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MANAGEMENT OF ORGANIC AND INORGANIC NITROGEN FOR DIFFERENT MAIZE VARIETIES

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ABSTRACT

Field trial to evaluate the response of different maize varieties to organic and inorganic nitrogen was conducted at Agricultural Research Farm, Agricultural University Peshawar during summer 2010. The experiment was consisted of eleven nitrogen treatments (Control, Nitrogen alone, FYM alone, Poultry manure alone, Green manure alone, 50% N (Urea) + 50% FYM, 50% N (Urea) + 50% PM, 50 % N (Urea) + 50% GM, 50% PM + 50% FYM, 50% PM + 50% GM and 50% GM + 50 % FYM) and two maize varieties (Azam and Jalal). Nitrogen treatments (N) were kept in the sub plots whereas varieties treatment (V) was allotted to the main plots. The experiment was carried out in randomized complete block design with split plot arrangement having four replications. The results revealed that varieties and nitrogen treatment significantly affected all parameters under study. Interactions between N x V were remained non significant for all parameters. Application of mineral N with organic manure in combination resulted in increased yield and yield components. Application of half Mineral N and half PM produced higher plant height, higher ear length, grain ear^{-1}, thousand grain weight, grain yield and biological yield of maize. Cultivars influenced yield and yield components of maize and higher maximum plant height, grains ear^{-1}, ear length, thousand grain weight, grain yield and biological yield was produced by Jalal variety. It was concluded that Organic and inorganic N application in combination Jalal cultivar resulted in higher yield and yield components of maize and hence recommend for higher productivity.

Key Words: **Maize, organic and inorganic nitrogen, Cultivars and yield**

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INTRODUCTION

Improving maize production is considered to be one of the most important strategies for food security of ever increasing population. However, chemical fertilizers and improved maize varieties, i.e., hybrids and open pollinated varieties (OPVs) whose traits have been improved for selected characteristics such as drought tolerance, disease resistance, short maturity rate, increased yield per unit of land, and quality protein (Byerlee, 1994), are not yet widely adopted in Pakistan. Cultivars are chosen on a number of characteristics including climatic (rainfall, elevation, temperature), genetic factors like maturity, grain quality and straw strength, head type (bearded, non-bearded), grazing and grain yield ability. No variety exhibits all the desirable attributes and choice depends on balancing the various risk factors (Freebairn, 2005). Likewise, cultivars contain enormous potential and are diverse in production because yield might be enhanced by the release of cultivars with improved traits (Khalil *et al.* 2002a). It is very important to identify maize verities that are able to produce high grain yield under low management cropping systems as practiced by small holder farmers. Research result has shown that various maize hybrids are significantly different in grain yield response to cultural practices. Crops yield improvements in past 50 years are due to breeding efforts or cultural Improvement of which N played a significant role (Duvick, 1992; Sinclair, 1995).

Soil fertility problem has been identified as a major factor hindering maize productivity in Pakistan. Majority of these soils are deficient in nitrogen, phosphorus and organic matter. Nitrogen is an integral component for many elements like chlorophyll and many enzymes necessary for plant physiological processes. Its amount in soil also effects the utilization of potassium, phosphorus and other mineral nutrients in plant. The optimum amount of these nutrients in soil cannot be utilized if N deficiency exists (Brady, 1984). Nitrogen fertilization plays a significant role in improving soil fertility and increasing crop productivity (Habtegebrial *et al*. 2007). N fertilization results in increased grain yield (43-68%) and biomass (25-42%) in maize (Ogola *et al.* 2002).

. There is also a positive interaction between the organic manures and urea as nitrogen source (Yang *at al.*2007) Studies have shown the superior effect of integrated nutrient supply over sole use of inorganic or organic source in terms of balanced nutrient supply, improved soil fertility and crop yield (Khan *et al.* 2008).Synergistic effects of N with organic fertilizers (residue or FYM) accumulate more soil total N (Huang *et al.* 2007, Zada *et al.* 2000), but sole effects of FYM result in increased yield of maize (Anatoliy and Thelen, 2007), more organic matter (44%) in soil, improved porosity (25%) and water holding capacity 16 times (Gangwar *et al.* 2006). Agricultural scientists are engaged to establish agricultural systems with lower production cost and conserving the natural resources. Therefore, recent interest in the manuring has re-emerged because of high fertilizer prices and importance of green manure, farm yard manure and poultry manure in maintaining long term soil productivity besides meeting timely requirement of nutrient

The present study was therefore conducted to evaluate yield and other agronomic parameters of maize cultivars under different organic and inorganic fertilization.

MATERIALS AND METHODS

To determine the effect of inorganic N and organic manure on different maize varities an experiment was carried out at New Ddevelopmental Farm of Agricultural University, Peshawar, Pakistan during 2009. The soil used in this experiment was silty clay loam and was deficient in available nitrogen. Soil organic matter contact was less than 1%. The experiment treatments were made of two maize varities (Azam and Jalal) and eleven fertilizer treatments combinations i.e. Control, Nitrogen alone, FYM alone, Poultry manure alone, Green manure alone, Urea + 50% FYM, 50% N (Urea) + 50% PM, 50 % N (Urea) + 50% GM, 50% FYM + 50% PM, 50% GM + 50% PM and 50% GM + 50 % FYM. The experiment was laid out in randomized complete block design with split plot arrangement having four replications. Maize cultivars "Azam" and Jalal were main plot on 18th June, 2009 with row to row and plant to plant distance of 75 and 25 cm, respectively. All organic manures were applied one month before sowing. Urea was used as a source of Mineral N while FYM, PM and GM was used as organic manure. The field was irrigated as and when needed. All other agronomic practices were kept constant for all the experimental units. Data were recorded on era length, grains ear^{-1}, rows ear^{-1}, grains row^{-1}, thousand grain weight and grain yield.

Ears from randomly selected five plants were removed and their length was measured in cm and then was averaged. Row in each ear was counted and then averaged to calculate rows ear^{-1}. Grains row^{-1} was counted in five ears and was averaged to get grains per row data. Grains from ten randomly selected ears of each treatment was shelled, counted and converted into average number of grains ear^{-1}. Thousand grains were counted at random from each sub plot of each treatment and weighed at 12% moisture content. The grain yield was determined by harvesting five central rows in each subplot. The ears from harvested plants were detached and then was threshed, weighed and was converted to kg ha^{-1}.Chemical analysis of FYM, PM and soil of the experimental site is given in (Table I).

Table I ***Plant height, Ear length and grains ear^{-1} of two maize varities as affected by organic and inorganic nitrogen and their various combinations.***

Maize Varities	**Plant height (cm)**	**Ear length (cm)**	**Grains ear^{-1}**
Azam	139 b	11 b	266 b
Jalal	146 a	13 a	283 a
Nitrogen Management			
Control	129 f	9 d	160 h
Nitrogen Alone (Urea)	156 a	14 a	351 b
FYM Alone	138 de	12 b	249 ef
Poultry Manure Alone	147 bc	11 bc	241 f
Green Manure alone	136 e	11 bc	222 g
50% N + 50 % FYM	147 bc	15 a	277 d
50% N + 50 % PM	151 ab	15 a	368 a
50% N + 50 % GM	147 bc	12 b	324 c
50% PM + 50 % GM	139 de	10 cd	259 e
50% PM + 50 % FYM	143 cd	11 bc	276 d
50% FYM + 50 % GM	137 e	11 bc	288 d
LSD	**5.403**	**1.486**	**16.47**
Interaction			
N x V	Ns	Ns	**Ns**

Means followed by the same letters with in columns are not different statistically.

Data collected were analyzed statistically according to the procedure relevant to RCB design. Upon significant F-Test, least significance difference (LSD) test was used for mean comparison to identify the significant components of the treatment means (Jan et al,).

RESULTS AND DISCUSSION

Plant Height

Data regarding plant height is presented in (Table I).Treatment mean comparison revealed that plant height was significantly affected by corn varieties and N management techniques. Maize variety Jalal resulted in tallest plant (146 cm) followed by Azam variety (139 cm).Tallest plants were recorded in plots which was fertilized with sole mineral N which was at par with the application of 50 % N + 50% PM followed by sole application of PM and 50 % N+ 50% GM. Smaller plants were produced by control plots. The increase in plant height in case of half PM and mineral N each was mainly due the availability of more N both from urea as well as PM through out the growing season. These results are confirmed by the finding of Mitchell and Tu (2005) and Warren et al., (2006).

Grains Ear^{-1}

There was a significant effect (p 0.05) of varieties, organic and inorganic nitrogen and their various combinations on grain ear^{-1} of maize (Table I). The interaction between varieties and various fertilizer treatments was found not significant. More grain ear^{-1} (283) was produced by Jalal varity as compare to Azam variety (266) grain ear^{-1}. These results are in line with finding of Shah and Arif (2000) who reported that grain ear^{-1} are more affected by genetic make up rather then management practices. Higher grains ear^{-1} (368) was recoded in plots where PM and Mineral N was used in combination followed by sole mineral N application. Control plots resulted in fewer grain ear^{-1} (160). The highest grain yield obtained in PM and FYM amended with N plots could also be attributed to improved uptake of N by maize through enhancing the organic matter decomposition-mineralization process, or indirectly maize root development. Our results confirm the finding of Bocchi and Tano (1994), Sharma *et al.,* (1998) who reported that soil physio-chemical properties can be improved and corn yield can be increased by the application of different organic matter.

Ear Length

Statistical analysis of the data revealed that both cultivars and fertilizer treatments had significantly affected ear length (Table I). Not significant interaction exists between varieties and N treatment. Taller ears were recorded in plots where Urea and PM was used in integration (Half Urea + Half PM) which was statistically similar to sole urea application and half FYM + half urea application followed by 100% FYM, however it was similar with plots where 50% GM + 50% Urea was used. Control plots resulted in shorter ears. Organic and inorganic N combination resulted in long ears mainly due to least N loses and availability of nutrients through out the growing season of the crop. These results are in line with Zhang *et al.* (1998) who reported that combined allocation of manure and mineral fertilizer to maize crop can be as effective as commercial N fertilizer for yield response. Similarly in varieties, longer ears were obtained from Jalal variety while Azam variety resulted in shorter ears. It could partly due the reason that Jalal Cv was more responsive to fertilizer as compared to Azam variety and partly due to more efficient utilization of water received from irrigation and rain fall.

Thousand grain weight.

Thousand grain weight was significantly affected by varieties and various organic and inorganic N-treatments (Table I). Interaction between V and N was not significant. Jalal Varity produced heavier grains while Azam resulted in lighter grains. Higher grain weight (269) was obtained from plots where PM and urea was applied in combination (50% PM + 50% U) which was at par with sole N application followed by the application of urea and FYM in integration .Control plots resulted in lighter grain weight (244 g). The lower N level in the soil results in lower yield due to less available N for the optimum plant growth (Khan et al., 2008).The incorporation of organic manure in the soil have thought to reduce the evaporation demand, thus have adequate water for plant root growth, or perhaps due to the softness of soil caused by manure in which the roots may expand rapidly enough into wet soil to meet plant water requirements (Negassa *et al.,* 2001).Our results are also confirmed by the findings of Beyaert *et al.,* (2002) and Delate *et al.,* (2008).

Grain Yield

Grain yield is a function among various yield components that were affected significantly by various N managements and varieties. Data regarding grain yield (kg ha^{-1}) are presented in (Table II). Interaction between N and V was not significant. Higher grain yield (4799.1 kg $ha^{-1)}$ was produced from the plots which received 50% Urea + 50% PM followed by FYM and urea in combination which was at par with sole N application. Lower grain yield (2445 kg ha^{-1}) was recorded in control plots. Similarly Jalal variety resulted in maximum grain yield as compare to Azam variety. These results are in accordance with Beyaert *et al.,* (2002) who suggested that timely availability of N could be insured and corn productivity can be positively increased by combined use of mineral N and Organic manures .These results are in line with Boateng *et al.,* (2006), Deksissa *et al.,* (2008) and Negassa *et al.,* (2001) who found that corn yield was 35% increased by integrated N management.

Biological Yield (kg ha^{-1})

Data concerning to biological yield are reported in (Table II). Statistical analysis of the data revealed that biological yield was significantly affected by nitrogen and verities while Interaction between nitrogen and verities was not significant. Maximum biological yield was produced in plots where N was applied in combination with PM (50 % N +50 % PM) which was at par with sole N application whereas minimum biological yield (9732 kg ha^{-1}) was recorded in control plots. Verities affected biological yield and thus higher biological yield (11951 kg ha^{-1}) was obtained from Jalal Varity as compared to Azam Varity (11030 kg ha^{-1}). . Similar results were reported by Benjamin *et al.* (1978) who noted that integrated N management had significant effect on the total production of maize biomass and increase maize yield 32% as compare to control. These results are in line with Royo *et al.* (1999) who reported Maize Stover yield can be increased by improving fertilizer use efficiency and cultural practices.

Table II Thousand *grain weight, Grain yield and biological yield of two maize varieties as affected by organic and inorganic nitrogen and their various combinations*

Maize Varities	**Thousand Grain weight**	**Grain yield**	**Biological Yield**
Azam	253 a	3453 b	11951 a
Jalal	241 b	3872 a	11030 b
Nitrogen Management			
Control	244 d	2445 g	9732 d
Nitrogen Alone (Urea)	262 b	4301 b	13644 a
FYM Alone	234 ef	3703 c	10266 cd
Poultry Manure Alone	237 e	3591 cd	11193 bc
Green Manure alone	2303 f	3373 e	10498 bc
50% N + 50 % FYM	246 cd	4341 b	13053 a
50% N + 50 % PM	269 a	4799 a	13645 a
50% N + 50 % GM	244 d	3608 cd	11003 bc
50% PM + 50 % GM	247 cd	3199 f	11017 bc
50% PM + 50 % FYM	251 c	3513 de	10886bc
50% FYM + 50 % GM	252 c	3413 e	11455 b
LSD	6.56	169.7	**1007.01**
Interaction			
N x V	Ns	ns	**ns**

Mean followed by the same letters within columns are not different statistically.

CONCLUSION AND RECOMMENDATIONS

From the results of the present study it is concluded that the integrated use of mineral nitrogen with poultry manure is an alternative to sole application of chemical fertilizer. Similarly Jalal variety may be used for better yield as compared to Azam variety.

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