RESPONSE OF HYBRID MAIZE TO DIFFERENT PLANTING METHODS AND NUTRIENT MANAGEMENT

Muhammad Rasheed, Tariq Mahmood and Muhammad Shafi Nazir
Dept. of Agronomy, University of Agriculture, Faisalabad, Pakistan

Effect of planting methods and nutrient application on a maize hybrid was studied at the University of Agriculture, Faisalabad for two years (1997-98). The planting methods were 70 cm spaced single rows, 105 cm spaced double-row strips and 70 cm spaced ridges. The nutrient levels (Kg ha⁻¹) were N (250), N + P (250 + 100), N + P + K (250 + 150 + 100), N + P + K + S (250 + 150 + 100 + 15), N + P + K + Mg (250 + 150 + 100 + 15 + 15) and N + P + K + S + Mg (250 + 150 + 100 + 15 + 15). The crop sown on ridges produced significantly taller plants, more number of grains per cob, heavier grains, higher grain and stover yield with greater harvest index than the crop sown on flat either in 105 cm spaced double-row strips or 70 cm spaced single rows. Among the nutrient levels, application of Mg with NPK had no significant effect on grain yield.

Key words: Planting methods, nutrient management, hybrid maize

INTRODUCTION

Maize (Zea mays L.) is an important food and feed crop of the country. We obtain low maize per hectare yields for several reasons and proper nutrition management and agronomic practices are considered impartent. Of the agronomic practices, planting technique is of considerable importance. It ensures optimum plant population and enable plants to utilize land and other input resources more efficiently for better growth and development (Ali et al., 1998). According to Jafar et al. (1988) and Khan et al. (1994) maize planted in paired rows (30/90 cm) performed better than that grown in single-rows. On the contrary, Khaliq et al. (1988) and Bhagwan and Bhatia (1990) reported that ridge planting showed a positive effect on agro-qualitative traits of maize as compared to flat sowing.

Nutrient management is another important factor of crop production. Balanced nutrition is an essential component of nutrient management (Mahmood et al. 2000) and plays a significant role in increasing crop production and its quality. For the major processes of plant development and yield formation the presence of nutrient elements like N, P, K, S, Mg etc in balanced form are essential (Samad et al., 1983, Mahmood et al., 1999, Maqsood et al., 2000 and Qasim et al., 2001). Thus, there is a need to carry on systematic research in this direction.

The present study was, therefore, planned to determine the effect of different planting techniques and balanced nutrition on various agronomic traits of hybrid maize under the agro-climatic conditions of Faisalabad in irrigated environment.

MATERIALS AND METHODS

The study was conducted on a sandy clay loam during 1997 and 1998. The soil had 0.043% total N, 1 ppm available P and 125 ppm available K. The treatments comprised three planting methods (70 cm spaced single rows, 105 cm spaced double-row strips (35/105 cm) and 70 cm spaced ridges) and seven nutrient levels i.e. 250 kg N, 250 kg N + 150 kg P, 250 kg N + 150 kg P + 100 kg K, 250 kg N + 150 kg P + 100 kg K + 15 kg S, 250 kg N + 150 kg P + 100 kg K + 15 kg Mg and 250 kg N + 150 kg P + 100 kg K + 15 kg Mg + 15 kg S + 15 kg Mg ha⁻¹. The experiment was laid out in a split plot arrangement keeping plantation methods in main plots and nutrient levels in subplots with three replications. The net plot size measured was 4.20 m x 7.5 m. Maize double cross hybrid (DCH), Cargill-707 was sown during the 1st week of August each year with a single row hand drill both in case of flat planting as well as ridges. The seed rate used was 30 kg ha⁻¹. All the P, K, S and Mg alongwith 1/3 of total N were applied as single superphosphate, potassium chloride, potassium sulphate and magnesium chloride hydrated and urea respectively. The remaining N was applied in two equal splits, at first irrigation and at knee high stage of the crop. A plant to plant distance of 15 cm was maintained. The crop was kept weed free through out the growing season by hoeing twice and hand weeding to avoid competition. In all, seven irrigation each of 15 cm were applied to mature the crop in addition to soaking irrigation of 10 cm. The crop was harvested at maturity during first week of November every year. Observations on desired agronomic traits were recorded using standard procedures. Harvest Index (H.I) was computed by using the following formula:

\[
HI = \frac{\text{grain yield ha}^{-1}}{\text{Total biomass ha}^{-1}} \times 100
\]

The data collected were subjected to Freed and Eisen smith (1986) analysis of variance technique and least significant difference (LSD) test at \( P < 0.05 \) was used to compare the treatment means (Steel and Torrie, 1986).
Table 1. Response of hybrid maize to different planting methods and nutrient management.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Plant height (cm)</th>
<th>Day taken to 50-% tasseling</th>
<th>Days taken to 50% silking</th>
<th>Ear number plant(^{-1}) (ENP)</th>
<th>1000-grain weight (g)</th>
<th>Grain yield (tha(^{-1}))</th>
<th>Stover yield (tha(^{-1}))</th>
<th>Harvest index (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Plantation methods</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(M_1 = 70 \text{ cm spaced single rows})</td>
<td>202.2 c</td>
<td>46.53 a</td>
<td>51.56 a</td>
<td>0.97 b</td>
<td>371.3 c</td>
<td>205.0 c</td>
<td>6.27 c</td>
<td>10.06 c</td>
</tr>
<tr>
<td>(M_2 = 105 \text{ cm spaced double row strips})</td>
<td>210.3 b</td>
<td>44.64 b</td>
<td>49.40 b</td>
<td>0.98 a</td>
<td>385.9 b</td>
<td>213.6 b</td>
<td>7.11 b</td>
<td>11.11 b</td>
</tr>
<tr>
<td>(M_3 = 70 \text{ cm spaced ridges})</td>
<td>211.5 a</td>
<td>44.09 c</td>
<td>49.14 c</td>
<td>0.98 a</td>
<td>388.2 a</td>
<td>214.9 a</td>
<td>7.50 a</td>
<td>11.39 a</td>
</tr>
<tr>
<td>LSD 0.05 p</td>
<td>0.31</td>
<td>0.44</td>
<td>0.16</td>
<td>0.005</td>
<td>0.50</td>
<td>0.51</td>
<td>0.11</td>
<td>0.06</td>
</tr>
<tr>
<td>B</td>
<td>Nutrient levels (kg ha(^{-1}))</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>P</td>
<td>K</td>
<td>S</td>
<td>Mg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(F_0)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>166.5 e</td>
<td>52.12 a</td>
<td>56.96 a</td>
</tr>
<tr>
<td>(F_1)</td>
<td>250</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>202.3 d</td>
<td>47.79 b</td>
<td>52.61 b</td>
</tr>
<tr>
<td>(F_2)</td>
<td>250</td>
<td>150</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>211.7 c</td>
<td>45.32 c</td>
<td>49.56 c</td>
</tr>
<tr>
<td>(F_3)</td>
<td>250</td>
<td>150</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>217.6 b</td>
<td>43.00 de</td>
<td>48.24 a</td>
</tr>
<tr>
<td>(F_4)</td>
<td>250</td>
<td>150</td>
<td>100</td>
<td>15</td>
<td>0</td>
<td>219.2 ab</td>
<td>42.53 de</td>
<td>47.79 d</td>
</tr>
<tr>
<td>(F_5)</td>
<td>250</td>
<td>150</td>
<td>100</td>
<td>0</td>
<td>15</td>
<td>218.8 ab</td>
<td>42.92 d</td>
<td>48.02 d</td>
</tr>
<tr>
<td>(F_6)</td>
<td>250</td>
<td>150</td>
<td>100</td>
<td>15</td>
<td>15</td>
<td>219.8 a</td>
<td>41.95 e</td>
<td>47.05 e</td>
</tr>
<tr>
<td>LSD 0.05 p</td>
<td>2.25</td>
<td>0.88</td>
<td>0.59</td>
<td>0.02</td>
<td>4.36</td>
<td>1.67</td>
<td>0.12</td>
<td>0.18</td>
</tr>
</tbody>
</table>

Means in a column not sharing a letter differ significantly at p ≤ 0.05.

NS = Non-significant
RESULTS AND DISCUSSION

The different planting methods showed a significant effect on tasseling and silking period of maize. Tasseling and silking was significantly earlier in crop planted in 70 cm spaced ridges than that planted in 105 cm spaced double row strips. These results are in line with those of Khaliq et al. (1988).

As regards nutrient levels, the unfertilized crop took significantly greater number of days to both tasseling and silking than all the fertilized treatments. Combined application of S+Mg alongwith NPK reduced the tasseling and silking period to a significant level over NPK (Table 1), probably because of their synergistic effect on enhancement of the processes, involved in phonological development like tasseling and silking. Hastening effect of different nutrient elements on tasseling and silking (Anonymous 2000) has also been reported by Samad et al. (1983), Mahmood et al. (1999) and Ali et al. (2000).

There were significant differences among the planting methods with regard to ear number plant$^{-1}$ (ENP). The crop sown on ridges and in 105 cm spaced double row strips produced the same ENP (0.98) but differed significantly from that grown in 70 cm spaced single-rows (0.97). Similarly Khan et al. (1996) reported more ENP for the crop grown in 120 cm spaced double-row strips than single rows flat planting. However Irshad (1987) and Khan et al. (1994) reported that different planting methods have non-significant effect on ENP. ENP varied significantly among the different nutrient levels. Though all the fertilizer treatments increased the ENP significantly over control, yet the differences among $F_s$, $F_4$, $F_5$ and $F_6$ were non-significant. However, $P$ application in addition to $N$ increased the ENP significantly over $N$ alone. Positive effect of $P$ alongwith $N$ on ENP has also been reported by Qasim et al. (2001). These results also corroborate the findings of Hussain et al. (1999) and Ali et al. (2000) who observed the suppressive effect of $S$ or $Mg$ on ENP when applied alongwith NPK.

The three plantation methods varied significantly in respect of grain number ear$^{-1}$ (GNE). The crop sown on ridges produced significantly greater GNE (388.21) than the other three methods. Better ear development in ridge sown crop was attributed to effective utilization of soil moisture as compared to flat plantation. These results are in consonance with those of Khaliq et al. (1988) who recorded more GNE in maize sown on ridges.

- All the fertilizer treatments increased GNE significantly over control. Among the fertilizer treatments although application of 250-150-100-15-15 kg NPKSMg ($F_5$) or 250-150-100-15 kg NPKS ha$^{-1}$ produced statically similar GNE but they differed significantly from rest of the treatments. It was further observed that application of $K$ increased GNE significantly over NP while application of $S$ in combination with $NPK$ further increased GNE to a significant level. However, $Mg$ application alone or in combination with $S$ failed to increase GNE over NPK treatments ($F_4$). These results corroborate the findings of Mahmood et al. (1999) and Maqsood et al. (2000) who reported significant increase in GNE with the addition of $K$ to NPK. These findings also concur with those of Hussain et al. (1999) and Ali et al. (2000) who narrated that application of $S$ and or $Mg$ to NPK increased the GNE significantly over control.

The weight per 1000-grains varied significantly among the different plantation methods. The crop sown on ridges produced significantly heavier grains than that grown on 105 cm spaced double row strips which differed significantly from the crop planted in 70 cm spaced single rows. Higher test weight of maize grain for crop sown on ridges has also been reported by Ahmad et al. (2000).

Although all the nutrient levels increased 1000-grain weight significantly over control, but the difference between $F_4$ and $F_5$ was non-significant indicating thereby that application of $Mg$ alongwith NPKS did not affect the 1000-grain weight. However, the effect of $S$ was more pronounced when applied with NPK than that of Mg. These results are in agreement with those of Samad (1992) and Maqsood et al. (2000). Increase in 1000-grain weight with the addition of $S$ to NPKS has also been observed by Hussain et al. (1999). The data on grain yield ha$^{-1}$ (GYH) revealed significant differences among the three planting methods. The crop sown on ridges produced significantly higher GYH (7.50 t ha$^{-1}$) than the crop planted in the pattern of 105 cm spaced double-row strips (7.11 t ha$^{-1}$) which was significantly higher than that grown in 70 cm spaced single-rows (6.77 t ha$^{-1}$) (Table 1). Higher GYH of the crop sown on ridges was attributed to increased GNE and 1000-grain weight as compared to flat plantation. Promotive effect of ridge plantation on GYH and its components has also been reported by Khokhar et al. (1986) and Bhagwan and Bhatia (1990).

The different nutrient levels, improved the GYH significantly over control. Among the nutrient levels, although the yield level of $F_4$ and $F_5$ was statistically similar but it was significantly higher than rest of the nutrient levels (Table 1). The results further indicated that application of each of $P$ or $K$ in combination with $N$ or $NP$ increased the GYH significantly over $N$ alone while $S$ application in combination with NPK increased the yield further over NPK to a significant level. However Mg application alongwith NPKS had no promotive effect on GYH. Promotive effect of $N$, $P$, $K$ and $S$ alone or in combination with one another on GYH has also been reported by Hussain et al. (1999) and Mahmood et al. (1999). By contrast Ali et al. (2000) observed the promotive effect of $Mg$ on GYH, when applied alongwith NPKS.

The stover yield ha$^{-1}$ (SYH) varied significantly among the three methods of plantation. Ridge plantation ($M_3$) gave significantly more SY ($11.39$ t ha$^{-1}$) than the
other two methods (M₂ and M₃) which also differed significantly from each other (Table-1). These results are in accordance with the findings of Khaliq et al. (1988) and Bhagwan and Bhatia (1990) who reported more SYH for the crop sown on ridges. Although there was a progressive increase with each successive fertilizer treatment over check but the differences among F₄, F₅ and F₆ were non-significant indicating the promotive effect of S only when applied in combination with NPK and showed the corresponding SYH of 12.08, 12.09 and 12.14 t ha⁻¹ respectively. The results reported by Malik et al. (1997) are in agreement with these findings, but are contradictory to those of Hussain et al. (1999) and Ali et al. (2000) who observed the promotive effect of S and Mg on SYH. The harvest index (HI) under the different planting methods varied significantly. The crop sown on ridges (M₃) gave significantly higher HI (38.93%) than M₂ and M₁ which were statistically at par with each other and showed HI of 38.19 and 37.62% respectively. Probably increased GNE as result of better ear development of the crop planted on ridges resulted in higher HI. Similar results were reported by Anonymous (1998).

The harvest index improved significantly by the different nutrient levels over control. Among the fertilizer treatment, although the crop fertilized with 250-150-100-15 kg NPK ha⁻¹ (F₄) gave significantly higher HI than other treatments but it was at par with F₅ (250-150-100-15 kg NPKSMg ha⁻¹) and F₆ (250-150-100 kg NPK ha⁻¹) indicating that Mg application along with NPK had no effect on HI. The results reported by Ali et al. (1998) and Mahmood et al. (1999) are in line with these findings. The results suggested that the crop yields or yield components is a valuable tool to analyse crop performance in response to agronomic treatments.

REFERENCES


