Int.J.Curr.Microbiol.App.Sci (2017) *6*(3): 1252-1258

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 6 Number 3 (2017) pp. 1252-1258**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2017.603.144

Response of Seed Cotton Yield to Potassium Fertilization under Cotton-Wheat Cropping System

Rajesh Kumar*, D.S. Jakhar, Dheeraj Panghaal and Devraj

Department of Soil Science, CCS Haryana Agricultural University,
Hisar – 125 004, Haryana, India
**Corresponding author*

Keywords

Seed cotton, Potassium fertilization, Cotton-wheat cropping system.

Article Info

Accepted:
20 February 2017
Available Online:
10 March 2017

A B S T R A C T

The present study was carried out at the research farm of Krishi Vigyan Kendra, Sirsa during kharif 2014. The climate of this tract was semi-arid, sub-tropical with hot and dry summer and cold winters. The maximum temperature during summer months of May and June reached up to 47.2 °C. The total rainfall obtained during the crop season was about 327.5 mm. The cropping history of field from 2011 was cluster bean in kharif and in rabi crop wheat was grown. Seed cotton yield increased significantly with the application of K and mean highest yield (2751.98 kg/ha) was observed where K was applied @ 60 kg/ha along with two foliar spray of 1% of KNO_3. The seed cotton yield increased significantly in the high K fertility soil up to the treatment T_4 ($N_{175}P_{60}$ + K_{30}). However, the mean seed cotton yield was higher in high K fertility soil as compared to medium K fertility soil. It indicates that in the high K fertility soils, application of potassium at the rate of 30 kg/ha is sufficient of optimizing the seed cotton yield. The number of bolls per plant and boll weight increased with application of K in all the treatments in both soils where as the GOT and harvest index remained unaffected.

Introduction

Cotton is the most important cash crop in India it cotton plays a dominant role in the industrial and agricultural economy of the country. In India cotton is grown in 11.88 million hectares and constituting about 25% of the world area under cotton cultivation. Introduction of transgenic cotton in Indian agriculture has resulted in an immense increase in seed cotton yield. This economically viable technology (Mehta *et al.*, 2009) of Bt. cotton has helped significantly in increasing the net income of farmers. Accounting for 11.91 per cent production and 6.77 per cent of hectarage, Haryana is the fifth largest producer of cotton in India. About 80 per cent of the production comes from Hisar, Sirsa and Fatehabad districts. Bhiwani, Jind and Rohtak and Ambala are other cotton producing districts.

Cotton is a heavy feeder and removes a large quantity of nutrients from the soil thus crop nutrition forms a crucial component of cotton production (Kaur *et al.*, 2007). To cater the uptake needs of these crops, soil reserves alone are not sufficient, hence needs to supply them through chemical fertilizers. Nitrogenous and phosphoric fertilizers are more emphatically used by the farmers leading to an imbalanced nutrient supply ratio. Due to intensive cropping and not applying potassium through chemical fertilizers according to soil test basis, the level of potassium in soil is decreasing. Bt cotton is cultivated on nearly 90 percent of the area under cotton in Haryana, but the crop suffers from premature leaf senescence during boll development. Leaves near the top of the canopy turn bronze/ red, which then fall off. The symptoms move down the canopy, defoliating the crop and reducing lint yields. The characteristic rusting and premature senescence of both lower and young cotton leaves at the top of the plant late in the season, resembling potassium deficiency symptoms, have been reported earlier.

Potassium is required in larger amounts than any other mineral element except nitrogen, but in crops like banana and cotton particularly during the boll formation period; potassium uptake is more than that of nitrogen. Potassium is one of the principle plant nutrients and it play important role in crop yield production and quality determination. While involved in many physiological processes, potassium's impact on water relations, photosynthesis, assimilate transport and enzyme activation can have direct consequences on crop productivity (Pettigrew, 2008). Foliar application of nutrients is highly beneficial, as crop benefits are achieved when the roots are unable to meet the nutrient requirement of the crop at a critical stage. Foliar applications of K, especially late in the season when soil application may not be feasible or effective, correct the deficiency quickly and efficiently. In order to suggest the best choice/alternate sources for foliar spray and soil applied in cotton, there is a need to evaluate the comparative efficacy of various methods and whether their additional sprays can be beneficial. The present study was planned to study the effect of K application on seed cotton yield and yield attributes in *Bt.* Cotton.

Materials and Methods

The present study was carried out at the research farm of Krishi Vigyan Kendra, Sirsa during kharif 2014. The climate of this tract was semi-arid, sub-tropical with hot and dry summer and cold winters. The maximum temperature during summer months of May and June reached up to 47.2 °C. The total rainfall obtained during the crop season was about 327.5 mm. The cropping history of field from 2011 was cluster bean in kharif and in rabi crop wheat was grown.

The experimental soil was sandy loam in texture, slightly alkaline in reactions, low in organic carbon and nitrogen, medium in phosphorus with medium to high potash levels. The *Bt.* cotton (var. Bioseed-6588) seed was sown in two soils with varying K fertility with three replications and seven treatments and the design was RBD. In the experiment *Bt.* cotton (var. Bioseed-6588) was sown. The important characters of this variety are high ginning percentage (36%), two to three monopods, semi-spreading type with hairy medium size light green leaves. The average height of plant is 120-150 cm. It matures in 170-175 days.

The treatments was comprised of T_1 - $N_{175}P_{60}$, T_2 - $N_{175}P_{60}$ + Water Spray, T_3 - $N_{175}P_{60}$+ 1% foliar spray of KNO_3, T_4 - $N_{175}P_{60}$+ K_{30}, T_5 - $N_{175}P_{60}$+ K_{30}+1% foliar spray of KNO_3, T_6 - $N_{175}P_{60}$+K_{60} and T_7 - $N_{175}P_{60}$+K_{60}+ 1% foliar spray of KNO_3. The two foliar spray was done at the time of early and peak boll development stages. All recommended cultural practices were followed during the crop season.

Pre and post harvest surface (0-15cm) soil samples were collected from each treatment and analysed for available N by alkaline permanganate method (Subbiah and Asija, 1956), P was extracted by the method of

Olsen *et al*. (1954). with 0.5 N $NaHCO_3$ (pH 8.5), and K was determined by using flame photometer as described by USDA Hand Book No. 60 (Richards, 1954). International Pipette method (Piper, 1950) was used for mechanical analysis. Soil EC and pH was determined in 1:2:: soil: water suspension by using EC meter and pH meter, respectively.

Particulars	Medium K Fertility	High K Fertility
Sand (%)	57.4	57.2
Silt (%)	29.3	29.4
Clay (%)	13.3	13.4
pH (1:2)	8.2	8.2
EC	0.17	0.2
Organic Carbon	0.25	0.30
Available N(kg/ha)	224	227
Available P_20_5(kg/ha)	12	12
Available K_20(kg/ha)	260	390

Yield attributes like plant population, number of bolls per plant, boll weight, seed cotton yield per plant and per hectare was determined. The data were analyzed statistically by applying the analysis of variance Technique as suggested by Cochran and Cox (1968). The critical differences were obtained at 5% level of significance as described by Panse and Sukhatme (1961).

Results and Discussion

Yield and yield components in medium K fertility field

In medium K fertility field, seed cotton yield increased gradually in response to K application, probably due to some relative improvement in soil K status. The basal K application of 30 kg/ha (T_4) resulted in a yield significantly increase of 23.25% compared to the control. Nevertheless, a doubled basal dose (T_6) enhanced the yield by 31.97%, compared to the control. The seed-cotton yield increase may be attributed to the improvement in every yield-determining component involved. In respect to control (T_1), the number of bolls per plant significantly increased by 12.75 and 23.86%, boll weight increased by 8.54 and 11.07% in treatments T_4 and T_6, respectively.

The two foliar application of K alone (T_3) and along with basal dose of 30 kg/ha (T_5) and 60 kg/ha (T_7) significantly increased the seed cotton yield by significant increase in number of bolls per plant and boll weight. The application of water spray increase the yield but it was not significant. The yield increased significantly by the application of potassium in the both ways and the highest yield was obtained 2801.52 kg/ha in the treatment T_7($N_{175}P_{60}$ + K_{60} + 1% Foliar spray of KNO3). The seed cotton yield increase was to the tune of 37.20% in the T_7 ($N_{175}P_{60}$ + K_{60} + 1% Foliar spray of KNO3) of medium K fertility over control. The effect of soil applied potassium and foliar application on GOT and harvest index was not significant.

Yield and yield components in high K fertility field

Seed cotton yield, number of bolls and boll weight were increased by plant K fertilization in the high K fertility field, but GOT and harvest index was not affected. The yield was increased to the tune of 4.50% in the treatment T_3 where foliar application of K was done, but after that increase was quite constant ranging from 4.96 to 8.26%, in the treatment T_4 to T_7. It means the basal dose of potassium not give better results. It may be because the experimental soil had high K level which had reduced the effect of added K. Although, the highest seed cotton yield was recorded 2801.52 in the treatment T_7 ($N_{175}P_{60}$ + K_{60} + 1% Foliar spray of KNO_3). Water spray increases the yield but it was not significant (Tables 1 and 2).

Dry matter produced by plant parts

Figure 1 shows that the dry matter produced per plant by leaves, khokri, seed and stems in the high K fertility soil was significantly higher as compare to medium K fertility soil. Effect of soil and foliar applied potassium on dry matter production of leaves, khokri, seed and stems was significant. The dry matter production was highest in the treatment T_7 ($N_{175}P_{60}$ + K_{60} + 1% foliar spray of KNO_3) which was 29.19, 48.33, 140 and 149.94 g/plant by leaves, khokri, seed and stems, respectively. The average dry matter production by leaves, khokri, seed and stems was 23.27, 37.48, 119.43 and 143.73 g/plant, respectively in the medium K fertility field. In the high K fertility field, dry matter production by leaves, khokri, seed and stems was 24.09, 41.67, 132.06 and 156.96 g/plant, respectively.

Potassium is required in large amounts by cotton for normal crop growth and fiber development, with a typical high yielding crop containing about 200 kg K/ha soils not considered K deficient (Cassman *et al.*, 1989). When soil K levels are insufficient, the cotton crop moves more quickly (earlier) from the vegetative to the reproductive phase (Gwathmey and Howard, 1998; Pettigrew, 1999) resulting in a decline in yield (Pettigrew, 2008). In the present study, seed-cotton yield were significantly enhanced by K application both soil and foliar applied, compared to control. When two doses were examined through basal application, 30 and 60 kg K/ha along with foliar application of potassium, seed cotton yield seemed to respond linearly to K dose. These results provide additional evidence for the critical role of K fertilization for enhancing cotton yields grown on poor arid soils in Pakistan (Ahmed *et al.*, 2013; Karim *et al.*, 2016).

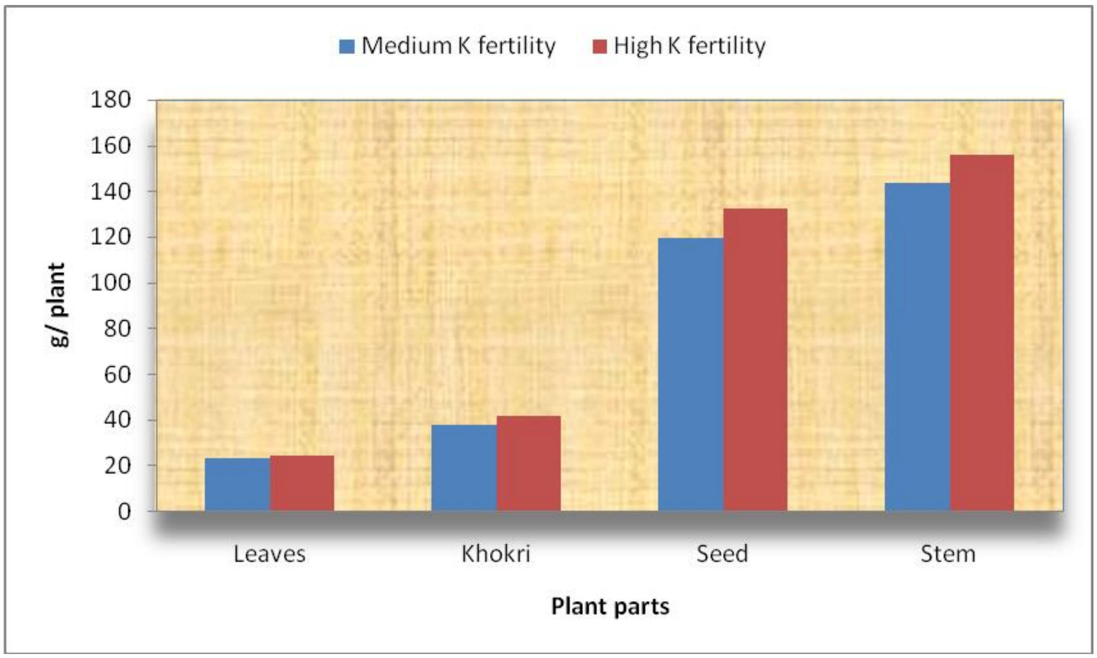
Table.1 Effect of potassium application on yield and yield components in medium K fertility field

Treatments	Seed Cotton Yield	Number of bolls	Boll Weight	GOT	Harvest Index
$T_1(N_{175}P_{60})$	2041.78	37.96	3.16	35.49	31.77
$T_2(N_{175}P_{60}$ + Water Spray)	2089.27	38.19	3.20	35.02	30.76
$T_3(N_{175}P_{60}$ + 1% Foliar spray of KNO_3)	2388.17	42.19	3.34	35.27	31.52
$T_4(N_{175}P_{60} + K_{30})$	2516.62	42.80	3.43	36.06	30.76
$T_5(N_{175}P_{60} + K_{30}$ + 1% Foliar spray of KNO_3)	2611.58	43.89	3.48	35.57	30.47
$T_6(N_{175}P_{60} + K_{60})$	2694.68	45.60	3.50	35.77	30.94
$T_7(N_{175}P_{60} + K_{60}$ + 1% Foliar spray of KNO_3)	2801.52	47.02	3.51	34.45	30.00
Mean	2449.09	42.52	3.37	35.38	30.89
SE	21.26	0.78	0.03	N/A	N/A
CD	68.00	2.43	0.09	N/A	N/A

Table.2 Effect of potassium application on yield and yield components in high K fertility field

Treatments	Seed Cotton Yield	Number of bolls	Boll Weight	GOT	Harvest Index
$T_1(N_{175}P_{60})$	2496.68	44.00	3.38	35.82	32.47
$T_2(N_{175}P_{60}$ + Water Spray)	2509.97	44.42	3.39	35.51	30.86
$T_3(N_{175}P_{60}$ + 1% Foliar spray of KNO_3)	2609.21	45.60	3.43	35.22	30.38
$T_4(N_{175}P_{60} + K_{30})$	2620.37	45.95	3.47	35.57	30.24
$T_5(N_{175}P_{60} + K_{30}$ + 1% Foliar spray of KNO_3)	2660.02	46.18	3.50	35.77	29.50
$T_6(N_{175}P_{60} + K_{60})$	2675.93	46.36	3.52	35.82	29.16
$T_7(N_{175}P_{60} + K_{60}$ + 1% Foliar spray of KNO_3)	2702.44	46.92	3.53	36.02	29.07
Mean	2610.66	45.63	3.46	35.68	30.24
SE	50.79	1.04	0.007	N/A	N/A
CD	N/A	N/A	0.021	N/A	N/A

Fig.1 Dry matter produced per plant by different plant parts



Foliar K applications offer the opportunity of correcting deficiencies quickly and efficiently, especially late in the season when soil contribution of K may not be effective or possible (Oosterhuis, 2002). Foliar feeding of a nutrient may actually promote root absorption of the same nutrient (Keino *et al.*, 1999). In the present study, two foliar applications of KNO_3 (1%) increases the yield as compared to the control, and depending on the basal K dose. In the high K fertility field the yield is increased considerably in the treatment T_3 where only foliar spray of KNO_3 was applied along with recommended dose of N and P, after that the yield was not considerably increased it may be because the experimental soil had high K level which had reduced the effect of added K. The similar results have also been reported by Devraj *et al.*, (2007) and Singh *et al.*, (2001) who have reported the same results in the wheat-pearl millet cropping sequence in soils having high level of available K.

The increase in the dry matter in various plant parts may be attributed to adequate quantities of nutrients due to balanced fertilizer application. The similar trend was also noticed by Srinivasan and Ramalingum (2011).

In conclusion, seed cotton yield increased significantly with the application of K and mean highest yield (2751.98 kg/ha) was observed where K was applied @ 60 kg/ha along with two foliar spray of 1% of KNO_3. The seed cotton yield increased significantly in the high K fertility soil up to the treatment $T_4(N_{175}P_{60} + K_{30})$. However, the mean seed cotton yield was higher in High K fertility soil as compare to Medium K fertility soil. It indicates that in the high K fertility soils, application of potassium at the rate of 30 kg/ha is sufficient of optimizing the seed cotton yield. The number of bolls per plant and boll weight increased with application of K in all the treatments in both soils where as the GOT and harvest index remained unaffected.

References

Ahmad, R., Hur R.G.M., Waraich E.A., Ashraf M.Y. and Hussain M. 2013. Effect of supplemental foliar-applied potassium on cotton (*Gossypium hirsutum* L.) yield and lint quality under drought stress. *Pak. J. Life Soc. Sci.*, 11: 154-164.

Cassman, K.G., Kerby, T.A., Roberts, B.A., Bryant, D.C. and Brouder, S.M. 1989. Differential response of two cotton cultivars to fertilizer and soil potassium. *Agron. J.*, 81: 870-876.

Cochran, W.G. and Cox, G.M. 1968. Experimental designs. John Wiley and Sons Inc, New York.

Devraj, Sharma, A.P., Kumari, Promila and Duhan, B.S. 2007. Effect of balanced fertilization on seed cotton yield and nutrient uptake by cotton (*Gossypium hirsutum* L.) under irrigated condition. *J. Cotton Res. Dev.*, 21(1): 72-74.

Gwathmey, C.O. and Howard, D.D. 1998. Potassium effects on canopy light interception and earliness of no- tillage cotton. *Agron. J.*, 90: 144-149.

Karim, F., Iqbal J., Shabbir M., Kaleem S., and Waqar M.Q. 2016. Response of cotton to foliar and soil applied nutrients under Dera Ghazi Khan Conditions. *J. Environ. Agric. Sci.*7:14-18.

Kaur, M., Kaur, M. and Brar, A.S. 2007. Effect of potassium on the growth and yield of American cotton (*Gossypium hirsutum* L.. *J. Cotton Res. Dev.* 21(2): 187-190.

Keino, J., Beyrouty, C.A. and Oosterhuis, D.M. 1999. Differential uptake of potassium by plant roots. *In* D.M. Oosterhuis and G. Berkowitz (eds.) Frontiers in potassium nutrition: New Perspectives on the Effects of Potassium on Crop Plant physiology. *Published Potash and Phosphate Institute and American Society of Agronomy.*

Mehta, A.K., Saharan, H.S., Thakral, S.K. and Beniwal, J. 2009. Performance of Bt cotton hybrids at farmers field in Haryana. *J. Cotton Res. Dev.* 23: 243-46.

Olsen, S.R., Cole, V.C., Watanabe, F.S. and Dean, L.A. 1954. Estimation of available phosphorus in soils by extraction with sodium bicarbonate. *Cir. U.S. Dep. Agric.*, 939.

Oosterhuis, D.M. 2002. Potassium management of cotton. *In* Potassium for Sustainable Crop Production. Eds Pasricha, N.S. and Bansal, S.K., Int. Potash Inst. Basel, Switzerland, pp.

331-346.

Pense, V.G. and Sukhatme, P.V. 1961. Statistical methods for agricultural workers. IInd Ed. I.C.A.R. Agric. Circ. No. 843.

Pettigrew, W.T. 1999. Potassium Deficiency Increases Specific Leaf Weights of Leaf Glucose Levels in Field Grown Cotton. *Agron. J.*, 91: 962-968.

Pettigrew, W.T. 2008. Potassium influences on yield and quality production for maize, wheat, soybean and cotton. *Physilogia Plantarum*, 133(4): 670-681.

Piper, L.S. 1950. Soil and plant analysis. Inter-Science Publishers Inc., New Yok.

Richards, L.A. 1954. Diagnosis and improvement of saline and alkali soils. Handbook No. 60, Washington: United States Department of Agriculture.

Singh, R., Singh, M., Mehta, S.C. and Dixit, M.L. 2001. Dynamics of soil potassium in wheat-pearl millet cropping sequence under different fertilizer treatments. *Proc. International Symposium on Importance of Potassium in Nutrient Management for Sustainable Crop Production in India*, Potash Institute of India and International Potash Research Institute 1: 341-343.

Srinivasan, G. and Ramaligam, A. 2011. Response of summer irrigated cotton (*Gossypium hirsutum* L.) to foliar nutrition of potassium. *J. Cotton Res. Dev.*, 25(2): 214-216.

Subbiah, B.V. and Asija, G.L. 1956. A rapid procedure for the estimation of available nitrogen in soils. *Curr. Sci.*, 25(8): 259-260.

How to cite this article:

Rajesh Kumar, D.S. Jakhar, Dheeraj Panghaal and Devraj. 2017. Response of Seed Cotton Yield to Potassium Fertilization under Cotton-Wheat Cropping System. *Int.J.Curr.Microbiol.App.Sci.* 6(3): 1252-1258. doi: https://doi.org/10.20546/ijcmas.2017.603.144