
INTERNATIONAL JOURNAL OF CURRENT RESEARCH IN BIOLOGY AND MEDICINE

ISSN: 2455-944X

www.darshanpublishers.com

DOI:10.22192/ijcrbm

Volume 1, Issue 9 - 2016

Original Research ArticleDOI: <http://dx.doi.org/10.22192/ijcrbm.2016.01.09.002>

Demonstration and evaluation of the effect of different doses of Nitrogen 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 different doses of Nitrogen on the yield and yield components of cotton. The experiment was conducted at farmer's field sites during the year 2014-15 of Bahawalnagar District. The experiment was laid out in RCBD design with three replications. The different doses of Nitrogen i.e (280, 340, 400, 460 and 520) significantly affected the plant population/m², plant height (cm), number of mature bolls/plant, seed cotton boll weight (g), and seed cotton yield kg/ha. The different doses of Nitrogen was significantly affected almost all the characters related to growth and yield of B.T cotton variety FH-142. The average of two years result revealed that significant maximum plant population/m² i.e 5.90, plant height (cm) i.e 156.5, number of bolls/plant i.e 26, boll weight (g) i.e 3.29 and maximum seed cotton yield i.e 1981 kg/ha was obtained when Nitrogen was applied @ 520kg/ha.

Keywords: of Nitrogen fertilizers, RCBD, cotton

Introduction

Cotton (*Gossypium hirsutum* L.) is the most important cash 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). 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). 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). 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). 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 $80\text{-}120 \text{ kg ha}^{-1}$ N, $60\text{-}90 \text{ kg ha}^{-1}$ P and $100\text{-}200 \text{ kg ha}^{-1}$ 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).

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 2014 and 2015 to determine the effect of different doses of Nitrogen on the growth and yield of seed cotton. The experiment was laidout in Randomized Complete Block Design (RCBD) with five 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), 0.75% organic matter, 0.041% N, 4.4ppm available phosphorous & 135ppm available potash. Experimental treatments comprised of five different doses of Nitrogen i.e (280, 340, 400, 460 and 520), while Phosphorus and Potash was applied as recommended doses. Seed bed was prepared by cultivating the field for two times with tractor mounted cultivated each followed by planking. The cotton B.T variety FH-142 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/m² 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 1 during both years 2014 and 2015. Statistical analysis of the data revealed that the effect of different doses of Nitrogen have significant results on germination counts for the both growing seasons. Average maximum germination counts were recorded as 5.9 in T₅ where N was applied @ 520kg/ha for the both kharif season 2014-15. On the other hand, lowest value was recorded as 4.4 where N applied @ 280kg/ha for both years respectively.

Plant height (cm):

Nitrogen significantly increased plant height. Nitrogen application @ 520 kg ha^{-1} resulted in proportionate increase in the plant height of cotton variety FH-142 as mentioned in Table-2. The taller plants (156.5cm) were recorded on cotton variety where Nitrogen was

was applied @ 520kg/ha during both years 2014-15. The height observed (149.5cm) when nitrogen was applied @400 kg ha⁻¹. The minimum height (140.5cm) was observed where Nitrogen was applied @ 280 kg ha⁻¹. It is well known fact that nitrogen

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.

Table 1: The effect of different doses of Nitrogen fertilizer on the growth and yield of seed cotton during 2014 and 2015.

Year	Treatments	Average germination counts (m ⁻²)	Average plant height (cm)	No. of Bolls/plant	Boll weight (g)	Average seed cotton yield (kg/ ha)
2014	T ₁	3.5d	147e	16e	2.81c	1547e
	T ₂	5.0b	150d	17d	2.86c	1620d
	T ₃	4.0c	153c	18c	3.0b	1711c
	T ₄	5.0b	156b	19b	3.02b	1867b
	T ₅	5.3a	159a	20a	3.13a	1923a
LSD		1.01	2.65	Non-significant	1.2	29.7
2015	T ₁	5.3e	134e	26e	3.10e	1644e
	T ₂	6.3b	140d	28d	3.18d	1823d
	T ₃	5.6d	146c	30c	3.30bc	1949bc
	T ₄	06c	150b	31b	3.35b	1982b
	T ₅	6.6a	154a	32a	3.46a	2039a
LSD		1.02	2.10	Non-significant	1.17	41.89

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 N @520kg ha⁻¹ significantly influenced boll weight. Maximum boll weight (3.29 g) was recorded where N was applied at the rate of 520 kg ha⁻¹

¹ during both years 2014-15. The minimum boll weight (2.95) was observed in case of N @ 280 kg ha⁻¹. The results agree with those of Sawan *et al.* (2006); who recorded increase in boll weight by increasing N 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).

Table 2: Average values of all parameters from 2014-2015

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	4.4d	140.5d	21d	2.95e	1595.5e
T ₂	5.6b	145c	22.5d	3.02d	1721.5d
T ₃	4.8c	149.5c	24c	3.15c	1830c
T ₄	5.5b	153b	25b	3.18b	1924.5b
T ₅	5.9a	156.5a	26a	3.29a	1981a

Seed cotton yield kg ha⁻¹:

Data pertaining to seed cotton yield per hectare as influenced by different doses of Nitrogen as mentioned in Table-2 indicates that N had significant effect on the seed cotton yield per hectare. Maximum seed cotton yield per hectare (1981kg ha⁻¹) was recorded where N at a rate of 520 kg ha⁻¹ on FH-142

cotton variety. The lowest seed cotton yield (1595.5kg ha⁻¹) was obtained where N was applied @ 280kg ha⁻¹ during both years 2014-15. These findings agree with the findings of Howard *et al.* (2001). These results are supported by Elayan (1992) who reported that nitrogen influenced seed cotton yield ha⁻¹ and decrease in seed cotton yield ha⁻¹ was recorded when nitrogen was applied beyond the optimum level.

Table 3: Percentage increase in wheat yield (kg/ha) between different Nitrogen doses for the year 2014 and 2015

Treatments	Combined Avg. yield of 2014 and 2015 (kg/ha)	Percentage increase in wheat yield (%)
T1	1595.5	-
T2	1721.5	7.0
T3	1830	14.0
T4	1924.5	20.0
T5	1981	24

Table 3 shows that the highest yield was produced in T₅ (where N applied @ 520kg/ha in comparison with 460, 400, 340 and 280 doses) with 24% yield increase for both study years i.e.2014-15.

Conclusion

The results concluded that different doses of Nitrogen have varied effects on wheat yield and other growth parameters when used in different combinations. It has significantly ($p < 0.05$) affected germination, plant height, boll weight and yield during both years of the study. N when applied @ 520 kg/ha has improved grain yield (1981 kg/ha) over 2 years in comparison with other doses. Therefore under ecological zone of Bahawalnagar, Nitrogen dose 520kg/ha for cotton crop can be recommended in the region.

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How to cite this article:

Laila Khalid, Mueen u din, Muhammad Yamin and Muhammad Anjam Ali. (2016). Demonstration and evaluation of the effect of different doses of Nitrogen fertilizer on the growth and yield of seed cotton in ecological zone of Bahawalnagar. Int. J. Curr. Res. Biol. Med. 1(9): 8-12.
DOI: <http://dx.doi.org/10.22192/ijcrbm.2016.01.09.002>