Research Update 1993

Soybeans

Effects of a Damage Threshold of Sicklepod on Soil Seed Reserves

Research indicates that one sicklepod per 9.6 ft. of rows spaced 30 in. apart will not adversely affect soybean yields. However, at this density soil seed reserves of the weed increase 200-250%, resulting in unmanageable sicklepod problems in following years.

Experiments at the E.V. Smith Research Center in Tallassee and the Prattville Experiment Field from 1989-92 investigated the frequency with which one sicklepod per 13 ft. in conventional planting of soybeans can return seeds to the soil without increasing the degree of infestation. Allowing one sicklepod per 13 ft. to reseed all four years resulted in decreased soil seed reserves at both sites. Infestation was reduced by 58% at Tallassee and 52% at Prattville.

Infestation at Tallassee for plots that remained weed free for four years was reduced 87%. Infestation in plots allowed to reseed one year was reduced 90%; two years, 88%; and three years, 64%.

At Prattville, infestation was reduced 70% in weed-free plots; 64% with one year of reseeding; 69%, two

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Percent of the Initial Sicklepod Seed Infestation in the Soil as Affected by the Frequency of Reseeding of a Damage Threshold, 1989-1992

Time	Tallassee					Prattville				
	0/4[1]	1/4	2/4	3/4	4/4	0/4	1/4	2/4	3/4	4/4
1989										
Spring	100	100	100	100	100	100	100	100	100	100
Fall	52	68	67	88	70	71	83	80	80	72
1990										
Spring	27	34	31	31	27	61	75	68	66	65
Fall	20	22	25	21	41	43	42	42	34	95
1991										
Spring	15	14	14	10	28	42	46	37	35	90
Fall	11	12	9	29	42	21	31	28	41	72
1992										
Spring	13	10	12	36	42	30	36	31	35	48

[1] Years that reseeding occurred: 0/4 = none; 1/4 = 1989; 2/4 = 1989, 1992; 3/4 = 1989, 1991, 1992; 4/4 = 1989, 1990, 1991, 1992.

Crop Rotation May Aid Stem Canker Control in Reduced Tillage Systems

Disease reduced the South's 1991 soybean crop by approximately 12.6%, a loss of almost $382.5 million. One major yield-reducing soybean disease, southern stem canker, apparently can be managed by crop rotation, especially under tillage systems that leave crop debris on the soil surface.

An AAES study was conducted to determine the effect of crop rotation and its interaction with tillage on two soybean varieties: Essex, which is moderately resistant to stem canker; and Forrest, which is moderately susceptible.

A severe outbreak of stem canker occurred during an ongoing cropping system and tillage experiment at the Sand Mountain Substation in Crossville. Using Essex and Forrest, three tillage systems were compared in three cropping systems. Plots were rated for stem canker development and yield.

Averaged over the two cultivars, stem canker incidence was higher under strip- and no-till tillage — with 35 and 25%, respectively, of plants dead or dying — than for conventional till-

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Stem Canker Control, continued

age, with less than 10% of plants affected. Incidence averaged 60% for plots planted continuously with soybeans and 25% where soybeans followed corn. No stem canker was detected in soybeans planted after wheat.

However, the effect of crop rotation was highly dependent upon tillage system. Under conventional tillage, stem canker ratings were not affected by rotation, but under strip- and no-till, rotation with corn greatly reduced stem canker incidence. Conventional tillage was effective enough in controlling stem canker that rotation provided no added benefit.

Effect of tillage on yield was dependent upon crop rotation, with crop rotation having less effect under conventional tillage. See tables 1 and 2 for further analyses of how the various treatments affected yield for each cultivar.

Contact: J.H. Edwards, 844-3979

Table 1. Effects of Tillage Systems and Crop Rotation on Essex Soybean Yields in 1992

Cropping system	Yield, by tillage systems			
	Conventional	Strip	No-till	Avg.
	Bu./a	*Bu./a*	*Bu./a*	*Bu./a*
Continuous	37.0	25.5	26.9	29.8
Soybean-corn	41.2	36.9	36.8	38.3
Corn-wheat-soybean	33.1	37.1	37.6	33.7
Tillage, avg	37.1	33.1	33.7	

Table 2. Effects of Tillage Systems and Crop Rotation on Forrest Soybean Yields in 1992

Cropping system	Yield, by tillage systems			
	Conventional	Strip	No-till	Avg.
	Bu./a	*Bu./a*	*Bu./a*	*Bu./a*
Continuous	23.1	14.1	12.4	16.5
Soybean-corn	34.0	18.5	12.4	26.4
Corn-wheat-soybean	29.8	31.1	32.0	32.0
Tillage, avg.	29.0	21.2	23.6	

Effects of Sicklepod, continued

years; and 65%, three years (see the table). Lesser declines in seed reserves at Prattville may have been due to difficulty in fully inserting the six-in. soil probe used in sampling for these studies. Also, fewer weed flushes were observed at Prattville.

The AU tests indicate that producers should base weed control programs on damage thresholds to help reduce weed control cost. However, damage threshold of weeds needs to be based on more than just short-term yield losses. If allowing the damage threshold to reseed causes substantial increases in soil seed reserves, lowering the damage threshold may be required to realize greater economic benefits.

Contact: R.H. Walker, 844-3994

Cultural Practices That Aid Weed Control and Yield

Because of low yields and declining prices, complete reliance on herbicides for weed control in soybeans will quickly drive a producer out of business. Recent research has focused on using narrow row spacing and early planting to benefit yield and reduce production costs.

Experiments at the Plant Breeding Unit of the E.V. Smith Research Center showed a slight advantage for soybeans planted in eight-in. rows with a grain drill. Comparisons were made with soybeans planted in conventional 30-in. rows, and both planting techniques were observed with minimum herbicide inputs and without. However, yields were not impressive regardless of treatment, suggesting that drill planting is not a cure all (Table 1).

Later experiments in Tallassee continued these comparisons but also included an early planting variable. Table 2 shows that April 30 planting in narrow rows plus herbicides was the best combination. Even without herbicides, April planting in narrow rows produced good yields. Lack of adequate control of sicklepod in the tests probably prevented yields above 40 bu. per acre.

Similar experiments also were conducted in Prattville. Planting April 16 in 10-in. rows and controlling weeds produced an average of more than 45 bu. per acre. Even without complete weed control, yield was above 35 bu. per acre.

Early planting in narrow rows not only shows potential to improve weed control with fewer herbicides, it also makes soybeans less vulnerable to drought during the critical bloom and pod filling stages and allows the crop to be harvested earlier.

Contact: R.H. Walker, 844-3994

Table 1. Effects of Row Spacing and Herbicides on Yield of Soybean When Planted Early June 1991, Tallassee[1]

Row spacing	No herbicide	herbicide[2]
	Bu./a	*Bu./a*
Rotill, 30 in.	20.5	22.9
Drill, 8 in.	21.6	24.3

[1] Average of three experiments with the Stonewall cultivar.

[2] Dual + Sencor (2 + 0.375 lb. ai/A). Weed species included large crabgrass, smooth pigweed, prickly sida, and sicklepod.

Table 2. Effects of Row Spacings, Herbicides, and Planting Dates on 1992 Soybean Yield, Tallassee[1]

Planting date	Drill—8 in. rows		Rotill—30 in. rows	
	No herbicide	herbicide[2]	No herbicide	herbicide
	Bu./a	*Bu./a*	*Bu./a*	*Bu./a*
April 30	31.5	37.2	26.1	29.7
June 22	24.2[3]	29.2	27.0	30.1

[1] Average of two experiments. Cultivars were Hutcheson (4/30) and Stonewall (6/22).

[2] Dual + Lexone and Dual + Canopy (2 = 0.375 lb. ai/A). Weed species included large crabgrass, smooth pigweed, prickly sida, and sicklepod.

[3] Low yields in one experiment due to poor stand with the drill planting.

A Flower and Pod Staging System for Soybean

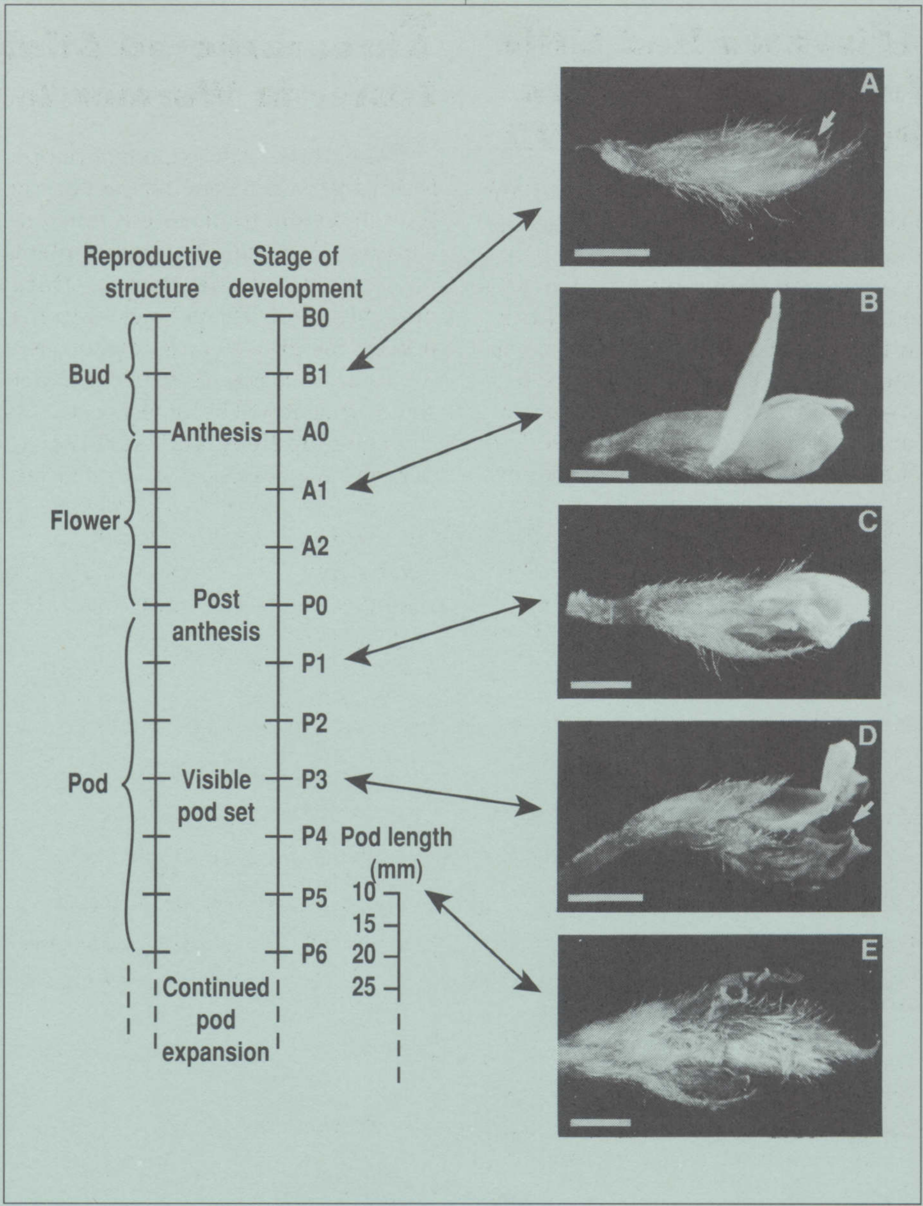
Most soybean flower and pod shedding, which can greatly limit yield, occur within 14 days after flowering, a time that includes the critical period of pod set and early pod extension. A system for quantifying flower and pod development based on the morphological appearance of the flower before and after flowering has been developed by Auburn University and USDA researchers.

Changes in the appearance of the flower petals are used to distinguish the different stages of the system. External dimensions of the pistil, or young pod, have been correlated with internal features of the immature seeds, or ovules, for each stage of development. See the figure showing flowers at several stages of development.

From flower opening to pod set, which is four to five days under typical field conditions, pistil length and weight increase about twofold and fivefold, respectively. Ovule development progresses from unfertilized egg cells to embryos surrounded by cellular endosperm. Pod lengths are correlated with ovule dimensions and embryo cell number.

Stages can be determined without removing flowers or pods from the plant, thus permitting observations or experiments to be completed without impeding pod development. The system identifies precise stages when pod set occurs and when young pods cease growing and eventually shed. This system of standardized descriptions of flower and pod development is useful in studies assessing effects of stress and genetic factors that influence pod set and abortion.

Contact: C.M. Peterson, 844-1632



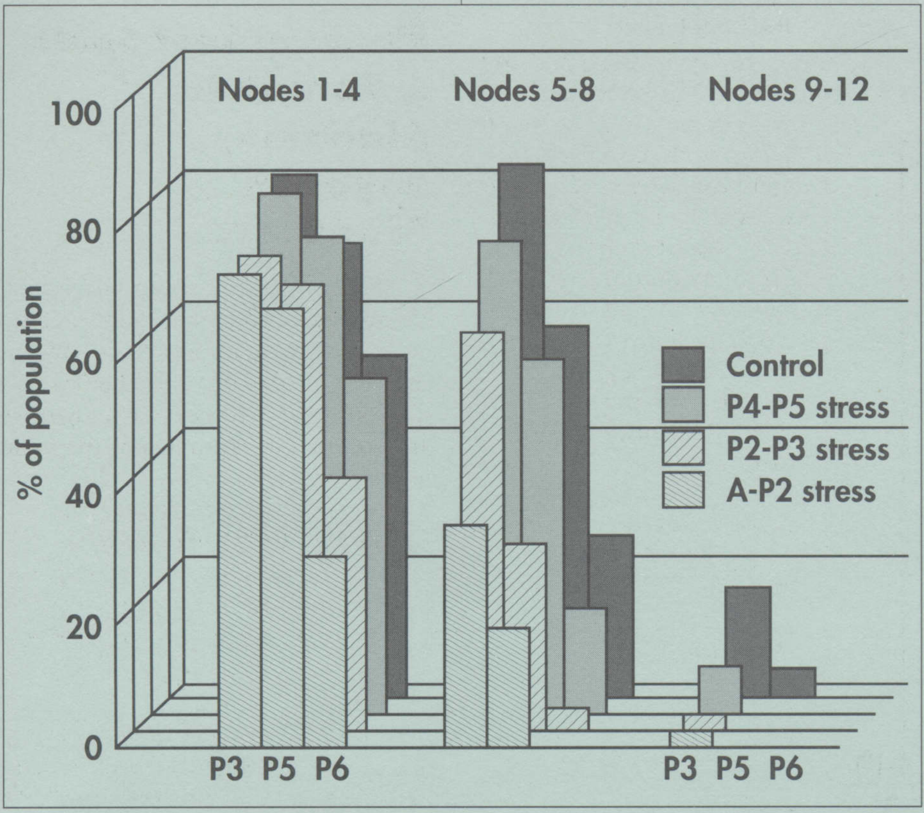
This figure shows the stages of soybean reproductive development from the flower bud to early pod extension: (A) B1 bud with the tip of the banner petal (arrow) slightly extended two days before flowering; (B) A1 flower with completely opened and reflexed banner petal at full flower; (C) P1 pod showing collapse and withering of the petals two to three days after flowering; (D) P3 or pod set stage with the stigma (arrow) beyond the withered petals at four to five days after flowering; and (E) P5 pod stage showing further pod extension beyond the withered corolla five to eight days after flowering. The bar on each photograph is two mm.

Flower and Pod Development in Water-Deficient Soybeans

Droughts during flowering and early pod development decrease soybean yield, primarily due to an increase in flower and pod abortion. Failure to set pods may indicate an inherent sensitivity to low tissue water potential at critical stages.

Water status and pod set of flowers exposed to water deficits at various stages of development from bud (B0) to early pod expansion (P5) were measured in a joint AAES/USDA project. See the figure with "A Flower and Pod Staging System for Soybean" for a description of flower and pod stages.

Results indicate that sensitivity of soybean flowers to low water potential varies with flower cluster position and



This figure shows the effect of brief water deficit on the percentage of the total flower population that set pods on the last-formed flower clusters of soybeans. Water was withheld for two days when flowers/pods at transition nodes (5-8) were at A-P2, P2-P3, or P4-P5 stages of development. Three stages of pod development (P3 = pod set; P5 = pods 10-20 mm; and P6 = pods greater than 20 mm) were present 10-12 days after rewatering, and the numbers of each stage are presented as a percentage of the total population. See the figure with a "A Flower and Pod Staging system for Soybean" for a description of flower and pod stages.

Water Deficient Soybeans, continued

stage of development. Flowers in mid-cluster positions are particularly vulnerable. Early ovary expansion is the critical stage in soybean reproductive development under drought conditions.

Water potential of leaves and reproductive structures decreased when water was withheld for two days, and then returned to normal values within one day. The water potential of pods that had just formed (P2) but were not set recovered more slowly. This brief water deficit decreased pod set on terminal flower clusters by as much as 70%.

The effect of low water potential on pod set varied with flower position on the cluster and stage of development. In general, low water potential during flowering and prior to rapid pod expansion (A to P2 stages) caused the largest decrease in pod set. See the figure with this report.

Reproductive structures at basal nodes of flower clusters (1-4) were least affected, regardless of when stress was imposed. Flowers borne on middle nodes (5-8) were far more vulnerable, and low water potential eliminated pod set almost completely at the last-formed nodes (9-12) of the clusters. Pods destined to shed ceased to develop at the P2 stage within three to four days of flowering.

Understanding the stage of development when soybeans need water the most can help producers time irrigation to this critical period and may also provide information useful in the selection of more drought-resistant strains.

Contact: C.M. Peterson 844-1632

Stimulation of Pod and Ovule Growth of Soybean by BAP

A staging system developed by Auburn scientists was used to study the influence of the plant growth regulator 6-benzylaminopurine, or BAP, on soybean flower and pod shedding.

Previous studies showed that shedding of last-formed flowers on flower clusters is preceded by starch depletion within the flowers or young pods three to four days after flowers fully open during the P2 stage of development. Loss of starch may signal the onset of abortion that leads to shedding. Some growth regulators have been shown to delay this abortion and in some cases actually increase the starch deposition generally associated with pod set.

Studies were performed to determine the influence of BAP on pod development at the last-formed flowers on terminal clusters. Three daily applications of lanolin or BAP in lanolin paste were made to the base of fully opened flowers at the four most distal flower nodes of flower clusters (D, D-1, D-2, and D-3).

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Alternative Rotation Crop for Nematode Control

Previous AAES research found that one of the best ways to control root-knot or soybean cyst nematodes is rotation with a nonhost crop combined with a nematode-resistant cultivar. Grass crops, such as bahiagrass, corn, and sorghum, are effective in reducing nematode populations and increasing soybean yields. During 1991-92, some less well-known crops were evaluated for their effectiveness in providing these benefits.

Velvetbean, an African legume that was once widely grown in Alabama as a nitrogen source, was shown to differ from most other legumes in

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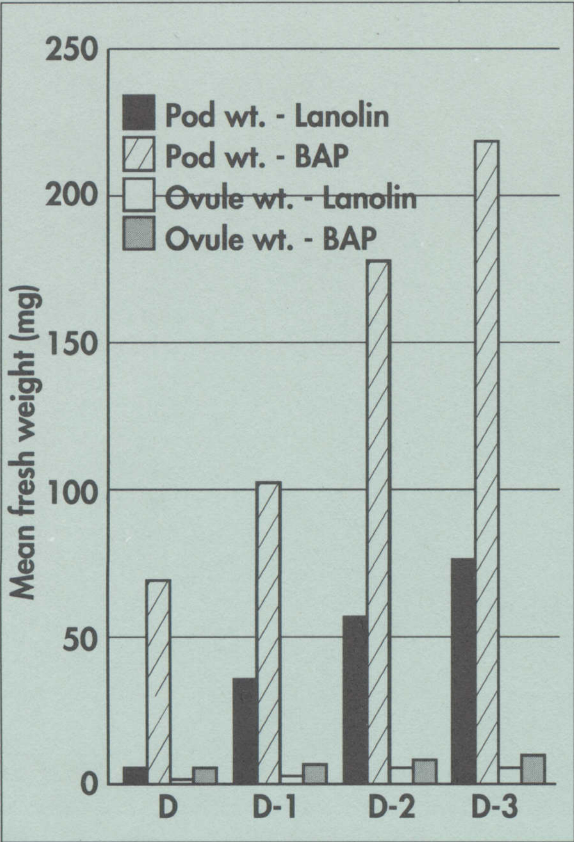

This figure shows mean fresh weight of pod walls and ovules collected from various positions on the flower cluster six days after the first lanolin or BAP application.

BAP, continued

BAP increased pod and ovule length, width, and weight at all four distal nodes within clusters when compared to controls treated with lanolin (see the figure). Greater amounts of starch were found in BAP-treated ovules, and this increased starch was associated with improved pod set.

Results indicate that BAP prevents shedding and stimulates renewed growth of distal pods by delaying the onset of abortion. Changes detected in the physical attributes of BAP-treated pods support this hypothesis.

Further research can use this information in two ways: (1) to pursue the development of a spray-on application of a pod-setting hormone such as BAP, or (2) to select for a soybean cultivar that is efficient at producing its own growth regulating hormone.

Contact: C.M. Peterson, 844-1632

Alternative Rotation Crop, continued

that it is a nonhost for both common species of root-knot nematode and the soybean cyst nematode.

Velvetbean and soybean were planted in 1991 in a field infested with a mixture of these nematodes to compare the response of a soybean crop planted at the site in 1992. Nematode populations prior to planting the 1992 soybean crop were much lower in the velvetbean plots than the soybean plots.

Yields in plots planted in soybeans for two consecutive years averaged 13.7 bushels per acre. Yields in plots planted first in velvetbean averaged 27.9 bushels per acre. Yields were averaged over seven cultivars with a wide range of nematode resistance (see the table). The highest yielding treatment was Leflore, a nematode-resistant cultivar, following velvet-bean, which produced 32.7 bushels an acre.

Further experiments are planned to evaluate the potential of velvetbean as a crop in Alabama and to determine the agronomic worth of various velvetbean types.

Contact: R. Rodriguez-Kabana, 844-5003

Yield of Seven Soybean Cultivars Following Soybean or Velvetbean as a Previous Crop in a Soil Infested with Root-knot and Soybean Cyst Nematodes, 1992

	Previous crop	
Cultivar	Soybean	Velvetbean
	Bu./a	*Bu./a*
Braxton	11.3	26.4
Brim	10.0	24.5
Bryan	15.2	29.5
Kirby	15.2	27.9
Leflore	18.3	32.7
Stonewall	11.8	24.9
Thomas	13.9	29.6

Frogeye Leaf Spot: A Threat to Alabama Soybean Producers

Frogeye leaf spot can have a significant negative impact on soybean yield. Severe outbreaks of the disease occurred in Alabama and elsewhere in the Southeast in recent years, but there are no reliable estimates of the yield loss caused by it.

The disease, which is caused by a wind-borne fungus similar to the one that causes early and late leaf spot of peanuts, is characterized by dead spots on the leaves. It gets its name from the gray color of these spots, which resemble a frog's eyes.

Moist conditions favor development of the disease, which causes damage by reducing the photosynthetic capacity of the leaf. AAES tests have shown that the severity of leaf symptoms is directly related to yield loss, and much of the yield loss is attributable to a reduction in individual seed weight.

Unlike leaf spot of peanuts, which is normally controlled by fungicide sprays, the best way to control frogeye is by growing soybeans with genetic resistance. Although resistant cultivars exist, many cultivars now grown in Alabama are susceptible.

To determine yield loss due to frogeye, Auburn researchers conducted a two-year project to test soybean lines that differed only in that one is susceptible and the other contains genes that provide resistance to the disease.

At the Gulf Coast Substation in Fairhope, no disease developed, and there was no difference between the resistant and susceptible lines.

At the E.V. Smith Research Center in Shorter, plots were inoculated with the disease. Conditions for inoculation were poor in 1991, and frogeye reduced the yield of susceptible plants by 5%. Inoculation in 1992 was more

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Diseases Had Little Impact on Soybean Production in 1992

Diseases were not an important factor in soybean production during the 1992 season.

Soybean stem canker, which devastated Alabama's soybean industry in the late 1970s and early 1980s, was not observed in the state, except in a few susceptible varieties at the E.V. Smith Research Center in Tallassee. Use of resistant varieties, adoption of new cultural practices, and unfavorable weather conditions for canker development are the principal reasons Alabama has not experienced the problems with stem canker as neighboring states have in recent years.

Sudden Death Syndrome (SDS) was observed in a few fields in Jackson County last season, but only one soybean field suffered appreciable losses to the disease. First observed in a soybean variety test at the Sand Mountain Substation in 1990, SDS has not been as serious a problem to soybean production in Alabama as it has been in Mississippi, Arkansas, Tennessee, Kentucky, and Illinois.

Pod and foliar diseases — Anthracnose and pod and stem blight — were responsible for an estimated 6-7% reduction in yield in 1992. Other foliar diseases such as frogeye leaf spot, brown spot, downy mildew, and cercospora leaf blight accounted for less than 2% yield losses in soybean last season.

Contact: W.S. Gazaway, 844-5505

EDITOR'S NOTE

April 1993 1 M

Threecornered Alfalfa Hoppers Grow Faster in Warmer Temperatures

The Threecornered alfalfa hopper is considered an economic pest of soybean in several southeastern states, including Alabama. They injure plants by girdling main stems, lateral branches, and leaf petioles. Information on the growth and development of this insect is needed to better understand when it will become a pest.

Development and survival of nymphs was assessed at 10 constant temperatures from 55 to 95°F. Twenty-four nymphs were reared at each temperature while individually caged on two-in. sections of beans in clear plastic Petri dishes. They were observed every 24 hours for molting or death.

Development increased with temperature from 55 to 90°F. Sixty-two to 100% of nymphs died at 95°F. Survival of nymphs to adulthood was greater than 50% at 80 to 85°F. Nymphs grew slowly or not at all in temperatures ranging from 55 to 60°F. These data indicate that threecornered alfalfa hoppers will grow and develop best during summer months, but will not grow well early in the growing season or when daily maximum temperatures regularly exceed 100°F.

Contact: T.P. Mack, 844-2558

Frogeye Leaf Spot, continued

effective, and yield of susceptible lines was reduced by 38%.

Greenhouse reaction to frogeye leaf spot for most cultivars available in Alabama will be published in the 1993 Soybean Variety Test Report.

Contact: D.B. Weaver, 844-3982

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