rhizoctonia limb/pod rot.

Non-Chemical Pest Management Measures:

Crop rotations of three or more years are recommended.

Little information about response to these diseases is available for Virginia type cultivars.

Sclerotinia Blight

Sclerotinia blight (*Sclerotinia minor*) is found throughout North Carolina but is most severe in the most northerly counties. This disease starts by killing individual limbs rather than causing an overall wilt.

Careful scouting is required to see this disease when symptoms first appear. Vines must be pulled back to expose lower stems and early infection. The end portion of infected limbs will remain green and healthy-looking for some time. Only after the disease has been present for many days will limbs be visibly wilted. Sclerotinia blight exhibits cottony mold growth (seen on humid mornings) on straw-colored stem injuries (lesions). Small black sclerotia (irregular in shape) can be seen both on and in infected tissues.

Registered Fungicides:

Iprodione (Rovral): Not used due to poor efficacy and high cost.

Fluazinam (Omega): This fungicide provides very good control of Sclerotinia blight, but high cost is a major concern among growers. The period of protection provided is 21 to 28 days and the PHI is 30 days.

Boscalid (Endura): This fungicide provides very good control of Sclerotinia blight, but high cost is a major concern. The period of protection provided is 14 to 21 days and the PHI is 14 days. Boscalid also controls foliar diseases.

Non-Chemical Pest Management Measures:

Crop rotation: At least four years between peanut or other hosts are recommended

Plant early: Planting before May 1 can provide opportunities for an early harvest which reduces crop exposure to disease in October when disease pressure is likely to be greatest. Early planting increases risk of tomato spotted wilt.

Variety selection: Plant a partially-resistant variety (Perry).

Reduce vine injury: Since physical injury to vines increase disease severity and spread, growers should limit trips across fields with equipment by adopting leaf spot advisories, eliminating cultivation for weed control, and eliminating needless applications of insecticides such as sprays for corn earworms and southern corn rootworm.

Limit use of chlorothalonil: Foliar applications of chlorothalonil for foliar disease control should be spaced at least 21 days apart. Where applications are needed at less than 21-day intervals, chlorothalonil should be rotated with other fungicides (Abound, Folicur, Stratego, Headline, Endura).

Cylindrocladium Black Rot (CBR)

CBR, the shortened name for Cylindrocladium black rot or black root rot (*Cylindrocladium parasiticum*), is found in all peanut counties in North Carolina. Plants become light green and die as a whole, although some limbs may die before others. A blackened, rotting root system, which allows plants to be easily pulled from the ground, is characteristic of this disease. Red fungus structures (as large as the head of a pin) may be found on dead tissue near the ground following moist weather.

CBR can be confused with tomato spotted wilt virus (TSWV) late in the season when both cause root rots.

Registered Biocides:

Metam sodium (Metam, Vapam, Sectagon): soil fumigation at 2 weeks prior to planting with metam sodium is the only available chemical means for effective, economical control of CBR. Varieties of peanut with partial resistance to CBR often show a favorable response to soil treatment in heavily infested fields. Growers are advised to monitor soil temperatures and weather forecasts to insure fumigant is applied under optimum conditions (greater than 60 degrees F; little rainfall for 3 to 5 days) for maximum performance.

Tebuconazole (Folicur): in-furrow and foliar applications of tebuconazole may provide some suppression of CBR. In-furrow applications can greatly slow emergence.

Non-Chemical Pest Management Measures:

Crop rotation: Three or four years between peanut or other hosts are recommended.

Variety selection: Perry and NC 12C are partially resistant to CBR.

Clean seed: CBR can be seed transmitted. Use high quality seed treated with a good chemical seed treatment.

Delay planting: Planting about May 10 or later provides an opportunity to escape early season infection,

since soil temperatures are likely to be warmer and less favorable for growth of the fungus. Likewise, bedding can result in CBR suppression.

Nematodes

Peanut nematodes include the northern root knot (*Meloidogyne hapla*), peanut root knot (*Meloidogyne arenaria*), lesion (*Pratylenchus brachyurus*), ring (*Criconemella ornata*), and sting (*Belonolaimus longicaudatus*). Nematodes cause plants to be stunted, wilted, or off-colored. Damage can also result in increased susceptibility to black root rot (CBR).

Registered Nematicides:

Metam sodium (Metam, Vapam, Sectagon): Soil fumigation with metam sodium at 2 weeks prior to planting is the most efficient means for control of plant parasitic nematodes. Growers are advised to monitor soil temperatures and weather forecasts to insure fumigant is applied under optimum conditions (greater than 60 degrees F; little rainfall for 3 to 5 days) for maximum performance.

Aldicarb (Temik 15G): In-furrow applications of aldicarb provide early season control of nematodes and thrips and enhance the nematode control provided by metam fumigation. Aldicarb is particularly important when no other nematicide is used, since it provides some good control when nematode populations are near the threshold for causing crop damage.

Fenamiphos (Nemacur): An 8- to 10-inch band of fenamiphos in combination with aldicarb (Temik 15G) in the seed furrow is the most effective alternative to use of metam sodium. Nemacur has been particularly effective in control of sting nematode.

1,3-dichloropropane (Telone II): This fumigant nematicide is highly effective but generally is not used because of the cost relative to metam sodium, which also controls CBR.

1,3-dichloropropane + chloropicrin (Telone C-17): This fumigant nematicide is highly effective but generally is not used because of the cost relative to metam sodium, which also controls CBR.

Non-Chemical Pest Management Measures:

Crop rotation: Rotation of peanut crops at intervals of 3 or 4 years with non-host crops provides good control of northern root knot nematode. Crop rotation has limited value for management of sting, stubby root and lesion nematode because of their wide host range.

No resistant varieties: All varieties of Virginia-type peanut are considered susceptible to damage by northern root knot, sting, stubby root and lesion nematodes.

Fungicide and Nematicide Use on Peanuts in North Carolina

Use of Fungicides

Across the production area, an average of slightly more than 4 fungicide sprays are applied per year for control of foliar diseases, southern stem rot, and Rhizoctonia limb and pod rot. Chlorothalonil (alone or mixed with propiconazole) is used for 1 or 2 of these sprays and 1 to 3 sprays are divided among tebuconazole, pyraclostrobin or azoxystrobin (in descending order); others (Artisan, Stratego) are used on fewer acres and/or with less frequency.

Approximately 25 to 30% of acres are treated 1 or 2 times for Sclerotinia blight control. Fluazinam accounts for the majority of these treatments; boscalid was sold in North Carolina for the first time in 2004 and accounts for the balance.

Use of Nematicides and Fumigants

See insecticides for use of aldicarb.

About 45% of acres are treated (one application per peanut crop) with metam sodium for control of CBR and nematodes.

Current Fungicide and Nematicide Recommendations for Peanuts in North Carolina

Current North Carolina Cooperative Extension Service recommendations for fungicide and nematicide use on peanuts (including information on formulations, application rates and schedules, minimum days to harvest, and precautions/limitations) are provided in the following tables from the *North Carolina Agricultural Chemicals Manual*:

Tables 6-7 and 6-8: Peanut Disease Control and Peanut Disease Management Calendar http://ipm.ncsu.edu/agchem/chptr6/603.pdf

Weeds

Effective weed management is essential for profitable peanut production. Peanuts are not very competitive with weeds and thus require higher levels of weed control than most other agronomic crops to avoid yield losses. A weed management program in peanuts consists of good weed control in rotational crops; cultivation, if needed; establishment of a satisfactory stand and growing a competitive

crop; and proper selection and use of herbicides. Non-chemical control methods used in peanut include crop rotation and cultivation. Accurate weed identification and timely herbicide applications are also keys to successful weed management.

Crop Rotation:

Peanuts should be rotated with corn or cotton to help manage various pests, including weeds. Crop rotation allows use of different herbicides on the same field in different years. Crop and herbicide rotation, along with good weed control in the rotational crops, helps prevent the buildup of problem weeds and helps keep the overall weed population at lower levels. Crop rotation also helps to reduce the chance of developing populations of weeds that are resistant to herbicides.

Cultivation:

Cultivation is an excellent means of supplementing chemical weed control. One or two "non-dirting" cultivations often improve weed control. Additionally, cultivation in combination with banded herbicide applications can reduce costs. However, cultivation can damage the crop and reduce yield if not done properly. Movement of soil onto the lower branches and around the base of the plants causes physical damage and enhances development of stem and pod diseases. Deep cultivation also destroys residual herbicide barriers and brings up additional weed seeds. Peanuts should be small when cultivated. Sweeps should be set to run flat and shallow to avoid throwing soil onto peanut plants.

Weed Scouting:

All fields, regardless of the crop being grown, should be surveyed for weeds between mid-August and the first killing frost. Written record of the weed species present and the general level of infestation of each species (light, moderate, or heavy) is advised. Weeds present in the fall will be the ones most likely to be problems the following year. Knowing what problems to expect allows growers to better plan a weed management program for the following crop. Peanut fields should be scouted weekly from planting through mid-July to determine if or when postemergence herbicide treatment is needed. Proper weed identification is necessary because species respond differently to various herbicides. County Extension centers can aid in weed identification. Timely application of postemergence herbicides is critical for effective control. HADSS (Herbicide Application Decision Support System), a computer-based program designed to

assist in making decisions pertaining to postemergence herbicide applications, is available through the North Carolina Cooperative Extension Service. Weed density, predicted crop value, predicted weed-free crop yield, herbicide cost, and herbicide efficacy are used to develop a ranking of the economics of herbicide options for a specific weed complex. This approach does not consider the long-term affect of weed seed production if weeds are not controlled. The patchiness of weeds in each field and the

time needed to scout fields are limitations to this approach. However, this decision support system is

beneficial in explaining herbicide options.

Preplant Incorporated Herbicides:

Registered herbicides and tank mixes suggested for preplant incorporated application include the following:

Prowl	Prowl + Dual or Outlook
Sonalan	Sonalan + Dual or Outlook
Vernam	Pursuit + Prowl or Sonalan
Dual, Dual Magnum	Pursuit + Dual or Outlook
Pursuit	Prowl + Strongarm
Outlook	Sonalan + Strongarm
Strongarm	Strongarm + Dual or Outlook

Prowl and Sonalan are similar products and provide similar season-long and control common annual grasses, pigweed, and lambsquarters but are inadequate for control of most other broadleaf weeds. They also do not control nutsedge.

Dual, Dual Magnum, and Outlook control broadleaf signalgrass, crabgrass, crowfootgrass, fall panicum, foxtails, goosegrass, and pigweed but are weak on Texas panicum. They also control or suppress yellow nutsedge. Mixtures of Prowl or Sonalan plus Dual, Dual Magnum, or Outlook provide somewhat better initial grass control, especially in heavily infested fields.

Strongarm can be applied preplant incorporated to control common ragweed, eclipta, common lambsquarters, morninglories, cocklebur, and other broadleaf weeds. Weed control with Strongarm is generally better when applied with Prowl, Sonanlan, Dual, Dual Magnum, or Outlook. It does not control annual and perrenial grasses. Strongarm only suppresses yellow and purple nutsedge. Rotation restrictions include corn, tobacco, and sorghum, but not cotton.

Pursuit 70 DG is registered for preplant-incorporated, preemergence, at-cracking, and postemergence application to peanuts at the rate of 1.44 ounces per acre. Split applications of a half rate preplant incorporated and a half rate at late cracking or early postemergence have tended to give the most consistent control of a range of weed species. Pursuit has activity on some grasses and often has given good control of broadleaf signalgrass, especially when applied postemergence. However, it is suggested that Pursuit be used in combination with a soil-applied grass herbicide. Pursuit will suppress or control yellow and purple nutsedge, with purple nutsedge usually being the more susceptible. There are rotational restrictions of concern following use of Pursuit. Wheat and rye may be planted 4 months after Pursuit application. Corn, tobacco, and barley may be planted 8.5, 9.5, and 9.5 months, respectively, after Pursuit application. In most cases, there is an 18-month rotational restriction for cotton.

Preemergence Herbicides:

Herbicide and tank-mix options include Dual, Dual Magnum, Outlook, Lasso, Pursuit, Dual + Pursuit, Dual Magnum + Pursuit, Lasso+ Pursuit, Outlook + Pursuit, Valor, and Valor + Dual or Outlook. Lasso (alachlor) is registered for use on peanuts but some marketing contracts may exclude alachlor-treated peanuts. Before using Lasso, growers must consult with buyers to determine if marketing restrictions exist.

Dual, Dual Magnum, Lasso, and Outlook control annual grasses (except Texas panicum) and pigweed. Dual, Dual Magnum, Outlook, and Frontier applied preemergence may adequately control light infestations of yellow nutsedge. (Dual, Outlook, and Dual Magnum incorporated are preferred for moderate to heavy infestations).

Strongarm can be applied preemergence as well as pre-plant incorporated. Nutsedge control may be better if Strongarm is incorporated.

Valor received Federal and State labels for use in peanut in 2001. Considerable injury occurred in 2001 in North Carolina. Injury was also noted in Virginia and throughout the peanut belt. Weather conditions most likely contributed to the level of injury. However, there is not a conclusive answer as to the cause of injury. Valor controls many of the small-seeded broadleaf weeds found in peanut. It does not adequately control grasses.

At-Cracking Herbicides:

Herbicide and tank-mix options include Dual, Dual Magnum, Outlook, Lasso, Gramoxone MAX, Paraquat + Basagran, Paraquat + Dual or Dual Magnum or Outlook, Pursuit, and Pursuit + Dual or Dual Magnum or Outlook.

Dual, Dual Magnum, Lasso, and Outlook will provide residual control of annual grasses and pigweed to supplement control provided by the preplant or preemergence herbicide(s). Dual or Frontier would be preferred in fields with yellow nutsedge or with very coarse soil.

Gramoxone MAX will control small annual grasses and most small broadleaf weeds. For consistent results, the weeds should be 1 inch or shorter. Gramoxone MAX controls only emerged weeds; it does not provide residual control. Application of Gramoxone MAX is of benefit only if weeds are present. Dual, Dual Magnum, or Outlook may be added to Gramoxone MAX to provide residual control of annual grasses and small-seeded broadleaf weeds. Tank mixing 0.5 to 1 pint of Basagran with Gramoxone MAX may improve control of ragweed, prickly sida, spurred anoda, and lambsquarters and reduce Paraquat burn on peanuts.

Pursuit may be applied at-cracking and may be tank mixed with Dual, Dual Magnum, Outlook, or Gramoxone MAX. Although late at-cracking application (small weeds) has generally given good control

of many species, split application may be preferred.

Postemergence Herbicides:

Postemergence herbicide and tank-mix options include: 2,4-DB, Basagran, Basagran + 2,4-DB, Blazer, Blazer + 2,4-DB, Basagran + Blazer, Storm, Storm + 2,4-DB, Paraquat, Paraquat + Basagran, Paraquat + 2,4-DB, Pursuit, Pursuit + Basagran, Pursuit + Blazer, Pursuit + 2,4-DB, Pursuit + Paraquat, Cadre, Classic, Cobra, Poast, Poast Plus, Arrow and Select.

2,4-DB: 2,4-DB (Butyrac 200, Butoxone, Chemnut, others) can be applied twice per season anytime from 2 weeks after planting up to 45 days before harvest. It primarily controls cocklebur and morningglories. Unless treated when small, pitted morningglory may not be killed by 2,4-DB. Late-season applications of 2,4-DB are discouraged because of potential injury and possible adverse affects on seed quality.

Basagran: Basagran controls controls cocklebur, jimsonweed, smartweed, prickly sida, spurred anoda, velvetleaf, and yellow nutsedge. Control of common ragweed and lambsquarters may be adequate if Basagran is applied when these weeds are small. However, the label warns that in-furrow insecticides may predispose peanuts to injury from Basagran. Injury, sometimes severe, has occasionally been noted in North Carolina when Basagran was applied to peanuts receiving an in-furrow application of Di-Syston. 2,4-DB may be added to Basagran to improve control of morningglory and spurred anoda. This tank mix may be applied from 2 weeks after planting up to 45 days before harvest. The tank mix may be applied twice per season.

Blazer: Multiple postemergence applications of Blazer can be made so long as the amount of applied postemergence does not exceed 2 pints per acre per season. Blazer may be applied anytime from cracking up to 75 days prior to harvest. Blazer controls morningglories, jimsonweed, smartweed, common ragweed, tropic croton, pigweed, and small lambsquarters. Blazer may cause leaf crinkling and bronzing and sometimes leafburn. Peanuts recover and yield is generally not affected. 2,4-DB may be added to Blazer to improve control of cocklebur and large morningglories. A Blazer plus Basagran

tank mix will control a broader spectrum of broadleaf weeds than either product applied alone. The best rate of each product to apply will depend upon weed species present, weed size, and growing conditions; see labels for details. This tank mix may be applied anytime from cracking up to 75 days before harvest.

Storm: This prepackaged mixture contains the active ingredients in both Basagran and Blazer. Application of 1.5 pints per acre of Storm is equivalent to applying 1 pint of Basagran plus 1 pint of Blazer. Storm may be applied anytime from cracking up to 75 days before harvest. This herbicide controls most common annual broadleaf weeds. Unless applied when weeds are small, however, Storm may not give consistent control of lambsquarters, prickly sida, spurred anoda, and velvetleaf.

Gramoxone MAX may be applied postemergence in addition to an at-cracking application and should not

be applied later than 28 days after cracking. Gramoxone MAX controls small annual grasses and most small broadleaf weeds. Gramoxone MAX applied to emerged peanuts will cause varying amounts of leaf burn. However, peanuts recover and yield is not affected. A second application of Gramoxone MAX should not be made if peanuts are showing injury symptoms from the first application. Also, Gramoxone MAX should not be applied to peanuts showing thrips damage. A tank mix of Gramoxone MAX plus 1 pint of Basagran will provide better control of weeds, such as cocklebur, common ragweed, prickly sida, smartweed, spurred anoda, and velvetleaf, than Gramoxone MAX alone. Adding at least 0.5 pint of Basagran to Gramoxone MAX also reduces peanut injury from Gramoxone MAX and is highly recommended.

Pursuit: Pursuit can be applied postemergence to peanuts alone or tank mixed with Basagran, Blazer, 2,4-DB, or Paraquat. It is important that Pursuit be applied to small weeds. Adding 2,4-DB to Pursuit will enhance control of broadleaf weeds.

Cadre: Cadre controls most broadleaf weeds except croton, ragweed, lambsquarters, and eclipta. Cadre also controls purple and yellow nutsedge. It should be applied before weeds exceed 3 inches. Although Cadre will control escaped broadleaf signalgrass, fall panicum, and Texas panicum, a soil-applied grass control herbicide should be used. There are rotational restrictions on the label, especially for cotton. Cadre must not be applied within 90 days of harvest.

Cobra: Cobra controls many of the broadleaf weeds that Blazer controls. However, it is generally more effective than Ultra Blazer in controlling larger weeds, especially common ragweed and eclipta.

Classic: Classic is registered for late postemergence application to peanuts for control of Florida beggarweed only. It should be applied only from 60 days after crop emergence to within 45 days of harvest. Earlier application will stunt peanuts and reduce yield. Classic should not be applied to peanuts under drought stress. It is recommended as a salvage treatment only.

Arrow, Poast, Poast Plus, and Select: Poast, Poast Plus, and Select provide good to excellent control of annual grasses. If applied twice, Poast, Poast Plus or Select also will control bermudagrass and rhizome johnsongrass.

Layby Herbicides:

Dual, Dual Magnum, and Outlook are registered for layby application to peanuts. The value of a layby herbicide application depends upon the soil texture, organic matter content, and amount of rainfall received during the first 4 to 5 weeks after planting. If above-normal rainfall is received during the first 4 to 5 weeks after planting, especially on coarse, sandy soils with very low organic matter, a layby application of Dual or Frontier banded in the row middles may improve digging efficiency or yield. The layby herbicide should be applied to a weed-free surface (cultivate first or treat with appropriate herbicide if emerged grasses, pigweed, or eclipta are present). If rainfall is at or below normal levels during the first 4 to 5 weeks after planting, a layby application will seldom be economically justified for

annual grass control. These herbicides do not control emerged weeds. A layby application of Dual, Dual Magnum, Outlook also may be beneficial in managing eclipta. Look closely to make sure eclipta has not emerged. These herbicides will not control eclipta that has emerged.

Herbicide Programs for Specific Weeds:

Annual Grasses

Crabgrass, Fall Panicum, Foxtails, Goosegrass: The management program begins with either a preplant-incorporated or preemergence herbicide. Prowl, Sonalan, Dual, Dual Magnum, Outlook, Lasso, or Frontier provide good control.

Broadleaf Signalgrass: Broadleaf signalgrass is a major problem in all peanut-producing counties. A management program for broadleaf signalgrass should begin with a preplant incorporated application of Prowl, Sonalan, Dual, Dual Magnum, or Outlook. If broadleaf signalgrass escapes the above treatments, a shallow cultivation would be an option. Alternatively, apply Arrow, Poast, Poast Plus, or Select. A layby application of Dual, Dual Magnum, or Outlook is also an option.

Texas Panicum: This annual grass has been observed in most peanut-producing counties in North Carolina. Infestations are relatively isolated, but further spread is expected. Management programs for Texas panicum may vary from those recommended for other annual grasses. Therefore, proper identification during fall scouting of the preceding crop is critical. Texas panicum can be controlled with a preplant-incorporated application of Prowl or Sonalan; Dual, Dual Magnum, Outlook, and Lasso do not provide adequate control. Because of its large seed, Texas panicum can emerge from deeper in the soil than other annual grasses. Prowl or Sonalan should be incorporated to a depth of 3 inches (this is deeper than specified on Prowl label). Preemergence, at-cracking, or layby applications of Dual, Dual Magnum, Outlook, and Lasso are of little benefit in controlling this species. A shallow cultivation could be considered if Texas panicum begins to emerge in the row middles. Also, Texas panicum is very susceptible to Poast, Poast Plus, or Select.

Nutsedge: Both yellow and purple nutsedge can be found in peanut fields. In recent years, purple nutsedge has been increasing and is now the predominant nutsedge species in many areas. Because management programs may vary for the two species, it is important to determine which species is present during fall scouting of the preceding crop. Nutsedge-infested fields should receive a preplant incorporated application of either Dual, Dual Magnum, or Outlook. If the annual grass population is heavy or is predominantly broadleaf signalgrass or Texas panicum, growers should tank mix Prowl or Sonalan with Dual, Dual Magnum, or Outlook. This should be followed with a preemergence or at-cracking application of Dual, Dual Magnum, and Outlook where yellow nutsedge is expected. Dual, Dual Magnum, and Outlook will not control purple nutsedge. If an economic infestation of yellow nutsedge is present after making the above treatments, Basagran may be applied postemergence when the yellow nutsedge is approximately 7 inches tall. As an alternative to the above strategies, a grower may use a split application of Pursuit. Incorporate 0.72 ounces of Pursuit 70 DG plus a grass control

herbicide. Dual, Dual Magnum, or Outlook would be the preferred grass herbicides unless a grass species is present that these herbicides do not control. Strongarm suppresses both purple and yellow nutsedge, but does not completely control these weeds. Follow up applications of postemergence herbicides are generally needed. Cadre controls purple and yellow nutsedge. Applications should be made when nutsedge is small. Research indicates that rainfall or irrigation that sufficiently moves Cadre into the soil improves control. Although Cadre is applied after nutsedge and other weeds have emerged, a significant amount of uptake by weeds occurs through roots.

Annual Broadleaf Weeds

Common Broadleaf Weeds: Preplant or preemergence herbicides used for annual grass control usually will provide good control of certain small-seeded broadleaf weeds such as pigweed, carpetweed, Florida pusley, common purslane, and lambsquarters (although Dual, Dual Magnum, Outlook, and Lasso are weak on lambsquarters). These herbicides also will suppress a number of other broadleaf weeds. Tank-mix applications with Prowl or Sonalan are most effective for suppressing broadleaf weeds. Strongarm and Valor are effective in controlling many of the broadleaf weeds found in peanuts. These herbicides do not control grasses and must be used in conjunction with preplant incorporated or other preemergence herbicides that control annual grasses. If broadleaf weeds have emerged at the cracking stage of peanuts, Gramoxone MAX or Gramoxone MAX plus Basagran would be an economical option. If additional control is needed for subsequent flushes, one of the postemergence herbicides or tank mixes could be applied. Timing of postemergence herbicide application is critical.

Sicklepod: Gramoxone MAX or Gramoxone MAX plus Basagran should be applied at-cracking or early postemergence when the sicklepod are in the cotyledonary to first true leaf stage. A second application of Gramoxone MAX or Gramoxone MAX plus Basagran is an option if a new flush of sicklepod emerges. For control of sicklepod later in the season, growers can apply 1 pint per acre of 2,4-DB before sicklepod exceeds 12 inches tall. A second application can be made about 2 weeks later. Alternatively, Cadre controls sicklepod very well. Rotation restrictions, however, limit utility of Cadre.

Florida beggarweed: This broadleaf weed has traditionally been confined to the southeastern counties in North Carolina. Isolated infestations are now beginning to appear in some of the northern peanut-producing counties. Since Florida beggarweed is particularly troublesome in peanuts, growers should learn to recognize this weed and strive for the best control possible in all crops in the rotation before the weed becomes widely established. Hand-removal of isolated plants is highly recommended. For earlyseason control of Florida beggarweed, apply Dual, Dual Magnum, Outlook, or Lasso preemergence. Apply Gramoxone MAX when the beggarweed is 2 inches tall or less. A second application of Gramoxone MAX can be made if needed to control beggarweed emerging after the first application. Basagran, Storm, or 2,4-DB may be tank mixed with the Gramoxone MAX for additional control of other broadleaf weeds.

Eclipta: Eclipta tends to be more of a problem in lower areas of fields and in wetter years. Except for extremely heavy infestations, eclipta probably is not very competitive in peanuts because it tends to be a

mid- to late-season problem and is a low-growing weed. Additionally, it does not appear to greatly interfere with digging since it usually dries down before digging time. Dual, Dual Magnum, Outlook, or Lasso will suppress eclipta. Strongarm and Valor control eclipta as well, generally better than these herbicides. Hence, one or more of these herbicides should be applied in fields with a history of eclipta problems. An at-cracking application of Paraquat will control very small eclipta (1/4 inch). Ultra Blazer, Storm, or Cobra applied postemergence will control small eclipta (1 inch or less). Strongarm does an excellent job controlling eclipta. Most eclipta appears to emerge after the normal postemergence herbicide application for broadleaf weeds. In fields with a history of eclipta, growers are encouraged to scout closely for 4 weeks after the normal postemergence broadleaf herbicide application. If enough eclipta emerges to indicate a problem, another postemergence herbicide application (Blazer, Storm, or Tough) may be in order. A layby application of Dual, Dual Magnum, or Outlook may be of value in fields with a history of eclipta problems. Enhanced control of eclipta has been observed where these herbicides were applied at layby.

Perennial Broadleaf Weeds

Perennial broadleaf weeds, such as horsenettle, trumpetcreeper, maypop passionflower, and bigroot morningglory, cannot be controlled in peanuts. Ultra Blazer or 2,4-DB may give suppression but control will not be adequate. These weeds are best controlled in corn grown in rotation with peanuts. In corn, make a layby application of 2,4-D amine plus surfactant or a mixture of Beacon plus Banvel. After corn harvest, any remaining infestations can be spot sprayed with Roundup or a mixture of 1 pint per acre of 2,4-D amine plus 0.5 pint per acre of Banvel plus surfactant. Alternatively, glyphosate can be applied preharvest in cotton.

Bermudagrass: Two applications of Arrow, Poast, Poast Plus, or Select in combination with good crop competition usually will provide adequate to good control of bermudagrass. Growers strive for good control in rotational crops. In cotton, growers can apply glyphosate, Assure II, Fusilade DX, Poast, Poast Plus, or Select postemergence.

Herbicide Use on Peanuts in North Carolina

Use of Herbicides

The following herbicide use data were collected from an informal survey of 67 peanut growers in North Carolina and Virginia from 2002 to 2003.

Herbicide	Percent of Growers Responding
Pendamethalin (Prowl)	60
Metolachlor (Dual)	68
Dimethenamid (Outlook)	12

Diclosulam (Strongarm)	25
Flumioxazin (Valor)	10
Imazethapyr (Pursuit)	20
Imazapic (Cadre)	25
Acifluorfen (Ultra Blazer)	15
Acifluorfen (Storm)	38
Paraquat (Gramoxone MAX)	27
2,4-DB (Butyrac)	50
Bentazon (Basagran)	27
Clethodim (Arrow, Select)	10
Sethoxydim (Poast, Poast Plus)	10

Current Herbicide Recommendations for Peanuts in North Carolina

Current North Carolina Cooperative Extension Service recommendations for herbicide use on peanuts (including information on formulations, application rates, and precautions/limitations) are provided in the following tables from the *North Carolina Agricultural Chemicals Manual*:

Table 8-4A-C: Chemical Weed Control in Peanuts, Weed Response to Preplant Incorporated, Preemergence and At-Cracking Herbicides in Peanuts, and Weed Response to Postemergence Herbicides in Peanuts (http://ipm.ncsu.edu/agchem/chptr8/805.pdf)

Reduced Rates of Herbicides

With crop prices so low, producers are looking for ways to reduce production costs. One possibility is to reduce the application rate of herbicides. Under certain environmental conditions and with certain weed species or weed complexes, specific herbicides can be applied below the manufacturer's suggested use rate without sacrificing weed control. However, growers are cautioned that herbicides applied at reduced rates often do not control weeds adequately when environmental conditions (soil moisture in particular) do not favor herbicide activity. Applying herbicides at reduced rates to large weeds or weeds that are "hardened" often results in poor control as well. Weeds can also be more difficult to control if they were injured by herbicide with previous treatment. Using reduced rates will require that growers apply herbicides in a more timely manner and when weeds are not stressed. Regardless of the previously mentioned factors relative to reduced rates, manufacturers of herbicides will not back up their products when they are applied below the suggested use rate. Liability falls exclusively to the grower.

Compatibility of Agricultural Chemicals

Compatibility is an important consideration when applying two or more products in the same tank. North Carolina Cooperative Extension Publication AG-653, *Tank Mixing Chemicals Applied to Peanut: Are the Chemicals Compatible?,* is a comprehensive guide to agricultural chemical compatibility.

Herbicide-Resistant Weeds

In recent years, populations of weeds that were once controlled by specific herbicides have developed resistance to herbicides. Historically, the frequency if resistance of individual weeds within a population of a species has been very low. However, increased selection pressure and the occurrence of cross resistance have resulted in increased frequency of herbicide resistance in some peanut fields. Two steps are critical in order to prevent yield loss from weed interference and preserve herbicides. Growers should determine whether weed escapes are herbicide resistant and develop an appropriate management strategy for herbicide-resistant weeds. While most weed escapes are the result of an application error or weather conditions, herbicide resistance is a real threat. Indicators of herbicide resistance and approaches to managing herbicide-resistant weed populations are listed in the North Carolina Cooperative Extension Service Publication AG-331, *2005 Peanut Information*. Growers are advised to contact their local Cooperative Extension Agent if herbicide resistance is suspected.

Growth Regulators

Apogee (prohexadione calcium) is registered for use in peanut production. Research has demonstrated that Apogee improves row definition, which can lead to increased efficiency in the digging and inversion process. Apogee should be applied when 50 percent of vines from adjacent rows are touching. Sequential applications (7.2 ounces per acre followed by 7.2 ounces per acre) spaced two to three weeks apart are generally needed. Crop oil concentrate and nitrogen solution (UAN) should be included with Apogee. Depending upon growing conditions, soil fertility, frequency of rainfall and irrigation, and variety selection, row visibility obtained in mid-August may not be sufficient through digging. Research suggests that in addition to increased row visibility, Apogee minimizes pod shed and pod loss during digging and harvesting operations. Significant yield increases have been observed. Research at North Carolina University suggests that the plant grow regulators Early Harvest and Messenger do not increase peanut yield and quality factors.

Current Plant Growth Regulator Recommendations for Peanuts in North Carolina

Current North Carolina Cooperative Extension Service recommendations for plant growth regulator use on peanuts (including information on formulations, application rates, and proper use) are provided in the following table from the *North Carolina Agricultural Chemicals Manual*:

Table 9-12: Growth Regulators for Peanut http://ipm.ncsu.edu/agchem/chptr9/910.pdf

Contacts

Rick L. Brandenburg
Department of Entomology
North Carolina State University
Box 7613
Raleigh, NC 27695-7613
Telephone: 919-515-8876
E-mail: Rick_Brandenburg@ncsu.edu

David L. Jordan
Department of Crop Science
North Carolina State University
Box 7620
Raleigh, NC 27695-7620
Telephone: 919-515-4068
E-mail: David_Jordan@ncsu.edu

Barbara B. Shew
Department of Plant Pathology
North Carolina State University
Box 7903
Raleigh, NC 27695-7903
Telephone: 919-515-6984
E-mail: Barbara_Shew@ncsu.edu

John W. Wilcut
Department of Crop Science
North Carolina State University
Box 7620
Raleigh, NC 27695-7620
Telephone: 919-515-5647
E-mail: John_Wilcut@ncsu.edu

Stephen J. Toth, Jr.
Department of Entomology
North Carolina State University
Box 7613
Raleigh, NC 27695-7613
Telephone: 919-515-8879

E-mail: Steve_Toth@ncsu.edu

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2. Jordan, D. L., G. Sullivan, A. York, and S. Toth. 2005. Informal Survey Results of Pesticide Used by Top Peanut Growers in North Carolina and Virginia. 2004 Proceedings of the Southern Weed Science Society. Volume 57. In Press.
3. Jordan, D. L., J. F. Spears, R. L. Brandenburg, A. B. Brown, B. Shew, G. T. Roberson, and S. G. Bullen. 2004. 2005 Peanut Information. Publication AG-331. North Carolina Cooperative Extension Service, Raleigh. http://ipm.ncsu.edu/Production_Guides/Peanuts/contents.html
4. Sherrell, E. M. (ed.). 2004. North Carolina Agricultural Statistics 2004. Publication No. 204. North Carolina Department of Agriculture & Consumer Services, Raleigh.
5. Toth, S. J., Jr., M. J. Weaver and T. N. Schooley. eds. 2002. Pest Management Strategic Plan for North Carolina/Virginia Peanuts. Summary of Workshop held on April 4, 2002 in Suffolk, Virginia.http://www.ipmcenters.org/pmsp/pdf/NCVApeanutpmsp.pdf

On-line Resources

- Peanuts – N. C. Department of Agriculture & Consumer Services, Marketing Division
  http://www.agr.state.nc.us/markets/commodit/horticul/peanut/
- Peanut Information – North Carolina Cooperative Extension Service
  http://ipm.ncsu.edu/Production_Guides/Peanuts/contents.html
- Peanut Publications and Related Information - Department of Crop Science, North Carolina State University
  http://www.peanut.ncsu.edu/
- Tank Mixing Chemicals Applied to Peanut: Are the Chemicals Compatible? - North Carolina Cooperative Extension Service
  http://www.peanut.ncsu.edu/ag653.pdf
- IPM Peanut Scouting Manual
  http://ipm.ncsu.edu/peanuts/peanutscout.pdf
- Pesticides and Wildlife – Peanuts
  http://ipm.ncsu.edu/wildlife/peanuts_wildlife.html
- North Carolina Pest News
  http://ipm.ncsu.edu/current_ipm/pest_news.html
- Insect Pests of Peanuts
  http://ipm.ncsu.edu/AG271/peanuts/peanuts.html

- Southern Corn Rootworm Advisory for North Carolina and Virginia
  http://ipm.ncsu.edu/scr/
- The Peanut Gallery - photos and drawings of important peanut diseases in North Carolina
  http://www.ces.ncsu.edu/depts/pp/notes/Peanut/gallery/index.html
- North and Virginia Peanut Disease Guide
  http://ipm.ncsu.edu/peanuts/diseases/guide/contents.html
- Peanut Disease Information Notes
  http://www.ces.ncsu.edu/depts/pp/notes/Peanut/peanut_contents.html
- Weather-based Peanut Disease Advisories
  http://www.cals.ncsu.edu:8050/plantpath/people/faculty/shew-b/

Prepared by:

Rick L. Brandenburg, David L. Jordan, Barbara B. Shew, John W. Wilcut, and Stephen J. Toth, Jr. (ed.).

The image of unshelled peanuts is provided by the Department of Communication Services at North Carolina State University.