

COMPARATIVE PERFORMANCE AND PROFITABILITY OF TWO CORN HYBRIDS WITH ORGANIC AND INORGANIC FERTILIZERS

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A field experiment was carried out to determine the effect of NPK and organic manures on growth and yield of two maize hybrids. Experiment comprised of two factors (H) hybrids (H₁: FHY-421 and H₂: FHY-434) and (F) four fertilizer types, viz. F₁: inorganic fertilizer (control) NPK @ 120:60:50 kg NPK ha⁻¹, F₂: poultry manure @ 15 t ha⁻¹, F₃: FYM @ 20 t ha⁻¹ and F₄: bio-fertilizer @ 30 g kg⁻¹ seed. So, the treatments comprised of T₁ (F₁+H₁), T₂ (F₁+H₂), T₃ (F₂+H₁), T₄ (F₂+H₂), T₅ (F₃+H₁), T₆ (F₃+H₂), T₇ (F₄+H₁), and T₈ (F₄+H₂). As the experiment was laid out in randomized complete block design with factorial arrangement, it was observed that although FHY-434 with inorganic fertilizer NPK @ 120:60:50 kg NPK ha⁻¹ i.e T₂ (F₁+H₂) produced maximum plant height (212.30 cm), number of grains cob⁻¹ (606.60), 1000-grain weight (310.90 g), grain yield (8.44 t ha⁻¹) and net profit (Rs. 85803 ha⁻¹), followed by FHY-434 with poultry manure @ 15 t ha⁻¹ i.e T₄ (F₂+H₂) in the same parameters, yet T₄ (F₂+H₂) with net profit Rs. 83764 ha⁻¹, is being advocated for organic cultivation for long term and sustainable production keeping in WTO scenario, as it produced grain yield 8.91 t ha⁻¹.

Keywords: Organic and inorganic fertilizers, maize hybrids, yield and its attributes, profitability

INTRODUCTION

Maize (*Zea mays* L.) has gained much importance in the world as well as in Pakistan. It is an important source of food, and fodder. Maize has been used in the manufacturing of shortening compounds, soaps, ammunition, varnishes, paints and similar other products (Martin *et al.*, 1975), whereas the by-product seed cake is a valuable component of livestock feed (Ahmad *et al.*, 2007b). Maize oil is used in cooking, bakery products, oleomargarine, salad dressing and pharmaceutical. Maize starch is used for producing bio-fuel (as ethanol) after its fermentation (Ahmad *et al.*, 2007a; Rajoo, 1998), making plastics, cellophane, photographic films, dyeing of clothes, manufacturing of paper and paper boards and tanning of the hides.

At present it is cultivated on an area of 1.01 million hectares with total production of 3.31 million tons showing 46.3% increase of production than that of preceding year due to adequate and timely application of inputs (Anonymous, 2008). Like other production factors fertilizer is of key importance, which determines crop yields (Veloso *et al.*, 2001). Conventionally we are habitual of using inorganic fertilizer, may or may not be along with organic sources. But now in scenario of WTO there is era of transition from inorganic farming to organic farming (Tamayo *et al.*, 1997).

Protecting long term soil fertility by maintaining soil organic matter levels, supporting soil biological activity and careful mechanical intervention, providing crop nutrient directly by using relatively insoluble nutrient sources which are made available to the plants by the action of soil micro-organisms, nitrogen self sufficiency

through the biological nitrogen fixation (Hossain *et al.*, 2004) as well as effective recycling of organic materials including livestock wastes organic manuring (Safdar, 2002), using high yielding and resistant hybrids (Jarwar *et al.*, 2005), may sustain productivity of the system, however, there is need to evaluate their profitability keeping in view our economic conditions (Chaudhry, 2005; Saleem, 2000).

Competitive organic yields have been obtained in the systems where there is the enhancement of the organic matter and soil biotic diversity occurred (Charles and Shuxin, 2005). An examination of entire agro ecosystem is critical in the development of the successful organic farming system. Short and long term benefits have been described to the organic farming (Delate and Camberdella, 2004). Organic fertilizers including farmyard manure, poultry manure, sheep manure, and bio-fertilizer may be used for crop production as a substitute of chemical fertilizers (Khan *et al.*, 2005). Organic fertilizers supply all the essential elements necessary for growth though not in equal proportion, and are readily decomposed by soil microorganisms (Afzal *et al.*, 2005). Organic matter produced by organic fertilizers has a strong, positive effect on moisture holding capacity, improvements in aggregation and structure (Sharif *et al.*, 2004). Organic fertilizers improve soil fertility without leaving any residual effects in the soil and are much cheaper as compared with chemical fertilizers (Chatter and Gasser, 1970).

Maize hybrids have a pivotal role while deciding about the type and amount of fertilizer in order to meet the requirements for growth and development through out

life span of crop (Chandrashekra *et al.*, 2000). The newly evolved hybrids have a better ability to withstand different macro and microenvironments affecting plant growth and development than older ones. But these new hybrids show different behavior in utilizing the nutrients efficiently (Afzal *et al.*, 2005; Reddy *et al.*, 1988).

Keeping in view the importance of organic farming it is needed to evaluate the effect of different organic and inorganic sources of nutrients on growth, yield and profitability of different hybrids of maize. The present study was therefore, planned to determine the effect of organic and inorganic fertilizers on growth, yield and profitability of maize varieties.

MATERIALS AND METHODS

To determine the performance of maize hybrids with organic and inorganic fertilizer, an experiment was conducted on sandy clay loam soil with 0.79% organic matter, total available nitrogen 0.045%, available phosphorous 1.4 ppm, and available potassium was 129 ppm at the Agronomy Research Area, University of Agriculture, Faisalabad. The crop sown on the experimental site was previously maize with no organic manure application. Soil at the site was well drained silt loam and research area was completely flat. Net plot size was 3m x 8m. Crop was sown at a row spacing of 75 cm by hand drill on August 7, 2005.

The experiment was designed in randomized complete blocks (RCBD) with factorial arrangement having three replicates. Experiment comprised of two factors (H) hybrids (H₁: FHY-421 and H₂: FHY-434) and (F) four fertilizer types, viz. F₁: inorganic fertilizer (control) NPK @ 120:60:50 kg NPK ha⁻¹, F₂: poultry manure @ 15 t ha⁻¹, F₃: FYM @ 20 t ha⁻¹ and F₄: bio-fertilizer @ 30 g kg⁻¹ seed. So, the treatments comprised of T₁ (F₁+H₁), T₂ (F₁+H₂), T₃ (F₂+H₁), T₄ (F₂+H₂), T₅ (F₃+H₁), T₆ (F₃+H₂), T₇ (F₄+H₁), and T₈ (F₄+H₂). After germination of seeds, plant spacing was maintained 15 cm by thinning at 5-6 leaf stage in order to achieve proper plant population. Manual weed control was practiced to keep the field weed free.

Full dose of inorganic fertilizer (P, K) and half dose of N were applied at sowing, while remaining half N was applied at flowering stage. Recommended dose of NPK (120:60:50 kg ha⁻¹) was used for comparison. Pre separated strains of diazotroph and phosphate solubilizing bacteria were obtained from soil bacteriology section Ayub Agricultural Research Institute (AARI), Faisalabad. For inoculation 10% pure sugar solution was prepared and seeds were dipped into the inoculums may stick over the seed. Inoculated seeds were dried under shade and used for the sowing

in the respective plots. All other agronomic and plant protection operations except the ones under study were kept normal and uniform for all the treatments.

Ten plants were taken from each plot at random and their height was measured with the help of measuring tape and average was calculated from those ten measured values. In the same way, ten cobs were selected at random. Total numbers of grains of each cob were counted and then average was calculated accordingly. Crop was harvested and sun dried in the field for ten days as there was faint sunshine due to winter. After drying, the cobs were removed from the stalks and again sun dried. Then cobs of each plot were shelled with electric maize sheller and samples were obtained from grains of each plot. Samples were again sun dried to moisture level of 10-12 %. 1000-grain weight were counted from each sample randomly and weighed with the help of electrical balance in the laboratory. After shelling, total grain weight of each plot was recorded with a portable balance and grain yield on tones hectare⁻¹ basis was calculated.

The data collected were analyzed using Fisher's analysis of variance techniques and individual treatment means were compared using least significance difference (LSD) test at 5% probability level (Steel and Torrie, 1984). Net profit was accomplished by following the procedure laid down by Byerlee (1988).

RESULTS AND DISCUSSION

It is depicted from the Table 1 that inorganic/organic fertilizers application in different maize hybrids significantly affected plant height. Maximum plant height (212.30 cm) was found in plots receiving NPK at 120:60:50 kg ha⁻¹, which was statistically at par with that of plot fertilized with poultry manure @ 15 t ha⁻¹ (212.10 cm). Bio-fertilizer @ 30g kg⁻¹ seed gave minimum plant height (190.90cm).

As far as maize hybrids; both significantly differ from each other showing that they have much genetic difference in attaining the maximum plant height. Plant height of FHY-434 (207.91 cm) was significantly higher than that of FHY-421 (203.28 cm). The positive effect of NPK fertilizer might be due to the availability of essential nutrients required for plant growth and development in proportion because this especially N along with P has a pronounced effect on the vegetative growth of the plants. The plant height given by poultry manure at par with inorganic fertilizer might be due to ample and readily availability of growth elements and minimum plant height of plots receiving seed inoculation alone might be due to deficiency of growth elements because neither fertilizers nor manures were

Table 1. Influence of inorganic fertilizers and organic manures on yield and yield components of corn hybrids

| Treatments | Plant height (cm) | No. of grains cob ⁻¹ | 1000-grain weight (g) | Grain yield (t ha ⁻¹) |
|---|-------------------|---------------------------------|-----------------------|-----------------------------------|
| Hybrids | | | | |
| FHY-421 | 203.28 b | 455.96 b | 293.79 b | 5.64 b |
| FHY-434 | 207.91 a | 499.19 a | 300.41 a | 6.92 a |
| LSD (p<0.05) | 0.3008** | 23.371** | 3.119** | 0.213** |
| Inorganic fertilizers and organic manures | | | | |
| NPK at 120:60:50 kg ha ⁻¹ | 212.30 a | 606.60 a | 310.90 a | 8.44 a |
| Poultry Manure @ 15 t ha ⁻¹ | 212.10 a | 559.40 b | 306.00 b | 8.14 b |
| Farm Yard Manure @ 20 t ha ⁻¹ | 207.10 b | 415.90 c | 291.30 c | 5.38 c |
| Biofertilizers (for N & P) Each at 30 g kg ⁻¹ seed | 190.90c | 328.40 d | 280.30 d | 3.16 d |
| LSD (p<0.05) | 2.206** | 33.02** | 4.405** | 0.2950** |

*Means not sharing a letter in common differ significantly at p< 0.05

applied in seed inoculation. Interaction effects of hybrids and inorganic/organic fertilizers on plant height were, however, non significant. Similar promotive effects of organic/inorganic fertilizers on plant height of maize hybrids have also been reported by Chandrashekhara *et al.* (2000), Afzal *et al.* (2005), and Jarwar *et al.* (2005).

Inorganic/organic fertilizers application in different maize hybrids significantly affected number of grains cob⁻¹. Inorganic fertilizer (NPK at 120:60:50 kg ha⁻¹) produced maximum number of grains cob⁻¹ (606.60) followed by application of poultry manure at 15 t ha⁻¹ (559.40), whereas bio-fertilizers resulted in lowest number of grains cob⁻¹ (328.40) as shown in table 1. Correspondingly FHY-434 produced higher number of grains cob⁻¹ (499.19) than FHY-421 (455.96). Interaction effects of hybrids and inorganic/organic fertilizers on number of grains cob⁻¹ were, however, non significant. These results are in accordance with those of Saleem (2000), Hossain *et al.* (2004) and Afzal *et al.* (2005), who stated that application of organic/inorganic fertilizers in maize hybrids, improved number of grains cob⁻¹.

Maize hybrids and inorganic/organic fertilizers application significantly influenced 1000-grain weight. The heaviest grains were recorded with the application of NPK at 120:60:50 kg ha⁻¹ (310.90 g), however, among organic sources poultry manure @ 15 t ha⁻¹ (306.00 g) proved as better source of nutrients as indicated in Table 1. Minimum 1000-grain weight (280.30 g) was recorded in plot sown with only seed inoculation. FHY-434 gave significantly higher 1000-grain weight (300.41g) as compared to the FHY-421 (293.79g). Interaction effects of hybrids and inorganic/organic fertilizers on 1000-grain weight were, however, non significant. These findings are supported

by Veloso *et al.* (2001) and Sharif *et al.* (2004), who reported that organic/inorganic fertilizers application in maize hybrids improved 1000-grain weight.

Maize hybrids and inorganic/organic fertilizers application significantly influenced grain yield. Maximum grain yield (8.44 t ha⁻¹) was recorded with the application of NPK at 120:60:50 kg ha⁻¹, however, among organic sources poultry manure @ 15 t ha⁻¹ (8.14 t ha⁻¹) proved as better source of nutrients. Minimum grain yield (3.16 t ha⁻¹) was recorded in plot sown with only seed inoculation. FHY-434 gave significantly higher grain yield (6.92 t ha⁻¹) as compared to the FHY-421 (5.64 t ha⁻¹). Interaction effects of hybrids and organic/inorganic fertilizer on grain yield were, however, non significant. These observations are in conformity to Tamayo *et al.* (1997), Safdar (2002), Sharif *et al.* (2004) and Charles and Shuxin (2005), who stated that organic/inorganic fertilizers application significantly influenced maize hybrids in terms of grain yield.

Maize hybrids and inorganic/organic fertilizers application significantly influenced net profit. Data showed (Table 2) that maximum net profit was obtained by application of inorganic fertilizer (NPK @ 120:60:50 kg ha⁻¹) to FHY-434 (Rs. 85803 ha⁻¹) followed by application of poultry manure @ 15 t ha⁻¹ to FHY-434 (Rs. 83764 ha⁻¹). Likewise, FHY-421 yielded net profit (Rs. 71729 ha⁻¹) by application of inorganic fertilizer (NPK @120:60:50 kg ha⁻¹) followed by application of poultry manure @ 15 t ha⁻¹ (Rs.68576 ha⁻¹). Minimum profit was calculated when bio-fertilizer @ 30 g kg⁻¹ seed was used in hybrid FHY-421 (Rs. 27450 ha⁻¹). These results corroborate with the findings of Chaudhry (2005), Chatter and Gasser (1970) and Saleem (2000), who reported that inorganic fertilizer use, returned maximum profit in different maize hybrids.

Table 2. Economic analysis of different sources of nutrients in corn production

| | T ₁ | T ₂ | T ₃ | T ₄ | T ₅ | T ₆ | T ₇ | T ₈ | Remarks |
|------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-----------------------------------|
| Grain yield | 7.750 | 9.140 | 7.410 | 8.910 | 4.720 | 6.030 | 2.720 | 3.60 | t ha ⁻¹ |
| Adjusted yield | 6.975 | 8.226 | 6.669 | 8.019 | 4.248 | 5.427 | 2.448 | 3.240 | Bring at farmers levels (10%less) |
| Gross income | 78469 | 92543 | 75026 | 90214 | 47790 | 61054 | 27540 | 36450 | Rs. 450 per 40 Kg |
| NPK fertilizer | 6740 | 6740 | 0 | 0 | 0 | 0 | 0 | 0 | Rs. ha ⁻¹ |
| Poultry manure | 0 | 0 | 6450 | 6450 | 0 | 0 | 0 | 0 | Rs. 430 t ⁻¹ |
| Farm yard manure | 0 | 0 | 0 | 0 | 4400 | 4400 | 0 | 0 | Rs. 220 t ⁻¹ |
| Seed inoculants | 0 | 0 | 0 | 0 | 0 | 0 | 90 | 90 | Rs. 15 packet ⁻¹ |
| Cost that vary | 6740 | 6740 | 6450 | 6450 | 4400 | 4400 | 90 | 90 | Rs. ha ⁻¹ |
| Net Profit | 71729 | 85803 | 68576 | 83764 | 43390 | 56654 | 27450 | 36360 | Rs. ha ⁻¹ |

T₁ = NPK @ 120:60:50 kg ha⁻¹ + FHY-421, T₂ = NPK @ 120:60:50 kg ha⁻¹ + FHY-434, T₃ = Poultry manure @ 15 t ha⁻¹ + FHY-421, T₄ = Poultry manure @ 15 t ha⁻¹ + FHY-434, T₅ = FYM @ 20 t ha⁻¹ + FHY-421, T₆ = FYM @ 20 t ha⁻¹ + FHY-434, T₇ = Bio fertilizer (*Rhizobium*) @ 8g per kg of seed + FHY-421, T₈ = Bio fertilizer (*Rhizobium*) @ 8g per kg of seed + FHY-434

From the above results, it can be concluded that maize hybrid FHY-434 surpassed FHY-421 in production potential and yielded maximum grains when inorganic fertilizer, i.e. NPK at 120:60:50 kg ha⁻¹ was applied and net profit of Rs. 85803 ha⁻¹ under given set of conditions. However, for sustainable production and long term benefits keeping in view WTO scenario application of poultry manure @ 15 t ha⁻¹ to FHY-434 with net profit Rs. 83764 ha⁻¹ is advocated for organic cultivation, as it produced grain yield 8.91 t ha⁻¹.

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