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Demonstration and evaluation of the effect of foliar application of potash on the growth and yield of seed cotton in ecological zone of Bahawalnagar

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Keywords

Cotton,
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foliar application,
growth and yield.

Abstract

A field experiment was conducted to evaluate the effect of foliar application of potash on the growth and yield of seed cotton. The experiment was conducted at farmer's field sites during the year 2015 and 2016 of Bahawalnagar District. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. The four different doses of potash i.e (recommended dose as 92kg/ha, SOP @ 1%, 2% and 3%) significantly affected the plant population/m^2, plant height (cm), number of mature bolls/plant and seed cotton yield kg/ha. The various doses of fertilizer K was significantly affected almost all the characters related to growth and yield of B.T cotton variety MNH-886. The average of two years result revealed that significant maximum plant population/m^2 i.e 7.1, plant height (cm) i.e 152, number of bolls/plant i.e 39.5 and maximum seed cotton yield i.e 2351.6 kg/ha was obtained when fertilizer K was applied @ 3% in SOP form.

Introduction

Cotton is the most important crop of Pakistan, cultivated on 2.879 million hectares and is the source of large amount of foreign exchange, contributing about 7.0% of value added in agriculture and about 1.5 percent of GDP and contributes about 66.50% share in national oil production (Anonymous, 2013). Fertilizers occupy vital position in raising seed cotton yield. An optimal yield could only be produced with the balanced application of all major nutrients in soil (Ahmad, 1998). Potassium is essential for the growth and development of cotton crop. Additionally potassium also plays a significant role in photophosphorylation, turgor maintenance, photoassimilate transport from source tissues via phloem to sink tissues, stress tolerance and enzyme activation in plants. Potassium is an essential nutrient for all living organisms. 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). Potassium plays a foremost role in translocation of carbohydrates, photosynthesis, water relations, resistance against insects and diseases and sustains balance between monovalent and divalent cations (Brar and Tiwari, 2004). Potassium plays a remarkable role in transpiration, stomatal opening and closing and osmoregulation (Cakmak 2005, Millford and Johnson 2002). Cotton plant requires large amount of potassium ranging from 3-5 $kgha^{-1} day^{-1}$.

Potassium taken up by plant represents total quantity that is related to the level of available soil and potassium fertilizer (Kirby et al., 1985) and yield demand of the crop. Foliar feeding of potassium is of great significance for plants because it includes low cost, quick response to plant. Foliar fertilization use only small quantity of nutrients and it provides compensation for lack of soil fixation, but w hen potassium concentration is found to be very high foliar fertilization may cause foliar burn and can also cause compatibility problems with other pesticides. 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. 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). 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 El-Sayeed,1997). The practice of foliar feeding with plant nutrients gives quick benefits and economizes nutrient element as compared to soil application (Verma and Sahani, 1963). The lint yield were enhanced by foliar application of potassium having 116 kg/ha Mehlich^{-1} extractable potassium whereas opposite results were shown by Bednarz et al., (1999) that foliar fertilization when used as a supplemental source did not increase cotton yield to recommended fertility program. 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).

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). Seed cotton weight boll^{-1} and seed cotton yield ha^{-1} have been found affected by NPK application at various doses (Nehra *et al*. 1986; Khan *et al*. 1993). 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).

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

Materials and Methods

The experiment was conducted at farmer's field of Adaptive Research station Bahawalnagar during 2015 and 2016 to determine and evaluate the effect of foliar application of potash on the growth and yield of seed cotton. The experiment was laidout in Randomized Complete Block Design (RCBD) with four treatments and repeated thrice. Soil sample were collected before planting crop from plough lair of the experimental sites and analysis carried out as per method (Jackson 1962). The soil of the experimental sites was sandy loam with alkaline pH (8.2), 0.73% organic matter, 0.041% N, 4.2ppm available phosphorous & 134ppm available potash. Experimental treatments comprised of four different doses of potash fertilizer i.e (recommended dose @ 92kg/ha and others three in foliar application form 1%, 2% and 3% of SOP). The recommended dose of K fertilizer was applied at sowing, while foliar application of K fertilizer was started to apply when the crop was 80 days old then after 15 days intervals at 95 days, 110 days and 125 days. Seed bed was prepared by cultivating the field for two times with tractor mounted cultivated each followed by planking. The cotton B.T variety MNH-886 was sown on sandy loam soil. Sowing was done on well prepared seed bed 1st week of May in two years. With the help of single row cotton drill by maintaining 2.5 feet row spacing and 12 inch plant to plant distance was maintained by thinning at 6 inch height of the cotton plant. Over all nine 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/m^2 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. 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 1 during both years 2015 and 2016. Statistical analysis of the data revealed that the effect of various doses of fertilizer have no significant results on germination counts for the both growing seasons. Average maximum germination counts were recorded as 7.1 in T_2 and T_4 where fertilizer SOP was sprayed @ 1% and 3% for the both kharif season 2015-16. On the other hand, lowest value was recorded as 6.5 where fertilizer SOP spray dose was 2 % for both years respectively.

Table 1: The effect of foliar application of K fertilizer on the growth and yield of seed cotton during 2015 and 2016.

Year	Treatments	Average germination counts (m^{-2})	Average plant height (cm)	No. of Bolls/plant	Average seed cotton yield (kg/ ha)
2015	T_1	5.3b	131c	20c	1889.1c
	T_2	5.6a	142b	24b	1958.3b
	T_3	4.6c	141b	23b	1973.0b
	T_4	5.6a	146a	28a	2039.3a
LSD		**Non-significant**	**2.26**	**1.04**	**16.67**
2016	T_1	8.3c	142d	43d	2500d
	T_2	8.6a	148c	46c	2588c
	T_3	8.5b	153b	48b	2609b
	T_4	8.6a	158a	51a	2664a
LSD		**Non-significant**	**2.53**	**1.41**	**18.05**

Plant height (cm):

Fertilizer K doses significantly increased plant height. Application of fertilizer K @ 3% resulted in proportionate increase in the plant height of cotton variety MNH-886 as mentioned in Table-2. The taller plants (152cm) were recorded on cotton variety where fertilizer K @3% was applied during both years 2015-16. The height observed (147 cm) when K was applied @ 2%. The minimum height (136.5cm) was observed where K was applied @ 92 kg ha^{-1}. It is well known fact that K application boosts crop growth and development. 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:

Fertilizer doses significantly affected no. of cotton bolls/plant. Application of fertilizer K (recommended dose @ 92kg/ha and others three in foliar application form 1%, 2% and 3% of SOP) resulted in proportionate increase in the number of cotton bolls/plant as mentioned in Table-2. The greater no. of bolls/plant (39.5) was recorded on cotton variety where fertilizer K @3% was applied during both years 2015-16. The no. of bolls/plant (35.5) was observed when K was applied @ 2%. The minimum no.of cotton bolls/plant (31.5) was observed where K was applied @ 92 kg ha^{-1} as recommended dose.

Table 2: Average values of all parameters from 2015-2016

Treatments	Average germination counts (m^{-2})	Average plant height (cm)	No. of Bolls/plant	Average seed cotton yield (kg/ ha)
T_1	6.8b	136d	31.5c	2194.5d
T_2	7.1a	145c	35.0b	2273.1c
T_3	6.5c	147b	35.5b	2291.0b
T_4	7.1a	152a	39.5a	2351.6a

Seed cotton yield kg ha^{-1}:

Data pertaining to seed cotton yield per hectare as influenced by different doses of K as mentioned in Table-2 indicates that K had significant effect on the seed cotton yield per hectare. Maximum seed cotton yield per hectare (2351.6kg ha^{-1}) was recorded where K was applied @ 3% in SOP form on MNH-886 cotton variety. The lowest seed cotton yield (2194.5kg ha^{-1}) was obtained where K was applied @ 92kg ha^{-1} as recommended dose during both years 2015-16. These findings agree with the findings of Howard *et al.* (2001).These results are supported by Elayan (1992) who reported that NPK influenced seed cotton yield ha^{-1}.

Table 3: Percentage increase in wheat yield (kg/ha) between various fertilizer doses for the year 2015 and 2016.

Treatments	Combined Avg. yield of 2015 and 2016 (kg/ha)	Percentage increase in wheat yield (%)
T1	2194.5d	-
T2	2273.1c	3.4
T3	2291.0b	4.2
T_4	2351.6a	6.6

Table 3 shows that the highest yield was produced in T_4 (where K applied @ 3% in SOP form in comparison with 1%, 2% and recommended dose 92kg/ha) with 6.6% yield increase for both study years i.e.2015-16.

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