RESEARCH PAPER

Growth, seed cotton yield and yield attributes of American cotton (Gossypium hirsutum L.) hybrids under different spacing and nitrogen levels

KULVIR SINGH
Regional Research Station (P.A.U.), FARIDKOT (PUNJAB) INDIA (Email: kulvir@pau.edu)

Abstract: Field studies were conducted at Punjab Agricultural University, Regional Station, Faridkot during Kharif 2013 to evaluate the performance of two hirsutum hybrids (FHH200 and LHH144) in main, two spacing levels (67.5×75 cm and 67.5×90 cm) in sub and three nitrogen levels (i.e. 112, 150 and 187 kg N/ha) in sub plots of Split Plot Design replicated thrice. FHH200 recorded significantly highest seed cotton yield (SCY) of 2953.1 kg/ha followed by LHH144 (2495.2 kg/ha), while among spacing levels differences were non-significant. Among tested N levels, 150 kg N resulted in highest SCY (2868.1 kg/ha) followed by 187 kg N (2738.1 kg/ha) while statistically least SCY was recorded with 112 kg N (2566.3 kg/ha). Though cost of cultivation increased with each increase of nutrient levels, but gross as well as net returns improved significantly only up to 100 per cent RD and declined thereafter. B:C ratio was significantly higher under 150 kg N/ha (2.34) as compared to 187 kg N/ha (2.15). Farmers should opt for FHH200 and a spacing level of 67.5×75cm for hirsutum hybrids and must apply N @150 kg/ha to realize higher SCY and consequently remunerative returns.

Key Words: Fertilizer use efficiency (FUE), Nitrogen levels, Seed cotton yield (SCY), Water productivity (WP)


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INTRODUCTION

Cotton is one of the most important cash crop grown in southwestern zone of Punjab state during Kharif season. In Punjab, total cotton acreage of 4.8 thousand hectare resulted in production of 1627 thousand bales with an average lint yield of 575 kg/ha (Anonymous, 2014). Among different agronomic manipulations, selection of potential genotypes along with optimum plant stand and ideal fertilization play crucial role in increasing the productivity of cotton crop. The yield parameters and their components have been found to vary with fertilizer application under variable population pressure (Ahlawat et al., 1973 and Shrinivasan et al., 1979). Higher SCY due to improved yield contributing parameters per plant under elevated levels of nutrients has also been observed by Bhulerao et al. (2010) and Sunitha et al. (2010). Significant improvement in SCY and consequently better monetary parameters with application of optimum nutrient levels has also been reported in Bt cotton (Singh et al., 2013). Development of new varieties with high yield potential is a continuous phenomenon meant for replacement of old ones. However, their agronomic requirements need to be ascertained in relation to the new genotypes under a given set of environment and edaphic conditions. Farmers also demand information on cultivar differences in response to location specific needs. Obviously, the best way to achieve these aims is through the scientific evaluation of cultivars (Singh et al., 2014). Therefore, present studies were undertaken to evaluate the yield potential of hirsutum hybrids FHH200 and LHH144 under the specific agro-climatic conditions, work out their...
optimum spacing and nitrogen requirement for achieving high productivity and also their economic viability.

**MATERIAL AND METHODS**

The experiment was conducted during Kharif 2013 at Punjab Agricultural University, Research Station, Faridkot which lies in Trans-Gangetic agro-climatic zone, representing the Indo-Gangetic alluvial plains (30° 40’ N and 74° 44’ E) of Punjab [a typical representative of semi-arid south-western cotton belt (Zone IV)] situated at 200m above MSL. The soil of the experimental field was loamy sand in texture, slightly alkaline (pH 8.8), normal EC (0.19 mmhos/cm), medium in OC (0.27%) and available P (16.8 kg/ha) but high in available K (375 kg/ha). The experiment comprised of two hirsutum hybrids (FHH200 and LHH144) in main, two spacing levels (67.5×75 cm and 67.5×90 cm) in sub and three nitrogen levels (i.e. 112 kg N/ha 75% of recommended),150 kg N/ha (100% of recommended) and 187 kg N/ha (125% of recommended) in sub plots of Split Plot Design was replicated thrice. Sowing was done on May, 15 by dibbling 2-3 seeds/hill which were later thinned to one seedling per hill. A uniform inter row spacing of 67.5 cm was maintained. Full dose of 30kg P<sub>2</sub>O<sub>5</sub>/ha was applied before sowing while N dose was given in two splits i.e. first half at the time of thinning and remaining half at flowering stage. Data on growth and yield attributes were recorded from five randomly selected plants in each treatment plot. SCY was recorded from whole plot. Water productivity (WP) and Fertilizer use efficiency (FUE) was worked out by dividing the SCY with total amount of irrigation water and fertilizer applied for the respective parameter. Monetary parameters were calculated on the basis of prevailing market price of inputs and seed cotton. The data were analyzed statistically using SAS proc to test the significance (SAS Institute Inc., 2009). The least significant difference (LSD) at 5 per cent probability level was used for comparing the differences among the treatments and mean values have been used to discus results.

**RESULTS AND DISCUSSION**

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

**Effect on growth, yield and ancillary characters of g. hirsutum hybrids**

The tested hirsutum hybrids differed significantly for growth, yield attributing characters as well as for SCY (Table1). FHH200 recorded significantly better yield (2953.1 kg/ha) by 18.3 per cent than LHH144 (2495.2 kg/ha) due to statistically higher number of bolls/plant. However, plant height, monopods and boll weight per plant were not affected. Singh et al. (2007) also found significant differences for SCY among tested cultivars due to difference in number of bolls and sympods per plant. Boll number of FHH200 (66.4) was also found to be significantly higher by 24.5 per cent than LHH144 (53.3). Kaur and Brar (2005) also reported significant differences among American cotton genotypes for SCY and other attributes. Manjunatha et al. (2010) also reported significant differences for SCY among cotton hybrids particularly due to improved number of bolls per plant. The results in the Table 2 indicated that ginning out turn (GOT %) varied non-significantly among cotton hybrids but lint and seed yield were significantly influenced with statistically higher values for FHH200. The data further revealed statistically highest values of 6.53 and 656.2 gm<sup>3</sup> under FHH200 for fertilizer use efficiency (FUE) and water productivity (WP) indices, respectively while least FUE (5.55) as well as WP (554.5 g<sup>3</sup>) was recorded for LHH144. Due to higher SCY under

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Plant height (cm)</th>
<th>Monopods/plant</th>
<th>Sympods/plant</th>
<th>Bolls/plant</th>
<th>Boll weight (g)</th>
<th>Seed cotton yield (kg/ha)</th>
<th>Biomass (q/ha)</th>
<th>Plant stand/ha</th>
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</thead>
<tbody>
<tr>
<td><strong>Hybrids</strong></td>
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</tr>
<tr>
<td>FHH200</td>
<td>148.1</td>
<td>5.2</td>
<td>41.9</td>
<td>66.4</td>
<td>3.98</td>
<td>2953.1</td>
<td>169.5</td>
<td>17340</td>
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<tr>
<td>LHH144</td>
<td>146.6</td>
<td>4.2</td>
<td>34.0</td>
<td>53.3</td>
<td>4.01</td>
<td>2495.2</td>
<td>163.7</td>
<td>17431</td>
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<tr>
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<td>NS</td>
<td>NS</td>
<td>3.8</td>
<td>12.8</td>
<td>NS</td>
<td>409.1</td>
<td>NS</td>
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<td><strong>Spacing (cm)</strong></td>
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<tr>
<td>67.5×75</td>
<td>150.0</td>
<td>4.6</td>
<td>36.3</td>
<td>58.1</td>
<td>3.90</td>
<td>2729.0</td>
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<td>144.7</td>
<td>4.8</td>
<td>40.0</td>
<td>61.6</td>
<td>4.08</td>
<td>2719.3</td>
<td>164.2</td>
<td>15701</td>
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<tr>
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<td>NS</td>
<td>3.2</td>
<td>NS</td>
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<tr>
<td>112 kg/ha (75% Rd)</td>
<td>142.1</td>
<td>4.4</td>
<td>35.1</td>
<td>55.6</td>
<td>3.90</td>
<td>2566.3</td>
<td>157.6</td>
<td>17459</td>
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<td>150 kg/ha (100% Rd)</td>
<td>147.7</td>
<td>4.7</td>
<td>39.0</td>
<td>62.8</td>
<td>4.05</td>
<td>2868.1</td>
<td>168.4</td>
<td>17459</td>
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<tr>
<td>187 kg/ha (125% Rd)</td>
<td>152.1</td>
<td>5.0</td>
<td>40.3</td>
<td>61.0</td>
<td>4.03</td>
<td>2738.1</td>
<td>173.9</td>
<td>17240</td>
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<td>LSD (0.05)</td>
<td>6.7</td>
<td>NS</td>
<td>2.8</td>
<td>4.4</td>
<td>NS</td>
<td>189.5</td>
<td>10.8</td>
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</tr>
</tbody>
</table>

NS=Non-significant
Effect of spacing on growth, yield and monetary parameters:

Perusal of Table 1 revealed that plant height, monopods, boll weight, bolls per plant, SCY and biomass were not significantly affected by spacing levels. However, significantly higher number of sympods per plant was recorded in spacing combinations of 67.5×90 (40.0) over that of narrow spacing of 67.5×75 cm (36.3). Spacing levels failed to influence GOT, lint and seed yield significantly. Kaur and Brar (2005) also recorded significantly more number of bolls per plant under wider spacing (90×60 cm) as compared to narrow spacing combinations (67.5×45 and 67.5×60 cm). Narayana et al. (2007) also reported significantly better number of bolls/plant was under wider (120×60 cm) than the closer plant geometry (90×60 cm) owing to the reasons discussed above. Reddy and Gopinath (2008) also observed statistically improved bolls per plant under wider plant geometry due to lesser competition among plants for the available resources. However, Srinivasulu et al. (2006) and Brar et al. (2008) reported non-significant differences for SCY with respect to plant geometries. All other studied parameters varied non-significantly.

Effect of nitrogen on growth, yield and monetary parameters:

The results indicated that various nitrogen levels significantly affected growth attributes like plant height, biomass, yield attributes like bolls and sympods per plant, boll weight and overall SCY (Table 1). There was a significant improvement in SCY when the N level was increased from 112 kg (2566.3 kg/ha) to 150 kg/ha though it was at par with 187 kg of N (2738.1 kg/ha). It was further observed that SCY improved significantly only up to 100 per cent level of Rd (2868.1 kg/ha) and thereafter, it declined. Lint and seed yield also followed the similar trend. Hence, an increase of 11.7 and 6.7 per cent in SCY was observed at N levels of 150 and 187 kg/ha, respectively over that of 112 kg N/ha. The non-significant yield differences at 150 and 187 kg N/ha indicated that recommended level of 150 kg N/ha is sufficient enough to get higher yield from tested hybrids. Ram and Giri (2006) also reported similar results where 50 and 60 kg N/ha resulted in significantly higher SCY than 40 kg N/hectare. Bolls per plant improved from 55.6 to 62.8 and then declined to 61.0 with each successive increase in level of N application. However, Singh et al. (2007) also reported significant improvement in SCY with increasing N levels among tested cotton genotypes. Higher SCY due to better number of bolls per plant under elevated levels of nutrients has also been reported by Bhalerao et al. (2010) and Sunitha et al. (2010). Water productivity also improved significantly with every increase in N levels i.e. from 570.2 (112 kg N) to 637.3 (150 kg N) and then indicated declining value of 608.4 g/m² with application of 187 kg N/ha. However, Singh et al. (2013) observed a significant improvement in WP up to 710.8 g/m² with improved nutrition in cotton over that of control (491.5 g/m²). Contrarily, FUE followed the reverse trend as it declined from 7.31 to 6.12 and then to a significantly least value of 4.68 with every successive increase in N levels (Table 2). N application exhibited significantly enhanced cost of cultivation with each

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Lint yield (kg/ha)</th>
<th>Seed yield (kg/ha)</th>
<th>GOT (%)</th>
<th>FUE</th>
<th>WP</th>
<th>GR (Rs./ha)</th>
<th>NR (Rs./ha)</th>
<th>B.C ratio</th>
</tr>
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<tbody>
<tr>
<td>Hybrids</td>
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<tr>
<td>FHH200</td>
<td>989.0</td>
<td>1694.0</td>
<td>33.4</td>
<td>6.53</td>
<td>562.6</td>
<td>38926</td>
<td>132891</td>
<td>93964</td>
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<tr>
<td>LHH144</td>
<td>881.6</td>
<td>1653.6</td>
<td>33.7</td>
<td>5.55</td>
<td>554.5</td>
<td>36179</td>
<td>112288</td>
<td>76108</td>
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<tr>
<td>LSD (0.05)</td>
<td>105.3</td>
<td>304.4</td>
<td>NS</td>
<td>0.95</td>
<td>90.8</td>
<td>2456</td>
<td>18406</td>
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<td>67.5×75</td>
<td>914.4</td>
<td>1814.6</td>
<td>33.5</td>
<td>6.05</td>
<td>510.4</td>
<td>37738</td>
<td>12808</td>
<td>85069</td>
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<tr>
<td>67.5×90</td>
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<td>85003</td>
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<tr>
<td>LSD (0.05)</td>
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<td>NS</td>
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<tr>
<td>112 kg/ha (75% Rd)</td>
<td>861.0</td>
<td>1705.2</td>
<td>33.5</td>
<td>7.31</td>
<td>570.2</td>
<td>35328</td>
<td>115484</td>
<td>80156</td>
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<tr>
<td>150 kg/ha (100% Rd)</td>
<td>961.0</td>
<td>1907.1</td>
<td>33.5</td>
<td>6.12</td>
<td>637.3</td>
<td>38416</td>
<td>129067</td>
<td>90651</td>
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<tr>
<td>187 kg/ha (125% Rd)</td>
<td>923.9</td>
<td>1814.1</td>
<td>33.7</td>
<td>4.68</td>
<td>608.4</td>
<td>38914</td>
<td>123216</td>
<td>84302</td>
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<tr>
<td>LSD (0.05)</td>
<td>68.1</td>
<td>124.8</td>
<td>NS</td>
<td>0.45</td>
<td>42.1</td>
<td>1136</td>
<td>8528</td>
<td>7391</td>
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</tbody>
</table>

FUE and WP indicate fertilizer use efficiency (kg seed cotton yield/ kg fert. applied) and water productivity (g/m²), respectively. GOT, COC, GR, NR and B.C ratio indicates ginning outturn, cost of cultivation, gross returns, net returns and benefit cost ratio, respectively. NS=Non-significant.
successive increase but gross and net returns increased significantly up to 150 kg N/ha (i.e. 100% RD) only and declined thereafter. Highest net returns (Rs. 90651/ha) were recorded with application of 150 kg N/ha (i.e. 100% RD). As a result of this, better B:C ratio was recorded under 150 kg N/ha (2.34) as compared to 112 kg N/ha (2.26) and 187 kg N/ha (2.15). Contrarily, Biradar et al. (2010) reported higher returns with enhanced level of nutrition (150% RD) than 100 per cent recommended level. It can be concluded from the studies that in south-western cotton belt of Punjab state, farmers should opt for FHH200 and a spacing level of 67.5×75cm for hirsutum hybrids and must apply N @ 150 kg/ha to realize higher SCY and consequently remunerative returns.

REFERENCES


