Effects of Two Cropping and Two Tillage Systems and Pesticides on Peanut Pest Management[1]

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ABSTRACT

In one or more years of a 3-year study, white mold (*Sclerotium rolfsii*) and Rhizoctonia limb rot (*Rhizoctonia solani*) damaged peanuts less in a wheat-peanut than in the fallow-peanut cropping system, but velvetbean caterpillar (*Anticarsia gemmatalis*) damage was less in the fallow-peanut. Thrips (*Frankliniella fusca*) and Rhizoctonia limb rot damage was less in minimum tillage than in conventional tillage but root-knot nematode (*Melodogyne arenaria*) damage was less in conventional tillage. Aldicarb reduced root-knot and lesion nematode (*Pratylenchus brachyurus*), thrips, and potato leafhopper (*Empoasca fabae*) damage, but increased numbers of three cornered alfalfa hoppers (*Spissistilus festinus*) and velvetbean caterpillar damage. Flutolanil reduced white mold and Rhizocotonia limb rot damage. There was a high negative correlation (P=0.0001) of number of white mold loci with yield (r=-0.70). Rhizoctonia limb rot, gall and lesion indices and number of lesion nematodes in the soil were also negatively correlated with yield, but at low levels. Cropping systems did not affect peanut yields; however, tillage systems and nematicide/insecticide and fungicide treatments had major effects. Mean yield in conventional-tillage plots were greater than in minimum-tillage plots for the control and each chemical treatment. Mean yields were 11.1%, 55.9%, and 77.3% greater than control of aldicarb, flutolanil, and aldicarb plus flutolanil treatments, respectively, across cropping systems, tillage systems, and years.

Key Words: *Arachis hypogaea, Triticum aestivum*, tillage systems, cropping systems, *Meloidogyne arenaria, Pratylenchus brachyurus, Sclerotium rolfsii, Rhizoctonia solani, Anticarsia gemmatalis, Empoasca fabae, Frankliniella fusca, Spissistilus festinus.*

Growing small grain crops during the winter on cultivated land and reduced tillage culture for summer row crops are excellent conservation practices. Conservation tillage is widely utilized in the production of corn (*Zea mays* L.), soybean (*Glycine max* L.), cotton (*Gossypium hirsutum* L.), grain sorghum (*Sorghum vulgare* Pers.), small grain, forage crops, and certain other crops in the Southeastern United States (1). In Georgia in 1986, ca 551,000 hectares of crop land was in some form of conservation tillage. Minimum tillage, a form of conservation tillage, disturbs the soil less than conventional tillage and may result in less soil and water loss and may require less energy for cultural practices with many crops. A large percentage of crops in conservation-tillage systems are planted in small grain stubble. In contrast, peanuts (Arachis hypogaea L.) are usually planted in a well prepared seed bed regardless of whether they are planted after small grain or in soil that was fallowed the previous winter (29). Rotating small grains, as a grazing crop, with peanut is often recommended (2). Boyle (5) determined that the incidence of white mold caused by *Sclerotium rolfsii* Sacc. was reduced and peanut generally did better following a monocotyledonous crop.

Improved weed (6, 30) and disease (3, 4) control and root growth (32) have been cited as the basis for deep turing the soil with a moldboard plow to prepare a smooth seed bed that is weed- and residue-free for planting peanut. This methiod of soil preparation in conjucntion with application of herbicides has been used since the early 1950's, because research had shown significant yield increases from conventional tillage compared to less intensive tillage practices (13, 14, 23).

However, recent research indicates that minimum tillage for peanut production may be feasible (9, 10, 11, 15). Acceptable weed management systems utilizing herbicides have been developed for minimum tillage peanut production (12, 33). Damage by nematodes, diseases and insects in peanuts grown in reduced tillate and conventional tillage has not been consistent. Hartzog and Adams (16) found the same number of nematodes in soils in conventional - as in minimum-tillage peanut planted in crop residue of rye (*Secale cereale* L.), and oat, (*Avena sativa* L.) killed with

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herbicides; and wheat (*Triticum aestivum* L.) harvested for grain. But, Minton *et al* (21) reported that the peanut root-knot nematode (*Meloidgyne arenaria*) ((Neal) Chitwood) caused more damage in minimum-tillage peanut planted after wheat harvested for grain than in conventional tillage while damage by the lesion nematode, *Pratylenchus brachyurus* ((Godfrey) Filipjev and Schuurmans Stekhoven) was the same in both tillage systems. Hartzog and Adams (16) found the incidence of white mold to be the same in conventional- and minimum-tillage peanut planted in rye, oat, or wheat residue. Colvin *et al.* (11) also found the incidence of white mold to be the same in minimum- and conventional-tillage peanut planted in wheat killed with herbicide. Grichar and Boswell (15) reported that the incidence of white mold was not significantly affected by tillage systems in peanut planted in oat that had been shredded, except during one of four years when the conventional-tillage plots produced a lower disease rating than minimum-or no-tillage plots. Minton *et al.* (21) reported that the incidence of white mold was greater in coventional- than in minimum-tillage peanut planted after wheat harvested for grain. Campbell *et al.* (8) found that pod rot caused by *Pythium myriotylum* Dreschs. was less severe in minimum- than in conventional-tillage peanut planted in rye killed with a herbicide. Conversely, Wright and Porter (34) reported that pod rot was less severe in conventional-than in no-tillage peanut planted in wheat cover crop.

Campbell *et al* (8) found that numbers of thrips (*Frankliniella* spp.) were lower, and damage by potato leafhopper (*Empoasca fabae* Harris) in no-tillage was less than in conventional-tillage peanut planted after rye killed with a herbicide. Corn earworm (*Heliothis zeae* Boddie) damage was the same in the two tillage systems but pod damage caused by insects was higher in no-tillage than in conventional-tillage systems. In another experiment, Campbell(7) found fewer thrips and corn earworms, and less thrips, corn earworm, and leafhopper damage, in no-tillage peanut than in conventional-tillage peanut planted after wheat. Pod damage by southern corn rootworm, (*Diabrotica undecimpunctata howardi* Barber) was greater in NC6 peanut cultivar planted in no-tillage than in conventional-tillage plots, but damge was the same in the Florigiant cultivar in the two tillage systems (7).

In an earlier study (21) conducted at three sites at this location, the management of nematodes, soilborne fungi, and insects in minimum- and conventional-tillage peanuts double-cropped with wheat was investigated. Management studies on nematodes, diseases and insects of peanuts in fallow-peanut and wheat-peanut cropping systems, and conventional and minimum tillage have not been reported. The purpose of this study was to evaluate single and combined effects of fallow-peanut and wheat-peanut cropping systems, minimum and conventional tillage, and pesticides (aldicarb (2-methyl-2(methylthio) propionaldehyde 0 (methylcarbamoyl)oxime) and flutolanil (3'-isopropoxy-2-trifluoromethyl)benzanilide) on peast management and yield to peanuts.

Materials and Methods

Field experiments were conducted during 1987-89 near Tifton, Georgia on a Clarendon Loamy sand (fine-loamy, siliceous, thermic Plinthaquic Paleudults) infested with *M. arenaria*, *P. brachyurus*, *S. rolfsii*, and *Rhizoctonia solani* Kühn. Peanut was grown as a commercial crop on this site in 1985 and 1986 in an effort to ensure a high and uniform infestation of nematodes an soil-borne pathogens. A split-split plot design with six replications was used. Treatments were: A. cropping systems (whole plots) 1) fallow-peanut and 2) wheat-peanut; B. tillage systems (subplots) 1) conventional and 2) minimum; C. pesticides (sub-subplots) 1) control, 2) aldicarb 3.4 kg ai/ha, 3) flutolanil 2.2 ka ai/ha, and 4) aldicarb 3.4 kg ai/ha plus flutolanil 2.2 kg ai/ha. Each whole plot consisted of twelve rows spaced 0.9 m apart and 7.6 m long and each sub-subplot consisted of two rows. The experiment was conducted on the same site, and treatments were applied to the same plots each year.

Wheat was planted 12 November 1986, 20 November 1987, and 29 November 1988. Cultivars planted were Coker 983 in 1986 and Stacey in 1987-88. Soil preparation for wheat consisted of disking twice, but plots not plated to wheat were left undistributed. Grain was harvested 27 May 1988 and 1989, but was not harvested in 1987 since the Hessian fly (*Phytophaga destructor* say) destroyed the stand. The wheat straw was left on the plots. Weeds grew in fallow plots each year.

The Florunner cultivar of peanut was grown each year. In 1987, peanuts were planted in both fallow and wheat plots on May 18-19. Fallow plots were planted later in 1987 than in 1988 and 1989 because of dry soil condtions from mid-April to mid-May. Also, because of the destruction of wheat by the Hessian fly followed by the emergence and growth of weeds, wheat plots were planted to peanut in 1987 at the same time as in fallow plots. In 1988 and 1989 fallow plots were planted May 4 and May 3, respectively and wheat plots in 1988 and 1989 were planted May 31-June 1 and May 31, respectively. Soil preparation for peanuts in conventional-tillage plots in both rotations consisted of disking twice and turing the soil with a moldboard plow to a depth of 20 cm. Low, flat-top beds were formed and herbicides were incorporated with a rototiller. A flexiplanter equipped with gauge shoes was used to plant conventional-tillage plots. No soil preparation was used prior to palnting minimum-tillage plots with a subsoiler, minimum-till planting unit. The subsoiler shanks ran 36 cm deep followed by two flutted coulters with attached gauge wheels that back filled the subsoiler slit and prepared a 12-cm wide seedbed.

Aldicarb was applied in a 30-cm wide band ahead of the planter and was lightly incorporated as the planter passed over the treated band. Flutolanil was sprayed in 76 L/ha of water in a 45-cm wide band centered over the row 45 days after planting. Weeds were controlled with herbicides and cultivation in conventional-tillage plots and with herbicides in minimum tillage plots. The choice of herbicides for each cropping and tillage system was based on weeds present each year. Preplant herbicides were: Conventional tillage-benefin (N-Butyl-N-ethyl-a, a, a-trifluoro-2, 6-dinitro-p-toluidine) 1.7 kg ai/ha in 1987 and metolachlor (2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl)acetamide) 2.2 kg ai/ha plus pendimethalin (N-(1-ethylpropyl)-3, 4-dimethyl-2, 6-dinitro-benzenamine) 1.1 kg ai/ha and alachlor (2-Chloro-2' -6' diethyl-N- (methoxymethyl)-acetanilide) 2.8 kg ai/ha in 1988 and 1989; Minimum tillage-glyphosate (isopropylamine salt of N- (phosphono-methyl) glycine)1.1 kg ai/ha plus pendimethalin 1.1 kg ai/ha and metolachlor 2.2 kg ai/ha in 1987, and alachlor 2.2 kg ai/ha in 1988 and 1989. Preemergence herbicides were:Chloramben (3-amino-2, 5-dichlorobenzoic acid) 5.6 kg ai/ha plus alachlor 3.3 kg ai/ha. Postplant herbicides were: bentazon (3-isopropyl-1H-2, 1, 3- benzothiadiazin-4(3H)-one 2, 2-dioxside) 0.84 kg ai/ha, sethoxydim (2[1-(ethoxyimino) butyl]-5-[2-(ethylthio) propyl]-3- hydroxy-2-cyclohexen-1-one)0.32 kg ai/ha, acifluorfen (sodium 5-[2-chloro-4-(trifluromethyl) phenoxy]-2-nitrobenzoate) 0.25 kg ai/ha, paraquat (1, 1' Dimethyl-4, 4'-bipyridinium ion) 0.14 kg ai/ha, and 2, 4-DB (4-(2,4-Dichlorophenoxy) butyric acid) 0.25 kg ai/ha.

Fertilizer was applied on the basis of soil tests for peanut and wheat production in Georgia. Gypsum (calcium sulfate) was applied at 600 kg/ha in a 30-cm band over the row at early bloom stage of peanut. The plots were irrigated within 48 hours of seeding if rainfall did not occur and subsequently as needed during the growing season.

Foliar diseases across all treatments were controlled with chlorothalonil (tetrachloroisophthalonitrile) 1.3 kg ai/ha applied on a 14-day schedule. Foliar insect infestations were evaluated each year. Thrips and potato leafhopper damage was rated on a 1-9 acale with 1 = no foliage damage and 9 =severe damage with some leaf necrosis. The number of three cornered alfalfa hoppers, *Spissistilus festinus* Say, and velvetbean caterpillars, *Anticarsia gemmatalis* Hüber, per 0.9 m of row were counted. Potato leafhoppers and velvetbean caterpillars were controlled with methomyl (S-Methyl-N- ((methylcarbamoyl)oxy)-thioacetimidate (0.5 kg ai/ha) if population levels were approaching damage thresholds.

Numbers of peanut seedlings emerged per 2 m of row were counted 14 days after seeding. Soil samples collected 2-6 days before digging-inverting were assayed for nematodes using the centrifugal-sugar flotation method

(17). The number of nematodes per 150-cm3 of soil was counted. Peanuts were dug and inverted in fallow plots on 6 October 1987, 23 September 1988, and 15 September 1989 and in wheat plots on 6 October 1987, 20 October 1988, and 6 October 1989. Peanuts in fallow and wheat plots were dug on different dates in 1988 and 1989 due to different planting and maturity dates. Ten plants per plot were rated at time of digging-inverting for root-knot nematode galling. Each plant was given a composite gall rating of roots, pods and pegs. A 1-5 scale was used with 1= no galls, 2= 1-25%, 3= 26-50%, 4= 51-75%, and 5 = 76-100% of roots, pods, and pegs galled. Lesions caused by *P. brachyurus* on peanut pods on 10 plants per plot were also given an index rating based on a 1-5 scale with 1 =no lesions on pods, 2 = 1-25%, 3 = 26-50%, 4 = 51-75%, and 5 = 76-100% of pod surface covered with lesions. The number of white mold loci per 15.2 m of row was recorded within 12 hours after digging-inverting. A white mold locus was defined as one or more plants infected per 31 cm of row (27). The severity of Rhizoctonia limb rot was also estimated at time of digging-inverting. Severity was based on rating obtained from six 0.6 -m locations per plot. Ratings were an estimate of the percentage of infected vines at each location. Pod yield was calculated at 8% moisture and the percentage of sound mature kernels was determined on a 300-g pod sample.

Analysis of variance of the data was determined by the general linear model procedure, and least significant differences analysis was utilized to determine average variance of applied treatments (31). Only differences significant at $P \leq 0.05$ will be discussed unless otherwise indicated.

Results and Discussion

Population densities of *M. arenaria* juvenile in soil and the gall indices (Table 1) were low during the 3-year study, and lower than in the study conducted in this field in 1982-83 (20). During the present study many *M. arenaria* juveniles were heavily infected with the bacterium (*Pasteuria penetrans* Sayre & Starr) which may have had a suppressive effect on populations of this nematode (22). Neither cropping nor tillage systems affected population densities of *M. arenaria* juveniles, or pod lesions caused by *P. brachyurus*. Gall indices were less in conventional- than in minimum- tillage systems, but were not significantly affected by cropping systems (data not shown). These results of tillage are in agreement with those reported by Minton *et al.* (21). Aldicrab and aldicarb plus flutolanil reduced the number of M. arenaria juveniles, and gall and lesion indices compared to control.

Table 1. Effects of nematicide/insecticide and fungicide treatments on the number of *Meloidogyne arenaria* juveniles and gall and lesion indices of peanut across cropping and tillage systems and years.

Nematicide/ insecticide and fungicide treatments	Number M. aremaria juvenjles /150-cm³ soil	Gall index[1/]	Lesion index[2/]
Control	220	2.3	2.0
Aldicarb (A)	120	1.5	1.1
Flutolanil (F)	213	2.2	1.9
A + F	128	1.3	1.1
LSD 0.05	82	0.2	0.1

[1/]Gall index 1-5: 1=no galls, 2=1-25%, 3=26-50%, 4=51-75% and 5=76-100% of roots, pods, and pegs galled.

[2/]Lesion index 1-5: 1=no lesions, 2=1-25%, 3=26-50%, 4=51-75% and 5=76-100% of pod surface with lesions.

Thrips damage to foliage was less in minimum- than conventional-tillage plots where aldicarb was not applied (Table 2). The mean thrips damage across cropping systems, nematicide/insecticide and fungicide treatments and years was less in the minimum- than conventional-tillage plots. Campbell *et al.* (8) and Campbell (7) found less thrips damage in no-tillage than conventional- tillage peanut. Aldicarb provided consistent conrol of thrips damage, whereas flutolanil had no effect.

Table 2. Thrips damage to peanut as affected by tillage systems and nematicide/insecticide and fungicide treatments across cropping systems and years.

Nematicide/insecticide and fungicide treatments	Tillage systems: Conventional	Tillage systems: Minimum	LSD 0.05	Mean
	Damage rating[1]			
Control	5.4	4.7	0.3	5.1
Aldicarb (A)	2.4	2.4	NS	2.4
Flutolanil (F)	5.6	4.6	0.3	5.1
A + F	2.4	2.3	NS	2.4
LSD 0.05	0.2	0.2		0.2
Mean	4.0	3.5	0.2	

[1]Damage based on ratings of 1-9 with 1 = no damage and 9 = severe damage with some leaf necrosis.

Potato leafhopper damaged peanut plant in 1987 and 1988 (data not shown). Damage levels were affected only by aldicarb and aldicarb plus flutolanil treatments which reduced the 2-year mean damage ratings from 4.1 in the control to 1.3 and 1.4 in aldicarb and aldicarb plus flutolanil treatments, respectively. Campbell *et al* (8) and Campbell (7) reported that leafhopper damage was greater in conventional- than no-tillage peanut. In the present study, however, no differences were recorded in the amount of damage due to potato leafhopper that could be attributed to tillage systems.

The three cornered alfalfa hopper was present in 1987 and 1989 (data not shown) but not in 1988. Neither cropping nor tillage systems affected population levels in either year. In 1987, the number per 0.9 m of row was higher in plots treated with aldicarb (1.6) than in plots treated iwth flutolanil (0.6) but numbers present in treated plots did not differ significantly from control (1.3).

Velvetbean caterpillars were numerous in 1987 and 1989. Numbers present per 0.9 m of row were 11.8, 8.3, and 9.1 for aldicarb and flutolanil treatments and control, respectivley. The number present in the adicarb treatment was significantly greater than in the flutolanil treatment but neither treatment differed from control. Increases in numbers of velvetbean caterpillars have been noted after application of aldicarb to cotton (28) and soybean (25). Numbers present in 1989 were affected only by cropping systems; greater numbers were present in the wheat-peanut (13.8 per 0.9 m of row) than in the fallow-peanut (6.7 per 0.9 m of row) cropping system. Peanut plants in the wheat-peanut cropping system were 31 days younger than in the fallow-peanut cropping system, hence the younger plants were more succulent and may have attracted more velvetbean caterpillars than the older plants. Damage by potato leafhoppers, three cornered alfalfa hoppers and velvetbean caterpillars was minimal since these insects were controlled when population levels approached the economic threshold.

There was a high incidence of white mold in plots not receiving flutolanil (Table 3) which was ca. twice that in the previous experiment in this field in 1982-83 (20). Growing peanuts in this field two consecutive years prior to this study undoubtedly contributed to the increase. Tillage systems had no effect on the incidence of white mold (data not shown) which agrees with results of Hartzog and Adams (16) in peanut planted after rye, oat, and wheat, but does not agree with results obtained in a previous study at Tifton (21) in which peanut was planted in wheat stubble. Flutolanil and aldicarb plus flutolanil reduced the incidence of white mold loci in both cropping systems but differences due to aldicarb alone were not significant. (Table 3). The mean numbers of disease loci across cropping and tillage systems and years were less in flutolanil and aldicarb plus flutolanil treatments, but greater in the aldicarb treatment than in control. Numbers of loci were less in the wheat-peanut than in the fallow-peanut cropping system where the fungicide was not applied. The mean number of loci across tillage systems and nematicide/insecticide and fungicide treatments and years was less in the wheat-peanut than in the fallow-peanut cropping system. Disease ratings for the wheat-peanut cropping system were made 3-4 wks later than for the fallow-peanut cropping system in 1988 and 1989 because of different planting and maturity dates. Hence, differences in environmental conditions in the two cropping systems resulting from different planting and harvesting dates may have affected disease development differently in the two system.

The incidence of Rhizoctonia limb rot was evaluated in only 1988 and 1989(Table 4). Flutolanil and aldicarb plus flutolanil reduced the incidence of limb rot in both cropping systems across tillage systems and years. Also, flutolanil and aldicarb plus flutolanil reduced the incidence of limb rot in both tillage systems across cropping systems and years. Peanuts not treated with flutolanil had less limb rot in the wheat-peanut than in the fallow-peanut cropping system. The mean percentage of plants infected was less in the wheat-peanut than in the fallow-peanut cropping system across tillage systems and nematicide/insecticide and fungicide treatments and years. As in the case of white mold, limb rot ratings were made 3-4 weeks later in the wheat-peanut than in the fallow-peanut cropping system; therefore, enviromental conditions that affects the development of Rhizoctonia limb rot may have differed in the cropping systems. The disease was less severe in the minimum- than in the conventional-tillage system in control, aldicarb, and flutolanil treatments across cropping systems and years. The mean percentage of plants infected was less in minimum than in conventional tillage across cropping systems, nematicide/insecticide and fungicide treatments and years. Percentages of limb rot were less in flutolanil and aldicarb plus flutolanil treatments than in control and aldicarb treatments across cropping and tillage systems and years.

There was a high negative correlation beteen number of white mold loci and yield (Table 5). Rhizoctonia limb rot, gall and lesion indices and number of *P. brachyurus* in the soil were also negatively correlated with yield, but at lower r values. These correlation coefficients indicated that white mold contributed the major portion of the yield variability due to pests. Stepwise regression indicates that the negative factors of nematodes and plant diseases were not additive in reducing peanut yield. However, the model was improved slightly from an r^2 of 0.49 for white mold loci to r^2 of 0.54 when root-knot and lesion nematode indices were included with white mold counts.

Plant population densities per 2 m of row across cropping and tillage systems and nematicide/insecticide and fungicide treatments were 25.6, 26.4 and 24.4 in 1987, 1988, and 1989, respectively. Tillage systems and nematicide/insecticide and fungicide treatments across years had no significant effect on stand, but the stand was greater in fallow-peanut (26.3 plants/2 m of row) than in wheat-peanut plots (24.7 plants/

Table 3. Incidence of white mold as affected by interaction of cropping systems and nematicide/insecticide and fungicide treatments across tillage systems and years.

Nematicide/insecticide and fungicide treatments	Cropping systems: Fallow-peanut	Cropping systems: Wheat-peanut	LSD 0.05	Mean
	Number disease loci/15.2 m row[1]			
Control	23.4	13.0	2.2	18.2
Aldicarb (A)	24.9	14.7	2.2	19.8
Flutolanil (F)	3.4	2.6	NS	3.0
A + F	4.4	3.5	NS	4.0
LSD 0.05	2.0	2.0		1.4
Mean	14.0	8.4		1.4

[1]Disease locus consists of one or more plants infected per 31 cm of row.

Table 4. Severity of Rhizoctonia limb rot as affected by cropping systems and nematicide/insecticide and fungicide treatments across tillage systems and years, and effects of tillage systems and nematicide/insecticide and fungicide treatments across cropping systems treatments and years (2-year mean).

Nematicide/ insecticide and fungicide treatments	Percentage of vines infected						
	Cropping system			Tillage system			
	Fallow-peanut	Wheat-peanut	LSD 0.05	Conventional	Minimum	LSD 0.05	Mean
Control	4.5	2.3	2.1	4.6	2.2	0.8	3.4
Aldicarb (A)	4.7	2.5	2.1	4.2	3.0	0.8	3.6
Flutolanil (F)	1.4	1.1	NS	1.7	0.8	0.8	1.3
A + F	2.0	1.1	NS	1.9	1.2	NS	1.6
LSD 0.05	0.8	0.8		0.8	0.8		0.6
Mean	3.2	1.8	1.0	3.1	1.8	0.7	

[1]Estimate of percentage of infected vines from rating six 0.6-m row sections.

Table 5. Correlation coefficients of yield with certain nematode and soil disease measurements[1].

	Gall index	Lesion index	Number *Pratylenchus brachyurus*	Number White mold loci	Percentage Rhizoctonia limb rot
Yield	-0.22**	-0.23***	-0.15*	-0.70***	-0.30***

[1]Correlation coefficients for gall and lesion indices and number of *P. brachyurus*, and white mold loci based on three years data; percentage of Rhizoctonia limb rot based on two years data.

*, **, *** indicate significance at P=0.05, P=0.0002 and P=0.0001, respectively.

2 m of row). Correlation of stand with yield was not significant indicating that stand did not affect yield. Also, plant spacings of 7.6 cm and 8.1 cm for fallow-peanut and wheat-peranut plots, respectively, were within the range that others have obtained maximum yield of runner-type peanut in conventionally-tilled seed beds (18, 19, 24).

Cropping systems across tillage systems, nematicide/insecticide and fungicide treatments and years did not affect the three-yr mean peanut yields even though white mold and Rhizoctonia limb rot were less severe in the wheat-peanut than in the fallow-peanut cropping system. This may lead one to expect greater yields in the wheat-peanut than in the fallow-peanut cropping system. However, later planting and maturity dates in 1988 and 1989 for the wheat-peanut cropping system than for the fallow-peanut cropping system and other undetermined factors apparently negated any positive effects of disease suppression in the wheat-peanut cropping system.

Tillage systems, aldicarb, and flutolanil were the major treatments affecting peanut yields. Mean yields across cropping systems and years were greater in the conventional- than in the minimum-tillage system within each nematicide/insecticide and fungicide treatment. The mean yield across cropping systems and nematicide/insecticide and fungicide treatments and years was 577 kg/ha greater in the conventional- than in the minimum tillage system. These results are similar to those obtained in another experiment at this location (21). Other researchers (10, 16, 23) have reported yields in minimum tillage equal to or greater than conventional tillage. Tilleage systems had no effect on the severity of white mold, the fungal disease responsible for the major protion of yield variability (Table 5). Therefore, pest pressure apparently had little effect on yield differences between tillage systems.

Mean yields across cropping systems and years were increased by aldicarb, flutolanil, and aldicarb plus flutolanil in both tillage systems (Fig. 1). Mean yields across cropping and tillage systems and years were 11.1%, 55.9%, and 77.3% greater for aldicarb, flutolanil, and aldicarb plus flutolanil treatments, respectively, than for control. These data indicate that yield increases due to aldicarb and flutoanil when combined were more than additive. However, the relative increases in yield from aldicarb and flutolanil would be expected to differ in fields where the nematode, disease, and insect pressures differed These data indicate the value of aldicarb and flutolanil and the combination of the two

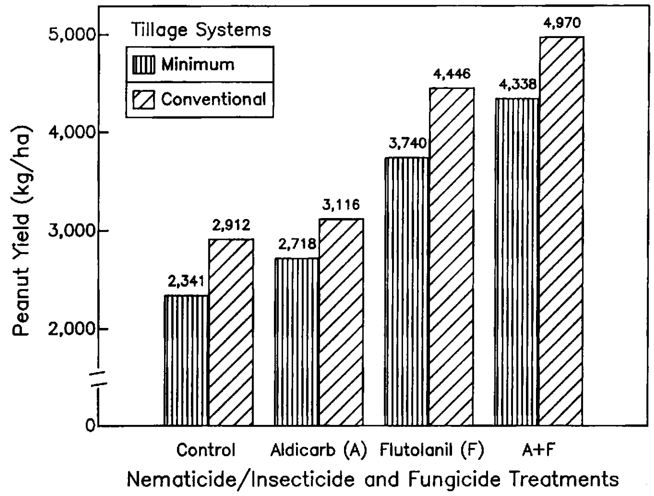

Fig. 1. Peanut yields as affected by tillage systems and nematicide/insecticide and fungicide treatments across cropping systems and years. LSD (P=0.05) =208 kg/ha for tillage system means within a nematicide/insecticide and fungicide treatment and 196 kg/ha for means among nematicide/insecticide and fungicide treatments within a tillage system.

materials in peanut production in both tillage systems.

Soil strength data were not collected in this experiment, but compaction in the pegging zone in the minimum-tillage system may have been present and restricted root growth, thus reducing pod set and yields compared to the conventional-tillage system. Measurements in a previous, unrelated experiment within 0.5 km of this test site showed that soil strength was greater in minimum- than conventional-tillage plots except within the subsoiler trench i.e in the row (26).

Colvin (12) and Wilcut (33) reported that poor weed control was related to reduced peanut yields in minimum-tillage as compared to good weed control in the conventional-tillage system. However, weed control in our experiment was adequate and equal in both tillage systems, with the exception of the minimum-tillage system in the wheat-peanut cropping system in 1989. Volunteer wheat plants that emerged in the minimum-tillage plots with the peanuts did not die soon after emergence due to relatively cool, moist conditions. Also, weeds were a greater problem in the minimum-tillage plots in the wheat-peanut cropping system in 1989 than in 1987 and 1988. The wheat and weeds were controlled with acifluorfen, sethoxydim and bentazon. As the result of the wheat plus weed competition and apparent herbicide injury in 1989, peanut plants in the minimum-tillage, wheat-peanut cropping system appeared to be stunted as compared to plants in the conventional-tillage plots. No plant measurements were recorded.

Cropping systems had some effect on the severity of nematodes, diseases, and insects however, tillage systems, aldicarb, and flutolanil were the major factors affecting peanut yields. The greatest yield was produced in conventional tillage plots treated with aldicarb plus flutolanil. Growing peanuts onthe same land for five consecutive years, as was done in this experiment, may have provided conditions conducive to the increase of *P. pasteuria* and reduced nematode pressure. Also, white mold and Rhizoctonia limb rot were probably more severe than they would have been if peanuts had been grown less frequently.

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