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Improving the productivity of BT cotton (*Gossypium hirsutum L.*) through soil and Fertigation K Application under agro-climatic conditions of Sahiwal, Pakistan

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Keywords

Gossypiumhirsutum; methods of K application, yield and yield components; Pakistan.

Abstract

Cotton is an important cash crop of Pakistan and it is very popular among the farmers' community in Punjab. Farmers apply fertilizers in haphazard manners without any recommendation and they have very little know-how about the role of fertigation especially potassium on cotton (*Gossypium hirsutum* L.). A two year experiment was conducted on farmer's field at Adaptive Research Station Sahiwal to determine the response of cotton variety IUB-2013 to different levels of potash i.e. T1.Soil application of K2O (recommended) i.e. 92 kg ha-1,T2Fertigation of K2O after 30, 45, 60 and 75 days of sowing (15 days interval), and T3Fertigation of K2O after 30, 37, 44, 51, 58, 65 and 72 days of sowing (7 days interval) on the yield and yield components during the year 2017 and 2018.The experiment was laid out in randomized complete block design with three replications. The results of Kharif 2017revealed that T3 caused a significant improvement in yield(2015 kg/ha), higher number of bolls (21.4/plant) and boll weight (2.58g) followed by seed cotton yield (1984 kg/ ha), number of bolls (19.8/plant) and boll weight (2.41g) obtained withT2as against the minimum seed cotton yield of 1879 kg/ ha, number of bolls (18.2/plant) and boll weight (2.17g) obtained withT1.The trend of data of Kharif 2018 and Kharif 2017was statistically similar. The mean data indicated significant relationship (R2=0.97,0.97) among boll number, boll weight and seed cotton yield during the year 2017-18. To maintain profitable production, cotton producers may need to make split soil fertility programs with fertigation of potash except soil application.

Introduction

Cotton (*Gossypium hirsutum*L.) is a strategic crop to sustain economy of Pakistan. The country stands 4th largest producer, 3rd largest exporter, 4th largest consumer of cotton in the world. It contributes more than 60 percent to total foreign exchange earnings and about 8.5 percent to domestic edible oil needs (Anon. 2001). Despite this fact, the productivity of cotton is far low compared to other cotton producing countries. In Pakistan cotton growers use a desirable amount of N (125 kg/ha) but use of K is negligible (0.7 kg/ha) (Reddy *et al.,* 2000). Improved plant K status also promoted the uptake of other macro and micronutrients, indicating an improved capacity of the root system. Nevertheless, the very low efficiency of the soil K application (20%) calls for an alternative approach of K fertilization practice, such as splitting the dose into several applications during the season. Cotton, being a deep-rooted crop, removes large quantities of nutrients from the soil profile. For every 100 kg of seed cotton produced, the crop depletes the soil by 6-7 kg nitrogen (N), 1.9-2.5 kg phosphorus (P), 6-8 kg potassium (K) and 1.2-2.0 kg sulfur (S) (Pettigrew, 2008). An adequate K supply is crucial throughout the period of cotton growth and development (Makhdum et al., 2007) mainly due to its vital role in: biomass production (Zhao et al., 2001); enzyme activation; sucrose transport; starch and fat/oil synthesis; leaf area expansion; carbon dioxide (CO2) assimilation (Reddy et al., 2004); photosynthesis; leaf pressure potential; transpiration and water use efficiency (Pervez et al., 2004); boll weight and size; and lint yield (Akhtar et al., 2003).

Malik *et al.,* 1989 reported that cotton crop could benefit from higher doses of potassium fertilizers when applied at different times after sowing. This may be attributed to equilibria between various forms of potassium and degree of potassium fixation in soil (Mengel, and Kirby, 1982).Abd El-Mohsen *et al*.,(2015) investigated that the application of recommended dose of mineral N and K fertilizer (70 kg N fed^{-1} and 24 kg K_2O fed^{-1}) gave the highest values of plant height, number of open bolls plant-1 , boll weight, seed index, lint %, seed cotton yield $plant^{-1}$ and seed cotton yield fed^{-1}. Fertigation K applications in splits is instrumental in correcting nutrient deficiencies during the reproductive phase, whenever required. Thus, the potential of K fertilizers to enhance cotton production has been clearly demonstrated but is still far from being fully exploited. To maintain profitable production, cotton producers may need to change from traditional soil fertility programs to Fertigation K applications in splits. Optimal NPK fertilization is an important consideration for harvesting higher cotton yield, but farmers usually overuse nitrogenous fertilizer along with insufficient dose of phosphorus and potash. The mineral nutrition of cotton depends on both the cotton root's ability to explore the soil and ability to supply N, P and K nutrients on the soils (Bisson *et al,* 1994). Soil tests carried out in Pakistan showed a general lack of N, a wider spread deficiency of P and an occasional deficiency of K (Wahhab, 1985). Potassium fertilization increased cotton yield by 9% in 2 yr. of a 3-yr. study (Pettigrew, 2003).

Potassium has been recognized as an important plant nutrient in cotton because of its high uptake rate and the relative efficiency of cotton as a K absorber (Kerby and Adams, 1985). The need for K increases dramatically when bolls are set on the plant because they are the major sink for K (Leffler and Tubertini, 1976). Keeping in view the significance of cotton in Pakistan this study wasconducted to see cotton response to soil and fertigation K application.

Materials and Methods

The experiment was conducted at farmer's field of Adaptive Research station Sahiwal in the first week of May during 2017and 2018to determine the response of cotton (IUB-2013) to three treatments :- T1 .Soil application of K2O i.e. 92 kg ha-1,with recommended NP 170-114 kg ha-1,T2Fertigation of K2O after 30, 45, 60 and 75 days of sowing (15 days interval), with recommended NP 170-114 kg ha-1 and

T3Fertigation of K2O after 30, 37, 44, 51, 58, 65 and 72 days of sowing (7 days interval) with recommended NP 170-114 kg ha-1. The experiment was laid out in RCBD with three replications. Soil sample were collected pre planting from the experimental sites and analysis carried out as per method (Ryan et al. (2001)). The soil of the experimental sites was loamy clay with alkaline pH(8.4), 0.78% organic matter, 0.037% N, 5.3ppmavailable phosphorous & 136 ppm available potash. The values demonstrated that soil was medium textured, alkaline in reaction, free of excessive soluble salts, low in organic matter, nitrogen and phosphorus. The potassium level was inadequate to harvest an economic yield.

cotton variety IUB 2013 was sown during first WEEK of May on a well-prepared seed bed at 75 cm row to row and 22.5 cm plant to plant distances. Full dose of P_2O5 as single superphosphate was applied at planting and K as sulphate of potash was applied according to treatments and 170kgN as urea was applied in three equal splits. Pre-emergence weedicide i.e. Dual gold@800 ml/acre was applied to eradicate weeds. All required agronomic practices and plant protection measures were carried out accordingly. The seed cotton was harvested plotwise and finally converted into kg per hectare. Ten plants from each treatment were selected at random for counting number of bolls per plant and 25 bolls were collected from each treatment to measure boll weight. Agronomic efficiency was calculated (given yield over recommended dose/total NPK levels applied) using the experimental data (Novoa, and Loomis. 1981).The average maximum temperature (38.1C and 37.5ºC), minimum temperature (24.3°C and 25.3ºC) and total rainfall (231 mmand 197 mm), during 2017 and 2018, respectively were recorded during the crop growth period. The data on yield and yield components were subjected to statistical analysis andtreatment differences were determined using LSD (Gomez and Gomez. 1984).

Results and Discussion

The results (Tables 1) revealed that seed cotton yield and its components varied significantly ($p<0.05$) with different levels of potashduring 2017.

Table 1: Effect of soil and fertigation K application on the seed cotton yield in the Agro-climatic conditions of Sahiwal during kharif 2017

Tr. No.	Treatments	No. of bolls plant^{-1}	Boll weight(g)	Yield (kg ha^{-1})
T1	Soil application of K2O i.e. 92 kg ha-1,with recommended NP 170-114 kg ha-1	18.2C	2.17C	1879C
T2	Fertigation of K2O after 30, 45, 60 and 75 days of sowing (15 days interval), with recommended NP 170-114 kg ha-1	19.8B	2.41B	1984B
T3	Fertigation of K2O after 30, 37, 44, 51, 58, 65 and 72 days of sowing (7 days interval) with recommended NP 170-114 kg ha-1	21.4A	2.58A	2015A
	LSD	1.51	0.13	28.71

Means not sharing a common letter in column are significant at 5% probability level.

Maximum seed cotton yield (2015kg ha^{-1}) during kharif 2017 (table 1) was obtained fromT3i.e.Fertigation of K2O after 30, 37, 44, 51, 58, 65 and 72 days of sowing (7 days interval) with recommended NP 170-114 kg ha-1followed by seed cotton yield 1984 kg/ha from T2 as against the minimum seed cotton yield of 1879 kg/ha obtained from T1.

The similar trend was observed with respect to no. of bolls /plant and seed cotton yield during 2018 (Table 2). However data regarding boll weight varied non significantly in T3 and T2. Soil application of K and fertigation of K in split also influenced number of bolls, boll weight and seed cotton yield significantly ($p<0.05$) during 2018. The results in Table 2behaved similarly with the results of Kharif 2017 and depictedthatT3i.e. Fertigation of K2O after 30, 37, 44, 51, 58, 65 and 72 days of sowing (7 days interval) with recommended NP 170-114 kg ha-1proved to be better in seed cotton yield(2369 kg/ha) , number of bolls/plant(24.4) and boll weight(2.71 g) followed by the seed cotton yield of 2198 kg ha-1, no of boll.23.6/plant and boll weight2.61 g in the T2 as against the minimum seed cotton yield of 2113 kg /ha, number of bolls 21.4/plant and boll weight 2.43 g with T1. The results of Kharif 2018 were proved to better than Kharif 2017 due to low temperature. Significant relationship (R2=0.97) was revealed between boll number and seed cotton yield (Fig.1)elucidated that seed cotton yield was linearly increased with increase in boll number. It was also explained that seed cotton yield was linearly increased with increase in boll weight as significant relationship (R2=0.97) indicated in Fig. 2. The same trend of results was observed in case of Table 3 (mean data) with respect to seed cotton yield, No. of bolls and boll weight. For sustainable cotton production, cotton growers may need to make split soil fertility programs with fertigation of potash except soil application.

The results are in agreement with Akhtar etal; 2003,Makhdum, etal; 2007,Reddy et al; 2004 and Akhtar et al; 2003who concluded that deficiency of potassium at any plant growth stage may hamper plant growth and subsequently seed cotton yield.

Table 2. Effect of soil and fertigation K application on the seed cotton yield in the Agro-climatic conditions of Sahiwal during kharif 2018

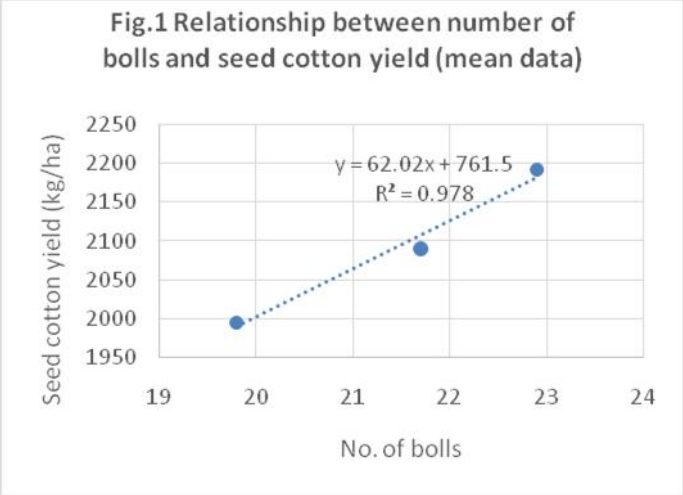
Tr. No.	Treatments	No. of bolls plant^{-1}	Boll weight(g)	Yield (kg ha^{-1})
T1	Soil application of K2O i.e. 92 kg ha-1,with recommended NP 170-114 kg ha-1	21.4C	2.43B	2113C
T2	Fertigation of K2O after 30, 45, 60 and 75 days of sowing (15 days interval), with recommended NP 170-114 kg ha-1	23.6B	2.61A	2198B
T3	Fertigation of K2O after 30, 37, 44, 51, 58, 65 and 72 days of sowing (7 days interval) with recommended NP 170-114 kg ha-1	24.4A	2.71A	2369A
	LSD	0.76	0.10	79.52

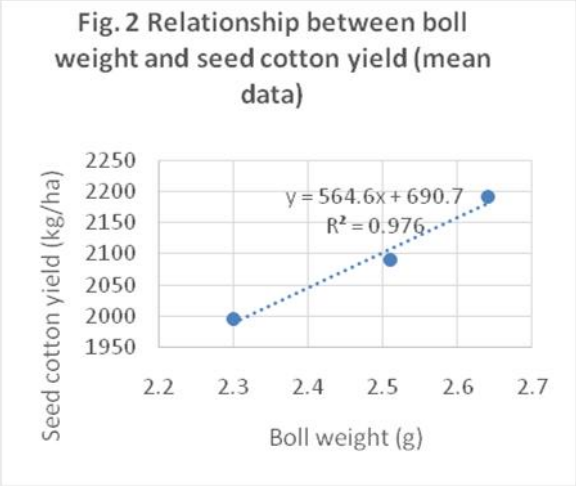
Means not sharing a common letter in column are significant at 5% probability level.

TABLE 3.Average effect of soil and fertigation K application on the seed cotton yield in the Agro-climatic conditions of Sahiwal during kharif 2017 and 2018

Tr. No.	Treatments	No. of bolls plant^{-1}	Boll weight(g)	Yield (kg ha^{-1})	Agronomic efficiency kg seed cotton/kg nutrients applied
T1	Soil application of K2O i.e. 92 kg ha-1,with recommended NP 170-114 kg ha-1	19.8C	2.30C	1996C	5.125
T2	Fertigation of K2O after 30, 45, 60 and 75 days of sowing (15 days interval), with recommended NP 170-114 kg ha-1	21.7B	2.51B	2091B	5.42
T3	Fertigation of K2O after 30, 37, 44, 51, 58, 65 and 72 days of sowing (7 days interval) with recommended NP 170-114 kg ha-1	22.9A	2.64A	2192A	5.63
	LSD	1.08	0.11	60.89	

Means not sharing a common letter in column are significant at 5% probability level.





Conclusion

This study revealed that fertigation of K with seven days interval is better than soil K application in cotton which substantially improved the number of bolls per plant, boll weight and seed cotton yield. Increase in yield and yield components was mainly due to translocation of various metabolites such as sugar, cellulose, etc. triggered by the enzymatic activation for increased photosynthetic efficiency which leads to increase in seed cotton yield.

References

1. Akhtar, M.E., A. Sardar, M. Ashraf, M. Akhtar, and M.Z. Khan. 2003. Effect of Potash Application on Seed Cotton Yield and Yield Components of Selected Cotton Varieties. Asian J. Plant Sci. 2:602-604.
2. Anonymous (2001) Agricultural Statistics of Pakistan. Ministry of Food, Agriculture and Livestock (MINFAL), Islamabad, Pakistan, pp 12–13
3. Ashraf Abd El-AalaAbd El-Mohsen, Mohammed Abd El-Azim Ahmed. 2015. The effect of applying different fertilizer regimes on productivity and profitability of Egyptian cotton under middle Egypt conditions. Advance in Agriculture and Biology, 4: 31–38.
4. Bisson, P., M. Cretenet and E. Jallas. 1994. Nitrogen, phosphorous and potassium availability in the soil, physiology of assimilation and use of these nutrients by the plant. Proceeding World Cotton Research Conference, 1: 115–124.
5. Gomez KA, AA Gomez (1984). Statistical Procedures for Agricultural Research. 2nd Ed. John Wiley and Sons, P 680.
6. KerbyT.A., and F. Adams. 1985. Potassium Nutrition of Cotton. *In:* Potassium in Agriculture. Amer. Soc. Agron., Madison, WI. p. 843-860.
7. LefflerH.R., and B.S. Tubertini. 1976. Development of Cotton Fruit, II: Accumulation and Distribution of Mineral Nutrients. Agron. J. 68:858-861.
8. Makhdum, M.I., H. Pervez, and M. Ashraf. 2007. Dry Matter Accumulation and Partitioning in Cotton (*Gossypiumhirsutum*L.) as Influenced by Potassium Fertilization. Biol. Fert. Soils 43:295-301.
9. Malik, K. N. A., M. I. Makhdum, M. B. Mirza and F.I. Chaudhry. 1989.Preliminary observations on potassium nutrition of cotton in silt and clayloam soils. The Pak. Cottons. 33 (3): 132-144.
10. Mengel, K. and E.A. Kirby. 1982. Principles of Plant Nutrition.International Potash Institute, Bern, Switzerland. p. 435-441.
11. Novoa, R. and R. S. Loomis. 1981. Nitrogen and plant production. Plant Soil. 58:177-204.
12. Pervez, H., M. Ashraf, and M.I. Makhdum. 2004. Influence of Potassium Rates and Sources on Seed Cotton Yield and Yield Components of some Elite Cotton Cultivars. J. Plant Nutr. 27:1295-1317.
13. Pettigrew, W.T. 2008. Potassium Influences on Yield and Quality Production for Maize, Wheat, Soybean and Cotton. Physiologia Plantarum 133:670-681
14. Reddy, K.P., H.F. Hodges and J. Varco. 2000. Potassium nutrition of cotton. Bulletin 1094. Mississippi Agricultural and Forestry Experiment Station, Mississippi
15. Reddy, K.R., S. Koti, G.H. Davidonis, and V.R. Reddy. 2004. Interactive Effects of Carbon Dioxide and Nitrogen Nutrition on Cotton Growth, Development, Yield and Fibre Quality. Agron. J. 96:1148-1157.

16. Ryan J, G. Estefan, A. Rashid (2001) Soil and Plant Analysis Laboratory Manual. International Center for Agricultural Research in the Dry Areas (ICARDA), Islamabad, Pakistan, P 172.
17. Wahhab, A. 1985. Crop response to fertilizer and soil data interpretation. FAO Project NFDC/069/ Pakistan
18. Zhao, D., D.M. Oosterhuis, and C.W. Bednarz. 2001. Influence of Potassium Deficiency on Photosynthesis, Chlorophyll Content, and Chloroplast Ultrastructure of Cotton Plants. Photosynthetica 39:103-109.

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