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Effect of Early Season Square Removal on Three Leaf Types of Cotton[1]

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ABSTRACT

In certain environments, reduced leaf-open canopy cottons (*Gossypium hirsutum* L.) allow more light penetration and air circulation within their canopies than do normal leaf types. However, too much reduction in canopy can reduce overall productivity and economic yield. Removal of floral buds (squares) early in the season has been shown to result in larger plant size. Square removal was carried out in the field (fine-silty, mixed, thermic, Aquic Fragiudalf soil type) on normal, okra, and super okra leaf type near-isogenic lines of a 'Stoneville 213' background cotton for 3 and 6 weeks to determine i) if improved yield could be obtained in one or both open canopy types by enlarging the canopy and ii) if delaying fruit set produced differential responses in these leaf types. Results would form a basis for development of a boll weevil (*Anthonomus grandis* Boh.) trap crop system using exogenous chemicals to effect square abscission. Removal of squares increased plant height, leaf area index (LAI) and number of sympodial branches. The super okra leaf type produced the greatest responses to square removal. Fruit set was more rapid and occurred during a shorter interval for all leaf types undergoing square removal for 3 weeks, but the greatest response was obtained from super okra. Comprehensive analysis in 1983 indicated the rapid fruit set was due primarily to more sympodia fruiting simultaneously. The 3-week treatment was more consistent in this response than the 6-week treatment because of the generally shorter horizontal and vertical flowering intervals. Economic yield of normal and okra leaf types was generally not improved by square removal, whereas the super okra leaf type in the 3-week square removal treatment produced an average 23.5% greater lint yield than its control. Differences in lint percentage were significant between treatments in 1981 with significant leaf type by treatment interactions in 1983. The data indicate that the super okra leaf type had the most consistent responses to 3 weeks of manual square removal. These results imply that this leaf type would produce the best response to exogenous chemical abscission of squares and the greatest chance of recovery from early season insect pressure.

Additional index words: Gossypium hirsutum, Okra leaf, Super okra leaf, Fruiting rate, Leaf area index.

OKRA leaf type (OL) and super okra leaf type (SOL) cottons (*Gossypium hirsutum* L.) have certain advantages over normal leaf type (NL) cotton. Both OL and SOL have shown an increased boll rot resistance (1, 2) presumably due to lower humidity, and better air circulation and light penetration within the canopy (16). SOL strains have the potential for improved drought tolerance as indicated by higher photosynthetic rates and higher leaf water potential at low soil moisture than a NL (17). Pegelow et al. (25) found the CO_2 exchange rate (CER) per unit leaf area to be consistently greater in the SOL compared with a NL. The OL had a CER similar to SOL when the leaf area index (LAI) was similar. Improved CER per unit leaf area was attributed to increased light penetration and reception by individual leaves in the OL and SOL canopies. The lower LAI of one or both leaf types compared with a NL canopy produced a lower CER per unit ground area. The reduced canopy size could therefore limit economic yield of these leaf types, especially the SOL. Jones (16) reported that three SOL isolines averaged 8% less lint yield than their NL counterparts in a two year study, with yields reduced by 26% compared to NL cotton at one location. The OL isolines, however, produced an average yield that was 5% greater than that of the NL lines.

Considerable data have been collected on the effects of fruit structure removal on growth and yield of cotton (4, 5, 6, 7, 8, 9, 10, 11, 13, 24). The data demonstrate that prolonged removal of fruiting structures (i.e. flower buds, flowers or young bolls) increases plant size. Increasing the size of OL and especially SOL plants would tend to increase LAI and, based on the data of Pegelow et al. (25), potentially increase CER per unit ground area. Reports regarding the effect of fruiting form removal on an economic yield have been inconsistent. Data indicate that yields either varied inconsistently from year to year (5, 10, 13, 24), consistently improved (8, 9), or decreased if fruiting forms were continually removed for long periods (5, 10). Increased flower numbers and increased flowering rate or boll carrying capacity have also been associated with fruiting form removal (4, 8, 9). Eaton (8) indicated the more "determinate" a cultivar, (i.e., cultivars which set fruit in a shorter period of time), the more noticeable the responses should be to fruiting form removal. A recent review of open canopy (i.e. OL and SOL) cottons (16) indicated that OL and SOL flowering rates can be 100 and 150% greater than NL, respectively, and this rapid flowering rate leads to earlier maturity. Thus, early season square removal should have a more pro-

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nounced effect on the OL and SOL than on NL cotton. Such information also implies a greater possibility of recovery from early season insect pressure by these leaf types compared with NL, although complete square removal simulates a severe infestation only.

The objectives of this research were to i) determine the effect of increased plant size, caused by delayed flowering and boll set, on subsequent boll set and economic yield of the open canopy leaf types; and ii) determine differential responses in various growth parameters by plants of different leaf types to these treatments.

MATERIALS AND METHODS

Plant materials were near-isogenic lines differing in leaf type (NL, OL, and SOL). The OL and SOL types were developed by crossing 'Stoneville 7a' background lines of the respective leaf types, L^o (Stv. 7A)4 and L^s (Stv. 7A)6, to 'Stoneville 213' and backcrossing eight times to Stoneville 213, with the last five backcrosses being made to highly inbred lines of Stoneville 213 (LA. 213–16303–613). The OL and SOL near-isolines were established by selecting for the respective leaf types in the F_2 generation following the last backcross. The recurrent parent, LA. 213–16303–613, was used as the NL near-isoline. The seed supply of all entries was increased in 1976 in an area of low outcrossing and placed in cold storage to maintain seed viability.

Tests were planted in an Olivier silt loam (fine-silty, mixed, thermic, Aquic Fragiudalf) at Perkins Road Farm, Baton Rouge, LA. Planting dates were 18 May, 10 May, and 27 May in 1981 through 1983, respectively. Plant stands were thinned to 10 plants m^{-1} by the second or third true leaf stage. Plot were fertilized with 336 kg ha^{-1} 8–10–20 N-P-K preplant and an additional 40 kg ha^{-1} N as NH_4NO_3 during the square-producing stage of development. Weed control was maintained with a preplant application of trifluralin (α, α, α — trifluoro-2, 6-dinitro-N-N-dipropyl-p-toluidine), a preemergence application of fluometuron (3-(m-trifluoromethyl phenyl)-1,1-dimethyl urea), a postemergence application of fluometuron + MSMA (monosodium acid methane-arsenate), and additional spot spraying and hoeing as needed. Insect control was maintained by weekly applications of synthetic pyrethroids, either fenvalerate (cyano(3-phenoxyphenyl)methyl 4-chloro-(methylethyl)=benzene acetate) or permethrin ((3-phenoxyphenyl) methyl 3-(2, 2-dichloroethenyl)-2, 2-dimethylcyclopropane-carboxylate) and/or azinphosmethyl (0, 0-dimeyl S-[(4-oxo-1,2,3-benzotriazin-3(4H)-yl)methyl]phosphoro-dithioate). This regime, however, did not reduce a large, late season insect population in 1982. Therefore, insect control was augmented by the weekly application of carbaryl (1-naphthyl methylcarbamate) in 1983. This regime successfully controlled late season insects that year.

Square removal treatments began when a majority of plants had observable squares. Squares were manually removed at weekly intervals for periods of 3 or 6 weeks. Plots consisted of five rows each 1 m apart and approximately 7.6 m in length in 1981 and 10.6 m in 1982. Economic yield and fiber properties were determined from the center row with a border of 1.6 m on both ends. Two plants were removed from the two rows adjacent to the center row of each plot at various times during the season. In 1981, plants were removed first at weekly intervals and later at biweekly intervals from first flower through crop maturity for each treatment. In 1982, plants were removed biweekly from square stage to crop maturity in each treatment. Plant height, number and type (sympodial, monopodial) of branches and number and type (vegetative, reproductive) of leaves were determined on each plant. Leaf area of vegetative and reproductive leaves was measured on either a Licor LI-3000 or a Hayashi-Denko AAM-5 area meter, and leaf area of both types of leaves was combined to determine LAI. Flowers were counted in the center row 1 day per week in 1982. In 1983, plots consisted of four rows approximately 4.5 m in length. LAI was not determined in 1983 due to reduced plot size. Flowers were tagged daily on plants located in the central 1.5 m of the two inside rows of each plot. At the end of the season, plants were diagrammed according to procedures similar to those of Munro and Farbrother (22) and all tagged, retained bolls and plant heights were recorded. Economic yield and fiber properties were obtained from bolls within the tagged area. There were two replicate plots per leaf type by treatment in a simple factorial, randomized complete block design. The average of the two inside rows of each plot was used as a statistical replication in 1983.

RESULTS AND DISCUSSION

Vegetative Growth

In general, plant size, indicated by height, branching, and LAI, increased with increased duration of square removal treatment (Table 1). Where treatments did not show increases over the control, a reduced early growth rate may have been the major contributing factor. On a 3-year average, the 3-week and 6-week square removal treatments for all leaf types averaged 15% and 27% increases above controls for plant heights, respectively. Production of sympodial branches was greatest for the SOL with significant increases of 49% and 75% sympodia over that of the control for the 3-week and 6-week treatments, respectively (3-year combined analysis). The NL and OL plants had similar 3-year average increases in sympodia number (15% vs. 14% and 34% vs. 37% for NL vs. OL for the 3- and 6-week square removal treatments, respectively). Average LAI was increased by the 6-week square removal treatment, with increases in the NL usually being larger than for either reduced leaf type. The SOL made gains in LAI with the 3-week square removal treatment and was not affected by further square removal. The maximum individual LAI data suggest that some plants had excessive leaf area that may have caused problems of self shading and reduction of insecticide penetration (15). As with average LAI, maximum individual LAI within the sampling period was greatest for the NL. The increases in all parameters observed in 1982 can be partially attributed to strong late-season insect pressure that undoubtedly advanced the vegetative growth effects initiated by early season square removal. Although LAI was not determined in 1983, observations indicated that square removal treatment plots produced larger, leafier plants than controls and most probably had larger LAI values than controls.

Sympodial leaf number was highly correlated with plant height for all leaf types whereas the LAI correlation with height declined the more each isogenic line's climax leaf shape and size was reduced (Table 2). This suggested that number of leaves increased

Table 1. Effect of square removal treatments and leaf types on plant height, sympodia number, and leaf area index (LAI) of field-grown near-isogenic cottons.

		Plant height‡			Sympodia/plant‡			LAI			
								Average§		Maximum¶	
Leaf type	Treatment†	1981	1982	1983	1981	1982	1983	1981	1982	1981	1982
		cm			no.			$m^2 m^{-2}$			
Normal	Control	113.9	120.3	85.3	22.2	24.1	15.5	3.77	3.58	4.76	4.97
	3-week square removal	113.0	153.4	101.9	21.3	31.0	18.4	3.21	3.95	5.74	7.79
	6-week square removal	152.4	160.3	109.2	27.1	33.2	22.9	4.86	5.25	7.78	8.07
Okra	Control	118.6	109.1	85.2	20.8	26.6	18.3	3.21	2.81	4.56	4.20
	3-week square removal	110.5	151.5	92.1	23.2	34.2	17.2	2.93	3.75	4.34	6.49
	6-week square removal	130.9	165.7	106.6	29.1	36.8	24.2	3.56	3.72	5.10	6.15
Super Okra	Control	99.7	101.6	85.5	18.2	26.2	23.3	1.83	2.19	2.88	3.93
	3-week square removal	110.1	115.6	110.7	30.8	38.1	32.3	2.78	2.46	3.96	4.00
	6-week square removal	118.7	137.0	91.2	35.0	46.3	37.1	2.46	2.43	3.79	4.26
	LSD 0.05	10.1#	8.6#	12.4††	4.6††	7.2††	3.3#	0.65#	0.64#	NS	1.20#

† Control treatments had no manual square removal. Weekly manual square removal for periods of 3 or 6 weeks after first observable squares were the 3-week (square removal) and 6-week (square removal) treatments, respectively.
‡ Based on plants at the end of the season where differences in height or sympodial number between sampling dates were NS.
§ Taken from boll set period to period prior to appreciable LAI reduction due to leaf senescence.
¶ Maximum individual LAI taken during the above period.
# Significant treatment effect and significant leaf type effect only.
†† Significant treatment effect only.

Table 2. Correlation coefficients of total sympodial leaves, sympodial branches and leaf area index (LAI) with plant height for normal, okra, and super okra leaf type near-isogenic lines in 1981 and 1982.

	Total sympodial leaves†		LAI†		Sympodial branches‡	
Leaf type	1981	1982	1981	1982	1981	1982
Normal	0.86***	0.72***	0.75***	0.47***	0.67***	0.54***
Okra	0.75***	0.73***	0.51**	0.43**	0.47***	0.47***
Super Okra	0.73***	0.71***	0.35**	0.05 NS	0.52***	0.56***

*,**,*** Significant at $P < 0.05$, 0.01 and 0.001 respectively ($n = 48$ for each leaf type in each year).
† Correlation coefficients determined from boll set to prior to appreciable leaf senescence.
‡ Correlation coefficients determined at the end of season where differences between sampling dates were NS.

as the plant grew taller, but individual leaf area became more reduced as sink competition increased, and this reduction became more acute the more the climax leaf shape was genetically reduced. The moderate correlations of sympodial branch number with height (Table 2) may indicate that change in internode length and/or the development of sympodia on monopodial branches affected this relationship. Although there was no significant difference in monopodia production by leaf types or treatments in either 1981 or 1982, correlation coefficients between sympodia number and monopodia were equivalent to those between sympodia number and height in 1982 but were lower in 1981.

Reproductive Growth

The effect of square removal treatments on weekly boll carrying patterns for the SOL (Fig. 1) was generally similar for each leaf type. An exception was the 6-week square removal treatment for the NL which was similar to the control. The lack of baseline points at 3 weeks from first control flowers in the 3-week treatment is due to having missed the small number of earliest flowers produced. Weekly flowering patterns (data not presented) essentially paralleled the boll carrying patterns, but differed in magnitude between leaf types. The SOL produced a greater number of flowers per week than the other leaf types because of the greater number of fruiting sites for this leaf type (18). A similar, rapid flowering response was observed for the SOL when flowers were counted 1 day per week in 1982. The rapid onset of flowering indicated by Eaton (8) and Dale (4) and the compressed period of boll setting as indicated by Hamner (13) were clearly evident for each leaf type. The rapid rate of fruiting in the 3-week square removal treatment produced maximum accumulation of bolls at the same approximate time as controls (Fig. 2B and 3B). Boll accumulation patterns for the OL were similar to the NL and SOL for 3 and 6 weeks of square removal, respectively. Rates of accumulation for bolls in the linear portion of the curve in the 3-week square removal treatment were 162, 106, and

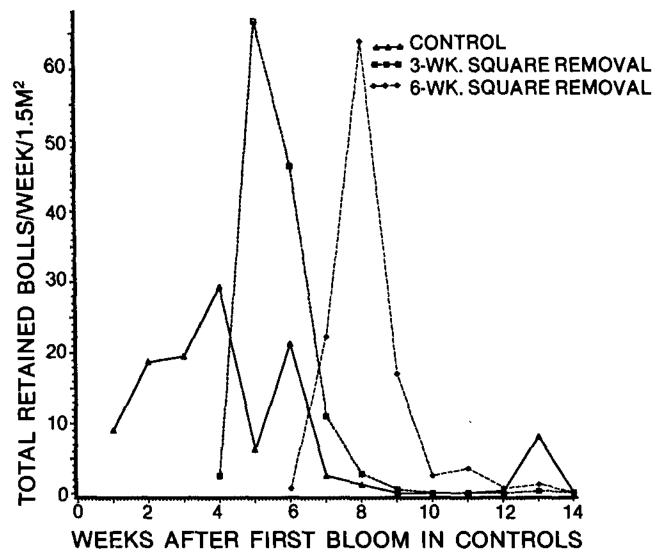

Fig. 1. Effect of weekly square removal for 0 weeks (control), 3 weeks (3-week square removal), and 6 weeks (6-week square removal) on weekly retained bolls for the super okra leaf type near-isogenic line. 1983.

237% greater than controls for NL, OL, and SOL, respectively (Table 3). Flowering rates for the 3-week treatment were 61, 66, and 135% greater than controls for NL, OL, and SOL, respectively, Eaton (8) indicated that the probability was greater for larger responses to early season square removal being obtained with more "determinate" types of cottons since 'Acala' was more responsive than 'Pima'. Patterson et al. (24) found a 'Deltapine' cultivar more responsive than a variety of Acala. The SOL is a rapid-fruiting cotton and is more "determinate" than its NL and OL counterparts (16). This study has shown the response of flowering and boll set rates after 3 weeks of square removal in 1983 to be considerably greater in the SOL compared with the OL or NL.

The cause of the rapid fruit-set was not clearly established, but three morphologically-based factors are possible. During the flower tagging process in the square removal treatment plots in 1983, it was noted that on a given branch two flowers occasionally appeared within a much shorter time interval than indicated by published values (21) for normal development; sometimes they appeared on the same day. At least one of these flowers was of second axillary origin. It was originally thought that the increased rate of flowering in square removal treatment plots might have resulted largely from the increased number of second axillary fruiting sites. However, the greater number of second axillary fruiting sites in the 6-week vs. 3-week square removal treatments did not correspond to an increase in flowering rate over that of the 3-week treatment (Table 3). An increased vertical flowering interval in the 6-week treatment (Table 3) might have negated the effect of second axillary fruiting site production on flowering rates in that treatment. Thus, the contribution of second axillary flowers appears to have been more toward total flower production than flowering rate.

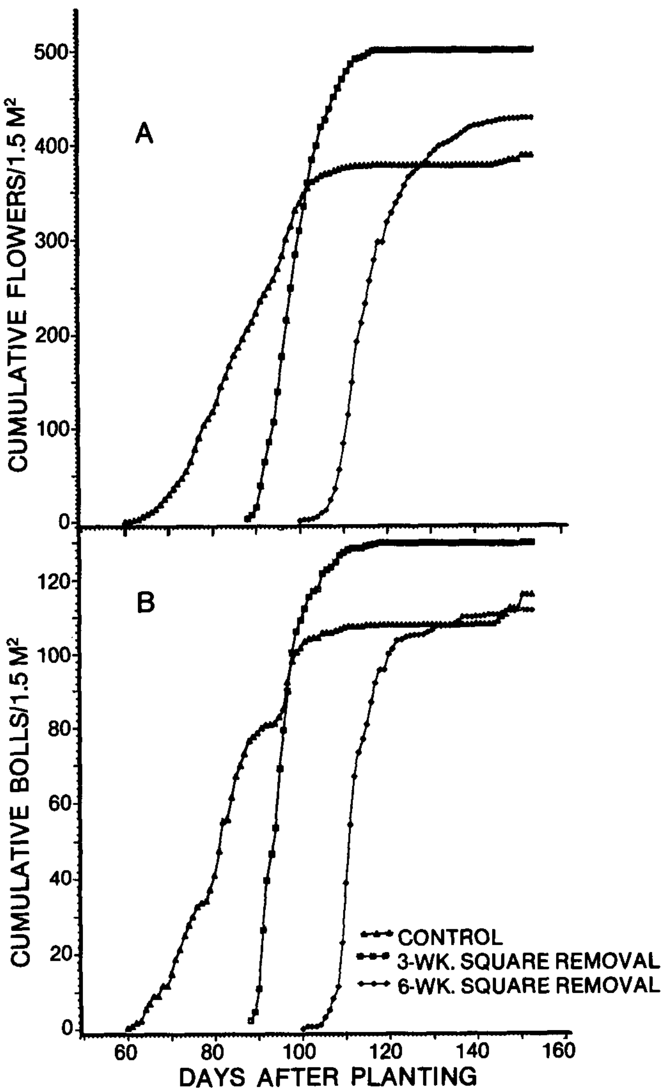

Fig. 2. Effect of weekly square removal for 0 weeks (control), 3 weeks (3-week square removal) and 6 weeks (6-week square removal) on seasonal flower production (A) and accumulation of bolls (B) for the super okra leaf type near-isogenic line, 1983. Boll accumulation patterns for the okra leaf were similar to the super okra leaf type in the 6-week square removal treatment.

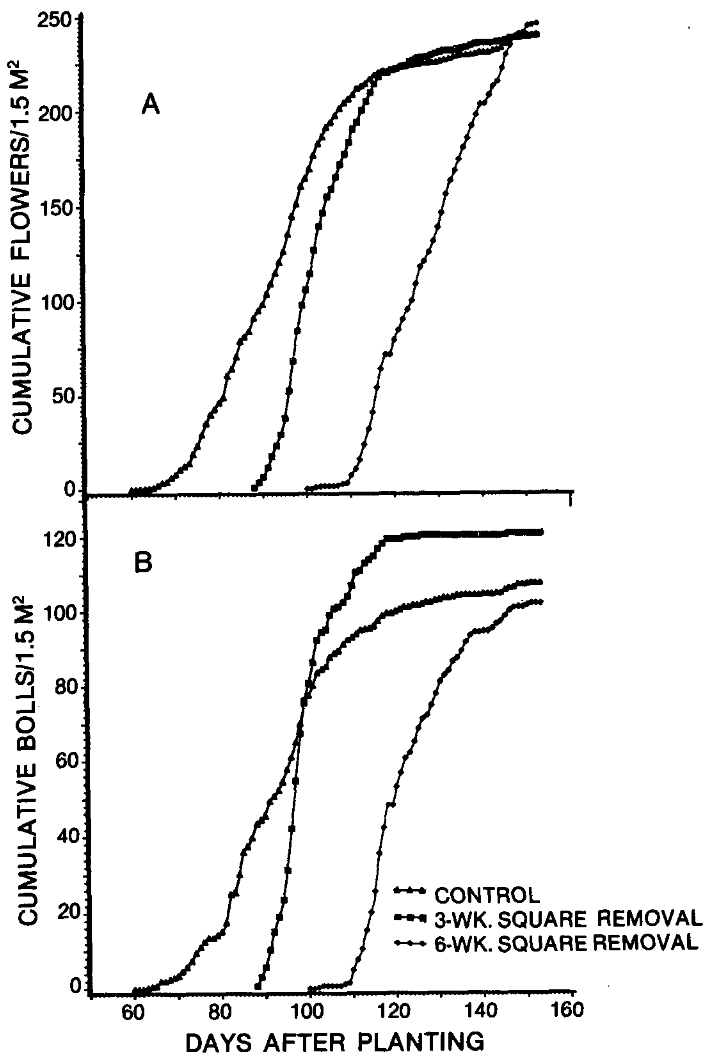

Fig. 3. Effect of weekly square removal for 0 weeks (control), 3 weeks (3-week square removal) and 6 weeks (6-week square removal) on seasonal flower production (A) and accumulation of bolls (B) for the normal leaf type near-isogenic line, 1983. Flower and boll accumulation patterns for the okra leaf type were similar to the normal leaf type in the 3-week square removal treatment.

It was then suspected that the delay in fruit-set caused by square removal produced a larger plant framework consisting of more reproductive branches (from the main stem as well as monopodia) which were simultaneously at productive stages of development. This type of growth pattern would certainly contribute to rapid fruiting (8) and was consistent with Tables 1 and 2. Table 3 displays the tendency for a greater range in main stem node positions of sympodia setting fruit during a given period of time for the square removal treatments compared to controls. The increased range was attributed to the ability of cotton to set fruit on lower sympodia at nodes further out on the branch. Vertical and horizontal flowering intervals of the 3-week square removal treatment were normally shorter than the control and 6-week treatments (Table 3). This condition, coupled with a range of branches setting fruit for a given interval equivalent to that of the 6-week treatment, usually produced the greatest accumulation rates in the 3-week treatment.

Although rates of flowering and boll accumulation were affected by square removal, there was little or no effect on total numbers. The total number of tagged flowers in 1983 was significantly greater only in the SOL compared to controls (Fig. 2A). In that year the number of retained bolls were numerically although not significantly greater in the 3-week square removal treatment compared with controls for all leaf types (Table 4). The comprehensive 1983 data suggest that the greater amount of flowers contributed to the higher average number of retained bolls in the 3-week square removal treatment of the SOL. In NL and OL, higher average boll numbers in the 3-week treatment vs. controls resulted from a higher average retention rate as indicated by flower and boll cumulatives in Fig. 3. Loss of a fruiting form on the first node of a sympodial branch often increases the retention of bolls/fruiting forms on nodes farther out on the branch (12). Assimilate transport to developing bolls from leaves of lower nodes on a sympodium has been found to occur if the fruiting forms for these leaves were missing (14, 26). This mechanism might have contributed to the increased reten-

Table 3. Effect of square removal treatment and leaf types on fruiting rate, second axillary fruiting sites, flowering interval, and span of boll-set locations of field-grown near-isogenic cottons for 1983.

Leaf type	Treatment†	Flowering rate	Boll-set rate	Second axillary fruiting site	Flowering interval‡ Vertical	Flowering interval‡ Horizontal	Weekly boll-set location span Vertical§	Weekly boll-set location span Horizontal¶
		no. day⁻¹ 1.5 m⁻²		% of total sites	days		(Highest node − lowest node = span)	
Normal	Control	5.6	2.6	0.0	3.90	7.74	6.6	1.5
	3-week square removal	9.0	6.8	2.5	3.11	5.64	8.9	3.3
	6-week square removal	6.6	3.5	8.7	7.54	8.25	10.6	4.4
Okra	Control	6.1	3.1	0.0	3.63	7.47	7.2	1.5
	3-week square removal	10.1	6.4	0.5	2.96	5.48	10.0	2.5
	6-week square removal	10.0	8.2	10.8	5.14	4.44	13.2	4.9
Super Okra	Control	10.4	2.7	0.0	3.20	5.62	7.0	1.6
	3-week square removal	24.5	9.1	4.0	2.80	4.36	10.6	3.7
	6-week square removal	16.7	8.4	8.8	4.06	4.40	10.8	4.2
	LSD 0.05	3.5	1.4	2.3#	1.14††	1.32#	2.1#	1.2#

† Control treatments had no manual square removal. Weekly manual square removal for periods of 3 or 6 weeks after first observable squares were the 3 week (square removal) and 6 week (square removal) treatments, respectively.
‡ Seasonal average based on tagged, retained bolls.
§ Span of main stem nodes.
¶ Span of sympodial nodes.
# Significant treatment effect only.
†† Significant treatment effect and significant leaf type effect only.

Table 4. Effect of square removal treatment and leaf types on lint, lint percent, lint per boll, and boll number of field grown near-isogenic cottons for 3 years.

Leaf type	Treatment†	Lint‡ 1981	Lint‡ 1982	Lint‡ 1983	Lint % 1981	Lint % 1982	Lint % 1983	Bolls‡ 1981	Bolls‡ 1982	Bolls‡ 1983	Lint boll⁻¹ 1981	Lint boll⁻¹ 1982	Lint boll⁻¹ 1983
		kg ha⁻¹			%			no. ha⁻¹ × 10⁻³			g		
Normal	Control	922	1022	1341	40.2	39.8	37.9	508	533	804	1.8	1.9	1.7
	3-week square removal	755	678	1577	42.4	39.6	38.4	429	357	1021	1.7	1.6	1.5
	6-week square removal	1096	206	811	39.8	36.6	39.0	507	127	624	2.2	1.6	1.3
Okra	Control	868	1100	1101	41.6	40.0	38.4	507	584	697	1.7	1.9	1.5
	3-week square removal	888	727	1140	42.2	36.5	38.0	495	401	881	1.8	1.8	1.3
	6-week square removal	989	218	1053	39.2	36.9	39.3	536	135	798	1.8	1.6	1.3
Super Okra	Control	626	979	1173	40.3	41.1	40.1	440	504	717	1.4	1.9	1.6
	3-week square removal	855	1079	1453	43.7	41.6	38.3	459	637	921	1.9	1.7	1.6
	6-week square removal	793	315	818	38.3	34.3	39.7	425	255	693	1.8	1.3	1.2
	LSD 0.05	NS	180§	244§	1.4§	NS	0.5	NS	102¶	101§	0.1	0.2§	0.2§

† Control treatments had no manual square removal. Weekly manual square removal for periods of 3 or 6 weeks after first observable squares were the 3-week (square removal) and 6-week (square removal) treatments, respectively.
‡ Lint weight and boll numbers were normalized to a hectare basis using areas of 4.4, 7.4, and 1.5 m^2 for 1981 through 1983, respectively.
§ Significant treatment effect only.
¶ Significant treatment effect and leaf type effect only.

tion rate of NL and OL. The prolific flowering habit of SOL coupled with the tendency for this leaf type to shed fruiting forms as young bolls rather than squares (19) contributed to the lower percentage retention of this leaf type. The reduced percentage retention of fruit set in the 6-week square removal treatment for each leaf type in 1983 was probably due to the lower temperatures which occurred during the boll set period of this treatment.

Yield responses due to square removal treatments were variable from year to year due in part to the complicating environmental factors of extreme late season insect pressure in 1982 and a late planting in 1983. Regardless of environmental conditions, the reduced leaf types (OL and SOL) had more square removal treatments that produced numerically greater yields than their controls compared to the NL (Table 4). The 3-week square removal treatment of the SOL consistently averaged more lint production compared with its control; its 3-year average yield increase over the control was 23.5%. There was a similar but slightly lower average increase in boll production (19.7%). The increase in lint and boll numbers was significant ($P<0.10$) for a 3-year combined analysis of the SOL.

With the exception of certain leaf type-by-treatment interactions in 1981, lint per boll tended to be reduced by square removal for 3 or 6 weeks (Table 4). The lower productivity per boll in the square removal treatments might have been due to the more rapid fruit-set of these treatments. The competition among bolls would be more intense as more bolls would set within a shorter time span. Kittock et al. (20) reported similar results when comparing node competition on sympodial branches. Assuming that bolls set rapidly in 1981, the numbers were very similar between control and square removal treatments and the increased plant size in the SOL had the potential for supplying an increased level of assimilate to developing bolls. Those treatments of leaf types in 1981 which tended not to produce plants larger than controls had no change in unit boll productivity compared with their control. Although plants were relatively large in 1982, there was still a decline in unit boll productivity even though boll loads were very slight. Maximum LAI values in Table 1 suggest the possibility of excessive leaf area for some plants of NL and OL square removal plots, an effect that would increase self-shading and reduce the CER of productive, subtending leaves. Data from the SOL plots of the 6-week square removal treatment do not support this theory and suggest that some other factor (possibly insect-related) might have been involved. Seed weight per boll as calculated from Table 4 for 1981 and 1983 paralleled the changes in lint per boll, a result indicating overall plant competition rather than redistribution within the boll as the major effect on lint differences per boll.

There were enough differences between average seed and lint weight changes to produce significant differences in lint percentage between treatments in 1981 and significant leaf type by square removal treatment interactions in 1983 ($P<0.05$). Because the 3-week square removal treatment responded differently each year, it is assumed that environmental differences during the period of boll development for each year were the major contributors to this response rather than a direct physiological effect produced by square removal. The same can be said for differences in fiber properties which were not consistent from year to year. Regardless of the source of modulation, the fiber properties remained in the acceptable commercial range in the 3-week square removal treatment (data not presented).

Delaying the flower bud development of a cotton crop at no expense to sympodial production would aid in producing an excellent trap crop system for control of early season generations of boll weevil (*Anthonomus grandis* Boh.) (23) by providing a differential timing of fruiting form development between main and trap crops. The use of exogenous chemicals to remove squares (3, 27) would produce an effective trap crop system if application results would resemble results of manual square removal. The rapid fruit-set response resulting from square removal early in the reproductive development of the crop should convert to a shorter interval of boll opening in many cotton growing areas, i.e., areas having a reasonably long growing season. This effect would increase first harvest percentage, although at some cost of season earliness. These data indicate that a SOL cultivar would perform more consistently than NL or OL.

CONCLUSION

Plant size of all the leaf types was usually increased by manual square removal as was the rate of fruit set. The SOL, the most reduced in size genetically and the most "determinate," had the greatest responses to square removal. The SOL was also the most consistent in economic yield with the 3-week square removal treatment averaging numerically but not significantly greater lint production than controls in each year. This result would indicate that the SOL would respond more consistently to timing modifications of fruit set by exogenous chemicals. It would also imply that the SOL could recover more quickly from early season insect pressure than the other leaf types studied.

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