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Effect of foliar and split application of potassium on seed cotton yield and fibre quality of American cotton (*Gossypium hirsutum*)

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ABSTRACT

A field experiment was conducted at Ludhiana (30°56' N latitude, 75°52'E longitude) during rainy (*kharif*) of 2006–09 on a sandy loam soil low in organic carbon, available nitrogen and high in available phosphorus and potassium to study the effect of foliar and split application of potassium as a supplement to one time application of potassium on the growth, yield and fibre quality of American cotton (*Gossypium hirsutum* L.). The area is characterized by sub-tropical semi-arid type climate with hot summer and very cold winters. The highest mean seed cotton yield (2 612 kg/ha) was recorded with application of four sprays of 2% KNO_3 solution at weekly interval starting from flowering onwards and the lowest seed cotton yield (2 077 kg/ha) was recorded in control. The foliar and split application improves the 2.5% span length significantly as compared to control. The highest benefit: cost ratio (31.5) was obtained in treatment where muriate of potash @ 50 kg/ha (30 kg K_2O) was applied in four split doses and the lowest (1.72) was observed where four sprays of 3% KNO_3 were applied.

Key words: American cotton, Fibre quality, Foliar application, Potassium, Split application

Cotton (*Gossypium hirsutum* L.) is one of the most important commercial crops and plays a key role in economic and cultural facets of world, India and Punjab. The high and sustainable productivity of cotton is associated with balanced application of nutrients to the soil. Despite multiplicity of varieties, hybrids and *Bt* hybrids, input-related constraints and problems of instability are there. Among yield-sustaining factors, crop nutrition is of great importance under irrigated conditions. Cotton crop is a heavy feeder and removes large quantities of nutrients from the soil. The amount of potassium added is less than its removal and results in heavy depletion of potassium leading to negative balance in the soil. With the increase in the cost of fertilizers, it is imperative to reduce the quantity of fertilizers and increase their efficiency by way of getting higher yield/unit area. The methods of application of these nutrients are important and affect the productivity of the crop. The foliar application of nutrients regulates the biochemical changes in seed and increases the yield of cotton (Chaudhary *et al.* 2001). The Punjab soils are dominated by micas and feldspars group of minerals and the potassium dynamics in these soils are enigmatic. Most of the soils started showing negative K balance that accelerates the weathering of soil minerals. Hence, application of potash fertilizers may be a kingpin for sustaining seed cotton yields. The foliar application of potassium on cotton from mid to late season can increase yields as the uptake of potassium from the soil slows down beyond 120 days after sowing of the crop (Adadakatti *et al.* 2006). In addition to the soil supplied nutrients, foliar nutrition in cotton when used as a supplement to the soil fertilizer application is highly beneficial. Foliar nutrition further assumes importance at critical growth stages of flowering and boll formation as the roots of the crop are not active much to meet the nutrient requirement of the crop. The foliar application of potassium and its role in production and improving the quality of cotton is well documented (Sharma *et al.* 2000) and can supplement the high demand of the crop during the critical fruiting period of the cotton crop. Pettigrew (2003) and Pervez *et al.* (2005) also observed significant increase in seed cotton yield with increasing levels of potassium. However, the information regarding usefulness of foliar applied nutrients in cotton is inadequate. Hence, the present investigation was carried out to study the effect of foliar applications of potassium nitrate and split doses of muriate of potash as a supplement to single dose applied muriate of potash (recommended practice) on

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the growth and yield of varieties and *Bt* hybrids of American cotton.

MATERIALS AND METHODS

The field experiment was conducted during rainy (*kharif*) seasons of 2006–07, 2007–08 and 2008–09 at Punjab Agricultural University, Ludhiana (30°56' N latitude, 75°52'E longitude and altitude of 247 m above the mean sea level) to study the effect of foliar application of potassium nitrate on the growth and yield of American cotton. The soil characteristics of the experimental site are presented in Table 1 and climatic parameters are presented in Fig 1. The nine treatments in the experiment were as follows: T_1: control (water spray), T_2: two sprays of 2% KNO_3, T_3: three sprays of 2% KNO_3, T_4: four sprays of 2% KNO_3, T_5: two sprays of 3% KNO_3, T_6: three sprays of 3% KNO_3, T_7: four sprays of 3% KNO_3, T_8: split application of muriate of potash @ 50 kg/ha (4 splits- sowing, 45 DAS, 60 DAS, 75 DAS), T_9: single application of muriate of potash @ 50 kg/ha (30 kg K_2O/ha) at sowing. The experiment was laid out in randomized block design (RBD) and each treatment was replicated three times. The American cotton variety LH 1556 (*Gossypium hisutum* L.) was sown on 1 May and 4 May during 2006 and 2007 respectively. During 2008, *Bt* cotton hybrid MRC 6304 was sown on 4 May. During third year *Bt* cotton hybrid was sown intentionally to verify the applicability of results on *Bt* cotton also. During all the three years, after giving pre-sowing irrigation of 10.0 cm depth, the crop was sown by dibbling method at row-to-row spacing of 67.5 cm and plant-to-plant spacing of 60 cm for LH 1556 and 75 cm for MRC 6304. The first irrigation to crop was applied four weeks after sowing and the subsequent irrigations at IW/ CPE (irrigation water applied/ cumulative pan evaporation) ratio of 0.4 by keeping in view the effective rainfall received during the crop season. Four irrigations were applied during each year to the crop and crop was kept free from water stress during the crop season. The crop was kept free from water stress during all the years of study by applying irrigation when needed. Nitrogenous and phosphatic fertilizers as recommended by Punjab Agricultural University, Ludhiana were applied in all the treatments. Full dose of phosphorus (30 kg P_2O_5/ha) was applied before sowing while nitrogenous fertilizer was applied in two equal splits, i e half at thinning and half at flower-initiation stage of the crop. Potassium @ 30 kg K_2O /ha was applied in the form of muriate of potash @ 50 kg/ha either as single application, i e full dose at sowing or as split application, i e divided in four splits (sowing, 45 DAS, 60 DAS and 75 DAS). Two, three or four supplementary sprays of KNO_3 @ 2 and 3% concentration as per the treatments were given at weekly intervals starting from the flower initiation onwards. The net plot size harvested each year was 24.3 m^2. Other cultural practices and plant protection measures were given as per the recommendations of the University schedule. At maturity, five plants/plot were selected for recording the observations on plant height, boll number, yield/plant and other ancillary characters. The quality analysis was done during 2008. Plant stand and seed cotton yield were recorded on net plot area basis, while boll weight was the average of seed cotton of 20 good opened bolls taken at the time of picking.

Table 1 Soil characteristics of experimental site at Punjab Agricultural University, Ludhiana

Soil property	
*p*H	7.6
Electrical conductivity (dS/m)	0.20
Organic carbon (%)	0.30
Available P (kg/ha)	16.50
Available K(kg/ha)	267
Soil texture	Sandy loam

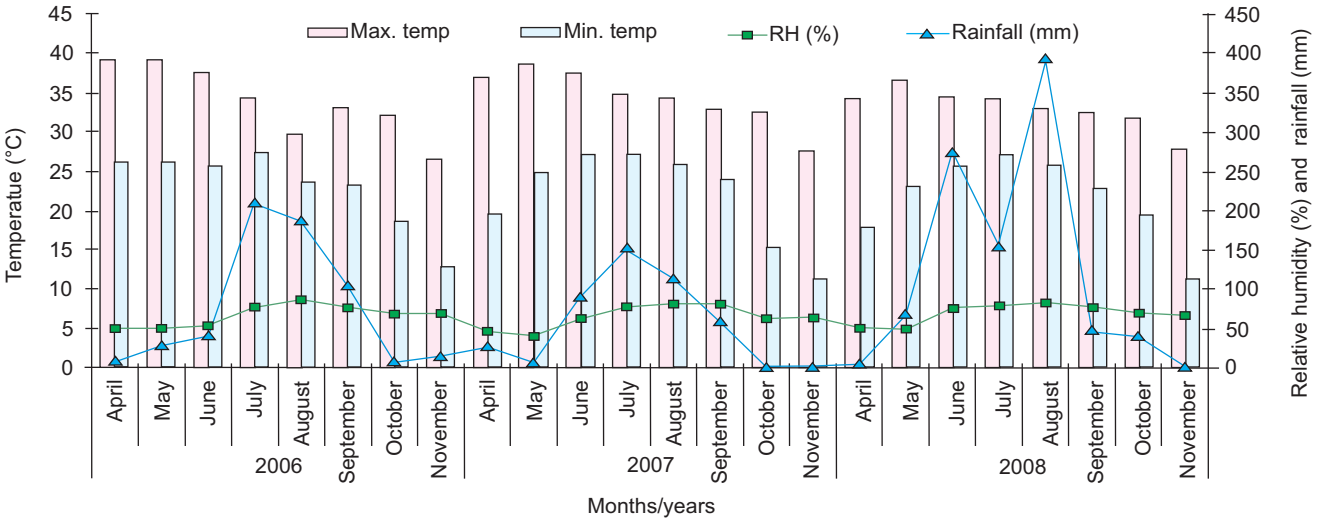

Fig 1 Monthly meteorological data of three years

RESULTS AND DISCUSSION

The results revealed that there was significant effect of different treatments on the seed cotton yield during first and third year. However, the differences among treatments were non-significant during the second year of study. During 2006, all the treatments were found to be significantly superior over the control treatment but were at par with each other. Three sprays of 3% KNO_3 (T_6) recorded the highest seed cotton yield (1 802 kg/ha), followed by three sprays of 2% KNO_3 (T_3) (1 780 kg/ha). The per cent increase in yield in these two treatments T_6 and T_8 over control was 32.2 and 30.5 respectively. During 2007, the seed cotton yields were higher in all the potash treatments as compared to control but all the treatments were statistically at par with each other (Table 2). The treatments with four sprays of 2% KNO_3 (T_4), two sprays of 3% KNO_3 (T_5) and four sprays of 3% KNO_3 (T_7) were slightly better than the other treatments and the respective increase in yield in these treatments was 28.2, 31.6 and 28.4% over the control. Nehra and Kumawat (2003) also reported 16.8% increase in seed cotton yield over control with 2% spray of KNO_3. As revealed in Table 3, the seed cotton yield obtained during the third year was much higher than that of first and second years owing to higher yield potential of *Bt* cotton hybrid MRC 6304 than non-*Bt* cotton variety LH 1556. Significant increase in yield of cotton was observed in T_4 i e four sprays of 2% KNO_3 over all the treatments except treatments T_5 and T_6 which were statistically at par with T_4. The yield increase in T_4, T_5 and T_6 was 23.8, 15.8 and 18.8% over control (T_1). Singh *et al.* (2004) also reported yield benefit in cotton crop grown on loamy sand soil with spray of 2% solution of KNO_3. Similarly, Kumar *et al.* (2010) also reported significantly higher seed cotton yield with potassium application of 20 kg /ha than control on sandy loam soil conditions. Sharma and Singh (2007) also reported that foliar application of 2% K_2O @ 5 kg/ha at flower initiation and peak boll formation stage gave significantly higher seed cotton yield. The foliar and split application of potash also significantly increases the

Table 2 Effect of different treatments on the yield-attributing characters and seed cotton yield of LH 1556

Treatment	Bolls/ plant		Boll wt (g)		Final plant height (cm)		Monopods/ plant		Sympods/ plant		Seed cotton yield (kg/ha)	
	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
T_1: Control	32.9	37.7	3.4	3.1	179.3	97.3	1.3	1.3	21.5	12.5	1 363	1 353
T_2: 2 sprays of 2% KNO_3	27.9	44.1	3.7	3.1	180.7	108.3	1.3	1.3	21.9	15.9	1 669	1 692
T_3: 3 sprays of 2% KNO_3	32.0	40.1	3.4	3.3	172.7	91.7	1.5	1.0	21.5	12.6	1 780	1 602
T_4: 4 sprays of 2% KNO_3	30.5	40.7	3.7	3.2	180.3	101.7	1.2	1.1	21.7	13.6	1 749	1 735
T_5: 2 sprays of 3% KNO_3	32.3	43.9	3.5	3.2	179.7	105.7	1.3	1.0	22.3	15.2	1 648	1 780
T_6: 3 sprays of 3% KNO_3	25.7	41.5	3.6	3.1	175.0	94.7	0.9	0.9	22.3	14.1	1 802	1 634
T_7: 4 sprays of 3% KNO_3	29.2	43.1	3.5	3.1	170.0	99.7	1.3	1.1	22.4	14.6	1 738	1 737
T_8: Muriate of potash (split doses)	35.9	39.5	3.6	3.2	175.7	90.7	1.2	1.2	20.7	12.7	1 796	1 620
T_9: full dose of muriate of potash at sowing	26.6	39.2	3.3	3.2	177.3	89.3	1.3	1.0	22.7	12.8	1 596	1 504
CD (*P*=0.05)	2.0	2.2	NS	NS	NS	NS	NS	NS	NS	NS	214	NS

Table 3 Effect of foliar application of KNO_3 on yield-attributing characters and quality of cotton (MRC 6304 *Bt*) during 2008

Treatment	Bolls/ plant	Boll wt (g)	Final plant height (cm)	Monopods/ plant	Sympods/ plant	Seed cotton yield (kg/ha)
T_1: Control	44.23	4.95	2.11	17.33	117.3	3 514
T_2: 2 sprays of 2% KNO_3	51.90	5.45	2.22	19.80	127.2	3 685
T_3: 3 sprays of 2% KNO_3	55.57	5.28	1.67	20.43	118.9	3 785
T_4: 4 sprays of 2% KNO_3	56.87	5.28	2.00	20.90	115.0	4 352
T_5: 2 sprays of 3% KNO_3	54.70	5.21	2.56	20.33	113.9	4 069
T_6: 3 sprays of 3% KNO_3	51.00	5.40	2.67	20.23	120.0	4 176
T_7: 4 sprays of 3% KNO_3	53.90	5.37	2.33	18.63	122.0	3 713
T_8: Muriate of potash (split doses)	47.00	5.47	2.11	20.67	122.9	3 952
T_9: full dose of muriate of potash at sowing	44.23	5.03	2.11	19.00	117.8	3 524
CD (*P*=0.05)	3.1	NS	NS	NS	NS	332

Table 4 Effect of different treatments on the fibre quality of cotton

Treatment	2.5 % span length (mm)			Micronaire			GOT (%)			Tenacity		
	2006	2007	2008	2006	2007	2008	2006	2007	2008	2006	2007	2008
T_1: Control	28.1	28.0	28.1	4.5	4.9	4.8	31.0	31.1	31.3	21.5	22.5	22.3
T_2: 2 sprays of 2% KNO_3	28.3	28.1	29.4	4.7	4.9	4.8	31.8	32.2	31.5	22.3	23.1	22.7
T_3: 3 sprays of 2% KNO_3	28.2	29.1	29.2	4.6	4.5	4.8	31.5	32.7	31.8	21.8	22.7	23.9
T_4: 4 sprays of 2% KNO_3	28.9	29.7	29.4	4.1	4.7	4.5	32.5	32.0	31.6	21.9	22.9	21.8
T_5: 2 sprays of 3% KNO_3	28.2	29.1	28.7	4.9	4.6	4.6	31.9	30.7	31.9	22.5	22.4	21.6
T_6: 3 sprays of 3% KNO_3	28.4	28.4	29.5	4.7	4.8	4.9	31.7	31.7	31.7	22.4	21.7	22.0
T_7: 4 sprays of 3% KNO_3	28.7	28.1	28.5	4.7	4.7	4.8	32.8	33.5	31.7	23.2	22.1	21.6
T_8: Muriate of potash (split doses)	28.7	28.7	29.5	4.8	4.6	4.6	32.7	33.5	31.4	22.1	23.2	22.9
T_9: full dose of muriate of potash at sowing	28.4	28.2	28.2	4.6	4.2	4.7	31.8	31.2	31.9	21.5	22.9	21.4
CD (P=0.05)	0.4	0.6	0.5	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 5 Effect of foliar application of KNO_3 on mean seed cotton yield and benefit : cost ratio of American cotton

Treatment	Seed cotton yield (kg/ha)			Mean	Additional yield over control (kg/ha)	Additional returns over control seed cotton (₹/ha)	Additional cost of treatment (₹/ha)	Net returns over treatment (₹)	Benefit: cost ratio
	2006	2007	2008						
T_1, Control	1 363	1 353	3 514	2 077					
T_2, 2 sprays of 2% KNO_3	1 669	1 692	3 685	2 349	272	7 617	1 140	6 477	5.68
T_3, 3 sprays of 2% KNO_3	1 780	1 602	3 785	2 389	312	8 736	1 710	7 026	4.11
T_4, 4 sprays of 2% KNO_3	1 749	1 735	4 352	2 612	535	14 980	2 280	12 700	5.57
T_5, 2 sprays of 3% KNO_3	1 648	1 780	4 069	2 499	422	11 816	1 640	10 176	6.20
T_6, 3 sprays of 3% KNO_3	1 802	1 634	4 176	2 537	460	12 880	2 460	10 420	4.24
T_7, 4 sprays of 3% KNO_3	1 738	1 737	3 713	2 396	319	8 932	3 280	5 652	1.72
T_8, Muriate of potash (split doses)	1 796	1 620	3 952	2 456	379	10 612	327	10 285	31.5
T_9, full dose of muriate of potash at sowing	1 596	1 504	3 524	2 208	131	3 668	222	3 446	15.5
CD (P=0.05)	214	NS	332						

Seed cotton @ ₹ 28.0 /kg KNO_3 @ ₹ 100 / kg, labour cost @ ₹ 14/hr, muriate of potash ₹ 4.45/kg

2.5 span length and numerically increases other quality characters over the control (Table 4). Sharma and Singh (2007) also reported that foliar application of 2% K_2O @ 5 kg/ha at flower initiation and peak boll formation stage significantly increased fibre quality parameters, i e ginning percentage, staple length, length uniformity, micronaire value, fibre strength etc. The ancillary characters were not significantly affected by different treatments except number of bolls/plant during the three years of study (Tables 2, 3). The number of bolls/plant increased significantly (Tables 2, 3) with split and foliar application of potash over single dose application of potash (T_9). During all the three years under study, split application of muriate of potash was better than its single application. The application of muriate of potash @ 50 kg/ha (30 kg K_2O) in four basal split doses gave the highest benefit : cost ratio (Table 5) as compared to other treatments.

It may be concluded that four foliar sprays of 2% potassium nitrate solution starting from flowering at weekly interval are needed to obtain the highest seed cotton yield. However, four basal split doses of muriate of potash @ 50 kg/ha (30 kg K_2O) is required to get the highest benefit: cost ratio.

REFERENCES

Adadakatti Y R, Hallikeri S S, Nandagavi R A, Naveen N E and Blaise D. 2006. Effect of potassium on yield and fibre qualities of cotton. *Proceedings of the International Symposium*, held during November 22–25 at PAU, Ludhiana.

Chaudhary C S, Pawar W S, Mendhe S N, Nikam R R and Ingole A S. 2001. Effect of land confirmation and nutrient management on yield of rainfed cotton. *Journal of Soils Crops* **11**: 125–7.

Kumar J, Yadav M P, Kushwaha S P and Kumar N. 2010. Effect of different spacing and potassium levels on yield attributes, yield and economics of *hirsutum* cotton. *Journal of Cotton Research Development* **24**(2): 208–9.

Nehra P N and Kumawat P D. 2003. Effect of foliar nutrition on

productivity of American cotton (*Gossypium hirsutum*). *Journal of Cotton Research Development* **17**(1): 30–1.

Pervez H, Ashraf M and Makhdum M I. 2005. Influence of potassium rates and sources on seed cotton yield and yield components of some elite cotton cultivars. *Journal of Plant Nutrition* **27**: 1295–1317.

Pettigrew W T. 2003. Relationships between insufficient potassium and crop maturity in cotton. *Agronomy Journal* **95**: 1323–9.

Singh A, Rathore P and Pathak D. 2004. Effect of foliar application of inorganic nutrients on yield of American cotton. *Journal of Cotton Research Development* **19** (1): 169–71.

Sharma J K, Vhamparia S K, Parsai G S, Mishra U S and Mandloi K C. 2000. Performance of cotton genotypes in relation to spacing and fertility levels in East Nimar. *Journal of Cotton Research Development* **14**: 235–7.

Sharma S K and Singh S. 2007. Yield, yield attributes and quality of cotton as influenced by foliar application of potassium. *Journal of Cotton Research Development* **21**(1): 51–4.