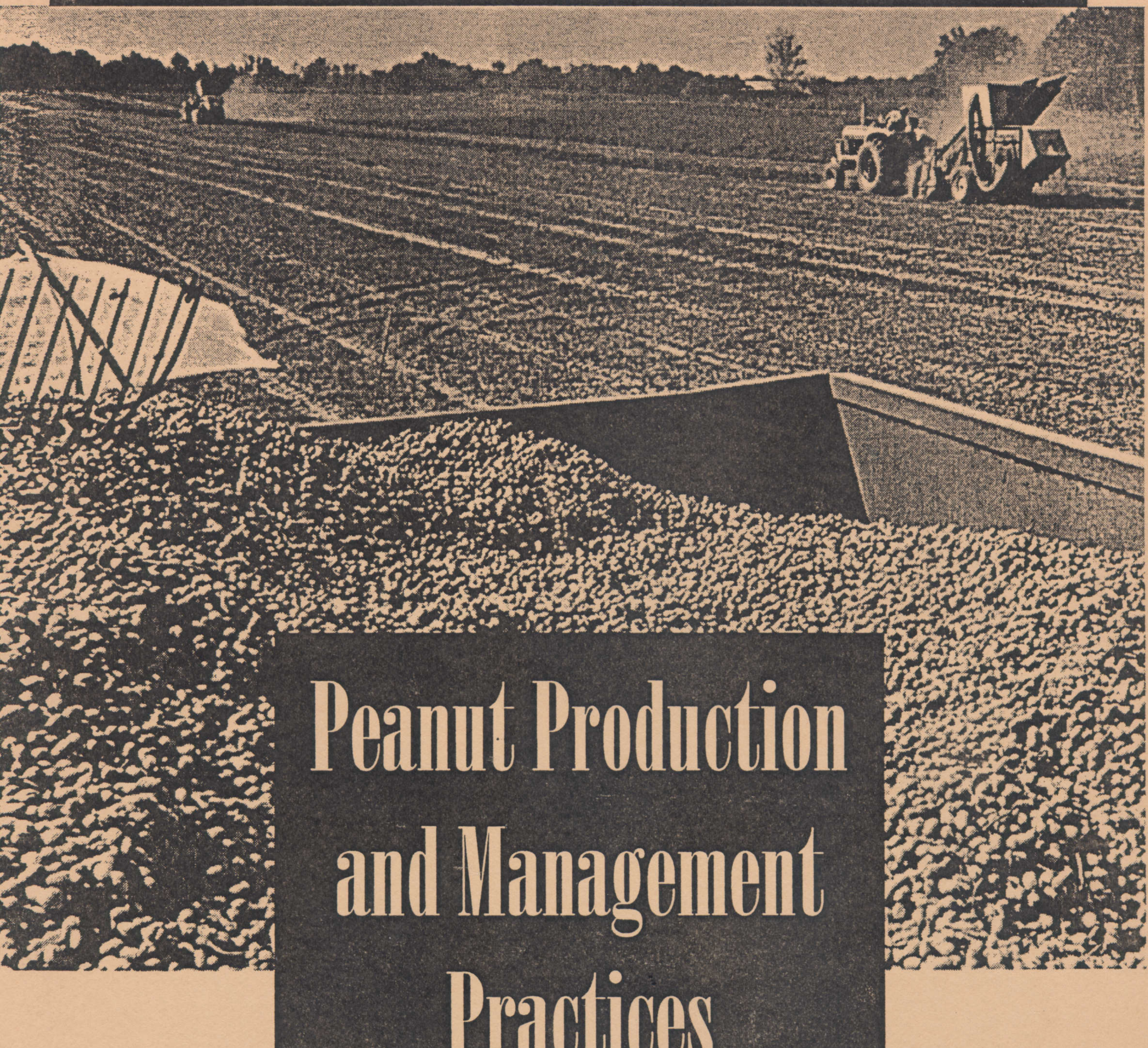
Brief Summaries of Research Studies Conducted by Auburn University



# Peanut Production and Management Practices

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# PREFACE

Management practices, such as rotations, fertilizer applications, seeding dates and rates, insect and disease control, and predicting the need for pest control, greatly influence profitability associated with peanut production. Over the years, many studies dealing with the relationships between management practices and peanut yield have been conducted. Detailed information from some of these studies has been printed in various publications. The objective of this publication is to briefly summarize data from some of these studies and to consolidate the information into a single publication. Additional information from most of these studies can be obtained by contacting the researchers listed at the beginning of each article.

The articles have been grouped into six categories - rotations; fertility; planting dates, seeding rates, and seed quality; diseases; insects; and models and prediction aids. Due to the nature of the research and treatments involved, some articles could have been placed in other categories, and as a result, information on a specific topic may be found in more than one category.

*Mention of trade names does not indicate endorsement by the Alabama Agricultural Experiment Station or Auburn University of one brand over another. Any use of pesticide rates in excess of labeled amounts in research reported does not constitute recommendation of such rate. Such use is simply part of the scientific investigation necessary to evaluate various materials. No chemical should be used at rates above those permitted by the label.*

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# ROTATIONS

## Peanut-Corn Rotations
### J.T. Cope & J.G. Starling
### Summarized by J.T. Touchton

**A STUDY** was conducted from 1965 through 1979 on a Dothan fine sandy loam soil at the Wiregrass Substation in Headland, Alabama. The primary objective was to evaluate time of phosphorus (P) and potassium (K) fertilization for both crops. Other than fertilizer variables, production practices were the same for rotated and continuously cropped peanuts.

Peanut yields (Table 1) are averaged over three five-year periods. Over the years, peanut yields steadily increased regardless of rotation. This increase over time is attributed to improved production practices, such as pesticides and varieties. Although it took several years for the rotation to result in relatively large yield increases, these increases occurred at a time in which yields of continuous peanuts were also increasing. The effect of the rotation on corn yields were not as dramatic as with peanuts. Over the 15-year period, corn yields averaged 70 and 75 bu. per acre for the continuous and rotated systems, respectively.

The economic analyses (Table 2) using the average yield for the 1975-1979 period indicate that the rotation was economically beneficial. With current quotas and pricing system, the rotation resulted in a net return (return to land, quota, and management) of $153 per acre compared to $52 for the continuous peanuts. The $153 value includes a $51 per acre loss from the corn crop. These results suggest that even if the rotation limits peanut acreage, it is more profitable to net $153 every other year ($76.50 per acre per year) than $52 each year. In addition, the potential for reduced production costs that a rotation may provide, such as reduced needs for pest and disease control, was not included in these analyses.

TABLE 1. YIELD OF CONTINUOUSLY CROPPED PEANUTS AND PEANUTS ROTATED WITH CORN

| Cropping system | Year | | | |
|---|---|---|---|---|
| | 65-69 | 70-74 | 75-79 | 65-79 |
| | -----------lb./acre------------- | | | |
| Continuous ...... | 1,390 | 2,040 | 2,510 | 1,980 |
| Rotation .......... | 1,620 | 2,590 | 3,060 | 2,420 |
| (Difference) .... | 230 | 550 | 550 | 440 |

TABLE 2. ECONOMIC COMPARISON OF CONTINUOUS AND ROTATED PEANUTS WITH CURRENT SUPPORT SYSTEM AND PRICE NEEDED TO BREAK EVEN WITHOUT QUOTA AND PRICE SUPPORT SYSTEMS FOR THE 1975-79 AVERAGE YIELD DATA[1]

| Cropping System | Net return ($/acre) with current price support | Price needed ($/ton) to break even without price support |
|---|---|---|
| Continuous ... | 52 | 511 |
| Rotation ....... | 153 | 453 |

[1] Net return and break even figures are return to land, quota, and management. Calculations are based on the following fixed figures: (1) a 2:1 ratio of quota to additionals; (2) a quota value of $679 per ton and $300 per ton for additionals; (3) a production cost of $642 per acre; and (4) a net loss of $51 per acre for the corn crop rotated with peanuts. This net loss was calculated from a 75 bu. per acre corn yield, valued at $2.40 per bu., and a production cost of $231 per acre.

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Cope and Touchton, Department of Agronomy and Soils; Starling, Wiregrass Substation.

## Rotations with Cotton and Bahiagrass for Management of Root-Knot Nematodes in Florunner Peanuts
### R. Rodríguez-Kábana, H.W. Ivey, D.G. Robertson, and L.W. Wells

**DAMAGE** caused by the southern root-knot nematode is one of the principal yield-limiting factors in peanuts in Alabama and other areas of the southeastern United States. The nematode is present in 40% of the peanut fields in Alabama, and approximately 12% of the fields are so heavily infested that production is not possible without management of the pest. Traditionally, management strategies for the nematode in the southeastern United States have been based on the use of nematicides and on rotation with crops that are either nonhosts or that are poorer hosts than peanuts. This management approach was prompted by the decreasing availability of inexpensive and effective nematicides such as DBCP and EDB, which have been eliminated, and by the lack of commercial peanut cultivars that are resistant or tolerant to the nematode. Management strategies based on crop rotations are at present the only viable long-term solution to nematode problems in peanuts. A number of crops have been studied in rotation with peanuts for suppression of root-knot problems.

The value of Deltapine 90 cotton in rotation with Florunner peanut for the management of root-knot nematode (*Meloidogyne arenaria*) and southern blight (*Sclerotium rolfsii*) was studied for six years.

Peanut yields (Table 1) following either one or two years of cotton (C-P and C-C-P, respectively) were higher than those of a peanut monoculture without nematicide [P(-)]. At-plant application of Temik® 15G to continuous peanuts [P(+)] averaged 22.1% higher yields than those for P(-) over the six years of the study. The use of the nematicide in cotton and peanuts in the C-C-P rotations increased yields of both crops over the same rotations without nematicide. When Temik was applied to both crops in the C-P rotation, peanut yields were increased in only two of the possible three years when peanuts were planted. Application of the nematicide to cotton only in the C-P rotation did not improve peanut yields over those obtained with the rotation without nematicide.

Juvenile populations of the nematode determined at peanut harvest time were lowest (Table 2) in plots with cotton. Plots with C-P or C-C-P had lower populations of the nematode than those in continuous peanuts with or without nematicide treatment.

The incidence of southern blight (white mold) in peanuts (Table 3) was lower in plots with the rotations than in those with continuous peanuts.

Net economic return from the 1990 peanut crop based on current prices for support and world market price peanuts showed (Table 4) a clear economic advantage for the use of rotations over the monoculture systems. Production of peanuts using the monoculture system was not competitive but was profitable with any of the rotation systems studied.

The effect of Pensacola bahiagrass in rotation with Florunner peanut on root-knot nematodes and peanut yields has been studied since 1986 in a field experiment. Peanut yields in plots following bahiagrass were 27% higher than in plots under continuous peanuts (Table 5). Each year soil densities of second stage juveniles of the root-knot nematode, determined near peanut harvest, were 96-98% lower under bahiagrass than under peanuts; numbers of juveniles in plots with bahiagrass-peanuts were 41% lower than in plots with continuous peanuts. Using bahiagrass for reducing population densities of root-knot nematode was at least as effective as using Temik at recommended rates for use in peanuts.

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Rodríguez-Kábana and Robertson, Department of Plant Pathology; Ivey and Wells, Wiregrass Substation.

TABLE 1. RELATION BETWEEN YIELDS OF PEANUT (P) AND OF COTTON (C) AND THE CROPPING SEQUENCE FOLLOWED IN AN EXPERIMENT AT THE WIREGRASS SUBSTATION, HEADLAND, IN A FIELD INFESTED WITH *MELOIDOGYNE ARENARIA*

| Cropping sequence and year[1] | | | | | | Yield (lb./acre)[2] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 |
| P(-) | P(-) | P(-) | P(-) | P(-) | P(-) | 3,173 | 2,929 | 1,383 | 1,899 | 2,061 | 1,546 |
| P(+) | P(+) | P(+) | P(+) | P(+) | P(+) | 3,689 | 3,200 | 1,817 | 2,495 | 2,577 | 2,088 |
| C(-) | P(-) | C(-) | P(-) | C(-) | P(-) | [2,794] | 3,499 | [1,654] | 1,573 | 1,573 | 2,235 |
| C(+) | P(-) | C(+) | P(-) | C(+) | P(-) | [3,689] | 3,499 | [2,061] | 1,736 | 1,736 | 2,685 |
| C(-) | P(+) | C(-) | P(+) | C(-) | P(+) | [2,821] | 3,363 | [1,790] | 2,088 | 2,088 | 2,659 |
| C(+) | P(+) | C(+) | P(+) | C(+) | P(+) | [3,083] | 3,689 | [2,088] | 2,360 | 2,360 | 2,712 |
| C(-) | C(-) | P(-) | C(-) | C(-) | P(-) | [2,875] | [1,844] | 2,088 | [1,329] | [1,329] | 2,820 |
| C(+) | C(+) | P(+) | C(+) | C(+) | P(+) | [3,445] | [1,899] | 2,495 | [1,844] | [1,980] | 3,417 |
| | | | | | FLSD (P = 0.05): | 489<br>[320] | 409<br>[377] | 336<br>[342] | 404<br>[478] | 469<br>[561] | 507 |

[1] (-) = without nematicide; (+) = with at-plant application of Temik 15G at three lb. a.i. per acre row in an eight-in.-wide band.

[2] Yield and FLSD values in brackets are for cotton; values without brackets are for peanuts.

TABLE 2. EFFECT OF CROPPING SYSTEMS WITH PEANUT (P) AND COTTON (C) ON END-OF-SEASON JUVENILE POPULATIONS OF *MELOIDOGYNE ARENARIA* IN A FIELD EXPERIMENT AT THE WIREGRASS SUBSTATION, HEADLAND

| Cropping sequence and year[1] | | | | | | Juveniles per 100 cm³ soil | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 |
| P(-) | P(-) | P(-) | P(-) | P(-) | P(-) | 579 | 72 | 144 | 97 | 155 | 283 |
| P(+) | P(+) | P(+) | P(+) | P(+) | P(+) | 539 | 15 | 281 | 84 | 151 | 226 |
| C(-) | P(-) | C(-) | P(-) | C(-) | P(-) | 5 | 41 | 1 | 59 | 2 | 128 |
| C(+) | P(-) | C(+) | P(-) | C(+) | P(-) | 10 | 23 | 5 | 17 | 6 | 128 |
| C(-) | P(+) | C(-) | P(+) | C(-) | P(+) | 24 | 15 | 2 | 69 | 7 | 68 |
| C(+) | P(+) | C(+) | P(+) | C(+) | P(+) | 6 | 10 | 7 | 47 | 5 | 59 |
| C(-) | C(-) | P(-) | C(-) | C(-) | P(-) | 15 | 16 | 24 | 8 | 6 | 88 |
| C(+) | C(+) | P(+) | C(+) | C(+) | P(+) | 14 | 12 | 65 | 11 | 4 | 50 |
| | | | | | FLSD (*P* = 0.05): | | 26 | 116 | 43 | 47 | 114 |

[1] (-) = without nematicide; (+) = with at-plant application of Temik 15G at three lb. a.i. per acre row in an eight-in.-wide band.

TABLE 3. EFFECT OF VARIOUS CROPPING SYSTEMS WITH PEANUTS (P) AND COTTON (C) ON THE INCIDENCE OF WHITE MOLD *(SCLEROTIUM ROLFSII)* IN PEANUTS AT THE END OF A SIX-YEAR EXPERIMENT IN A FIELD AT THE WIREGRASS SUBSTATION, HEADLAND

| Cropping sequence and year[1] | | | | | | Loci per 100 m row[2] |
|---|---|---|---|---|---|---|
| 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | |
| P(-) | P(-) | P(-) | P(-) | P(-) | P(-) | 137 |
| P(+) | P(+) | P(+) | P(+) | P(+) | P(+) | 145 |
| C(-) | P(-) | C(-) | P(-) | C(-) | P(-) | 110 |
| C(+) | P(-) | C(+) | P(-) | C(+) | P(-) | 89 |
| C(-) | P(+) | C(-) | P(+) | C(-) | P(+) | 96 |
| C(+) | P(+) | C(+) | P(+) | C(+) | P(+) | 100 |
| C(-) | C(-) | P(-) | C(-) | C(-) | P(-) | 90 |
| C(+) | C(+) | P(+) | C(+) | C(+) | P(+) | 84 |
| | | | | FLSD (*P* = 0.05): | | 25 |

[1](-) = without nematicide; (+) = with at-plant application of Temik 15G at three lb. a.i. per are row in an eight-in.-wide band.
[2]Number of disease loci ("hits") of $\leq$30 cm per 100 m of row.

TABLE 4. EFFECT OF SEVERAL PRODUCTION SYSTEMS WITH COTTON (C) AND PEANUTS (P) ON THE NET ECONOMIC RETURN FROM THE 1990 PEANUT Crop Based on Current Prices for Support and World Market Price for Peanuts

| Cropping sequence and year[1] | | | | | | Net return/ha in U.S.$[2] | |
|---|---|---|---|---|---|---|---|
| 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | World price | Support |
| P(-) | P(-) | P(-) | P(-) | P(-) | P(-) | -136.72 | -90.50 |
| P(+) | P(+) | P(+) | P(+) | P(+) | P(+) | 14.97 | 29.32 |
| C(-) | P(-) | C(-) | P(-) | C(-) | P(-) | 53.65 | 105.05 |
| C(+) | P(-) | C(+) | P(-) | C(+) | P(-) | 118.87 | 232.76 |
| C(-) | P(+) | C(-) | P(+) | C(-) | P(+) | 97.74 | 191.38 |
| C(+) | P(+) | C(+) | P(+) | C(+) | P(+) | 105.42 | 206.43 |
| C(-) | C(-) | P(-) | C(-) | C(-) | P(-) | 138.43 | 271.07 |
| C(+) | C(+) | P(+) | C(+) | C(+) | P(+) | 207.60 | 406.51 |

[1](-) = without nematicide; (+) = with at-plant application of Temik 15G at three lb. a.i. per acre row in an eight-in.-wide band.
[2]Calculations based on a production cost of U.S. $1,307 per ha without Temik 15G and U.S. $1,391 per ha with Temik 15G, and prices of $701 per ton and $358 per ton for support and world market peanuts, respectively.

TABLE 5. EFFECT OF PENSACOLA BAHIAGRASS ON *MELOIDOGYNE ARENARIA* J2 POPULATION DENSITY AND ON THE YIELD OF FLORUNNER PEANUTS IN A TWO-YEAR FIELD EXPERIMENT CONDUCTED AT THE WIREGRASS SUBSTATION, HEADLAND

| Cropping sequence and treatment[1] | | *M. arenaria* J2[2] | | Peanut yield (lb./acre) | |
|---|---|---|---|---|---|
| 1986 | 1987 | 1986 | 1987 | 1986 | 1987 |
| Peanut (-) | Peanut (-) | 255 | 277 | 2,303 | 1,600 |
| Peanut (+) | Peanut (+) | 8 | 283 | 3,553 | 2,333 |
| Bahiagrass | Peanut (-) | 15 | 163 | | 2,034 |
| Bahiagrass | Peanut (+) | 2 | 89 | | 2,495 |
| Bahiagrass | Bahiagrass | 5 | 12 | | |
| LSD (*P* = 0.05) | | 94 | 113 | 727 | 387 |

[1](-) = without nematicide; (+) = Temik 15G applied at-plant at three lb. a.i. per acre row in an eight-in.-wide band.
[2]Number per 100 $cm^3$ soil two weeks before harvest.

# Bahiagrass in Rotations Shows Promise for Boosting Peanut Yields

## J.C. Jacobi, P.A. Backman, R. Rodríguez-Kábana, and D.G. Robertson

SOILBORNE diseases of peanuts are on the increase in Alabama. Both white mold and limb rot have become more severe problems as irrigated acreage has increased and rotation use and length of rotation have declined. The bottom line has been a gradual but consistent decline in peanut yields over the past few years.

Unfortunately, fungicidal control for soilborne diseases is limited. Terraclor® is the only fungicide currently recommended for control of white mold, but it does not control limb rot. The experimental fungicides Folicur® and Spotless® have given excellent control of peanut leafspot, white mold, and limb rot in field trials, but these materials are not registered for use on peanuts.

Under existing conditions, crop rotations appear to offer the best hope for reducing severity of soilborne peanut diseases, and this approach is being emphasized in Alabama Agricultural Experiment Station (AAES) research. Suitable rotations are being sought despite the problems of a lack of economically attractive rotation crops, and the broad host ranges of the white mold and limb rot fungi.

Peanut rotations commonly used in Alabama include either corn, cotton, sorghum, or soybeans. Since previous AAES research has shown that bahiagrass reduces root-knot nematode populations, bahiagrass was included, along with corn, in a long-term rotational study with irrigated peanuts at the Wiregrass Substation, Headland.

Results indicate that either a one-year rotation with corn or one- and two-year rotations with bahiagrass did not significantly reduce white mold severity (Table 1). Rotations of one to two years between peanut crops are not long enough to reduce white mold severity due to the ability of the white mold pathogen to remain in the soil for an extended time period (three to four years). Three- and four-year rotations between peanut crops are generally required to reduce white mold severity.

Limb rot severity was reduced 16% and 43% by one- and two-year rotations, respectively, with bahiagrass when compared to continuous peanuts (Table 1). A one-year rotation with corn did not significantly reduce limb rot severity, because corn is a host of the causal fungus of the disease. All rotations increased yields over continuous peanuts (Table 2). Peanut yields following a two-year rotation with bahiagrass were 44% higher than yields of nonrotated peanuts.

The effects of the nematicide Temik® and the fungicide Folicur also were evaluated for each rotational system. Chemical treatment increased yields and reduced soilborne disease intensity, regardless of crop rotation. However, yield increases with these chemicals were higher for rotated peanuts than nonrotated peanuts. In several cases, yields were increased by 1,000 lb. per acre. Similar yield increases with Folicur have been seen in tests conducted across the Southeast. However, until Folicur is registered by the EPA, growers must rely largely on management practices, such as rotation, to minimize yield losses to soilborne diseases.

These preliminary results indicate that one- or two-year rotations with bahiagrass can significantly increase yields over continuous peanut production. While the reasons for yield increases with bahiagrass rotations are not entirely understood, reduced severity of soilborne diseases, such as limb rot and root-knot, along with enhanced soil physical properties are thought to be important factors. Although white mold severity was not significantly reduced in either bahiagrass rotation, rotations longer than two years between peanut crops may reduce white mold disease severity.

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Jacobi, Backman, Rodríguez-Kábana, and Robertson, Department of Plant Pathology.

Table 1. Effects of Crop Rotation and Chemical Treatment on Disease Intensity of White Mold and Rhizoctonia Limb Rot in Irrigated Florunner Peanuts

| Crop rotation[1] | Treatment[2] | White mold hits[3] | Limb rot lesions[4] |
|---|---|---|---|
| Peanuts-peanuts-peanuts | (-) | 32.9 | 10.5 |
| | (+) | 9.4 | 6.8 |
| Peanuts-corn-peanuts | (-) | 37.5 | 10.0 |
| | (+) | 7.8 | 6.1 |
| Peanuts-bahiagrass-peanuts | (-) | 35.9 | 8.8 |
| | (+) | 7.8 | 3.8 |
| Bahiagrass-bahiagrass-peanuts | (-) | 32.9 | 6.0 |
| | (+) | 4.0 | 3.8 |

[1] Crops grown in 1988, 1989, and 1990, respectively.

[2] (-) = no Temik, no Folicur; (+) = Temik applied at plant at three lb. a.i. per acre in an eight-in. band and Folicur applied twice during the season at a rate of 0.225 lb. a.i. per acre.

[3] Average number per 100 ft. of row.

[4] Total number per five lateral limbs.

Table 2. Effects of Crop Rotation and Chemical Treatment on Yield of Irrigated Florunner Peanuts

| Crop rotation[1] | Treatment[2] | Pod yield/ acre | Change in yield over continuous peanuts[3] | Additional yield with Folicur-Temik |
|---|---|---|---|---|
| | | *Lb.* | *Lb.* | *Lb.* |
| Peanuts-peanuts-peanuts | (-) | 2,693 | --- | + 634 |
| | (+) | 3,327 | | |
| Peanuts-corn-peanuts | (-) | 2,978 | + 285 | +1,569 |
| | (+) | 4,547 | | |
| Peanuts-bahiagrass-peanuts | (-) | 3,127 | + 434 | + 948 |
| | (+) | 4,075 | | |
| Bahiagrass-bahiagrass-peanuts | (-) | 3,878 | +1,185 | +1,122 |
| | (+) | 2,693 | | |

[1] Crops grown in 1988, 1989, and 1990, respectively.

[2] (-) = no Temik, no Folicur; (+) = Temik applied at-plant at three lb. a.i. per acre in an eight-in. band and Folicur applied twice during the season at a rate of 0.225 lb. a.i. per acre.

[3] Change in yield per acre from continuous peanuts due to rotation effect.

[4] Per acre yield increase with chemical treatment for the same crop rotation.

# Potential Yield Increases from a New Fungicide for White Mold Control in Peanuts

## A.K. Hagan, J.R. Weeks, K.L. Bowen, W.A. Miller, and D.L. Hartzog

WHITE MOLD is the most damaging disease of peanuts in Alabama. Annual losses to this disease have been estimated at 20% of expected yields. Greatest losses have usually occurred in fields cropped to peanuts every other year. The objective of this study was to determine the potential impact of the unregistered new fungicide Moncut® on peanut production in Alabama.

Trials were conducted in 16 farm fields in 1991, and in 21 fields in 1992. One of the following cropping patterns was followed in each field: continuous peanut production (three-year minimum), one year of peanuts behind one year of corn/grain sorghum/clean fallow, peanuts after two to three years of cotton/corn, and peanuts behind bahiagrass (five-year minimum). Six nontreated control plots were paired with treated plots. Treatments were applied approximately 60 to 70 days after planting with Moncut 50W at two lb. per acre as a full canopy spray at 15 gal. per acre.

The occurrence of other diseases and nematodes was periodically monitored. Plots were rated for white mold after inverting, then harvested.

In 1991, an 82% reduction in the incidence of white mold was seen in all Moncut-treated plots across all four rotations (Table 1). The lowest level of disease control (60%) occurred in those fields where peanuts followed bahiagrass, while the best protection from white mold was noted where peanuts followed two or more years. Despite heavy disease pressure, yield increases after treatment with Moncut (23.3%) were largest where peanuts were grown every other year. Under modest disease pressure, yield increases of 14% were also obtained in fields cropped to peanuts every third year. Smaller yield increases were seen in fields in continuous peanut production. In peanuts behind bahiagrass, disease pressure was light and no yield gains were noted. Overall, an application of Moncut increased average peanut yields across all rotations by 18.1% over that of the nontreated plots. Yield increases in selected fields under severe white mold pressure were in the range of 40 to 45% (1,700 lb. per acre).

In 1992, Moncut provided 85% control of white mold across all rotations (Table 2). Best disease control occurred in those rotations with heaviest white mold pressure. Sizable yield increases were noted in all rotations except bahiagrass-peanuts, where little white mold was present. Overall, yields from the Moncut-treated plots were 19.4% higher than yields from the nontreated controls across all rotations.

In both years, superior control of white mold and yield increases were obtained with a single application of Moncut. Greatest yield increases consistently occurred in those fields where white mold historically has caused extensive damage. Where disease pressure was low, such as when peanuts were cropped after bahiagrass, Moncut had little impact on yield.

TABLE 1. WHITE MOLD CONTROL AND YIELD INCREASES IN PEANUTS TREATED WITH MONCUT, 1991

| Rotation | Control | Yield increase | |
|---|---|---|---|
| | *Pct.* | *Lb./acre* | *Pct.* |
| Peanuts after bahia (4) ..... | 60 | -181 | -4.9 |
| Peanuts every 3 yr. (4) .... | 90 | 516 | 14.0 |
| Peanuts every 2 yr. (5) .... | 82 | 836 | 23.3 |
| Continuous peanuts (3) .... | 72 | 208 | 6.1 |
| Average | 82 | | 18.1 |

TABLE 2. WHITE MOLD CONTROL AND YIELD INCREASES IN PEANUTS TREATED WITH MONCUT, 1992

| Rotation | Control | Yield increase | |
|---|---|---|---|
| | *Pct.* | *Lb./acre* | *Pct.* |
| Peanuts after bahia (5) .... | 60 | -63 | -1.6 |
| Peanuts every 3 yr. (9) .... | 78 | 502 | 11.1 |
| Peanuts every 2 yr. (4) .... | 85 | 743 | 20.4 |
| Continuous peanuts (2) ... | 89 | 768 | 19.3 |
| Average | 85 | | 19.4 |

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Hagan and Bowen, Department of Plant Pathology; Weeks, Department of Entomology; Miller, Department of Agricultural Economics and Rural Sociology; and Hartzog, Department of Agronomy and Soils.

# Impact of Crop Rotation on Soilborne Diseases and Nematodes in Peanuts

### A.K. Hagan, K.L. Bowen, J.R. Weeks, and D.L. Hartzog

**CROP ROTATION** has long been recognized as a valuable component in peanut disease management systems. For a variety of reasons, crop rotation has been largely eliminated as a control measure for soilborne diseases on Alabama peanut farms. A study was conducted to determine occurrence of destructive diseases, such as southern stem rot and Rhizoctonia limb rot, in Alabama peanut fields with a variety of cropping histories; document disease-related losses in those fields; and assess the role of crop rotation as a disease management tool.

Trials were established in 16 fields in 1991, and in 21 fields in 1992. The fields had one of the following rotation sequences: continuous peanut production (three-year minimum), one to two years of peanuts behind one year of corn/grain sorghum/clean fallow, peanuts after two to three years of cotton/corn/or other nonhost crop of the white mold fungus (*Sclerotium rolfsii*) and the peanut root-knot nematode, and peanuts after bahiagrass (five-year minimum). Defoliation from early leafspot and root-knot larval populations were periodically determined during the growing season. Plots were rated for disease after inverting, then harvested with a combine.

In 1991, white mold and root-knot nematodes were largely absent and yields were highest when peanuts were grown behind bahiagrass (Table 1). Where peanuts followed two to three years of corn or cotton, white mold incidence increased, but no nematode pressure occurred. Yields were slightly lower in these fields than in those where peanuts followed bahiagrass. The numbers of white mold hits peaked where peanuts were cropped every other year. Light nematode pressure also was noted. Yields in these fields did not differ substantially from those fields cropped less often to peanuts. Lowest yields, along with moderate white mold damage, heavy leafspot defoliation, and severe nematode pressure were seen in fields in continuous peanut production.

In 1992, white mold incidence and root-knot pressure again were exceptionally low where peanuts were grown after bahiagrass (Table 2). Early leafspot and, to a lesser extent, limb rot greatly suppressed yields in several fields in a bahiagrass-peanut rotation sequence. Despite increases in numbers of white mold hits and root-knot larvae, yields in fields in a three-year rotation were similar to those of the bahiagrass-peanut rotation. Serious white mold damage was seen in only one of the nine fields and nematode damage occurred in two of the nine fields in the three-year rotation category. Fields cropped every other year to peanuts had moderate white mold damage and modest nematode pressure, which resulted in a slight reduction in yield as compared to other rotations. Lowest yields were recorded in fields in continuous production, which apparently were due to a combination of white mold and root-knot nematode damage. Crop rotation had little effect on defoliation from early leafspot and on development of limb rot.

Adoption of better crop rotations by Alabama peanut producers should result in some yield gains due to a reduction in damage caused by white mold and root-knot nematode. Lowest white mold and nematode pressure was consistently seen in the bahiagrass-peanut cropping sequence. Peanuts cropped every three years generally yielded well and suffered only moderate white mold damage. Unfortunately, most of Alabama's peanut land is cropped to peanuts every other year. Producers following this cropping sequence risk sizable yield losses due to white mold and possibly also to root-knot nematode, along with the added production costs needed for their control. Nematodes displaced white mold as the most destructive pest on continuous peanuts and the combination of the two in these fields further reduced yields. Disease and nematode pressure was not consistent from field to field in any rotation category except the bahiagrass-peanut rotation where white mold and nematodes were largely absent. No matter how favorable the rotation for diseases or nematodes, some fields in each of the other rotation categories escaped significant damage.

The development of Rhizoctonia limb rot apparently was not influenced by cropping sequence.

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Hagan and Bowen, Department of Plant Pathology; Weeks, Department of Entomology; and Hartzog, Department of Agronomy and Soils.

TABLE 1. YIELDS AND INCIDENCE OF WHITE MOLD, LEAFSPOT DEFOLIATION, AND ROOT-KNOT LARVAE IN FOUR ROTATION CATEGORIES, 1991

| Rotation | White mold hits/100 ft. | Leafspot defoliation | Root-knot nematodes | Yield lb./acre |
|---|---|---|---|---|
| | *No.* | *Pct.* | *No.*[2] | |
| Peanuts after bahia (4)[1] | 0.3 | 33.3 | 5.5 | 3,859 |
| Peanuts every 3 yr. (4) | 5.6 | 30.0 | .0 | 3,692 |
| Peanuts every 2 yr. (5) | 13.0 | 35.0 | 10.0 | 3,608 |
| Continuous peanuts (3) | 5.8 | 41.5 | 1,520.7 | 3,222 |

[1] Numbers of fields in each rotation category are in parenthesis.
[2] Number of larvae per 100 cc soil sample.

TABLE 2. YIELDS AND INCIDENCE OF WHITE MOLD, LEAFSPOT DEFOLIATION, AND ROOT-KNOT LARVAE IN FOUR ROTATION CATEGORIES, 1992[1]

| Rotation | White mold hits/100 ft. | Leafspot defoliation | Root-knot nematodes | Limb rot | Yield, lb./acre |
|---|---|---|---|---|---|
| | *No.* | *Pct.* | *No.*[3] | *Pct.* | |
| Peanuts after bahia (5)[2] | 0.1 | 35.6 | 0.0 | 5.5 | 3,932 |
| Peanuts every 3 yr. (9) | 5.0 | 32.8 | 75.6 | 5.6 | 4,035 |
| Peanuts every 2 yr. (4) | 14.7 | 31.8 | 48.5 | .0 | 3,645 |
| Continuous peanuts (2) | 11.3 | 27.4 | 124.0 | .0 | 3,229 |

[1] Preliminary information compiled from raw data.
[2] Numbers of fields in each rotation category are in parenthesis.
[3] Numbers of larvae per 100 cc soil sample.

## Peanut Economics

### W.A. Miller

ECONOMIC research on peanuts at the Wiregrass Substation, Headland, focused on comparisons of recommended (conventional) and reduced cost management practices during the 1982-85 period. Treatments involving row spacing, seeding rate, weed control, leafspot control, and drying practices were evaluated. Among the nonconventional treatments, only the use of twin row spacing produced higher yields and net returns with any consistency.

During the 1986-88 period the economic research on recommended versus reduced cost practices continued, but the treatments were changed. Reduced cost treatments involving tillage, seeding rate, weed control, and disease control were evaluated. The use of a 60-lb. seeding rate produced about the same yields as a 100-lb. seeding rate and increased net returns.

A long-term, sod-based, peanut rotation study was started in 1988 at the Wiregrass Substation. A multidisciplinary group of researchers is working with this experiment, which is expected to continue through 1995. In addition to including all possible combinations of one through four years of bahiagrass followed by one through four years of peanuts, the test includes a continuous peanut treatment and an every other year rotation of peanuts after corn. The table summarizes the average yields, graded values of peanuts, and net returns attributable to the these two cropping systems.

Peanut yields, graded values, and net returns to land and management appeared to respond favorably to the rotation treatment. The response to irrigation was not consistent. Neither the continuous peanut or corn-peanut cropping systems generated a net return under irrigation (on the average) over the study period. Analysis of the net return data suggested that irrigation can do more harm than good when pests and diseases are not adequately controlled in these cropping systems. The next step in this research project will be to evaluate the economic performance of alternative bahiagrass/cattle-peanut rotations.

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Miller, Department of Agricultural Economics and Rural Sociology.

AVERAGE YIELDS, GRADED VALUES, AND NET RETURNS OF CONTINUOUSLY CROPPED PEANUTS AND PEANUTS ROTATED WITH CORN, 1989-92[1]

| Yields | Nonirrigated | Irrigated |
|---|---|---|
| Continuous peanuts, lb./acre | 2,362 | 2,203 |
| Rotated peanuts, lb./acre | 2,503 | 2,633 |
| Corn, bu./acre | 72 | 132 |
| Graded values, dol./ton | | |
| Continuous peanuts | 663.43 | 660.12 |
| Rotated peanuts | 668.53 | 662.91 |
| Annual net returns by crops, dol./acre | | |
| Continuous peanuts | 80.28 | -84.88 |
| Rotated peanuts | 117.93 | 16.72 |
| Corn | -12.46 | -21.51 |
| Annual net returns by cropping system, dol./acre | | |
| Continuous peanuts | 80.28 | -84.88 |
| Corn-peanut rotation | 52.74 | - 2.40 |

[1] Net returns are the residual returns to land and management. The rotation treatment was an every-other-year rotation of peanuts following corn. Corn yields and net returns were averaged over the 1988-91 period. Peanut yields, graded values, and net returns were averaged over the 1989-92 period. The following information was used to compute net returns: (1) a 4:1 ratio of quota peanuts to additional peanuts, (2) a market price of $300 per ton for additional peanuts, and (3) a market price of $2.735 per bushel for corn. Peanut production costs averaged $302 (variable) and $164 (fixed) per acre for the nonirrigated test and $345 (variable) and $245 (fixed) for the irrigated test during the period 1989-92. In addition, peanut quota cost about $.08 per lb. These costs did not include certain costs normally incurred by peanut growers, such as crop insurance premiums, marketing assessments, and the cost of a winter cover crop. Both the Florunner peanuts and corn were produced using conventional production practices. Irrigation of both corn and peanuts was scheduled based on the water needs of the peanuts.

# FERTILITY

## Tillage, Subsoiling, Starter Fertilizer Combinations, and Starter Fertilizer Placement Comparisons for Peanuts

### J.T. Touchton

STUDIES were conducted on a Dothan sandy loam soil at the Wiregrass Substation, Headland, to evaluate the effects of tillage, subsoiling, starter fertilizer, and starter fertilizer placement on peanut yields. Peanuts were grown in a three-year rotation that consisted of cotton-corn-peanuts. After harvesting each fall the field was disked lightly and seeded in rye. Tillage treatments were no tillage into killed rye and disk-chisel-disk. Subsoiling treatments were no subsoiling and in-row subsoiling 12 to 14 in. deep at planting. Starter fertilizer combinations consisted of none; nitrogen (N); nitrogen and phosphorous (N-P); and nitrogen, phosphorous, and potassium (N-P-K). Fertilizer placement was 3 X 2 with and without subsoiling and 6 to 10 in. below the seed with subsoiling. The 3 X 2 fertilizer placement was approximately three in. from the row and two in. deep. Rates of N, P, and K were approximately 23, 10, and 6 lb. per acre, respectively. The residual soil P and K levels were high and remained high throughout the duration of the study.

With all possible combinations of treatments there were 22 treatments with three years of data for a total of 66 comparison points when yields were averaged over replications. Some of the results were easy to interpret, but others were not.

Within the conventional tillage system, in-row subsoiling with or without starter fertilizers either had no effect on yields or slightly reduced yields. Since in-row subsoiling within the conventional tillage system could not be considered profitable with or without the starter fertilizer, the only feasible placement method for the starter fertilizer would be the 3 X 2 application. In 1983, which was not a very good climatic year for peanut production, N alone and the N-P combination had essentially no effect on yields (Table 1), but K in the starter reduced yields. In 1984, starter fertilizer improved yields, but N alone was adequate. In 1985, best yields were obtained with the N-P-K combination. The three-year average yields, however, suggest that a starter fertilizer consisting of N alone would be adequate for peanuts grown in a conventional tillage system.

When starter fertilizers were not applied in the no-tillage system, yields averaged 3,100 and 2,600 lb. per acre per year with and without in-row subsoiling, respectively. Although the starter fertilizers improved yields when the subsoiler was not used, the yields were still inferior to those obtained with subsoiling.

With in-row subsoiling in the no-tillage system, the optimum starter fertilizer combination and placement method varied among years (Table 2). Based on the three-year average yield, the optimum combination was the N-P-K, and deep placement was as effective as the 3 X 2 placement.

The difference in yields between tillage systems also varied among years, and the difference was dependent on the starter fertilizer combination and placement method. When averaged across all treatments and years, yields with conventional tillage were 180 lb. per acre per year higher than with no tillage. The need for starter fertilizers was more critical with no tillage than conventional tillage. The average yield response to the best starter fertilizer combination was 240 lb. per acre per year with conventional tillage and 420 lb. per acre per year with no tillage. Studies with other crops have also shown that the most critical need for starter fertilizers occurs in no-tillage systems. The data also suggest that if the correct cultural practices are used, yields obtained with no tillage can be as high as yields obtained with conventional tillage.

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Touchton, Department of Agronomy and Soils.

TABLE 1. YIELD OF PEANUTS GROWN IN A CONVENTIONAL TILLAGE SYSTEM AS INFLUENCED BY 3X2-PLACED COMBINATIONS OF STARTER FERTILIZER

| Starter fertilizer | Year | | | 3-yr. average |
|---|---|---|---|---|
| | 1983 | 1984 | 1985 | |
| | *Peanut yield, lb./acre* | | | |
| None | 2,820 | 2,950 | 4,390 | 3,390 |
| N | 2,940 | 3,860 | 4,100 | 3,630 |
| N-P | 2,710 | 3,780 | 4,380 | 3,620 |
| N-P-K | 2,290 | 3,720 | 4,650 | 3,550 |

TABLE 2. YIELD OF PEANUTS GROWN IN A NO-TILLAGE SYSTEM WITH IN-ROW SUBSOILING AS INFLUENCED BY PLACEMENT OF STARTER FERTILIZER COMBINATIONS

| Starter fertilizer | Fertilizer placement | 1983 | 1984 | 1985 | 3-yr. average |
|---|---|---|---|---|---|
| | | *Peanut yield, lb./acre* | | | |
| None | ------ | 1,830 | 3,180 | 4,300 | 3,100 |
| N | deep | 2,420 | 3,290 | 4,480 | 3,400 |
| | 3 X 2 | 1,820 | 3,630 | 4,680 | 3,380 |
| N-P | deep | 2,240 | 3,160 | 4,510 | 3,300 |
| | 3 X 2 | 1,720 | 3,760 | 4,630 | 3,370 |
| N-P-K | deep | 2,220 | 3,460 | 4,840 | 3,510 |
| | 3 X 2 | 2,160 | 3,600 | 4,860 | 3,540 |

## Calcium Requirements for Maximum Yield

## J.F. Adams and D.L. Hartzog

THE ALABAMA Agricultural Experiment Station initiated fertility experiments with peanuts in the early 1900's. Through the years production practices and peanut cultivars have changed dramatically. Auburn University has and will continue to do fertility research on peanuts to meet current and future changes. From 1967 to 1993 more than 350 on-farm soil fertility experiments have been conducted. The following summary covers only those experiments dealing with calcium.

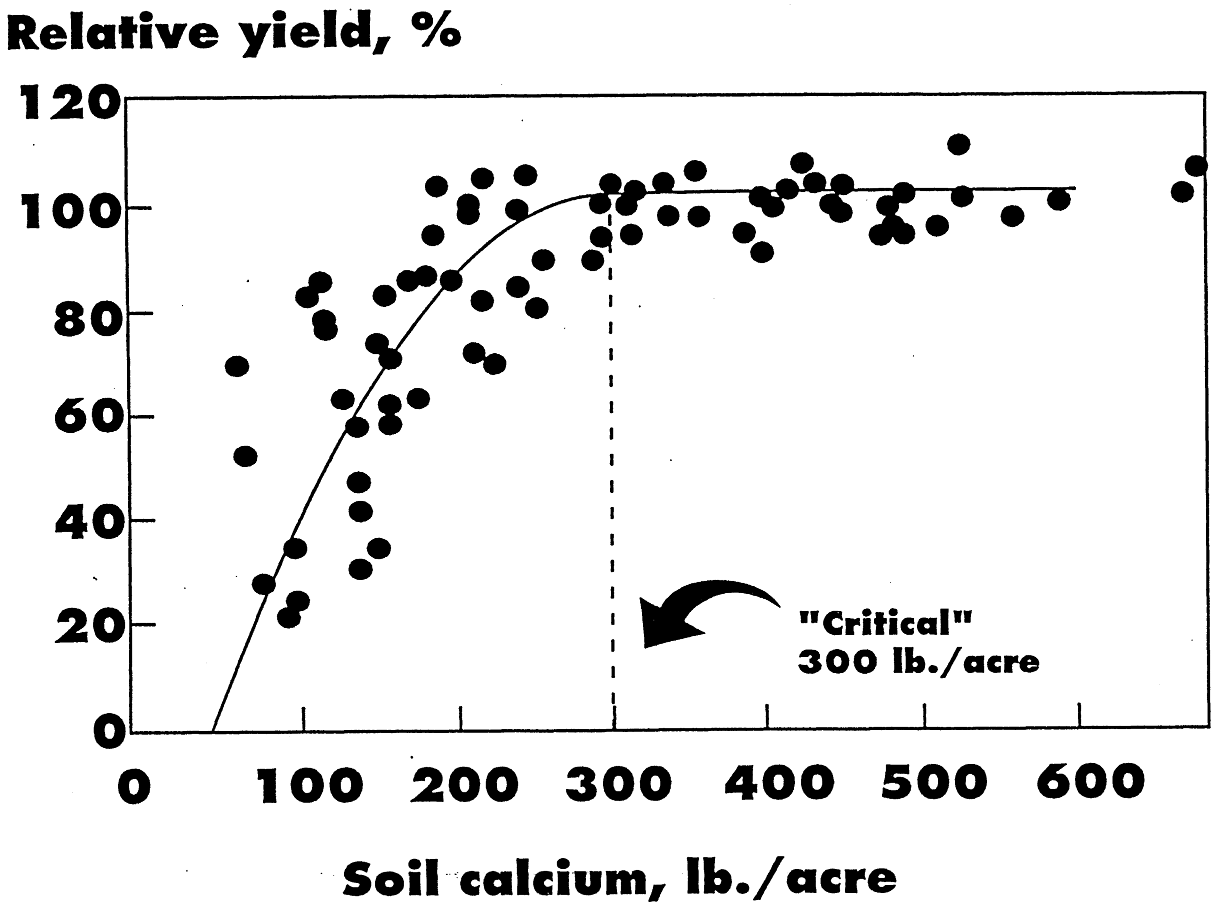
Calcium is the most limiting plant nutrient for peanut production. The addition of calcium prevents "pops" and increases yield and grade. The primary source of calcium in the past has been gypsum or landplaster, but the primary calcium source has changed to agricultural limestone. This change was based on research that has established a minimum soil-test calcium concentration for the Florunner cultivar. The 300-lb.-per-acre requirement for Florunner was developed from more than 75 on-farm experiments (see figure). On-farm experiments are continuing to define this critical soil calcium concentration for GK 7, Sunrunner, and Southern Runner cultivars. The data indicate that there will be little difference in calcium requirement for maximum yield and grade for these new cultivars.

Many calcium source comparison experiments have been conducted on-farm from 1967 to present using gypsum, gypsum rates, calcitic and dolomitic lime, lime suspensions, 420 landplaster, and basic slag. Seven on-farm experiments were conducted to determine if less gypsum could be used. The experiments showed that 250 lb. per acre of gypsum provided yields as high as the traditional 500-lb.-per-acre rate, even on soils that had as low as 120 lb. per acre of soil-test calcium. When comparing the 500-lb.-per-acre rate of gypsum with calcitic lime in 12 on-farm experiments, lime was superior to gypsum in two of five experiments that had increased yield due to added calcium and in no case did additional gypsum on lime treatments increase yield. Lime proves to be as good a calcium source as gypsum and there is no benefit to adding gypsum to freshly limed soil.

Lime sources also were compared to determine if dolomitic limestone supplied adequate calcium. Six on-farm experiments showed that dolomite was equal to calcitic lime, except for one experiment where the dolomitic lime gave a higher yield. This increase was assumed to be a response to the added magnesium and not calcium since the soil-test level was only seven lb. per acre. Lime was also compared to basic slag as a calcium source. When basic slag was incorporated into the top three to four in. of the soil, both were equally effective in increasing yield. But when basic slag was applied in the same manner as gypsum, then basic slag had very little value.

Lime suspensions were compared in seven on-farm experiments to dry agricultural limestone at a 500-lb.-per-acre rate and the recommended rate. The lime slurry was as effective as dry lime when applied at the recommended rate, but neither lime source gave maximum yields at the 500-lb.-per-acre rate.

Adams and Hartzog, Department of Agronomy and Soils.



Experiments show that 300 lb. Ca per acre is required for Florunner peanuts.

# Have We Been Overfertilizing Our Peanuts?

## C.C. Mitchell and J.F. Adams

**PERCEIVED** differences in fertilizer recommendations across the peanut growing regions of the Coastal Plain prompted peanut researchers in Alabama, Georgia, Florida, and other peanut growing states to take a new look at the research that provides the basis for current fertilizer recommendations. After four years of scrutiny, the general conclusion about phosphorous (P) and potassium (K) recommendations is that they are too high. By adjusting soil test interpretations and recommendations for peanuts and encouraging proper fertilization of the rotation crop, yields will improve with less direct inputs.

The critical soil test value is that level of extractable nutrient that separates the "medium" from the "high" rating. No yield response to additional application of a particular nutrient is expected above the critical value.

For Alabama, a critical soil test value of 50 lb. P per acre and 80 lb. K per acre are currently used. However, research suggests that these values should be reduced.

After more than 60 years of fertility experiments on a Dothan sandy loam soil in Alabama, no peanut yield response has ever been shown from P fertilization. A research-based interpretation of current research information regarding soil test P calibrations for peanuts would suggest dramatic changes in current critical values for runner-type peanut production. This would result in little or no P fertilizers recommended on most Coastal Plain soils. A more realistic critical soil test value of 20 lb. per acre has been proposed.

In general, there are contradictions and poor correlations between soil test K and response to K fertilizers by peanuts. Research has shown positive, negative, and no response to K. Recent on-farm tests in Alabama suggest that the critical soil test value for K should be about 26 lb. per acre. Evidence indicates a need to consider depth to the subsoil and subsoil K levels when interpreting soil test levels. However, 40 lb. extractable K per acre has been proposed as a more acceptable critical value for runner-type peanuts on all Coastal Plain soils.

These results suggest that modifying soil test calibration, interpretation, and recommendations for P and K on peanuts in Coastal Plain soils will require dramatic changes in existing soil test calibrations. Programs should emphasize soil testing and proper fertilization for crops in rotation with peanuts rather than direct fertilization of peanuts. The resulting lower direct inputs, in combination with the yield-enhancing benefits of crop rotation, could help assure the profitability of peanut production in Alabama.

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Mitchell and Adams, Department of Agronomy and Soils.

# PLANTING DATES, SEEDING RATES, AND SEED QUALITY

## Early Planting and Reduced Tillage Help Control Lesser Cornstalk Borer In Peanuts

T.P. Mack, H.W. Ivey, and L.W. Wells

THE HOT, dry growing season of 1990 was ideal for the lesser cornstalk borer (LCB). Population outbreaks of this insect pest of peanuts, sorghum, small grains, and soybeans are associated with hot and dry conditions. Although nothing can be done about the weather, results of Alabama Agricultural Experiment Station research suggest that early planting and reduced tillage can help reduce the problem.

Since population outbreaks usually develop in hot, dry weather, the potential exists for the reduction of lesser cornstalk borer damage to peanuts by altering planting dates so plants are less exposed to this type of weather. For example, by the time summer droughts occur, early planted peanuts would likely produce larger plants, making them less attractive to LCB than later planted peanuts. Tillage may also affect LCB population density by altering soil moisture and daily maximum soil temperatures.

A field study was begun at the Wiregrass Substation, Headland, in 1986 to determine if planting date and tillage practices affected LCB abundance. Florunner peanut seed were planted in 36-in. rows in a Dothan sandy loam soil. Herbicides were applied according to Cooperative Extension Service recommendations, and no insecticides were used. Each treatment plot was eight rows wide by 50 ft. long. Two planting dates were used (May 23 and June 11), along with three tillage systems (conventional, reduced tillage, and burned stubble).

The conventional tillage treatment was defined as turning and disking before planting. Reduced tillage involved planting peanuts into wheat stubble with a Ro-til® subsoiler and planter combination. The burned stubble treatment was similar to the reduced tillage except that the stubble was burned off before planting. This treatment was included because smoke attracts adult LCB moths.

The abundance of LCB larvae, which is the damaging stage, was monitored with pitfall traps. Two traps per plot were randomly placed in a selected central row within each plot. Traps were monitored weekly for most of the growing season.

Fewer larvae were caught in pitfall traps in the early planted, reduced tillage plots than in the conventional or burned stubble plots. This was especially evident for samples collected on July 15 and July 22, when 3.4 and 7.0 times more larvae, respectively, were caught in traps in conventionally tilled plots than in the reduced tillage plots. Daily maximum soil temperatures are usually lower in plots containing thick stubble, apparently because the stubble shades the soil. Since LCB larvae are subterranean and cold-blooded, their growth rate would be slowed by such temperature reduction.

The number of larvae caught per trap showed no difference among late planted tillage systems. This suggests that all plants were susceptible to LCB attack at this time. Larval populations were larger in late than in early planted peanuts, with a peak of 5.7 larvae per trap on July 25 in conventionally tilled plots.

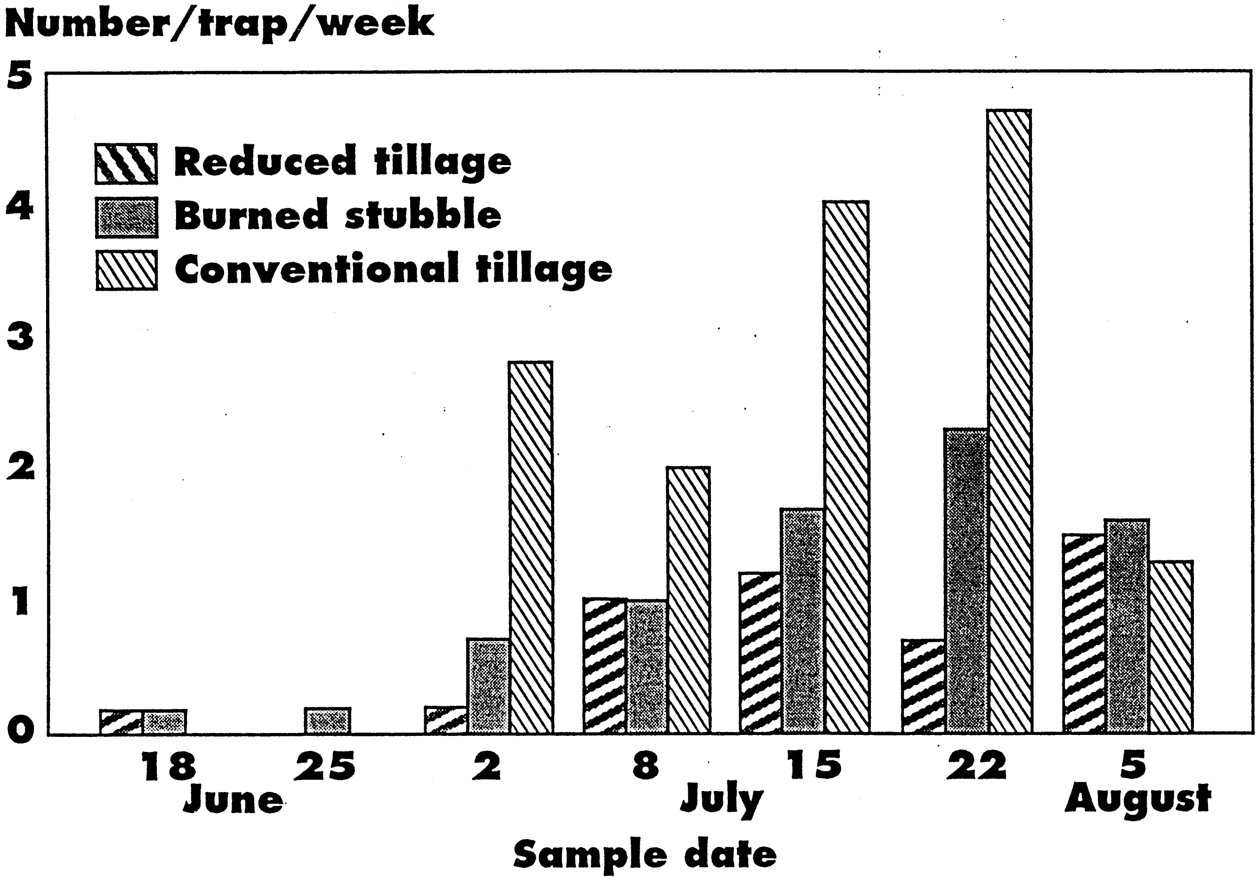
The early planting date yielded more peanuts than the late planting date, regardless of tillage system, 2,193 and 1,694 lb. per acre, respectively.

It is well known that the LCB is a hot and dry weather pest. In 1986, most of the hot weather occurred in July; 26 days had a daily maximum temperature of 95°F at Headland. The late planted peanut plants were smaller than the early planted peanuts because late planting was done during the drought. Thus, it should not be surprising that the late planted peanuts yielded significantly less than those that were planted early.

The month of May in Alabama typically has fewer hot days than June or July, so planting peanuts earlier to help avoid weather conducive to

LCB population outbreaks is probably a wise strategy. Reduced tillage at this time may also help reduce the abundance of this pest on peanuts, as indicated by the 1986 data.

Mack, Department of Entomology; Ivey and Wells, Wiregrass Substation.



Abundance of lesser cornstalk borer larvae in early planted peanuts.

## Peanut Performance and Disease Occurrence as Influenced by Planter and Seeding Rate

G.R. Wehtje, J.R. Weeks, M.S. West; L.W. Wells and P.F. Pace

IN RECENT years, "air" or "vacuum" planters have become available to peanut growers. These planters are advertised as being efficient in achieving an even spacing between seeds, and this added acurracy allows for a reduction in seeding rate compared to rates used with conventional planters, which would result in a cost savings.

An experiment was conducted in 1991 and 1992 at the Wiregrass Substation, Headland, to evaluate vacuum versus conventional planters. Peanuts were planted at 110, 90, 70, 50, and 30 lb. per acre with both type planters. The normal seeding rate is 90 to 100 lb. per acre. A common lot of peanut seed was used that averaged 750 seed per lb. Both planters were operated at four miles per hour.

Seed germination was about 70% in 1991, and 91% in 1992. Immediately after germination each year, the spacing between each of 20 consecutive seedlings was measured in a row that was deemed representative of the plot. These measurements were used to determine planter performance. Occurence of white mold and tomato spotted wilt virus (TSWV) was determined prior to harvest because the severity of these diseases has been linked to plant populations.

For all years and both planters, variation in seedling spacing increased as seeding rate decreased (see table). The study indicated that the normal seeding rates (less than or equal to 90 lb. per acre) allow seeds that are placed sufficiently close together to work cooperatively in opening (termed "cracking") the soil, allowing emergence. Thus, as the spacing between adjacent drops increased, this mutually-beneficial behavior was limited and consequently fewer seed emerged.

Both planters were successful in achieving a sufficient spacing between seedlings, but the conventional planter tended to have closer spacing, while the vacuum planter had wider spacing. Results also revealed that the incidence of white mold was influenced only by the seedling rate. The additional plant material and moisture-retaining canopy resulting from a higher seeding rate served to enhance the number of white mold infections. This phenomena was not influenced by type of planter. Similar results were obtained with (TSWV).

Across the entire experiment, yield was influenced by the seeding rate, but not by planter. Yields reached a maximum of 4,893 lb. per acre at a seeding rate of 90 lb. per acre. Yield with the 110-lb.-per-acre rate was slightly less (4,794 lb. per acre). Within each of the seeding rates, no yield benefit could be detected that indicated one planter offered an advantage over the other.

A vacuum planter does possess a more technologically advanced seed metering system. However, in peanuts under field operation, confounding factors such as seed viability and emergence renders any additional precision relative to that offered by the conventional planter nearly insignificant. These data serve to emphasize the importance of seeding rate in achieving maximum yield. Planter selection can not be seen as a means of reducing seeding rate.

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Wehtje Department of Agronomy and Soils; Weeks, Department of Entomology; West, Department of Research Data Analysis; Wells and Pace, Wiregrass Substation.

UNIFORMITY OF PLANT SPACING, OCCURRENCE OF DISEASE AND YIELD OF PEANUTS AS INFLUENCED BY SEEDING RATE AND PLANTER TYPE

| Seeding rate | Vacuum planter |  |  |  | Conventional planter |  |  |  |
|---|---|---|---|---|---|---|---|---|
|  | Plant spacing variability | White mold | TSWV | Yield | Plant spacing variability | White mold | TSWV | Yield |
| Lb./acre | Sd | Loci/ plot | Loci/ plot | Lb./acre | Sd | Loci/ plot | Loci/ plot | Lb./acre |
| 1991 |  |  |  |  |  |  |  |  |
| 30 ............................ | 8.2[1] | 3.3A[2,3] | 6.6A | 4,154B | 10.9 | 2.6B | 5.4A | 4,149B |
| 50 ............................ | 6.3 | 3.3A | 3.8B | 4,623A | 6.6 | 3.8AB | 3.7B | 4,647A |
| 70 ............................ | 4.1 | 3.6A | 2.6B | 4,823A | 3.8 | 3.9AB | 3.9B | 4,743A |
| 90 ............................ | 3.4 | 3.8A | 3.3B | 5,004A | 3.9 | 3.5AB | 1.5C | 4,901A |
| 110 .......................... | 3.0 | 4.5A | 2.5B | 4,890A | 3.4 | 4.1A | 2.6BC | 5,031A |
| Average .................. | 5.0 | 3.7 | 3.8 | 4,700 | 5.7 | 3.6 | 3.3 | 4,694 |
| 1992 |  |  |  |  |  | 7.3A |  |  |
| 30 ............................ | 5.1 | 7.0A | 5.6A | 4,558A | 6.5 | 8.3A | 6.5A | 4,340B |
| 50 ............................ | 3.5 | 8.9A | 6.3A | 4,632A | 4.1 | 8.5A | 4.3B | 4,626AB |
| 70 ............................ | 2.5 | 8.3A | 4.1B | 4,832A | 2.8 | 8.1A | 3.3B | 4,611AB |
| 90 ............................ | 2.1 | 8.8A | 3.6B | 4,881A | 2.6 | 9.1A | 3.8B | 4,787A |
| 110 .......................... | 1.9 | 9.2A | 3.1B | 4,647A | 2.0 | 8.3 | 3.9B | 4,606AB |
| Average .................... | 3.0 | 8.4 | 4.6 | 4,710 | 3.6 |  | 4.3 | 4,593 |
| 1991-92, pooled |  |  |  |  |  | 4.6A |  |  |
| 30 ............................ | 6.6 | 5.4A | 6.1A | 4,356C | 8.3 |  | 6.0A | 4,245B |

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[1] Indicates that standard deviation values between the two planters, within a common seeding rate, are significantly different according to an F test at the 5% level of probability.

[2] Means within a column followed by the same letter are equivalent according to Duncan's multiple range test at the 5% level of probability.

[3] Indicates that comparable mean values between the vacuum and conventional planter were different according to an LSD comparison at the 5% level.

# Extra Calcium is Needed for Peanut Seed

## D.L. Hartzog and J.F. Adams

PEANUT yields and grades are highly affected by the level of calcium in the soil. A calcium deficiency causes lower yields, reduces the percentage of sound mature kernels (SMK), and also decreases seed quality by inhibiting development of the plumule, which is essential for germination.

On-farm experiments in Alabama during the past two decades have defined the soil calcium concentration required for maximum yield and grade of Florunner peanuts. However, little work has been done to determine the calcium requirements for producing high quality seed. An Alabama Agricultural Experiment Station study was initiated to identify the soil calcium concentrations required for maximum yields and to demonstrate the role of supplemental gypsum in the production of high quality Florunner peanut seed.

Experiments were conducted at 13 sites from 1987 to 1989. Treatments included gypsum, topdressed over the row at the early bloom stage at 500 lb. per acre, and no gypsum. Farmers followed normal production practices, except for the use of gypsum and harvesting.

Yields were significantly increased when gypsum was added at the sites where soil calcium concentrations were less than 300 lb. per acre (see table). Yield did not increase for any experiment when soil test calcium concentrations of the check plots were more than 300 lb. per acre. An increase in grade was seen at most sites that experienced yield increases from the added gypsum.

Gypsum topdressing at early bloom generally increased seed calcium concentrations, even on soils testing high in calcium. Seed calcium concentrations ranged from 210 to 500 parts per million (ppm) for check plots and 198 to 622 ppm for gypsum-treated plots. Only two sites did not show increased seed calcium concentration when gypsum was applied.

Results of a standard germination test showed that seed germination ranged between 55% and 99%. Supplemental gypsum either had a positive effect or no effect on germination. Germination increased due to gypsum at each site that had an increase in yield from gypsum. Higher germination rates also were observed at five additional sites where no yield increases were seen. Maximum germination was achieved at a seed calcium concentration of 414 ppm, as shown in the figure.

These experiments suggest that more soil calcium is needed to produce high quality seed than is needed to achieve maximum yield.

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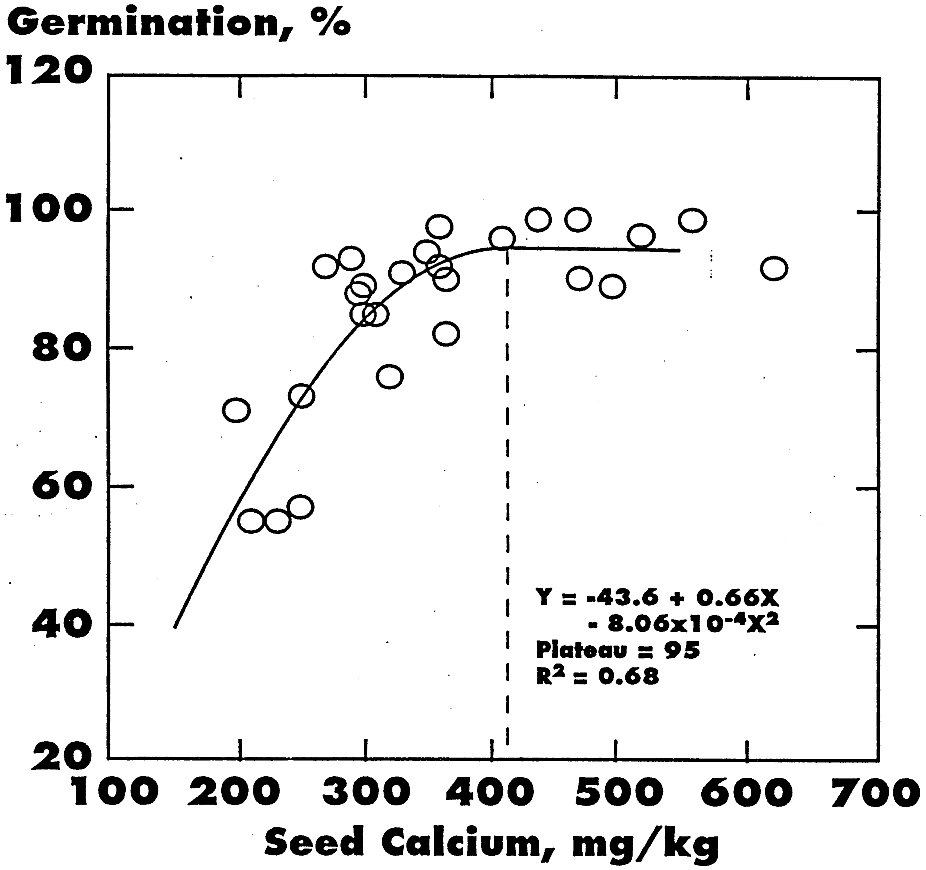
Hartzog and Adams, Department of Agronomy and Soils.

EFFECT OF TOPDRESSING WITH GYPSUM ON YIELD, SMK, SEED CA CONCENTRATION, AND GERMINATION OF FLORUNNER AT 13 SITES FROM 1987 TO 1989

| Site No. | Soil Ca | Yield | | SMK | | Seed Ca | | Germination | |
|---|---|---|---|---|---|---|---|---|---|
| | | No gyp | Gyp | No gyp | Gyp | No gyp | Gyp | No gyp | Gyp |
| | *Lb./acre* | *Lb./acre* | *Lb./acre* | *Pct.* | *Pct.* | *ppm* | *ppm* | *Pct.* | *Pct.* |
| 1 | 96 | 589 | 2,705* | 64 | 76* | 231 | 198 | 55 | 71* |
| 2 | 120 | 2,607 | 3,420* | 78 | 78 | 248 | 320* | 57 | 76* |
| 3 | 150 | 2,643 | 3,571* | 67 | 73* | 250 | 330* | 73 | 91* |
| 4 | 184 | 3,107 | 3,580* | 59 | 59 | 270 | 360* | 92 | 98* |
| 5 | 226 | 2,188 | 3,125* | 64 | 68* | 210 | 300* | 55 | 85* |
| 6 | 316 | 5,616 | 5,438 | 78 | 77 | 310 | 365 | 85 | 92 |
| 7 | 402 | 1,821 | 2,018 | 59 | 61 | 360 | 470* | 92 | 99* |
| 8 | 418 | 3,446 | 3,375 | 69 | 69 | 500 | 520 | 89 | 97* |
| 9 | 428 | 3,286 | 3,071 | 67 | 68 | 290 | 350* | 93 | 94 |
| 10 | 436 | 3,464 | 3,357 | 78 | 78 | 473 | 622* | 90 | 92 |
| 11 | 446 | 2,643 | 2,661 | 68 | 68 | 410 | 560* | 96 | 99* |
| 12 | 474 | 3,180 | 3,420 | 74 | 75 | 300 | 440* | 89 | 99* |
| 13 | 484 | 4,152 | 4,366 | 78 | 78 | 296 | 366* | 88 | 94* |

*Treatments are significantly different.



Germination response to seed calcium.

# DISEASES

## Application of Fungicides to Peanuts Through Irrigation Systems

### P.A. Backman, M.A. Crawford, and E.W. Rochester

RECENT droughts have convinced many farmers to purchase irrigation equipment for their peanut fields. Planning for this expenditure should encompass not only available water supply, pumping capacity, and probable yield increases, but should also include peripheral advantages that can be gained by having an irrigation system.

One of the less obvious advantages of irrigation equipment is the ability to utilize the irrigation system to deliver pesticides along with the irrigation water. Best suited for applying pesticides are systems with uniform application, such as pivots, side-roll, lateral-move, and some solid-set systems. Traveler systems are not as suited for applying pesticide because of irregularities in their watering patterns.

For applying fungicides and other pesticides, the irrigation system should be equipped with a pesticide pump capable of accurately delivering the product and a foot valve to prevent back-flow of these materials into the water source.

Since 1976, experiments have been conducted at the Alabama Agricultural Experiment Station's Wiregrass Substation, Headland, to determine if fungicides could be injected into irrigation lines to control peanut leafspot and/or white mold (stem rot). Data from the last three years are presented in this report.

The fungi causing peanut leafspot are difficult to control and only a few fungicides are recommended. Late leafspot is the most difficult to control, primarily because it produces spores in large numbers on the lower leaf surface. It is difficult to apply fungicides to this area even with a well set-up ground sprayer. In Table 1, results illustrate leafspot control tests, with comparisons between Bravo 500® applied with a ground sprayer and Bravo 500 applied through-the-line (TTL), both at 2 1/8 pt. per acre. The 1978 test utilized a stationary gun system; the 1979 and 1980 tests were conducted using a pivot irrigation system. For comparison, plots receiving fungicides applied with a ground sprayer were always located in an area under the same irrigation system.

Results indicate that leafspot was usually slightly more severe in plots receiving Bravo through the irrigation system; however, yields for TTL Bravo plots were increased. Published information indicates that less than 10% of the Bravo applied TTL is retained on the foliage, the rest is washed to the soil. TTL application of leafspot fungicides does a better job of treating the lower leaf surface because of the huge volume of water applied, resulting in a total wetting of the leaf. This may partially compensate for the low amount of fungicide retained by the leaf. Increased yields from TTL-applied Bravo may result from less equipment damage (eight fewer tractor trips), or from Bravo affecting pod and root diseases.

A similar system was used to apply fungicides for control of white mold, except that only two applications were made. The first application (2 1/2 gal. Terraclor 2EC® or 2 1/2 pt. Vitavax 3F®) was made in mid-July, and the second was made at the same rate three weeks later. All plots were also treated with Bravo to control leafspot; in the 1978 and 1979 tests, Bravo was applied TTL. Evaluation of treated plots indicated good control of white mold in all years, with yield increases in two of three years (Table 2).

These data indicate that applying fungicides through the irrigation system is effective in controlling peanut diseases. Further, this method is more economical since it does not require tractors, spray rigs, or operators. State labels [Alabama 24(c)] have been granted for the application of Bravo TTL for peanut leafspot control and for Terraclor TTL for white mold control. Delivery of some herbicides and Sevin® by this method also is effective.

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Backman and Crawford, Department of Plant Pathology; Rochester, Department of Agricultural Engineering.

TABLE 1. COMPARISON OF EFFECTS OF FUNGICIDES APPLIED THROUGH THE IRRIGATION SYSTEM (TTL) AND BY GROUND SPRAYER ON PEANUT LEAFSPOT AND YIELD

| Bravo applications | Yield (lb. per acre) | | | Infected leaves | | | Leaves lost | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1978 | 1979 | 1980 | 1978 | 1979 | 1980 | 1978 | 1979 | 1980 |
| | | | | *Pct.* | *Pct.* | *Pct.* | *Pct.* | *Pct.* | *Pct.* |
| None | 3,194 | 2,392 | 2,805 | 57 | 62 | 68 | 20 | 37 | 40 |
| Bravo TTL[1] | 4,041 | 4,075 | 4,268 | 40 | 41 | 38 | 18 | 24 | 30 |
| Bravo ground | 3,823 | 3,853 | 3,188 | 21 | 15 | 61 | 12 | 9 | 36 |

[1] TTL = through-the-line application technique.

TABLE 2. EFFECTS OF FUNGICIDES APPLIED THROUGH THE IRRIGATION SYSTEM ON INCIDENCE OF WHITE MOLD AND YIELDS

| Bravo applications | Yields (lb. per acre) | | | White mold hits per 100 ft. row | | |
|---|---|---|---|---|---|---|
| | 1978 | 1979 | 1980 | 1978 | 1979 | 1980 |
| None | 4,219 | 4,075 | 4,268 | 10.5 | 14.0 | 9.9 |
| Bravo TTL[1] | 4,503 | 4,897 | 4,290 | 5.0 | 2.7 | 8.2 |
| Bravo ground | --- | 4,679 | 4,189 | --- | 1.7 | 5.6 |

## Disease Reduced by Management of Southern Runner Peanuts

## J.C. Jacobi, P.A. Backman, and L.W. Wells

**FUNGICIDES** provide good control of leafspot on peanuts and some control of other peanut diseases. The downside is that leafspot control alone may cost $50-$60 per acre. Tests by the Alabama Agricultural Experiment Station (AAES) indicate that alternative management practices and a new peanut variety, Southern Runner, may cut production costs in fields with historically high levels of peanut diseases.

Florunner is by far the most popular peanut variety grown in the Southeast, because of its high yield potential and other beneficial qualities. However, it is highly susceptible to leafspot, white mold, and limb rot. Since the release of Southern Runner by the University of Florida, AAES research has been developing a reduced input fungicide program to take advantage of the new variety's reported resistance.

Tests at the Wiregrass Substation, Headland, compared reduced rates of Bravo®, longer intervals between Bravo applications, and the use of less expensive and less effective fungicides on both Southern Runner and Florunner peanuts. Yields of Florunner peanuts decreased more sharply than Southern Runner when the rate of Bravo was decreased from 1.1 lb. (1 1/2 pt.) to 0.55 lb. (3/4 pt.) and when harvest was delayed 14 days beyond optimum harvest date (Table 1). The table also shows that the amount of defoliation was similar in the two varieties; however, Southern Runner apparently tolerated leaf loss better, based on comparative yield loss.

Southern Runner has a more compact growth habit than Florunner and produces more secondary branches. Neither cultivar received any fungicide, yet Southern Runner, due to increased branching, had a relatively healthy looking canopy compared to Florunner, which was nearly defoliated. Delaying harvest produced greater yield loss in Florunner than in Southern Runner, especially at high levels of defoliation. The ability of Southern

Runner to maintain yield could become important when adverse weather delays harvest.

Over the past three years, Southern Runner has averaged 65% less white mold damage than Florunner in tests at Headland (Table 2). Observations of the two varieties indicate Southern Runner is less susceptible to tomato spotted wilt virus, but no differences were detected in limb and pod rot.

These tests indicate Southern Runner can be managed for peanut leafspot less intensively without significant yield loss, and it is less susceptible to white mold. It can be a good choice in fields where serious leafspot or white mold damage is expected. However, Southern Runner is a later maturing variety, requiring about 10 days longer than Florunner to reach harvest maturity.

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Jacobi and Backman, Department of Plant Pathology; Wells, Wiregrass Substation.

TABLE 1. EFFECTS OF FULL SEASON SPRAY PROGRAM ON YIELD AND LEAFSPOT SEVERITY OF SOUTHERN RUNNER AND FLORUNNER PEANUTS, THREE-YEAR AVERAGE

| Treatment[1] | Yield/acre at: Optimum harvest date | Yield/acre at: Harvest delayed 14 days | Leafspot defoliation[2] |
|---|---|---|---|
| | *Lb.* | *Lb.* | *Pct.* |
| Florunner | | | |
| Bravo, 0.55 lb. | 2,757 | 2,666 | 44.7 |
| Bravo, 1.1 lb. | 2,868 | 2,672 | 36.0 |
| Manzate, 1.5 lb. | 2,649 | 2,114 | 53.0 |
| Southern Runner | | | |
| Bravo, 0.55 lb. | 3,124 | 3,344 | 46.1 |
| Bravo, 1.1 lb. | 3,179 | 3,106 | 31.8 |
| Manzate, 1.5 lb. | 3,143 | 2,837 | 51.2 |

[1] All rates are in pounds active ingredient per acre.
[2] Defoliation rated prior to harvest.

TABLE 2. INCIDENCE OF WHITE MOLD AND LIMB ROT IN PLANTING OF FLORUNNER PEANUTS, THREE-YEAR AVERAGE

| Treatment[1] | White mold hits/80 row-ft. |
|---|---|
| Florunner | |
| Bravo, 0.55 lb. | 8.1 |
| Bravo, 1.1 lb. | 11.1 |
| Manzate, 1.5 lb. | 9.9 |
| Southern Runner | |
| Bravo, 0.55 lb. | 3.1 |
| Bravo, 1.1 lb. | 3.3 |
| Manzate, 1.5 lb. | 3.7 |

[1] All rates are in pounds active ingredient per acre.

# New Biological Seed Treatment Fungicide Increases Peanut Yields

## P.A. Backman, J.T. Turner, M.A. Crawford, and R.P. Clay

SEED treatment fungicides have been a standard component of peanut disease control recommendations for many years. These fungicides are applied to prevent seedborne fungi from rotting the seed, and to protect the emerging seedling from fungi living in the soil. However, they provide virtually no benefit beyond two weeks after planting.

Alabama Agricultural Experiment Station (AAES) studies have been conducted to evaluate a new seed treatment that contained a bacterium called *Bacillus subtilis*. Results of the study showed that farmers who used the bacteria-treated seed had average yield increases of more than 8%. Furthermore, yield increases were more than 15% for 17% of the farmers.

When the AAES study began in 1980, peanut seed treated with this product produced seedlings that emerged sooner and lapped the row sooner than did plants developing from seed treated with the traditional chemical fungicides. In addition, the bacteria could be mixed with chemical seed treatments without being killed, and the commercial product had excellent shelf life, unlike the nitrogen-fixing bacteria.

In 1982, researchers began to better understand what was happening to the more vigorous peanut plants. Early emergence was probably a growth response to a hormone produced by the bacteria. However, the faster growth of plants and the yield increases were probably because of healthier roots (Table 1). The bacteria were found growing on the roots throughout the life of the peanut plants, while the peanut plant itself had a healthier root system with less *Rhizoctonia* and *Fusarium* damage. The *Bacillus subtilis* organism applied to the seed is known to produce several antibiotics. The antibiosis that probably results following successful root colonization, plus the competition with pathogens for growth sites, apparently serves to protect the peanut root system from several root-rotting fungi. Improved yields are caused by these healthier roots.

Studies were conducted during 1982 and 1983 to determine which peanut farmers would benefit from this bacterization procedure, and how often this would translate into a significant economic benefit. These comparisons were made throughout the Southeast with randomly selected farmers growing treated seed (bacteria plus standard seed treatment fungicide) in side-by-side comparison with seed treated only with the standard fungicide.

Results of this experiment indicated that approximately 60% of the farmers who used the bacteria-treated seed had yield increases of more than 5%, while 17% of the farmers had yield increases of more than 15% (Table 2). When all of the approximately 24 locations were averaged, the yield increase for *Bacillus*-treated peanuts was 8.3%. Only one case of a reduced yield was reported. Farmers who grew either peanuts or soybeans in either of the previous two crop years averaged 12.3% increases in yield, while farmers who had no history of these crops in the previous two years reported only a 3.4% yield improvement.

The bacterial preparation, which will be marketed under the name Kodiak®, was remarkably capable of colonizing peanut roots. All treated seed resulted in successfully colonized roots. Lack of yield response was caused by lower levels of fungal disease on the root systems of nontreated plants, not by lack of colonization. Peanuts that showed an obvious vigor response almost always recorded considerably improved yields. However, many peanut tests that did not show vigor differences still resulted in improved yields for the *Bacillus*-treated peanuts.

Peanut fields most likely to benefit from the practice are those that have two-year or less rotations of peanuts or soybeans or both. If peanuts are planted before May 10 on these poor rotations, yield improvements will be even more pronounced. *Bacillus subtilis* is presently sold for use on peanuts and cotton under the tradenames Kodiak and Quantum®.

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Backman, Turner, Crawford, and Clay, Department of Plant Pathology.

TABLE 1. EFFECTS OF BACTERIA APPLIED TO SEED ON ROOT DISEASE AND YIELD OF PEANUTS, 1982

| Strain | Root rot[1] | Yield/ acre | Increase |
|---|---|---|---|
| | | *Lb.* | *Pct.* |
| No bacteria | 2.45 | 2,171 | — |
| *Bacillus subtilis* | | | |
| No antibiotic | 2.68 | 2,264 | + 4.2 |
| Antibiotic producer | 2.14 | 2.541 | +17.0 |

[1] Scale of 1 to 5: 1 = no disease, 2 = 25% rotted, 3 = 50% rotted, 4 = 75% rotted, and 5 = 100% rotted.

TABLE 2. YIELD EFFECTS OF PEANUT SEED TREATED WITH *BACILLUS SUBTILIS* SPORES AND FUNGICIDE AS COMPARED TO FUNGICIDE ALONE, 1983

| Previous date | Legumes in either of previous 2 years | No legumes in previous 2 years |
|---|---|---|
| Early | (6)[1] | (2) |
| (before May 10) | + 15.2% | + 3.0% |
| Late | (5) | (3) |
| (after May 10) | + 8.7% | + 3.7% |
| Weighted | (11) | (5) |
| average[2] | + 12.3% | + 3.4% |

[1] ( ) parentheses indicate number of locations fitting the description.

[2] At eight other locations there was a 6.3% increase in yield following bacterization by *Bacillus subtilis*.

## SM-9 Spray Adjuvant and Control of Southern Stem Rot of Peanuts

### A.K. Hagan and J.R. Weeks

**IN LATE** winter 1992, the spray adjuvant SM-9 was being marketed to Alabama peanut producers for the control of white mold and several other destructive diseases of peanut. Claims of white mold control were based solely on a single laboratory study and several farmer testimonials. Extensive field research information documenting the activity of SM-9 against any peanut disease does not exist. Finally, SM-9 is not registered as a pesticide in accordance with the requirements of FIFRA and can only be marketed as a surfactant. A study was conducted to determine if SM-9 spray adjuvant had any effect on white mold and yield of peanuts.

Trials were conducted in two rain-fed fields in Henry County that had a history of white mold damage. Florunner peanuts were planted in late April and maintained according to Alabama Cooperative Extension Service recommendations. Fungicides were applied by hand using a backpack sprayer on the dates listed in the table. Hit counts were made the day after digging, and the plots were harvested with a combine.

SM-9 spray adjuvant did not protect peanuts from white mold. The numbers of white mold hits were similar in the plots treated with SM-9 and the nontreated control plots. On the other hand, two or four sprays of Folicur® and a single application of Moncut® gave excellent disease control. In addition, considerable foliar burn on the newer peanut leaves was seen in both fields after each application of SM-9. No damage to the foliage was seen in the plots sprayed with Folicur or Moncut.

Yields from the SM-9 treated plots also were similar to those from the nontreated plots. Yields from all other fungicide-treated plots were considerably higher than those in the SM-9 or nontreated control plots. Greatest yield increases occurred in the plots treated with two or four applications of Folicur or a single application of Moncut.

In this trial, SM-9 surfactant had no effect on white mold or on peanut yield. Based on these results, Alabama peanut growers are advised not to use SM-9 as an alternative to registered products for the control of white mold on peanuts. EPA registration of Folicur and Moncut for the control of white mold on peanut is pending. Both of these fungicides were very effective and should have significant impact on peanut yields in fields with a history of serious white mold damage.

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Hagan, Department of Plant Pathology; Weeks, Department of Entomology.

EFFECT OF SM-9, MONCUT, AND FOLICUR ON WHITE MOLD AND YIELDS OF PEANUTS, 1992

| Treatment and rate/acre | Spray date(s) | No. hits/100 row ft. | Yield lb./acre |
|---|---|---|---|
| Folicur 3.6F, 8 fl. oz. | July 27 | 8.1 | 3,729 |
| Folicur 3.6F, 8 fl. oz. | July 14, July 27 | 2.1 | 4,584 |
| Folicur 3.6F, 8 fl. oz. | July 1, July 14<br>July 27, Aug. 4 | .3 | 4,579 |
| Moncut 50W, 2 lb. | July 14 | 1.9 | 4,469 |
| SM-9, 1 pt. | July 1, July 14<br>July 27, Aug. 4 | 17.3 | 2,923 |
| Nontreated control | ----- | 19.4 | 3,236 |
| LSD (P=0.05) | | 3.2 | 355 |

## Fungicide-Nematicide Seed Treatment Combinations: Results and Potentials

### P.A. Backman and R. Rodríguez-Kábana

**TO CONTROL** nematodes, row crop farmers in the Southeast routinely apply nematicides as a separate operation at planting time. In addition, peanut farmers apply systemic insecticides in planting furrows for thrips control. The development of a technique for the simultaneous application of nematicide, insecticide, and fungicide-treated seed would reduce farm operations and resultant soil compaction.

Studies were conducted through the Alabama Agricultural Experiment Station to develop a treatment that could provide control of seedling disease, early-season insects, and nematodes with a minimal amount of labor and chemical inputs.

Tests were conducted on Florunner peanuts using several systemic nematicides or insecticides. Treatment rates were adjusted to deliver in-furrow rates of approximately 0.5 lb. per acre using the seed as the vehicle (Table 1).

Furadan® and Nemacur® depressed emergence only slightly, and peanuts in general (Table 2) showed very little phytotoxicity. Although nematodes were not a problem in the peanut test area, thrips damage was assessed and found to be sharply reduced in the presence of Orthene® or DS-15647® (Table 2). For both chemicals, however, higher levels of phytotoxicity were observed than for Furadan.

These data indicate that nematicides can be coated on seed without excessive damage to the seed and seedling, and that biologically active rates of nematicides can be coated onto the seed and still be compatible with seed treatment fungicides. These studies have revealed treatments that are good nematicides and others that are good insecticides. As yet, the combination effect has not been achieved.

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Backman and Rodríguez-Kábana, Department of Plant Pathology.

TABLE 1. EFFECTS OF FUNGICIDE-NEMATICIDE COMBINATIONS ON PEANUT SEEDLING EMERGENCE

| Nematicide used, rate/acre | Emergence | |
|---|---|---|
| | 1973 | 1974 |
| Fungicide only | 58.5 | 56.0 |
| Furadan 75, 225 g | 54.6 | 52.2 |
| Nemacur 95% tech., 250 ml | 53.3 | 52.5 |
| DS-15647, 160 ml | ---- | 47.3 |
| Orthene 80 SD, 132 g | ---- | 38.5 |

TABLE 2. EFFECTS OF NEMATICIDES IN COMBINATION WITH SEED FUNGICIDES ON SEEDLING EMERGENCE, NEMATODE POPULATIONS, AND THRIPS DAMAGE IN FLORUNNER PEANUTS

| Nematicide used, rate/acre | Emergence | Total nematodes[1] | Thrips[2] |
|---|---|---|---|
| | *Pct.* | | |
| Fungicide only | 56.0 | 187 | 4.3 |
| Furadan 75, 225 g | 52.2 | 131 | 3.8 |
| Nemacur tech., 250 ml | 52.5 | 86 | 3.2 |
| Orthene 80 SD, 160 ml | 38.5 | 147 | 1.4 |
| DS-15647, 132 g | 47.3 | 145 | 2.0 |

[1] Total nematodes per pint of soil from root region.

[2] Severity rating from 1 = no damage to 5 = severe leaf cupping and chlorosis.

## Peanut Foliar Fungicides: Relationships Between Leafspot Control and Kernel Quality

## J.M. Hammond, P.A. Backman, and J.A. Lyle

THE EFFECTIVENESS of foliar fungicides for control of peanut leafspot was evaluated from 1971 to 1974 through the Alabama Agricultural Experiment Station.

Benlate®, Bravo®, Duter®, and Kocide 404-S® were applied at recommended rates using a conventional ground sprayer at 14-day intervals. Leafspot severity was rated by determining percent defoliation and infections. All fungicide-treated plots had less defoliation and infection than the nontreated control plots (Table 1). Kernel quality was determined using Federal-State Inspection Service procedures. Plots sprayed with Bravo had slightly better quality kernels than those from any other fungicide treatment. However, kernels harvested from the nontreated control plots had significantly better quality than those from the

Bravo treatment. Kernels harvested from the Benlate and Kocide 404-S treatments were slightly inferior in quality compared to the Bravo treatment, although not significantly. Kernels from the Duter-treated plots were significantly inferior in quality to those from plots treated with other fungicides (Table 2).

These data indicate two possible mechanisms for kernel quality effects: (1) maintenance of a complete foliar canopy and (2) a direct toxin action effect of the fungicide on soilborne fungi. The maintenance of a relatively complete foliar canopy made at least three major changes in the ecology of soilborne fungi: (1) fewer leaves were lost to the soil surface to serve as an organic food source; (2) pesticides were filtered from the soil surface by the "umbrella effect" of the canopy; and (3) an altered subcanopy environment was created that may stimulate certain soilborne fungi.

If a direct toxin action of the fungicide on soilborne fungi was responsible for the deterioration of kernel quality, one would expect kernels of superior quality from plots where the fungicide exhibited toxicity to the pathogenic fungi, but little or no effect on the natural antagonists. Inferior quality kernels would be found in plots where fungicides exhibited toxicity to the antagonists, but with little or no effect on the quality deteriorating pathogens. Several observations support this hypothesis. First, similar levels of defoliation were obtained when Benlate, Duter, and Kocide 404-S were used to control leafspot (Table 1). However, use of Duter resulted in significantly inferior kernels when compared to the other two fungicides giving similar leafspot control (Table 2). Secondly, when values for kernel quality were examined, the control had a significantly higher dollar value per ton than any of the fungicide treatments.

If peanuts from the control plots are of better quality and a true inverse relationship exists between leaf maintenance and kernel quality, the Benlate- or Kocide-treated plots, which had the least defoliation, should have the most inferior kernel quality of the fungicide-treated plots. Peanuts from Benlate and Kocide-treated plots were not significantly inferior in quality to peanuts from Bravo-treated plots.

A third indication that a toxic action of the fungicides altered the geocarposphere was observed with the fungicide Benlate. Benlate was extremely effective as a leafspot control fungicide in 1971 and 1972. However, in 1973, the pathogen developed resistance to this fungicide and during the 1974 season disease severity in the Benlate-treated plots was nearly equal to that of the control (Table 1). Comparisons of quality data for Benlate-treated plots over the four-year period showed no improvement in kernel quality as defoliation levels increased (Table 2). While not conclusive, these observations indicate that a direct toxic effect of a fungicide on a natural antagonist (or pathogen) is more important to kernel quality than the degree of leaf maintenance and the canopy, although they are interrelated.

It is important to realize that even though regular fungicide treatments for control of leafspot result in inferior quality peanut kernels, the tremendous yield increase resulting from the use of these fungicides dictates their continued use in the Southeast (Table 3).

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Hammond, Backman, and Lyle, Department of Plant Pathology.

TABLE 1. DEFOLIATION LEVEL (%) OF *ARACHIS HYPOGAEA* L. CAUSED BY *CERCOSPORA* SP. IN LEAFSPOT CONTROL TEST, 1971-1974

| Treatment | 1971 | 1972 | 1973 | 1974 | |
|---|---|---|---|---|---|
| Control | 79.9a | 53.0a | 44.0a | 64.4c | 59.3a |
| Bravo 54 F | 43.4c | 6.4d | 5.8bc | 15.0d | 22.7c |
| Benlate 50 WP | 24.8d | 5.3d | 6.1bc | 55.1b | 17.5d |
| Duter 47 WP | 50.2bc | 18.5b | 12.4b | 33.1d | 30.3b |
| Kocide 404-S (27 + 15) F | 56.3b | 12.1c | 2.6c | 18.7d | 20.7cd |

Values within columns followed by the same letter are not significantly different at the 5% level using Duncan's Multiple Range Test.

TABLE 2. KERNEL QUALITY VALUES OBTAINED FROM PEANUT (*ARACHIS HYPOGAEA* L) LEAFSPOT CONTROL TEST, 1971-1974

| Treatment | Rate/acre | 1971 | 1972 | 1973 | 1974 | X |
|---|---|---|---|---|---|---|
| | | Dol. value/ton | | | | |
| Control | 0.0 | 304.90 | 296.73 | 298.60 | 409.43 | 327.03a |
| Bravo 54 F | 1.5 pt. | 301.40 | 290.92 | 277.21 | 398.45 | 316.56b |
| Benlate 50WP | 6.0 oz. | 297.32 | 281.66 | 268.55 | 268.55 | 310.64b |
| Duter 47 WP | 6.0 oz. | 298.87 | 284.79 | 239.68 | 239.68 | 298.33c |
| Kocide 404-S (27 + 15) F | 2.0 qt. | 301.15 | 299.27 | 291.63 | 291.63 | 312.94b |

Values within columns followed by the same letter are not significantly different at the 5% level of probability using Duncan's Multiple Range Test.

TABLE 3. YIELD, QUALITY, AND VALUE PER ACRE OBTAINED FROM PEANUT LEAFSPOT CONTROL TESTS, 1971-1974

| Treatment | Rate/ acre | Yield/ acre | Value/ ton | Value/ acre |
|---|---|---|---|---|
| | | *Lb.* | *Dol.* | *Dol.* |
| Control | 0.0 | 2,558d | 327.03a | 418.27d |
| Bravo 54F | 1.5 pt. | 3,889a | 316.56b | 615.55a |
| Benlate 50WP | 6.0 oz. | 3,286c | 310.64b | 510.38c |
| Duter 47WP | 6.0 oz. | 3,433bc | 298.33c | 512.08b |
| Kocide 404-S (27 + 15) F | 2.0 qt. | 3,592b | 312.94b | 561.88b |

Values within columns followed by the same letter are not significantly different at the 5% level of probability using Duncan's Multiple Range Test.

## Control of Peanut Soilborne Diseases May Afford Yield Breakthrough

### P.A. Backman

**IMPROVED** management practices by Alabama growers have increased state peanut yield averages by almost 1,500 lb. per acre since 1970, to a current level of nearly 3,000 lb. per acre. Despite this increase, yield losses of 20-30% to soilborne diseases, such as white mold, limb rot, pod rot, and root rot, still occur statewide. Currently, available fungicides provide only 40-60% control of these diseases, but Alabama Agricultural Experiment Station tests indicate more promising materials are on the way for peanut growers.

Spotless® and Folicur®, nonlabeled triazole fungicides, have provided leafspot control similar to Bravo® for several years, when applied in a season-long schedule. Because of their activity on fungi that cause white mold, limb rot, pod rot, and root rot, peanuts from fields treated with Spotless and Folicur routinely outyielded peanuts from Bravo-treated fields by 400 to 1,200 lb. per acre.

Since development of fungicide tolerant strains of fungi has occurred where other triazole fungicides have been used, Auburn researchers also evaluated alternative treatment schedules that will allow growers to benefit from soilborne disease control from the triazole materials, but also utilize Bravo during times of the season when leafspot is the only problem. Additional benefits are to delay development of resistance to the triazoles and to reduce the overall cost of the fungicide program. Bravo is likely to be less expensive than the new triazole fungicides.

Research on midseason applications of Spotless and Folicur indicate that both fungicides do an excellent job of controlling white mold, either when banded as granules over the row or directed-sprayed onto the crown of the peanut plant (Table 2). Since the product is delivered in a narrow band where white mold is most active, disease control is achieved at lower use rates than when the same products are applied broadcast with a leafspot sprayer.

Flutolonil (Moncut®) is a relatively new compound that may have experimental use registration in 1994. When used for soilborne disease control, this product can be mixed with Bravo and applied with a leafspot sprayer, can be banded sprayed as was done with the triazoles, or can be applied as a granule. Unlike the triazole fungicides, there is no effect on peanut leafspot. In all cases, it has been highly effective in controlling white mold and suppressing the Rhizoctonia-induced diseases. Yields have often been improved by more than 1,000 lb. per acre in fields with only moderate disease severity (Table 3).

All of the fungicides tested and reported here have activities to several soilborne diseases. It is not always possible to quantify their impact on each disease nor to tell if these represent all of the fungi that are being controlled. These fungicides are highly active on a group of fungal diseases that are largely ignored by peanut farmers in the Southeast. These new fungicides should dramatically increase the profitability of peanut production, despite an estimated $30 to $40 per acre cost.

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Backman, Department of Plant Pathology.

TABLE 1. EFFECTS OF FULL-SEASON SPRAY PROGRAMS ON PEANUT YIELDS AND WHITE MOLD

| Treatment[1] | Yield, lb./acre | | | | | White mold (hits/40 ft. row) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1984 | 1985 | 1986 | 1987 | Av. | 1984 | 1985 | 1986 | 1987 | Av. |
| Bravo, 1.1 lb. | 4,737 | 3,666 | 3,763 | 2,459 | 3,656 | 7.0 | 2.0 | 5.7 | 18.0 | 8.2 |
| Spotless, 0.12 lb. | 5,944 | 4,167 | 4,054 | 3,497 | 4,415 | .7 | 1.0 | 2.8 | 3.7 | 2.1 |
| Folicur, 0.22 lb. | 5,917 | 4,589 | 4,380 | 3,545 | 4,608 | .2 | .3 | 4.0 | 6.3 | 2.7 |

[1] All rates in lb. active ingredient per acre.

TABLE 2. EFFECTS OF ONE APPLICATION OF FUNGICIDES[1] AT TWICE THE RATE USED FOR CONTROL OF PEANUT LEAFSPOT

| Treatment | Yield, lb./acre | | | | Soilborne diseases | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 1985 | | 1986 | | 1987 | |
| | 1985 | 1986 | 1987 | Av. | White mold | Pod rot | White mold | Pod rot | White mold | Pod rot |
| No treatment | 2.650 | 2,750 | 3,001 | 2,800 | 6.5 | 3.6 | 6.2 | 4.0 | 10.2 | 3.3 |
| Terraclor, 10 lb. | 3,129 | 3,513 | 3,448 | 3,363 | 6.0 | 3.5 | 3.0 | 2.9 | 4.2 | 2.9 |
| Spotless, 0.25 lb. | 4,015 | 3,436 | 4,144 | 3,865 | .8 | 3.0 | 4.0 | 2.9 | 2.4 | 2.7 |
| Folicur, 0.44 lb. | 3,583 | — | — | 3,583 | 1.5 | 2.4 | — | — | — | — |

[1] Applied in a 12- to 16-in. band at pegging over the row, using either a granule or directed (crown) spray.

TABLE 3. YIELD RESPONSE OF PEANUTS FOLLOWING TREATMENT WITH FLUTOLONIL FUNGICIDE

| Treatment[1] | Yield, lb./acre | | | | White mold (hits/40 ft. row) | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1985 | 1986 | 1987 | Av. | 1984 | 1985 | 1986 | 1987 | Av. |
| No treatment | 2,920 | 2,520 | 3,001 | 2,814 | 4.0 | 5.1 | 13.5 | 11.5 | 8.5 |
| Terraclor, 10 lb. | 3,294 | 3,513 | 3,448 | 3,418 | 2.7 | 1.9 | 6.2 | 3.9 | 3.7 |
| Flutolonil, 1.0 lb. | 3,219 | 3,775 | 4,586 | 3,860 | 1.1 | 1.9 | 5.7 | 3.0 | 2.9 |
| Flutolonil, 2.0. lb. | 3,763 | 3,674 | 4,876 | 4,104 | 1.0 | 1.5 | 5.8 | 1.0 | 2.4 |

[1] All rates in lb. active ingredient per acre.

# Viruses Infecting Peanuts

**R.T. Gudauskas, K.B. Burch, P. Jin, A.K. Hagan, and J.R. Weeks**

A STUDY was conducted from mid-July to mid-August in 1990 and 1991 to determine the identity and distribution of the major virus pathogens of peanuts in Alabama. Leaves from peanut plants showing virus-like symptoms were collected from fields selected at random in the 14 counties making up the major peanut production area. Symptoms on suspect virus-infected plants included leaf chlorosis, mottling, necrosis, line patterns, and distortion, as well as overall plant stunting. Leaf samples also were taken in most of these same fields from plants showing no apparent symptoms. Sap was extracted from all samples and tested for peanut mottle virus (PMV), peanut stripe virus (PStV), peanut stunt virus (PSV), and tomato spotted wilt virus (TSWV) by bioassays on indicator plants in the greenhouse, and by enzyme-linked immunosorbent assays in the laboratory.

A total of 1,883 peanut plants from 158 fields throughout the 14-county area were assayed for viruses during the 1990 and 1991 growing seasons (see table). PMV and TSWV, singly or in combination, were identified in every county and generally at high frequencies in most counties. PSV was found in all but one of the counties, but at a much lower frequency. PMV and TSWV were detected in samples from a majority of the fields in all 14 counties. PSV was identified in about one-fourth of the fields surveyed, but these fields were in 13 counties. No other viruses, including PStV, were identified in any sample during the two-year period.

These results show that PMV and TSWV were prevalent throughout the peanut production area, and that PSV occurred at lesser, but significant levels as well. Generally, incidence of all the viruses was higher than was previously suspected. The impact of these viruses on the peanut crop in Alabama has not been determined; however, their potential for causing serious losses has been well documented in other states.

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Gudauskas, Burch, Jin, and Hagan, Department of Plant Pathology; Weeks, Department of Entomology.

VIRUSES IDENTIFIED IN PEANUT PLANTS DURING 1990 AND 1991 GROWING SEASONS IN ALABAMA

| County | Fields | Plants | Plants infected with: | | | |
|---|---|---|---|---|---|---|
| | | | PMV[1] | PSV | TSWV | PMV+TSWV |
| | *No.* | *No.* | *No.* | *No.* | *No.* | *No.* |
| Barbour | 12 | 136 | 40 | 1 | 47 | 17 |
| Bullock | 8 | 114 | 50 | 4 | 34 | 27 |
| Butler | 6 | 79 | 11 | 0 | 7 | 2 |
| Coffee | 17 | 111 | 25 | 1 | 23 | 10 |
| Conecuh | 7 | 108 | 27 | 14 | 39 | 12 |
| Covington | 10 | 121 | 36 | 1 | 20 | 6 |
| Crenshaw | 7 | 73 | 26 | 4 | 27 | 21 |
| Dale | 12 | 149 | 24 | 3 | 55 | 16 |
| Escambia | 7 | 80 | 25 | 12 | 43 | 14 |
| Geneva | 16 | 214 | 56 | 14 | 91 | 37 |
| Henry | 19 | 239 | 70 | 6 | 96 | 34 |
| Houston | 18 | 183 | 48 | 4 | 44 | 20 |
| Pike | 12 | 167 | 31 | 19 | 46 | 18 |
| Russell | 7 | 109 | 10 | 8 | 27 | 2 |
| Totals | 158 | 1,883 | 479 | 91 | 599 | 236 |

[1] Total of all single and mixed infections with this virus.

# INSECTS

## Pheromone Traps Inadequate for Sampling Lesser Cornstalk Borer

### T.P. Mack and C.B. Backman

ACCURATE sampling of lesser cornstalk borer in peanuts is critical since damage in heavily infested fields can exceed 70%. Larvae feed inside stems and usually live underground, making sampling at this stage difficult and time consuming. Sampling adult moths, which have distinctive size, shape, and coloration characteristics is an alternative being tested at the Alabama Agricultural Experiment Station. Commercially available pheromone traps that contain a flypaper-like adhesive and a chemical sex attractant were used to trap lesser cornstalk borer moths. Based on on-site sampling of adult moths by trained entomologists, the traps have been unreliable in monitoring large population increases of this pest.

Field studies were conducted at the Wiregrass Substation, Headland, in 1984-86 in conventionally tilled and planted Florunner peanuts. Four pheromone traps per field were examined twice weekly throughout the growing season each year. The pheromone source (a chemically impregnated rubber septum) was changed weekly, and sticky traps were changed when approximately 100 moths were captured.

The number of male moths per trap per night was compared to the number of moths per yard of row determined by flushing moths from peanut plants. Two people each used a yardstick to agitate peanut plants in two 300-ft. rows, and researchers identified and counted the number of moths flying from the disturbed plants. Flushing was conducted weekly at dawn, when adult moths are still active.

Few adults were found in weekly flush sampling in 1984 and 1985, which were years of low lesser cornstalk borer populations. The average number of moths flushed each week in 1984 and 1985 ranged from approximately 0 to 0.4 per yard. The population in the hot, dry summer of 1986 was much greater than the previous year's populations, and ranged from 0 to 1.2 moths per yard. Cooperative Extension Service recommendations specify that insecticides should be applied when fresh damage or larvae are found on 30% or more of the plants in a field. This threshold level was reached on June 2, 1986, when the larval population, as determined by soil sieving, was approximately one per yard. The larval population eventually increased to more than 14 per yard on August 7, so the large adult moth population did produce a large population of larvae.

The number of male lesser cornstalk borer moths per trap per night varied with time and year, and ranged from 0 to 43. Male moth abundance exceeded 20 per trap per night only three times from 1984 to 1986, so moth abundance was usually low. No pheromone trap catches exceeded 20 per trap night in the population outbreak year, 1986. Instead, trap catches fluctuated greatly from date to date, ranging from 2.5 to 14.5 in August 1986.

The number of moths per pheromone trap per night was statistically related to the number per yard determined by flushing in only one of the three years, and trap catches were not similar to flush counts in the population outbreak year of 1986. In short, pheromone traps did not accurately determine if a large number of the moths were in a field. A possible explanation for this result is that the sex attractant in the trap may not be exactly the same chemical that a female moth produces.

Pheromone traps are useful because they can quickly inform growers of the presence of lesser cornstalk borer moths. Presence of moths can alert a grower of the need for scouting fields for lesser cornstalk borer larvae. This information can be important because, if no moths have been caught in a trap for the previous 30 days, then the chances are small that a large population of larvae is present.

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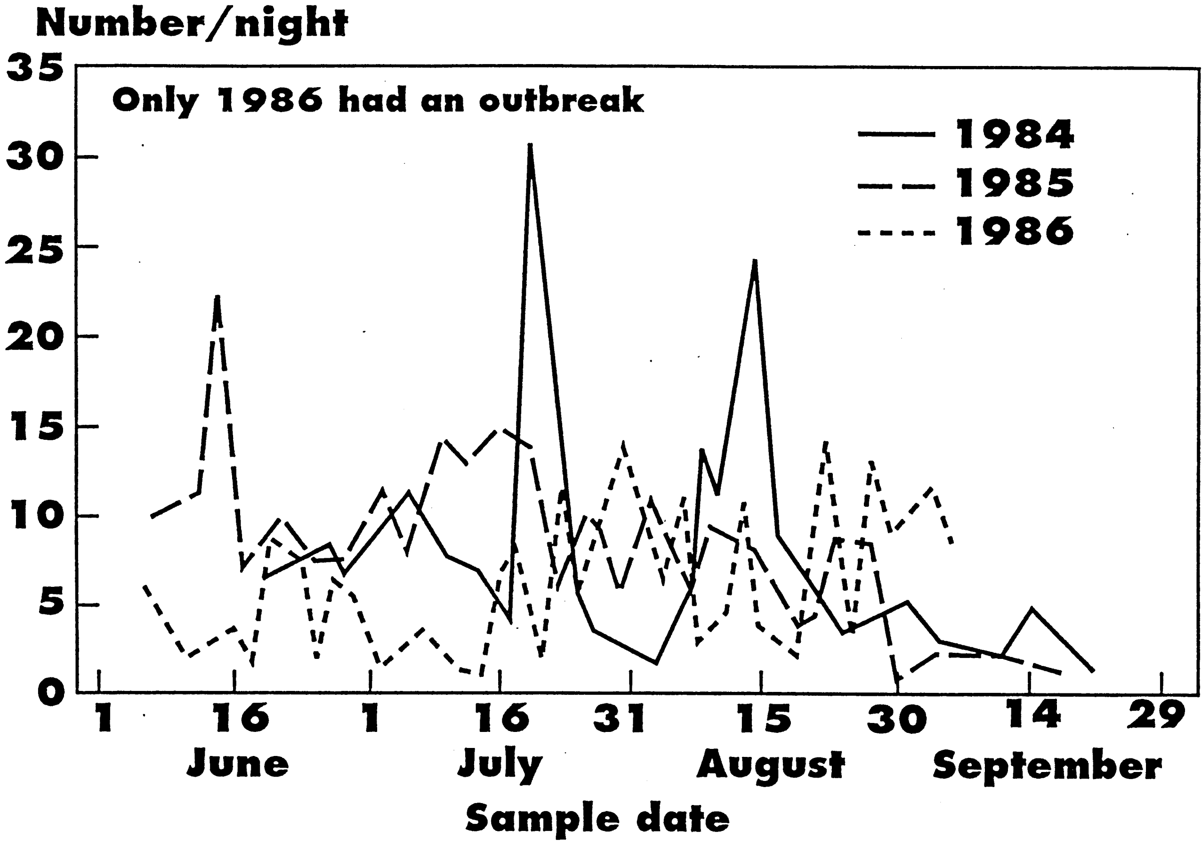
Mack and Backman, Department of Entomology.



Abundance of lesser cornstalk borer adult males from pheromone traps, 1984 to 1986.

## Long-Lasting Granular Insecticide the Most Effective Against Lesser Cornstalk Borers

### T.P. Mack

WHEN to apply granular insecticides to control lesser cornstalk borers in peanuts often becomes a balancing act for growers. Late applications may allow larvae to damage peanuts before chemicals are applied and too early an application may mean the insecticide degrades and larvae damage peanuts late in the season. Recent Alabama Agricultural Experiment Station (AAES) research indicates none of the currently available insecticides consistently lasts the necessary 60 days to provide adequate protection to pods. Lorsban® provided 19 to 50 days of control against infestations of lesser cornstalk borers, depending upon environmental conditions, and was consistently the longest lasting insecticide available.

Since there are no insecticides to protect peanuts for the 60-day duration of time that lesser cornstalk borers may feed on the crop, time of application of available materials is critical. It is equally critical for growers to know how long these insecticides remain toxic to this insect. However, determining length of effectiveness of a soil insecticide against a pest insect is challenging, because of movement of the pest, predation and disease impact on pest abundance, and the effects of soil temperature and moisture on pesticide degradation. A bioassay developed by the AAES allows researchers to overcome many of these problems and determine the length of effectiveness of several common granular insecticides against the lesser cornstalk borer.

Experiments were conducted at the Wiregrass Substation, Headland, in conventionally tilled and planted Florunner peanuts in 1988 and 1989. Plots were eight rows wide by 50 ft. long. Treatments consisted of a nontreated control, and each of the following granular insecticides: Lorsban, Dyfonate®, XRD-429®, Mocap®, Force®, and Fortress®. Of these materials, only Lorsban and Dyfonate are labeled for use on peanuts. Insecticides were applied with a small-plot granular applicator.

The length of effectiveness of each insecticide was determined in the laboratory by collecting soil from each field plot and by exposing small larvae to it. One soil sample was collected from each plot about every two weeks. Each sample was collected by taking a 12-in.-wide by four-in.-long by one-in.-deep subsample from three randomly selected rows within each plot. The biweekly collection of soil from the field allowed researchers to determine the length of effectiveness of each insecticide since the collected soil had been exposed to the same conditions as normal soil in the field.

Toxicity was evaluated as follows: Small larvae were placed in two-oz. plastic cups that were filled with a sample of field-collected soil to a depth of 0.5 in. Sorghum seedlings were placed in each cup as a food source for the larvae. Cups were kept in a controlled environment chamber for the assays, and the number of living larvae in each cup was determined at 72 hours. An effective treatment was defined as a treatment that decreased the percent survival of larvae compared with that of larvae exposed to nontreated soil. Treatment effectiveness was evaluated for each of the biweekly sampling dates.

In 1988, 59% to 85% of larvae survived a 72-hour exposure to soil from nontreated plots. Dyfonate and Lorsban were the only treatments that reduced larval survival at five days after application. Only Lorsban reduced survival at 19 days after application. No treatments reduced larval survival at 33 days after application.

Results in the table show that survival of larvae in nontreated soil in 1989 ranged from 78% to 96%. Lorsban, XRD-429, and Dyfonate reduced larval survival at 6, 19, and 25 days after application. Lorsban was the only insecticide tested that reduced larval survival at 39 and 53 days after application, and it was the only insecticide that was effective for more than 14 days in both years of the test.

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Mack, Department of Entomology.

AVERAGE PERCENTAGE SURVIVAL OF LESSER CORNSTALK BORER LARVAE EXPOSED TO INSECTICIDE-TREATED SOIL IN ALABAMA, 1989

| Insecticide | Treatment, a.i./acre | Survival by days after treatment, pct. | | | | | |
|---|---|---|---|---|---|---|---|
| | | 0 | 6 | 19 | 25 | 39 | 53 |
| Nontreated | -- | 78 | 93 | 96 | 96 | 89 | 81 |
| Lorsban 15G[1] | 2.0 lb. | 4 | 7 | 0 | 0 | 4 | 29 |
| XRD-429 2G | 1.0 lb. | 11 | 30 | 37 | 37 | 85 | 81 |
| Dyfonate10G[1] | 2.0 lb. | 7 | 0 | 14 | 33 | 88 | 78 |
| Force 1.5G | .3 lb. | 26 | 59 | 33 | 81 | 78 | 88 |
| Fortress 10G | .5 lb. | 0 | 33 | 81 | 81 | 85 | 88 |
| Mocap 15G | 3.0 lb. | 74 | 85 | 89 | 78 | 85 | 89 |

[1] Labeled for use on peanuts.

# Why Are Lesser Cornstalk Borers a Hot And Dry Weather Pest of Alabama Peanuts?

## T.P. Mack and C.B. Backman

THE LESSER cornstalk borer is a major insect pest of peanuts in Alabama, with damaging population outbreaks typically occurring in hot, dry weather and on sandy soils. In the drought plagued season of 1980, lesser cornstalk borers caused more than $43 million in damage to peanut crops in Alabama, Georgia, Oklahoma, and Texas. Why these outbreaks are more severe in hot, dry weather is being studied at the Alabama Agricultural Experiment Station as part of a research project to develop a microcomputer-based model that predicts when damaging populations of lesser cornstalk borers occur. To do this, the life cycle of the lesser cornstalk borer was studied in detail.

Eggs of the insect are laid singly within 0.25 in. of the soil surface under the peanut canopy. Newly hatched larvae crawl across the soil from the oviposition site and feed on a peanut plant or other edible organic matter. Larvae spend most of their time below the soil's surface and construct a silken tube interwoven with soil particles, which is attached to the plant. Pupation occurs in the soil from which adult moths emerge. Female moths appear to lay eggs only at night, and may spend a significant amount of time away from peanut fields.

Since lesser cornstalk borers are cold-blooded, temperature changes affect their rate of growth and development. The growth rate and hence the feeding rate of lesser cornstalk borers are temperature dependent, with hot weather greatly increasing lesser cornstalk borer feeding.

Lesser cornstalk borers spend most of their life cycle as larvae. This stage lasts 455 F degree-days. The lower developmental threshold for lesser cornstalk borers is 59°F, so it would take 13 days with an average daily temperature of 94°F [(94 - 59) x 13 = 455] for a newly emerged lesser cornstalk borer larvae to reach pupation. An average *air* temperature of 94° F would be difficult to achieve, since it would require a daily maximum of 112°F and a minimum of 76°F [(112 + 76) ÷ 2 = 94]. These are soil temperatures, however, that can be reached in July and August when peanuts begin to wilt from lack of moisture.

Leaves of a wilted peanut plant droop when under moisture stress, allowing more sunlight to reach the soil's surface. This significantly increases soil temperatures, which in turn will increase the growth and feeding rate of any lesser cornstalk borer larvae in the soil. So, lesser cornstalk borer larvae could be feeding at their greatest rate when a peanut plant cannot withstand significant damage.

Temperature was found to also affect the number of eggs laid per adult female lesser cornstalk borer. In a laboratory study at Auburn, adult females laid two times more eggs, at a two times faster rate when they were held at a constant temperature of 89°F, compared to those held at a constant temperature of 72°F. Thus, hot temperatures are conducive to the laying of a large number of lesser cornstalk borer eggs.

High soil moisture has been known to inhibit the development of lesser cornstalk borer populations, but the mechanisms for this have, until recently, been unknown. Research has shown that small larvae emerged from the soil when it was moist, and either stayed on the soil's surface or attacked the plant above the soil line. This behavior exposed the larvae to predators, such as striped earwigs and fire ants. Soil moisture-holding capacity is directly related to soil type, with sandy soils having the least soil water-holding capacity. Thus, sandy soils dry out the fastest, indicating that small lesser cornstalk borers in sandy soils would be exposed to predation less than those in soils with a high clay content.

Soil moisture may also affect oviposition. Lesser cornstalk borers laid 98% of their eggs in the soil when it was dry and only 55% in wet soil. The other eggs were laid on the plant, where they would be exposed to egg parasites and predators.

So, why do lesser cornstalk borer outbreaks occur in hot and dry weather, and typically on sandy soils? It appears that the effects of temperature on the total number of eggs per female, the number of eggs laid per day, and the growth and feeding rate of the larvae are important. Also, the effects of soil moisture on the behavior of small larvae and on the oviposition site selection by the adults are important. Since lesser cornstalk borers have two to four generations during the peanut growing season, hot and dry weather must coincide with a major moth flight to produce a damaging outbreak.

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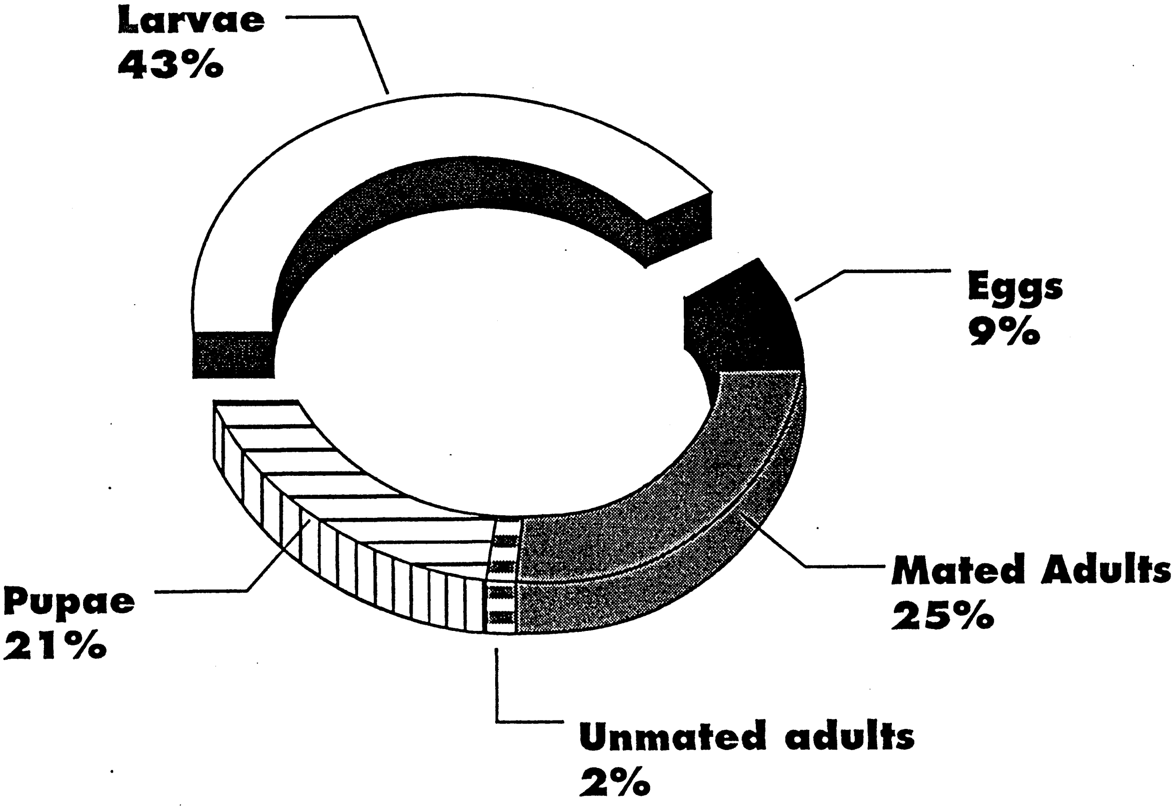
Mack and Backman, Department of Entomology.



Life cycle of the lesser cornstalk borer showing percentage of total lifetime in any stage.

## Lesser Cornstalk Borer Damage to Peanuts

### T.P. Mack, J.R. Weeks, and C.B. Backman

THE LESSER cornstalk borer is a key pest of peanuts grown on sandy soils in the southeastern United States, with damaging populations occurring during hot and dry years. Yield losses exceeding 70% have been reported in fields where damaging lesser cornstalk borer populations have developed. It is essential that lesser cornstalk borer damage to leaf, flower, peg, pod, and seed production be quantified so that growers know when this insect is causing economic damage.

To quantify lesser cornstalk borer damage, a two-year greenhouse study was conducted at the Alabama Agricultural Experiment Station. Florunner peanut plants potted in Dothan sandy loam soil were infested with five densities of lesser cornstalk borer larvae. Each plant had from zero to eight larvae feeding on it for approximately one month. Five different plant ages were studied to see if peanut plants were more susceptible to lesser cornstalk borer feeding at (1) just prior to flowering, (2) flowering, (3) early pegging, (4) early pod fill, or (5) late pod fill.

The dry weight of peanut pods, seeds, and roots decreased by an average of 6% for each larva feeding throughout its larval life on the plant. Lesser cornstalk borer larvae do not feed on roots, but damage the root crown and reduce the flow of sugars produced by leaves to the root system. So, the lesser cornstalk borer affects the *entire plant*, not just pegs and pods. This effect did not change with plant age. A reduction in a peanut plant's root system decreases its ability to obtain nutrients from the soil and withstand environmental stresses. This is critical because damaging populations of the lesser cornstalk borer often develop during a drought. When this happens, water stress from both lesser cornstalk borer damage and the drought could greatly reduce peanut yield.

Based on the results of these studies, it appears that in order for lesser cornstalk borer management to be successful, control tactics must be employed before many large-sized larvae are found in a field. Insecticides applied after peg, pod, and root crown damage has occurred will probably reduce the lesser cornstalk borer larval population, but economic damage will already have occurred. Recommended granular insecticides applied when most larvae are small to medium-sized will reduce the larval population and prevent economic losses. Rainfall should improve insecticide performance, but is not needed to "activate" some of the recommended granular insecticides, since lesser cornstalk borers regularly crawl on the soil surface.

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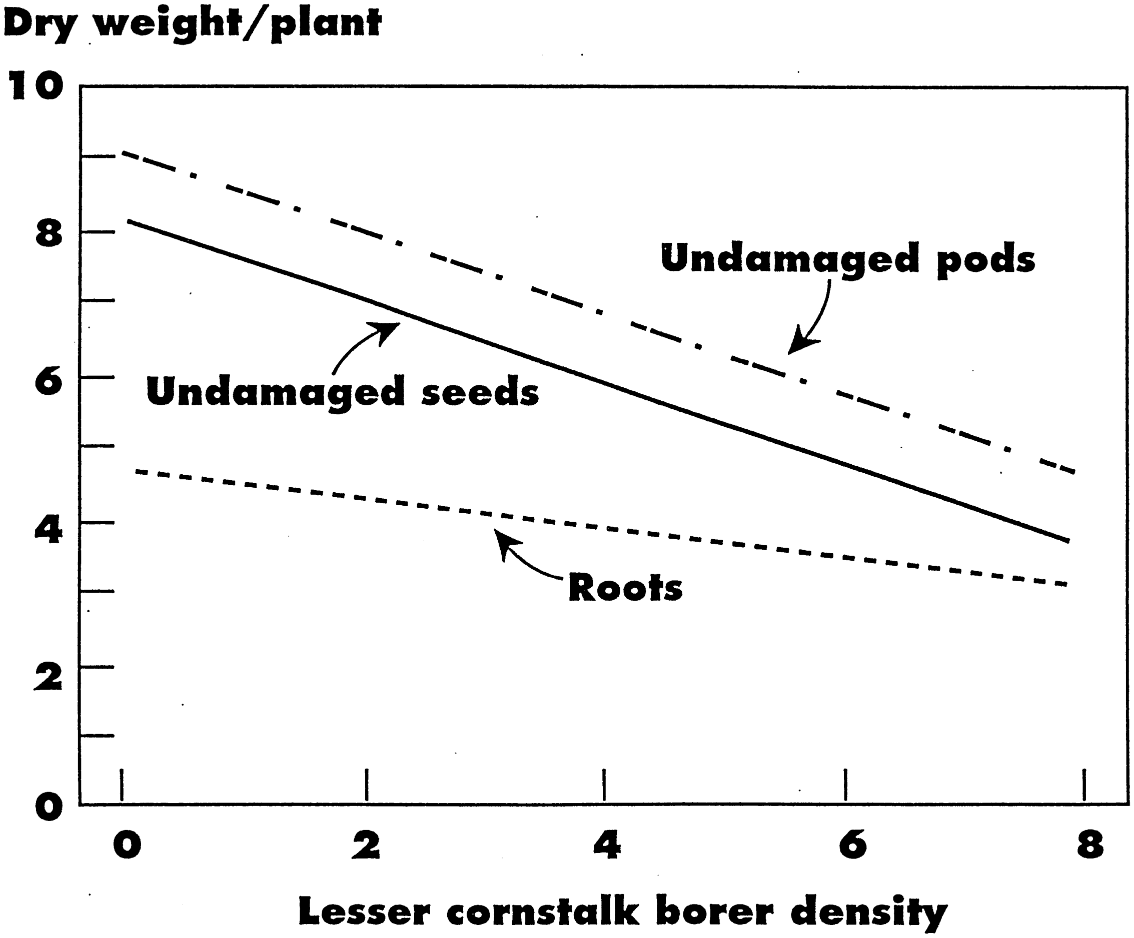
Mack, Weeks, and Backman, Department of Entomology.



Dry weight loss to peanuts from the lesser cornstalk borer.

# Lesser Cornstalk Borer And Aflatoxins Are Double Trouble For Peanut Growers

## T.P. Mack and K.L. Bowen

**LESSER** cornstalk borers and aflatoxins have more in common than hot weather, according to recent Alabama Agricultural Experiment Station research. In tests at the Wiregrass Substation, Headland, there was a close relationship between damage by lesser cornstalk borers and visible *Aspergillus flavus*, the aflatoxin-producing fungi (94% correlation). However, the use of insecticides reduced this correlation.

Aflatoxin-producing fungi are predominant in the light soils in which peanuts are grown, and occur most frequently when hot dry conditions prevail. High temperatures favor growth of these fungi, limit growth of competing organisms, and stress peanut plants, making infection more likely. Infestation of seed by aflatoxin-producing fungi also is greater in peanuts that are damaged in any way.

Hot and dry conditions also favor population outbreaks of the lesser cornstalk borer. Larvae of this insect feed on peanut root hypocotyls, developing pegs, and pods, and can be a devastating pest of peanuts. In feeding on the developing pods, lesser cornstalk borers cause extensive damage to pods and seeds. Thus, larval feeding may provide a means of entry for *A. flavus* into the peanut seed.

In a 1990 study, plant and insect samples were collected from nonirrigated plots used in insecticide trials on peanuts. All plots were conventionally tilled and planted with Florunner peanuts. Trials included a comparative insecticide study and a study on the date of application of the insecticide Lorsban®. Peanuts were planted on May 7. On July 5, at early bloom, plots were treated with Lorsban at two lb. active ingredient (a.i.) per acre, Mocap® at three lb., Dyfonate® at two lb., Fortress® at 1/2 lb., and Counter® at two lb. Of these materials, only Lorsban and Dyfonate are labeled for use on peanuts. Nontreated control plots were left for comparison.

A second trial was planted on May 23 and consisted of four treatments: a nontreated control and Lorsban at two lb. a.i. applied either 30, 45, or 71 days after planting.

Initially, larvae were collected from these field trials to determine if the lesser cornstalk borer carried aflatoxin-producing fungi. These larvae were collected by uprooting plants and taking larvae back to the laboratory. In addition, relative abundance of lesser cornstalk borers was determined with pitfall traps on a weekly basis during the growing season. Incidence of aflatoxigenic fungi was determined on several dates in August and September by randomly selecting and pulling five whole plants from which 10 pegs and 10 pods were removed. These pegs and pods, once removed from plants, were surface sterilized and incubated for three days, after which aflatoxigenic fungi were visually identified by the color and shape of the spores.

After harvest, peanut pods were collected from experimental plots and rated on the occupance of damage by lesser cornstalk borer, scarification and other hull or pod damage, and presence of visible aflatoxigenic fungi. Samples of harvested peanuts were graded and incubated to determine if aflatoxigenic fungi colonized peanut tissue.

Field-collected larvae did carry spores of aflatoxin-producing fungi on their cuticles or "skin," as well as internally. Additionally, as lesser cornstalk borer populations increased in the latter part of the season, incidence of *A. flavus* on developing pegs and pods increased. In fact, in peanuts that had not been treated with any insecticide, where there was damage by the lesser cornstalk borer, there were almost always aflatoxigenic fungi present. This relationship changed somewhat when insecticides were applied, generally decreasing the apparent interaction between these two organisms.

Peanuts treated with a single application of Lorsban at 30, 45, or 71 days after planting had consistently less damage by lesser cornstalk borer, less visible *A. flavus*, lower levels of aflatoxins, and greater yields (see table). Plants treated 45 days after planting (at flowering) had better grades and yields than those in the other treatments.

Since it is currently not possible to treat a peanut field with a fungicide for *A. flavus*, it is important to understand the relationship between contamination with this fungus and damage due to lesser cornstalk borer. Such information may provide growers the option of treating for an infestation of lesser cornstalk borer, thereby decreasing the risk of aflatoxin contamination in peanuts.

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Mack, Department of Entomology; and Bowen, Department of Plant Pathology.

Incidence of Pod Damage and Fungal Occupance, Yield, and Total Aflatoxin Content in Peanuts from Lorsban Timing Trial, 1990

| Treatment | Visible LCB damage | Scarification | Observed *A. flavus* | Yield/acre | Aflatoxin level |
|---|---|---|---|---|---|
| Nontreated | 2.25 | 43.5 | 11.0 | 709 | 114 |
| 30 days after planting | 1.75 | 35.5 | 6.2 | 1,243 | 5 |
| 45 days after planting | 1.75 | 22.5 | 3.6 | 1,454 | 16 |
| 71 days after planting | 1.75 | 37.1 | 4.9 | 1,063 | 31 |

## Granular Insecticides Harmful to Beneficial Insects in Peanuts

### T.P. Mack

**GRANULAR** insecticides are used to control the lesser cornstalk borer in peanuts. There is a great potential for destroying beneficial arthropods, such as spiders and bigeyed bugs, because the insecticides are applied during the growing season when insects are present in fields. This should be especially true of beneficial arthropods that live on the soil surface, such as earwigs and fire ants, where the granules are applied. It is very important to maintain the abundance of beneficial arthropods in peanut fields because they provide free and effective control of many insect pests. Destroying beneficials also increases the abundance of some insects pest in other crops.

The effects of five granular insecticides on beneficial insects were studied in a two-year field study in conventionally planted and tilled peanuts done in 1989 and 1990 at the Wiregrass Substation, Headland. Goals of the study were to compare the effects of several granular insecticides, learn if any kill beneficial arthropods, and determine if other pests increase in abundance.

Sunrunner peanut seeds were conventionally planted in a Dothan sandy loam soil. Insecticides used were Lorsban 15G® at two lb. active ingredient (a.i.) per acre, Mocap 15G® at three lb. a.i. per acre, Dyfonate 10G® at two lb. a.i. per acre, Fortress 10G® at 0.5 lb. a.i. per acre, Counter 15G® at two lb. a.i. per acre, and a nontreated control. Of these materials, only Lorsban and Dyfonate are labeled for use on peanuts. Beat sheets were used to sample for insects living on the foliage of peanuts, and pitfall traps were used for insects on the soil-surface. Samples were taken for at least five weeks after treatment.

Applications of granular insecticides had very transitory effects on insect pests, such as the corn earworm and fall armyworm. The applications had no effect of beneficial arthropods in the foliage such as bigeyed bugs and spiders (Table 1).

Predators such as striped earwigs and red imported fire ants were the most abundant beneficial insects. Abundance of these predators declined in some treated plots for as long as one month, which would increase the probability of economic damage from insect pests such as the lesser cornstalk borer (Table 2).

A potentially serious result of applying a granular insecticide to peanuts is the observed reduction of soil surface dwelling arthropods, such has fire ants and striped earwigs. These two predators were the most abundant arthropods sampled, so the negative effects of granular insecticides could increase the probability of economic damage from the lesser cornstalk borer and other insect pests. This underscores the need for timely applications of insecticides based on scouting. Insecticides applied too early may not only degrade and be ineffective against the lesser cornstalk borer, but may also reduce the abundance of striped earwigs and imported fire ants for the remainder of the growing season.

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Mack, Department of Entomology.

TABLE 1. ABUNDANCE OF SELECTED PREDATORS BY TREATMENT COMBINED OVER ALL SAMPLE DATES, 1990

| Insecticide | Imported fire ants[1] | Bigeyed bugs[2] | Spiders (canopy)[2] | Spiders (soil-dwelling)[1] | Ground beetles |
|---|---|---|---|---|---|
| Nontreated | 20.8 ± 3.1 | 0.8 ± 0.2 | 0.2 ± 0.1 | 1.7 ± 0.2 | 3.9 ± 0.8 |
| Lorsban | 4.2 ± .9 | .6 ± .2 | .2 ± .1 | 1.2 ± .4 | 4.3 ± 1.0 |
| Mocap | 7.3 ± 2.0 | 1.3 ± .5 | .1 ± .1 | 1.3 ± .3 | 4.4 ± 1.0 |
| Dyfonate | 9.6 ± 2.5 | 1.0 ± .3 | .3 ± .1 | 1.7 ± .3 | 4.5 ± 1.1 |
| Fortress | 8.8 ± 1.5 | 1.1 ± .4 | .3 ± .1 | 1.7 ± .3 | 5.2 ± 1.2 |
| Counter | 12.0 ± 1.8 | .6 ± .2 | .4 ± .1 | 1.0 ± .2 | 4.5 ± 1.0 |

[1] Number per trap per week from pitfall traps.

[2] Number per six row-feet per week, from beat sheets.

TABLE 2. ABUNDANCE OF STRIPED EARWIGS FOR 35 DAYS AFTER TREATMENT ON JULY 5, 1990[1]

| Insecticide | 5 | 12 | 19 | 28 | 35 |
|---|---|---|---|---|---|
| Nontreated | 14.9 ± 5.1 | 8.6 ± 2.4 | 23.0 ± 3.2 | 112.5 ± 20.1 | 100.5 ± 11.1 |
| Lorsban | 3.9 ± 1.4 | 4.1 ± 2.0 | 13.1 ± 3.9 | 89.4 ± 7.3 | 102.6 ± 9.2 |
| Mocap | 2.9 ± 1.2 | 5.3 ± 1.6 | 20.3 ± 2.9 | 90.9 ± 7.9 | 135.1 ± 3.0 |
| Dyfonate | 5.4 ± 1.4 | 6.6 ± 2.6 | 25.5 ± 8.8 | 97.9 ± 18.7 | 133.1 ± 28.5 |
| Fortress | 1.5 ± .5 | 6.9 ± 3.3 | 36.8 ± 11.1 | 101.9 ± 12.5 | 132.1 ± 15.7 |
| Counter | .6 ± .3 | 2.1 ± 1.1 | 10.8 ± 2.8 | 89.0 ± 14.2 | 130.9 ± 10.3 |

[1] Number (average ± standard error) per trap per week, from pitfall trap samples.

# MODELS AND PREDICTIONS AIDS

## AU-PNUTS--AAES Developed Expert System Helps Manage Peanut Pests

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AN "EXPERT SYSTEM," which refers to a program that uses the knowledge of human experts to solve problems, is being developed by the Alabama Agricultural Experiment Station to aid Alabama peanut growers.

This system, known as AU-Pnuts, is being designed to apply expert-like reasoning for decision making when human experts are not available. Most expert systems can even inform the persons using them how a conclusion was reached. Eventually, the user may learn how the expert system arrives at decisions, which has the added benefit of educating the user.

AU-Pnuts is an example of the many expert systems being developed for use in agriculture. This AAES-developed system is for managing pests in peanuts, and was designed to be a "planting-to-harvest" decision aid. Growers may maximize profitability while reducing pesticide use by using AU-Pnuts to (1) determine yield loss from root-knot nematodes and identify profitable alternatives for nematode control, (2) determine most profitable timing of treatments for fungal diseases, and (3) conduct cost/benefit analyses for control of foliar feeding insects and the lesser cornstalk borer. Management of these pests requires knowledge of pest density, crop value, costs of control, and weather conditions.

The expert system would inquire what the previous crop was. If the previous crop was not peanuts (or another crop on which these nematodes survive well), then peanuts could be planted without economic losses from nematodes. If the previous crop was peanuts, then AU-Pnuts would ask for the number of nematodes extracted from a soil sample.

An equation has been developed that allows prediction of yield loss based on nematodes in soil samples. If this loss is greater than 600 lb. per acre, then AU-Pnuts would recommend planting an alternate crop. If the loss estimate was less than 600 lb. per acre, then it would recommend planting peanuts. AU-Pnuts would also ask for the cost of nematicides to determine whether they should be used, and what alternative crops the farmer could plant, to estimate the most profitable rotational schemes.

AU-Pnuts has several important advantages over other methods of decision making for pest management. It recommends pesticide applications only when they are economically justified, so unnecessary applications will be reduced. Further, AU-Pnuts integrates the management of insects, diseases, and nematodes into a single unit, since decisions made for one pest affect almost all subsequent actions.

Control of leafspot disease is expensive for Alabama peanut growers, usually requiring six to eight sprays applied on a 14-day schedule. AU-Pnuts uses environmental factors and history of leafspot development on Alabama peanuts since 1980 to offer an alternative for this approach. Use of AU-Pnuts successfully eliminated one or more fungicide applications without reducing leafspot control or yields in tests throughout the three U.S. peanut belts.

Plant pathologists have long known that the fungus that causes peanut leafspot requires moisture to infect the leaf. Therefore, applications made during dry periods are of little value when leaves are not wetted by rain, fog, prolonged dews, or irrigation water, within a period of about 10 days after the fungicide is applied. Additionally, rotated peanuts usually need not be sprayed as early in the growing season as peanuts planted behind peanuts, since fungal spores from peanut residue are not present. The end result is farmers over-treating for leafspot because of the lack of a system that advises a more appropriate timing for leafspot control sprays.

To develop a set of rules to manage leafspot, research was begun by looking at the progress of the disease in Florunner peanuts in every year since 1980. These studies indicated that rainfall of

0.1 in. or greater on any given day was a good predictor of leafspot development. Close examination of the data indicated that after six to eight days with 0.1 in. of rain, disease begins to develop quickly.

From this and a knowledge of disease development, guidelines were developed and tested, for the management of leafspot on Florunner peanuts using chlorotholonyl (Bravo®, Evade®, Terronil®, and Echo®) fungicides. The only equipment necessary is a rain gauge that can accurately measure 0.1 in.

For the use of these results the term "rain event" means any day with more than 0.1 in. of rain, or more than 0.1 in. of irrigation water, or with a fog that begins before 8:00 p.m. If you have plans to irrigate soon, the forecast for a rain event is 100%.

A. TIMING FOR THE FIRST SPRAY OF THE SEASON:

1. After plant emergence, begin counting the number of rain events. Spray when six rain events have been recorded, Or,
2. If leafspot is observed in the lower leaves of the plant (two or more spots per plant), spray immediately even if the number of rain events in rule 1 has not been reached.

B. TIMING FOR SECOND AND ALL LATER SPRAY APPLICATIONS:

1. Discontinue fungicide applications if you are within 14 days of harvest. Or,
2. If you are more than 14 days from harvest, wait 10 days after the previous fungicide application, then begin counting rain events, and checking the five-day weather forecast.
    a. Even if no rainfall has occurred yet, if the average rainfall probability for the next five days is 50% or higher, spray immediately. Or,
    b. Spray after one rain event if the average rainfall probability is 40% or greater for the next five days. Or,
    c. Spray after two rain events if the average rainfall probability for the next five days is 20% or higher. Or,
    d. Spray when three rain events have been recorded.

These rules were tested during the wet season of 1989 and the dry season of 1990 on irrigated peanuts at the Wiregrass Substation, Headland. In both years the number of fungicide applications was reduced without sacrificing disease control or yield.

During the 1990 season, additional tests of this system were conducted in Georgia, Florida, and Oklahoma. In all locations, fungicide sprays were reduced, requiring only three to five applications (depending on irrigation timing and rotation) to achieve a similar level of disease control and yield as peanuts sprayed seven times on the standard 14-day program.

Results obtained on farms throughout the peanut-growing region of Alabama indicate use of AU-Pnuts leafspot module can result in better disease control and higher yields for Alabama's peanut farmers than calendar-based applications.

In 1991, on-farm studies were conducted with seven peanut producers[1] in five counties in Alabama. On-farm evaluations required coordination and training of county agents and volunteer producers. The National Weather Service provided weather forecast information for the predictive portion of AU-Pnuts, and this information was delivered to producers via a toll-free phone service and an answering machine. AU-Pnuts plots consisted of one to 10 acres of peanuts. Each plot was compared to the remainder of the field treated by farmers using the conventional fungicide program.

During the 1991 test season, spring rains triggered early applications with AU-Pnuts. Initial sprays were made on average at 33 days after planting (DAP) in nonrotated fields and 36 DAP in rotated fields, compared to an average of 42 DAP for the conventional program. Earlier applications, when requested by AU-Pnuts, often resulted in major differences in disease control. Subsequent applications were coordinated with infection periods. The average number of fungicide applications with AU-Pnuts and conventional programs was 5.6 and 6.0, respectively.

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[1] Ten producers started in the demonstration, but three dropped out due to failure to follow AU-Pnuts advisories and other technical problems.

On the farms in which AU-Pnuts was successfully utilized, the combination of earliness and timeliness resulted in significantly improved season-long disease control. On average, AU-Pnut plots had 10% less infection by end-of-season. No failures of the AU-Pnuts system were reported, and yields were higher (258 lb. per acre) in four of five fields in which yields were compared.

The strength of the AU-Pnuts system may be its ability to help in making wise decisions. Under normal weather conditions, AU-Pnuts may often save sprays due to timeliness. In heavy rainfall years, AU-Pnuts may call for more sprays than a conventional 14-day schedule. Based on research results and suggestions from producers, AU-Pnuts was revised for limited release in 1992 and 1993. More information on use of AU-Pnuts in 1994 is available through county Extension Service offices.

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## Weather Variables Aid in Predicting Abundance of Lesser Cornstalk Borer

### T.P. Mack and D.P. Davis

THE LESSER cornstalk borer can severely limit yields of peanuts when larvae feed on the crown and developing pods and pegs of peanut plants. Population outbreaks of this insect occur in hot, dry weather in peanuts grown in sandy soils.

Research on the lesser cornstalk borer at the Alabama Agricultural Experiment Station has focused on the life history of this pest and how weather influences population outbreaks. Since all factors known to contribute to outbreaks involved hot, dry weather, researchers began to explore the possibility that certain variables could be developed to predict outbreaks based on weather.

Such a prediction system would be extremely useful to anticipate outbreaks of this insect, because scouting for larvae is time-consuming and growers often start scouting after damage occurs. Many growers apply a preventative application of a granular insecticide for control of larvae. However, all the insecticides used for management of the lesser cornstalk borer degrade in as few as 19 days in hot, dry weather. An insecticide applied too early also will degrade, leaving plants unprotected. If treatments are applied too late, much of the damage to peanut plants already will have occurred and yield will decline.

Through this research, a prediction equation was developed by simplifying a complex simulation model. This equation uses a single variable incorporating positive effects of hot, dry weather and the negative effects of normal, wetter weather.

The equation developed is $Y = (H-W)$. In this equation, $Y$ is equal to the LCB-days and represents the cumulative effect of weather on larval abundance. $H$ is the number of days where the temperature is 95°F or higher and less than 0.1 in. of rainfall occurs; $W$ is the number of days that the temperature is less than 95°F and 0.1 in. of rainfall or more occurred. The variable $H$ represents days that produce a higher population. Neutral days (i.e., more than or equal to 95°F and more than or equal to 0.1-in. rainfall) do not contribute to LCB-days. Thus, LCB-days are a running total of the cumulative weather events since planting. A cumulative total of zero to 10 LCB-days at 30 or more days after planting means that scouting fields for the lesser cornstalk borer is needed.

The usefulness of LCB-days was tested in four validation experiments done at the Wiregrass Substation, Headland, in 1989 and 1990. The tests determined whether or not an application of a granular insecticide for control of the lesser cornstalk borer at a given number of LCB-days increased yield. Conventionally tilled and planted Sunrunner peanuts were used in both years. If LCB-days were positive and a treatment was suggested, a granular insecticide was applied and yields were compared from treated and nontreated plots. If LCB-days were negative, it was validated that no yield increase would ensue if pesticide was used, as compared with nontreated plots. The granular insecticide used was chlorpyrifos (Lorsban®) applied at two lb. active ingredient per acre in a band application over the row.

Plots were surveyed weekly for damage. Soil was sieved weekly, or when dry enough to be sieved during the growing season, to determine the number of larvae present. Yields were taken from the center two rows of each plot at crop maturity.

LCB-days were mostly negative in 1989 and lesser cornstalk borers were rarely found. Insecticide applied at negative values of LCB-days did not increase yields, compared with yields in the nontreated plots. In the outbreak year (1990), LCB-days exceeded 35 and lesser cornstalk borers were abundant. More than 20 larvae per yard were found in some fields. Insecticide applied at 0.5, or eight LCB-days increased yield compared with yield in nontreated plots, and insecticide applied at more than 20 LCB-days either did not increase yield, or actually decreased yield.

These studies verify that LCB-days are useful in timing scouting and applications of insecticide. A three-tiered approach can be used with LCB-days, as shown in the figure, which suggests scouting at more than zero LCB-days, danger at five to 10 LCB-days, and damage occurring at more than 10 LCB days. Growers must record the amount of daily rainfall and daily maximum temperatures in each field throughout the growing season and calculate LCB-days from planting.

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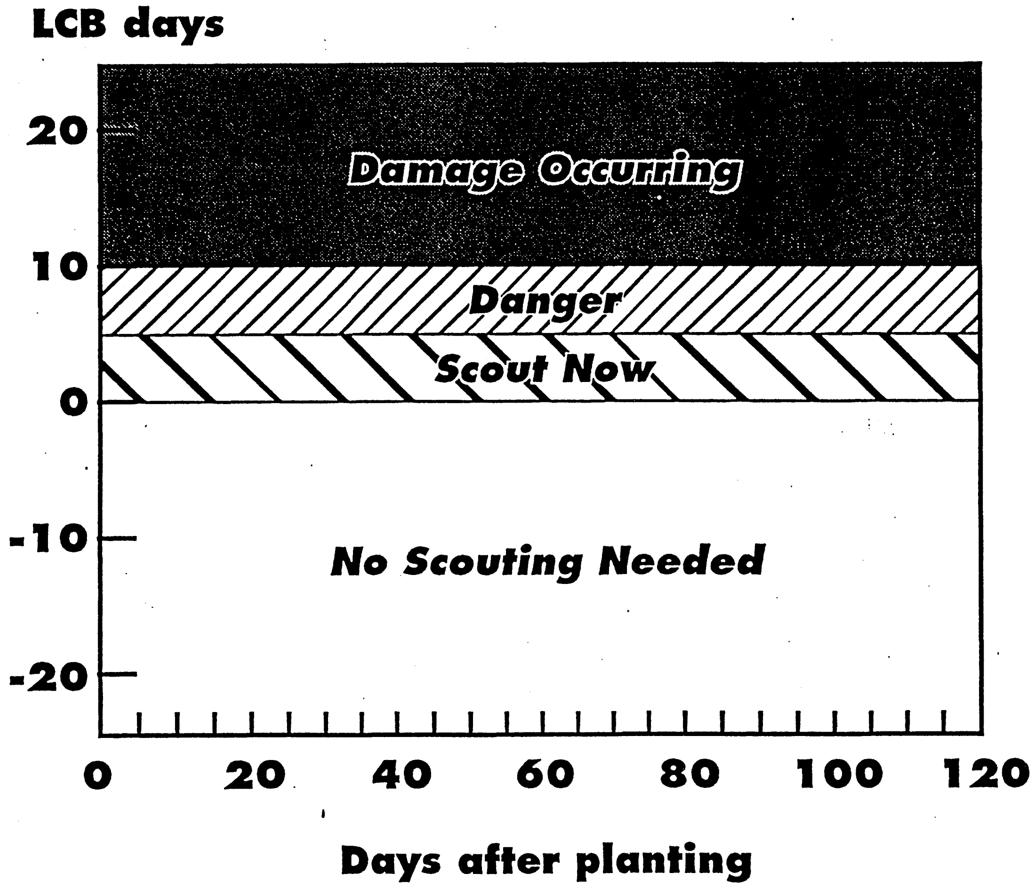

Three-tiered approach to timing scouting and applications of insecticide for control of lesser cornstalk borer.

# Estimating Abundance of Lesser Cornstalk Borer Larvae One Week in Advance

### T.P. Mack and D.P. Davis

**SAMPLING** for lesser cornstalk borer larvae is a time consuming and laborious process, since the larvae live in the soil and are difficult to find. Predicting population outbreaks before they occur would be helpful, since pod and root-crown damage is permanent. Can the abundance of larvae be predicted from estimates of adult abundance? The adult is a small moth that is easily flushed from peanut fields, so predicting the abundance of larvae from adults would be very desirable.

The abundance of larvae and adults of the lesser cornstalk borer was monitored in conventionally tilled and planted Florunner peanuts from 1984 to 1986 at the Wiregrass Substation, Headland. Lesser cornstalk borer larvae were sampled by sieving 10 three-ft. sections of a large production field approximately weekly throughout the growing season. The abundance of adults was monitored by flushing male and female moths from rows in the morning by beating plants with a stick. Two people vigorously agitated plants with a stick while another person identified and counted moths that were flushed. Lesser cornstalk borer adults were easily distinguished from other small moths flushed from the rows by their unique coloration and distinctive flight pattern.

The average number of larvae found by weekly soil sieving was compared with the average number of adults from flushing. Larval abundance one week after the adult abundance was used because eggs laid by the adults sampled by flushing would hatch in about three days, with small larvae present about four to seven days later.

The average number of larvae in any given week increased linearly with an increase in adult flush counts from the previous week indicating that larval density could be predicted by adult abundance. There was no year effect on this relationship, so data were pooled over all three years and a common slope was generated. The equation is:

$$Y= -0.27 + 11.57X,$$

where Y = the average number of larvae per yard in any given week from soil sieving and X = the average number of adults per yard in the previous week, as determined by flushing. The slope of 11.57 indicates that about 12 larvae per yard can be expected to be found one week later for each adult per yard flushed.

To validate this relationship, the abundance of lesser cornstalk borer adults was determined in five peanut fields in 1990 by flushing 30.3-m of row in the morning, as described above. All fields were conventionally tilled and planted with Florunner peanuts. Fields were chosen based on adult population size, so that a range of adult populations could be tested. The abundance of larvae was determined in the following week by randomly taking three sieve samples in each field. Means from four of the five model validation fields in 1990 fell within the 95% confidence limits for the regression equation, indicating that the equation captures the pattern of the data and that the equation agrees with the field data.

This equation could be a significant addition to management of the lesser cornstalk borer, because the use of adult flush counts allows for the prediction of damaging larval populations **before** they occur. The laborious, time-consuming and destructive sampling for larvae can be reduced by using this method. For example, if a grower flushes no adults from fields for several consecutive weeks, it is unlikely that an economically damaging population of larvae is present. However, if the number of adults per yard increases for several consecutive weeks or if a large number of adults is found on any given week, then scouting for larvae should be considered. Alabama Cooperative Extension Service recommendations should then be consulted to determine if control is needed.

Care should be taken in the applying this equation to any and all situations. Fields that were sampled in this study for larvae and adults were conventionally tilled and planted runner peanuts. Any factor that would change the relative efficiency of soil sieving, such as reduced tillage or twin rows, would affect this relationship. Given these limitations, the regression equation still should be a useful method of predicting population outbreaks of the lesser cornstalk borer.

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