

EFFECT OF NITROGEN APPLICATION THROUGH DIFFERENT COMBINATIONS OF UREA AND FARM YARD MANURE ON THE PERFORMANCE OF SPRING MAIZE (*Zea mays* L.)

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ABSTRACT

Integrated use of mineral fertilizers and organic material is considered as a good and healthy approach for sustainable crop production. This hypothesis was tested on maize crop through field experiment, laid out in randomized complete block design with three replications, having six treatments with a net plot size 3.0 m x 6.0 m. The treatments were; control, 100% N through FYM, 25% N through urea and 75% N through FYM, 50% N through urea and 50% N through FYM, 75% N through urea and 25% N through FYM and 100% N through urea. The crop was sown on the ridges having rows 75 cm apart with plant to plant distance of 15 cm distance. The data on yield and crop growth parameters were recorded by using standard procedures and was statistically analyzed using Fisher's analysis of variance technique and least significant difference (LSD) test ($P < 0.05$) was employed to compare the treatment means. Application of 50% N from Urea + 50% from FYM produced longer cobs (18.57 cm), maximum cob weight (216.4 g), maximum 1000-grain weight (279.1 g), higher grain yield (5793 kg ha⁻¹) and maximum biological yield (14880 kg ha⁻¹). On the basis of these results, it can be concluded that 50% N through urea and 50% N through FYM should be used for spring maize in order to get maximum yield.

Key words: Maize, Farmyard manure, Urea, Growth, Yield.

INTRODUCTION

Maize is widely planted crop in most countries of the world and is the third most important grain crop after wheat and rice in Pakistan. It is grown twice a year (spring and autumn). It is not only a source of food, feed but also utilized as a major ingredient of animal feed and industrial product. Before the advent of chemical fertilizers, farmers mostly relied on organic matter as the sole source to promote health and productivity of the soil. Later on, the era of chemical fertilizers started and farmers left the use of organic matter because chemical fertilizers were an effective substitute as a ready source of nutrients. However, inorganic fertilizers increase the crop yield but on the other hand, their haphazard use is worsening the soil structure and causing contamination in ground water (Sagardoy, 1993).

The incorporated use of organic sources of nutrients not only supply essential nutrients but also has some positive interaction with chemical fertilizers to increase their efficiency and thereby to improve the soil structure (Elfstrand *et al.*, 2007). Integrated use of chemical fertilizers and organic material may be a good approach for sustainable production of crops. Integrated use of organic matter and chemical fertilizers is beneficial in improving crop yield, soil pH, organic carbon and available N, P and K in sandy loam soil (Rautaray *et al.*, 2003).

Dilshad *et al.* (2010) reported that the besides increasing the crop yield, IPNM saved the mineral fertilizer and enhanced agricultural production in the less fertile soils of rainfed Pothwar region of Pakistan. The use of organic matter is not a complete substitute to chemical fertilizer but infact; it is an added dimension to organic farming and can play a vital role in optimizing the best soil use, crop management and conservation. Organic sources ameliorate the micronutrient deficiencies. It has been suggested that humic acid present in organic matter increased the permeability of cell membrane, which resulted in increased uptake of water and nutrient elements (Cheng, 1997). Organic matters not only increase the water holding capacity of the soil but also the portion of water available for plant growth and improve physical properties of soil (Sial *et al.*, 2007)

During its application in spring than in autumn-winter (Dellin and Engstorm, 2010). Keeping in view above facts the present study was undertaken to determine the effect of integrated use of organic manure and nitrogenous fertilizer (urea) on growth and yield component of spring maize.

MATERIALS AND METHODS

The study pertaining to the combined effect of organic manure and fertilizer N on the growth and yield of maize hybrid Pioneer 32-W-86 was carried in spring

season at the Agronomic Research Area, University of Agriculture, Faisalabad. The chemical and physical analysis of soil was carried out before sowing using standard procedures (Table. 1). The experiment was laid out in randomized complete block design, with three replications, having a net plot size of 3.0 m x 6.0 m. The experiment comprised of the following treatments; T₁ = Control (No Fertilizer Applied), T₂ = 0 % N from urea + 100 % N from FYM, T₃ = 25 % N from urea + 75 % N from FYM, T₄ = 50% N from urea + 50% N from FYM, T₅ = 75 % N from urea + 25 % N from FYM and T₆ = 100 % N from urea + 0 % N from FYM. The chemical analysis of FYM was done before sowing (Table. 2)

The crop was sown on a well-prepared seedbed on 16th of February 2006, on 75 cm spaced ridges, using a seed rate of 30 kg ha⁻¹, maintaining plant-to-plant distance of 15 cm. Plant to plant distance was achieved through thinning the crop at 3 to 4 leaf stage 15 days after sowing. Recommended dose of NPK @ 250:125:125 kg ha⁻¹ was applied. Analysis of FYM was carried out to determine the percentage of NPK prior to the application. Whole calculated amount of N from FYM was applied at the time of sowing, while the remaining half dose of N in case of urea fertilizer was applied 40 days after sowing. Then the amount of P and K was calculated from the amount of farmyard manure applied and remaining dose of P and K was fulfilled by using sources as single super phosphate (SSP) and murate of potash (MOP). Full dose of phosphorous and potassium was applied at the time of sowing. All the other agronomic operations except those under study were kept normal and uniform for all the treatments. The crop was harvested on physiological maturity June 22, 2006. During the course of study, different parameters regarding yield components of maize were recorded and data was analyzed through analysis of variance technique using M-Stat-C and LSD test was applied to test the difference among the treatments (Steel *et al.*, 1997).

Table. 1. Chemical analysis of soil

<i>Determination</i>	<i>Unit</i>	<i>Value obtained</i>
Organic matter	%	0.63
Available P ₂ O ₅	ppm	6.875
Available K ₂ O	ppm	225
Total Nitrogen	%	0.03

Table. 2. Chemical analysis of FYM

<i>Determination</i>	<i>Unit</i>	<i>Value obtained</i>
Nitrogen	%	0.875
Phosphorous (P ₂ O ₅)	%	0.26
Potassium (K₂O)	%	0.5

RESULTS AND DISCUSSION

Plant height at harvest (cm): Growth behavior of the crop plant is reflected by the final height of the plants at maturity. Among the treatments, in which N source was 100% through urea produced the tallest plants (211.3 cm) but was statistically similar to the application of 50% N from urea + 50% N from FYM and 75 % N from urea + 25 % N from FYM (207.4 cm and 205.8 cm), respectively. The minimum plant height (188.2 cm) was recorded in T1 treatment, where no nitrogen was applied; it was however, statistically at par with T2 (Figure 1). It argues that integrated use of organic and chemical fertilizer plays greater role in the improvement of growth and development of plant. This may be due to, firstly the incorporation of organic manure in the soil which improved the physical properties of soil and secondly the application of chemical fertilizer which make it productive. These results are supported by those of Achieng, *et al.*, (2010), and Shah, *et al.*, (2009) who reported that plant height, number of grains per cob, 1000-grain weight, grain yield and harvest index of maize gave higher values, when N and FYM were integrated as compared to the alone application of the two sources of nutrients.

Cob length (cm): Cob length is one of the important factors to determine the yield of maize. As the length of cob will be more, there will be more number of grains per row and ultimately more grain yield per cob. Maximum cob length (18.57cm) was observed in treatment where N was applied 50% from urea + 50% from FYM and was statistically at par with treatments; 100 % N from urea + 0 % N from FYM and 75 % N from urea + 25 % N from FYM (17.73 cm and 17.60 cm respectively). Minimum cob length (14.13 cm) was recorded in control plot, where no fertilizer was applied (Figure 2). These results are in line with Chapagain (2010), who reported that application of farmyard manure along with 50% of the recommended urea fertilizer resulted in vigorous plant growth and increase in cob length, and grain yield of maize. The increase in cob length might be attributed to the availability of more nitrogen and other nutrients from both urea and organic manure required for plant development at least up to cob formation. These results suggested that adequate supply of nutrients from both organic and inorganic source throughout vegetative growth was necessary for proper cob development in maize.

Cob weight (g): Maximum cob weight (216.4 g) was recorded by the application of 50% N from urea + 50% N from FYM, which was statistically at par with the application of 75 % N from urea + 25 % N from FYM and 100 % N from urea + 0 % N from FYM in which cob weight was 210.6 g and 210.1 g respectively. The minimum cob weight was obtained in treatment where no

fertilizer was applied (189.9 g). It was statistically at par with the application of 0 % N from urea + 100 % N from FYM and 25 % N from urea + 75 % N from FYM (Figure 3). This might be due to the better nutrient uptake and development of the plant and cob due to the combined application of mineral fertilizer + organic material.

1000-Grain weight (g): Grain weight is an important yield component. Maximum 1000-grain weight (279.1 g) was obtained in the plot which was fertilized with 50% N from urea + 50% N from FYM followed by the application of 100 % N from urea + 0 % N from FYM (270.2 g), where only urea fertilizer was applied. While the minimum 1000-grain weight (242.4 g) was obtained where no nitrogen was applied (Figure 4). Results are corroborating with Gowda and Ibrahim, (2001) and Achieng *et al.*,(2010). The increase in 1000-grain weight in T₄ was mainly due to the balanced supply of food nutrients from both urea and FYM throughout the grain filling and development period.

Grain yield (kg ha⁻¹): Grain yield is a function of the integrated effect of the entire individual yield components. The combined application of N 50% from urea + 50% from FYM produced the maximum maize grain yield (5793 kg ha⁻¹) followed by the application of 75 % N from urea + 25 % N from FYM which produced the grain yield (5717 kg ha⁻¹). Whereas, control plots gave minimum yield (4417 kg ha⁻¹) (Figure 5). These results are similar to the findings of Gowda and Ibrahim, (2001) and Achieng *et al.*,(2010), who reported that combined use of organic and chemical fertilizer increased soil moisture, soil fertility, growth of maize, maize yield and promoted maize grain quality.

Biological yield (kg ha⁻¹): Maximum biological yield (14880 kg ha⁻¹) was obtained where N was applied 50% from urea + 50% from FYM followed by (13830 kg ha⁻¹) in which only urea fertilizer was applied. Application of 25 % N from urea + 75 % N from FYM and 100 % N from urea + 0 % N from FYM statistically gave the same results. The minimum biological yield (12210 kg ha⁻¹)

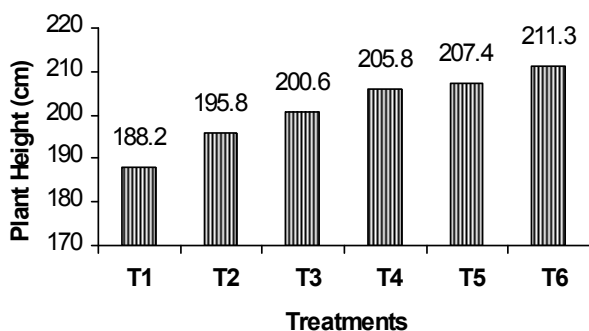


Figure 1. Plant height (cm) of maize as affected by different combinations of urea and farmyard manure

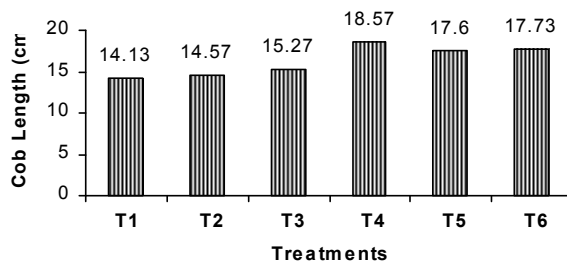


Figure 2. Cob Length (cm) of maize as affected by different combinations of urea and farmyard manure

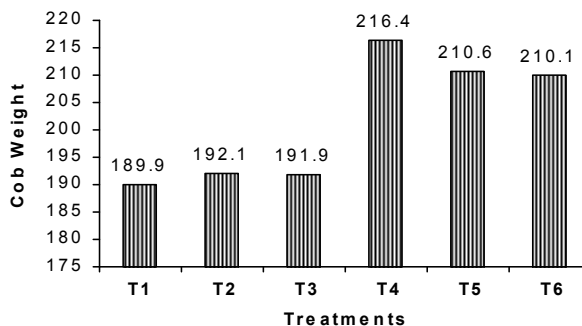


Figure 3. Cob weight (g) of maize as affected by different combinations of urea and farmyard manure.

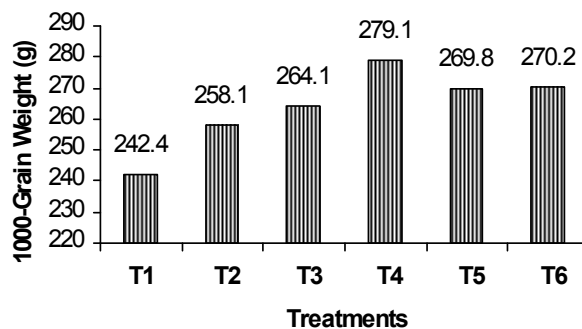


Figure 4. 1000 grain weight (g) of maize as affected by different combinations of urea and farmyard manure.

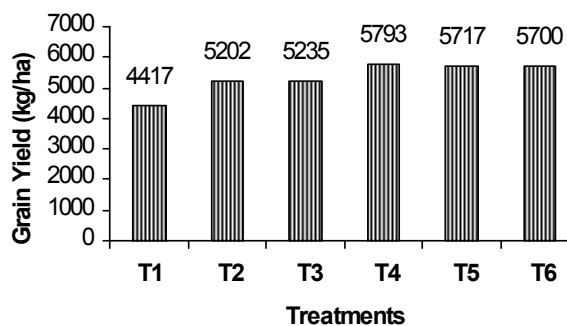


Figure 5. Grain yield (kg ha⁻¹) of maize as affected by different combinations of urea and farm yard manure

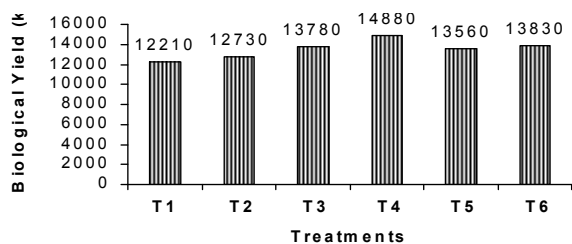


Figure 6. Biological yield (kg ha⁻¹) maize as affected by different combinations of urea and farm yard manure

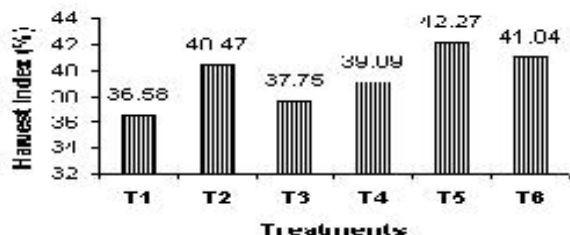


Figure 7. Harvest Index (%) of maize as affected by different combinations of urea and farm yard manure

was obtained in the plot which was control and no fertilizer was applied there (Figure 6). These results are in line with those of Achieng, *et al.*, (2010), and Shah, *et al.*, (2009) who reported increase in the grain weight, grain and straw yield because of combined application of organic and mineral fertilizers. The increase in biological yield of maize by fertilizing the plots with 50% from urea + 50% from FYM might be due to the proper and balanced supply of nutrients to the plants through out the growth period.

Harvest index (%): Crop yield is also measured in terms of harvest index. The data on economic and biological yield was used to calculate harvest index as per treatment. Significantly higher harvest index was found in plots, which were supplied with 75 % N from urea + 25 % N from FYM (42.27%). It was followed by the treatment in which 100 % N from urea + 0 % N from FYM were applied. Whereas the minimum harvest index was found in plots where nitrogen was not applied (Figure 7). These results suggest that adequate and balanced supply of nutrients assured by integration of manuring and mineral N application may have increased utilization of relatively large proportion of assimilates throughout its development process. These results are in line with the findings of Khaliq *et al.*, (2004) and Shah *et al.*, (2009) who observed that the harvest index in maize was positively affected by integration of organic and inorganic fertilizers.

Conclusion: This study suggested that the maize should be fertilized with N 50% from urea and 50% from FYM to get the maximum yield per hectare under agro-ecological conditions of Faisalabad.

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