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Yield Variations of CIM-499, CIM-511 AND CIM-707 Cotton Varieties as Affected by Different Nitrogen Levels

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Abstract

Response of varying levels of nitrogen viz 50, 100, 150 and 200 kg ha^{-1} to different varieties of cotton namely CIM-499, CIM-511 and CIM-707 was studied at Agronomic Research Area, Central Cotton Research Institute, Multan. Maximum number of bolls (25.33), boll weight (2.8 gm) and seed cotton yield (2765 kg ha^{-1}) were recorded at 200 kg ha^{-1} of nitrogen. Lowest rate of nitrogen (50 kg ha^{-1}) had least effect on number of bolls (19.33), average boll weight (2.39 gm) and seed cotton yield (1972 kg ha^{-1}). The shedding percentage (75.67 %) was highest in CIM-511 where 50 kg ha^{-1} of nitrogen was applied. The lowest shedding percentage (59.33 %) was recorded in CIM-707 with 150 kg ha^{-1} and CIM-499 having 200 kg ha^{-1} of nitrogen.

Key words: Cotton, Nitrogen, Varieties, Yield and yield component

Introduction

Cotton (*Gossypium hirsutum* L.) is one of the most important non-food cash crops and plays a significant role in agriculture, industrial development, employment generation and economic development of Pakistan. The cotton crop meets the increasing demands of domestic agri-based industries but also fetches a substantial amount of foreign exchange 11.7 % through exportable surplus of cotton fiber and fiber made products and about 2.9 % of GDP (Anonymous, 2002).

In Pakistan, the average seed cotton yield (621 kg/ ha) is very low as compare to the other countries this is due to the unpredictable weather, viral disease like cotton leaf curl virus (CLCV) and non-availability of pure cottonseed. The other cause that should be taken into account seriously is the imbalance application of nutrient elements as fertilizers.

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We can increase the total yield of cotton by extending the area of cultivation and improving average production per hectare by using improved, virus resistant and high yielding varieties. It necessitates giving serious consideration to determine the optimum level of nitrogen for increase in average yield per hectare. Nitrogen plays a dominant role in growth processes. It is an integral part of chlorophyll molecule, protein and nucleic acid (Marschner, 1986). Nitrogen fertilizer requirement depends on many factors including yield, Nitrogen concentration, Nitrogen mineralization, soil type and numerous environmental factors (Power and Schepers, 1989).

Arshad *et al.* (1986) observed that the application of 50 kg N increased seed cotton yield from 1.15 to 1.22 t ha^{-1} but higher N rates had no significant effects. Angadi *et al.* (1989) observed that the application of 0, 50, 100, and 150 kg N ha^{-1} on cotton hybrid DCH-321 gave yields of 1.62, 2.45, 2.86, and 2.75 t ha^{-1}, respectively. Arain *et al.* (1989) noted that maximum seed cotton yield of 1825.22 kg ha^{-1} was achieved with 100 kg N ha^{-1}. Marsh *et al.* (2000) tested the response of California Acala cotton varieties to nitrogen fertilizer and found that cotton lint yield increased significantly with each fertilizer increment up to 150 kg N ha^{-1}. Zhao and Oosterhuis (2000) reported that low N supply at the reproductive stage decreased leaf area, leaf net photosynthetic rate and chlorophyll content, while fruit abscission of N deficient plants increased, and lint yield decreased.

In Pakistan, different cultivars of cotton with different growth habits are grown. Tall and medium cultivars vary in relation to maturity and morphological characters such as leaf area and plant size. These cultivars respond differently to various agro-management practices especially sowing time, plant population and fertilizer management. The present study was, therefore, planned to observe the effect of varying levels of nitrogen to growth of the different varieties of cotton under agro climatic conditions of Multan.

Materials and Methods

The study was carried out to determine the optimum level of nitrogen fertilizer in cotton varieties at the Agronomic Research Area, Central Cotton Research Institute, Multan during the year 2002 on the silty

clay loam soil. Experiment was laid out in randomized complete block design with split plot arrangement and three repeats, four Nitrogen levels (50, 100, 150 and 200 kg ha^{-1}) and three varieties (CIM-499, CIM-511 and CIM-707) were tested by using a net plot size of 9m x 15m ($135m^2$). Nitrogen levels were randomized in main plots and Varieties in sub plots. Cotton varieties were sown on well-prepared seedbed with 75 cm RxR (Row to Row) and 30 cm PxP (Plant to Plant) distance. All the nitrogen applications were completed before 15th of August *i.e.* at 1st irrigation, 3rd irrigation, flowering and boll formation stages. All other agronomic practices were uniform and normal for all the treatments. Yield parameters studied were shedding percentage, number of bolls $plant^{-1}$, boll weight, number of seeds $boll^{-1}$, 100-seed weight, seed cotton yield and ginning out turn. Data collected were statistically analyzed by using the Fisher's analysis of variance techniques and least significant difference (LSD) test at 5% probability was applied to compare the significant treatment means (Steel and Torrie, 1984).

Results and Discussion

The shedding of buds and flowers affects the number of bolls per plant and ultimately final yield. The data on the shedding percentage of buds and flowers is given in table 1, which showed that the interaction of different nitrogen levels with varieties had a significant influence on shedding percentage. The average shedding percentage of buds, flowers and bolls was highest in 50 kg N ha^{-1} with CIM-511 that was 75.67%, CIM- 499 and CIM-707 reach 74.33% and 73.67% at 50 kg N ha^{-1} respectively. Minimum shedding percentage was recorded in 150 kg N ha^{-1} with CIM-707 and 200 kg N ha^{-1} with CIM-499 which was 59.33%.200 kg N ha^{-1} show 59.33, 61.00, 63.33 percent shedding in CIM-499, CIM-511and CIM-707 respectively. Shedding percentage decreased till the level of 150 kg N ha^{-1} significantly but there was no major difference between 150 kg N ha^{-1} and 200 kg N ha^{-1}. 200 kg N ha^{-1} gave 61.67, 59.67, 59.33 percent shedding in CIM-499, CIM-511and CIM-707 respectively. 50 kg N ha^{-1} and 100 kg N ha^{-1} gave statistically same results with all the varieties individually. According to the data suitable dose of nitrogen fertilizer to CIM-511 and CIM-707 was 150 kg N ha^{-1} while 200 kg N ha^{-1} increase the shedding percentage as compare to 150 kg N ha^{-1} in CIM-511 and CIM-707. In the form of access of nitrogen (200 kg N ha^{-1} compare with 150 kg N ha^{-1}) 7 % increase in CIM-707 and 3% increase in CIM-511 which directly effect on the yield and the expenses of crop. These results are supported by the finding of Ishwar and Chouhan (1993), Zhao and Oosterhuis (2000).

Final data recorded on 1st October nitrogen levels gave significant difference on number of bolls per plant. Average number of bolls per plant (table 2) was 19.33 in 50 kg N ha^{-1}, 21.33 in 100 kg N ha^{-1}, 25.00 in 150 kg N ha^{-1}, 25.33 in 200 kg N ha^{-1}. Data indicates that 100 and 150 kg N ha^{-1} gave 11 and 32 percent more boll then 50 kg N ha^{-1} respectively. There was no statistically difference between 150 and 200kg N ha^{-1}. Varieties gave non-significant difference, the interaction between nitrogen levels and varieties also found to be non-significant. Such increase in number of bolls per plant was the direct consequences of higher number of sympodial branches and less buds and flower shedding per plant. Similar results also reported by Abuldahab and Hassanin (1991), Boquet *et al*. (1993), Brar *et al.* (1993).

Weight of seed cotton per boll are directly related to the final yield table 3 revealed significantly differences average boll weight among different nitrogen levels and varieties. The average boll weight was 2.39, 2.51, 2.66 and 2.68 g in 50, 100, 150 and 200 kg N ha^{-1} respectively. Maximum boll weight observed in 200 kg N ha^{-1} (2.60g), there was no significant difference in boll weight between 200 and 150 kg N ha^{-1}. Nitrogen at the rate of 150 kg ha^{-1} gave significant more boll weight then 50 and 100 kg N ha^{-1}. CIM-511 shows the maximum boll weight of 2.65g while minimum observed in CIM-707 (2.44g). CIM-499 and CIM-511 show statistically same results. The interaction effect found to be non-significant. These results are supported by the findings of Brar *et al*. (1993).

Data regarding the number of seeds per boll were affected significantly by nitrogen application and varieties as presented in table 4.11. The maximum number of seeds per boll (18.33) was obtained by applying 150 and 200 kg N ha^{-1} no significant difference in seed per boll observed by applying 150 and 200 kg N ha^{-1}. Least number of seed per boll found in 50 and 100 kg N ha^{-1} that was 16.33. Varieties show 18.33, 17.42, 16.58 in CIM-499 CIM-511 and CIM-707 respectively. Data shows that as increase in nitrogen level number of seeds per boll increased up to 150 kg N ha^{-1}. The interaction effect was found to be non-significant. These results are supported by the findings of Brar *et al*., (1993).

Different varieties show significant effect on 100-seed weight as it is evaluated from the table 5. Maximum seed weight (9.60 g) was noted from CIM-511 and CIM-707 while CIM-499 gave 8.60 g of 100-seed weight. The data indicates that nitrogen levels and their interaction never gave significant response on 100-seed weight. These results are supported by the findings of Elayan (1992).

Table 1: Effect of different nitrogen levels on shedding % age on three varieties of cotton.

Nitrogen Level (Kgha^{-1})	Variety			Mean
	CIM-499	CIM-511	CIM-707	
N_1 = 50	74.33 ^{a}	75.67 ^{a}	73.67 ^{a}	74.56 ^{a}
N_2 = 100	69.33 ^{b}	69.00 ^{b}	69.67 ^{b}	69.33 ^{b}
N_3 = 150	61.67 ^{cd}	59.67 ^{de}	59.33 ^{e}	60.22 ^{c}
N_4 = 200	59.33 ^{e}	61.00 ^{de}	63.33 ^{c}	61.22 ^{c}
Mean	66.17 ^{ns}	66.33	66.50	

Table 2: Effect of different nitrogen levels on number of bolls on three varieties of cotton

Nitrogen Level (Kgha^{-1})	Variety			Mean
	CIM-499	CIM-511	CIM-707	
N_1 = 50	19	19	20	19 ^{b}
N_2 = 100	21	21	22	21 ^{b}
N_3 = 150	24	26	25	25 ^{a}
N_4 = 200	25	26	25	25 ^{a}
Mean	22 ^{ns}	23	23	

Table 3: Effect of different nitrogen levels on average boll weight on three varieties of cotton.

Nitrogen Level (Kgha^{-1})	Variety			Mean
	CIM-499	CIM-511	CIM-707	
N_1 = 50	2.37	2.53	2.27	2.39 ^{c}
N_2 = 100	2.49	2.56	2.47	2.51 ^{bc}
N_3 = 150	2.71	2.75	2.51	2.66 ^{ab}
N_4 = 200	2.75	2.77	2.51	2.68 ^{a}
Mean	2.58 ^{a}	2.65 ^{a}	2.44 ^{b}	

Table 4: Effect of different nitrogen levels on seed per boll on three varieties of cotton.

Nitrogen Level (Kgha^{-1})	Variety			Mean
	CIM-499	CIM-511	CIM-707	
N_1 = 50	17	17	15	16 ^{b}
N_2 = 100	17	16	16	16 ^{b}
N_3 = 150	19	18	18	18 ^{a}
N_4 = 200	20	18	17	18 ^{a}
Mean	18 ^{a}	17 ^{ab}	17 ^{b}	

Seed cotton yield is the combined effect of individual yield components under particular environmental conditions. Data regarding seed cotton yield are presented in table 6. It is evident that different levels of nitrogen showed significant effect on seed cotton yield. Maximum seed cotton yield observed in 200 kg N ha^{-1} that was 2.765 kg ha^{-1} and 150 kg N ha^{-1} show the seed cotton yield of 2741 kg ha^{-1} that was statistically same with 200 kg N ha^{-1}. Minimum seed cotton yield observed in 50 kg N ha^{-1} which shows 1972 kg ha^{-1}. On over all average basis of different varieties show significant difference, Seed cotton yield of 2583, 2545 and 2280 kg ha^{-1} observed in CIM-499, CIM-511, CIM-707 respectively. 150 kg N ha^{-1} gave 28 and 14 percent more seed cotton yield then 50 and 100 kg N ha^{-1} where as 100 kg N ha^{-1} gave 18 percent more seed cotton yield than 50 kg N ha^{-1}. Data shows that seed cotton yield increased significant with each.

Increment of nitrogen levels up to 150 kg N ha^{-1}. The interaction effect found to be non significant. All the above findings are supported by Brar *et al* (1993), Giri *et al* (1994), Ravankar and Laharia (1994) and Marsh *et al* (2000).

Table 5: Effect of different nitrogen levels on 100 seed weight on three varieties of cotton.

Nitrogen Level (Kgha^{-1})	Variety			Mean
	CIM-499	CIM-511	CIM-707	
N_1 = 50	8.5	9.7	9.9	9.3 ^{ns}
N_2 = 100	8.9	9.9	9.9	9.6
N_3 = 150	8.8	9.5	9.1	9.1
N_4 = 200	8.4	9.5	9.6	9.2
Mean	8.6 ^{b}	9.6 ^{a}	9.6 ^{a}	

Table 6: Effect of different nitrogen levels on seed cotton yield on three varieties of cotton.

Nitrogen Level (Kgha^{-1})	Variety			Mean
	CIM-499	CIM-511	CIM-707	
N_1 = 50	1988	2108	1821	1972 ^{c}
N_2 = 100	2492	2494	2208	2398 ^{b}
N_3 = 150	2874	2778	2572	2741 ^{a}
N_4 = 200	2978	2799	2518	2765 ^{s}
Mean	2583 ^{a}	2545 ^{b}	2280 ^{b}	

Table 7: Effect of different nitrogen levels on GOT on three varieties of cotton.

Nitrogen Level (Kgha^{-1})	Variety			Mean
	CIM-499	CIM-511	CIM-707	
N_1 = 50	39.7	37.2	35.4	37.4 ^{ns}
N_2 = 100	38.6	36.2	34.5	36.4
N_3 = 150	39.1	36.9	35.1	37.0
N_4 = 200	38.8	37.0	34.4	36.7
Mean	39.1 ^{a}	36.8 ^{b}	34.8 ^{c}	

Table 7 revealed significantly differences ginning out turn among different varieties. Maximum ginning out turn observed in CIM-499 (39.10 %), CIM-511 show the ginning out turn of 36.80 % while minimum observed in CIM-707 (34.80 %). CIM-499, CIM-511 and CIM-707 show statistically significant results. while nitrogen levels and their interaction was also show non significant difference These results are suppoted by the findings of Brar *et al*. (1993).

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