International Journal of Research in Agriculture and Forestry
Volume 7, Issue 3, 2020, PP 8-12
ISSN 2394-5907 (Print) & ISSN 2394-5915 (Online)

Influence of Soil and Foliar Application of Potassium Fertilization on the Growth and Yield Component of Cotton Crop in Ecological Zone of Rahim Yar Khan

Muhammad Aslam[1], Tanweer Ahmed[2] and Mrs. Laila Yaseen[3]

[1]*Senior Subject Matter Specialist (Agronomy) Department of Adaptive Research Farm, Rahim Yar Khan*
[2] *Director (Farms and Trainings) Adaptive Research Rahim Yar Khan*
[3]*Assistant Research Officer Adaptive Research Rahim Yar Khan*

***Corresponding Author:** Muhammad Aslam, Senior Subject Matter Specialist (Agronomy) Department of Adaptive Research Farm, Rahim Yar Khan.*

ABSTRACT

A field experiment was conducted to study the effect of soil and foliar application of potassium fertilization on the growth and yield of cotton. The experiment was conducted at Adaptive Research Farm Rahim Yar Khan District during the Kharif season 2017-18. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications to check the five different doses of fertilizer i.e Recommended dose of NP, recommended dose of NPK, recommended dose of NPK + 2%K_2 O foliar spray in the form of potassium sulphate (K_2 SO_4) at 80 days of sowing, recommended dose of NPK + 2%K_2 O foliar spray in the form of potassium sulphate (K_2 SO_4) at 105 days of sowing and recommended dose of NPK + 2%K_2 O foliar spray twice at both 80 and 105 days of sowing which has significantly affected the plant germination, plant height, number of mature bolls plant^{-1} and seed cotton yield kg ha^{-1}. The effect of soil and foliar fertilization of potassium on cotton variety was non- significant for boll weight plant^{-1}. Recommended dose of NPK + 2%K_2 O foliar spray twice at both 80 and 105 days of sowing gave the highest and significant average increase in seed cotton yield (1988.0 kg ha^{-1}) over recommended dose of NPK + 2%K_2 O foliar spray in the form of potassium sulphate (K_2 SO_4) at 105 days of sowing (1772.4 kg ha^{-1}) and recommended dose of NPK + 2%K_2 O foliar spray in the form of potassium sulphate (K2 SO4)at 80 days of sowing (1608.9 kg ha-1) on cotton variety BS-15 during both years 2017-18. The lowest average yield during both years was observed where NP fertilizer was used only i.e (1196.2 kg ha-1).

INTRODUCTION

The Cotton is known as the “white gold” of Pakistan. It is the most important and economy dependent crop of Pakistan (Hakim et al. 2011). Cotton plays a significant role in agriculture, industrial development, employment, financial stability and economic viability ever since the country attained the independence. It is the most beneficial fiber and cash crop of Pakistan and earns a good fortune for the country in the form of foreign exchange (Ahmed et al. 2009). Cotton is the most important crop of Pakistan, cultivated on 2917 thousands hectares and is the source of large amount of foreign exchange, contributing about 5.2% of value added in agriculture and about 1.0 percent of GDP and contributes about 66% share in national oil production (Anonymous, 2015).

Fertilizers occupy vital position in raising seed cotton yield. Experiments have shown that an optimal yield could only be produced with the balanced application of all major nutrients in soil (Ahmad, 1998). The scarcity of any nutrient in the soil can be a barrier for the growth of crops even when all other nutrients are in excess in the soil (Soleymani and Shahrajabian 2012. Low yield of cotton in Pakistan is due to many crop husbandry problems such as low or more plant population, water shortage, low seed rate, improper fertilizer management, weed infestation, insect pest and disease problems (Ahmed et al. 2009). Colakoglu, (1980) recommended optimum dose of 80-120 kg ha^{-1} N, 60-90 kg ha^{-1} P and 100-200 kg ha^{-1} K for optimum seed cotton yield. There is heavy drain of nutrients due to more demand by varieties at certain early maturing and high yielding cotton growth stages. To satisfy the required level of plant nutrients, farmers in Pakistan are indispensably inclined to use commercial fertilizers. Cotton plant requires large amount of potassium

ranging from 3-5 kg ha^{-1} day^{-1}. Potassium taken up by plant represents total quantity that is related to the level of available soil and potassium fertilizer (Kirby et al., 1985). Potassium is essential for the growth and development of cotton crop Potassium deficiency symptoms appear as yellowish, white mottling to a light, yellowish, green color with yellow spots appearing between the veins. Potassium is considered to be an important mineral nutrient element for the plants after nitrogen which needs to be applied in sufficient amount to produce healthy and productive crop (IRRI 2007). Cotton growers in Pakistan use a desirable amount of N (125 kg ha^{-1}) but use of K fertilizer is negligible (Mithaiwala et al., 1981). Colakoglu, (1980) recommended optimum dose of 80-120 kg ha^{-1} N, 60-90 kg ha^{-1} P and 100-200 kg ha^{-1} K for optimum seed cotton yield. Time of fertilizer application can affect the N utilization efficiency by cereals (Ragheb et al., 1993). Howard et al. (2000) observed that foliar fertilization may be helpful to correct up potassium deficiencies when root growth and nutrient uptake are restricted.

However, where supply of nutrients and soil potassium uptake is insufficient for plant demand foliar application of fertilizer may provide plenty of nutrients for plant growth (Eettigrew et al., 2000). The practice of foliar feeding with plant nutrients gives quick benefits and economizes nutrient element as compared to soil application (Verma and Sahani, 1963). Various doses of potassium fertilizer was significantly affected almost all the characters related to growth and yield of B.T cotton varieties (Khalid et al.2017). Potassium plays a remarkable role in transpiration, stomatal opening and closing and osmoregulation (Cakmak 2005, Millford and Johnson 2002). El- Ashry et al. (2005) reported that negative effects of drought on wheat growth can be diminished by foliar application of potassium.

Plants translocate the potassium to all parts of plant and in turn yield per plant is increased. It has been observed that in monsoon season effect of foliar potassium spray was found to be more effective than in winter season because high temperature, humidity favoured foliar potassium spray (El-Fouly and ElSayeed,1997). Early symptoms of potassium deficiency in cotton can be minimized by foliar application of potassium (Oosterhuis 1995) and may be used to supplement soil application as means to maximize lint yields (Howard et al.1998). Modifying foliar potassium solution chemistry has improved the potassium uptake of cotton (Howard and Gwathmey1995).Optimum levels of micro and macro inorganic nutrients are required for normal growth and supplements give improvements. Low yield of cotton in Pakistan is due to many crop husbandry problems such as low or more plant population, water shortage, low seed rate, improper fertilizer management, weed infestation, insect pest and disease problems (Ahmed et al., 2009).The lint yield were enhanced by foliar application of potassium having 116 kg/ha Mehlich-1 extractable results were shown by Bednarz et al., (1999) that foliar fertilization when used as a supplemental source increase cotton yield to recommended fertility program.

Keeping in view the significance of cotton in Pakistan this study was conducted to see cotton response against soil and foliar application of potassium fertilizer.

MATERIAL AND METHODS

This experiment was conducted at Adaptive Research Farm during 2017-18. The experiment was laid out in RCBD with three replications having 5 net plot size of 15 ×30ft. Five different doses of fertilizer were checked out i.e Recommended dose of NP, recommended dose of NPK, recommended dose of NPK + 2%K2 O foliar spray in the form of potassium sulphate (K2 SO4)at 80 days of sowing, recommended dose of NPK + 2%K2 O foliar spray in the form of potassium sulphate (K2 SO4) at 105 days of sowing and recommended dose of NPK + 2%K2 O foliar spray twice at both 80 and 105 days of sowing. The crop variety BS-15 was sown in the month of May delinted with commercial H2SO4 before sowing. Required irrigations were applied and weeds were controlled through weedicides. Insecticides were applied to control the sucking insects (Whitefly, Thrips, Jassid, & Mites) and boll worms (Pink boll worm). All other agronomic practices were kept normal and uniform for all the treatments.

Plant population/m2 was counted after three weeks of sowing. Plant height (cm) of randomly selected plots from each plot was measured at the time of last picking and average height was calculated. The total number of bolls on the randomly selected plants picked at the time of each picking was counted. Thus total number of bolls on the plants was obtained by summing up the bolls picked during all pickings and average of number of bolls per plant was calculated. For

boll weight (g), three samples each of 100 seeds from each plot were weighted and finally averaged. Average boll weight (g) was calculated by dividing the total plants seed cotton yield with respective number of bolls per plant. Seed cotton picked from selected plants during all the pickings was weighted in grams using electric balance. After that the yield of seed cotton per plant was calculated. Seed cotton yield kg ha-1 was computed from seed cotton yield per plot. Data collected on different parameters were analyzed statistically by using M STAT-C programme (Anonymous,1986) for analysis of variance and means were separated using Fisher's protected least significant difference (LSD) test at 5% probability level (steel et al. 1997).

Results and Discussion

Plant Population (M^{-2})

Data concerning average number of germination counts is shown in Table 2 during both years 2017 and 2018. Statistical analysis of the data revealed that the effect of soil and foliar application of potassium fertilizer have significant results on germination counts for the both growing seasons. Average maximum germination counts were recorded as 6.1 in T_5 where recommended dose of NPK + 2% K_2 O foliar spray applied twice at both 80 and 105 days of sowing for the both kharif season 2017-18. On the other hand, lowest value was recorded as 3.9 where recommended dose of NP was applied only.

Plant Height (Cm)

Soil and Foliar application potassium fertilizer has significantly increased plant height. Soil and foliar application resulted in proportionate increase in the plant height of cotton variety BS-15 as mentioned in Table-2. The taller plants (152cm) were recorded on cotton variety where recommended dose of NPK + 2% K_2 O foliar spray twice at both 80 and 105 days of sowing was applied followed by recommended dose of NPK + 2%K_2 O foliar spray in the form of potassium sulphate (K_2 SO_4) at 105 days of sowing i.e. (147cm) during both years 2017-18. The lowest height observed (129.5cm) where recommended dose of NP was applied only. These results are in agreement with those of Rochester et al. (2001) that plant height in cotton is related to nitrogen, phosphorus and potash applications.

No. Cotton Bolls Per Plant

Soil and foliar application of potassium significantly affected on no. of cotton bolls/plant. Soil and foliar application of potassium resulted in proportionate increase in the number of cotton bolls/plant as mentioned in Table-2. The greater no. of bolls/plant (31.2) was recorded where recommended dose of NPK + 2% K_2 O foliar spray twice at both 80 and 105 days of sowing was applied followed by recommended dose of NPK + 2%K_2 O foliar spray in the form of potassium sulphate (K_2 SO_4) at 105 days of sowing i.e (28.6) during both years 2017-18. The lowest height was observed (21.1) where recommended dose of NP was applied only. These results are similar as described by Khan et al. (1993).

Boll Weight (G)

Average boll weight is one of the major components of seed cotton yield in cotton. Data given in Table-2 indicates the non significant influence of boll weight. Maximum boll weight (3.3g) was recorded where recommended dose of NPK + 2% K_2 O foliar spray twice at both 80 and 105 days of sowing was applied during both years 2017-18. The minimum boll weight (2.4) was observed in case where recommended dose of NP was applied only. The findings are agreed with those of Sawan et al. (2006).

Seed Cotton Yield Kg Ha^{-1}

Data pertaining to seed cotton yield per hectare as influenced by foliar application of various nutrients as mentioned in Table-2 indicates that soil and foliar application of potassium has significant effect on the seed cotton yield per hectare. Maximum seed cotton yield per hectare (1988.05kg ha^{-1}) was recorded where where recommended dose of NPK + 2% K_2 O foliar spray twice at both 80 and 105 days of sowing was applied followed by recommended dose of NPK + 2%K_2 O foliar spray in the form of potassium sulphate (K_2 SO_4) at 105 days of sowing i.e. (1772.4kg ha^{-1}) during both years 2017-18. The lowest seed cotton yield (1196.2kg ha^{-1}) was obtained where recommended dose of NP was applied only during both years 2017-18. These findings agree with the findings of Bednarz et al., (1999). Supplement soil application of potassium as means to maximize lint yields (Howard et al.1998).

Table1. *Influence of soil and foliar application of potassium fertilizer on the growth and yield of cotton during 2017 and 2018*

Year	Treatments	Average germination counts (m^{-2})	Average plant height (cm)	No. of Bolls/plant	Boll weight (g)	Average seed cotton yield (kg/ ha)
2017	T_1	4.0e	131e	20.5e	2.41e	1180.9e
	T_2	4.2d	137d	23.2d	2.59d	1433.5d
	T_3	4.6c	143c	26.0c	2.70c	1512.2c
	T_4	5.0b	148b	28.1b	2.88b	1679.3b
	T_5	6.0a	154a	30.0a	3.28a	1898.9a
LSD(0.05)		**0.41**	**3.66**	**1.32**	**Non-significant**	**38.50**
2018	T_1	3.8e	128e	21.7e	2.5e	1211.5e
	T_2	4.1d	138d	24.3d	2.7d	1490.7d
	T_3	4.5c	142c	27.3c	2.8c	1705.6c
	T_4	4.9b	146b	29.1b	3.0b	1865.6b
	T_5	6.2a	150a	32.5a	3.4a	2077.2a
LSD(0.05)		**0.21**	**1.68**	**1.40**	**Non-significant**	**66.07**

Table2. *Average values of all parameters from 2017-2018*

Treatments	Average germination counts (m^{-2})	Average plant height (cm)	No. of Bolls/plant	Boll weight (g)	Average seed cotton yield (kg/ ha)
T_1	3.9e	129e	21.1e	2.4e	1196.2e
T_2	4.1d	137d	23.7d	2.6d	1462.1d
T3	4.5c	142c	26.6c	2.7c	1608.9c
T4	4.9b	147b	28.6b	2.9b	1772.4b
T5	6.1a	152a	31.2a	3.3a	1988.0a

CONCLUSION

The results concluded that recommended dose of NPK + 2%K_2 O foliar spray twice at both 80 and 105 days of sowing that effects on seed cotton yield and other growth parameters. It has significantly ($p<0.05$) affected germination, plant height, boll weight and yield during both years of the study. Recommended dose of NPK + 2%K_2 O foliar spray twice at both 80 and 105 days of sowing has improved seed cotton yield (1988.0kg/ha) over 2 years in comparison with other applications of recommended dose of NPK + 2%K_2 O foliar spray in the form of potassium sulphate (K_2 SO_4) at 105 days of sowing, recommended dose of NPK + 2%K_2 O foliar spray in the form of potassium sulphate (K_2 SO_4) at 80 days of sowing, ie (1772.4 and 1608.9kg/ha). Therefore under ecological zone of Rahim Yar Khan, NPK + 2%K_2 O foliar spray twice at both 80 and 105 days of sowing can be recommended for better production.

REFERENCES

[1] Ahmad, N. 1998. Plant nutrition management for sustainable agriculture growth in Pakistan. Proc. Symp. Plant Nutrition Management for Sustainable Agriculture Growth. NFDC, Islamabad.pp.11-21.

[2] Ahmed, A.U.H., R.Ali, S.I Zamir and N. Mahmood. 2009. Growth, yield and quality performance of cotton cultivars BH-160 (Gossypium hirsutum L.) as influenced by different plant spacing. JAPS, 19:189-192.

[3] Anonymous. 1986, MSTATC Microcomputer Statistical Programme. Michigan State University Michigan, Lansing, USA.

[4] Anonymous, (2015-16). "Economic survey of Pakistan", Ministry of Food and Agriculture, Islamabad. pp. 21.

[5] Bednarz, C.W., Hopper, N.W. and Hickey, M.G. (1999). Effects of foliar fertilization of Texas Southern High Plains cotton. Leaf, P, K, Zn, Fe, Mn, B, Ca and yield distribution. Journal of Plant Nutrition22: 863-875.

[6] Cakmak, I. (2005). The role of potassium in alleviating detrimental effects of abiotic stresses in plants. Journal of Plant Nutrition and Soil Science168: 521-530.

[7] Colakoglu, H. 1980. Nutrient requirement and fertilization of cotton in Turkey. Potash Rev. 12:3.

[8] El-Ashry, M., Soad, M. and El- Kholy, M.A. (2005). Response wheat cultivars to chemical desiccants under water stress conditions. Journal of Applied Science Research1: 253-262.

[9] El-Fouly, M.M. and El Sayed, A.A. (1997). Foliar fertilization: An environmentally friendly application fertilizer. In: Proc. Dahlia Griedinger International Symposium on Fertilization and Environment, Technion Israel Institute of Technology, Haifa, Israel. pp. 346-358.

[10] Ettigrew, W.T., McCarty, J.C., Vaughn, K.C. (2000). Leaf senescence-like characteristics

contribute to cottons premature photosynthetic decline. Photosynthesis Research 65: 187-195.

[11] Hakim, A.S., Lanjar, A.G., Ashfaque A.N., Khajjak, A.S., Shafique, A.M. and Bhugro, M. (2011). Seasonal occurrence of *Phenacoccus solenopsis* Tinsley (Hemiptera: Pseudococcidae) and its natural enemies on different varieties of cotton crop. Pak. j. entomol. Karachi 26 (1): pp17-24.

[12] Howard,D.D., Essington, M.E.,Gwathmey, C.O.and Percell, W.M.(2000). Buffering of foliar potassium and Boron solutions for no tillage cotton production. Journal of Cotton Science 4: 237-244P.

[13] Howard, D.D. and Gwathmey, C.O. (1995). Surfactant effect potassium uptake by cotton form foliar KNO3 applications. Journal of Plant Nutrition18: 2669-2680.

[14] Howard, D.D., Gwathmey, C.O.,Roberts, R.K. and Lessman, G.M.(1998). Potassium fertilization of cotton produced on low K soil with contrasting tillage systems. Journal of Production Agriculture 11: 74-79.

[15] IRRI. (2007). Potassium. http://www. Knowledge bank. irri. org/ fa c tsheets/-How To GrowRice /Nutrient_Management/Specific_Nutrients/fs_potassium.pdf.

[16] Khan, M.D., M. Hassan, M.A. Khan and M. Ibrahim. 1993. Effect of different doses and times of application of N on cotton variety S-12 yield and yield components. The Pakistan Cottons, 37: 91–6.

[17] Khalid, L., Din M. U. and Ali. M. (2017). Demonstration and evaluation of the effect of foliar application of potash on the growth and yield of seed cotton in ecological zone of Bahawalnagar. Int. J. Adv. Multidiscip. Res. 4(11): 13-17.

[18] Kirby, T.A., Adams, F. and Munson, R.D. (1985). Potassium nutrition of cotton. Potassium in Agriculture. American Society of Agronomy, Madison. pp. 843-860.

[19] Millfrod, G.F. and Johnston, A.E. (2002). Potassium and nitrogen interactions in crop production. Proc.No: 615, International Fertilizer Society, York, UK.

[20] Mithaiwala, I. K., M. J. Mirbahar, A.A. Channa and M. H. Arain. 1981. Effect of fertilizers on the yield of long staple variety K-68/9 in Guddu Barrage Area. The Pak. Cottons. 25: 73-79.

[21] Oosterhuis, D. (1995). Potassium nutrition of cotton in the USA, with particular reference to foliar fertilization. In: G.A. Constable and N.W. Forester (eds.). Proceedings 1st World Cotton Research Conference, Brisbane, Australia. 14-17 Feb. 1994. CSIRO Publications, Melbourne, Victoria, Australia.

[22] Ragheb, H.M., R.A. Dawood, and K.A. Kheiralla. 1993. Nitrogen uptake and utilization by wheat cultivars grown under saline stress. Assiut. J. Agric. Sci. 24: 97-117.

[23] Rochester, I. J., M. B. Peoples, N. R. Hulugalle, R. R. Gault and G. A. Constable. 2001. Using legumes to enhance nitrogen fertility and improve soil condition in cotton cropping systems. Field Crops Research, 70(1): 27-41.

[24] Sawan, Z. M., M. H. Mahmoud and A. H. El-Guibali. 2006. Response of yield, yield components, and fiber properties of Egyptian cotton (*Gossypium barbadense* L.) to nitrogen fertilization and foliar applied potassium and mepiquat chloride. The J. Cotton Science 10:224–234.

[25] Soleymani A, Shahrajabian MH (2012). The effects of Fe, Mn and Zn foliar application on yield, ash and protein percentage of forage sorghum in climatic condition of Esfahan. Inter J Bio 4: 3–7.

[26] Steel, R.G.D., J.H. Torrie and D.A. Dickey. 1997. Principles and Procedures of Statistics. A biochemical approach. 3rd Ed. McGraw Hill Book. Int. Co. New York: pp172-177.

[27] Verma, S.S. and Sahani, V.M. (1963). Effect of foliar application of nutrients on yield of cotton. Indian Cotton Growing Review17: 247-248.

Citation: *Muhammad Aslam, Tanweer Ahmed and Mrs. Laila Yaseen, "Influence of Soil and Foliar Application of Potassium Fertilization on the Growth and Yield Component of Cotton Crop in Ecological Zone of Rahim Yar Khan", International Journal of Research in Agriculture and Forestry, 7(3), 2020, pp 8-12.*