Yield and Quality Properties of Cotton as Affected by Potassium Fertilization

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ABSTRACT

A four year field test was initiated in 1997 to evaluate potassium as a soil treatment on yield and fiber quality of cotton in Adana. Four rates of potassium as K_2SO_4 (0, 80, 160 and 240 kg/ha) were applied to C.1518 cotton in two splits with half the K applied at planting and half when the crop reached the first bloom stage. Yield, plant growth and development and High Volume Instrument quality evaluation were measured for each treatment. Averaged over all treatments, adding K produced significant seed-cotton and lint yield responses (P=0.01) compared with the untreated control. K treatments produced a significantly higher boll weight than the control. HVI lint quality values were not affected by any treatment.

Introduction

Researchers agree that K has a positive impact on yield and fiber quality. According to Cassman *et al.* (1990), there was a significant seed-cotton yield response to applied K, lint yield increased relatively more than seed yield, resulting in a greater lint percentage as plant K supply increased (Cassman *et al.*, 1990). Soil-applied KNO_3 at 20 lb/acre increased lint yields by a significant 81 lb/acre. The increase in lint yield was reflected in an increase in boll size and boll number but only fiber strength consistently improved with soil-applied KNO_3 (Matocha *et al.*, 1994). The K deficiency associated with the 0 K treatment reduced lint yield (9 %), lint percentage (1 %), fiber elongation (3 %), 50 % span length (1 %), uniformity ratio (1 %), micronaire (10 %), fiber maturity (5 %), and perimeter (1 %) in all genotypes (Pettigrew *et al.*, 1996).

Most growers and researchers in Turkey believe that K is not a limiting factor in cotton yield and there is no need to treat cotton with K fertilizer due to high soil potassium levels. There is confusion, since grower all agree that K fertilization is not necessary for high yields in cotton but visual mid-season K deficiencies in cotton have been reported in many parts of Turkey. Symptoms of K deficiency in cotton have been well defined for many years and described by several researchers. The use of faster-fruiting and higher-yielding cotton cultivars has resulted in the occurrence of potassium deficiency, therefore, there was increased interest in potassium as a limiting nutrient in Turkey. Many producers started applications without determining if it would increase yields or fiber quality or be profitable under their management and growing conditions. Still, the basic question is 'do we need potassium to achieve high yields' or very importantly 'what do we know about it'. These basic questions necessitated the initial studies to improve our understanding of the onset of K deficiency in cotton and our ability to know how cotton crops respond to K fertilization.

For all these reasons, a four-year field test was initiated to evaluate potassium as a soil treatment on yield and fiber quality of cotton in Adana in 1997.

Material and Methods

A field experiment was conducted in 1997 at the Çukurova University, Department of Field Crop's Research Station at Adana on silt loam soil. Soil was sampled for K analysis prior to K fertilizer application at planting. Soil samples were taken from 0-20 and 20-40 cm deep in the drill. All soil samples were analyzed by the Soil Testing Laboratory at Çukurova University. Soil tests normally indicated high to very high potassium levels in the test area. Although soils may be rated as high in available K, in-season crop shortages can develop due to heavy demand during periods of rapid boll set and fill.

Cotton was grown at a population of 62,500 plants/hectare on 80-cm rows in 4 row plots, 12 metres long with one metre row spacing between plots. There were four replications. A randomized complete block design was used. Planting date was April 24, 1997. Seeding rates were approximately 50 kg/hectare. All plots received basal N and P.

Four K rates (0, 80, 160 and 240 kg/ha) were applied to Çukurova 1518 cotton in 2 splits with half the K applied at planting and half when the plant reached the first bloom stage. K was banded approximately 10-15 cm into the centre of prepared seedbeds.

Weeds were controlled with preplant, preemergence and pestemergence herbicides. Mechanical weed control was employed as needed. Recommended insecticides were applied when warranted to control insects. The plots were furrow irrigated as needed.

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Twenty plants in each plot were randomly selected for measurements. Mature (open) bolls from 10 of these plants were hand harvested at a single date in late-September. The 2 centre rows of each plot were picked. Lint percentage was determined from these hand-harvested samples. Total seed cotton yield per plot was multiplied by the lint percentage obtained from the hand-harvested samples to produce the total lint yield. Lint from the hand-harvested samples was sent to SANKO for determination of fiber strength, elongation, span lengths, uniformity index, micronaire, elongation, reflectance (Rd %) and yellowness (+b) degree.

Analyses of variance were performed. Means were separated by use of LSD at $P\leq0.05$ or $P<0.10$.

Results and Discussion

Yield Performance

K fertilization treatments produced significant seed-cotton yield responses (P=0.01) compared to the untreated control. Largest increases in seed cotton yield were produced by the application of 160 kg K_2O/ha, resulting in a yield increase of 72 kg/ha (24.3 %) followed by 80 kg K_2O /ha (+ 16.7 %) and 240 K_2O /ha (7.7 %) (Table 1, Fig 1).

Since there was a trend for all K treatments to increase yield it seems likely that the yield performance of cotton plant can be improved through the application of K fertilization.

Plant Growth and Development

No differences in plant height, number of fruiting branches per plant, number of bolls per plant and crop earliness were found with the use of K fertilization (Table 2). However, all K treatments were numerically higher than the control but not significantly different from each other. The numerical trend indicated a taller plant resulting from all of the K treatments in comparison to the control. A higher number of fruiting branches per plant and improvement of crop earliness were also observed with some of the K treatments, but none of them are conclusive.

Though statistically not significant, all the K treatments increased seed-cotton weight per boll, lint percentage and seed index compared to the control (Table 3). All treatments were numerically higher than the control but not significantly different from each other. The K fertilizer treatments produced a significantly higher boll weight than the check but there were no significant differences among the treatments (Table 3, Fig. 2).

There was a significant lint yield response to applied K. Lint yield increased in all K treatments compared to the untreated control (Fig. 1). The greatest increases were produced by the application of 160 kg K_2O/ha, resulting in a yield increase of 24.3 kg/ha (+29.4 %) followed by 80 kg (+21.3 %) and 240 kg K_2O /ha (+10.9 %) (Table 1).

No significant K effects were detected for any measured fiber quality parameters but there was a non-significant trend for K treatments to decrease uniformity index and micronaire (Table 4).

Conclusions

Preliminary results demonstrate that application of K fertilizer will enhance seed-cotton and lint yield. Additional information is required on the application methods of potassium so as to adapt the practice to best fit current cotton production systems.

These studies will be continued with additional trials to elucidate the effects of the K on growth and yield, to establish effective application methods and for economic evaluation of potassium application to determine its profitability under Turkish management and growing conditions.

References

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Table 1. Effect of K fertilization on seedcotton yield and lint yield.

Treatments	Seed-Cotton Yield (kg/ha)	Yield Increase		Lint Yield (kg/ha)	Yield Increase	
		Quantity	Percent %		Quantity	Percent %
Control	2960	-	-	1142	-	-
160 kg K/ha	3680	720	24.3	1385	243	29.4
80 kg K/ha	3453	493	16.7	1478	336	21.3
240 kg K/ha	3188	228	7.7	1266	124	10.9
LSD (0.05)	355.0			153.9		

Table 2. Effect of K fertilization on plant height, number of bolls per plant, number of fruiting branch per plant and earliness.

Treatments	Plant ht. (cm)	Number of Bolls	Number of Fruiting Branch	Earliness (%)
Control	102.0	11.2	10.4	77.25
160 kg K/ha	105.3	11.3	10.7	82.73
80 kg K/ha	103.2	10.8	10.5	81.65
240 kg K/ha	103.9	11.9	10.9	81.45
LSD (0.05)	NS	NS	NS	NS

Table 3. Effect of K fertilization on boll weight, seed cotton weight per boll, lint percentage and seed index.

Treatments	Boll Weight (g)	Seed Cotton Weight Per Boll (g)	Lint Percentage (%)	Seed Index (g)
Control	6.87	6.02	39.59	11.81
160 kg K/ha	8.12	6.42	40.15	11.75
80 kg K/ha	8.22	6.90	40.09	12.00
240 kg K/ha	7.91	6.40	39.71	11.75
LSD (0.05)	0.65	NS	NS	NS

Table 4. Effect of K fertilization on quality properties.

Treatments	Mike.	Strength	Length	Unif.	Elon.	Rd (%)	+b
Control	4.95	27.02	30.05	86.75	3.7	35.77	7.4
160 kg K/ha	4.85	27.77	30.10	85.85	4.3	77.22	7.4
80 kg K/ha	4.55	29.10	29.90	85.32	4.1	79.50	7.8
240 kg K/ha	4.90	27.12	30.40	85.45	3.9	77.57	8.1
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS

Figure 1. Effect of potassium fertilization on seed-cotton yield and lint yield.

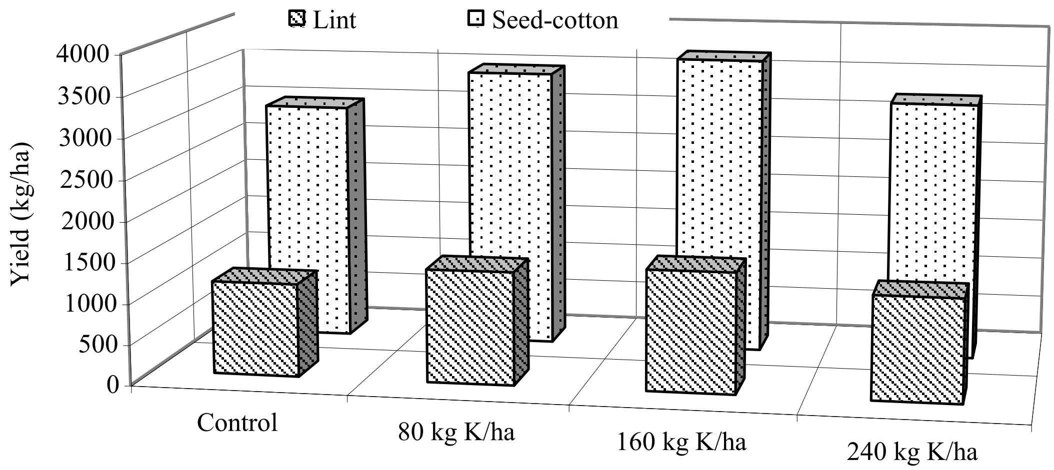

Figure 2. Effect of potassium fertilization on boll weight.