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Growth and Yield of Cotton as Influenced by various Nitrogen Levels and Plant Population

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ABSTRACT

An investigation to study the effect of nitrogen @ 0, 187 and 250 kg ha^{-1}, and plant population of 58080, 43560 and 34847 plants ha^{-1}, on growth and yield of cotton variety-MNH-147 was conducted under field conditions. The levels of nitrogen and plant population significantly affected the plant height, number of sympodial branches plant^{-1}, number of matured bolls plant^{-1}, seed cotton weight boll^{-1} and seed cotton yield ha^{-1}. The interaction between N and plant population was not significant. Nitrogen levels and plant population did not affect the number of monopodial branches plant^{-1} and seed oil contents. Application of nitrogen @ 187 kg ha^{-1} gave the highest and significant increase in seed cotton yield over control where no nitrogen was applied. Plant population level of 43560 plants ha^{-1} produced the higher seed cotton yield.

Key Words: Cotton; Nitrogen; Plant population; Yield and yield components; Oil contents

INTRODUCTION

Cotton *(Gossypium hirsutum* L.) is an important cash crop of Pakistan. It accounts for 58.70% of the total export earnings and 57.43% of the domestic edible oil production (Anonymous, 1998). In Pakistan, cotton is grown on an area of 2922.8 thousand hectares with total production of 8790.2 thousand bales, making an average yield of 512 kg ha^{-1} (Anonymous, 2000).

The use of fertilizers on the responsive varieties have played a pivotal role in boosting the agricultural productivity, and nitrogen is apparently the most contributing fertilizer (Touchton, 1987). Nitrogen has been reported to increase plant height, number of monopodial/ sympodial branches plant^{-1} and number of matured bolls plant^{-1} in cotton (Soomro & Waring, 1987; Mukand *et al*., 1989). Seed cotton weight boll^{-1} and seed cotton yield ha^{-1} have been found affected by nitrogen application at various doses (Nehra *et al*., 1986; Khan *et al.,* 1993). Gomaa *et al*. (1981) reported a decrease in seed oil contents by increasing nitrogen application rate.

Plant population is a production factor, which affects light interception by plant canopy. High plant population has been found to give higher plant height, lower number of monopodial/ sympodial branches plant^{-1} and reduced boll weight (Wali & Koraddi, 1989). Abuldahab and Hassanin (1991) reported a decrease in boll weight and number of bolls plant^{-1} by increasing plant densities from 70000 to 140000 plants feddan^{-1} (0.42 ha).

The present study was conducted to find out an optimum combination of nitrogen level and plant population for enhancing the seed cotton production.

MATERIALS AND METHODS

The experiment was conducted at the Experimental Farm, University College of Agriculture, Multan on a clay loam soil. The experiment was laid out in a RCBD in factorial fashion with four replications having a net plot size of 4.5 m X 6.0 m. Three levels of nitrogen (0, 187 and 250 kg ha^{-1}) were used in combination with three plant population levels (58080, 43560 and 34847 plants ha^{-1}) to make nine treatment combinations. The plant population levels were obtained by maintaining plant to plant distance of 22.50, 30 and 37.50 cm, respectively. The seed of cotton variety MNH-147 was soaked in water for four hours before sowing. The crop was sown on a well-prepared moist seedbed with a single row hand drill in 75 cm apart rows. The total supply of nitrogen fertilizer was split into three equal doses, applied at sowing, first irrigation and flowering, respectively. Thinning was done to maintain the desired plant population when the plants attained a height of 15 cm. All other agronomic practices were kept normal and uniform for all the treatments. Ten plants from each plot were selected at random to record number of monopodial branches plant^{-1}, number of sympodial branches plant^{-1}, number of matured bolls plant^{-1} and plant height at maturity. Fifty bolls were taken randomly from each plot, weighed and averaged to record the seed cotton weight boll^{-1}. Two pickings from the whole plot, first 180 and second 195 days after sowing were done to obtain the seed cotton yield. The seed cotton yield plot^{-1} (kg) was calculated after the last picking and was converted to seed cotton yield ha^{-1}. The samples of the cotton- seed were analyzed by NMR (4000 Oxford) for oil contents, which gives direct reading from whole seed.

Data collected were analyzed statistically using Fisher's analysis of variance technique. LSD test at 0.05 probability level was employed to compare the differences among the treatments means (Steel & Torrie, 1984).

RESULTS AND DISCUSSION

Plant height was significantly different at different N levels (Table I). Application of N @ 250 kg ha^{-1} produced the tallest plants. Soomro and Waring (1987) reported significant differences in plant height with different levels of N application. Different plant population levels affected significantly the plant height (Table I). Population level of 58080 plants ha^{-1} gave significantly taller plants (154.5 cm) than all other levels of plant population. Less space between the cotton plants caused them to attain height instead of forming branches. Wali and Koraddi (1989) have also reported increase in plant height with increasing plant population. Interaction between various levels of N and plant population was not significant.

Number of monopodial branches $plant^{-1}$ were not significantly different in different N application levels (Table I). Application of N @ 250 kg ha^{-1} produced highest number of monopodial branches $plant^{-1}$ (2.95) followed by application rate of 187 kg N ha^{-1} which had 2.80 monopodial branches $plant^{-1}$. Control gave the lowest number of monopodial branches $plant^{-1}$ (2.10). These results are in line with those of Soomro and Waring (1987). Various plant population levels had a non-significant effect on number of monopodial branches $plant^{-1}$ (Table I). Population level of 34847 plants ha^{-1} produced the highest number of monopodial branches $plant^{-1}$ (2.96). It was closely followed by population level of 43560 plants ha^{-1} which had 2.84 monopodial branches $plant^{-1}$. Population level of 58080 plants ha^{-1} produced the lowest number of monopodial branches $plant^{-1}$ (2.15). Similar results were reported by Wali and Koraddi (1989). The interaction between various levels of N and plant population was not significant.

Both levels of N increased significantly the number of sympodial branches $plant^{-1}$ over control (Table I). Application of N @ 250 kg ha^{-1} produced the highest number of sympodial branches $plant^{-1}$ (22.3). It is argued that nitrogen promoted the growth of axillary positions on the main stem, which resulted in an increase in number of fruiting branches in treatments where nitrogen was applied. The increase in number of fruiting branches with increasing N application rate has also been reported by Mukand *et al*. (1989). Various levels of plant population showed a significant effect on number of sympodial branches per plant (Table I). Population level of 34847 plants ha^{-1} gave significantly the maximum number of sympodial branches $plant^{-1}$ (22.7) and was followed by population level of 43560 plants ha^{-1} with 17.8 sympodial branches $plant^{-1}$. The differences between population levels of 43560 and 58080 plants per ha^{-1} could not reach to a significant level. Widely spaced cotton plants (spaced 30 and 37.50 cm apart) significantly produced greater number of sympodial branches $plant^{-1}$ because of the availability of more space than closely spaced cotton plants (22.50 cm apart). These results are quite in line with those of Wali and Koraddi (1989). The interaction between various levels of N and plant population was not significant.

Number of matured bolls $plant^{-1}$ differed significantly under various levels of N application (Table I). Application of N @ 187 kg ha^{-1} produced the highest number of matured bolls per plant (18.2), which were statistically at par with the application rate of 250 kg ha^{-1}. Application of 250 kg ha^{-1} led to the formation of more flowers but it resulted in excessive shedding of buds and bolls, finally giving less number of matured bolls $plant^{-1}$. Higher N dose also caused the plants to become succulent and more attractive for insect attack and led to lower number of matured bolls $plant^{-1}$ at harvest. Similar results have also been shown by Mukand *et al*. (1989). Significant differences were observed among various plant population levels for number of matured bolls $plant^{-1}$ (Table I). Population level of 34847 plants ha^{-1} gave the highest number of matured bolls $plant^{-1}$ (18.7), which were at par with population level of 43560 plants ha^{-1}. These results are in agreement with those of Abuldahab and Hassanin (1991). The interaction between various levels of nitrogen and plant population was not significant.

Various levels of N affected significantly the seed cotton weight $boll^{-1}$ (Table I). Application of N @ 250 and 187 kg ha^{-1}, were at par with each other, however, produced

Table I. Response of a Cotton variety-MNH-147 to various levels of N and plant population

Treatments	Plant height at maturity (cm)	Monopodia $plant^{-1}$	Sympodia $plant^{-1}$	Matured bolls $plant^{-1}$	Seed cotton weight $boll^{-1}$	Seed cotton yield (kg ha^{-1})	Oil contents (%)
N levels (kg ha^{-1})							
0	135.00 c	2.10	16.42 c	14.66 b	1.73 b	1104 b	17.40
187	150.08 b	2.80	18.16 b	18.2 a	3.03 a	2411 a	17.50
250	165.08 a	2.95	22.3 a	17.1 a	3.15 a	2340 a	17.25
Population levels (plants ha^{-1})							
58080	154.5 a	2.15	16.4 b	13.7 b	2.41 b	1920 ab	17.15
43560	150.6 b	2.84	17.8 b	17.4 a	2.71 a	2080 a	17.48
34847	145.1 c	2.96	22.7 a	18.7 a	2.81 a	1830 b	17.32
Interaction	NS	NS	NS	NS	NS	NS	NS

Means sharing same letters are statistically non-significant at 5 % probability level; NS = Non-significant.

significantly the higher seed cotton weight boll^{-1} as compared to control. Lowest seed cotton weight boll^{-1} (1.73 g) was obtained from control. Significant effect of different levels of N application on seed cotton weight boll^{-1} have also been reported by Nehra *et al.* (1993) and Khan *et al*. (1993). Various levels of plant population varied significantly from one another for seed cotton weight boll^{-1} (Table I). Population level of 34847 plants ha^{-1} gave significantly higher seed cotton weight boll^{-1} (2.81g), which were not significantly different from population level of 43560 plants ha^{-1}. Control produced the lowest seed cotton weight boll^{-1} (2.41 g). These results are in confirmation with those of Wali and Koraddi (1989), and Abuldahab and Hassanin (1991). The interaction between various levels of nitrogen and plant population was not significant.

Significant differences were observed among various levels of N for affecting seed cotton yield ha^{-1} (Table I). Application of 187 kg N ha^{-1} produced the maximum seed cotton yield (2411kg ha^{-1}), which was statistically at par with the application rate of 250 kg N ha^{-1} (2340 kg ha^{-1}). Control gave the lowest seed cotton yield of 1104 kg ha^{-1}. Application of 187 kg N ha^{-1} resulted in maximum seed cotton yield ha^{-1} due to proper vegetative and reproductive growth. Higher N dose than this level resulted in excessive shedding of buds and bolls and ultimately less yield was obtained while in control treatment, due to acute lack of nitrogen could not have proper number of fruiting branches plant^{-1} and ultimately produced less seed cotton yield. Similar results have also been shown by Nehra *et al*. (1986) and Khan *et al*. (1993). Different population levels varied significantly as regards the seed cotton yield ha^{-1} (Table I). Population level of 43560 plants ha^{-1} produced the highest seed cotton yield (2080 kg ha^{-1}) which was statistically at par with population level of 34847 plants ha^{-1}(1920 kg ha^{-1}). Differences between population levels of 34847 and 58080 plants ha^{-1} could not reach to a significant level. The interaction between various levels of nitrogen and plant population was not significant.

Nitrogen application rates did not affect significantly seed oil contents in cotton (Table I). The highest seed oil contents (17.50 %) were produced by N application rate of 187 kg ha^{-1} and it was followed by control, which had 17.40 % oil contents. The lowest seed oil contents (17.25 %) were obtained from N application rate of 250 kg ha^{-1}. Decrease in oil contents with increase in N application rate has also been reported by Gomaa *et al.* (1981). Different plant population levels (Table I) did not affect seed oil contents significantly. Population level of 43560 plants ha^{-1} produced the highest seed oil contents (17.48%) and was followed by 58080 plants ha^{-1}, which had 17.32% oil contents. Population level of 34847 plants ha^{-1} gave the lowest seed oil contents (17.15%). The interaction between various levels of N and plant population was not significant.

CONCLUSION

Application rate of 187 kg N ha^{-1} and population level of 43560 plants ha^{-1} may be preferred over other levels of nitrogen and plant population due to higher seed cotton yield and oil contents.

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