Effect of Nitrogen Level under Different Salinity Conditions on the Yield and Leaf Reddening in Cotton.[1]

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ABSTRACT

This experiment was carried out in the salinity laboratory at Alexandria in 1968. It included three salt concentrations: 4,000, 8,000 and 12,000 ppm of 1 : 1 NaCl and $CaCl_2$ in combination with three nitrogen levels: 0.0, 30, and 60 kgs N/acre.

Results indicated an inverse relationship between salinity and the yield of seed cotton per plant. As salinity was increased the yield of seed cotton per plant, the number of bolls per plant and the average boll weight was decreased. The yield of seed cotton, the number of bolls per plant and the average boll weight increased as the nitrogen level was increased.

Results also showed that leaf reddening in cotton resulting from high salinity might be controlled by optimal nitrogen level application. 60 kgs N/acre proved to be the most effective level in this respect.

INTRODUCTION

Leaf reddening in cotton has become one of the most interesting problems to cotton physiologists in Egypt. It is believed that leaf reddening reduces cotton yield. The main factors responsible for the problem are closely related to those which affect the water stress conditions (1,2,10,11,12). It was reported that unsuitable soil conditions such as high soil humidity, high water table and poor drainage are the main factors responsible for the trouble. Hamawi (5) in a comparative study on the differences in chemical composition between healthy and affected plants, reported that the main difference lies mainly in the total and protein nitrogen content of plants. He concluded that leaf reddening could be also attributed to some nutritional disorders and that any factor which could affect the nitrogen content or retard plant growth would depress the food reserves of plants. Hamawi *et al.* (7) in another study proved that the leaf reddening in cotton could be attributed to those factors which affect the protein nitrogen content of plants. They found that the effect of optimal nitrogen level was much greater than the effect of deep plough-

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ing and must be considered the effective means for the control of leaf reddening in cotton. Studying the influence of chemical composition of soils on leaf reddening trouble in cotton, they indicated that cotton plants in affected areas were suffering from abnormal soil conditions, mainly sub-soil alkali conditions. Affected soils showed a higher exchangeable sodium percentage (E.S.P). The E.S.P. was almost higher than 15% in the case of affected areas at depths deeper than 50 cms, while in the case of healthy areas the E.S.P. did not exceed 5.8% at any depth. It was found by Barakat and El-Ghamry (3) that irrigation with saline water did not reduce cotton yield when the salt concentration was 3,000 ppm. In another study Barakat *et al.* (4) noted a relative increase in yield by increasing salinity before its decrease by continuous increase in salinity. They found that on the average for all the varieties tested the decrease in cotton yield started when the salt concentration reached 6,000 ppm. The relative yield was 80% from the standard yield by increasing salinity to 8,000 ppm and 50% from the standard when the concentration was 9,500 ppm. Lashin *et al.* (10) obtained continuous increase in the yield of seed cotton with the increase in the level of added nitrogen. When nitrogen was added at 30, 45, and 60 kgs per acre, significant differences were obtained between the different treatments and the control. The difference between the yield obtained from adding 45 and 60 kgs N per acre was not significant.

MATERIALS AND METHODS

This experiment was conducted in the Salinity Laboratory at Alexandria in 1968 in barrels of 30 cms diameter and 40 cms height filled with clay loamy soil. The experimental design was randomized complete blocks with 4 replications. It included 3 salinity conditions: 4,000, 8,000, and 12,000 ppm of 1 : 1 sodium chloride and calcium chloride in combination with 3 nitrogen levels 0.0, 30, and 60 kgs N per acre.

Giza 45 cotton seeds were planted in the barrels in the middle of April 1968. The barrels were prepared and fertilized before planting with 100 kgs of superphosphate and 50 kgs of potassium sulphate per acre. The amount of nitrogen for each level was applied in 3 additions; 1/4 of the amount with the first, 1/2 with the second, and 1/4 with the third irrigation after planting. The salinity treatments started with the first irrigation after planting in the irrigation water on 5th of May 1968. Irrigation continued during the growing season every 10 days. When flowering started on June 27th, daily counts were made until the end of the flowering period on the beginning of August. Leaf reddening was estimated on July 14th according to its severity into 4 classes as follows: (−) means no leaf reddening, (+) means slight leaf reddening, (+ +) means moderate leaf reddening, and (+ + +) means severe leaf reddening.

Seed cotton was picked twice on August 19th and September 8th. The total yield of seed cotton, the number of harvested bolls, and the average boll weight were determined. Percentage boll setting was calculated as percent total bolls retained from flowers produced under the different treatments.

The purpose of this experiment was to study the physiological effects of nitrogen level under different salinity conditions on the yield and leaf reddening in cotton.

RESULTS AND DISCUSSION

I. Leaf Reddening

Both nitrogen level and salinity conditions had great influence on the severity of the leaf reddening problem in cotton. The results presented in Table 1 indicate the influence

of the added nitrogen in reducing the severity of the leaf reddening trouble in cotton under the different salinity conditions.

At the zero level of added nitrogen the severity of leaf reddening reached its maximum rate under the highest salinity condition (12,000 ppm), while it became moderate under lower salinity conditions (4,000 and 8,000 ppm). Slight leaf reddening resulted under the high level of salinity (12,000 ppm) only when 30 kgs N/acre was added. Leaf reddening disappeared under all salinity conditions by the addition of 60 kgs N/acre. These results suggest that the severity of leaf reddening as a result of high salinity might be controlled by optimal nitrogen level application. Sixty kgs N/acre proved to be the most effective level in this respect, since it gave a complete control of reddening under the different salinity conditions. Similar results were obtained by Hamawi *et al.* (6) and Lashin *et al.* (8) which showed the influence of the optimal level of added nitrogen in reducing the trouble in their field experiments carried out in different locations.

II. Flowering and Fruiting

The results showed in Table 2 indicate the influence of the different treatments on flowering and fruiting.

Table 1 Effect of salinity and nitrogen level on the severity of leaf reddening.

Salinity p.p.m.	Nitrogen level kgs/acre		
	0	30	60
4,000	(+)	(−)	(−)
8,000	(+ +)	(−)	(−)
12,000	(+ + +)	(+)	(−)

Degree of leaf reddening:
(+) = slight; (+ +) = moderate;
(+ + +) = severe; (−) = none

Table 2 Effect of salinity and nitrogen level on flowering and fruiting.

Treatments		Number of flowers (a)	Number of bolls retained (a)	Percentage boll setting (b)
N/acre in kgs	Salinity p.p.m.			
0.0	4,000	17.0	9.0	55.3
	8,000	15.0	7.8	50.8
	12,000	15.7	6.3	39.9
30	4,000	21.5	15.8	73.3
	8,000	25.8	13.5	48.6
	12,000	23.0	11.0	48.8
60	4,000	19.5	17.0	80.5
	8,000	23.3	13.8	84.3
	12,000	27.3	10.5	39.2
L.S.D. 5%		5.8	2.9	20.9
L.S.D. 1%		7.9	4.1	28.5

(a) Results are based on 4 barrels per treatment and each barrel contained 3 plants.
(b) Percentage boll setting was considered as percent total number of bolls retained from total flowers produced.

Applying statistical analysis on the data presented in Table 2, it was found that although the total number of flowers was not significantly affected by the change in salinity condition, the total number of flowers was increased significantly with the increase in the nitrogen level from the zero to the 30 and 60 kgs N/acre. Both salinity and nitrogen treatments affected the total number of bolls significantly. The total number of bolls was increased by increasing the nitrogen level and decreased by increasing salinity. Percentage boll setting was not affected significantly at the zero nitrogen level by variation in salinity although a trend toward a decrease in boll setting was noted with the increase in salinity. On the other hand, at 30 kgs N/acre boll setting was decreased significantly by increasing salinity to 8,000 ppm and 12,000 ppm. When 60 kgs N/acre was added, the percentage boll setting decreased with the increase in salinity. A highly significant difference was obtained under the 12,000 ppm level of salinity.

III. Yield and Yield Components

The yield of seed cotton, the average boll weight, and the number of harvested bolls were affected significantly by both salinity and nitrogen treatments as indicated in Table 3. A highly significant effect on yield was found between salinity and nitrogen level.

The results in Table 3 indicate that under the zero level of nitrogen the decrease in the yield of seed cotton with the increase in salinity was not significant. When the nitrogen level was raised to 30 or 60 kgs N/acre, the decrease in yield of seed cotton with the increase in salinity was highly significant. The average boll weight tended to decrease with the increase in salinity. While at the zero nitrogen this decrease in boll weight was not significant, highly significant decrease in boll weight was obtained at both 30 and 60 kgs N/acre. The total number of harvested bolls was increased by increasing the nitrogen level and decreased by increasing salinity. At the zero level of nitrogen the decrease in the total number of harvested bolls was not significant whereas at the level of 30 kgs N/acre

Table 3 Effect of salinity and nitrogen level on the yield and yield components.

Treatments		Yield of seed cotton in gm (a)	Average boll weight in gm (a)	Number of harvested bolls
N/acre in kgs	Salinity p.p.m.			
0.0	4,000	14.6	1.55	9.0
	8,000	11.5	1.51	7.8
	12,000	8.8	1.45	6.3
30	4,000	36.0	2.27	15.8
	8,000	24.5	1.84	13.5
	12,000	17.5	1.61	11.0
60	4,000	39.4	2.31	17.0
	8,000	24.7	1.85	13.8
	12,000	16.1	1.53	15.5
L.S.D. 5%		6.4	.34	2.9
L.S.D. 1%		8.9	.48	4.1

(a) Results are based on 4 barrels per treatment and each barrel contained 3 plants.

it was decreased significantly when salinity was raised from 4,000 ppm to 12,000 ppm. At 60 kgs N/acre significant decrease in the number of harvested bolls was obtained by raising salinity to any higher level above 4,000 ppm. It can be concluded that the decrease in the yield of seed cotton with the increase of salinity is mainly due to harmful effect of high salinity in decreasing both number and size of harvested bolls. On the other hand, it may be assumed that the increase in the yield of seed cotton with the increase in nitrogen level is the net result of added nitrogen effect in increasing the number and size of harvested bolls. These results are in close agreement with those obtained by Lashin *et al.* (8).

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