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Evaluation of Various Cotton Cultivars for Seed Cotton Yield and Related Attributes at Different Nitrogen Levels

Zahid Usman[1] Kalim Ullah[1] Rehmat Ullah[2] Yousaf Imran[3] Khalid Nawab[2] Iftikhar Ali[3] Noor P. Khan[4] Inam Ullah[4]

1.PCCC, Cotton Research Station D.I.Khan, Pakistan

2.Department of Agricultural Extension Education and Communication, The University of Agriculture, Peshawar

3.Department of Soil and Environmental Sciences, Faculty of Agriculture, Gomal University D.I.Khan, Pakistan

4.Institute of Developmental Studies, The University of Agriculture, Peshawar

Abstract

Response of four cotton cultivars viz., CIM-598, CIM-599, CIM-602 and Ali akbar 703 to different nitrogen levels (0, 50, 100, 150 and 200 kg ha^{-1}) was investigated during the cropping season 2014 at Cotton Research Station, Dera Ismail Khan, Pakistan. Results revealed that application of N dominantly increased plant height, boll weight, number of bolls per plant and seed cotton yield but different cultivars responded differently in increase over control. The maximum seed cotton yield observed was 2579.65 kg ha^{-1} and 200 kg ha^{-1} was proved to be the best level for maximum seed cotton yield. Non-significant interaction was observed for all the studied parameters whereas cotton cultivars varied significantly ($P \leq 0.05$) for seed cotton yield on account of boll weight and number of bolls per plant. Overall maximum Seed cotton yield was observed in Ali akbar 703 (3093.26 kg ha^{-1}) at all N levels suggesting that it could be the promising cotton cultivar under the agro climatic conditions of Dera Ismail Khan and could be grown by supplying 200 kg N ha^{-1}. As steeply linear increase in all the studied attributes was recorded up to 200 kg N ha^{-1}, studies with further higher levels (beyond 200 kg N ha^{-1}) are suggested for confirmation of the present findings.

Keywords: Gossypium hirsutum; Cultivars; N levels; Seed cotton yield

1. INTRODUCTION

Cotton (*Gossypium hirsutum* L.), the crop of commerce, history, industry and civilization, attracts renewed global concentration being the silver fibre Salman et al. (2011) and second most important oilseed crop in the world (Ehsan et al., 2008). Cotton is grown in about 76 countries, covering more than 32 million hectares, under diverse environmental conditions worldwide and world cotton commerce is about US$20 billion annually (Saranga et al., 2001). Pakistan cotton yields have been stagnant from the most recent decade because of numerous reasons i.e. exorbitant downpours at the season of sowing, high temperatures at flowering stage, late wheat harvesting resulting in a decline of area planted to cotton, incidence of Cotton Leaf Curl Virus (CLCV) and improper production technology in the major cotton growing Areas (Khan et al., 2009). Due to these factors during 2013-14, Cotton production stood at 12,769 thousand bales as compared to 13,031 thousand bales in 2012-13, and registered a decline of 2 percent (Pakistan Economic Survey, 2014). To beat these components a good administration and technology is essential thusly.

Nitrogen is the integral part of chlorophyll, protein, nucleic acids, biomolecules, chromosomes and phytochromes (Marschner, 1986; Mengel and Kirkby, 1987). Nutrients affect the photosynthesis, leaf area of the crop [8] and supply of carbohydrates to sink of the crop. To prevent the bolls and squares from abscission, nitrogen is important controlling factor (Perumai, 1999; Borowski, 2001). In crops like cotton, excesses of N delay maturity, promote vegetative tendencies, and usually result in lower yields (Mcvonell et al., 1996). Increased nitrogen rate reduces the lint percentage by 0.16%. Excess application of N than the required for optimum crop performance can reduce yield or fiber quality (Saleem et al., 2010). Consequently nitrogen deficiency has a profound effect on yield and quality, however, [10] reported that nitrogen rate had no effect on fiber uniformity. Several workers have reported that increasing rates of nitrogen play a major role in increasing yield and quality of seed cotton (Wiatrak et al., 2005; Wajid et al., 2010).

On account of cotton crop importance and its role in country's economy, there is a dire need to improve the cotton yield under prevailing conditions. The present study was, therefore, planned to determine the optimum level of nitrogen and to select a high yielding strain of cotton under the prevailing environment.

2. MATERIAL AND METHODS

The experiment was conducted at Cotton Research Station, D.I.Khan during the cotton cropping season 2014. The experimental material comprised of CIM-598, CIM-599, CIM-602 and Ali Akbar 703. The seed of these cultivars were hand sown on 10 May, 2014 in randomized complete block (RCB) design having four replications. Each subplot has four rows, 10 meter long with plant to plant and row to row distance of 30 and 75 cm respectively. Four nitrogen levels Viz. 50, 100, 150 and 200 kg per Ha^{-1} was applied and compared with control

where no nitrogen was applied. To ensure single plant per hill, thinning was performed after 20 days of germination. All the recommended cultural practices and standard plant protection measures were applied the same to all the entries so as to reduce the environmental variations. Picking was performed on single plant basis in October and December, 2014. At maturity, ten plants were randomly selected from central two rows to reduce the border effect**.** The data was recorded on plant height (cm), number of bolls plant^{-1}, boll weight (g) and seed cotton yield (kg ha^{-1}). The data recorded were subjected to analysis of variance (ANOVA) technique as outlined by steel and Torrie (1980). The means were further compared by using the least significant difference (LSD) test at 5% level of probability.

3. RESULTS AND DISCUSSION

3.1 Plant Height: Various nitrogen levels highly significantly (P≤0.01) influenced the plant height (Table 1) whereas varieties and interaction of varieties with nitrogen levels was non-significant. Overall the plant height gradually increased with an increase in N level and thus maximum plant height of 129 cm was recorded in the plants treated with 200 kg N ha^{-1} followed by the 150 kg N ha^{-1} and recorded as 122.75 cm. Minimum plant height (106.67 cm) was recorded in control where no N was applied. The remaining N levels depicted intermediate response for plant height. Increase in plant height with an increase in N level might be attributed to the boosting of physiological attributes like photosynthesis which increased the plant height. If lodging is neglected, taller plants might have more number of bolls per plant which ultimately increased the yield. Copur, 2006 and Ehsan et al. (2008) also observed similar response to N levels in cotton which confirms the present findings.

3.2 Boll weight: Boll weight is directly related to the seed cotton yield and the second major yield contributor after number of bolls per plant. Highly significant (P≤0.01) differences were recorded in both varities and nitrogen level regarding boll weight while interaction was non-significant (Table 5). Maximum boll weight was observed in Ali Akbar-703 i.e. 3.15 gm followed by CIM-602 in which boll weight observed was 2.704 gm. In CIM-599 boll weight observed was 2.562 gm while minimum boll weight was observed in CIM-598 i.e. 2.286 gm (Table 2). An increasing trend was observed among boll weight and nitrogen levels i.e. boll weight increased with increase in nitrogen levels. Maximum boll weight was observed in plot where nitrogen was applied at the rate of 200kg ha^{-1} i.e. 3.013 gm followed by the plot where nitrogen was applied at the rate of 150 kg ha^{-1} i.e. 2.815 gm. Minimum boll weight was observed in control plot which was 2.345 gm (Table 2). Increase in boll weight might be attributed to the increased N level resulting in increased photosynthetic assimilation and accumulation (Sawan et al., 2006). Significant impact of various N levels on boll weight and seed cotton yield has also been reported by (Saleem et al., 2010).

3.3 Number of bolls per plant: Mean square table shows highly significant (P≤0.01) differences among varieties and nitrogen levels while non-significant difference was observed in interaction (Table 5). Maximum number of bolls per plant was observed in Ali Akbar-703 i.e. 26.866 boll per plant followed by CIM-602, CIM-599 and CIM-598 i.e. 25.856, 23.838 and 21.264 respectively (Table 3). Similar results were also observed by Khan et al. (2007) who found variation in number of bolls per plant with variation in variety. This variable response of different cultivars might be attributed to the unavoidable genetic diversity among cultivars. When values were averaged across N levels, maximum numbers of boll per plant were observed in plots where 200 kg ha^{-1}and 150 kg ha^{-1}nitrogen was applied i.e. 27.04 and 25.955. Minimum number of bolls per plant was observed in control plot i.e. 21.165. Khan et al. (2001) mentioned that nitrogen levels significantly affected bolls per plant and seed cotton yield, and nitrogen @ 187 kg ha^{-1} provided significant increase in yield components and yield.

3.4 Seed cotton yield: Means square table shows highly significant (P≤0.01) differences among varieties and nitrogen levels while non-significant interaction was there (Table 5). Though the seed cotton yield in all the cultivars increased with an increment of N level, however various cultivars responded differently. Maximum seed cotton yield was observed in Ali Akbar-703 i.e. 3093.26 kg ha^{-1} followed by CIM-602 in which seed cotton yield was 2705.28 kg ha^{-1}. Seed cotton yield of CIM-599 was 2472.88 kg ha^{-1} while minimum seed cotton yield was observed in CIM-598 i.e. 1897.04 kg ha^{-1}. Among nitrogen levels maximum seed cotton yield observed was in plots where 200 kg ha^{-1}nitrogen was applied i.e. 2579.65 kg ha^{-1} followed by the plot which was treated at the rate of 150 kg ha^{-1} nitrogen i.e. 2564.05 kg ha^{-1} (Table 4). While minimum seed cotton yield was observed in controls plot i.e. 2491.8 kg ha^{-1}. Our results are supported by Wiatrak et al. (2005) and Wajid et al. (2010) who also reported that seed cotton yield increased with increase in nitrogen level. Integration of growth and development mediated by N led to favorable canopy environment for production (square and seed cotton yield) (Perumai, 1999). The maximum seed cotton yield observed in Ali Akbar-703 is due to maximum number of boll weight and number of bolls per plant. Zhao and Oosterhuis (2000) indicated that low N supply at the reproductive stage decreased cotton leaf area, leaf net photosynthetic rate, and chlorophyll content. They also

observed that fruit abscission increased and lint yield decreased in N deficient plants. Yield decrease also reported as a result of N application above an optimum level (Howard et al., 2001).

4. CONCLUSIONS

The instant result concludes that significant variations were observed among cultivars and nitrogen levels for all the traits. Application of N significantly increased plant height, bolls plant-1, boll weight and consequently the seed cotton yield of all cultivars. However, the increases in these parameters with increasing level of N were different for various cultivars that could be associated with genetic variations of genotypes. Overall, the cultivar Ali Akbar 703 showed best performance and increased seed cotton yield at all levels of N suggesting that it could be the promising cultivar if grown with maximum N level of 200 kg ha^{-1} under environmental conditions of Dera Ismail Khan, Pakistan.

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Table 1. Plant height (cm)

Varieties	0	50	100	150	200	Mean
CIM-598	107.67	114.00	118.00	123.00	128.00	118.13
CIM-599	103.67	112.33	116.33	120.67	126.67	115.93
CIM-602	108.67	115.33	119.33	124.00	130.67	119.6
ALI AKBAR 703	106.67	113.33	119.00	123.33	130.67	118.60
Mean	106.67 e	113.75 d	118.17 c	122.75 b	129.00 a	

Table 2. Number of bolls per plant

Varieties	0	50	100	150	200	Mean
CIM-598	18.33	20.66	21.33	23.50	22.50	21.264 d
CIM-599	21.00	24.33	24.00	23.66	26.20	23.838 c
CIM-602	22.33	25.66	25.30	27.33	28.66	25.856 b
ALI AKBAR 703	23.00	26.00	25.20	29.33	30.80	26.866 a
Mean	21.16 d	24.16 c	23.95 c	25.95 b	27.04 a	

Table 3. Boll weight (gm)

Varieties	0	50	100	150	200	Mean
CIM-598	2.00	2.33	2.10	2.40	2.60	2.286d
CIM-599	2.26	2.31	2.66	2.73	2.85	2.562c
CIM-602	2.36	2.30	2.86	2.90	3.10	2.704b
ALI AKBAR 703	2.76	3.10	3.16	3.23	3.50	3.15a
Mean	2.34e	2.51d	2.69c	2.81b	3.01a	

Table 4. Seed cotton yield (Kg ha^{-1})

Varieties	0	50	100	150	200	Mean
Cim-598	1850.3	1911	1920.2	2119.2	2445.8	2049.3d
Cim-599	2220.1	2381.3	2453.7	2514.4	2721.7	2458.24c
Cim-602	2358.3	2421.5	2523.3	2692.5	2865.9	2572.3b
Ali Akbar 703	2514.2	2865.3	2921.4	3140.3	3219.5	2932.14a
Mean	2235.725e	2394.775d	2454.65c	2616.6b	2813.225a	

Table 5. Mean square table of different parameters of cotton

Source of variation	DF	Plant Height (cm)	Number of bolls	Boll Weight (gm)	Seed Cotton Yield (kg/ha)
Rep	2	140.467	20.1417	0.09617	25648
N Levels	4	870.225**	45.108**	0.4504**	12505**
Varieties	3	35.956	141.2**	1.59133**	3751331**
N x V	12	1.636	2.019	0.00508	3896
Error	38	15.537	2.101	0.00932	2719
CV%	-	3.34	5.91	3.60	2.05