EFFECTS OF REDUCED TILLAGE, CULTIVAR SUSCEPTIBILITY, AND REDUCED FUNGICIDE PROGRAMS ON LEAF SPOT OF PEANUT (*Arachis hypogaea* L.)

by

WALTER SCOTT MONFORT

(Under the direction of Albert K. Culbreath)

ABSTRACT

Effects of reduced tillage, resistant cultivars, and reduced fungicide regimes on peanut leaf spot disease were evaluated in small and large field experiments. Reduced tillage (Strip-till) delayed the onset of Early Leaf Spot *Cercospora arachidicola* Hori. (Early Leaf Spot) thus reduced the final incidence of leaf spot when compared to Conventional-till. Resistant cultivars (C99-R and MDR-98) were less infected by *Cercospora arachidicola* Hori. compared to that of the leaf spot susceptible cultivar, Georgia Green. Leaf spot severity was typically higher in the reduced fungicide regime (21- day Expanded Regime) when compared to the standard fungicide regime (14- day Regime). However, the 21- day fungicide regime in the strip-tillage system provided control of leaf spot that was comparable to that of the 14- day fungicide regime in conventional-tillage, especially in resistant cultivars. In the mulch amendment tests, leaf spot epidemics were not significantly affected the wheat mulch based on visual observations. However, mulch treatments had a significant effect on leaf spot when the number of lesions per leaflet were analyzed which suggest that the addition of mulch itself can provide some suppression of leaf spot epidemics. In addition to the much treatments, glyphosate did not significantly effect leaf spot of peanut.

Key words: Reduced tillage, Roundup.

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**DEDICATION**

I would like to dedicate this Master's Thesis in memory of my father:

Wiley Alec "Butch" Monfort, Jr.

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# CHAPTER 1

## INTRODUCTION AND LITERATURE REVIEW

The peanut or groundnut (*Arachis hypogaea* L.) is an important annual legume worldwide. It produces edible seed that are very nutritious and high in proteins, carbohydrates, and vitamins (53). Peanuts can be eaten raw or cooked and have served as an important part of the everyday diet of people in many parts of the world, especially in developing countries. Most of the peanuts produced throughout the world are either ground into peanut butter or crushed to make oil (17,45, 46,).

Peanuts originated in the tropical and subtropical countries in South America some 3800 years ago (46,53). Through exploration and slave trade, peanuts were introduced to Africa, India, and later to the United States (45,46). Today, peanuts are grown mostly in the more temperate regions between the latitudes 40 N and 40 S. Peanuts thrive on an abundance of sunlight and temperatures that range from 25-30$^{o}$ C with night temperatures not falling below 10$^{o}$ C (45,46). Temperatures below or above these ranges can severely retard the growth and development of the peanut plant. Peanuts also require an average of 50-76 centimeters of rainfall during production to ensure optimum vegetative growth and seed maturity (4,46). Peanuts can be grown in all types of soil, but grow best and produce the highest yields in soils that are well-drained, loose, and sandy, with a pH between 5.5 and 7.0 (4,46).

The United States is the third largest peanut producer in the world with an average of 675,000 ha harvested annually with an estimated farm gate value of 1.3 billion dollars (17,49). Production is limited to nine states, of which Georgia is the largest, producing an average of 273,169 ha annually (46,50). Peanuts are produced across the coastal plain region of Georgia, but most of the peanuts are produced in the southwestern part of the state, where the temperature, soil type, and rainfall are optimal for peanut production (46).

Unfortunately, the same environmental conditions found in Georgia that are favorable for peanut production also are very conducive for the development of peanut diseases. Among the most important and costly peanut diseases in Georgia are the peanut leaf spots. Cost of control of leaf spot diseases and direct losses in yield account for an average annual loss of over $63 million for Georgia producers (4,7-10,66,67). The two most important leaf spot diseases are early leaf spot, caused by *Cercospora arachidicola* (Teleomorph = *Mycosphaerella arachidis* Deighton), and late leaf spot, caused by *Cercosporidium personatum* (Berk. & M. A. Curtis) Deighton (Teleomorph = *Mycosphaerella berkeleyi* Jenk.) (49,61). Although both leaf spot diseases can be found wherever peanuts are produced, there can be dramatic, often unexplainable shifts in prevalence of one leaf spot pathogen over the other. For the past two decades in Georgia, the occurrence of early and late leaf spot epidemics have fluctuated from late leaf spot to early leaf spot with both diseases often occurring in the same field (13). Two other important peanut diseases that producers are faced with each year in Georgia are spotted wilt, caused by tomato spotted wilt tospovirus (TSWV) and southern stem rot or white mold caused by *Sclerotium rolfsii* (4,49).

Both leaf spot pathogens can cause lesions on peanut leaves, petioles, pegs, central stems, and lateral branches, but both diseases are more destructive on peanut leaves (49). Lesions may be seen as early as ten days after spore germination and infection. Lesions often first appear as a small chlorotic spots (49). In ten to twenty days after infection, the lesions can enlarge to 1-10 mm in diameter and sporulate. The two leaf spot diseases can be distinguished based on lesion appearance. In many cases, early leaf spot tends to have a distinct yellow halo surrounding the lesion; whereas, the halo is usually absent on late leaf spot lesions (49). On peanut cultivars currently grown in the southeastern U.S. however, an obvious yellow halo may occur around lesions caused by both pathogens. A more consistent characteristic for differentiating leaf spot diseases in the southeastern U.S. is color of the lesion on the abaxial (lower) surface of the leaf. Early leaf spot lesions are usually light brown in color, whereas late leaf spot lesions are more commonly dark brown to black in color (49,62,64). Even though these characteristics are typical, they can vary with peanut genotype and environmental conditions.

The most accurate way to distinguish between the two leaf spot diseases is by microscopic examination of the conidia produced on the lesions. Conidia of *C. arachidicola* are generally formed on the adaxial (top) surface of the lesion on the leaflet. Conidia are produced on conidiophores or stalks that are yellowish brown, 15-45 × 3-6 :m in size and are formed mainly on the upper surfaces of the leaf (49). Conidia are typically subhyaline in color, 35-110 × 3-6 :m in size, and sometimes curved in shape (49). Each conidium has a truncate base and a subacute tip, and can possess up to 12 septa. The conidia and conidiophores develop from a dark colored fungal stroma (49).

Conidia of *C. personatum* are produced on lesions on both the adaxial (top) and abaxial (lower) surface of peanut leaflets. However, they are most frequently formed on the abaxial surface (4,49,62,64). The stromata, in which both conidia and conidiophores are formed, are more dense and larger than the stromata of *C. arachidicola*. Conidiophore and conidia size ranges from 10 – 100 × 3.0 – 6.5 :m and 20 – 70 × 4 – 9 :m, respectively (49). Conidiophores tend to be light brown in color, smooth, and can have conidial scars 2 – 3 :m wide. Conidia are typically light yellow in color, cylindrical, slightly curved, rounded at the apex, and usually contain 3 – 4 septa (49,62,64).

Optimal environmental conditions for reproduction and infection are quite similar for the two pathogens. Both pathogens thrive when relative humidity exceeds 93% for extended periods of time (49,64). *C. arachidicola* is capable of infection at temperatures between 16 - 24$^{o}$ C, while infection by *C. personatum* is favored at temperatures between 20 and 26$^{o}$ C. Conidia are typically dispersed via wind, splashing water, and may be carried by insects (49,55,64). Conidia dispersal is often greatest when dew evaporates in the morning and at the onset of a rainy period. Although inoculum can be spread from field to field, the initial inoculum for the disease usually comes from within the field on infected peanut residue from previous peanut crops (49). The pathogen overwinters on infected residue as dormant stromata until environmental conditions are favorable for reproduction and dispersal.

If not managed, peanut leaf spots can cause up to 70% reduction in yield (23,55). Typically, leaf spots have been managed using two strategies. Initial inoculum can be reduced through burial of peanut crop residue with a moldboard plow and through crop rotation of 2-3 years between peanut crops (55). The second strategy involves reducing the rate of development of the leaf spot disease. This strategy involves intensive use of fungicides and partially resistant peanut cultivars (24).

Although crop rotation and burial of peanut debris is routinely practiced throughout peanut production regions of the southeastern U.S., these practices alone will not eliminate all of the overwintering pathogen populations in the soil. Thus, multiple applications of fungicides are usually necessary to ensure control of the diseases in a given year (54). In much of the peanut production area of the southeastern U.S., fungicides are applied on a calendar schedule that begins 30 to 40 days after planting with subsequent applications made at10 to 14-day intervals thereafter (54). Many fungicides, such as copper/sulfur dust, benomyl, copper hydroxide, fentin hydroxide, chlorothalonil, and maneb, have been used as protectants against foliar pathogens over the last few decades (24). However, some of these fungicides are no longer used due to cost and pathogen resistance problems. Chlorothalonil, a broad-spectrum fungicide, is among the more effective fungicides leaf spot control registerd on peanut (28,60,64). For this reason, it has remained one of the most widely used fungicides on peanuts in the southeast.

*Sclerotium rolfsii*, the causal agent of southern stem rot, and other soilborne pathogens have also gained respect of peanut producers in the southeast (15,49). Southern stem rot was noted as one of the most destructive peanut diseases in the 1990s causing an estimated $44 million in losses annually (7-10, 66,67). Unfortunately, chlorothalonil is not effective for control of stem rot in peanut, and even fungicides, such as PCNB, chlorpyrifos, tebuconazole and azoxystrobin that are registered for management of stem rot, often provide only moderate control (15, 29). The introduction of sterol demethylation-inhibiting (DMI) and strobilurin fungicides in the mid to late 1990's allowed for more effective alternatives for management of leaf spots and southern stem rot in peanut (15). Although these fungicides have good activity against both foliar and soilborne pathogens in peanuts, they may be at risk for development of resistance by the pathogens, since they have site –specific modes of action (6).

This threat of fungal resistance to these new fungicides has resulted in the evaluation of various application schedules that alternate single-site fungicides with a broad-spectrum fungicide like chlorothalonil (6, 64). Bertrand et al. in 1997 (6) suggested that a successful resistance management program is one that is built around a highly efficacious yet low-risk fungicide. In developing such a program, several fungicide schedules and/or combinations were recommended to give the best control without increasing resistance to fungicides with single site modes of action (6). These fungicide schedules or combinations involve the use of a broad-spectrum (low-risk) fungicide and a single-site mode-of-action (high-risk) fungicide in tank mixed, alternated, or in block applications (6,27).

In research trials, Culbreath et al. (28) demonstrated the efficacy of chlorothalonil and cyproconazole as a tank mix treatment. Tank mix treatments of chlorothalonil (low risk) at 0.63 kg a.i./ha and cyproconazole (higher risk) at 0.062 kg a.i./ha and 0.093 kg a.i./ha controlled peanut leaf spot as well as or better than chlorothalonil alone (26,28). However, tank mixed applications of chlorothalonil with the high rate of cyproconazole provided the greatest suppression of southern stem rot (26,28). In another study, tank mixes of propiconazole (a DMI fungicide) and chlorothalonil also improved the control of peanut leaf spot diseases over that of chlorothalonil alone (26,27). Unfortunately, the biggest disadvantage of tank mixing these fungicides is often the added cost to obtain greater disease control (6).

Block application of low and high-risk fungicides is another way to achieve effective disease control and reduce the risk of fungal resistance to single-site fungicides (6). In a block application schedule, two or more consecutive applications of single-site fungicides are alternated with a broad-spectrum fungicide like chlorothalonil (6). In fungicide trials conducted from 1991 to 1993, Brenneman and Culbreath (15) compared various fungicide application schedules of chlorothalonil and tebuconazole (DMI fungicide). The application schedules were comprised of a standard 14-day (7 sprays) schedule and an extended 21- day (5 sprays) application schedule for chlorothalonil and for chlorothalonil/tebuconazole in a block schedule. In the chlorothalonil/tebuconazole block schedule, tebuconazole was applied in sprays 3-6 for the 14-day application and sprays 2-4 for the 21-day application (15). They determined that the chlorothalonil/tebuconazole block application reduced the severity of both foliar (early and late leaf spots) and soilborne (southern stem rot) diseases. Both early and late leaf spot were more severe in the extended 21-day application schedule than in the 14-day application schedule. They further determined that the block application of chlorothalonil/tebuconazole increased pod yield and kernel quality over that of chlorothalonil alone (15).

Culbreath et al (30) compared the efficacy of various mixtures, alternations, and block applications of benomyl and chlorothalonil for control of late leaf spot in locations where a significant portion of the pathogen populations was resistant to benomyl. They found that alternating full rates of chlorothalonil with full rates of benomyl, or using full-season tank mixes of half rates of those two fungicides provided control of late leaf spot that was comparable to that of the full rate of chlorothalonil alone. In those tests, final leaf spot intensity ratings in plots that received full season applications of benomyl alone were no lower or only slightly lower than those of the non-treated control (30).

Although currently available fungicides can be very effective for peanut disease control, fungicides are one of the highest input costs in peanut production (21). Fungicide spray programs cost Georgia producers $50-70 million annually (7-10,66,67).

An alternative to managing peanut diseases with costly fungicides alone is the integration of genetic resistance (1,13,19,21,22,61). Because leaf spot diseases are among the most damaging peanut diseases worldwide, development of cultivars resistant to one or both leaf spot pathogens is highly desirable.

Breeding for leaf spot resistance has become a major objective for many of the peanut breeding programs throughout the southeast (19,20,57). Prior to the 1980s, breeding lines with leaf spot resistance were generally late maturing and low yielding (38). Dr. Gorbet at the University of Florida developed the first commercial acceptable leaf-spot-resistant cultivar, released in 1986 as Southern Runner (20,38). Southern Runner is a late-maturing cultivar, but it has moderate resistance to late leaf spot and high yield potential (23,25,38,57).

Gorbet et al. conducted research trials on the response of various experimental genotypes of differing levels of leaf spot resistance to fungicide treatments (38). The late-leaf-spot-resistant cultivar Southern Runner and the susceptible cultivar Florunner were included in the trials. They concluded fungicide applications could be reduced on peanut cultivars with partial resistance to leaf spot pathogens (38,57). Despite its resistance to *C. personatum*, Southern Runner did not become a widely grown cultivar due to its late maturity and industry quality standards (25).

In the early 1990s, breeding for leaf spot resistance was concentrated on the development of early maturing cultivars (13). Branch et al. compared maturity, leaf spot resistance, and yield potential of six advanced breeding lines with those of medium to late maturing resistant cultivars (Southern Runner and Georgia Brown) and an early maturing susceptible cultivar (Florunner) (13). The six advanced breeding lines were GA T-2843, GA T-2847, GA T-2845R, GA T-2846 (which was released as Georgia Green), GA T-2742, and GA T-2844 (12). GA T-2742 and Florunner had the highest mean leaf spot ratings for all three years. Southern Runner had the lowest mean rating of 3.7 with all remaining cultivars being intermediate. GA T-2844 and Georgia Browne had the highest yield of 4164 lbs per acre and 4040 lbs per acre, respectively. Southern Runner and Florunner produced the lowest yield.

All of the advanced breeding lines were early to medium maturing cultivars with GA T-2844 maturing the earliest at 134 days. They concluded that even though GA T-2844 had lower leaf spot resistance than Southern Runner, it has potential as an early maturing and high yield cultivar with leaf spot disease tolerance (13).

GA T-2844 and other early-maturing leaf-spot-resistant breeding lines were not commercialized due to their susceptibility to spotted wilt, caused by tomato spotted wilt tospovirus (TSWV). Spotted wilt is one of the most destructive diseases in peanut production in the southeastern United States, which has cost Georgia producers as much as $40 million in crop losses alone in a single season (59,66,67). Although the virus is vectored by seven species of thrips, only two species, the tobacco thrips, *Frankliniella fusca* (Hinds) and the western flower thrips, *Frankliniella occidentalis* (Pergande), are known to vector the virus in Georgia (33,49). Spotted wilt was first observed in peanut in Georgia in the mid 1980s but was not a widespread problem in peanut until 1989, when symptomatic plants were found in every field surveyed inGeorgia (32).

Because of the complexity and severity of the spotted wilt problem, many breeders began to screen currently available cultivars as well as advanced breeding lines for tolerance or resistance to the virus (33,34,59). Some of the first evidence of field resistance or tolerance to TSWV was observed during the epidemics in Texas in the mid 1980s, where TSWV incidence was lower in Southern Runner than in Florunner (32). This was later supported by research trials conducted by Culbreath et al. (32). Discovery of TSWV resistance in Southern Runner increased the emphasis on field screening for resistance. Subsequently, Georgia Green (formerly GA-T 2846), the dominant cultivar now planted in Georgia, and several other TSWV-resistant cultivars (33,34,35) have been released. Advances in peanut breeding also lead to the development and commercialization of several multi-disease resistant cultivars, such as UF MDR 98, and C-99R, which have resistance to *C. arachidicola*, *C. personatum*, TSWV, and *S. rolfsii* (34,35).

The importance of spotted wilt management in peanut production in the Southeastern U.S. resulted in multi-disciplinary, regional investigations of this disease in Georgia, Florida, and Alabama (16,31,35). These multi-state efforts resulted in the identification of six critical management practices, in addition to resistant cultivars, that greatly help to minimize the losses caused by TSWV (16,31). The six management inputs are manipulation of planting date, establishment of adequate plant populations, application of phorate insecticide at planting, use of twin row patterns, and reduced tillage. A risk index was developed that allowed producers to evaluate the risk of loss to spotted wilt based on specific peanut production practices (16, 31). Therefore if a producer's risk of loss or damage is high, he can alter his management inputs to lower his risk without dramatically changing his overall farming operation, with the exception of tillage.

Research has shown that the incidence of spotted wilt in peanut is significantly lower in reduced tillage compared to conventional tillage systems (16,48). So, to reduce incidence of spotted wilt peanut producers must convert from the standard conventional tillage system to a reduced tillage system. A producer using the standard conventional system may till the soil six to seven times, using implements such as disk harrows, moldboard plows, rotor tillers, and bedders, to form a clean seedbed in which to plant (65). In a reduced tillage system, a producer utilizes cover crops and rarely uses any tillage implement except for a strip-tillage implement to prepare a narrow (24 cm) seedbed to plant (65).

Until the mid 1990s, the uncertainty of modifying or changing from an established and profitable conventional tillage practice discouraged most growers from seeking any benefits that might be realized from reduced tillage practices in peanuts. Some of these possible benefits are reduction in production costs, soil erosion, and water runoff (11,42,44). However, the suppression of crop prices, increases in energy costs, and reductions in the labor force have made it necessary for many producers to evaluate options like reduced tillage in an effort to reduce production costs without reducing productivity. The transition to reduced tillage systems could prove to be a good strategic move by producers to become more efficient, thus reducing the risk involved with producing crops in an already unstable agricultural economy.

Although the reduced tillage system has been proven as a viable tillage practice for many growers in the southeastern U.S., both economically and environmentally, there are still many questions to be answered on how plant pathogens and other pests are affected by the adaptation of a reduced tillage system (11,39). Over the past three decades, the largest shift of producers from conventional-tillage to reduced tillage has been in corn and small-grain-producing areas in the mid-western U.S. (11). This shift prompted many researchers to investigate the effects of reduced tillage on disease development.

In corn and wheat, reduced tillage has been associated with an increase in both foliar and soilborne disease development compared to conventional tillage (47). Payne et al. showed that gray leaf spot could survive and serve as primary inoculum for the next growing season when plant debris is left on the soil surface in a reduced tillage system (56). When soil debris was buried at least 15 centimeters below the soil surface, gray leaf spot did not survive until the next growing season. Incidence and severity of anthracnose and corn leaf blight also were higher in the reduced tillage system compared to the conventional tillage system (11). Many researchers have shown both negative and positive effects of reduced tillage on disease development in wheat. For example, epidemics of diseases caused by *Pyrenophora tritici-repentis* (tan spot), *Gaeumannomyces graminis* var. *tritici* (take-all), and *Cephalosporium gramineum* (cephalosporium stripe) were more severe in a reduced tillage system, but development of diseases caused by *Bipolaris sorokiniana* (Sacc.), *Fusarium graminearium*, and *Psuedocercosporella herpotrichoides* was suppressed in the reduced tillage system compared to the conventional tillage system (3,11).

With the utilization of reduced tillage increasing in many non-grain crops, the importance of determining the effects of reduced tillage on disease development and current recommended disease control programs has become a research priority. Everts et al. characterized the effects of reduced tillage (no-till) on the development of powery mildew, caused by *Sphaerotheca fuliginea* and microdochium blight, caused by *Plectosporium tabacinum* in pumpkin (*Cucurbita pepo*) (36). She determined that severity of microdochium blight was lower in the no-till plots than in conventionally tilled plots, and that the effects of tillage on powdery mildew were variable. Everts further determined that fungicide inputs could be reduced without increasing severity of microdochium blight or reducing yield. In the no-till plots, area under the disease progress curve (AUDPC) values for powdery mildew epidemics treated with a reduced fungicide application schedule were similar to those for standard fungicide schedule on powdery mildew resistant varieties. Damping off of cotton seedlings, caused by *Pythium sp*. and *Rhizoctonia solani* is enhanced by reduced tillage in early plantings (18). This might be due to lower soil temperature and increased soil water holding capacity associated with reduced tillage systems.

Of the producers of major row crops, peanut growers have been among the last to adopt reduced tillage primarily because of concern for potential increases in disease problems (51). The increased residue on the surface and potential for greater soil moisture, may favor disease development (40,41,51). However, in short and long time studies, incidence of southern stem rot was not significantly affected by reduced tillage compared to conventional tillage (37,41,42,44,52). Tillage practices also can affect foliar diseases of peanut. Spotted wilt was one of the first peanut diseases reported to be suppressed by reduced tillage (16,48). This was determined in many trials conducted in the southeastern U.S. in the late 1990's (16,48). In a four-year trial conducted by Porter et al., peanut leaf spot disease severity was less in reduced tillage plots than in conventional tillage plots (58) (Phatak, personal communication). However, Sholar reported conflicting results that peanut leaf spot incidence was higher in both minimum tillage and no-tillage plots than in conventional tillage (63). With little known about the mechanisms involved in the effects of reduced tillage practices on leaf spot development on peanut, research needs to be conducted to investigate the potential cultural or physical and chemical interactions on disease that may be associated with adapting from a intensive tillage practice to a reduced tillage practice. Disruption in the development and reproduction of other peanut diseases like the soil borne pathogens *Calonectria parasiticum* (Anamorph = *Cylindrocladium parasiticum* (C. A. Loos) D. K. Bell & Sobers) that causes Cylindrocladium black rot (CBR) in peanut were noted in previous studies of mulch amendments and pre-plant application of glyphosate for weed control (5,42). This research was undertaken to evaluate the effects of combinations of reduced tillage, current labeled recommended fungicide regimes and reduced fungicide regimes, and multi-disease resistant peanut cultivars on peanut leaf spot epidemics in peanut. In these experiments, effects on spotted wilt and southern stem rot would also necessarily have to be considered. Research trials were conducted on a small experimental plot scale, to maximize disease development and eliminate as many possible confounding influences of variability in environmental conditions and nutrient availability, and on a large farm scale to in which normal growing conditions under standard recommended production practices would be emulated. With leaf spot disease development in 2000 following the similar trends in 2000 as concluded by D. M. Porter, small plot experiments were conducted under greenhouse and field conditions in initial attempts to determine the reasons (Cultural and/or chemical) for suppression of leaf spot epidemics in reduced tillage (58).

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# CHAPTER 2

# EFFECTS OF REDUCED TILLAGE, RESISTANT CULTIVARS AND REDUCED FUNGICIDE INPUTS ON PROGRESS OF LEAF SPOT DISEASES OF PEANUT (*Arachis hypogaea* L.)

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**Abstract**

Field experiments were conducted in 2000 and 2001 on Georgia Green, MDR-98 and C-99R peanut (*Arachis hypogaea*) cultivars on the Lang Farm, Tifton, Georgia to determine the effects of tillage practices and reduced fungicide inputs on progress of early leaf spot (*Cercospora arachidicola*) epidemics. Fungicide treatments (Trts) were: 1) no fungicide; 2) chlorothalonil (CHL) 1.26 kg/ha; 3) tebuconazole 0.23 kg/ha (sprays 3-6) and CHL 1.26 kg/ha (all other sprays); 4) azoxystrobin 0.33 kg/ha (sprays 3 and 5) and CHL 1.26 kg/ha (all other sprays), at 14-d intervals (7 sprays). Trts 5-7 included the same fungicides as Trts 2-4, but at 21-d intervals (4 sprays). AUDPC values were lower in strip-till than in conventional tillage plots. AUDPC values for Trts 1-7 were 381, 255, 239, 228, 311, 260, and 247 in 2001 (LSD = 21) and 328, 131, 111, 119, 212, 163, and 150 in 2000 (LSD = 20), respectively, for conventional-till plots and 297, 190, 177, 186, 231, 197, and 185 in 2001 (LSD = 27) and 238, 97, 98, 95, 144, 120, and 106 in 2000 (LSD = 22), respectively, for strip-till for Georgia Green. AUDPC values were lower for C-99R and MDR-98, but followed similar trends for treatments and tillage. Within tillage and cultivar combinations, leaf spot intensity was typically higher in the 21-day fungicide regimes than in the 14-day schedule. However, in most cases, leaf spot control in the 21-day fungicide regimes in the strip-till system was comparable to that of the 14-day fungicide regimes in conventional tillage. Based on these results, fungicide usage could be reduced without compromising control of leaf spot when reduced tillage and resistant cultivars are used. This reduction in fungicide applications could cut production costs by $30 per hectare (2000 average fungicide cost).


Key words: Reduced fungicide schedule, Reduced Tillage, Resistant Cultivars,

**Introduction**

Early leaf spot, caused by *Cercospora arachidicola* Hori, and late leaf spot, caused by *Cercosporidium personatum* (Berk. & Curt.) Deighton, are among the most important diseases of peanut (*Arachis hypogaea* L.) in Georgia. Cost of control and direct yield reduction account for an average annual loss of $63 million for Georgia producers (2,30,31). If not managed, these leaf spots can cause up to 70% loss in peanut yield (10,25). Historically, leaf spots have been managed through the combination of crop rotation, the burial of peanut crop residue with a moldboard plow (25) and multiple applications of fungicides. Although rotation and deep turning are used throughout peanut growing regions of the southeastern U.S., those practices alone will not eliminate all sources of initial inoculum over-wintering in the soil. Thus, multiple applications of fungicides are required in most years (24).

Suppressed crop prices, higher energy costs, and a reduced labor force have prompted many producers to evaluate options like conservation tillage to lower production cost. The largest shift of producers from conventional-tillage to conservation tillage has been in corn and small-grain-producing areas in the mid-western United States (7). In the last two decades, conservation tillage (strip-tillage) has become more frequently utilized in corn, small grains, soybeans, and cotton in the southeast. The acceptance of strip-tillage in peanut production has been slow due to concern with potential problems with disease, plant stands, weed control, and harvest associated with increased residue buildup. Through the availability and increased knowledge of new herbicides and conservation tillage implements, peanut acreage produced utilizing strip-tillage has increased from 6% in 1997 to 17% in 1999 (1). With this rapid increase in strip-tillage, producers are concerned that the increase in residue and a greater potential for soil water holding capacity may enhance the development of the major peanut diseases (17,18,22). This is extremely important since disease control is one of the most expensive inputs in peanut production. However, spotted wilt caused, by tomato spotted wilt tospovirus (TSWV), was one of the first peanut diseases found to be suppressed by reduced tillage (8,21). Based on results of long- and short-term studies, southern stem rot (*Sclerotium rolfsii)* was not significantly affected by reduced tillage compared to conventional tillage (16,18,19,20,23). In a 4-year trial conducted by Porter, severity of peanut leaf spots in reduced tillage plots was lower than in conventional tillage plots (26). However, Sholar et al. reported conflicting results that leaf spot was significantly higher in both minimum tillage and no-tillage plot compared to conventional tillage (28).

This research was undertaken to compare the effects of strip-till and conventional tillage practices on progress peanut leaf spot epidemics, in susceptible and partially-resistant peanut cultivars under standard and reduced fungicide regimes.

## Materials and Methods

Field tests were conducted in a field of Tifton loamy sand at the Coastal Plain Experiment Station, Lang Farm, Tifton, GA in 2000 and 2001. The field site had been planted to cotton (*Gossypium hirsutum* L.) the previous year. Both sites were planted to a cover crop consisting of a mixture of wheat (*Triticum aestivum*) and rye (*Secale cereale*) at a rate of 104.4 kg per ha in the fall prior to spring planting. A pre-mixed 3-9-18 N-P-K fertilizer was applied at a broadcast rate of 336 kg/ha in 2000 and 560 kg/ha in 2001 in late March. A split-split-plot experimental design was used with four replications. Tillage treatments were the main plots, cultivars were the sub-plots, and fungicide regime treatments were the sub-sub-plots. Main plots were separated by four to six non-sprayed border rows and blocks were separated by 2.4-m fallow alleys. Sub-sub plots were 9.1 m long by 0.9 m wide in 2000 and 7.6 m long by 0.9 m wide in 2001. Tillage treatments included conventional and reduced tillage (strip-till) systems. In the conventional-tillage plots, the cover crop was mowed and disked twice in early April. The soil was deep-turned 20 to 25 cm deep with a switch plow to aid in burial of previous crop debris and bedded using a disk bedder in early May. Ethalfluralin (Sonalan HFP 3.0, Dow AgroScience, LLC, Indianapolis, IN) at 0.95 kg a.i./ha and metoachlor (Dual Magnum 8E, Syngenta Crop Protection, Inc, Greensboro, NC) at 2.52 kg a.i./ha (2000) and 1.68 kg a.i./ha (2001) were incorporated in the soil for weed control in the conventional-tillage plots prior to planting.

For the strip-till plots, the cover crop was killed using glyphosate (Roundup 4 EC, Monsanto, Kansas City, MO) at 1.2 kg a.i./ha approximately 2 weeks prior to planting. A strip-till implement manufactured by Kelly Manufacturing, Tifton, GA was used to prepare a minimum amount of soil for the seedbed. The strip-till implement was equipped with a subsoil shank to loosen the plow pan beneath the row (33 cm) deep, and tilled a strip approximately 20 to 25 cm wide. All cultivars were planted in both tillage plots at 13 to 20 seed per m of row on 91 cm row spacing on 16 May 2000, and 18 May 2001. Aldicarb (Temik 15G, Aventis Crop Science, Research Triangle Park, NC) was applied at a rate of 1.12 kg a.i./ha in furrow at planting. Pendimethalin (Prowl 3.3 EC, BASF Corporation, Mount Olive, NJ) at 0.92 kg a.i./ha, paraquat (Starfire 1.5, Syngenta Crop Protection, Inc, Greensboro, NC) at 0.13 kg a.i./ha, and bentazon (Basagran 4 EC, BASF Corporation, Mount Olive, NJ) at 1.12 kg a.i./ha were applied in 2000 and 2,4-DB (Butyrac, Aventis Crop Science, Research Triangle Park, NC) at 0.28 kg a.i./ha, pyridate (Tough 5 EC, Syngenta Crop Protection, Inc, Greensboro, NC) at 1.14 kg a.i./ha, and bentazon at 0.56 kg a.i./ha were applied in 2001 for weed control in the strip-till plots after planting. Bentazon, 2,4DB, and sethoxydim (Poast Plus 1.0 EC, BASF Corporation, Mount Olive, NJ) were applied at standard recommended rates in late July to early August for control of grasses and broadleaf weeds. To satisfy calcium requirements for the peanut, calcium sulfate was applied as gypsum at 1120 kg/ha on 7 July 2000, and at 1900 kg/ha on 19 July 2001. Cultivars used included Georgia Green, a leaf spot susceptible cultivar, and two cultivars, MDR-98 (15) and C99-R (14), with moderate levels of partial resistance to *C. personatum* and *C. arachidicola*. All three cultivars have moderate levels of resistance to TSWV (8,14,15), and MDR-98 (15) and C-99R (14) have some resistance to *Sclerotium rolfsii*.

Fungicide treatment regimes consisted of: 1.) nontreated control; 2.) chlorothalonil (Bravo WeatherStik 720 F, in 2000 and Bravo Ultrex 82.5 WDG, in 2001, Syngenta Crop Protection, Inc, Greensboro, NC ) at 0.1.26 kg a.i./ha, sprays 1-7, applied at 14-day intervals; 3.) applications of chlorothalonil 1.26 kg a.i./ha, sprays 1,2 and 7, and tebuconazole (Folicur 3.6 F, Bayer Agriculture Division, Kansas City, MO) 0.23 kg a.i./ha, sprays 3-6, applied at 14-day intervals; 4.) applications of chlorothalonil 1.26, sprays 1,2,4,6 and 7, and azoxystobin (Abound 2.08 F, Syngenta Crop Protection, Inc, Greensboro, NC) 0.33 kg a.i./ha, sprays 3 and 5, applied at 14-day intervals; 5.) chlorothalonil at 1.26 kg a.i./ha, sprays 1-4, applied at 21 to 28 day intervals; 6.) applications of chlorothalonil 1.26 kg a.i./ha, sprays 1 and 4, and tebuconazole at 0.23 kg a.i./ha, sprays 2-3, applied at 21 to 28-day intervals; 7.) applications of chlorothalonil at 1.26 kg a.i./ha, sprays 1 and 4, and azoxystobin at 0.33 kg a.i./ha, sprays 2 and 3, applied at 21 to 28 day intervals.

In 2000, fungicides were applied at 36, 51, 64, 78, 92, 107, and 119 days after planting (DAP) for the 14-day schedule, and at 36, 58, 78, and 107 DAP for the extended schedule. In 2001, fungicides were applied at 35, 49, 62, 75, 89, 102, and 118 DAP for the 14-day schedule and 35, 59, 75, and 97 DAP for the extended schedule. Fungicides were applied using a multiple-boom tractor- mounted $CO_2$-propellant sprayer. Each boom was equipped with three D3-23 hollow-cone spray nozzles per row. Fungicides were applied in 114 liters of water/ha at a pressure of 345 kPa. Leaf spot intensity (severity and defoliation) was assessed for the entire plots, based on the Florida 1 to 10 scale, where 1 = no leaf spot, and 10 = plants completely defoliated and killed by leaf spot (9). Leaf spot intensity ratings were made at 85, 100, 118, and 135 DAP in 2000, and 68, 77, 83, 90, 96, 105, 112, 119, 126, 130, and 144 DAP in 2001. Area under the disease progress curve (AUDPC) values were calculated for each plot using leaf spot intensity ratings and time in DAP (27). Tomato spotted wilt was evaluated 96 DAP in 2000 and 92 DAP in 2001 as described by Culbreath et al.(15). Spotted wilt intensity was determined in each plot using a disease intensity rating that represents a combination of incidence and severity as previously described. The number of 0.3-m portions of row containing severely stunted, chlorotic, wilted or dead plants was counted for each. The number of 0.3-m portions of linear row severely affected by spotted wilt was converted to a percentage of row length for comparison of treatments.

Plants were dug and inverted 140 DAP in 2000 for all cultivars and 131 DAP for Georgia Green and 144 DAP for MDR-98 and C99-R in 2001. Immediately after plants were inverted, loci of southern stem rot (*Sclerotium rolfsii*) were counted for each plot, where a locus represented 31 cm or less of linear row with one or more plants showing symptoms of *Sclerotium rolfsii*. Incidence of stem rot was calculated as the percentage of 31 cm sections of row with symptoms of stem rot and/or signs of the pathogen. Plants were allowed to dry in the wind-rows, and pods were harvested mechanically on 144 DAP in 2000 for all cultivars and 136 DAP for Georgia Green and 148 DAP for MDR-98 and C99-R in 2001. Harvested pods from each plot were dried and adjusted to 12% w/w moisture for treatment weight comparisons. For 2000 and 2001, data from each year were analyzed independently by analysis of variance (29). Subsequent reference to significant differences among means indicates significance at $P \leq 0.05$ unless otherwise stated.

**Results**

Early leaf spot was the predominant foliar disease in both years. Tillage x fungicide treatment, tillage x cultivar, and cultivar x treatment interactions were significant ($P \leq 0.05$) for leaf spot final intensity ratings and AUDPC values for both years (Table 2.1); therefore fungicide treatments were compared with in each cultivar and tillage treatment. Leaf spot was more severe in 2001 than in 2000 (Figures 2.1,2.2). In all treatment comparisons, leaf spot final intensity and

AUDPC values were lower in the strip-tillage production system than in the conventional-tillage system (Table 2.3). Tillage effects were more evident in the leaf spot susceptible cultivar, Georgia Green, and in the 21- day expanded fungicide regimes treatments (Table 2.2,2.3). Except for MDR-98 and C99-R in 2000 and Georgia Green in 2001, the non-treated fungicide treatments had the least numerical difference in tillage treatments than all of the other fungicide regime treatments. AUDPC values were significantly higher in conventional-tillage production system when compared to the strip-tillage system (Table 2.3). The leaf spot AUDPC values were significantly greater in all conventional-tillage fungicide regimes treatments for all cultivars except for the non-treated fungicide treatment in the C99-R cultivar in 2001 (Table 2.3). Effects of tillage varied among cultivars and fungicide regime treatments in 2000. Tillage had a significant ($P \leq 0.05$) effect on tomato spotted wilt in all cultivars except MDR-98 in 2000 (Table 2.5). Southern stem rot disease incidence was not significantly affected by tillage in 2000 (Table 2.4).

In 2001, there were no significant tillage, cultivar, or fungicide regime treatment interactions on southern stem rot. Across all other factors, average white mold incidence for conventional-tillage was significantly higher (10.0%) than for strip-tillage (6.2%) (LSD = 1.0.). Peanut yield was not significantly affected by tillage in 2000. In 2001, there were no significant interactions of tillage, cultivar, or fungicide regime treatment on yield. Across all other factors the mean average yield was 4806 kg per hectare in conventional-tillage and 4355 kg per hectare in strip-tillage with a LSD = 184.

Final leaf spot intensity and AUDPC values were higher for Georgia Green than for other cultivars in most of the fungicide treatments (Table 2.2,2.3). C99-R had the lowest levels of leaf spot in both years. MDR-98 had a lower incidence of southern stem rot in 2000 among all of the fungicide regime treatments in 2000 (Table 2.4). There were no significant tillage, cultivar, or fungicide regime treatments interactions for incidence of southern stem rot in 2001 (Table 2.1). Across all other factors Georgia Green had the lowest incidence of white mold at 6.7 with MDR-98 = 8.1 and C99-R = 9.5 (LSD = 1.2). Yield varied among cultivars in 2000. There were no significant tillage, cultivar, or fungicide regime treatment interactions in 2001 (Table 2.1). Across all other factors, the average yield was 4069 kg per hectare for Georgia Green, 4749 kg per hectare for MDR-98, and 4922 kg per hectare for C99-R (LSD = 225).

The final leaf spot intensity rating (Table 2.2) and leaf spot AUDPC values (Table 2.3) were significantly higher for the non-treated plots than in any other treatment in both years. Leaf spot intensity was typically higher, however not always significantly, in most of the 21-day expanded fungicide regimes compared to the 14-day fungicide regime treatments. Chlorothalonil was least effective of the three fungicide regime treatments for both the 14-day and 21-day schedules on leaf spot (Table 2.2,2.3) and southern stem rot (Table 2.6). Fungicide treatments had no effect on tomato spotted wilt incidence. Of the treatment combinations for 2000 and 2001, the non-treated and 21-day chlorothalonil treated plots had the lowest yields. Yield varied among the 21-day and 14-day fungicide regime treatments among all cultivars (Table 2.6,2.7).

## Discussion

In this study, epidemics of early leaf spot were suppressed in plots of peanut grown using strip-tillage in all cultivar and fungicide regime treatment combinations compared to the respective cultivar and treatment combination grown using conventional-tillage. A similar reduction in final incidence of early leaf spot in reduced tillage was previously reported by Porter et al. (26). Disease progress curves from this current study indicate that leaf spot epidemics were delayed in strip-till plots compared to the conventional tillage plots (Fig 1, 2). This delay in leaf spot was more evident in 2001 when leaf spot was more severe and leaf spot ratings were recorded more frequently. Suppression of leaf spot epidemics with strip-tillage alone was not sufficient to prevent yield losses. However, the reduction in the spread of leaf spot epidemics via reduced tillage would not only aid in the control of one Georgia's most costly disease but would also reduce the cost of peanut production.

Suppression of leaf spot epidemicscan be further enhanced by planting leaf spot resistant cultivars like MDR-98 (15) and C99R (14). Results with these two cultivars in the conventional tillage plots corroborate previous findings with *C. personatum* on the moderately resistant cultivar, Southern Runner (10,11,13), where reductions in applications of chlorothalonil, less effective methods of application of chlorothalonil, or less effective fungicides could be used in combination with moderate resistance without sacrificing yield. Although Georgia Green is the predominantly grown cultivar in Georgia, new cultivars like C99-R would give producers more management options to control certain diseases as well as aid in managing harvest intervals by planting cultivars with varying days to maturity. The results from this trial indicated that fungicide usage could be reduced when strip-tillage and resistant cultivars are used. Leaf spot was typically higher in the 21-day fungicide regimes than in the 14-day schedule. However, the 21-day fungicide regimes in the strip-tillage system provided control of leaf spot that was comparable to that of the 14-day fungicide regimes in conventional-tillage. Control of leaf spot might be enhanced further by the use of more effective fungicides. In this test, all fungicide applications made solely for leaf spot control utilized only chlorothalonil. Other treatments, such as mixtures of reduced rates of chlorothalonil and propiconazole have been shown to provide superior control of leaf spot compared to full rates of chlorothalonil alone (12). The ability to control leaf spot adequately with an expanded schedule could reduce both the input costs of producing peanuts and the amount of fungicides applied into the environment. This reduction in fungicide applications based on regimes tested in these experiments could cut production costs by an estimated $49.40 /ha (2000 average fungicide cost).

Results from this study support previous reports that spotted wilt is suppressed in peanut grown under a reduced tillage system and that southern stem rot is not consistently affected by reduced tillage (8,16,18,19,23). Incidence of both of these diseases was relatively low in the fields used in these tests. In fields with severe epidemics of spotted wilt, suppression of that disease by use of strip-till could provide additional benefits not realized with epidemics less severe than those in these tests.

In these tests, for both years, peanuts grown under conventional-tillage typically produced higher yield than those grown under strip-tillage even though leaf spot was less severe in the reduced tillage system. Yield differences between the standard conventional tillage and strip-tillage may deter producers from utilizing reduced tillage practices. However, in Georgia, many producers are utilizing reduced tillage in other crops and have found that there are several advantages to using reduced tillage systems. Adoption of reduced tillage for peanuts would allow those producers to eliminate unnecessary tillage implements. Converting peanuts to a strip-till-system may translate into less overhead, labor, time in field, and management time. These reductions, combined with potential saving from fungicide inputs from utilizing a reduced tillage practice in peanut production could potentially offset the yield advantages observed in the conventional-tillage plots in these tests. Those comparisons are currently being examined. Furthermore, utilization of a reduced tillage practice like strip-tillage may potentially reduce soil erosion, nutrient and pesticide runoff, and may enhance water utilization. Results of this study show that a reduced tillage practice like strip-till can benefit peanut producers both economically and environmentally. Use of strip tillage delayed leaf spot epidemics 1 to 2 weeks, thus reducing the potential yield damage caused by leaf spot.

When strip-tillage is utilized in combination with moderately resistant cultivars, adequate leaf spot control may be achieved with three fewer applications of available fungicides. The reduction in fungicides could save the producer up to $49.40 per hectare and reduce potential environmental risks associated with application of fungicides.

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Table 2.1. Results of analysis of variance for effects of tillage, peanut cultivar, and fungicide treatment regime on leaf spot, southern stem rot, spotted wilt epidemics (TSWV), and peanut yield.

| Year | Source | Leaf Spot Final incidence | | Leaf Spot AUDPC | | Southern Stem Rot Incidence | | TSWV Incidence | | Final Yield | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2000 | | DF | Pr >F | DF | Pr >F | DF | Pr >F | DF | Pr >F | DF | Pr >F |
| | Tillage | 1 | < 0.001 | 1 | < 0.001 | 1 | 0.4388 | 1 | 0.450 | 1 | 0.8117 |
| | Rep(Tillage) | 6 | 0.0368 | 6 | < 0.001 | 6 | 0.0003 | 6 | 0.0127 | 6 | < 0.001 |
| | Cultivar | 2 | < 0.001 | 2 | < 0.001 | 2 | 0.0005 | 2 | < 0.001 | 2 | < 0.001 |
| | Tillage × Cultivar | 2 | 0.0248 | 2 | 0.0022 | 2 | 0.4677 | 2 | 0.8252 | 2 | 0.0380 |
| | Rep × Cultivar (Tillage) | 12 | 0.0107 | 12 | 0.1719 | 12 | 0.2367 | 12 | 0.7550 | 12 | 0.2681 |
| | Treatment | 6 | < 0.001 | 6 | < 0.001 | 6 | < 0.001 | 6 | 0.0771 | 6 | < 0.001 |
| | Tillage × Treatment | 6 | < 0.001 | 6 | < 0.001 | 6 | 0.9744 | 6 | 0.0035 | 6 | 0.0871 |
| | Cultivar × Treatment | 12 | 0.0009 | 12 | < 0.001 | 12 | < 0.001 | 12 | 0.4427 | 12 | 0.0002 |
| | Tillage × Cultivar × Treatment | 12 | 0.1658 | 12 | 0.8543 | 12 | 0.9603 | 12 | 0.5806 | 12 | 0.8545 |
| 2001 | Tillage | 1 | 0.006 | 1 | < 0.001 | 1 | 0.0013 | 1 | 0.0008 | 1 | 0.0062 |
| | Rep(Tillage) | 6 | < 0.001 | 6 | < 0.001 | 6 | 0.0858 | 6 | 0.0107 | 6 | 0.2764 |
| | Cultivar | 2 | < 0.001 | 2 | < 0.001 | 2 | 0.0142 | 2 | 0.0007 | 2 | < 0.001 |
| | Tillage × Cultivar | 2 | 0.0159 | 2 | < 0.001 | 2 | 0.7732 | 2 | 0.0318 | 2 | 0.9900 |
| | Rep × Cultivar (Tillage) | 12 | 0.1030 | 12 | 0.3185 | 12 | 0.0629 | 12 | 0.0096 | 12 | 0.4270 |
| | Treatment | 6 | < 0.001 | 6 | < 0.001 | 6 | 0.4746 | 6 | < 0.001 | 6 | < 0.001 |
| | Tillage × Treatment | 6 | 0.0021 | 6 | 0.007 | 6 | 0.3918 | 6 | 0.0886 | 6 | 0.7078 |
| | Cultivar × Treatment | 12 | 0.0004 | 12 | < 0.001 | 12 | 0.7312 | 12 | 0.6850 | 12 | 0.2405 |
| | Tillage × Cultivar × Treatment | 12 | 0.0309 | 12 | 0.1708 | 12 | 0.5466 | 12 | 0.6540 | 12 | 0.9952 |

Table 2.2. Effects of tillage, peanut cultivar, and fungicide application regime on final peanut leaf spot intensity.

| | | Conventional-till | | | Strip-till | | |
|---|---|---|---|---|---|---|---|
| | Fungicide Treatment | Georgia Green | MDR-98 | C99-R | Georgia Green | MDR-98 | C99-R |
| Year 2000 | Nontreated | 9.7[1] A[3]a[2] | 7.9 Ab | 7.7 Ab | 9.1 Aa | 7.4 Bb | 7.1 Bb |
| | 14 – Day chlorothalonil | 4.8 Aa | 3.2 Ab | 2.6 Ac | 3.3 Ba | 2.7 Aa | 2.1 Ab |
| | 14 – Day tebuconazole/chlorothalonil | 4.3 Aa | 2.8 Ab | 2.3 Ab | 3.4 Aa | 2.9 Aab | 2.4 Ab |
| | 14 – Day azoxystrobin/chlorothalonil | 3.6 Aa | 3.0 Aa | 2.6 Aa | 2.7 Aa | 2.1 Ab | 2.2 Aab |
| | 21 – Day chlorothalonil | 7.4 Aa | 5.6 Ab | 5.1 Ab | 5.1 Ba | 3.5 Bb | 2.9 Bb |
| | 21 – Day tebuconazole/chlorothalonil | 6.1 Aa | 5.1 Aab | 4.1 Ab | 4.3 Ba | 3.2 Bb | 3.1 Ab |
| | 21 – Day azoxystrobin/chlorothalonil | 7.7 Aa | 5.2 Ab | 3.6 Ac | 3.3 Ba | 3.2 Ba | 2.8 Ab |
| | LSD (P>0.05) Among treatments | 1.2 | 0.7 | 0.6 | 0.8 | 0.5 | 0.6 |
| Year 2001 | Nontreated | 9.6 Aa | 8.8 Ab | 8.8 Ab | 9.3 Ba | 8.4 Aa | 8.5 Aa |
| | 14 – Day chlorothalonil | 7.2 Aa | 6.6 Aa | 6.7 Aa | 5.7 Ba | 5.4 Aa | 4.4 Bb |
| | 14 – Day tebuconazole/chlorothalnil | 5.3 Aa | 4.6 Aa | 3.7 Ab | 3.7 Bb | 4.2 Aa | 3.4 Ab |
| | 14 – Day azoxystrobin/chlorothalonil | 5.7 Aa | 5.3 Aa | 4.3 Ab | 4.1 Ba | 4.4 Aa | 3.9 Aa |
| | 21 – Day chlorothalonil | 8.7 Aa | 7.6 Ab | 7.7 Ab | 7.2 Aa | 7.3 Aa | 6.4 Aa |
| | 21 – Day tebuconazole/chlorothalonil | 7.4 Aa | 7.3 Aa | 5.5 Ab | 5.6 Aab | 6.3 Aa | 4.4 Ab |
| | 21 – Day azoxystrobin/chlorothalonil | 6.4 Aa | 6.9 Aa | 4.9 Ab | 4.0 Bb | 5.2 Aa | 4.3 Ab |
| | LSD (P>0.05) Among treatments | 0.7 | 0.5 | 0.7 | 1.1 | 0.9 | 1.0 |

[1] Means based on Fla. 1-10 leaf spot severity scale (1= no leaf spots, 10= total defoliation).
[2] Means in a row within each tillage with a letter in common are not significantly different (P≥0.05; Fisher's protected least significant difference).
[3] Means in a row for same cultivar and fungicide treatment among tillage with a letter in common are not significantly different P≥0.05.

Table 2.3. Effects of tillage, peanut cultivar, and fungicide application regime on the area under the disease progress curve (AUDPC) for leaf spot epidemics on peanut.

| | | Conventional-till | | | Strip-till | | |
|---|---|---|---|---|---|---|---|
| | Fungicide Treatment | Georgia Green | MDR-98 | C99-R | Georgia Green | MDR-98 | C99-R |
| Year 2000 | Nontreated | 328[1] A[3] a[2] | 282 A b | 236 A b | 236 B a | 199 Bb | 184 Bb |
| | 14 – Day chlorothalonil | 131 Aa | 94 Ab | 84 Ac | 84 Ba | 88 Aa | 77 Ab |
| | 14 – Day tebuconazole/chlorothalnil | 111 Aa | 83 Ab | 78 Ab | 78 Aa | 77 Aab | 83 Ab |
| | 14 – Day azoxystrobin/chlorothalonil | 119 Aa | 91 Aa | 89 Aa | 89 Aa | 72 Ab | 76 Aab |
| | 21 – Day chlorothalonil | 212 Aa | 164 Ab | 144 Ab | 144 Ba | 106 Ab | 107 Bb |
| | 21 – Day tebuconazole/chlorothalonil | 163 Aa | 133 Aab | 124 Ab | 124 Ba | 97 Bb | 106 Bb |
| | 21 – Day azoxystrobin/chlorothalonil | 150 Aa | 135 Ab | 111 Ac | 111 Ba | 98 Ba | 91 Ab |
| | LSD (P>0.05) Among treatments | 20 | 20 | 18 | 22 | 13 | 11 |
| Year 2001 | Nontreated | 553 Aa | 436 Ab | 407 Ab | 463 Ba | 373 Ba | 353 Aa |
| | 14 – Day chlorothalonil | 383 Aa | 302 Aa | 296 Aa | 292 Ba | 239 Ba | 219 Bb |
| | 14 – Day tebuconazole/chlorothalnil | 334 Aa | 263 Aa | 226 Ab | 236 Bb | 218 Ba | 192 Bb |
| | 14 – Day azoxystrobin/chlorothalonil | 330 Aa | 258 a | 228 b | 262 Ba | 221 Ba | 198 Ba |
| | 21 – Day chlorothalonil | 466 Aa | 353 Ab | 344 Ab | 359 Ba | 314 Ba | 280 Ba |
| | 21 – Day tebuconazole/chlorothalonil | 393 Aa | 311 Aa | 261 Ab | 298 Bab | 258 Ba | 223 Bb |
| | 21 – Day azoxystrobin/chlorothalonil | 362 Aa | 297 Aa | 343 Ab | 260 Bb | 234 Ba | 205 Bb |
| | LSD (P>0.05) Among treatments | 21 | 17 | 22 | 27 | 18 | 22 |

[1]Means based on Fla. 1-10 leaf spot severity scale (1= no leaf spots, 10= total defoliation).
[2]Means in a row within each tillage with a letter in common are not significantly different ($P \geq 0.05$; Fisher's protected least significant difference).
[3] Means in a row for same cultivar and fungicide treatment among tillage with a letter in common are not significantly different $P \geq 0.05$.

Table 2.4. Effect of tillage, peanut cultivar, and fungicide application regime on incidence of southern stem rot on peanut.

| Fungicide Treatment | Disease Incidence[1] | | | | | |
|---|---|---|---|---|---|---|
| | 2000 | | | 2001 | | |
| | Georgia Green | MDR-98 | C99-R | Georgia Green | MDR-98 | C99-R |
| Nontreated | 39.9 a[2] | 9.6 b | 12.3 b | 5.5 a | 10.0 a | 11.0 a |
| 14 – Day chlorothalonil | 4.8 a | 4.4 a | 5.6 a | 6.5 a | 7.8 a | 9.5 a |
| 14 – Day tebuconazole/chlorothalnil | 2.1 a | 0.2 b | 1.5 ab | 7.3 a | 7.8 a | 9.3 a |
| 14 – Day azoxystrobin/chlorothalonil | 3.6 a | 0.8 b | 4.6 a | 7.0 a | 8.0 a | 10.0 a |
| 21 – Day chlorothalonil | 10.9 a | 4.4 a | 6.5 ab | 6.3 a | 8.0 a | 10.0 a |
| 21 – Day tebuconazole/chlorothalonil | 5.4 a | 2.5 a | 4.0 a | 8.3 a | 8.3 a | 9.3 a |
| 21 – Day azoxystrobin/chlorothalonil | 3.8 a | 2.7 a | 4.6 a | 6.3 a | 7.3 a | 7.3 a |
| LSD (P>0.05) Among treatments | 7.7 | 4.0 | 4.2 | 3.6 | 4.1 | 3.7 |

[1]Disease incidence based on a percentage of 31 cm section of row with symptoms of stem rot
[2]Means in a row with a letter in common are not significantly different (P≥0.05; Fisher's protected least significant difference).

Table 2.5. Effect of tillage, peanut cultivar, and fungicide application regime on tomato spotted wilt virus incidence on peanut.

| | Incidence of TSWV[3] | | | | | |
|---|---|---|---|---|---|---|
| Fungicide Treatment | 2000 | | | 2001 | | |
| | Georgia Green | MDR-98 | C99-R | Georgia Green | MDR-98 | C99-R |
| Conventional-Till | 7.5 b[1] | 13.2 a | 7.5 b | 14.5 a | 5.1 b | 8.0 b |
| Strip-Till | 5.6 b | 11.0 a | 4.9 b | 4.9 a | 1.9 b | 1.9 b |
| LSD[2] ($P \geq 0.05$) | 1.8 | 2.4 | 1.5 | 3.0 | 1.7 | 2.4 |

[1]Means in a row for each year with a letter in common are not significantly different (Fisher's protected least significant difference at $P \geq 0.05$)
[2]Denotes significant difference between tillage treatments at $P \leq 0.05$ in same cultivar.
[3]Disease incidence based on a percentage of 31 cm section of row with symptoms of TSWV

Table 2.6. Effect of tillage, peanut cultivar, and fungicide application regime on final yield of peanut in 2000.

| | Yield (kg/ha) | | | | | |
|---|---|---|---|---|---|---|
| Fungicide Treatment | Conventional-Till | | | Strip-Till | | |
| | Georgia Green | MDR-98 | C99-R | Georgia Green | MDR-98 | C99-R |
| Nontreated | 744 a[1] | 2286 b | 3194 c | 1573 a | 2372 b | 2771 b |
| 14 – Day chlorothalonil | 3115 ab | 3424 ab | 3854 b | 3321 a | 3406 a | 3902 a |
| 14 – Day tebuconazole/chlorothalnil | 3412 a | 3279 a | 4289 b | 3836 ab | 3703 a | 4404 ab |
| 14 – Day azoxystrobin/chlorothalonil | 3848 a | 3436 a | 4459 a | 4095 b | 3037 a | 3697 b |
| 21 – Day chlorothalonil | 2964 a | 2946 b | 3993 a | 3049 a | 3037 a | 3799 b |
| 21 – Day tebuconazole/chlorothalonil | 3533 a | 3448 a | 4053 a | 3533 a | 3025 a | 3648 a |
| 21 – Day azoxystrobin/chlorothalonil | 3533 a | 3442 a | 4380 b | 3200 ab | 3067 a | 3920 b |
| LSD (P>0.05) Among treatments | 942 | 698 | 580 | 717 | 839 | 487 |

[1]Means in a row within each tillage treatment with a letter in common are not significantly different (P> 0.05; Fisher's protected least significant difference).

Table 2.7. Effect of tillage, peanut cultivar, and fungicide application regime on final yield of peanut in 2001.

| | Yield (kg/ha) | | | | | | |
|---|---|---|---|---|---|---|---|
| Fungicide | Conventional-Till | | | Strip-Till | | | |
| Treatment | Georgia Green | MDR-98 | C99-R | Georgia Green | MDR-98 | C99-R | Mean |
| Nontreated | 2774 | 3151 | 3608 | 2606 | 2998 | 3296 | 3052 |
| 14 – Day chlorothalonil | 4196 | 4937 | 4668 | 3652 | 4153 | 4487 | 4336 |
| 14 – Day tebuconazole/chlorothalnil | 3753 | 4777 | 4930 | 35565 | 4472 | 4204 | 4306 |
| 14 – Day azoxystrobin/chlorothalonil | 4138 | 4922 | 5126 | 3289 | 4450 | 4443 | 4350 |
| 21 – Day chlorothalonil | 3783 | 3993 | 3913 | 3354 | 3899 | 3841 | 3764 |
| 21 – Day tebuconazole/chlorothalonil | 4145 | 4632 | 4951 | 3340 | 4240 | 4617 | 4276 |
| 21 – Day azoxystrobin/chlorothalonil | 4574 | 4581 | 5111 | 4240 | 4175 | 4378 | 4541 |
| LSD[1] ($P \leq 0.05$) Among treatments | 1277 | 535 | 496 | 972 | 527 | 647 | 307 |

[1]Denotes significant difference ($P \leq 0.05$) when compared to same cultivar within fungicide treatments.

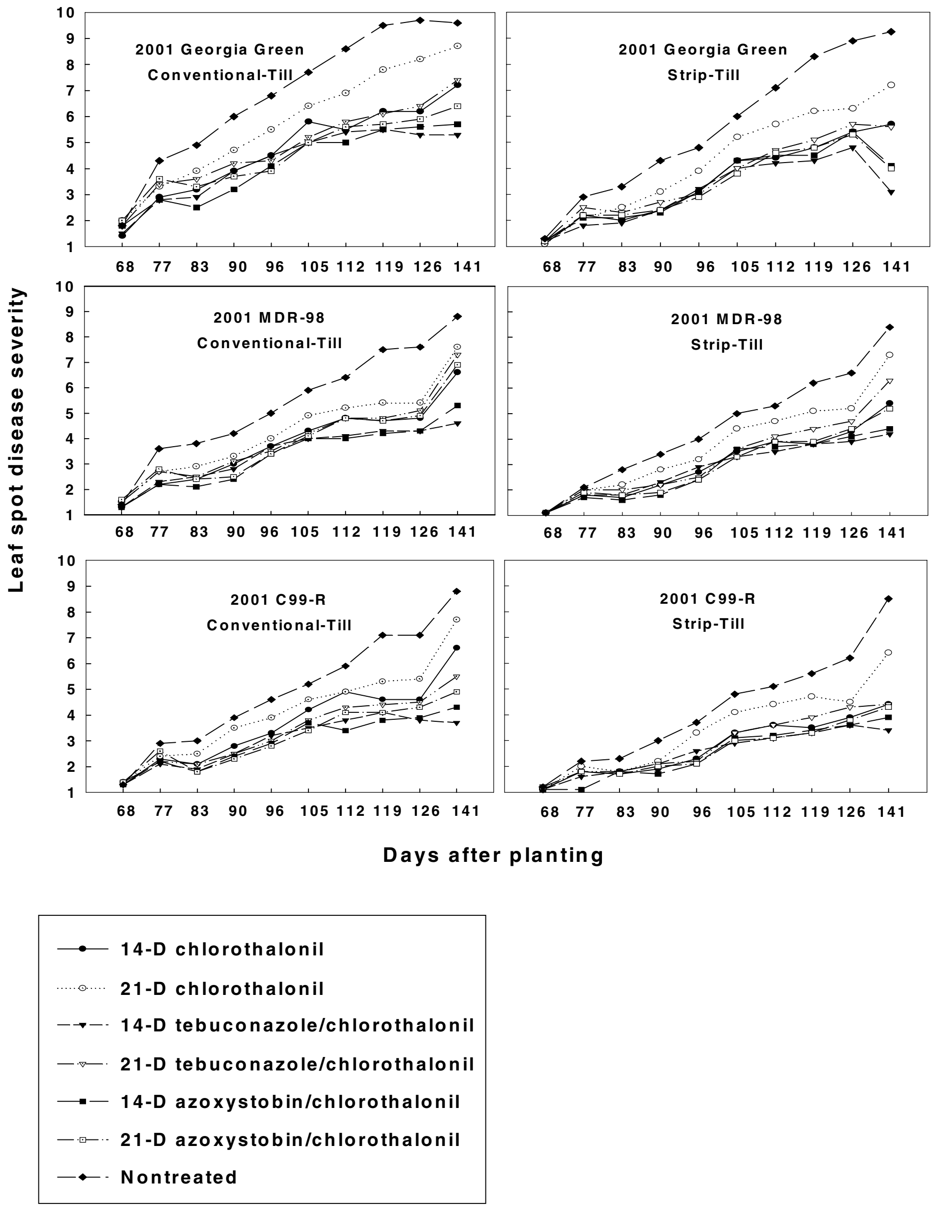


Figure 2.1. Effect of tillage, peanut cultivar, and fungicide application regime on progress of peanut leaf spot epidemics.

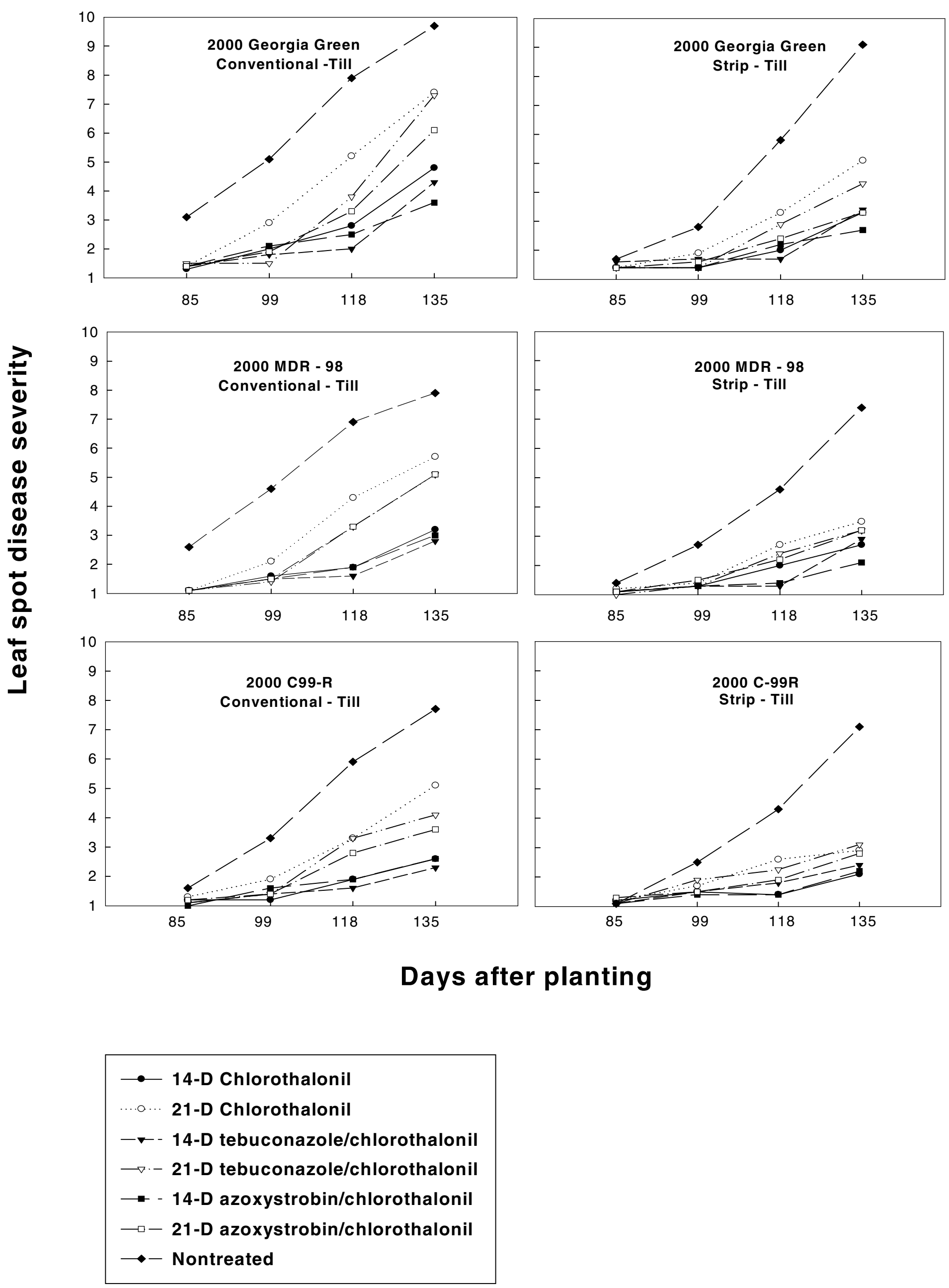


Figure 2.1. Effect of tillage, peanut cultivar, and fungicide application regime on progress of peanut leaf spot epidemics.

**CHAPTER 3**

# LARGE PLOT EVALUATIONS OF STRIP-TILLAGE, RESISTANT CULTIVARS, AND REDUCED FUNGICIDE INPUTS FOR MANAGEMENT OF EARLY LEAF SPOT OF PEANUT

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[1]Monfort, W.S., Culbreath, A.K., and Brenneman, T.B. To be submitted to *Plant Health Progress*.

## Abstract

Field experiments were conducted in 2000 and 2001 to determine the effects of tillage, the number of fungicide applications, and resistant cultivars on early (*Cercospora arachidicola*) leaf spot of peanut (*Arachis hypogaea*). Split-plot experiments with four replications were conducted in two commercial fields (one using strip-tillage and one using conventional-tillage practices) ca. 0.25 miles apart in 2000 and one commercial field (both tillage practices) in 2001 in Worth Co., GA. Whole plots were 3 m by 267 to 400 m in size, and treatments consisted of cultivars Georgia Green and Florida MDR-98 in 2000 with the addition of C-99R in 2001. Sub-plots were two fungicide treatments: 1) azoxystrobin (AZO) 0.33 kg/ha (sprays 3 and 5) and chlorothalonil (CHL) 1.26 kg/ha (all other sprays), applied at 14 day intervals and 2) AZO 0.33 kg/ha (sprays 2 and 4) and CHL 1.26 kg/ha (all other sprays), applied at 21-28 day intervals. Leaf spot ratings were 2.3 and 4.4 for GG and 1.9 and 3.3 for Florida MDR-98 (LSD = 0.4) for treatments 1 and 2, respectively in conventional-tillage plots, and 2.1 and 2.9 for GG and 2.3 and 1.7 for Florida MDR (LSD = 0.2) respectively in strip-tillage plots. Lower levels of leaf spot severity in large strip-tilled plots of resistant cultivars were similar to results observed in small plot experiments. Leaf spot control in reduced fungicide regimes in strip-till was comparable to leaf spot control in the standard 14-day fungicide regimes. Thus, the use of strip-tillage may reduce fungicide requirements for leaf spot control on Georgia Green, and should allow for even better leaf spot control when combined with resistant cultivars such as Florida MDR-98 or C-99R.


Key words: large scale plots, Peanut yield monitor, Residue

## Introduction

Peanut (Arachis hypogaea L.) production in the southeastern United Stated has changed dramatically over the last decade. Long used intensive tillage practices have been replaced in many instances with reduced or conservation tillage practices. This conversion was due largely to the suppression of crop prices, higher energy costs, and reduced labor force, which have forced producers to evaluate new production practices to lower production costs. In a reduced tillage system, a producer utilizes cover crops and rarely uses any tillage implement except for a strip-tillage implement to till a narrow seedbed (22). The standard tillage system, a very intensive tillage practice, may involve tilling the soil six to seven times with tillage implements like disk harrows, moldboard plows, rotor tillers, and "bedders", to form a clean seedbed into which to plant (22).

For most peanut producers, the uncertainty of modifying or changing from a well established and profitable conventional tillage practice has outweighed any possible benefits that might be reaped from a reduced tillage practice in peanut. These possible benefits include reductions in production costs, soil erosion, and water runoff (7,16). However, the development and availability of new herbicides and reduced tillage implements has improved the transition from conventional-tillage practices to a reduced tillage (strip-till) in peanut as well. The acceptance of reduced tillage in peanuts is growing each year. In Georgia alone, peanut acreage utilizing strip-tillage increased from 6 % to 17 % from 1997 to 1999 (1).

Although utilization of a reduced tillage system can be a viable tillage practice in the southeastern U. S. both economically and environmentally, there are still many questions to be answered about the effects of tillage on plant pests and pathogens (7,14). Over the last decade, peanut producers in Georgia have lost an average of over $200 million annually disease damage and control costs (3-6,23,24). Among the most important and costly peanut diseases in Georgia are peanut leaf spots caused by *Cercospora arachidicola* Hori (early leaf spot) and *Cercosporidium personatum* (Berk. & Curt.) Deighton (late leaf spot). The combination of direct losses to leaf spots and costs of disease control account for an annual loss of $63.35 million for Georgia producers (3-6,23,24). If not managed adequately, leaf spots can cause up to 70% reduction in yield (2,23,24,9,19). Two other important peanut diseases that producers are faced with each year in Georgia are spotted wilt, caused by tomato spotted wilt tospovirus (TSWV), and southern stem rot, caused by *Sclerotium rolfsii* (2,17). Investigations of tillage on pathogens and pests of peanut should include these two diseases.

In previous research trials leaf spot disease severity was lower in reduced tillage plots than in conventional tillage plots (20). Similar trends in peanut leaf spot disease development were observed in reduced tillage (strip-till) peanut trials conducted by Monfort et al. in Tifton, Georgia (Chapter 2/unpublished data). Although previous research showed that leaf spot disease intensity was lower in a strip-till system, most of these results are based on trials conducted on a small plot scale under controlled conditions. Small-scale research allows scientists to evaluate specific variables with minimum interference of extraneous factors or to investigate specific cropping practices like tillage that would be impractical to replicate due to land requirements and limitations of producer resources in large plot research trials. However, large plot evaluations are an important tool for determining if effects of tillage on peanut diseases that are found in small plot research will be consistent with where peanuts are produced under more typical large-scale production practices. This research was undertaken to evaluate effects of current labeled recommended fungicide regimes, reduced fungicide regimes and multi-disease resistant peanut cultivars on leaf spot, southern stem rot, and spotted wilt disease in reduced tillage and conventional tillage systems. Research trials were conducted on a large farm scale with normal growing conditions under standard recommended production practices.

## Materials and Methods

Field tests were conducted in fields of Tifton loamy sand at Sutton farms and Brooks Farms in 2000, and Young Farms, Worth, County, GA in 2001. Field sites had been planted to cotton (*Gossypium hirsutum* L.) the previous year. Both the Sutton and Young field sites were planted to a cover crop consisting of a mixture of wheat (*Triticum aestivum*) and rye (*Secale cereale*) at a rate of 104.4 kg/ha in the fall prior to spring planting. A split plot design was used with four replications. Cultivar treatments were the main plots and fungicide regime treatments were the sub-plots. All plot treatments were evaluated in a conventional tillage and a reduced tillage (strip-till) system. In 2000, the conventional tillage and reduced tillage systems were represented by two different fields that were 792 meters apart. For 2001, the two tillage practices were compared side-by-side in the same field.

Split plots were 375 to 450 m long by 3.6 m wide in 2000 and 240 m long by 3.6 m wide in 2001 and were evaluated at multiple sites within each plot. All cultivars were planted in both tillage plots at 13 to 20 seed/m of row on 91 cm row spacings on 16 May 2000 and 18 May 2001. Plots received aldicarb (Temik 15G, Aventis Crop Science, Research Triangle Park, NC) at a rate of 1.12 kg a.i./ha in furrow at planting. Application of plant nutrients and pesticides other than fungicides were based on the individual producer's needs and production practices. Peanut cultivar Georgia Green, a leaf spot susceptible cultivar, and two cultivars with moderate levels of partial resistance to *C. personatum* and *C. arachidicola* MDR-98 (12) and C99-R (8) were used in these trials (only MDR-98 in 2000). All three cultivars have moderate levels of field resistance to TSWV, and MDR-98 and C-99R have some resistance to *S. rolfsii*. Fungicide treatment regimes consisted of: 1.) applications of chlorothalonil 1.26 kg a.i./ha, sprays 1,2,4,6 and 7, and azoxystobin (Abound2.08 F, Syngenta Crop Protection, Inc, Greensboro, NC) 0.33 kg a.i./ha, sprays 3 and 5, applied at 14-day intervals and 2.) applications of chlorothalonil at 1.26 kg a.i./ha, sprays 1 and 4, and azoxystobin at 0.33 kg a.i./ha, sprays 2 and 3, applied at 21 to 28-day intervals.

In 2000, fungicide applications were made on 37, 51, 64, 79, 93, 107, and 126 days after planting (DAP) for the 14-day schedule, and on 37, 59, 79, and 107 DAP for the extended schedule. In 2001, applications were made on 34, 45, 62, 77, 90, 106, and 120 DAP for the 14-day schedule and 34, 56, 77, and 106 DAP for the extended schedule. Fungicide applications were made using a tractor-mounted hydraulic sprayer. The spray boom was equipped with three D3-23 hollow-cone spray nozzles per row. Fungicides were applied in water at 114 liter/ha at a pressure of 345 kPa. Leaf spot intensity (severity and defoliation) was assessed at multiple sites for entire plots by use of the Florida 1 to 10 scale where 1 = no leaf spot, and 10 = plants completely defoliated and killed by leaf spots (9,10,11). Leaf spot intensity ratings were made on 85, 100, 118, and 135 DAP in 2000, and 128 and 142 DAP in 2001. Plants in each plot were evaluated at multiple sites for severe symptoms of spotted 99 DAP in 2001 and 96 DAP in 2000. Incidence of spotted wilt was determined as the percent of row length severely affected by spotted wilt (12). Plants were dug and inverted 147 DAP in 2000 for all cultivars and 130 DAP for the Georgia Green cultivar and 150 DAP for the MDR-98 and C99-R cultivars in 2001. Immediately after plants were inverted, loci of southern stem rot were counted at multiple sites within each plot, where a locus represented 31 cm or less of linear row with one or more plants infected. Incidence of stem rot was calculated as the percentage of 31-cm sections of row with symptoms of stem rot and/or signs of the pathogen. Incidence of leaf spots, southern stem rot, and spotted wilt were mapped through out each field at 10-m intervals using a Global Positioning System (Trimble GPS, Sunnyvale, CA).

Plants were allowed to dry in the wind-row, and pods were harvested on 151 DAP in 2000 for all cultivars and 133 DAP for the Georgia Green cultivar and 154 DAP for the MDR-98 and C99-R cultivars in 2001. Plots were harvested using a two-row KMC peanut picker (Kelly Manufacturing Company, Tifton, GA) equipped with a peanut yield monitor developed by The University of Georgia Agricultural Engineering Department (Coastal Plain Experiment Station, Tifton, Georgia). Pod yields were determined for each plot after harvested pods were dried and adjusted to 12% w/w moisture for treatment comparisons. Data for the two years were analyzed independently by analysis of variance (21). Fisher's protected least significant differences were calculated for comparison of cultivars and treatment effects. Subsequent reference to significant differences among means indicates significance at $P \leq 0.05$ unless otherwise stated.

## Results

Early leaf spot was the predominant foliar disease in both years. Although the tillage treatment was not replicated, there was a significant location (tillage) effect on leaf spot intensity in 2000 and 2001 at (Table 3.1). Similar suppressive effects of tillage on spotted wilt were occurred across all cultivars in the large farm plots were also noted when compared to small plot experiments in 2000 (Fig. 3.1) and 2001 (Fig. 3.2) (Table 3.2). Incidence of southern stem rot was generally higher in strip-tilled fields than conventional tilled fields in 2000 (Fig. 3.3) and 2001 (Fig. 3.4) (Table 3.3). Final yield varied across conventional-tillage and strip-tillage systems (Fig 3.5).

Cultivar x treatment interactions were significant ($P \leq 0.05$) for leaf spot intensity ratings in 2001 in the conventional-tillage plots; therefore fungicide treatments were compared within each cultivar (Table 3.4). In 2000, leaf spot severity was higher for in Georgia Green than in MDR-98 across both fungicide regime treatments (Table 3.4). In 2001, C99-R had the lowest leaf spot disease ratings (Table 3.4). MDR-98 had a lower incidence of southern stem rot than Georgia Green in 2000 and lower incidence of this disease than in either Georgia Green or C-99R in 2001 (Table 3.3). There were no significant cultivar x fungicide treatment interactions for 2000 or 2001 (Table 3.1). Across all other factors, mean incidence of southern stem rot was 3.2 % for Georgia Green and 3.5 % for MDR-98 (LSD = 3.8) for the conventional-tillage field and 6.7 % for Georgia Green and 0.8 % for MDR-98 in the strip-till field (LSD = 1.6) in 2000. In 2001, incidence of stem rot was and 15.1 % for Georgia Green, 11.0 % for MDR-98, and 15.7 % for C99-R for conventional-tillage (LSD = 4.2) and 20.7 % for Georgia Green, 10.8 % for MDR-98, and 17.8 % C99-R for strip-tillage (LSD = 4.8) in 2001. There were no significant fungicide effects or cultivar x fungicide treatment interactions on incidence of spotted wilt (Table 3.1). Across fungicide treatments, incidence of spotted wilt was 8.1% for Georgia Green and 9.6 % for MDR-98 for conventional-tillage (LSD = 2.5) and 5.4% for Georgia Green and 1.1 % for MDR-98 for strip-tillage (LSD = 1.1) in 2000 and 14.6 % for Georgia Green, 20.8 % for MDR-98, and 24.1 % for C99-R for conventional-tillage (LSD = 2.0) and 9.6 % for Georgia Green, 16.6 % for MDR-98, and 18.2 % C99-R for strip-tillage (LSD = 2.1) in 2001.

Yield varied among cultivars for both years. Yield of Georgia Green was highest in both tillage systems in 2000 (Table 3.5). However, yield of MDR-98 was highest among the three cultivars in 2001. There were no significant cultivar, or fungicide regime treatment interactions in either year (Table 3.1). Across all other factors, the mean yield was 4491 kg/ha for Georgia Green and 3959 kg/ha for MDR-98 for conventional-tillage (LSD = 730) and 4750 kg/ha for Georgia Green and 4230 kg/ha for MDR-98 for strip-tillage (LSD = 404) in 2000. In 2001, across all other factors, the average yield was 4788 kg/ha for Georgia Green, 4806 kg/ha for MDR-98, and 4318 kg/ha for C99-R for conventional-tillage (LSD = 349) and 4221 kg per hectare for Georgia Green, 4684 kg/ha for MDR-98, and 4124 kg/ha for C99-R for strip-tillage (LSD = 363). Leaf spot intensity was typically higher in most of the 21-day expanded fungicide regimes compared to the 14-day fungicide regime treatments within the respective cultivars (Table 3.4).

Fungicide treatments had no effect on incidence of tomato spotted wilt (Table 3.2). Southern stem rot incidence was typically higher, however not always significant, in most of the 21-day expanded fungicide regimes compared to the 14-day fungicide regime treatments. Average yield varied among the 21-day and 14-day fungicide regime treatments among all cultivars in both years.

## Discussion

In this study, reduced leaf spot was observed in strip-tillage in all cultivar and fungicide regime treatment combinations when compared to conventional-tillage. This trend of reduced leaf spot in strip-till (Fig. 3.6, 3.7) agrees with previously published results of replicated small plot research (Chapter 2/unpublished data) (20). Although leaf spot epidemics did not reach severe levels in either year, the leaf spot epidemics were generally more severe in conventional tilled fields, especially those planted with the Georgia Green.

Suppression of leaf spot epidemics can be further enhanced by planting leaf spot resistant cultivars like MDR-98 (12) and C99R (8). Although Georgia Green is the predominant cultivar grown in Georgia, new cultivars like C99-R would enable producers to better control certain diseases as well as aid in managing harvest intervals by planting cultivars with varying days of maturity. The results from this trial indicated that fungicide usage could be reduced when resistant cultivars are used, especially in strip-till fields. Leaf spot severity was typically higher in plots receiving the 21-day fungicide application schedule than in the 14-day schedule. However, in both years, disease severity in the 21-day fungicide application schedule in the strip-tillage system was comparable to that of the 14-day fungicide regimes in conventional-tillage in the respective cultivars. The ability to adequately control leaf spot with an expanded schedule could reduce the input cost of producing peanuts and reduce unnecessary fungicide applications. Based on elimination of three applications of chlorothalonil represented by the extended spray schedule used in this study, the reduction in fungicide applications could cut production costs by an average $49.40 /ha (2000 average fungicide cost).

Results from this study support those of previous studies indicating that incidence of TSWV is suppressed in peanuts under a reduced tillage system and that southern stem rot is not consistently affected by reduced tillage (8,13,15,16,18).

Yields of both cultivars tended to be higher in strip-tilled fields than in the conventional-tilled fields. However, yields were higher in the conventional-tillage system than in the strip-tilled fields for all three cultivars in 2001. Lower yields (Fig. 3.5) in the strip-tilled field in 2001 may be due spatial patterns of southern stem rot that occurred in the field (Fig. 3.4). These micro epidemics were determined utilizing precision agriculture technologies.

Integrating reduced tillage practices into peanut would allow producers to eliminate unnecessary tillage implements. This adaptation may translate into less overhead and labor costs, and reductions in time required in the field, and management time. These reductions combined with potential savings from fungicide inputs from utilizing a reduced tillage practice in peanut production could potentially outweigh small yield reductions in strip-till compared conventional-tillage. Those comparisons are currently being examined. Furthermore, utilization of a reduced tillage practice like strip-tillage may potentially reduce soil erosion, nutrient runoff, and pesticides as well as enhancing water utilization (7).

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Table 3.1. Results of analysis of variance for effects of tillage, peanut cultivar, and fungicide treatment regime on leaf spot, southern stem rot, spotted wilt epidemics (TSWV), and yield of peanut in on-farm trials.

| Year | Source | Leaf Spot Final incidence | | Southern Stem Rot Incidence | | TSWV Incidence | | Final Yield | |
|---|---|---|---|---|---|---|---|---|---|
| 2000 | | DF | Pr >F | DF | Pr >F | DF | Pr >F | DF | Pr >F |
| | Tillage | 1 | 0.0019 | 1 | 0.0206 | 1 | 0.0016 | 1 | 0.8212 |
| | Rep(Tillage) | 6 | 0.1443 | 6 | 0.5919 | 6 | 0.2914 | 6 | 0.6829 |
| | Cultivar | 1 | < 0.001 | 1 | 0.3414 | 1 | 0.3300 | 1 | 0.0380 |
| | Tillage × Cultivar | 1 | 0.1522 | 1 | 0.1973 | 1 | 0.1410 | 1 | 0.1473 |
| | Rep × Cultivar (Tillage) | 6 | 0.7866 | 6 | 0.5732 | 6 | 0.4575 | 6 | 0.9552 |
| | Treatment | 1 | 0.0003 | 1 | 0.5796 | 1 | 0.3714 | 1 | 0.2588 |
| | Tillage × Treatment | 1 | < 0.001 | 1 | 0.8044 | 1 | 0.3941 | 1 | 0.3570 |
| | Cultivar × Treatment | 1 | 0.1951 | 1 | 0.8932 | 1 | 0.8126 | 1 | 0.6763 |
| | Tillage × Cultivar × Treatment | 1 | 0.0442 | 1 | 0.5651 | 1 | 0.9157 | 1 | 0.7400 |
| 2001 | Tillage | 1 | 0.0009 | 1 | 0.0505 | 1 | 0.0013 | 1 | < 0.001 |
| | Rep(Tillage) | 6 | 0.0280 | 6 | 0.5601 | 6 | 0.0408 | 6 | < 0.001 |
| | Cultivar | 2 | < 0.001 | 2 | 0.0050 | 2 | < 0.001 | 2 | < 0.001 |
| | Tillage × Cultivar | 2 | < 0.001 | 2 | 0.3114 | 2 | 0.6459 | 2 | 0.5279 |
| | Rep × Cultivar (Tillage) | 12 | 0.7252 | 12 | 0.1545 | 12 | 0.1317 | 12 | < 0.001 |
| | Treatment | 1 | < 0.001 | 1 | 0.0906 | 1 | 0.0356 | 1 | 0.0181 |
| | Tillage × Treatment | 1 | 0.0871 | 1 | 0.5765 | 1 | 0.9012 | 1 | 0.0286 |
| | Cultivar × Treatment | 2 | 0.0002 | 2 | 0.2999 | 2 | 0.0465 | 2 | 0.8321 |
| | Tillage × Cultivar × Treatment | 2 | 0.0840 | 2 | 0.3754 | 2 | 0.2489 | 2 | 0.0007 |

Table 3.2. Effect of peanut cultivar and fungicide application regime on incidence of TSWV on peanut.

| | | Disease Incidence (%)[1] | | | | | |
|---|---|---|---|---|---|---|---|
| Year | Fungicide Treatment | Conventional-Till | | | Strip-Till | | |
| | | Georgia Green | MDR-98 | C99-R | Georgia Green | MDR-98 | C99-R |
| 2000 | 14 - Day azoxystrobin/chlorothalonil | 7. 5 | 9.2 | NA | 5.3 | 5.1 | NA |
| | 21 - Day azoxystrobin/chlorothalonil | 8.7 | 10.0 | NA | 5.4 | 5.0 | NA |
| | LSD (P≥0.05) Among treatments | 3.3 | 5.6 | NA | 1.4 | 2.6 | NA |
| 2001 | 14 - Day azoxystrobin/chlorothalonil | 15.1 | 20.7 | 219 | 9.9 | 16.0 | 17.3 |
| | 21 - Day azoxystrobin/chlorothalonil | 14.0 | 20.9 | 26.2 | 9.2 | 17.2 | 19.2 |
| | LSD (P≥0.05) Among treatments | 4.0 | 3.4 | 4.4 | 1.7 | 5.9 | 4.0 |

[1]Disease incidence based on a percentage of 31 cm section of row with symptoms of TSWV

Table 3.3. Effect of peanut cultivar and fungicide application regime on incidence of southern stem rot on peanut.

| | | Disease Incidence (%)[1] | | | | | |
|---|---|---|---|---|---|---|---|
| | Fungicide | Conventional-Till | | | Strip-Till | | |
| Year | Treatment | Georgia Green | MDR-98 | C99-R | Georgia Green | MDR-98 | C99-R |
| 2000 | 14 - Day azoxystrobin/chlorothalonil | 2.3 | 3.5 | NA | 6.7 | 4.4 | NA |
| | 21 - Day azoxystrobin/chlorothalonil | 3.9 | 3.6 | NA | 6.6 | 5.1 | NA |
| | LSD ($P \geq 0.05$) Among treatments | 8.7 | 4.8 | NA | 3.1 | 3.0 | NA |
| 2001 | 14 - Day azoxystrobin/chlorothalonil | 14.5 | 10.3 | 14.8 | 19.3 | 11.7 | 14.5 |
| | 21 - Day azoxystrobin/chlorothalonil | 15.6 | 11.6 | 16.6 | 22.2 | 10.0 | 21.3 |
| | LSD ($P \geq 0.05$) Among treatments | 11.8 | 5.4 | 6.1 | 10.6 | 8.2 | 9.7 |

[1]Disease incidence based on a percentage of 31 cm section of row with symptoms of southern stem rot

Table 3.4. Effect of peanut cultivar and fungicide application regime on final leaf spot intensity in peanut

| Year | Fungicide Treatment | Conventional-Till | | | Strip-Till | | |
|---|---|---|---|---|---|---|---|
| | | Georgia Green | MDR-98 | C99-R | Georgia Green | MDR-98 | C99-R |
| 2000 | 14 - Day azoxystrobin/chlorothalonil | 2.5[1] a[2] | 2.0 a | NA | 2.9 b | 2.3 b | NA |
| | 21 - Day azoxystrobin/chlorothalonil | 4.3 b | 3.5 b | NA | 2.2 a | 1.7 a | NA |
| | LSD (P≥0.05) Among treatments | 1.1 | 0.4 | | 0.4 | 0.3 | |
| 2001 | 14 - Day azoxystrobin/chlorothalonil | 3.0 a | 2.4 a | 2.0 a | 1.9 a | 1.9 a | 1.6 a |
| | 21 - Day azoxystrobin/chlorothalonil | 4.7 b | 3.0 b | 2.4 b | 2.9 b | 2.4 b | 2.2 b |
| | LSD (P≥0.05) Among treatments | 1.0 | 0.3 | 0.2 | 0.8 | 0.3 | 0.1 |

[1]Means based on Fla. 1-10 leaf spot severity scale (1= no leaf spots, 10= total defoliation).
[2]Means in a column within each cultivar with a letter in common are not significantly different (P≥0.05; Fisher's protected least significant difference).

Table 3.5. Effect of peanut cultivar and fungicide application regime on incidence on peanut yield.

| | | Yield (kg/ha) | | | | | |
|---|---|---|---|---|---|---|---|
| | Fungicide | Conventional-Till | | | Strip-Till | | |
| Year | Treatment | Georgia Green | MDR-98 | C99-R | Georgia Green | MDR-98 | C99-R |
| 2000 | 14 - Day azoxystrobin/chlorothalonil | 4237 | 3962 | NA | 5337 | 4772 | NA |
| | 21 - Day azoxystrobin/chlorothalonil | 4745 | 3956 | NA | 5303 | 4703 | NA |
| | LSD (P≥0.05) Among treatments | 1380 | 1302 | NA | 917 | 737 | NA |
| 2001 | 14 - Day azoxystrobin/chlorothalonil | 4696 | 4871 | 4356 | 4370 | 4712 | 4115 |
| | 21 - Day azoxystrobin/chlorothalonil | 4880 | 4742 | 4281 | 4073 | 4656 | 4132 |
| | LSD (P≥0.05) Among treatments | 963 | 266 | 672 | 579 | 1011 | 460 |

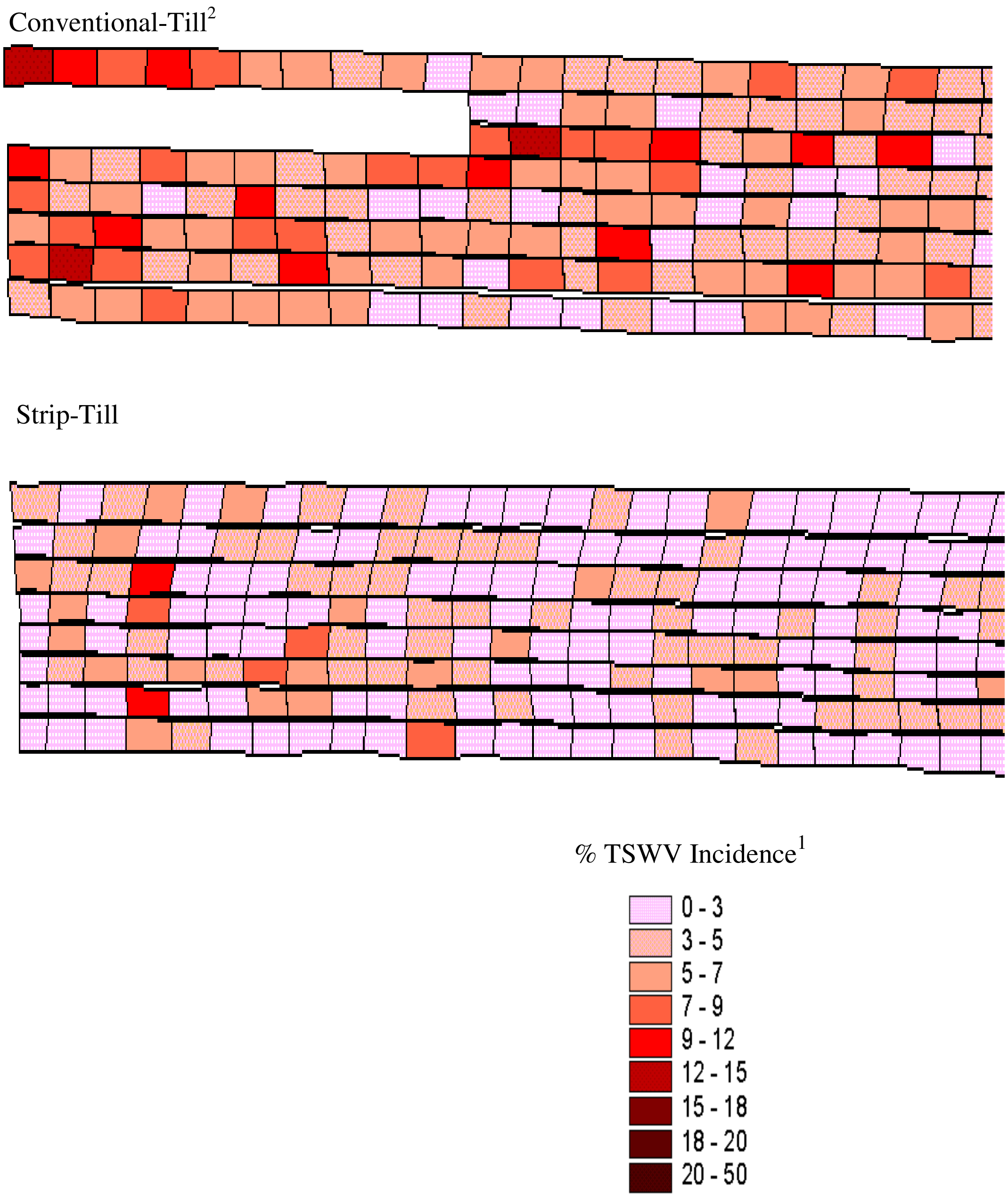


**Figure 3.1. Map of peanut TSWV incidence in on-farm trials conducted in 2000**

[1]TSWV incidence was mapped based on percentage of 31 cm sections of row infected on 10 m intervals within each plot for both tillage practices. Each block represents a 3m by 10m plot.

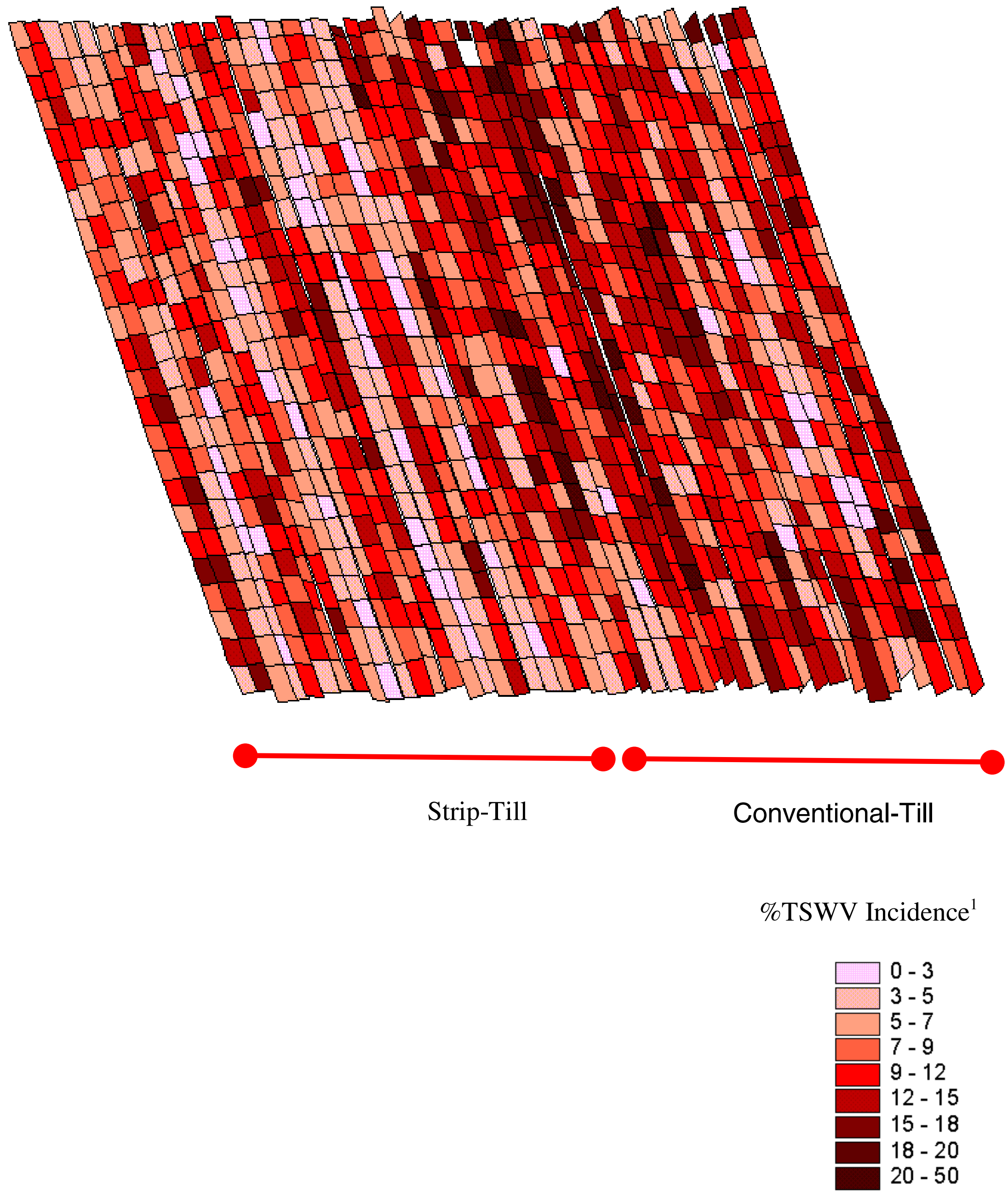


**Figure 3.2. Map of peanut TSWV incidence in on-farm trials conducted in 2001**

[1]TSWV incidence was mapped based on percentage of 31 cm sections of row infected on 10 m intervals within each plot for both tillage practices. Each block represents a 3m by 10m plot.

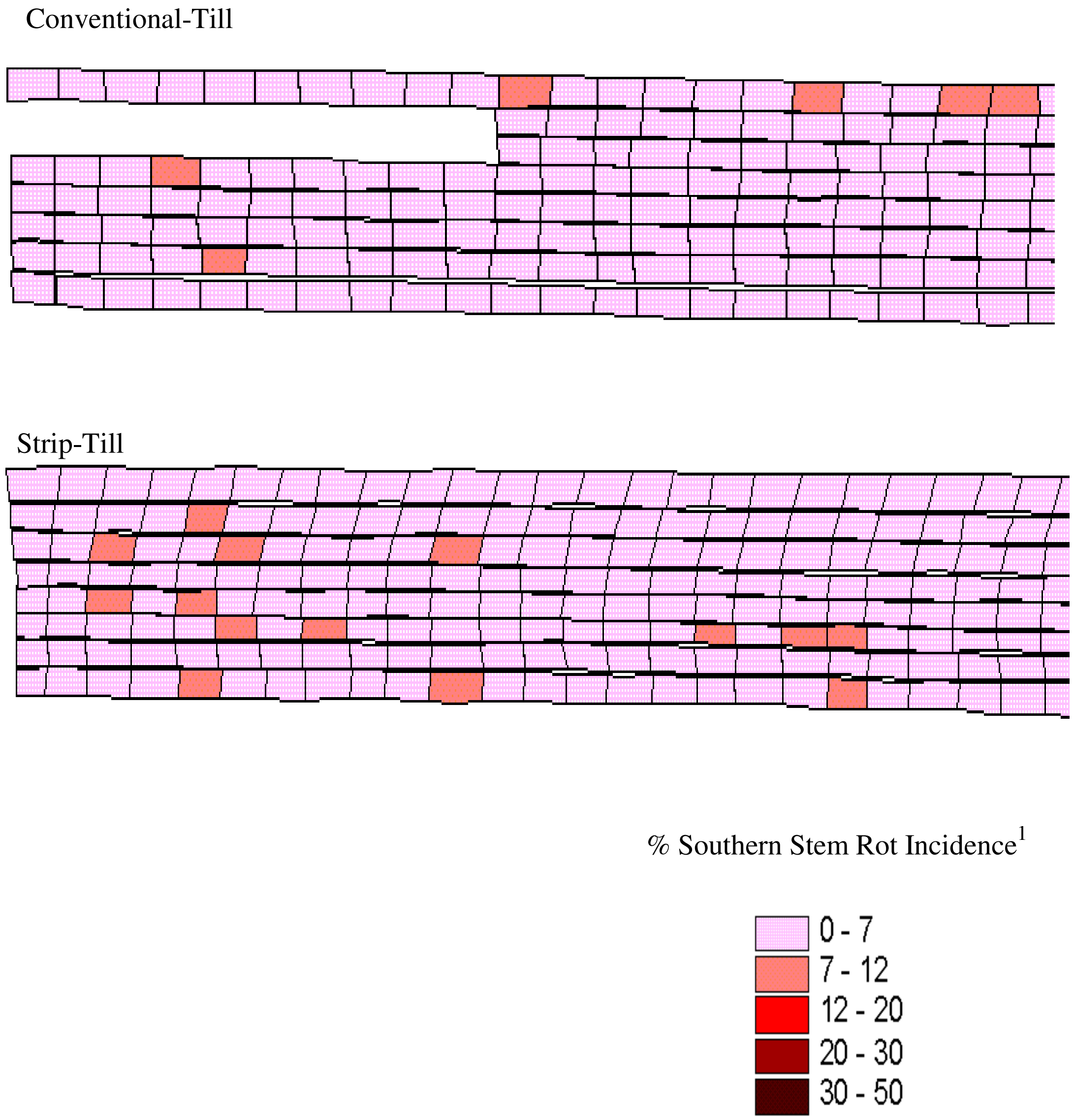


**Figure 3.3. Map of peanut Southern Stem Rot incidence in on-farm trials conducted in 2000**

[1]SSR incidence was mapped based on percentage of 31 cm sections of row infected on 10 m intervals within each plot for both tillage practices. Each block represents a 3m by 10m plot.

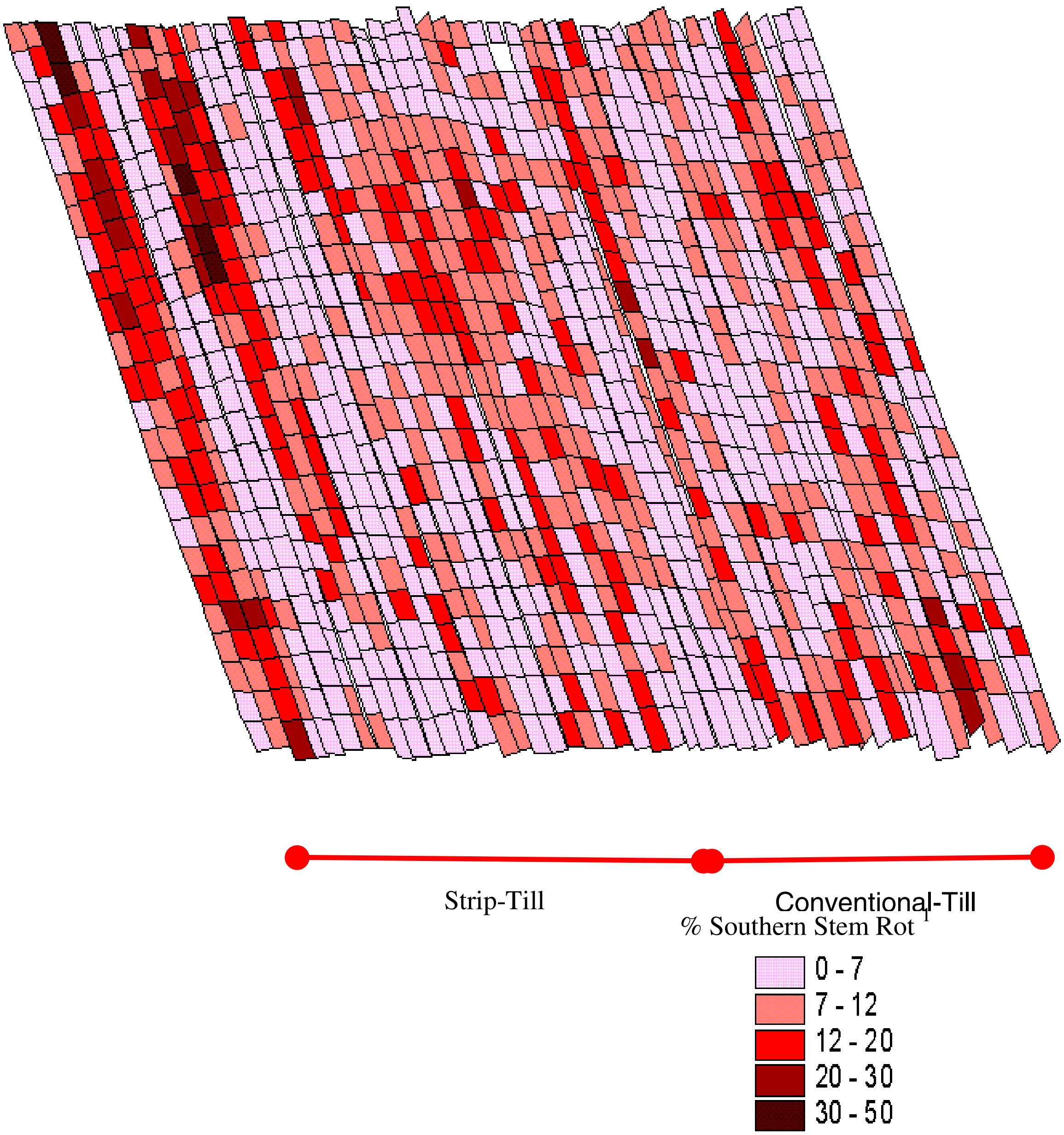


**Figure 3.4. Map of peanut Southern Stem Rot incidence in on-farm trials conducted in 2001**
[1]SSR incidence was mapped based on percentage of 31 cm sections of row infected on 10 m intervals within each plot for both tillage practices. Each block represents a 3m by 10m plot.

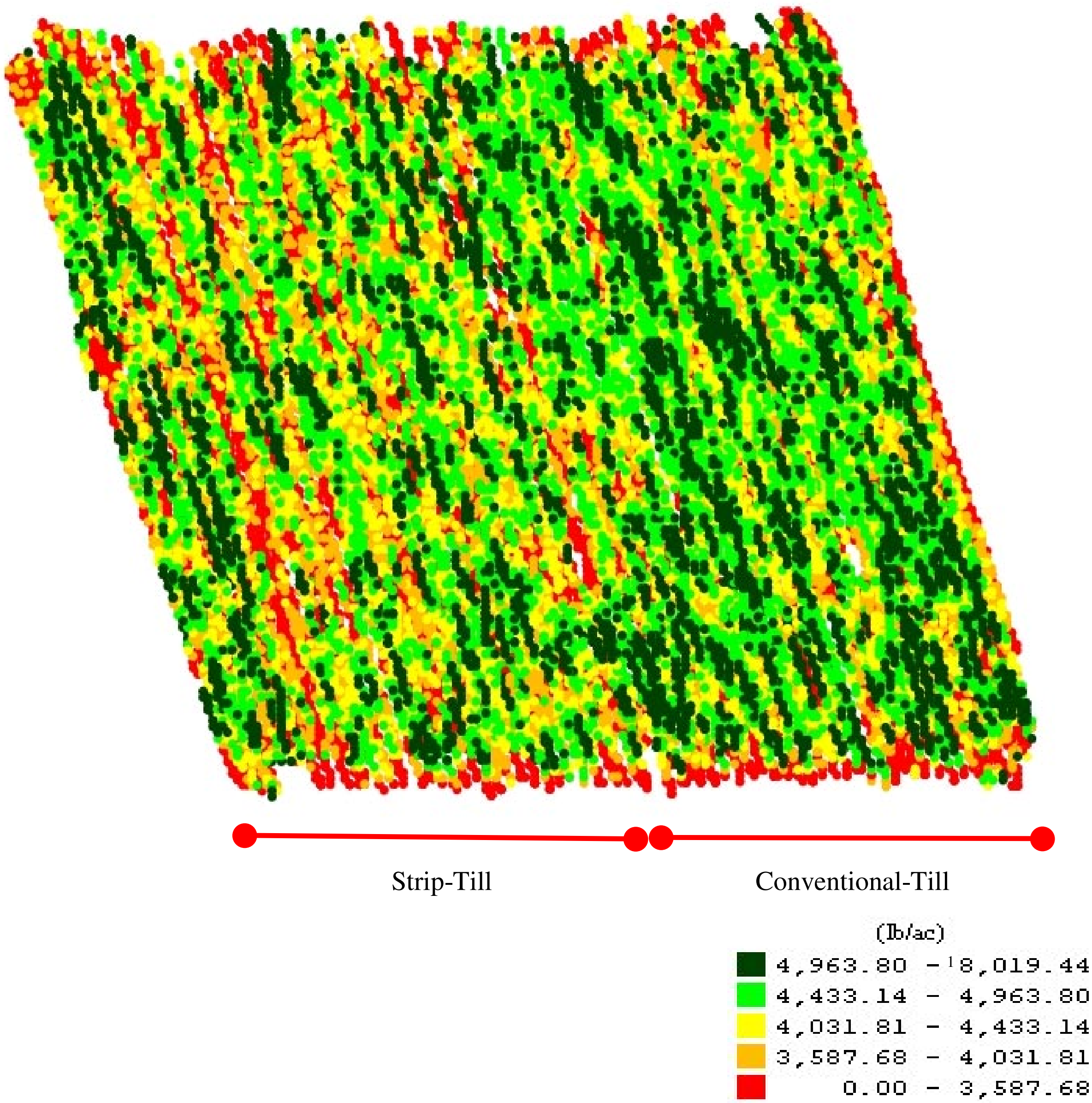


**Figure 3.5. Map of peanut yield in on-farm trials conducted in 2001**

[1]Yield is based on peanut yield monitor designed by The University of Georgia Department of Engineering.

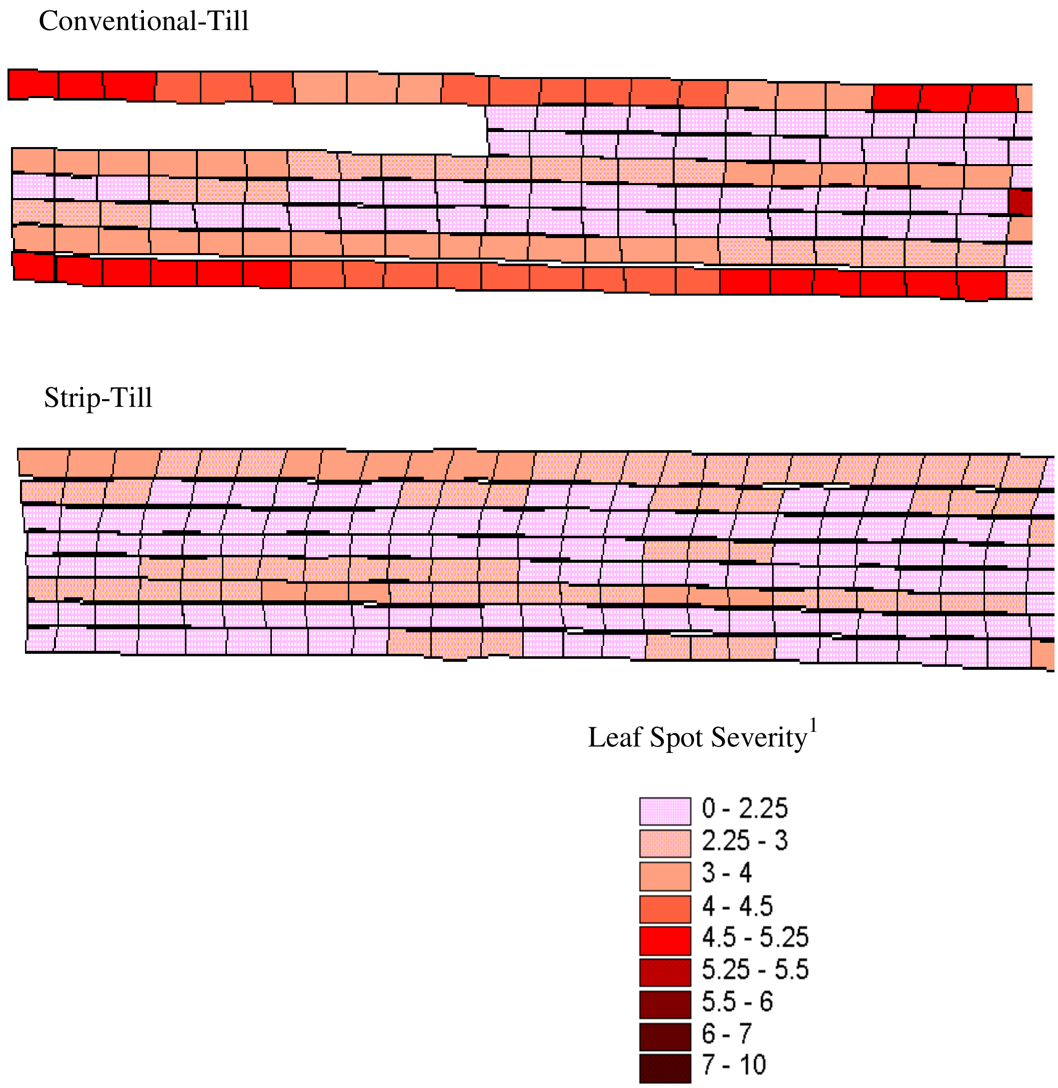


**Figure 3.6. Map of peanut leaf spot severity in on-farm trials conducted in 2000**
[1]Leaf spot Severity was mapped based on Fla 1-10 leaf spot severity Scale.
Each block represents a 3m by 10m plot.

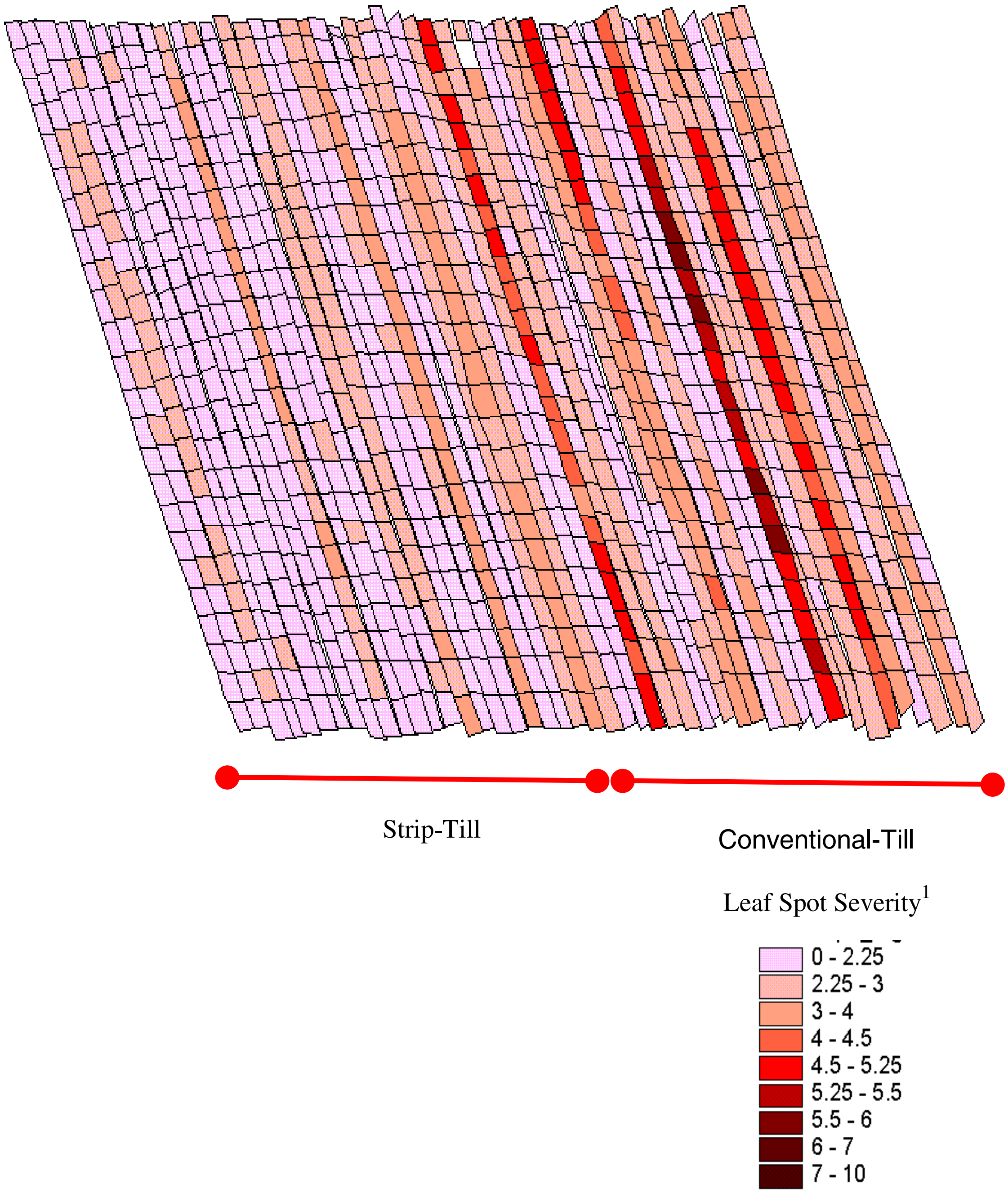


**Figure 3.7. Map of peanut leaf spot severity in on-farm trials conducted in 2001**
[1]Leaf spot Severity was mapped based on Fla 1-10 leaf spot severity
Each block represents a 3m by 10m plot.

**CHAPTER 4**

GREENHOUSE AND FIELD PLOT EVALUATION OF THE EFFECTS OF WHEAT STRAW MULCH ON EARLY LEAF SPOT OF PEANUT (***Arachis hypogaea*** L.).[1]

[1]Monfort, W. S., Culbreath, A. K., and Brenneman, T.B. To be submitted to *Plant Health Progress*.

**Abstract**

Greenhouse experiments were conducted in 2001and 2002 and field experiments were conducted in 2001 to determine the effects of wheat straw mulch and glyphosate on early leaf spot (*Cercospora arachidicola*) of peanut (*Arachis hypogaea*). A randomized complete block plot design with four replications was utilized in all experiments. The greenhouse experiments were conducted at the Plant Pathology Greenhouse on the Coastal Plain Expt. Station in Tifton, Georgia. The greenhouse experiments had four treatments consisted of 1) no wheat mulch, 2) no wheat mulch with a glyphosate treatment, 3) wheat straw mulch, 4) wheat mulch with a glyphosate treatment. Field experiments were conducted at the University of Georgia Southwest Branch Experiment Station, Plains, the University of Georgia Coastal Plain Experiment Station Rigdon Farm, Tifton, and the Young Farm, Worth County, Georgia. Treatments in the field experiments were 1) no wheat mulch, and 2) wheat mulch. Leaf spot was at very low levels for all experiments except for Plains. There were no significant effects of the mulch treatments on leaf spot in the greenhouse or field experiments based on the Fla. 1-10 scale assessment. However, a significantly fewer lesions per leaflet were observed on plants from plots where mulch was added in the Plains field experiment. Leaf spot was not significantly effected by glyphosate.

Key words: Residue, Roundup,

**Introduction**

Early leaf spot (*Cercospora arachidicola*) and late leaf spot *(Cercosporidium personatum)* of peanut (*Arachis hypogaea* L.) are some of the most economically important diseases observed in Georgia (11,15). Costs associated with control of leaf spot in peanut and direct reduction in yield by the pathogen account for an annual loss of over $63 million for Georgia producers (3,18,19). Optimal environmental conditions for reproduction and infection are quite similar for the two leaf spots. Conidia are typically dispersed via wind, splashing water, and insects (11,13,15). Peanut leaf spot can be spread from field to field, but the initial inoculum for the disease usually comes from infected peanut residue from previous peanut crops (12,13). The pathogen overwinters on the infected residue as dormant stromata until favorable environmental conditions are present for reproduction and dispersal. Typically, peanut management of leaf spot has included reducing the initial inoculum through burial of peanut crop residue with a moldboard plow and through crop rotation of 2 to 3 years between peanut crops (8,13).

Although intensive tillage practices are still commonly used in Georgia, depressed crop prices along with higher input cost have increased popularity of strip-till and other reduced tillage practices. Production of peanut with reduced tillage practices has increased to 20% of the total acreage (1). Peanut is one of the last major row crops to which reduced tillage practices has been adapted. One reason given for not using reduced tillage in peanut has been concern over potential increase in disease problems due to increased residue on the soil surface and greater soil moisture (5,10) providing an environment more favorable for disease development. Despite initial concerns, research trials have shown that reduced tillage can suppress some important peanut diseases. In a 4-year trial conducted by Porter et al. (14) in Virginia, leaf spot severity was significantly reduced in peanuts grown using a reduced tillage practice. This was further supported by Monfort et al. (Chapter 2/unpublished data) who found that epidemics of early leaf spot of peanut were suppressed in strip-tilled plots compared to those in conventional tilled plots. Although reduced tillage practices show potential for help in management of leaf spot, little is known about the environmental, biological, or chemical factors responsible for that reduction.

Some of the factors associated with reduced tillage practices have been noted in soil borne pathogens in peanut. In 2001, microplots trials conducted by Ferguson et al. indicated that the amendment of wheat straw did not increase the incidence of southern stem rot, however, density of the percentage final inoculum of *Sclerotium rolfsii* was higher in the in the wheat straw treatments (9). She further concluded that the amendment wheat straw had nominal effects on the final incidence of Cylindrocladium black rot caused by *Cylindrocladium parasiticum* and reduced the final incidence of Sclerotinia blight caused by *Sclerotinia minor* (9). Ferguston suggested the effects of the mulch or residue may alter the behavior of the pathogens by potentially changing the microclimate conditions (9). Chemical effects on disease development have also been described on *Cylindrocladium parasiticum* or Cylindrocladium black rot, an increasingly important soilborne disease in peanut. Berner et al. in (1991) evaluated the effects of glyphosate on *Calonectria crotalariae* in soybean (4). He concluded that the application of glyphosate at recommended label rates significantly reduced growth of *Calonectria crotalariae* in vitro as well as microsclerotia development (4).

This research was undertaken as a first step to determine the possible mechanisms involved in the reduction of leaf spot under reduced tillage. In particular, these studies were conducted to examine the effects of wheat straw much applied to soil which had been tilled in both field and greenhouse experiments, and to examine the chemical effects of glyphosate herbicide on leaf spot in a greenhouse experiment.

**Material and Methods**

Greenhouse experiments were conducted in 2001 and 2002 at the University of Georgia Coastal Plain Experiment Station in Tifton, GA. Field experiments were conducted at the University of Georgia Southwest Branch Experiment Station Plains, the University of Georgia Coastal Plain Experiment Station Rigdon Farm, Tifton, and the Young Farm, Worth County, Georgia. A randomized complete block experimental design was utilized in all of the experiments.

In the greenhouse experiments, peanuts were planted at a average rate of 12-18 plants per meter in sixteen 46cm x91cm x20cm wooden trays filled with top soil from non-treated peanut plots from the previous growing season on 16 January 2001 and 28 January 2002. Each wooden tray represented one replication of an individual treatment in the experiment. The leaf spot susceptible peanut cultivar Georgia Green was used in both years. Treatments consisted of: 1) no wheat mulch; 2) no wheat mulch with a glyphosate (Roundup, Monsanto, Kansas City, MO) treatment; 3) wheat mulch; and 4) wheat mulch with a glyphosate treatment. Treatments were replicated four times. Glyphosate was applied at the rate of 10 ml of formulated herbicide (454 g a.i.) per liter of water. There were no fungicides applied to peanuts in either year. Leaf spot intensity (severity) was assessed by the use of the Florida 1 to 10 scale where 1 = no leaf spots, and 10 = plants completely defoliated and killed by leaf spot (6). Leaf spot intensity ratings were made on 2 May 2001 and 29 March 2002. Plant height was measured on 6 April 2001 and 22 February 2002 in each treatment. Height was determined for the main stem, measured from the soil surface to the end of the stem at the base of the terminal leaf.

In the field experiments, treatments consisted of: 1) no mulch, and 2) wheat mulch applied to peanut beds prepared using normal conventional tillage practices. Both treatments were replicated eight times. Mulch treatments were applied on 12 June 2001 for Worth County, 15 June 2001 for Plains, and 22 June 2001 for Tifton. The leaf spot susceptible cultivar, Georgia Green, was planted in each location except for the Worth County location where the moderately resistant cultivar, C99-R, was planted. Fungicides were only applied at the Worth County location. Leaf spot intensity (severity) was assessed by the use of the Florida 1 to 10 scale (2). Final intensity ratings were made on 16 September 2001 for Plains, 27 September 2001 for Worth County, and 12 October 2001 for Tifton. Twelve to 15 central stems were collected from each plot at Plains on 8 August 2002. The number of early leaf spot lesions per leaflet was determined for each stem in each treatment. Data from all of the experiments were analyzed by analysis of variance (17). Subsequent reference to significant differences among means indicates significance at $P \leq 0.05$ unless otherwise stated.

**Results and Discussion**

In both years, early leaf spot was the predominant foliar disease. Leaf spot in the greenhouse for 2001 and 2002 occurred at very low levels at a range of 1.00 to 1.50 on the Florida 1-10 leaf spot scale. There was no significant difference in disease between mulch treatments in either year (Table 4.1). However, The addition of mulch resulted in a significant increase in plant height in both years (Table 4.1). Peanut plants in the mulch treatments were an average of 1-2 cm taller than the plants in the non-mulch treatments. Although not significant, the treatments with glyphosate had a slight numerical reduction in leaf spot for both years (Table 4.1).

Locations x leaf spot interactions were significant ($P \leq 0.05$) for the field trials; therefore treatments were compared within each location. Leaf spot epidemics were mild in all field locations except for Plains where high levels of leaf spot were observed (Table 4.2). Although there were differences among levels of leaf spot among the three locations, final leaf spot intensity ratings was not significantly affected by mulch when compared to the non-mulch (Table 4.2). With leaf spot more severe in Plains, lesions per leaflet were counted. The non-mulch treatments had significantly ($P \leq 0.05$) greater numbers of lesions per leaflet than the mulch treatments (Table 4.2).

In these studies, leaf spot epidemics were not significantly affected the wheat mulch based on visual observations. However, mulch treatments had a significant effect on leaf spot when the number of lesions per leaflet were analyzed which suggest that the addition of mulch itself can provide some suppression of leaf spot epidemics. The results of the visual assessments of leaf spot in the greenhouse and field experiments could be due to low incidence of leaf spot and mulch treatment application timing to that of initial infection. In addition to the much treatments, glyphosate did not significantly effect leaf spot of peanut. In addition to the much treatments, glyphosate did not significantly effect leaf spot of peanut. Additional studies are needed in this area to further explain the potential effects of wheat straw residue and glyphosate on peanut leaf spot.

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**Table 4.1.** Effect of wheat mulch and glyphoste treatment on severity of peanut leaf spot in greenhouse experiments

| | 2001 | | 2002 | |
|---|---|---|---|---|
| Mulch Treatment | Leaf Spot[2] | Plant Height Measurement (cm) | Leaf Spot[a] | Plant Height Measurement (cm)[b] |
| No Mulch | 1.3 a[1] | 3.5 a | 1.1 a | 3.1 a |
| No Mulch w/glyphosate | 1.0 a | 3.9 a | 1.1 a | 3.1 a |
| Wheat Mulch | 1.5 a | 5.7 b | 1.1 a | 4.1 b |
| Wheat Mulch w/ glyphosate | 1.0 a | 5.6 b | 1.1 a | 4.3 b |
| LSD(P<0.05) | 0.6 | 1.0 | 0.23 | 0.55 |

[1]Means in a column with a letter in common are not significantly different (P≥0.05; Fisher's protected least significant difference).

[2] Leaf spot based on Fla. 1-10 leaf spot rating (1 = no leaf spots, 10 = total defoliation).

**Table 4.1.** Effect of wheat mulch treatment on severity of peanut leaf spot in field experiments in 2001.

| Mulch Treatment | Rigdon Leaf Spot[2] | Worth Co. Leaf Spot[2] | Plains Leaf Spot[2] | Plains Lesions/leaflet[3] |
|---|---|---|---|---|
| No Mulch | 1.8 a[1] | 1.6 a | 8.0 a | 1.8 a |
| Mulch | 1.7 a | 1.6 a | 7.7 a | 1.5 b |
| LSD(P<0.05) | 0.3 | 0.1 | 0.1 | 0.2 |

[1]Means in a column with a letter in common are not significantly different (P≥0.05; Fisher's protected least significant difference).
[2] Leaf spot based on Fla. 1-10 leaf spot rating (1 = no leaf spots, 10 = total defoliation).
[3]Lesions/leaflet based on mean number of lesions per leaflet on a 12 stem sample.

# CHAPTER 5

## SUMMARY AND CONCLUSION

The effects of reduced tillage, moderately resistant cultivars, and reduced fungicide inputs on peanut leaf spot were evaluated in small and large plots in 2000 and 2001. Small plot were conducted in fields of Tifton loamy sand at the Coastal Plain Experiment Station, Lang Farm, Tifton, GA. Whole plots consisted of the tillage treatments and were separated by four to six non-sprayed border rows and blocks were separated by 2.4-m fallow alleys. Cultivar and fungicide plots were 9.1 m long by 0.9 m wide in 2000 and 7.6 m long by 0.9 m wide in 2001. Large plot trials were conducted in fields of Tifton loamy sand at Sutton farms, Brooks Farms, and Young Farms, Worth, County, GA in 2000 and 2001. A split plot design was used with four replications. Cultivar treatments were the base plots and fungicide regime treatments were the sub-plots. All plot treatments were evaluated in a conventional tillage and a reduced tillage (strip-till) system. In 2000, the conventional tillage (Brooks Farm) and reduced tillage (Sutton Farm) systems were represented by two different fields that were 792 meters apart. For 2001, the two tillage practices were represented in the same field (Young Farm). Split plots were 375 - 450 m long by 3.6 m wide in 2000 and 240 m long by 3.6 m wide in 2001 and were evaluated at multiple sites within each plot. Leaf spot was assessed based on the Fla. 1-10 leaf spot severity scale where 1 = no leaf spots and 10 = total defoliation (1).

Leaf spot epidemics were less severe in all cultivar and fungicide regime treatment combinations in strip-tillage than in similar cultivar and fungicide combinations in conventional-tillage. This supported previous studies conducted by Porter et al. of lower leaf spot incidence in reduced tillage (2). In 2000 and 2001, observation of the leaf spot disease progress in the non-treated control (absent of the influence of fungicide activity on development) indicates that leaf spot epidemics were delayed 1-2 weeks compared to conventional tillage. This delay was more evident in 2001 when leaf spot epidemics were more severe. Suppression of the leaf spot epidemics can be further enhanced with the utilization of leaf spot resistant cultivars like MDR-98 and C99R. Within tillage and cultivar combinations, leaf spot intensity was typically higher in the 21-day fungicide regimes than in the 14-day schedule. However, in most cases, leaf spot control in the 21-day fungicide regimes in the strip-till system was comparable to that of the 14-day fungicide regimes in conventional tillage. This was especially evident in the large on farm plot experiments where the field was on a rotation schedule that utilized multiple years out of peanut between peanut crops. Therefore based on these results, fungicide usage could be reduced without compromising control of leaf spot when reduced tillage and resistant cultivars are used. This reduction in fungicide applications could cut production costs by $ 49.40 per hectare (2000 average fungicide cost).

Observing the peanut yields harvested from this trial for both years, conventional-tillage typically had slightly higher yield than strip-till even though there was less leaf spot in the reduced tillage system. Although yields were often higher in conventional-tillage, there was not a consistent tillage effect on yield in both years. Adaptation of peanuts to a strip-till- system may translate into lower overhead and labor costs, and less time in the field and management time. These reductions along with potential saving from fungicide inputs from utilizing a reduced tillage practice in peanut production could potentially out weigh the advantages of higher yields in conventional-tillage. Those comparisons are currently being examined. Furthermore, utilization of a reduced tillage practice like strip-tillage may potentially reduce soil erosion, nutrient runoff, and pesticides as well as enhancing water utilization.

In wheat mulch experiments conducted in greenhouse and field experiments, leaf spot was not significantly affected by the wheat mulch based on visual observations. However, mulch treatments have a significant effect on number of lesions per leaflet. Although this work is not conclusive, the results from Plains indicates that the addition of mulch itself can provide some suppression of leaf spot epidemics. The results of the greenhouse studies indicated that glyphosate did not effect peanut leaf spot epidemics. Additional studies are needed in this area to further explain the potential effects of wheat straw residue and glyphosate on peanut leaf spot.

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