The Effect of Potassium Fertilizer Plus Higher Nitrogen Rates on Growth and Yield of Cotton

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ABSTRACT

Two field experiments were carried out in two locations of Beni-Suef Governorate in middle Egypt, on Giza 75 cotton cultivar (Gossypium barbadense L.) to increase cotton yield by increasing nitrogen rates, while enhanced by potassium. The treatments were 112.5, 150, 187.5 kg N/ha and 187.5, 225.5 kg N plus 60kg K/ha. Results revealed that previous treatments had little effect on plant growth and boll weight. Without K, the yield components and yield of seed cotton increased insignificantly by increasing nitrogen rate up to 150kg/ha but decreased significantly with the rate 187.5kgN/ha. Applying K fertilizer plus higher N rates, reversed the negative effect of nitrogen increases and raised the yield of seed cotton.

Introduction

Recently, reductions of seed cotton yield have been experienced in many locations. This phenomenon seems to be in relation to the increases of nitrogen rates and/or insufficient available potassium in the soils. Darwish *et al.* (1995) mentioned that higher nitrogen rates could be equalized by potassium applications, for producing higher yields. Janes *et al.* (1995) found that there were significant increases in yield of normal and half normal boll loads per plant, with higher potassium rates. Abd El-Aal *et al.* (1995) showed that potassium fertilizer had insignificant effect on plant height, while it increased number of fruiting branches, yield components and yield of seed cotton. This study was to determine the effect of potassium fertilizer combined with nitrogen on cotton growth and yield.

Material and Methods

Experiments were carried out at Beni-Suef Governorate, in two locations, during 1991 season, using the cotton cultivar Giza 75 (*Gossypium barbadense* L.). A complete randomized block design with four replications was used. The plot size was 25 m_2, with eight rows at 60 cm spacing. The treatments were 112.5 kg N, 150 kg N, 187.5 kg N, 187.5 kg N + 60 kg K_2O and 225.5 kg N + 60 kg K_2O per hectare. The nitrogen fertilizer was in the form of urea (46% N) and potassium in the form of potassium sulphate (48% K_2O). In addition, all plots received 375-kg/ha calcium super phosphate (15.5% P_2O_5), before planting. Soil samples were taken at 30-cm depth before sowing to estimate available NPK (p.p.m), $CaCO_3$% and T.S.S. % (Table 1). Leaf samples were taken at the beginning of flowering to estimate NPK concentration percentages (Table 2).

Five hills (ten plants) were chosen at random from each plot to estimate final plant height (cm), number of sympodia per plant and boll weight (gm). The yield of seed cotton per plant was estimated from yield per plot and number of plants at harvest. The number of open bolls was calculated from the yield per plant and boll weight. The data obtained were subjected to combined analysis for both locations using Duncan's Multiple Range Test.

Results and Discussion

Results showed that there was slight increase in final plant height and number of sympodia per plant with higher N rates (Table 3). This might be due to the adequacy of lower nitrogen rates in producing plant growth that equalled that of higher nitrogen rates in the effect. Similar results were obtained by Abd El-Aal *et al.* (1995).

Number of open bolls, yield per plant and yield per hectare were increased by raising N rate from 112.5 kg to 150 kg/ha but it decreased with further increased N rate to 187.5kg/ha, where differences between the mean yields were significant. Applications of K fertilizer at higher N rates increased the yield components and yield of seed cotton and corrected the negative effect of nitrogen increases (Tables 3 and 4). Boll weight and plant stand at harvest were slightly affected by N and N-K treatments.

However, previous results revealed that there was a strong relationship in the impact of N and K on the yield components and yield of seed cotton. While the lower nitrogen rate 112.5 kg/ha was relatively low to meet the maximum fruiting capacity of cotton plant, the nitrogen rate 150kg/ha gave the highest yield. This could be due to its adequacy with the available potassium content of the soil (Table 1). Further increase in N rates up to 187.5 kg/ha decreased the yield, possibly due to an imbalance between these elements. Consequently, applying K fertilizer with higher nitrogen rates rendered the higher N rates adequate, raising the yield.

From another standpoint, monitoring the concentrations of NPK in leaves of cotton plants at

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the flowering stage revealed that there was a tendency for decreased total nitrogen with increased yield of seed cotton, while the reverse was true with respect to the K concentration. Phosphorus concentration was slightly affected for all treatments (Table 2). These results included some exceptions especially with higher rates of nitrogen plus potassium. Generally, it could be concluded that the excess increases of N fertilizer demanded increases in K in order to maintain an adequate K content in the plant. These results are in line with those obtained by Janes *et al.* (1995) and Darwish *et al.* (1995).

References

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Table 1. Chemical and physical analysis of the soil experiment for the two sites.

Site	% T.S.S.	% $CaCO_3$	N	P (ppm.)	K
1	0.13	3.5	20	12.2	410
2	0.16	3.0	30	11.2	500

Table 2. Mean NPK concentration percentages in leaves at the beginning of flowering for the two sites.

Fertilizers rates N + K, kg/ha	N	% P	K
112.5 + 0	4.17	0.45	2.13
150.0 + 0	3.83	0.42	2.34
187.5 + 0	4.52	0.42	2.07
187.5 + 60	3.97	0.43	2.17
212.5 + 60	4.12	0.45	2.18

Table 3. Mean plant height, number of sympodia, open bolls and boll weight for the two sites.

Fertilizer rates N+K kg/ha	Plant height (cm)	Number of sympodia/plant	Open bolls/ plant	Boll weight (gm)
112.5 + 0	131	14.5	13.7	2.57
150.0 + 0	134	15.3	14.6	2.56
187.5 + 0	138	15.8	13.5	2.52
187.5 + 60	139	15.3	13.8	2.61
212.5 + 60	135	15.3	13.9	2.56

Table 4. Mean yield per plant and per hectare and plant stand at harvest for the two sites.

Fertilizers rates N + K kg /ha	Yield/plant (gm)	Yield/Hectare (kg)	Plants/ha at harvest (1000)
112.5 + 0	35.3	3800 a	107.5
150.0 + 0	37.3	3863 a	103.8
187.5 + 0	34.0	3563 b	104.9
187.5 + 60	34.7	3741 a	107.9
212.5 + 60	35.5	3851 a	105.6