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Arrangement of Sympodia and Earliness Potential of Cotton[1]

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ABSTRACT

Field studies were conducted in 1975 and 1976 to determine if short vertical flowering intervals (VFI) of cotton (*Gossypium hirsutum* L.) are associated with the arrangement of sympodia. In a random population of 'Tamcot SP-37', 24% of the plants had one or more side-by-side (S-S) sympodia with no discernable internode, 27% had one or more close (C) internodes, and 49% had all normal (N) internodes. Ninety-four and 81% of the S-S and C internode-type plants, respectively, had a 0- or 1-day VFI. At 97 days from planting, the average boll load of the plants with at least one S-S or C internode-type was 47 and 33% greater, respectively, than plants with all N internodes. At 124 days from planting, there were no significant differences in average boll load; however, the S-S and C internode-type plants had more than twice as many open bolls as did N plants. In 1976, we compared a Tamcot SP-37 population that had 100% of the plants with at least one S-S or C type internode (obtained by selective thinning at the five and six true leaf stage) with a random population (randomly thinned), and we verified the earliness potential demonstrated by the individual plant studies in 1975.

Additional index words: **Vertical flowering interval, Internode, Rapid fruiting, Fruiting branch, Selection, *Gossypium hirsutum* L.**

ONE of the most striking differences between early maturing and delta cotton breeding stocks and cultivars is the much faster flowering rate of the early maturing types, particularly during the early part of the bloom period (2, 4, 5, 6). Namken et al. (5) reported that 'Tamcot SP-37' produced 1.7 times more blooms during the first 20 days of the bloom period than did 'Stoneville 213'. They attributed this difference in bloom production to significantly shorter vertical and horizontal flowering intervals (VFI:HFI) for Tamcot SP-37. The population mean VFI for Tamcot SP-37 was 2.44 days as compared with 2.85 days for Stoneville 213. Also, individual Tamcot SP-37 plants had mean VFI as short as 1.75 to 2.00 days for the first seven to nine sympodia, suggesting that the basic flowering intervals could be further shortened in future cultivar populations. Moreover, the frequency of "double blooms" (blooms on the first site of two successive sympodia on the same day) was relatively high for the Tamcot SP-37 population (5). Field observations indicated that the very short VFI seemed to be associated with sympodial arrangement.

In 1975 and 1976 we conducted studies to determine if very short VFI are associated with sympodial arrangement, frequency of short VFI types in a random Tamcot SP-37 population, and earliness potential associated with this characteristic.

MATERIALS AND METHODS

Figure 1 shows the three types of sympodial arrangements observed in field populations of Tamcot SP-37 plants. These were defined as "side-by-side" (S-S): two sympodia, with associated true leaves, emerging at the same main stem node opposite each other with no discernable internode; close (C): internode length $\leq$ 1.5 cm; normal (N): internode length $>$ 1.5 cm. The S-S types resembles a decussate phyllotaxis within the normal spiral pattern and has been described as an anomaly morphologically different from any plant type described for the species (1).

For the 1975 studies, a 1-ha field of Tamcot SP-37 was planted on 20 February to a double-drill row configuration (two drills 20 cm apart on 101.6-cm centers). Plants were thinned to about 120,000 plants/ha.

Three studies were conducted in 1975. One study was conducted to determine if double blooms were associated with a particular sympodial arrangement or internode type by locating plants with double blooms each morning during a 2-week period shortly after first bloom. We made no effort to check every plant in the field. Each morning during the 2-week period, we located 50 to 100 plants with double blooms and measured the internode length between the two sympodia having white blooms on the first fruiting sites.

A second study was conducted to determine the frequency of short VFI on the S-S and C type internodes. We flagged 118 plants with an S-S-type internode and 118 plants with a C-type internode before first bloom. Each plant was checked daily for VFI until all plants had bloomed at the first fruiting site of both sympodia.

A third study was conducted to determine the percentage of plants in a random Tamcot SP-37 population with at least one S-S or C internode type to determine the earliness potential associated with plants that had these sympodial characteristics. All plants in a single row, 21.9 m long, from eight Tamcot SP-37 plots (eight replications) were characterized as having one or more S-S-type internodes, one or more C-type internodes, or all N-type internodes. Before the plant was characterized, it had to have an S-S- or C-type internode above the fifth node where sympodia had emerged. The eight replications averaged 218 plants/row; however, an average of 16 plants/row had damaged terminals and were not used. Thus, 1,616 plants (202 plants/row) were characterized.

On 19 May (22 days after first bloom in the field or 88 days after planting), the same 1,616 plants were checked for the number of sympodia that had bloomed at the first fruiting site. If the bloom of the first site of the highest sympodia bloomed before the day on which the count was made, a half unit was added to the count.

On 28 May (97 days after planting) and 24 June (124 days after planting), the number of bolls was recorded on each plant. Only bolls 7 days old or older were included in the count. A boll was considered to be at least 7 days old if it could easily be seen without manually parting the involucral bracts. The number of open bolls and the total number of bolls on each plant were recorded on 24 June. A boll was considered to be open if lint could be seen.

In 1976 we conducted a study to evaluate the earliness potential of a homogeneous population of Tamcot SP-37 plants with at least one S-S- or C-type internode as compared with a random Tamcot SP-37 population. A randomized complete block design with two treatments (selected and random populations) was replicated four times. The plots were 5.8 m wide (five rows) and 9.1 m long. Tamcot SP-37 was planted on 19 February at a high seeding rate in the same configuration used in 1975.

The selected population was thinned when the fifth and sixth true leaves were emerging from the terminal. We had previously observed that if the two true leaves are symmetrical in size, the internode between the two nodes will be either an S-S- or C-type. Thus, by removing all plants that did not have symmetrical true leaves emerging from the terminal, we obtained a homogeneous population of plants with at least one

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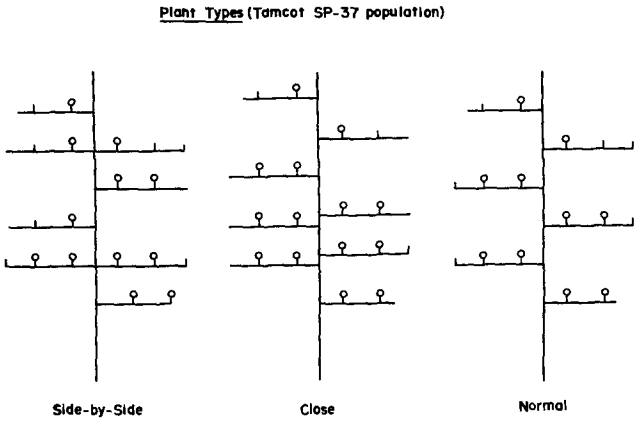

Fig. 1. Three plant internode types in a random field population of Tamcot SP-37.

S-S or C internode. The random population was obtained by randomly thinning plants so that the sample population represented the entire range of genetic variability for the cultivar.

After thinning the selected plots, there was an average of 295 plants/plot (about 64,000 plants/ha); however, there was considerable variation among rows and plots. To make conditions as uniform as possible for both populations, a paired row system was used. Within each replication, row 1 of the random population plot was thinned to the same number of plants that had been left in row 1 of the selected population plot. Any stand skips in the selected population rows were duplicated in length and location in the paired rows of the random population plot.

Blooms and double blooms on each row were counted daily during the first 30 days of the bloom period. Seed cotton yields were obtained by hand harvesting all rows of each plot on four dates beginning 130 days after planting.

RESULTS AND DISCUSSION

Table 1 gives field survey results during the first 2 weeks of the 1975 bloom period to determine if double blooms were associated with internode type. About 90% of 976 double blooms occurred on S-S- or C-type internodes. The percentage was highest during the 1st week of the bloom period and lower during the latter

Table 1. Frequency of double blooms in a random field population of Tamcot SP-37 on three internode types.

Internode type	Double-bloom plants	Total
	no.	%
Side by Side (S-S)	470	48.2
Close (C)	407	41.7
Normal (N)	99	10.1
Total	976	

Table 2. Vertical flowering intervals of side-by-side (S-S) and close (C) internode types.

Internode type	Plants flagged	Square shed	Vertical flowering interval (days)			
			0	1	2	3
	no. of plants					
S-S	118	6	49 (43.8)†	56 (50.0)	5 (4.5)	2 (1.8)
Close	118	12	24 (22.6)	62 (58.5)	18 (17.0)	2 (1.9)

† Percentage of total number of plants which had flowers at the first site of both sympodia indicated in parentheses.

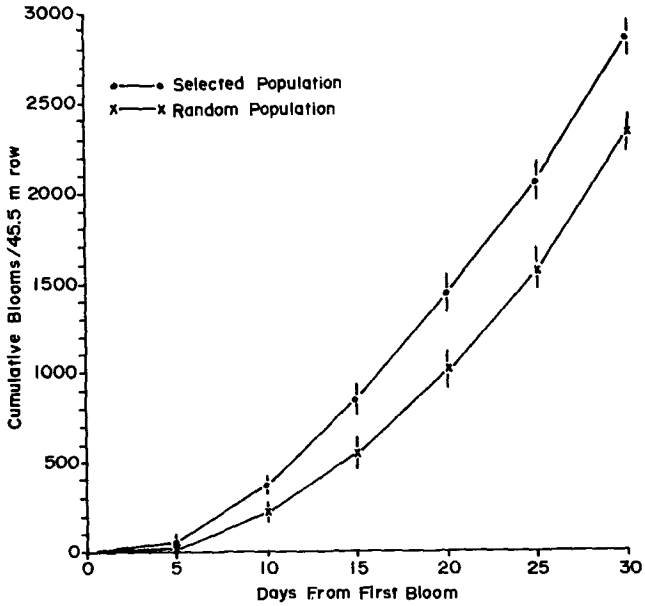

Fig. 2. Bloom production of selected and random Tamcot SP-37 populations as a function of days after first bloom. Vertical lines indicate magnitude of standard error of the means.

part of the period when the occurrence of double blooms decreased rapidly and double blooms were more difficult to find because the S-S- and C-type internodes occur most frequently in the lower portion of the plant. These data indicated that double blooms are associated with the S-S- and C-type internodes, but they did not indicate the frequency of occurrence on the specific internode types.

The frequency of double or short interval blooms on the S-S- and C-type internodes is given in Table 2. Of the 112-S-S- and 106-C-type plants that were checked for VFI, 93.8% of the S-S-type internodes had a 0- or 1-day VFI as compared with 81.1% of the C-type internodes. Less than 2% of the plants of either type plant had a 3-day VFI, a VFI that might be considered normal for most cotton cultivars. Previous bloom studies with Tamcot SP-37 indicated that the frequency of double blooms for normal internodes is less than 2% (3). These data indicated a high frequency of very short VFI associated with the S-S- or C-type internodes.

Table 3 presents the percentages of plants in a random Tamcot SP-37 population with at least one S-S- or C-type internode and the earliness potential asso-

Table 3. Earliness potential of three internode types of Tamcot SP-37 plants.

Internode type	Population	Sympodia†	Days after planting		Bolls open at 124 days
			97	124	
	%	no.	bolls/plant‡		%
Side by Side (S-S)	24.5 a*	6.6 a*	4.4 a*	6.0 a*	26.0 a*
Close (C)	26.5 a	6.3 a	4.0 b	5.7 a	23.0 a
Normal (N)	49.0 b	4.8 b	3.0 c	5.8 a	10.0 b

* Means followed by the same letter do not differ significantly at the 0.05 level of probability, according to Duncan's multiple range test.
† Mean number of sympodia that had bloomed at the first site by 19 May, 22 days after first bloom.
‡ Bolls 7 days or older counted.

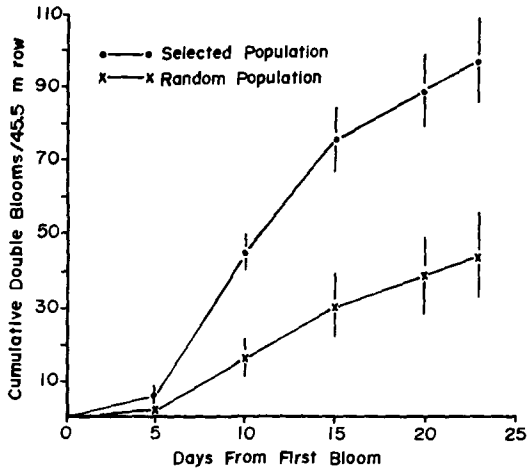

Fig. 3. Comparison of total number of double blooms observed on selected and random populations of Tamcot SP-37. Vertical lines indicate magnitude of standard error of the means.

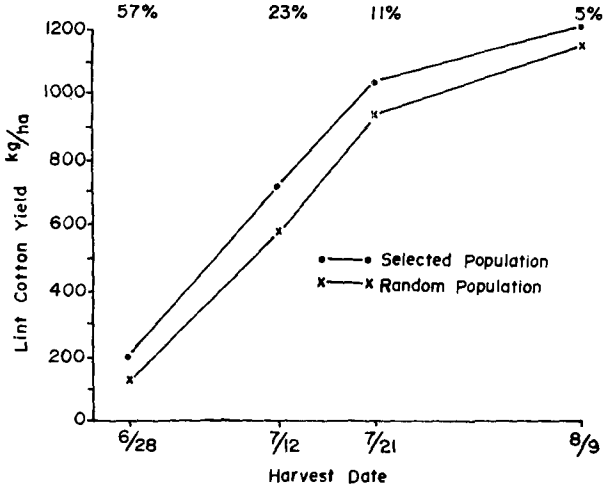

Fig. 4. Cumulative lint cotton yields of selected and random populations of Tamcot SP-37 for four harvest dates. The percent increase in yield for the selected population at each harvest date is given at the top of the figure.

ciated with plants having these sympodial characteristics. The random Tamcot SP-37 population had about one-fourth of the plants with one or more S-S, one-fourth with one or more C, and the other half had all N internodes, respectively (Table 3).

The earliness potential of the S-S and C internode-type plants was shown by the significantly higher number of sympodia that had bloomed at the first site by 19 May (22 days after first bloom was observed in the field) (Table 3). The differences between the S-S and C internode plant types and the N plant represent a 37 and 31% increase in potential blooms from first site positions only during the first 22 days of the bloom period.

Table 3 shows the mean number of bolls per plant (bolls 7 days old or older) for each of the three plant types 97 and 124 days after planting (32 and 59 days after first bloom, respectively) which is further evidence of the earliness potential associated with the S-S and C internode-type plants. At 97 days after planting, the mean boll load of the S-S-type plants was significantly greater than that of the C-type plant and both S-S- and C-type plants had a significantly greater mean boll load than the N-type plant. These differences represented a 46 and 33% increase in boll load at this growth stage for the S-S- and C-type plants, respectively.

At 124 days after planting, there was no significant differences in the mean number of bolls per plant among the three plant types (Table 3). However, the S-S- and C-type plants had more than twice as many open bolls per plant as compared with the N-type plants, indicating a significant increase in earliness associated with plants having the S-S- or C-type sympodial arrangements.

The cumulative blooms per 45.5 m row of the selected and random populations as a function of days after first bloom in the field are given in Fig. 2. The selected population had significantly greater total bloom production than the normal population at all points except 5 days after first bloom. At 20 days after first bloom, total bloom production by the selected population was approximately 42% greater than that of the normal population.

The cumulative double blooms per 45.5 m row for the selected and normal populations are presented in Fig. 3. The selected plant population with at least one S-S- or C-type internode produced more than twice as many double blooms as the random population.

The increased rate of bloom production by the selected population increased earliness of lint cotton yields as illustrated by the harvest data presented in Fig. 4. The selected population had significantly higher cumulative lint cotton yields than the random population at the first three harvest dates. Final yields on 9 August did not differ significantly.

The results of these studies indicate that the occurrence of double blooms or short VFI are associated with sympodial arrangement. Apparently, the presence of one or more S-S- or C-type internodes on a significant percentage of Tamcot SP-37 plants contributes greatly to the rapid bloom rates commonly observed shortly after first bloom. These rapid bloom rates are caused primarily by shorter VFI, which results in putting more sympodia into production in a shorter period. Therefore, significant advances in earliness would be possible if a homogeneous population of plants containing one or more of the S-S- or C-type internodes could be obtained.

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