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EFFECT OF POTASH LEVELS AND TIME OF APPLICATIONS ON SEED COTTON YIELD IN ECOLOGICAL ZONE OF RAHIM YAR KHAN

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ABSTRACT

A study was conducted in three successive seasons during 2008-10 on sandy loam soil at Adaptive Research Farm, Rahim Yar Khan. The objective was to investigate the response of cotton (cv.MNH-786) to different levels and times of application of potash. The treatments comprised three potassium doses (0, 62.5 and 125 kg ha^{-1}) and applied at different times (full on sowing, full at 1st irrigation and ½ at sowing + ½ at 1st irrigation). Potassium doses applied at different times significantly affected seed cotton yield. On an average the highest seed cotton yield (3030.75 kg ha^{-1}) was obtained when crop was fertilized at the rate of 125 kg ha^{-1} K (full sowing) followed by 62.5 kg ha^{-1} K full at sowing (2875.25 kg ha^{-1}). So potassium fertilizer application at sowing proved more beneficial than its split application at sowing and 1st irrigation. The lowest yield was noted in control (2258.52 kg ha^{-1}) where no potassium fertilizer was applied. Hence application of K at economical doses of 62.5 kg ha^{-1} is recommended in ecological zone of Bahawalpur.

Keywords: potash, application time, dose rate, cotton yield, fertilizer doses

INTRODUCTION

Cotton (*Gossypium hirsutum* L.) pays a vital role in the economy of Pakistan. It contributes to the National economy by providing raw material to the local textile industry, such as cotton lint as an export item. It accounts for 7.8 percent of value added in Agriculture and 1.6 percent of GDP. During 2011-12 the crop was cultivated on an area of 2835 thousand hectares 5.4 percent more than last years (2689 thousand hectares). (Government of Pakistan, 2011-12). Fertilizers occupy pivotal 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). Cotton growers in Pakistan use a desirable amount of N (125 kg ha^{-1}) but use of K fertilizer is negligible. The less use of K fertilizer in cotton may have serious consequences. Cotton appears to be more sensitive to K deficiencies than other crops, as root system of cotton is less dense than that of other crops (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 in Turkey. During the last two decades, cotton production scenario has changed. There is heavy drain of nutrients due to more demand by varieties at certain early maturing and high yielding cotton growth stages. Researchers (Makhdum, 2003 and 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 equilibrium between various forms of potassium and degree of potassium fixation in soils (Mengel and Kirby 1982).

Potassium is one of the most important elements in plant nutrition. All living organisms require its large amounts for normal growth and development. Potassium increases the photosynthetic rates, CO_2 assimilation and facilitates carbon movement (Saleem, 2002). The experiments conducted in Indian Punjab showed that cotton crop absorbed a large quantity of potassium indicated that it was more than both nitrogen and phosphorous intake (Brar et al., 1987). The trend of potassium removal by cotton crop indicates its heavy drain from Pakistani soils. The exploitation of soils is likely to lead to severe depletion of would eventually limit the efficiency of other nutrients (Malavolta, 1985). Potassium is an essential macro element for all living organisms required in large amounts for normal plant growth and development.

Keeping in view the significant of cotton in Pakistan this study was conducted to see cotton

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response to varying levels of potash applied at different times.

MATERIALS AND METHODS

A trial was conducted for the three consecutive seasons (2008-10) at Adaptive Research Farm Rahim Yar Khan. Soil samples were collected from 0-15 cm and 15-30 cm depth before fertilizer application during each season. The physical and chemical characteristics of investigated soils were determined according to methods recommended by Ryan et al., (2001). Data on soil chemical analysis are given as PH 8.2; EC (ds/m) 1.1, Organic matter 0.42, available P (ppm) 8, K (ppm) 114-165 and soil was loamy in texture having low organic matter. The potassium level seemed to be in sufficient to obtain an economic yield according to limits set by WFDC (Saleem, 1989). Layout system was RCBD with three replications. The treatments comprised three K levels (0, 62.5 and 125 kg ha^{-1}) applied at different times (full on sowing, full at 1st irrigation and ½ at sowing and ½ with 1st irrigation). Cotton variety (MNH-786) was sown during second week of May having a seed rate of 30 kg ha^{-1}. P_2O_5 (57 kg ha^{-1}) as diammonium phosphate at planting and 150 kg ha^{-1} nitrogen as urea was applied in three splits at planting, flowering and peak flowering. Pre emergence weedicide stomp 330EC @ 2.5 L ha^{-1} was applied to control weeds. Crop was kept free from insect pest attack through regular sprays of insecticides. Normal irrigation was given to the crop and standard production practices for the area were adopted through out the season. Data on seed cotton yield and its yield parameter such as boll weight, no of boll $plant^{-1}$ and height were collected at maturity. Seed cotton yield was calculated on area basis. The yield data were analyzed statistically through computer as suggested by Steel *et al*., (1997).

RESULTS AND DISCUSSION

The data on yield and its parameters differed significantly due to different levels of P_2O_5 applied at different times during 2008-10. During 2008 (Table-1) maximum seed cotton yield (3321 kg ha^{-1}) was produced when 125 kg ha^{-1} K was applied at sowing followed by (3005 kg ha^{-1}) yield of seed cotton when 62.5 kg ha^{-1} K was applied at sowing. The lowest yield of seed cotton (2491 kg ha^{-1}) was produced by control (no potash applied). The same trend of result was also seen for its parameters i.e., boll weight, no of boll per plant and height. There is immense scope of increasing productivity through adequate application of K (Bhattacharyya, 2000).

Table 1: Effect of potash levels applied at different times on yield of seed cotton and its parameters during 2008.

Treatments K (kg ha-1)	Plant height (cm)	No. of bolls $plant^{-1}$	Boll weight (g)	Yield (kg ha^{-1})
No. of K application	138e	21.40e	2.80f	2491f
62.5 full at sowing	152b	29.67ab	3.35ab	3005b
62.5 full at 1st irrigation	143.33d	23.27de	2.99e	2649e
62.5 half at sowing & half at 1st irrigation	143cd	25.20cd	3.18cd	2728d
125 full at sowing	158.67a	31.80a	3.47a	3321a
125 full at 1st irrigation	150bc	27.20bc	3.10de	2827cd
125 half at sowing & half at 1st irrigation	153.33b	29.00ab	3.30bc	2965bc
LSD(0.05)	**4.46**	**3.67**	**0.16**	**148.33**

During 2009 (Table-2) maximum seed cotton yield (3707 kg ha^{-1}) was produced when 62.5 kg ha^{-1} was applied at sowing followed by (3468 kg ha^{-1}) when 125 kg ha^{-1} K was applied at sowing followed by 3429 kg ha^{-1} yield of seed cotton 62.5 kg ha^{-1} was applied in splits ½ at sowing and ½ at 1st irrigation which are statistically at par. The same trend of results was also observed for other parameters.

Table 2: Effect of potash levels applied at different times on yield of seed cotton and its parameters during 2009.

Treatments K (kg ha-1)	**Plant height (cm)**	**No.of bolls plant^{-1}**	**Boll weight (g)**	**Yield (kg ha^{-1})**
No. of K application	142.33c	26.80b	2.49d	2671d
62.5 full at sowing	156ab	33.67a	3.34ab	3707a
62.5 full at 1st irrigation	149.33bc	27.27b	2.75cd	3269bc
62.5 half at sowing & half at 1st irrigation	151.67ab	29.20b	2.98bc	3429ab
125 full at sowing	158a	33.80a	3.46a	3468ab
125 full at 1st irrigation	152.33ab	29.20b	2.85cd	2910cd
125 half at sowing & half at 1st irrigation	153.67ab	29.67b	3.08bc	3110bc
LSD(0.05)	**7.02**	**3.31**	**0.37**	**392.16**

During 2010 (Table-3) maximum yield of seed cotton (1760 kg ha^{-1}) was produced when 125 kg ha^{-1}) K was applied at sowing followed by (1704 kg ha^{-1}) yield when same quantity of K was applied in splits ½ at sowing and ½ with 1st irrigation. The same trend of result was seen for boll weight but different trend of result for number of boll $plant^{-1}$ and height. Maximum height and number of boll $plant^{-1}$ were observed when 125 kg ha^{-1} K was applied at sowing followed by 62.5 kg ha^{-1} K was applied at sowing.

Table 3: Effect of potash levels applied at different times on yield of seed cotton and its parameters during 2010.

Treatments K (kg ha-1)	**Plant height (cm)**	**No.of bolls plant^{-1}**	**Boll weight (g)**	**Yield (kg ha^{-1})**
No. of K application	135.6d	13.80c	2.76d	1155c
62.5 full at sowing	144.53b	20.53a	3.08bc	1430abc
62.5 full at 1st irrigation	135.73d	16.40bc	2.97c	1374bc
62.5 half at sowing & half at 1st irrigation	138.27cd	14.67bc	3.09bc	1374bc
125 full at sowing	153.8a	20.80a	3.38a	1760a
125 full at 1st irrigation	139.0cd	16.87b	2.98c	1595ab
125 half at sowing & half at 1st irrigation	142.27bc	16.87b	3.22ab	1704ab
LSD(0.05)	**4.95**	**2.72**	**0.18**	**347.88**

The trend of results of average of three years (Table-4) was also same for yield and other parameters as during 2008-2009. Maximum yield of seed cotton (3030.75 kg ha^{-1}) was produced when (125 kg ha^{-1}) K applied at sowing followed by (2875.25 kg ha^{-1}) yield of seed cotton when (62.5 kg ha^{-1}) K applied at sowing. The same trend of results for Number of boll plant^{-1}, boll weight and height were seen.

Table 4: Effect of potash levels applied at different times on yield of seed cotton and its parameters during 2008-2010 (average of three years).

Treatments K (kg ha-1)	Plant height (cm)	No.of bolls plant^{-1}	Boll weight (g)	Yield (kg ha^{-1})
No. of K application	138.64f	20.66d	2.68f	2258.52e
62.5 full at sowing	150.84b	27.96a	3.26b	2875.25b
62.5 full at 1st irrigation	142.80e	22.31c	2.92e	2583.28d
62.5 half at sowing & half at 1st irrigation	145.58d	24.13bc	3.08cd	2645.70cd
125 full at sowing	156.82a	28.80a	3.44a	3030.75a
125 full at 1st irrigation	147.11c	24.42b	2.98de	2598.09d
125 half at sowing & half at 1st irrigation	149.76b	25.29b	3.20bc	2738.79c
LSD (0.05)	**2.45**	**2.06**	**0.15**	**117.97**

An economic analysis showed that addition of K fertilizer beyond 62.5 kg ha^{-1} was not cost effective (Table-5). Moreover application of K fertilizer at sowing time was economical than other time of application.

Table 5: Seed cotton yield and economics of K_2O application to cotton crop (average of three years).

Treatments K (kg ha-1)	Seed Cotton Yield (kg ha^{-1})	Increase in yield over control kg ha^{-1}	Value seed cotton Rs ha^{-1}	Cost of fertilizer Rs ha^{-1}	Net profit Rs ha^{-1}	Cost benefit ratio
No. of K application	2258.52	-	-	-	-	-
62.5 full at sowing	2875.25	616.73	41043	2959	38084	1:12:87
62.5 full at 1st irrigation	2583.28	324.76	21663	2959	18654	1:6:30
62.5 half at sowing & half at 1st irrigation	2645.7	387.18	25767	3159	22808	1:7:71
125 full at sowing	3030.75	772.23	51352	5918	45474	1:7:68
125 full at 1st irrigation	2595.09	339.57	22598	5918	16680	1:2:82
125 half at sowing & half at 1st irrigation	2738.79	480.27	31962	6118	26044	1:4:40

Seed cotton @ 66.55 Rs. Kg^{-1} potassium fertilizers @ 47.34 Rs. Kg^{-1}

The positive response addition of potassium fertilizer on soils deficient in soil K has been reported earlier (Saleem, 1989). Other researchers also reported increased seed cotton yield with application of potassium fertilizer. Report of the earlier studies indicated that soils of Pakistan have low K selectivity and buffering capacity (Oosterhuis and Bednarz 1997). The desired amount of K unit time from soil reserves is not sufficient to meet the crop nutrient requirement. Potassium deficiency adversely affects the ability of cotton to fertilize soil nitrogen translocation of photosynthetic assimilates of leaves in cotton (Makhdum, 2003). The data suggested that addition of potassium fertilizer made the soil well buffered for sustained supply of K to cotton crop. As the cotton crop has an indeterminate growth habit which require regular supply of nutrients over a longer growth period. It is apparent ability of soil to supply K to the roots is more important in determining K uptake than ability of roots to absorb K in solution of most of the soils which are insufficient to meet total K requirement of the crop calculated on the basis of mass flow (Bhattacharyya, 2000). The application of potassium fertilizer at sowing time made the soil well buffered to increase K concentration in the solution. It is extended N absorption for vigorous vegetative growth during early part of the season. As K is associated with the transport of sugar (Oosterhuis and Bednarz 1997) application of 125 kg ha^{-1} K_2 O at sowing produced significantly higher yield as compared to other treatments. Well balanced potassium nutrition is an important requirement for producing a high quality, high yielding cotton crop. Potassium plays an important role in translocation of sugar and activation of many of the enzyme required for various plant metabolic processes (Coker et al., 2000). Maximum yield was also reported at higher levels previously (Colakoglu, 1980, Makhdum, 2003 and Malik et al., 1989).

CONCLUSION

Cotton yield increased due to application of 125 kg ha^{-1} K_2 O at sowing time showing positive response of seed cotton yield to the fertilizer. However application of 62.5 kg ha^{-1} K_2O proved economical in loamy soils of southern Punjab.

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