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

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Abstract

A field experiment was conducted to study the effect of various doses of fertilizer on the yield and yield components of 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 different doses of fertilizer NPK i.e (280-57-92, 340-85-92 and 400-114-92) significantly affected the plant population/m^2, plant height (cm), number of mature bolls/plant, seed cotton boll weight (g), and seed cotton yield kg/ha. The various doses of fertilizer 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 6.8, plant height (cm) i.e 163.1, number of bolls/plant i.e 39.1, boll weight (g) i.e 2.9 and maximum seed cotton yield i.e 2603.0 kg/ha was obtained when fertilizer was applied @ 400-114-92 kg/ha.

Introduction

Cotton is the major cash crop and considering the white gold of Pakistan. It is the most important and economy dependent crop of Pakistan (Hakim et al. 2011). It contributes a huge share in the foreign exchange earnings and is important fiber crop (Ahmad et al.2011). In textile manufacturing, it produces seeds with a potential multi product base such as hulls, oil and lint (Ozyigit et al. 2007). 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. Experiments proved that an optimal yield could only be produced with the balanced application of all major nutrients in soil (Ahmad, 1998). Application of chemical fertilizers has played a vital 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). 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). 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. 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. 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). In boosting the agricultural productivity, nitrogen is apparently the most contributing fertilizer (Touchton, 1987). Nitrogen has been reported to increase plant height, number of monopodial/sympodial branches $plant^{-1}$ and number of matured bolls $plant^{-1}$ in cotton (Soomro and Waring, 1987; Mukand *et al*. 1989). 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 significant of cotton in Pakistan this study was conducted to see cotton response to varying levels of Nitrogen.

Materials and Methods

The experiment was conducted at farmer's field of Adaptive Research station Bahawalnagar during 2015 and 2016 to determine the effect of various doses of 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 (8.2), 0.73% organic matter, 0.042% N, 4.3ppm available phosphorous & 133ppm available potash. Experimental treatments comprised of three different doses of fertilizer NPK i.e (280-57-92, 340-85-92 and 400-114-92), while Potash was applied as recommended dose and similar dose applied in three treatments. 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 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 2015 and 2016. Statistical analysis of the data revealed that the effect of various doses of fertilizer have significant results on germination counts for the both growing seasons. Average maximum germination counts were recorded as 6.8 in T_3 where fertilizer NPK was applied @400-114-92 kg/ha for the both kharif season 2015-16. On the other hand, lowest value was recorded as 5.9 where fertilizer NPK dose was applied @ 280-57-92 kg/ha for both years respectively.

Plant height (cm):

Fertilizer doses significantly increased plant height. Application of fertilizer @400-114-92 NPK kg ha^{-1} resulted in proportionate increase in the plant height of cotton variety MNH-886 as mentioned in Table-2. The taller plants (163.1cm) were recorded on cotton variety where fertilizer NPK @400-114-92 was applied during both years 2015-16. The height observed (159.1 cm) when NPK was applied @ 340-85-92 kg ha^{-1}. The minimum height (150.3cm) was observed where NPK was applied @ 280-57-92 kg ha^{-1}. It is well known fact that NPK 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 on no. of cotton bolls/plant. Application of fertilizer @400-114-92 NPK kg ha^{-1} resulted in proportionate increase in the number of cotton bolls/plant as mentioned in Table-2. The greater no. of bolls/plant (39.1) was recorded on cotton variety where fertilizer NPK @400-114-92 was applied during both years 2015-16. The no. of bolls/plant (34.6) was observed when NPK was applied @ 340-85-92 kg ha^{-1}. The minimum no.of cotton bolls/plant (32.1) was observed where NPK was applied @ 280-57-92 kg ha^{-1}.

Boll weight (g):

Average boll weight is one of the major components of seed cotton yield in cotton. Data given in Table-2 indicates that NPK significantly influenced boll weight. Maximum boll weight (2.9 g) was recorded where NPK was applied at the rate of 400-114-92 kg ha^{-1} during both years 2015-16. The minimum boll weight (2.3) was observed in case of NPK @ 280-57-92 kg ha^{-1}. The results agree with those of Sawan *et al*. (2006); who recorded increase in boll weight by increasing NPK rate. 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).

Seed cotton yield kg ha^{-1}:

Data pertaining to seed cotton yield per hectare as influenced by different doses of NPK as mentioned in Table-2 indicates that NPK had significant effect on the seed cotton yield per hectare. Maximum seed cotton yield per hectare (2603.0kg ha^{-1}) was recorded where NPK at a rate of 400-114-92 kg ha^{-1} on MNH-886 cotton variety. The lowest seed cotton yield (2284.9kg ha^{-1}) was obtained where NPK was applied @ 280-57-92kg ha^{-1} 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 1: The effect of various doses of 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	Boll weight (g)	Average seed cotton yield (kg/ ha)
2015	T_1	4.6c	151c	22c	2.1c	2229.9c
	T_2	5.0b	159b	25b	2.5b	2483.9b
	T_3	5.3a	164a	29a	3.0a	2649.6a
LSD		**Non-significant**	**3.36**	**1.03**	**Non-significant**	**38.60**
2016	T_1	7.3c	149.6c	42.3c	2.5c	2339.9c
	T_2	7.6b	159.3b	44.3b	2.6b	2469.9b
	T_3	8.3a	162.3a	49.3a	2.8a	2556.5a
LSD		**Non-significant**	**2.59**	**1.53**	**Non-significant**	**44.03**

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

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	5.9c	150.3c	32.1c	2.3c	2284.9c
T_2	6.3b	159.1b	34.6b	2.5b	2476.9b
T_3	6.8a	163.1a	39.1a	2.9a	2603.0a

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	2284.9c	-
T2	2476.9b	8.4
T3	2603.0a	13.9

Table 3 shows that the highest yield was produced in T_3 (where NPK applied @ 400-114-92 kg/ha in comparison with 340-85-92 and 280-57-92 doses) with 13.9% yield increase for both study years i.e.2015-16.

Conclusion

The results concluded that various doses of fertilizer have varied 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. NPK when applied @ 400-114-92 kg/ha has improved seed cotton yield (2603.0 kg/ha) over 2 years in comparison with other doses. Therefore under ecological zone of Bahawalnagar, NPK dose 400-114-92 kg/ha for cotton crop can be recommended for better production.

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