Asian Journal of Plant Sciences

ISSN 1682-3974

science alert

ANSInet
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http://ansinet.com

Asian Journal of Plant Sciences
Volume 1 Number 2: 153-155, 2002

Fruiting Position Impact on Seedcotton Yield in American Cotton

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Abstract: Impact of fruiting positions on Seed cotton yield was studied in four commercially grown varieties of Sindh in an experiment conducted during 1996 cotton season. The first fruiting position contributed significantly highest percentage of the total seed cotton yield and number of bolls per plant in all the four cultivars ranging from 22.49 to 43.24 and 22.74 to 42.11 percent, respectively. Similarly, the second fruiting posrdon ranked second in order and contributed 16.87 to 28.68 and 17.81 to 28.15 percent of the total seed cotton yield and number of bolls per plant, respectively in all the cultivars. The results demonstrated that the first four positions on sympodial branches were more important than the remaining fruiting positions as their contribution ranged from 63.66 to 93.86 percent in case of seed cotton yield per plant and 65.35 to 92.46 percent in case of number of bolls per plant. The remaining four positions contributed 5.21 to 16.04 percent seedcotton yield and 6.60 to 16.29 percent number of bolls per plant. The monopodial branch was considered as the ninth position and it is very interesting to note that only in case of Reshmi, the ninth position contributed significantly highest percent of seedcotton yield and number of bolls per plant 20.30 and 18.36 respectively than all other varieties and collectively contribution of 5th to 8th positions. Thus from the cotton management point of view the first four positions were most important

Key words: Fruiting position, cotton, sympodial branch, contribution percent

Introduction

Cotton plant has very prominent main stem, which consist of series of nodes and internodes. Two types of branches are produced, vegetative or monopodial and fruiting or sympodial branches that bear flowers and fruits directly. Whereas, the vegetative branches are structurally like main stem, but they bear flower and fruit only after rebranching (Oosterhuis, 1990). Thus, the main stem and monopodia do not bear flowers directly, but produce fruiting branches (Munro, 1987).

Kerby and Buxton (1981), found 76 percent of the boll set at the position 1. Nodes 9 through 14 had the highest boll set and accounted for the majority of the yield. They further expressed that, if we assume a 3-day vertical flowering interval and a 6-day horizontal interval, the peak boll set occurred 15 to 18 days after first bloom. Peak boll set was of node 11 for position 1, Node 9 for position 2 and node 8 for position 3. Considering position 1, there was an increase in percentage of plants with a boll from node 6 through 12 and a decrease at each node after 12.

Jenkins *et al.* (1990) studied the effect of fruiting sites on the number of harvestable bolls in *Gossypium hirsutumi* cultivars sown in a conventional pattern of rows spaced 1 m apart with a plant population of approximately 95000 plants/ha for 2 years in Mississippi. Bolls at position one on sympodial branches produced 66 to 75 percent of the total yield, those at position 2 produced 18 to 21 percent; all other positions on sympodial branches produced from 3 to 9 percent of the total yield. Sympodial branches from nodes 9 to 14 percent produced the bulk of the lint in all cultivars.

Anjum *et al.* (2001) while studying on five cultivars opined that the first three positions on sympodia, branches, were more important than the remaining fruiting positions. The first fruiting position contributed significantly highest percentage of the total seedcotton yield per plant in all the five cultivars ranging from 55.91 to 63.46 percent. The second fruiting position ranked second in order and contributed 26.33 to 31.43 percent of the total seedcotton yield per plant in all the cultivars. Collectively the first three positions contributed about 95 to 97 percent of the total seedcotton yield per plant in all the cultivars. Thus from the cotton management point of Oosterhuis (1990) observed that the distribution of the bolls on the plants varied due to abscission from physiological and environmental causes. A large percentage of the total yield is derived from the central portion of canopy, approximately between main stem nodes 6 and 13 that coincide with the distribution of leaf area with the canopy. The relative importance of the fruiting positions (nodes) along fruiting branches varies i.e., the first, second and third sympodial positions contributed about 60, 30 and 10% of the total seedcotton yield, respectively. These studies were therefore, conducted to see the impact of different fruiting positions on seedcotton yield.

Materials and Methods

A field experiment was conducted at the experimental area of the Department of Plant Breeding and Genetics, Sindh Agriculture University, Tandojam during 1996 cotton season. The trial comprised of four commercial varieties of Sindh Rehmani, Reshmi, Chandi and CRIS-9. The experiment was conducted in Randomized Complete Block Design with five replications. The row-to-row distance was maintained at 2.5 feet whereas plants within rows were thinned out to maintain a distance of 8 - 9 feet between plants. Each treatment plot contained three rows 17.5 feet long. All the agronomical, nutritional and plant protection requirements of the experiment were completed when needed. A random number of five plants from the central row of each cultivar per replication were monitored individually. All the randomly selected plants of all the cultivars were picked separately and average seedcotton weight per plant was obtained by dividing the total seedcotton weight by the number of plants per replication. The position wise number of bolls for all randomly selected plants of all the four cultivars was recorded. All open bolls developed on the five randomly selected plants of the cultivar were picked and weighed separately to work out the position-wise boll weight. The position-wise seedcotton weight for all randomly selected plants of all cultivars was determined, position-wise seed cotton weight and seedcotton yield contribution percentage was also calculated by using following formula:

$$\text{Position-wise seedcotton weight} = \frac{\text{Seedcotton weight of a particular fruiting position}}{\text{Number of bolls of a particular fruiting position}}$$

$$\text{Position-wise seedcotton contribution \%} = \frac{\text{Seedcotton weight contributed by particular fruiting position}}{\text{Total seedcotton weight / plant}} \times 100$$

The data were statistically analyzed for analysis of variance (ANOVA). Least Significant Difference (LSD) test was also carried out for comparison of means after Snedecor and Cochran (1971).

Results and Discussion

Analysis of variance (Table 1) shows that significant differences among the cultivars for seedcotton yield per plant and highly significant differences for the characters fruiting points, number of bolls per plant and average boll weight. However, the data presented in Table 2 indicated that Reshmi had numerically the highest number of fruiting sites per plant (81.40) while Rehmani had the lowest (52.20) fruiting sites per plant.

CRIS-9 produced highest number of bolls (36.60) per plant whereas Rehmani produced the lowest number of bolls (20.08) per plant. Reshmi produced heavier bolls (3.54 gm) than other three cultivars under study. Numerically, CRIS-9 yielded highest (109.06 g) per plant and Rehmani produced lowest seedcotton yield (59.09 g) per plant.

The analysis of variance (Table 3) was also conducted separately for each set of data obtained from each cultivar regarding average boll weight, number of bolls, seedcotton yield and their contribution percentage. All the cultivars showed significant position effects on all the characters, except for average boll weight; Position-wise number of bolls per plant The data revealed that maximum number of bolls was developed by all the cultivars at their first fruiting position (Table 4). CRIS-9 produced 11.32 bolls at its first position followed by Chandi (10.68), Rehmani (8.36) and Reshmi (6.30). It was further noted that all the remaining seven fruiting position of all the four cultivars showed a gradual decline in boll production and maintained their ranking order according to their position number in such a way that eighth position produced significantly lowest lumber of bolls. However, the monopodial branches counted as ninth fruiting position produced significantly highest number of bolls in case of Reshmi (5.04) followed by CRIS-9 (2.60), Chandi (0.32) and Rehmani (0.28).

Position-wise seed cotton yield (g): It was revealed that significantly highest seedcotton yield was produced by all cultivars at their first position on sympodial branches (Table 4). Among the cultivars, CRIS-9 produced 36.02 g followed by Chandi, Rehmanj and Reshmi with average seedcotton yield per plant of 26.04, 25.25, and 22.04 gm respectively. The second position on sympodial branches in case of all cultivars produced significantly less than first position, yet it produced second highest seedcotton yield in case of all the cultivars under study. The remaining fruiting positions showed a gradual decline in seedcotton yield production in such a way that the eighth position produced significantly lowest seedcotton yield in case of all the cultivars except Rehmani where eighth position produced higher seedcotton yield (0.74 gm) than sixth and seventh positions (0.65 and 0.55 gm), respectively.

Position-wise bolls contribution percentage: The data presented in Table 5 revealed that first position contributed maximum percent of bolls ranging from 22.74 to 42.11 percent followed by second, third and fourth positions except in Reshmi where monopodial branches,(ninth position) contributed 18.36 percent of the bolls as compared to its Second through eighth positions. Collectively first four positions were important and their range of boll contribution percent was 65.35 (Reshmi) to 92.46 (Rehmani). The positions fifth to eighth of three cultivars contributed 6.60 to 12.83 percent bolls but Reshmi contributed the highest boll percentage (16.29). Similarly the ninth position in respect of three cultivars, Rehmani (0.94%),

Table 1: Mean squares for four characters in four American cotton cultivars

Source of variance	Replication	Cultivar	Error
Degree of Freedom	4.0	3.0	12.0
Seedcotton yield/plant	380.6	2871.2*	964.0
Fruiting points/plant	60.40	738.4**	233.25
Number of bolls per plant	10.55	237.60**	42.18
Average boll weight (gm)	0.095	0.883**	0.064

* = Significant at 5% level ** = Significant at 1% level

Table 2: Mean performance for four characters in four American cotton cultivars

Character studied	Rehmani	Reshmi	Chandi	CRIS-9
Seedcotton yield/plant	59.09	97.25	68.61	109.06
Fruiting points/plant	52.20	81.40	67.20	74.20
Number of bolls per plant	20.08	27.50	27.56	36.60
Average boll weight (gm)	2.73	3.54	2.57	2.85

Table 3: Mean squares obtained from analysis of variance for five quantitative traits to examine fruit position effects in four cotton cultivars

Source of variance	Replication	Positions	Error
Degree of Freedom	4	8	32
Variety REHMANI			
Position-wise boll number	4.41	43.09**	1.19
position-wise average boll weight	3.46	1.79NS	1.36
Position-wise seedcotton yield	42.69	290.58**	10.11
Percentage contribution of bolls	0.00	1093.01**	11.33
Percentage contribution of yield	0.00	1165.79**	12.11
Variety RESHMI			
Position-wise boll number	5.36	22.30**	1.12
position-wise average boll weight	1.11	0.24NS	0.46
Position-wise seedcotton yield	82.65	284.65**	16.89
Percentage contribution of bolls	0.00	294.22**	9.75
Percentage contribution of yield	0.00	302.21**	14.50
Variety CHANDI			
Position-wise boll number	1.37	49.01**	6.62
position-wise average boll weight	0.19	0.21NS	0.06
Position-wise seedcotton yield	14.28	409.71**	6.51
Percentage contribution of bolls	0.00	966.78**	11.27
Percentage contribution of yield	0.00	888.75**	16.58
Variety CRIS-9			
Position-wise boll number	6.93	74.05**	26.58
position-wise average boll weight	1.78	2.04NS	2.07
Position-wise seedcotton yield	136.56	714.98**	26.58
Percentage contribution of bolls	0.00	590.66**	16.45
Percentage contribution of yield	0.00	625.64**	19.40

* = Significant at 5% level ** = Significant at 1% level
NS = Non Significant

Table 4: Position wise mean performance of four cotton cultivars for number of bolls, average boll weight and seedcotton yield

	Position										
Varieties	1	2	3	4	5	6	7	8	9	Total	LSD
REHMANI											
No. Of bolls/position	8.36	5.64	3.08	1.40	0.56	0.28	0.24	0.24	0.28	20.08	1.36
Av. Boll wt (gm)	3.12	2.95	2.86	2.74	2.39	2.79	2.40	2.45	2.89	24.59	NS
Seed cotton yield (gm)	25.25	16.63	8.75	4.14	1.57	0.65	0.55	0.74	0.81	59.09	3.98
RESHMI											
No. Of bolls/position	6.30	4.90	4.04	2.70	2.30	1.08	0.70	0.44	5.04	27.50	1.32
Av. Boll wt (gm)	3.46	3.36	3.28	3.72	3.66	3.86	3.34	3.50	3.65	31.83	NS
Seed cotton yield (gm)	22.04	16.67	13.56	9.90	8.12	4.01	2.27	1.40	19.28	97.25	5.14
CHANDI											
No. Of bolls/position	10.68	7.68	4.56	2.16	1.04	0.72	0.20	0.10	0.32	27.56	3.22
Av. Boll wt (gm)	2.46	2.34	2.39	2.60	2.60	2.81	2.36	2.95	2.60	23.11	NS
Seed cotton yield (gm)	26.04	18.04	11.36	5.71	3.00	2.20	0.70	0.53	1.03	68.61	3.19
CRIS-9											
No. Of bolls/position	11.32	8.76	5.12	4.28	2.36	1.04	0.72	0.40	2.60	36.60	1.89
Av. Boll wt (gm)	3.00	2.90	2.82	2.78	2.69	2.72	2.93	3.17	2.63	25.63	NS
Seed cotton yield (gm)	36.02	26.06	15.38	12.60	6.52	2.95	2.14	1.16	6.24	109.1	6.45

Table 5: Position-wise mean performance of four cultivars for boll contribution and seedcotton contribution percent

	Position												
	1	2	3	4	Sub Total	5	6	7	8	Sub Total	Mono	G. Total	LSD
REHMANI													
Percentage contribution of bolls	42.11	28.15	15.24	6.96	92.46	2.55	1.19	1.13	1.73	6.60	0.94	100	13.81
Percentage contribution of yield	43.24	28.68	15.13	6.82	93.86	2.23	1.05	0.83	1.10	5.21	0.93	100	4.35
RESHMI													
Percentage contribution of bolls	22.74	17.81	14.48	10.32	65.35	8.44	3.85	2.37	1.63	16.29	18.36	100	3.91
Percentage contribution of yield	22.49	16.87	13.55	10.75	63.66	8.25	4.00	2.33	1.46	16.04	20.30	100	4.76
CHANDI													
Percentage contribution of bolls	39.27	27.66	16.42	7.64	90.99	3.66	2.64	0.71	0.69	7.70	1.31	100	4.20
Percentage contribution of yield	38.55	26.11	16.38	8.08	89.12	4.12	3.19	0.99	0.74	9.04	1.84	100	5.09
CRIS-9													
Percentage contribution of bolls	32.02	24.79	14.06	11.88	82.75	6.63	2.87	2.14	1.19	12.83	4.42	100	5.07
Percentage contribution of yield	33.66	24.26	13.58	11.52	83.02	82.02	2.67	2.18	1.26	12.17	4.81	100	5.07

Chandi (1.31%) and CRIS-9 (4.42%), contributed very little bolls in comparison to Reshmi (18.36%).

Position-wise seedcotton contribution percentage: It was revealed from Table 5 that the first position contributed significantly highest percentage of the total seedcotton yield per plant in all the four cultivars ranging from 22.49 to 43.24 percent. Though the second fruiting position contributed significantly less than the first position in case of all the cultivars, yet the second position was second in ranking order and contributed second highest percentage of seedcotton yield ranging from 16.87 to 28.68 percent. A significant and gradual decline was noted in seedcotton yield contribution percentage in case of remaining fruiting positions. The monopodial branches (ninth position) in case of Reshmi significantly contributed highest seedcotton yield (20.30%) followed by CRIS-9 (4.81%), Chandi (1.84%) and Rehmani (0.94%).

The above mentioned results are some what different than those reported by some research workers who have reported that first position on sympodial branches contributed about 69 to 80% of the open bolls (Heitholt, 1993). Kerby and Buxton (1981) and Jenkins *et al.* (1990) reported that about 76% of the open bolls were born at position 1, while Oosterhuis (1990) reported that the first, second and third sympodial branch positions contributed about 60, 30 and 10% of the total seedcotton yield, respectively. Although these results are not in full agreement with those referred above, yet are in partial agreement in the sense that the first fruiting positions as well as the first four fruiting positions contributed significantly highest number of bolls as well as seedcotton than the remaining four positions, which are normally produced after cutout stage.

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