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PHYSIOLOGICAL RESPONSES OF FOLIAR AND SOIL APPLICATION OF NITROGEN ON COTTON *(GOSSYPIUM HIRSUTUM L.)*

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A comparison of foliar and soil application of nitrogen on cotton (Gossypium hirsutum L.) was made as a field trial. Six treatments of nitrogen were applied on the basis of 50 kg/ha. Full dose of soil applied nitrogen enhanced the height of plant, number of bolls, number of branches, leaf area, and seed cotton yield. The treatments such as 1/4 soil + 3/4 spray and full dose spray exhibited parallel effects for seed cotton yield. NIAB-78 proved short statured, early flowering, producing significantly more number of branches with a high yield, whereas B-557 showed more leaf area but was poor yielding.

INTRODUCTION

Cotton (Gossypium hirsutum L.) possesses a wide range of ecological adaptability and is grown mainly under irrigated conditions. Unfortunately, its yield in Pakistan is low as compared to other cotton growing countries of the world. It is partly due to the unawareness on the part of our cotton growers regarding various suitable agronomic practices, of which optimum time of sowing and use of fertilizers are considered to be the most important factors responsible for the growth, development and subsequent performance of this plant.

Among different factors, nitrogen is the most limiting element and seems indispensible for successful cotton cultivation. Nitrogen secures the formation of sturdy plants with high yield.

But if the amounts applied are too heavy, it may hamper the maturation and vegetative development which may be advanced at the expense of flowers and boll formation. Nitrogen as foliar application on cotton increased internodal length and stem growth (Malik et al., 1982) and considerable variation in number of branches was also reported (Patil and Patil, 1982). Foliar and soil application of nitrogen on cotton plant increased plant height (Hussain et al., 1979). Foliar and soil application of nitrogen enhanced number of flowers, number of bolls and seed cotton yield. Gossypium hirsutum supplied with 60 kg N + 30 kg P_2O_5 and 30 kg K_2O/ha in 2-4 split dressings produced the highest seed cotton yield than control. Nitrogen applied at 40 kg/ha through soil and 10 kg (2% urea solution) in two foliar sprays produced more seed cotton than 50 kg N/ha applied to soil (Gupta and Bhattacharya, 1983). Nitrogen enhanced the protein composition in cotton seed and also increased the protein, starch and sugar content in leaves (Rzaev et al., 1984).

In canal irrigated lands, nitrogen is generally applied through soil to cotton before irrigation but where there is acute shortage of water, the soil application becomes a problem. In such serious situations, foliar feeding is an effective attempt to upkeep the yield. In view of the above, the present study was undertaken to determine the effectiveness of various combinations of nitrogen fertilization on cotton.

MATERIALS AND METHODS

The study was conducted as a field trial at the experimental area of Botany Department, University of Agriculture, Faisalabad, during Kharif, 1986. Two varieties of cotton, i.e. Niab-78 and B-557 were subjected to test fertilizer(N)through soil and foliar application alone and in combination. The experiment was laid out in a randomised complete block design having six treatments with three replications. A plant to plant distance of 2' and row to row of 4' was maintained. Total area of the experiment was 72' x 48' which was further subdivided into 12 plots each with 24' x 4' serving as an experimental unit, i.e. receiving a combination treatment. The texture of the soil was clay-loam. Six treatments of N fertilizer comprising control (T_0), full dose soil (T_1), 3/4 soil + 1/4 spray (T_2), 1/2 soil + 1/2 spray (T_3), 1/4 soil

+ 3/4 spray (T_4) and full dose spray (T_5) were applied. One per cent solution of urea was sprayed on cotton seedlings with a fine hand power sprayer twice at an interval of 15 days before the initiation of floral buds and soil application was done in 2 split dressings. Ten plants from each treatment were earmarked randomly for recording individual observations on various growth parameters. For protein content, extraction in 80% ethyl alcohol was made. The residue obtained from the extraction was dried and used for the estimation of leaf nitrogen content by Kjeldahl's Method. The data so collected was statistically analysed by using analysis of variance technique and the treatment means were compared by Duncan's Multiple Range Test (Steel and Torrie, 1980) at 5% probability.

RESULTS AND DISCUSSION

The perusal of the results in Table 1 showed that full dose soil application proved to be the best among all the treatments showing thereby a maximum plant height of 129.07 cm. A minimum plant height of 104.80 cm was observed with full dose spray. The varieties differed significantly among themselves in this respect. B-557 proved taller than Niab-78 producing plants with 117.78 and 105.91 cm height, respectively. This wide difference in plant height may be attributed to the difference in genetic make up of the cultivars.

The results regarding number of days taken to flowering led to the conclusion that all the treatments produced the flowers late as compared to control. As regards the varieties, flowers were set eleven days earlier in Niab-78 as compared to B-557. As regards the number of bolls, the results are very much consistent with number of flowers. An examination of the performance of different combinations indicated that full dose soil application produced maximum number of bolls (125.46) as compared to all the treatments. Full dose spray showed the poorest performance with 113.12 number of bolls. Likewise, the maximum number of bolls (139.95) was observed for Niab-78 and 93.30 bolls were produced by B-557. It appeared that production of more flowers resulted in more setting of bolls. These results are in full conformity with other workers (Malik et al., 1982) who reported an increased number of bolls after nitrogen application.

Cotton response to the application of N was positive for all the treatments (Table 1). The number of branches increased significantly in full dose soil application with maximum number of 29.92 branches (44.81%) as compared to all the treatments and control. As regards varieties, Niab-78 produced significantly more (23.31) and B-557 showed 18.82 number of branches. These results are in accordance with the previous findings (Patil and Patil, 1982) who applied N to cotton and scored more branches.

The relevant data pertaining to leaf area showed that the treatments differed significantly from control. Full dose soil application surpassed all the treatments in building up leaf area with a percentage increase of 35.37%. Strangely, B-557 produced maximum leaf area (137.95 cm^2) as against Niab-78 which was found superior to this in majority of the growth parameters under study. It is also interesting to note that the number of branches are more in Niab-78 but the leaf area is greater in B-557. This difference may be the result of genetic potential of cultivars. Similar observations have been reported by Hussain et al. (1979) who recorded an increased leaf area by nitrogen application to cotton.

There existed almost significant difference among treatments as far as seed cotton yield was concerned (Table 1). All the treatments except 1/4 soil + 3/4 spray and full dose spray showed an appreciable influence of nitrogen application. A remarkable degree of effect on seed cotton yield had been observed in plots where full dose nitrogen as soil was applied which gave 154.68 g of seed cotton yield. These differences among various treatments are attributed to the relative efficiency of nitrogen uptake by cotton. This emphasises the importance of applying adequate nitrogen to this crop plant. Niab-78 proved better yielding cultivar with 139.03 g against 118.87 g for B-557. These findings are in line with the results reported by Gupta and Bhattacharya (1983) and Verma (1978).

In summing up, it may fairly be concluded from this study that the optimum seed cotton yield can be achieved by full dose soil application of nitrogen which brought about much improvement in almost all the growth parameters. The treatments of 3/4 soil + 1/4 spray and 1/2 soil + 1/2 spray stood 2nd and 3rd in their ranking but the combination of 1/4 soil + 3/4 spray

Table 1. *Treatment and variety means comparison as influenced by nitrogen fertilization on Gossypium hirsutum L.*

Treatments	Height of plant (cm.)	Days to flower-ing.	Number of bolls	Number of branches	Leaf area (cm^2)	Seed cotton yield (g)
T_0	102.86d	65.77d	110.79e	19.97c	105.39e	125.25e
T_1	129.07a	71.84a	125.46a	29.92a	142.67a	154.68a
T_2	118.36b	68.80b	120.33b	25.09b	136.76b	144.78b
T_3	110.96c	67.96c	117.86c	22.17c	136.39c	140.53c
T_4	105.02d	66.71d	116.88c	20.09	128.38c	131.57d
T_5	104.80d	66.63d	113.12d	20.26c	113.81d	130.90d
Niab-78	105.91b	62.86b	139.95a	23.31a	114.15b	139.03a
B-557	117.78a	73.04	93.30b	18.82b	137.95a	118.87b

* Mean values in a row or column with different letters differ significantly at P = 0.05.

and full dose spray failed to show much response to nitrogen fertilizer for cotton with desirable physiologically most active characteristics. Joint efforts of both the agronomists and physiologists seem to be essential in this direction.

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