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Research Article

Demonstration and evaluation of the effect of different doses of phosphorous and time of application on seed yield of Bt cotton in ecological zone Rahim Yar Khan

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Keywords

Cotton growth, phosphorous, yield

Abstract

The study was carried out to determine the effect of different doses of phosphorous fertilizer & time of application on B.T cotton & yield of cotton. The B.T variety MNH-886 was sown at Adaptive Research Farm with three phosphorous levels P_2O_5 @ 85 kg ha-^{1}, 114 kg ha-^{1} & 142 kg ha-^{1} applied at sowing time & same three phosphorous levels applied ½ at sowing time and ½ after 45 days were arranged in RCBD design with three replications .The applying time of P levels significantly affected almost all the character related to growth and yield of B.T variety MNH-886. The average results of both years revealed that maximum plant height 158cm, number of bolls per plant 28, average boll weight 3.30g and seed cotton yield 3380kg ha^{-1} was obtained when P_2O_5 @ 142 kg ha-1 applied full dose at sowing time. The results showed significant increase in seed cotton yield due to full dose of phosphorous @ 142 kg ha-^{1} when applied at sowing time.

Introduction

Cotton (*Gossypium hirsutum*) is most important fiber crop is used in textile industry (Killi *et al*., 2005). Cotton is grown is about 76 countries, covering more than 32 million ha, under different environmental conditions world wide and world cotton commerce is about US$20 billion annually (Saranga *et al.*,2001). 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).Cotton growth and maturity are altered by cultivars, seasonal management and environmental conditions (Gwathmey and Craig,2003). Phosphorous deficiencies lead to reduction in the rate of leaf expansion and photosynthesis per unit leaf area (Rodriguez *et al*., 1998). Phosphorous is an integral component of several important compounds in the plant cells, including the sugar phosphate intermediates of respiration and photosynthesis and the phospholipids that make up plant membranes (Taiz and Zeiger, 2003). P significantly enhanced crop growth, N&K uptake, total chlorophyll concentration and dry matter yield of cotton plant (Sawan *et al*.,2008).Phosphorous is mobile in the plant which nourished young leaves and developing bolls which is available in older tissues of the plant .In cotton crop the critical-p concentration ranges from 0.20 to 0.31% (Crozier *et al*.,2004). P is essential for cell division and has significantly effect on the number of flower buds and bolls per plant (Russell, 1973). However, there are cases where cotton response to phosphorous has been positive & economical (Gill *et al.*, 2000).

About 80 to 90% soils from arid to semi arid regions of the world, included Pakistan are deficient in P (Memon *et al*., 1992). Phosphorous is essential for cell division, development of meristiematic tissue and causing stimulating effect on the number of floral buds and bolls per plant (Katkar et al.,2002). A study indicated that cotton response to phosphorous at medium or even low soil test P levels was inconsistent (Mitchell, 2000). Two years study showed that decreases in seed cotton yield , leaf area and a greater ratio of leaf dry mass to leaf area were found in p deficient cotton crop

(Singh *et al*.,2000).Keeping in view the importance of cotton crop and significant response of cotton crop to phosphorous fertilizer at the time of sowing , the present study was conducted to identify the proper dose and proper time of application of phosphorous in the soils of ecological zone of Rahim Yar Khan because the most soils of this area are sandy or sandy loam and porous in structure which significantly effecting the yield of cotton crop with the deficiency of phosphorous.

Materials and Methods

An experiment was conducted at Adaptive Research Farm 101/P, Rahim Yar Khan Pakistan during 2013-14. The experiment was laidout in randomized complete block design (RCBD) with six 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 was sandy loam with alkaline pH(8.3), 0.65% organic matter, 0.041% N, 5.8ppm available phosphorous & 150 ppm available potash. Experimental treatments comprised of T_1 P_2O_5 @ 85 kg ha-^{1} applied full at sowing time T_2 P_2O_5 @ 114 Kg ha-^{1} full at sowing time T_3 P_2O_5 @ 142 kg ha-1 full at the sowing time T_4 P_2O_5 @ 85 kg ha-^{1} ha applied ½ at sowing time and ½ after 45 days T_5 P_2O_5 @ 114 kg ha-1 ½ at sowing time and ½ after 45 days T_6 P_2O_5 @ 142 kg ha-1 ½ at sowing time and ½ after 45 days. The length of each plot was 18 m and width 6 m contained 8 rows of cotton crop. 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. A dose of 120 kg N kg ha-^{1} was applied in the form of urea. The N was applied in three splits 1/3 of nitrogen at sowing, 1/3 N after 35 days of sowing before the start of flowering and 1/3 of N after 65 days during at boll formation stage. Over all eight irrigation were applied and weeds were controlled through weedicides. Insecticides were applied to control the sucking insects (Aphid, Jassid, White-fly, Thrips & Mites) and boll worms (Pink boll worm and Armyworm). All other agronomic practices were kept normal and uniform for all the treatments. When seedling was established, twenty representative plants were selected randomly in each plot and marked for identification. These plants were monitored and tagged to collect the following data.

Plant height (cm) of twenty 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 twenty 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 twenty 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

Phosphorous availability in soil increased with each increment of fertilizer dose. However, increase in availability was not proportionate to added amount (table.1). Phosphorous availability in soil also increased with advancement with crop age. This could be ascribed to increase in root activity in soil, plant root activity in soil; plants roots excrete organic acid and chelating organic compound in rhizosphere. These compounds from multiple complex compounds with Ca, Mg & Fe and thereby increased phosphorous availability in soil.

Table.1 Effect of different doses of phosphorous and time of application on seed cotton yield of B.T cotton and its para meters during 2013

Treatments	Plant height(cm)	No.of bolls per plant	Boll weight(g)	Yield kg ha-^{1}
P2O5 @ 85 kg ha-^{1} full at sowing time	150d	27c	3.10e	2827d
P2O5 @ 114 kg ha-^{1} full at sowing time	152c	29b	3.35b	3005b
P2O5 @ 142 kg ha-1 full at sowing time	158.67a	32a	3.47a	3321a
P2 O5 @ 85 kg ha-1 ½ at sowing time ½ after 45 days	143.33e	23e	2.99f	2649f
P2O5 114 kg ha-1 ½ at sowing and ½ after 45 days	143e	25d	3.18d	2728e
P2O5 @ 142 kg ha-1 ½ at sowing time and ½ after 45 days	153.33b	29b	3.30c	2965bc
LSD (0.05)	1.092	0.542	0.103	62.778

The effect of different doses of phosphorous and time of application on seed cotton yield of B.T cotton and its para meters during 2013 as mentioned in table.1. Plant height as influenced by various levels of P and time of application as described in table.1 showed that the plant height 158.83 (cm) is maximum where P_2O_5 @ 142 Kg ha-1 applied full at sowing time & minimum height 143 in T4 where P_2O_5 @ 85 Kg ha-1 ½ at sowing time and ½ after 45 days. Kaynak (1995) reported that positive co relation exists between seed cotton yield and plant height. Plant height is genetically controlled factors but nutritional disorder may also influence the height of plant (Ahmed *et al*., 2009). Table.1 indicates that the efficiency of phosphorous decrease days after planting the crop. Data presented in table-1 indicate that dry matter yield and plant height increased with each increment of phosphorous dose. Increase in main stamp node numbers was mainly responsible for plant height (cm) is an important growth parameter of cotton plant with respect to seed cotton yield per plant, as plant height increases it produces more number of main stem node that allow to produce more number of bolls and boll weight that directly or indirectly can increase the seed cotton yield per plant. No. bolls per plant as influenced by various levels of P and time of application as described in table.1 showed that the no. of bolls per plant 32 was maximum where P_2O_5 @ 142 Kg ha-1 applied full at sowing time & minimum was 23 in T4 where P_2O_5 @ 85 Kg ha-1 ½ at sowing time and ½ after 45 days. Ismaiel and Al-Enani (1986) and Killi *et.,al* (1995) reported that seed cotton yield was highly affected by the numbers of bolls per plant. Boll weight (g) as mentioned in table.1 was maximum as 3.47 in case of P_2O_5 @ 142 Kg ha-1 applied full at sowing time& minimum as 2.99 in T4 where P_2O_5 @ 85 Kg ha-1 ½ at sowing time and ½ after 45 days. The maximum yield kg/ha was observed as 3321 in case of P_2O_5 @ 142 Kg ha-1 applied full at sowing time& minimum as 2649 in T4 where P_2O_5 @ 85 Kg ha-1 ½ at sowing time and ½ after 45 days during 2013. Sandhu et al., 1986) concluded that numbers fruiting branches per plant showed positive relationship with seed cotton yield per plant. P levels at seed bed preparation increased the plant height that might be due to the role of P to divert the plant towards reproductive phase, because P has vital role in cell division, cell elongation and stimulate early flowering (Singh, 2003). The effect of different doses of phosphorous and time of application on seed cotton yield of B.T cotton and its para meters during 2014 as mentioned in table.2. Plant height as influenced by various levels of P and time of application as described in table.2 showed that the plant height 157 (cm) is maximum where P_2O_5 @ 142 Kg ha-1 applied full at sowing time & minimum height 142 in T4 where P_2O_5 @ 85 Kg ha-1 ½ at sowing time and ½ after 45 days. Table.2 indicates that the efficiency of phosphorous decrease days after planting the crop. Data presented in table-2 indicate that dry matter yield and plant height increased with each increment of phosphorous dose. Increase in main stamp node numbers was mainly responsible for plant height (cm) is an important growth parameter of cotton plant with respect to seed cotton yield per plant, as plant height increases it produces more number of main stem node that allow to produce more number of bolls and boll weight that directly or indirectly can increase the seed cotton yield per plant. No. bolls per plant as influenced by various levels of P and time of application as described in table.2 showed that the no. of bolls per plant 25 was maximum where P_2O_5 @ 142 Kg ha-1 applied full at sowing time & minimum was 18 in T4 where P_2O_5 @ 85 Kg ha-1 ½ at sowing time and ½ after 45 days. Sandhu et al., 1986) concluded that numbers fruiting branches per plant showed positive relationship with seed cotton yield per plant. P levels at seed bed preparation increased the plant height that might be due to the role of P to divert the plant towards reproductive phase, because P has vital role in cell division, cell elongation and stimulate early flowering (Singh, 2003). Boll weight (g) as mentioned in table.2 was maximum as 3.13 in case of P_2O_5 @ 142 Kg ha-1 applied full at sowing time& minimum as 2.87 in T4 where P_2O_5 @ 85 Kg ha-1 ½ at sowing time and ½ after 45 days. The maximum yield kg/ha was observed as 3439 in case of P_2O_5 @ 142 Kg ha-1 applied full at sowing time& minimum as 2298 in T4 where P_2O_5 @ 85 Kg ha-1 ½ at sowing time and ½ after 45 days during 2013. Kaynak (1995) and killi *et.,al* (1995) reported that positive relationship exists between seed cotton weight per boll and seed cotton yield per plant; the same was confirmed in the present studies.

Table-2 Effect of different doses of phosphorous and time of application on seed yield of B.T Cotton in ecological zone of Rahim Yar Khan and its parameters during 2014

Treatments	Plant height(cm)	No.of bolls per plant	Boll weight(g)	Yield kg ha-^{1}
P2O5 @ 85 kg ha-^{1} full at sowing time	145d	20d	2.94c	2648d
P2O5 @ 114 kg ha-^{1} full at sowing time	150c	23c	3.03b	3156b
P2O5 @ 142 kg ha-1 full at sowing time	157a	25a	3.13a	3439a
P2 O5 @ 85 kg ha-1 ½ at sowing time ½ after 45 days	142f	18e	2.87d	2298e
P2O5 114 kg ha-1 ½ at sowing and ½ after 45 days	145e	20d	2.94c	2648d
P2O5 @ 142 kg ha-1 ½ at sowing time and ½ after 45 days	152b	24b	3.04b	2866c
Lsd (0.05)	1.208	0.627	0.267	72.670

The effect of different doses of phosphorous and time of application on seed cotton yield of B.T cotton and its para meters during both the years 2013-14 as mentioned in table.3 revealed that maximum plant height 158 (cm), no.of bolls per plant 28, boll weight 3.30(g) and yield 3380 kg/ha was obtained when P_2O_5 @ 142 Kg ha-1 applied full at sowing time. More phosphate fertilizer in addition to nitrogen was required from vigorous plant growth and higher boll setting in cotton. The positive response to added phosphorous in the cotton crop in the cotton belt of Punjab has been reported by researchers (Malik *et al.,* 1996 and Gill *et al*., (2000). It has been reported that cotton was likely to response to phosphorous fertilization where extractable phosphorous was < 14 mg kg^{-1} of soil (Halevy 1979).

Table-3 Effect of different doses of phosphorous and time of application on seed yield of B.T cotton and its parameters during 2013-14 (Average of two years).

Treatments	Plant height (cm)	No.of boll per plant	Boll weight (g)	Yield Kg ha^{-1}
P2O5 @ 85 kg ha^{-1} full at sowing time	147	23	3.02	2737
P2O5 @ 114 kg ha-1 Full at sowing time	151	26	3.19	3080
P2O5 @ 142 kg ha-1 Full at sowing time	158	28	3.30	3380
P2O5 @ 85 kg ha-1 ½ at sowing and ½ after 45 days	143	20	2.93	2473
P2O5 @ 114 Kg ha-1 ½ at sowing & ½ after 45 days	144	22	3.06	2688
P2O5 @ 142 kg ha-1 ½ at sowing and ½ after 45 days	153	26	3.17	2915
Lsd (0.05)	1.15	0.584	0.185	67.724

Conclusion

Among the six treatments P_2O_5 @ 142 kg ha^{-1} applied to B.T cotton crop at the sowing time was best for achieving more cotton yield in ecological zone of Rahim Yar Khan because this zone consist of mostly sandy or sandy loam soils, porous in nature and having poor soil fertility levels.

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