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Demonstration and evaluation of the effect of different doses of phosphatic fertilizer on the growth and yield of seed cotton in ecological zone Bahawalnagar

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Keywords

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Abstract

To determine the effect of different doses of phosphatic fertilizer on the growth and yield of seed cotton this study was conducted at farmer's field of Bahawalnagar during the years 2014 and 2015. The B.T variety MNH-886 was sown at farmer's field with three different phosphorous doses, while Nitrogen and Potash doses remains same in all treatments i.e N-P-K (T_1 340-57-92kg/ha, T_2 340-85-92 kg/ha and in T_3 340-114-92 kg/ha). The experiment was laid out in RCBD design with three replications. The different doses of phosphatic fertilizer was significantly affected almost all the characters related to growth and yield of B.T variety MNH-886 at sowing time. The average of two years result revealed that significant maximum plant population/m^2 i.e 5.33, plant height (cm) i.e 145.65, number of bolls/plant i.e 31.50, boll weight (g) i.e 3.25 and maximum seed cotton yield i.e 2273.8 kg/ha was obtained when Phosphatic fertilizer was applied @ 114 kg/ha.

Introduction

Cotton (*Gossypium hirsutum* L.) is the most important cash crop in 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). Cotton is rightly called the lifeblood of the economy of many countries in Asia. Pakistan is the 4th largest cotton producer after USA, China and India. However, national average per hectare yield is low as compared to these countries (Khan, 1997). 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). Application of chemical fertilizers has played a pivotal role in increasing crop production all over the world. The alkaline and calcareous soils of Pakistan are low both in nitrogen (N) and in phosphorus (P) requiring the addition of nutrients in appropriate amounts for improving crop yields. The use of N and P fertilizers increased many fold since their introduction in the late fifties (Ahmad, 2000). 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). Proper amount and time of fertilizer application is considered a key to the bumper crop. Time of fertilizer application can affect the N utilization efficiency by cereals (Ragheb et al., 1993). Phosphorus deficiencies lead to reduction in the rate of leaf expansion and photosynthesis per unit leaf area (Rodriguez et al., 1998). There are cases where cotton response to phosphorous has been positive & economical (Gill et al., 2000). P is essential for cell division and has significantly effect on the number of flower buds and bolls per plant (Russell, 1973). Phosphorus 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 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). In cotton crop the critical P concentration ranges from 0.20 to 0.31% (Crozier et al., 2004). Phosphorus is an essential component in growth and yield of seed cotton. Its response was observed different when applied with different doses as with 85, 114 and 142 kg/ha (Aslam et al., 2015). About 80 to 90% soils from arid to semi arid regions of the world, included Pakistan are deficient in P (Memon et al., 1992). 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 of phosphatic fertilizer in the soils of ecological zone of Bahawalnagar which significantly effecting the yield of cotton crop.

Materials and Methods

The experiment was conducted at farmer's field of Adaptive Research station Bahawalnagar during 2014 and 2015 to determine the effect of different doses of phosphatic fertilizer on the growth and yield of seed cotton. The experiment was laidout in randomized complete block design (RCBD) with three 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 (8.3), 0.73% organic matter, 0.043% N, 4.5ppm available phosphorous & 137 ppm available potash. Experimental treatments comprised of three different phosphorous doses, while Nitrogen and Potash doses remains same in all treatments i.e N-P-K (T_1 340-57-92kg/ha, T_2 340-85-92 kg/ha and in T_3 340-114-92 kg/ha). 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 eight irrigation 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 two 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

Phosphorous is an essential component of several important compounds in the plant cells including the sugar phosphate, intermediates of respiration, photosynthesis and the phospholipids that make up plant membranes. Phosphorus availability in soil increased with each increment of fertilizer dose (Tinker, 1980).

Data pertaining to plant population m^{-2} was non significant during the year 2014 in all three treatments as mentioned in table-1. Plant height per plant was affected by P doses. The plant height 162.3 (cm) maximum where P @ 114 Kg/ ha was applied full at sowing time followed by 153.4 (cm) where P @ 85kg/ha was applied. The minimum plant height 145.2 (cm) was observed where phosphorus dose was applied @ 57 kg/ha. Data presented in table-1 indicate that dry matter yield and plant height increased with each increment of phosphorous dose. Increase in main stem 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 Kaynak (1995). It is concluded by (Ahmed et al., 2009 and Sandhu et al., 1986) that number of fruiting branches per plant showed positive relationship with seed cotton yield per plant. Increasing 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). Number of bolls per plant was affected by the dose of phosphorous as mentioned in table-1. The maximum number of bolls per plant was observed in treatment 3 i.e 31 where P dose was applied @ 114kg/ha followed by P dose 85kg/ha i.e 26 Number of bolls per plant. The minimum number of bolls per plant was observed i.e 26 where P dose was applied @ 57kg/ha. Killy (1995) reported that seed cotton yield was highly affected by the numbers of bolls per plant. Boll weight is an important yield determining factor that varies among the levels of phosphorous and time of application. The boll weight (g) data was observed as non significant among all the treatments. The maximum boll weight 3.3 (g) where P @ 114 kg/ ha was applied at the time of sowing followed by 2.7 (g) where P dose was 85 kg/ha. Where as minimum boll weight 2.3 (g) was observed when phosphorus dose applied @ 57 kg/ ha. The B.T variety MNH-886 produced maximum seed cotton yield i.e 1857.6 kg/ha where P @ 114 kg/ ha was applied at sowing time followed by 1694.2 kg/ha where P applied @ 85 kg/ha. The minimum seed cotton yield was observed i.e 1483.2 kg/ha. The results indicated that 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 belt of Punjab has been reported by researcher (Malik et al., 1996).

Table.1 Effect of different doses of phosphatic fertilizer on seed cotton yield of B.T cotton and its parameters during 2014.

Treatments (N-P-K) kg ha^{-1}	Plant population m^{-2}	Plant height (cm)	No.of bolls per plant	Boll weight (g)	Yield kg ha^{-1}
340-57-92	5.33c	145.2c	23c	2.3c	1483.2c
340-85-92	5.00b	153.4b	26b	2.7b	1694.2b
340-114-92	5.66a	162.3a	31a	3.3a	1857.6a
Lsd (0.05)	N.S	5.401	2.123	N.S	13.39

In table-2 the data pertaining to plant population m^{-2} was non significant during the year 2015 in all three treatments. The maximum plant height 129 (cm) was observed in treatment T_3 where P @ 114 Kg/ ha was applied at sowing time followed by 121 (cm) where P @ 85kg/ha was applied. The minimum plant height 115 (cm) was observed where phosphorus dose was applied @ 57 kg/ha. It is concluded by (Ahmed et al., 2009 and Sandhu et al., 1986) that number of fruiting branches per plant showed positive relationship with seed cotton yield per plant. Number of bolls per plant was affected by the dose of phosphorous as mentioned in table-1. The maximum number of bolls per plant was observed in treatment 3 i.e 32 where P dose was applied @ 114kg/ha followed by P dose 85kg/ha i.e 29 Number of bolls per plant. The minimum number of bolls per plant was observed i.e 26 where P dose was applied @ 57kg/ha. Boll weight is an important yield determining factor that varies among the levels of phosphorous and time of application. The boll weight (g) data was observed as non significant among all the treatments. The maximum boll weight 3.2 (g) where P @ 114 kg/ ha was applied at the time of sowing followed by 2.8 (g) where P dose was 85 kg/ha. Where as minimum boll weight 2.5 (g) was observed when phosphorus dose applied @ 57 kg/ ha. The B.T variety MNH-886 produced maximum seed cotton yield i.e 2690 kg/ha where P @ 114 kg/ ha was applied at sowing time followed by 2421 kg/ha where P applied @ 85 kg/ha. The minimum seed cotton yield was observed i.e 2242 kg/ha. These results are similar with (Aslam et al., 2011) that phosphorus increased dose increases the seed cotton yield.

Table.2 Effect of different doses of phosphatic fertilizer on seed cotton yield of B.T cotton and its para meters during 2015.

Treatments (N-P-K) kg ha^{-1}	Plant population m^{-2}	Plant height (cm)	No.of bolls per plant	Boll weight (g)	Yield kg ha-^{1}
340-57-92	3.66c	115c	26c	2.5c	2242c
340-85-92	4.00b	121b	29b	2.8b	2421b
340-114-92	5.00a	129a	32a	3.2a	2690a
Lsd (0.05)	N.S	2.341	2.273	N.S	16.522

Among the three phosphatic doses of fertilizer applied to B.T cotton crop at the sowing time the best one is T_3 in which phosphorus was applied @ 114 kg/ha because Bahawalnagar zone consist of mostly sandy or sandy loam soils, porous in nature and having poor soil fertility levels. The average results of both years as mentioned in table-3 shows that T_3 where P was applied @ 114kg/ha produces maximum plant population i.e 5.33, plant height (cm) i.e 145.65, number of bolls/plant i.e 31.50, boll weight (g) i.e 3.25 and maximum seed cotton yield i.e 2273.8 kg/ha.

Table.3 Effect of different doses of phosphatic fertilizer on seed cotton yield of B.T cotton and its parameters average of two years (2014 and 2015).

Treatments (N-P-K) kg ha^{-1}	Plant population m^{-2}	Plant height (cm)	No.of bolls per plant	Boll weight (g)	Yield kg ha-^{1}
340-57-92	4.49bc	130.1c	24.50c	2.40c	1862.6c
340-85-92	4.50b	137.2b	27.50b	2.75b	2057.6b
340-114-92	5.33a	145.65a	31.50a	3.25a	2273.8a
Lsd (0.05)	N.S	3.871	2.198	N.S	14.956

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