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Inter Species Variation In the Performance of Cotton Under Soil Salinity Stress

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Abstract : The fruiting shedding mechanism, yield and growth parameters of three species of cotton were studied under different salinity gradients during kharif 1992-93. The per cent reduction of the total number of fruiting forms (squares) initiated, the total squares shed, the bolls matured, growth and yield parameters at higher salinity is lower in *Gossypium herbacium* than *G. hirsutum* and *G. arboreum*. The fewer bolls matured per plant and lower weight of seed cotton per boll were the two main factors responsible for the yield reductions of all the species at higher salinity levels.

Introduction

Fruit shedding mechanism of cotton is of considerable economic importance. Factors such as genetic, physiological and environmental are mainly responsible for abscession or retention of fruiting forms of the plant. It is reported that the genus *Gossypium* has the natural tendency to shed squares and small bolls throughout the fruiting period. The literature on the subject has been extensively reviewed (Addicott and Lynch 1955, Eaton 1995, Hall 1958). But little attention has been paid to understand the possible effects of salinity on cotton fruiting and shedding.

However, it has been reported to be more salt tolerant than other field crops (Anon. ,1954). The present investigation was undertaken to examine the effects of soil salinity on fruiting, shedding, growth and yield parameters of cotton species (*G. herbacium, G. hirsutum and G. arboreum).*

Materials and Methods

A field experiment was conducted at the Agricultural Research Station, Gangavati during *Kharif* 1992 on a saline vertisols with clay (44.8%) in texture, soil depth ranged from 0. 75 to 1.50m. The experiment was laid out in RBD with three replications and had a plot size of 10.8 sq.m. The site had pH in the range of 8.2 to 8.5 with salinity (EC) ranging from 0.62 to 30 ds/m. Organic carbon content was low (0.25%) with CaCo3 content remaining in the range of 10.2 to 11.2 percent. During *kharif* (1992-93) three genotypes *viz.*, Sarvottam *(Gossypium herbacium),* Laxmi *(Gossypium hirsutum)* and G. cot 15 *(Gossypium arboreum)* were tested under different salinity gradients. Crop received the recommended package during the growth period.

Counting of squares and bolls (newly appeared and shed) were initiated during early October 92 and continued till November at an interval of 3 days. Due to heavy unseasonal cyclone showers, counts

on squares shed were stopped in mid Nov. and continued later till Feb. 93. Observations on growth and yield parameters of all the three genotypes were recorded on randomly selected five plants. A complete record of all recognisable fruiting forms (Squares and bolls) initiated, shed and matured was obtained. Seed cotton harvested from each genotype was subjected to boll analysis. Soil salinity gradients considered were low (upto 5.1 ds/m), medium (5.1-7.67 ds/m) and high (7.67-14.6 ds/m). Soil salinity was measured (0.30 cm depth) in each species and replication at the time of sowing, flowering and harvest. Using these values, mean soil salinity to which genotypes were exposed during growth period was calculated.

Results and Discussion

An increase in soil salinity reduced growth and yield parameters in all the three cotton species (Table-1). At higher salinity (14.61 ds/m), more than 50 percent reduction in germination, plant height and bolls/plant was observed. However, boll weight was maintained in Sarvottam and reduced in Laxmi (31%) at higher salinity levels. Sarvottam and G. cot-15 showed early flowering under low salinity, whereas flowering was delayed in Laxmi (Table-1). Laxmi showed delayed maturity under low salinity compared to Sarvottam and G. cot-15. At higher salinity levels days to maturity was delayed by 44 days in Sarvottam and G. cot-15. Whereas such delay was 21 days in Laxmi. The dry matter reduction due to salinity was highest in Laxmi (79%) followed by Sarvottam (68%) and G.cot-15 (37%). this clearly indicated the ability of G. cot-15 *(G. arboreum)* to overcome the salinity stress over other species. A higher reduction in K/Na ratio was observed in all the three species at high salinity levels. This confirms the earlier findings of Longenecker *et al.* (1964).

Increase in salinity significantly decreased total number of fruiting forms (squares), squares shed and bolls matured. Seed yield decreased markedly as salinity increased. The growth was affected by salinity and resulted in shorter mainstem, lateral branches, internodes and shorter fruiting branches. Overall effect was a decrease in total number of fruiting cities developed by the plants.

Laxmi and G. cot-15 shed on an average of 3 and 8 bolls/plant, while bolls matured were 35 and 65, respectively. At higher salinity, boll shedding in Laxmi and G. cot-15 was nearly tripled. The difference between them was more evident when bolls shed to bolls matured ratios were computed. In case of Sarvottam, ratios increased moderately with increasing salinity (0.13 to 0.29) whereas, incase of laxmi (0.08 to 0.77) and G. cot-15 (0.12 to 0.60) increase was proportionately higher.

In general, all species recorded considerably lower fruiting forms shed at the medium (ECe 7.67 ds/m) salinity level than at higher or lower salinity (Table-2). The possibility exist that cotton with its considerable salt tolerance may respond favourable to moderately saline conditions. The delayed crop maturity and prolonged fruiting period was observed at higher salinity.

Seed cotton weight per boll was also reduced due to reductions in both seed and lint weight per boll (Table-3). However, reductions were drastic in Laxmi at higher salinity than others. The lint per cent of both Sarvottam and Laxmi were maintained upto medium salinity levels and varied at higher

Table 1: Inter species variations in growth/yield parameters of cotton under salinity stress (average of 5 plants in 3 replications)

Cotton species/ Varieties	Salinity levels	Germi-nation (%)	Plant height (cm)	No. of branches/ plant	Leaf K/Na ratio at 35 DAS	No. of days to 50 % flowering	Bolls/ plant	Single boll wt (g)	No. of days to maturity	TDM harvest (g)
G. herbacium	Low	82	154.0	23	3.31	64	29	3.60	137	74.0
Sarvottam	Medium	57	125.6	20	2.04	65	20	3.45	181	28.4
	High	40	43.4	06	1.18	65	17	3.64	181	23.3
G. hirsutum	Low	64	78.2	14'	2.06	90	14	5.29	181	59.9
Laxmi	Medium	60	49.8	08	0.74	88	08	3.74	181	21.0
	High	24	22.4	03	0.44	104	03	3.65	202	12.2
G. arboreum	Low	75	123.8	22	3.02	65	22	2.91	137	22.5
G. cot-15	Medium	65	68.4	08	0.65	87	08	2.90	141	17.0
	High	10	31.0	05	0.49	93	08	2.46	181	14.0
C.D. (5%)		6.85	5.28	3.94	0.35	5.88	3.87	0.67	4.44	3.96

Low ECe 3.14 ds/m Medium ECe 7.67 ds/m High ECe 14.6 ds/m

Table 2. Inter species variations of fruiting/shedding characteristics of cotton under salinity stress

Cotton species/ Varieties	Salinity levels	Squares shed	Bolls shed	Total fruiting forms shed	Bolls matured	Total fruiting forms initiated	% shed
G. herbacium	Low	30	8	38	59	97	39.1
Sarvottam	Medium	38	6	44	31	75	58.6
	High	29	9	38	31	69	55.0
G. hirsutum	Low	43	3	46	35	81	56.7
Laxmi	Medium	32	5	37	21	58	63.7
	High	28	14	42	18	60	70.0
G. arboreum	Low	68	8	76	65	141	53.9
G. cot-15	Medium	30	11	41	30	71	57.7
	High	20	17	37	28	65	56.9
	C D (5%)	6.55	3.92	4.54	4.14	4.97	1.81

Low ECe 3.14 ds/m Medium ECe 7.67 ds/m High ECe 14.6 ds/m

salinity gradients. Lint per cent of G. Cot-15 was maintained at medium and higher salinity conditions. The number of seeds per boll was counted. the lower boll weight was due to either reduced seed number or weight/density or both. This study showed that the reduced yield at higher salinity was attributed to reduced number of bolls matured per plant and lower seed cotton per boll.

At higher salinity, a significant reduction in growth/yield parameters, total number of fruiting forms initiated/bolls matured, weights of both seed and lint per boll etc., were observed in all the species. Sarvottam exhibited a marginal increase in total fruiting forms shed under medium salinity and maintained at higher salinity level. In contrast, per cent shedding in Laxmi was higher at all the salinity levels.

It was observed that higher salinity levels caused higher reduction in yield and other parameters studied both in Laxmi and G. cot-15 (*G. hirsutum* and *G. arboreum*) and were found more susceptible to salt stress. Sarvottam (*G. herbacium*) showed relatively lesser reduction in yield and other parameters compared to Laxmi and G. cot-15.

Table 3. Inter species variations in boll characteristics of cotton.

Cotton species/ Varieties	Salinity levels	Yield of seed cotton	Seed Wt boll (g)	Lint Wt boll	Seed cotton wt/boll	Lint %	Number of seed/boll
G. herbacium	Low	142.1	1.81	1.70	3.51	48.4	71
Sarvottam	Medium	87.4	1.76	1.69	3.45	48.9	49
	High	73.5	1.69	1.08	2.77	38.9	33
G. hirsutum	Low	127.7	3.07	2.97	6.04	49.1	49
Laxmi	Medium	48.3	2.00	1.95	3.95	49.3	28
	High	44.4	1.05	0.85	2.90	29.3	19
G. arboreum	Low	171.4	1.70	1.36	3.06	44.4	20
G. cot-15	Medium	60.8	1.36	0.94	2.30	40.8	19
	High	47.0	1.05	0.68	1.70	40.0	14
	C D (5%)	2.26	0.14	0.08	0.57	1.99	5.09

Low ECe 3.14 ds/m Medium ECe 7.67 ds/m High ECe 14.6 ds/m

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