Published September, 1982

A Second-Axillary Flower Trait in Upland Cotton[1]

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ABSTRACT

A cotton (*Gossypium hirsutum* L.) strain, "RQSX-1", was developed which consistently produces flowers at the second-axillary position. The purpose of this investigation was to determine the agronomic value of the trait, to study its production of flowers and fruit, and to estimate its inheritance.

A comparison of RQSX-1 with two cotton cultivars, 'Tamcot CAMD-E' and 'Lankart 611', showed that RQSX-1 had smaller fruit, earlier maturity, its first fruiting branch at a lower node, more total fruiting positions, fewer fruiting branches, and more fruiting positions/fruiting branch than did either cultivar. It set more fruit than Lankart 611, but not than Tamcot CAMD-E. The inheritance study suggested that the development of the second-axillary position was under quantitative genetic control.

Additional index words: ***Gossypium hirsutum*** **L., Cotton genetics, Fruiting, Earliness.**

STUDIES in west Texas have shown that the overwintered boll weevil (*Anthonomus grandis* Boheman) becomes established in cotton (*Gossypium hirsutum* L.) after square initiation. Emergence of the boll weevil prior to squaring is primarily suicidal in nature (White and Rummel, 1978). Based upon those and other findings, a screening program was established to search for fruiting characters of the cotton plant which would take advantage of weaknesses in the dynamics of the weevil population. A second-axillary flowering trait was discovered which suggested interesting possibilities for shortening the flowering period which would be of value in pest management programs.

The first flowers in upland cotton generally occur 6 to 7 weeks after planting at Lubbock, Tex. The first flower buds, called squares, are distinguishable about 3 to 4 weeks prior to the opening of the flowers. Growth of cotton is indeterminate; and after initial flowering, additional flowers are produced as the plant continues to grow. The cotton plant produces both vegetative and fruiting branches. One or more vegetative branches may arise from the lower nodes of the main stem. The fruiting branches grow horizontally from the main stem, beginning at about node seven, and produce a flower at each successive node. Thus, the number of flowers produced depends upon the number of fruiting branches and the number of nodes per fruiting branch (Ewing, 1918).

Mauney (1968) suggested that fruiting branches can develop from the second-axillary position, but that the induction of second-axillary flowers was not common and the tendency to develop those flowers at Phoenix, Ariz., seemed to be dependent upon both genotype and environment. Mauney stated that *Gossypium barbadense* L. cultivars had a greater tendency to express the trait than did upland cottons. He also indicated that moderate day and cool night temperatures favored the development of second-axillary flowers.

The objectives of the present investigation were to determine the agronomic value of the second-axillary flower trait, to study its production of flowers and fruit, and to estimate its inheritance.

MATERIALS AND METHODS

A strain, designated "RQSX-1", develops second-axillary flowers at most main-stem fruiting branch nodes. About 6 to 8 days after the first-axillary flower occurs, a second-axillary flower occurs in the apex between the main stem and the primary fruiting branch.

RQSX-1 originated as a plant selection from a cross between M8-SUL and CA 813. M8 is a doubled haploid derived from 'Deltapine 14' and M8-SUL is a super-okra leaf isoline of M8. CA 813 resulted from an apparent outcross between *G. barbadense* and *G. hirsutum* strains in the Cotton Winter Increase Nursery in Iguala, Mexico. The CA 813 strain has a tendency to develop second-axillary flowers.

Flowering Study. RQSX-1, 'Tamcot CAMD-E' (CAMD-E), and 'Lankart 611' (611) were planted in a randomized, complete block design with four rows of each entry/plot and randomized within each of four replications. Both CAMD-E and 611 are early maturing cultivars. This test was conducted at a field site in Stonewall Co., Tex., located in the Rolling Plains Region. Rainfall was 61 cm, and irrigation water was not applied. The test was planted on 17 May 1979.

After the initiation of flowering, all flowers were tagged daily on five randomly chosen plants in each row (20 plants of each entry/replication). The number of flowers that occurred on each row were recorded daily. After frost, the 80 tagged plants/entry were brought into the laboratory; and each plant was diagramed for time of flowering and location of fruiting positions. From those plant diagrams and the seedcotton harvested from the plants, the following characteristics were estimated:

(1) Seedcotton/plant in grams, (2) Boll size in grams of seedcotton/boll, (3) Node number of the first fruiting branch, (4) Vertical fruiting intervals expressed as the days between flowers at the first fruiting position on consecutive fruiting branches, (5) Horizontal fruiting intervals expressed as the days between consecutive flowers on the same fruiting branch, (6) Total number of fruiting positions/plant, (7) Number and percentage of fruit set/plant, (8) Number of main stem nodes with fruiting branches, (9) Number of fruiting positions/fruiting branch, (10) Number of second-axillary fruiting positions, and (11) Number and percentage of fruit set on the second-axillary positions.

An estimate of earliness of maturity was determined by the mean maturity date formula generated from weekly open boll counts made from August through October (Christidis and Harrison, 1955).

Inheritance Study. Crosses were made between RQSX-1 and both 'Acala 3080' and an experimental okra-leaf strain designated as Acala okra. The parents and F_1 hybrids were grown and self-pollinated in 1978, and segregating F_2 populations were

[1]Cooperative investigation between the Southern Plains Cotton Res. Lab., USDA-ARS, and the Texas Agric. Exp. Stn. Received 15 May 1981. Research was funded, in part, by EPA Cooperative Agreement CR-806277-02-0.

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Table 1. Means for agronomic traits/plant from the three cotton entries.

Traits	Units	RQSX-1	Tamcot CAMD-E	Lankart 611
Seedcotton/plant	g	20.4 a†	25.8 a	28.2 a
Boll size	g	2.5 c	3.8 b	4.7 a
Mean maturity date	days	108.6 c	114.4 b	116.3 a

† Means within rows followed by the same letter were not significantly different at the 0.05 probability level (based on a Duncan's Multiple Range Test).

Table 2. Means for fruiting traits/plant from the three cotton entries.

Traits	Units	RQSX-1	Tamcot CAMD-E	Lankart 611
Node of the first fruiting branch	no	4.6 c†	6.1 b	6.8 a
Fruiting intervals				
Vertical	days	3.1 a	3.2 a	3.2 a
Horizontal	days	7.2 a	7.3 a	7.3 a
Fruiting positions/plant	no	18.4 a	14.8 b	13.7 b
Fruit set/plant	no	8.0 a	6.8 ab	6.0 b
	%	43.5 a	45.9 a	43.8 a
Main stem nodes with fruiting branches	no	6.3 b	7.4 a	7.2 a
Fruiting positions/fruiting branch	no	2.9 a	2.0 b	1.9 b
Second-axillary fruiting positions	no	4.2 a	0.0 b	0.0 b
Fruit set on second-axillary positions	no	0.4 a	0.0 b	0.0 b
	%	9.5 a	0.0 b	0.0 b

† Means within rows followed by the same letter were not significantly different at the 0.05 probability level (based on a Duncan's Multiple Range Test).

grown in 1979. All plants were scored for the development of the second-axillary flower trait. If a single second-axillary flower occurred, the F_2 plant was considered to have the trait. Open-pollinated seed were harvested from each F_2 plant, and 20 F_3 plants/progeny row were grown in 1980 for 184 of 185 original F_2 plants. Each plant in each progeny row was scored for the presence or absence of the second-axillary fruiting trait, and the percentage of F_3 plants with the trait were calculated for each progeny row. All tests were planted in mid-May at Lubbock, Tex.

RESULTS AND DISCUSSION

Flowering Study. RQSX-1 had smaller fruit and earlier maturity than did the other two entries (Table 1). CAMD-E had smaller fruit and earlier maturity than did 611. The yield of seedcotton/plant of RQSX-1 was statistically equivalent to CAMD-E or 611.

RQSX-1 had its first fruiting branch at a lower node, more total fruiting positions, fewer fruiting branches, and more fruiting positions/fruiting branch than did the other two entries (Table 2). RQSX-1 set significantly more fruit than did 611, but not than CAMD-E. The vertical and horizontal fruiting intervals and the percentage of fruit set were the same for all three lines. Second-axillary flowers occurred only on RQSX-1 with 9.5% of the second positions setting fruit. This low set demonstrated that second-axillary positions have a much lower probability of retaining fruit than do first-axillary positions. Limited data (unpublished) suggested that if the first-axillary flower shed, the probability of the second-axillary flower being set was much higher.

Table 3. Chi-square tests for a single-gene segregation of the second-axillary flower trait in cotton.

Populations	Second-axillary flower	Normal	Total	Chi-square	P
	no.				
RQSX-1	38	0	38	--	--
Acala 3080 (A 3080)	0	52	52	--	--
F_1 (RQSX-1 × A 3080)	22	0	22	--	--
F_2 (RQSX-1 × A 3080)	131	54	185	1.52	0.3–0.2
Acala okra (Ao)	0	36	36	--	--
F_1 (RQSX-1 × Ao)	15	0	15	--	--
F_2 (RQSX-1 × Ao)	69	30	99	1.22	0.3–0.2

Table 4. Percentages of cotton plants expressing the second-axillary fruiting trait in 184 F_3 progeny rows of (RQSX-1 × Acala 3080) on two dates of scoring.

Percentages of plants with second-axillary trait	Date of scoring: 30 July	6 Aug.
	no.	
0	4	34
5	12	42
10	14	25
15	17	22
20	20	14
25	20	12
30	19	12
35	17	10
40	19	6
45	14	2
50	11	0
55	3	3
60	4	1
65	5	1
70	4	0
75	1	0

The RQSX-1 strain is not an agronomically acceptable cotton due to inferior fiber properties, but the tendency of the line to initiate second-axillary flowers may be useful in the development of earlier maturing cultivars. An agronomically acceptable cultivar possessing this trait may be desirable for pest management programs. Rapidity of fruiting and early maturity resulting from the second-axillary flower trait should offer a degree of escape from the buildup of late-season populations of the boll weevil and bollworm (*Heliothis zea* Boddie) damage (White and Rummel, 1978).

Inheritance Study. All RQSX-1 plants initiated second-axillary flowering positions, whereas none of the Acala 3080 or Acala okra plants did so (Table 3). All F_1 plants initiated the second-axillary trait thus demonstrating its dominant nature. Chi-square estimates from the two segregating F_2 populations suggested that the second-axillary flowering trait might be inherited as a single, at least partially dominant, gene. However, F_3 progeny rows from 184 of the 185 individual F_2 plants from the Acala 3080 × RQSX-1 cross showed segregation patterns significantly different from that exhibited by a single gene (Table 4). The F_3 progeny rows were scored for the second-axillary trait on 30 July and 6 Aug. 1980. The initial scoring showed an essentially normal distribution; however, only a week later, the distribution was skewed towards non-

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expression of the trait. From the latter data, one can conclude that the trait is not under single-gene control and is probably inherited in a quantitative manner. This conclusion is based on the fact that if a single dominant gene controlled the expression of the second-axillary trait, we would expect 25% of the F_2 plants to be homozygous for the trait. In the F_3 progeny rows resulting therefrom, we would expect all of the plants (100%) to express the second-axillary trait, regardless of the amount of outcrossing. None of the F_3 progeny rows had all 20 plants with the second-axillary trait.

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