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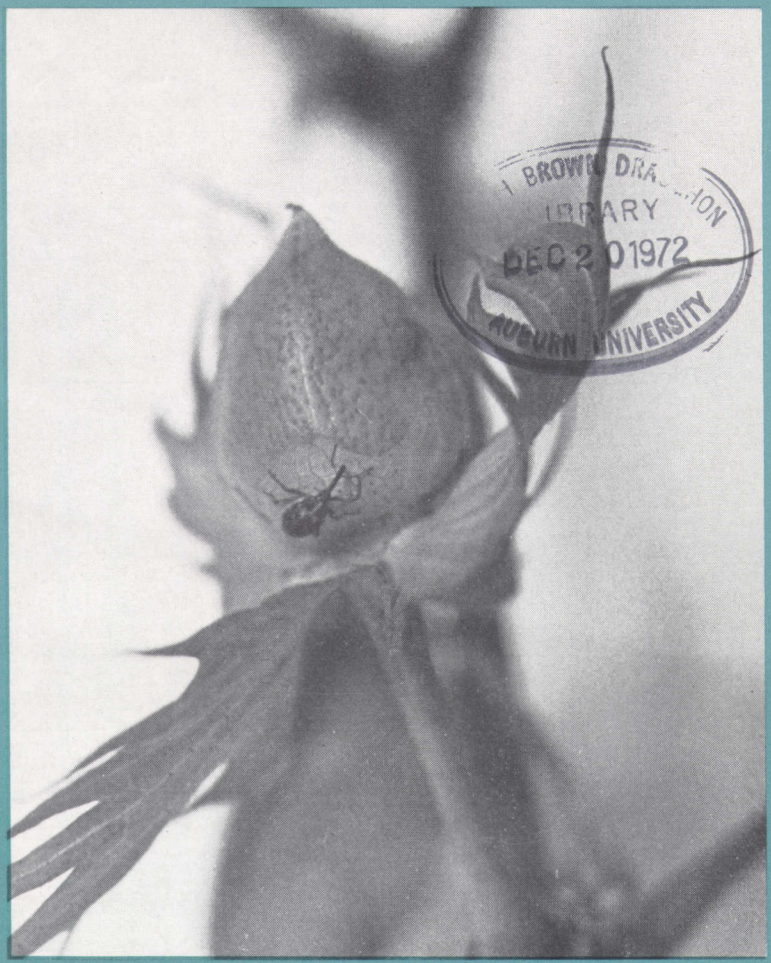

INFLUENCE OF SIMULATED EARLY-SEASON INSECT DAMAGE ON GROWTH AND YIELD OF COTTON

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Influence Of Simulated Early-Season Insect Damage On Growth And Yield Of Cotton

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DEVELOPMENT AND MATURATION of early-formed cotton squares (flower buds) generally have been considered essential for high cotton yields.

Producers often attribute most early-season square loss to injury from insects such as the cotton fleahopper, *Pseudatomoscelis seriatus* (Reut.), tarnished plant bug, *Lygus lineolaris* (P. de B.) and boll weevil, *Anthonomus grandis* Boheman. However, square abscission can be, and often is, a response to many other factors including drouth, temperature extremes, plant diseases, excessive soil moisture, and hereditary factors *(1,5)*. Fruit shed resulting from physiological stresses, i.e., natural shed, usually is slight early in the season while plants are young, but increases during the season. For a period of time after anthesis begins, flowering will greatly exceed shedding, but later in the season shedding of squares and young bolls may equal or outnumber the flowers produced *(1)*.

Several early workers, Eaton *(3)*, Hamner *(4)*, Dunnam et al. *(2)*, showed that early defloration caused no significant reduction in cotton yields, and in some cases they recorded yield increases. However, despite these reports, many still subscribe to the practice of protecting all early-formed squares, regardless of cost. Thus, experiments designed to simulate early-season insect square damage by manual removal of squares were conducted to determine the impact of early-season square loss on growth and yields of modern cotton varieties.

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PROCEDURES

These experiments were conducted at the Agricultural Engineering Research Unit near Marvyn, Alabama, in 1967, 1968, and 1969. The basic experimental method employed each year was similar; however, there were some changes each year in test procedures.

Square loss in response to insect injury was simulated by manual removal of all squares at weekly intervals for 1 to 6 weeks. Each year treatments were initiated when at least 50 per cent of the plants had at least one easily visible square. This date was arbitrarily selected as the date on which fruiting began. Squares were removed from the plants by pulling, breaking, or pinching the square from the fruiting branch. Care was exercised not to break branches or otherwise injure plants. Squares were removed from Treatment 1 for 1 week, from Treatment 2 for 2 consecutive weeks and so on until Treatment 6 had squares removed for 6 consecutive weeks, Table 1.

So that the effects of square loss would not be confounded with insect injury, injurious insect infestations were suppressed to very low levels throughout the test by regular applications of recommended insecticides.

In 1967, Coker 413 cotton was used for the test. Plots were planted April 19 in a solid pattern on 40-inch rows. Each treatment was replicated three times in single-row plots 25 feet long. Subsequent to square removal plant height and fruiting were monitored. All plots were hand harvested on November 19. During the picking operation, care was taken to exclude burrs and other extraneous plant matter from the samples.

In 1968, Coker 413 cotton was again used for the test. Plots were planted April 18 in the same pattern as 1967. Treatments

TABLE 1. DESCRIPTIONS OF TREATMENTS IN SQUARE REMOVAL TEST, MARVYN, ALABAMA

Treatment No.	Description
1	All sq. removed during first week of squaring
2	All sq. removed at weekly intervals for 2 weeks
3	All sq. removed at weekly intervals for 3 weeks
4	All sq. removed at weekly intervals for 4 weeks
5	All sq. removed at weekly intervals for 5 weeks
6	All sq. removed at weekly intervals for 6 weeks
7	Check (No. sq. removed).

were replicated four times in single-row plots 10 feet long. The effect of square loss on plant height was assessed by measuring 25 marked plants in each treatment at weekly intervals for 7 weeks following the first date of square removal. All plots were hand harvested on December 13.

In 1969, Auburn 56 cotton was planted on April 22 for the test, using the same planting pattern as the previous 2 years. Each treatment was replicated five times in single-row plots 10 feet long. Twenty-five plants were tagged and measured each week for 6 weeks following the first date of square removal to assess the effects of square removal on plant growth. Plant fruiting subsequent to square removal was assessed by determining the type and number of fruiting structures present on September 8, i.e., 11 weeks after square removal began. Cotton in all treatments was hand harvested on October 17 and November 14.

RESULTS AND DISCUSSION

1967

Although some variation in plant height within treatments was observed, the average plant height in all treatments where squares were removed was greater than for plants in the check, Table 2. The increase in plant height was most noticeable in those treatments where square removal occurred for 3 or more weeks.

Counts of fruiting structures present 12 weeks after the first date of square removal also show the impact of complete defloration on the cotton plants, Table 3. Plants undergoing com-

TABLE 2. HEIGHT OF COTTON PLANTS SUBSEQUENT TO EARLY SEASON SQUARE LOSS, MARVYN, ALABAMA, 1967

Treatment[1]	Av. plant height[2]			
	8/1	8/14	8/22	8/28
	In.	*In.*	*In.*	*In.*
1	40	46	45	47
2	38	45	47	49
3	43	48	49	51
4	45	50	48	48
5	42	49	50	52
6	38	46	54	51
7	39	41	44	46

[1] See Table 1 for description of treatments.
[2] Averages based on measurement of 30 plants.

TABLE 3. NUMBER OF FRUITING STRUCTURES PRESENT 12 WEEKS AFTER FIRST DATE OF SQUARE REMOVAL, MARVYN, ALABAMA, 1967[1]

Treatment[2]	Av. sq./acre	Av. bolls/acre[3]	Av. cracked or open bolls/acre
	No.	*No.*	*No.*
1	0	75,764	0
2	0	83,200	0
3	0	77,116	0
4	7,956	76,440	0
5	23,920	60,476	0
6	43,836	75,244	0
7	0	65,520	10,088

[1] Data are based on complete counts of all fruiting structures in each replicate on 9/12/67.
[2] See Table 1 for description of treatments.
[3] Blooms were counted as bolls.

plete square loss for 5 and 6 consecutive weeks were still developing squares whereas plants in the other treatments were devoid of squares. Boll counts indicated little differences in the number of bolls present in all treatments. However, the bolls present in treatments where squares were removed for 5 and 6 weeks were still quite small, while the check and plots where squares were removed for 1 to 4 weeks had larger and more mature bolls. Only the check had bolls that had matured to the open stage.

Yield data, Table 4, reflect the immaturity of the bolls found in the plots subjected to square removal for 5 or 6 successive weeks. Although harvesting was delayed until after cold weather had terminated boll maturation, many of the bolls produced by

TABLE 4. YIELD OF SEED COTTON FROM SQUARE REMOVAL TEST, MARVYN, ALABAMA, 1967

Treatment[1]	Yield per acre replicate[2]			Mean[3]
	1	2	3	
	Lb.	*Lb.*	*Lb.*	*Lb.*
1	2,132	2,366	2,756	2,418 a
2	1,950	2,444	2,964	2,454 a
3	2,548	2,444	2,184	2,392 a
4	2,366	2,314	2,678	2,454 a
5	1,664	1,742	1,690	1,700 b
6	1,170	1,534	1,118	1,274 b
7	2,262	2,392	2,470	2,376 a

[1] See Table 1 for description of treatments.
[2] Hand harvested 11/19.
[3] Means followed by same letter are not significantly different at the 5% level.

TABLE 5. HEIGHT OF COTTON PLANTS SUBSEQUENT TO EARLY SEASON SQUARE LOSS, MARVYN, ALABAMA, 1968

Treatment[1]	Average plant height[2]					
	7/1	7/8	7/15	7/22	7/29	8/7
	In.	*In.*	*In.*	*In.*	*In.*	*In.*
1	22.0	27.2	31.8	37.4	42.4	46.2
2	21.4	25.0	30.0	36.8	43.2	48.6
3	21.0	26.4	32.8	38.6	46.4	50.4
4	20.4	27.0	30.8	37.2	44.0	48.6
5	20.8	25.6	30.6	37.8	44.2	48.8
6	21.6	25.8	30.2	35.6	41.4	45.6
7	23.0	28.6	33.0	38.8	43.6	47.8

[1] See Table 1 for description of treatments.
[2] Averages based on measurement of 25 plants per treatment.

plants in these two treatments did not mature. Whereas the check and plots subjected to complete square removal for 1 to 4 weeks showed no significant differences in yield, the yields from the plots subjected to 5 and 6 weeks of square loss were significantly lower.

1968

During the early part of the 1968 test (until July 15), plants in the check plots were taller than plants in any of the plots where plants were deflorated, Table 5. By late July, however, plants in most of the treatments subjected to square loss had become taller than plants in the check. By August 7, the last day of plant measurement, two square removal treatments, 1 and 6, had plants shorter than the check. It was difficult to explain why plants subjected to 6 weeks of square loss were shorter than plants in the check. In 1967, plant measurements made on August 1 showed a similar situation; however, by late August plants in Treatment 6 were considerably taller than plants in the check, Table 2.

Counts of the various cotton plant fruiting structures were not made in 1968. However, periodic observations of the test plots showed the check plots to be the first treatment to have open bolls (August 10). In Treatment 1, open bolls were first observed on August 17, 56 days after squares were removed from the plants in those plots. Treatment 2, where squares had been removed for 2 successive weeks, had open bolls on August 23. On this date, the check plots had an average of 145,600 bolls

TABLE 6. YIELD OF SEED COTTON FROM SQUARE REMOVAL TEST, MARVYN, ALABAMA, 1968

Treatment[1]	Yield per acre replicated[2]				Mean[3]
	1	2	3	4	
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*
1	1,017	1,326	1,131	1,213	1,171 ab
2	982	1,014	950	1,017	991 bc
3	1,037	668	845	935	871 c
4	471	467	692	751	595 d
5	455	476	514	601	511 d
6	385	430	407	542	441 d
7	1,257	1,187	1,699	1,135	1,326 a

[1] See Table 1 for description of treatments.
[2] Hand harvested 12/11/68.
[3] Means followed by same letter are not significantly different at the 5% level.

per acre, 65 per cent of which were open. Plants subjected to 5 and 6 weeks of square removal (Treatments 5 and 6) were still blooming vigorously on August 23. Open bolls were observed in Treatment 3 on August 23 and in Treatments 4 and 5 on September 10. By this time (September 10), 100 per cent of the bolls in the check plots were cracked or open; 80 per cent of the bolls in Treatment 1 were cracked or open; and 70 per cent of the bolls in Treatment 2 were cracked or open.

Yield data for the 1968 test, Table 6 again reflected the influence of early season square loss. However, unlike 1967, plots subjected to 2 or more weeks of square loss produced significantly less cotton than the check plots. Perhaps the relatively little rainfall at the test site in 1968, Table 7, inhibited the cotton plants demonstrated capacity to replace lost squares.

1969

Plant height data, Table 8, followed the pattern observed in 1967 and 1968. Early measurements, made prior to mid-July,

TABLE 7. MONTHLY RAINFALL RECORDED AT THE SITE OF THE SQUARE REMOVAL SITE, MARVYN, ALABAMA

Year	Month			
	June	*July*	*Aug.*	*Sept.*
	In.	*In.*	*In.*	*In.*
1967	8.37	9.01	4.13	3.70
1968	1.60	3.02	1.70	2.05
1969	2.90	3.87	4.39	7.00

TABLE 8. HEIGHT OF COTTON PLANTS SUBSEQUENT TO EARLY SEASON LOSS, MARVYN, ALABAMA, 1969

Treatment[1]	Average plant height[2]					
	7/1	7/8	7/15	7/22	7/29	8/5
	In.	*In.*	*In.*	*In.*	*In.*	*In.*
1	24.2	25.2	28.2	29.0	29.1	29.0
2	24.6	25.2	29.3	30.4	30.8	30.4
3	24.4	24.8	27.6	28.4	29.2	29.2
4	26.4	27.6	29.7	30.3	30.4	31.2
5	24.2	25.6	27.0	27.7	28.5	28.1
6	23.6	25.5	27.0	28.3	28.8	28.8
7	24.4	26.0	27.4	28.0	27.8	27.8

[1] See Table 1 for description of treatments.
[2] Averages based on measurement of 25 plants per treatment.

showed plants in the check were taller or as tall as plants in plots subjected to square loss. However, by the first week in August, plants that had lost early season squares had become taller than plants in the check plots.

Plants in all treatments fruited much more in 1969 than in the 2 previous years. Counts made 11 weeks after the first date of square removal, Table 9, showed that plants in all plots except Treatment 4 had considerably more than 200,000 fruiting structures per acre. Plants in the check plots (Treatment 7) had fewer total fruiting structures than several square removal treatments; however, all of the fruit in the check plots were bolls, 29 per cent of which were already cracked or open. Over one-third of the fruit in Treatment 6 (plants subjected to 6 successive weeks of square loss) were squares.

TABLE 9. NUMBER OF FRUITING STRUCTURES PRESENT 11 WEEKS AFTER FIRST DATE OF SQUARE REMOVAL, MARVYN, ALABAMA, 1969[1]

Treatment[2]	Av. sq/acre	Av. bolls/acre[3]	Av. cracked or open bolls/acre
	No.	*No.*	*No.*
1	0	197,600	20,800
2	7,800	377,000	0
3	0	278,200	0
4	0	197,600	0
5	28,600	223,600	0
6	130,000	226,200	0
7	0	195,000	78,000

[1] Data based on counts of fruiting structures/10 row feet on 9/8/69.
[2] See Table 1 for description of treatments.
[3] Blooms were counted as bolls.

TABLE 10. YIELD OF SEED COTTON FROM SQUARE REMOVAL TEST, MARVYN, ALABAMA, 1969

Treatment[1]	Yield per acre replicated[2]					Mean[3]
	1	2	3	4	5	
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
1	3,770	4,407	3,770	3,783	3,627	3,871 a
2	3,029	4,420	3,224	4,264	3,172	3,621 a
3	3,562	3,653	3,328	4,186	3,757	3,697 ab
4	3,380	3,185	3,068	3,055	2,691	3,075 bc
5	2,470	2,652	3,458	2,639	2,678	2,779 cd
6	2,522	2,197	1,872	2,743	2,184	2,303 d
7	3,536	3,965	3,809	3,016	3,887	3,642 a

[1] See Table 1 for description of treatments.
[2] Hand harvested on 10/17 and 11/14. Data includes total for both harvests.
[3] Means followed by same letter are not significantly different at the 5% level.

Yields in all treatments were much higher in 1969 than the 2 previous years, Table 10. Total early season square loss for up to 3 successive weeks did not result in any reduction in seed cotton yield.

General Discussion

The results of this experiment may well give cause for some reassessment of the importance of certain early-season insect infestations. Obviously, the cotton plants have the capacity to replace all of the squares lost to early-season attack from such insects as plant bugs and boll weevil. However, the indication that some early-season loss of squares to insect injury might even be beneficial must be considered with caution. Adverse climatic conditions during the period following the loss of early-season squares could seriously inhibit capacity of cotton plants to compensate for the square loss. Also, in the event of an early onset of cold weather in the fall, a delay in the boll maturity, caused by the loss of early-season squares, might have a disastrous effect on yields. One must also consider the impact of providing an abundance of late season squares and developing bolls as food for the diapausing generation of the boll weevil and bollworm, *Heliothis* spp., during September and October.

These considerations, however, should not obscure the important point that can be made from the results of this experiment. That is, heavy infestations of square-feeding insects during the early part of the season (prior to the third week of squaring) should not necessarily be of great immediate concern.

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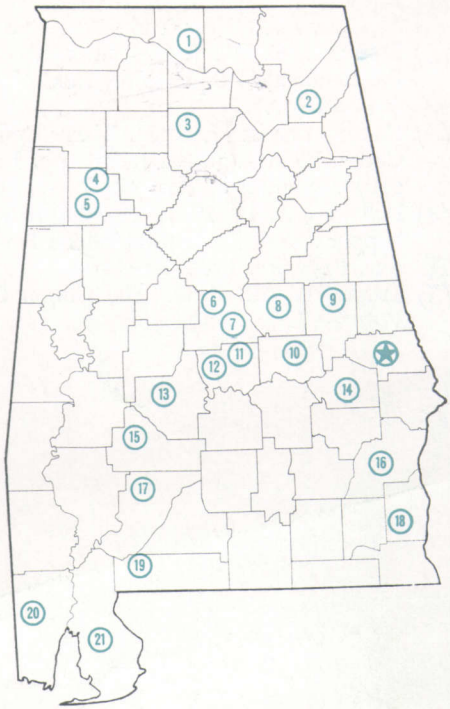

Research Unit Identification

★ Main Agricultural Experiment Station, Auburn.

1. Tennessee Valley Substation, Belle Mina.
2. Sand Mountain Substation, Crossville.
3. North Alabama Horticulture Substation, Cullman.
4. Upper Coastal Plain Substation, Winfield.
5. Forestry Unit, Fayette County.
6. Thorsby Foundation Seed Stocks Farm, Thorsby.
7. Chilton Area Horticulture Substation, Clanton.
8. Forestry Unit, Coosa County.
9. Piedmont Substation, Camp Hill.
10. Plant Breeding Unit, Tallassee.
11. Forestry Unit, Autauga County.
12. Prattville Experiment Field, Prattville.
13. Black Belt Substation, Marion Junction.
14. Tuskegee Experiment Field, Tuskegee.
15. Lower Coastal Plain Substation, Camden.
16. Forestry Unit, Barbour County.
17. Monroeville Experiment Field, Monroeville.
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21. Gulf Coast Substation, Fairhope.