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EFFECT OF POULTRY MANURE LEVELS ON THE PRODUCTIVITY OF SPRING MAIZE (*Zea mays* L.).

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ABSTRACT

Poultry manure has long been recognized the most desirable organic fertilizer. It improves soil fertility by adding both major and essential nutrients as well as soil organic matter which improve moisture and nutrient retention. The present paper investigates the effectiveness of different levels of applied poultry manure (PM) on the growth and yield of spring maize (*Zea mays* L). Research was carried out at the Agronomic Research Area, University of Agriculture, Faisalabad during spring season 2007. The experiment consisted of six treatments: control, 4 t ha^{-1} PM, 6 t ha^{-1} PM, 8 t ha^{-1} PM, 10 t ha^{-1} PM and 12 t ha^{-1} PM. Experiment was laid out in randomized complete block design with three replications. Number of cobs per plant was affected non significantly by the application of different levels of PM. While all others recorded parameters including plant height, number of rows per cob, number of grains per row, 1000-grain weight, grain yield, biological yield and harvest index were significantly affected by application of PM. Maximum values for all these parameters were recorded with the application of 12 t ha^{-1} PM.

Key words: Maize (*Zea mays* L.); poultry manure, growth, yield.

INTRODUCTION

Maize is an important cereal crop that provides staple food to large number of human population in world. In developing countries maize is a major source of income to many farmers (Tagne *et al.*, 2008). Maize is relatively a short duration crop and capable of utilizing inputs more efficiently and is potentially capable of producing large quantity of food grains per unit area. It can successfully be cultivated twice a year as spring and autumn crop. Maize has greater nutritional value as it contains about 72% starch, 10% proteins, 4.8% oil, 8.5% fiber, 3% sugar and 1.7% ash (Chaudhary, 1993).

In Pakistan, maize occupies third position after wheat and rice and 98% of the crop is grown in Punjab and NWFP Pakistan grows maize on about 1.11 million hectares with annual production of 4.04 million tones of grain and average yield of 3.62 tones ha^{-1} (Govt. of Pakistan, 2009). In Pakistan the potential of crop is not being exploited satisfactorily due to many constraints. Among those, inappropriate nutrients supply is important (Oad *et al*, 2004). The soils of Pakistan are generally low in organic matter, firstly because of arid climate resulting in a rapid decomposition of organic matter and secondly because very little organic matter is added to the soil.

In spite of substantial fertilizer use in Pakistan, the crop yields are not increasing correspondingly, which reflect low fertilizer use efficiency (FUE). Poultry manure is an excellent organic fertilizer, as it contains high nitrogen, phosphorus, potassium and other essential nutrients. In contrast to chemical fertilizer, it adds organic matter to soil which improves soil structures, nutrient retention, aeration, soil moisture holding capacity and water infiltration (Deksissa *et al*., 2008). It was also indicated that poultry manure more readily supplies P to plants than other organic manure sources (Garg and Bahla, 2008).

Organic fertilizers including farmyard manure, sheep manure and PM may be used for the crop production as a substitute of the chemical fertilizers because the importance of the organic manures cannot be overlooked. Worldwide, there is growing interest in the use of organic manures due to depletion in the soil fertility. Economic premiums for certified organic grains have been driving many transition decisions related to the organic farming (Delate and Camberdella, 2004). Continuous use of fertilizers creates potential polluting effect in the environment (Oad *et al*, 2004). Synthesis of chemical fertilizers consumes a large amount of energy and money. However, an organic farming with or without chemical fertilizers seems to be possible solution for these situations (Prabu *et al.*, 2003). The integration of organic sources and synthetic sources of nutrients not only supply essential nutrients but also have some positive interaction with chemical fertilizers to increase their efficiency and thereby reduce environmental hazards (Ahmad *et al.*, 1996).

Organic farming in agriculture preserves ecosystem. It does not involve use of harmful chemicals and fertilizers rather symbiotic life forms are cultured, ensuring weed and pest control and optimal soil biological activity, which maintain fertility. There is also a positive interaction between the combination of organic manures and urea nitrogen (Bocchi and Tano, 1994).

Poultry manure is a valuable fertilizer and can serve as a suitable alternate to chemical fertilizer. Poultry manure application registered over 53% increases of N level in the soil, from 0.09% to 0.14 % and exchangeable cations increase with manure application (Boateng *et al*., 2006). In agriculture, the main reasons for applying PM include the organic amendment of the soil and the provision of nutrients to crops (Warren *et al*., 2006).

Keeping in view the above facts, the present study was therefore, designed to evaluate the impact of different levels of poultry manures on the growth and yield of spring maize under Faisalabad conditions.

MATERIALS AND METHODS

The experiment was conducted at the Agronomic Research Area, University of Agriculture, Faisalabad, Pakistan. After deep ploughing field was cultivated two times each followed by planking. Experimental treatments comprised of six poultry manure levels viz. zero (T_1), four (T_2), six (T_3), eight (T_4), ten (T_5) and twelve (T_6) tones ha^{-1}. Experiment was laid out in randomized complete block design with three replications. Net plot size was 3 x 6 m. Dried poultry manure was applied to the respective plots and incorporated into the soil before sowing. Chemical analysis of poultry manure was carried out before its application.

Maize single cross hybrid (32-w-86) was sown on 26th of February in 2007. Sowing was done by dibbling method (by placing 2 seeds manually per hill at 20 cm apart hills) on 75 cm apart ridges. After germination of seeds, one plant per hill was maintained in order to achieve proper plant population. Manual weed control was practised to keep the field weed free. A total of eight irrigations were applied to the crop. First irrigation was applied twenty five days after sowing while subsequent irrigations were applied as and when required by the crop. Before poultry manure application and sowing of crop, soil samples were obtained from five different locations of the field, having equal sections, with the help of an auger at two depths i.e. 0-6 inches and 7-12 inches for the purpose of standard soil fertility analysis. These ten cores from five different locations were mixed together to form a composite soil sample. Then it was packed in a polyethylene bag, labelled and transferred to the laboratory for its physical and chemical analysis.

Chemical analysis of experimental soil and poultry manure (PM)

	Nitrogen	Phosphorus	Potassium
Soil	0.03%	6.9ppm	225.0ppm
PM	2.04%	2.06%	1.86%

Standard procedures were followed to collect the data for growth and yield parameters. Ten plants from each plot were selected at random and their height was measured with the help of measuring tape and average was calculated from those ten measured values. Total number of cobs from each plot was divided by total number of plants to get number of cobs per plant. From each plot, ten cobs were selected, number of grain rows and number of grains per row were counted and averaged. From each plot, ten samples, each of 1000 grains, were randomly collected and their weight was recorded. After shelling, total grain weight of grains of each plot was recorded with a portable balance and grain yield on tones per hectare basis was calculated. Crop was harvested and dried for ten days. After drying, overall biomass of each plot was obtained with the help of a weighing balance and then converted to tones per hectare. Harvest index (HI) of each plot was calculated by using the formula given by Hunt (1978)

HI = Economic yield/ Biological yield x 100

The data collected were analyzed statistically by using Fisher's analysis of variance technique and LSD at 5% probability was used to compare the differences among treatments' means (Steel *et al*., 1997).

RESULTS AND DISCUSSION

Data presented in table 1 show that plant height was significantly affected by different levels of poultry manure (PM). The comparison of treatments' means reveals that maximum plant height (230 cm) was recorded from plots where 12 t ha^{-1} PM was applied (T_6) followed by T_5 (10 t ha^{-1}) which was statistically at par with T_6. Application of 4, 6 and 8 t ha^{-1} PM did not differ significantly from each other with respect to plant height of maize while control (no PM) gave minimum plant height. The increase in plant height with PM was mainly due to the reason of more availability of nutrients by PM throughout the growing season. These results are in accordance with the findings of Mitchell and Tu (2005) and Warren *et al*. (2006).

The results presented in table 1 revealed that number of cobs per plant was not significantly affected by the application PM. This may be attributed to the reason that cob bearing potential of a variety controlled by its genetic make up rather than the agronomic practices. Non-significant effects of NP application on number of cobs per plant have also been reported by Maqsood *et al.,* (2001).

Number of grain rows per cob is an important yield determining factor in maize. It affects the number of grains per cob and cob weight. The data recorded (table 1) reveal that different levels of PM had significant effect on number of grain rows per cob. Significantly maximum number of rows per cob (16.0) was recorded in treatment T_6 where 12 t ha^{-1} PM was applied, and was followed by

T_5 and T_4 each of which produced 12 rows per cob. The lowest number of rows per cob (8.0) was recorded in case of T_1 (control) where no PM was applied. It was statistically at par with T_2 and T_3 treatments. The increase in number of grain rows per cob in case of 12 t ha^{-1} PM was mainly due to the reason of more availability of nutrients from PM throughout the growing season. These results are similar to the findings of Zhang *et al.* (1998) who reported that precise application of manure and mineral fertilizer to maize crop can be as effective as commercial N fertilizer for yield response.

Number of grains per row is also an important parameter contributing towards the final yield. Data presented in table 1 show that number of grains per row was significantly affected by different levels of PM. The comparison of treatments' means reveal that maximum number of grains per row (29.1) was recorded from plot fertilized with 12 t ha^{-1} PM (T_6) which was statistically equal to that of T_5 (10 t ha^{-1} PM) and T_4 (8 t ha^{-1} PM) followed by T_3 (6 t ha^{-1} PM) which was at par with that of T_2 (4 t ha^{-1} PM). The minimum number of grains per row (18.1) was recorded from plot where no manure was applied (T_1). The increase in number of grains per row may be attributed to the availability of more nitrogen and other nutrients from PM required for plant development up to cob formation.

Data presented in table 1 show that 1000-grain weight was affected significantly by different levels of poultry manure. Maximum 1000- grain weight (254 g) was recorded from plots where PM was applied @ 12 t ha^{-1} (T_6) followed by T_5 (241g). The minimum 1000-grain weight (173 g) was noted in control (T_1) which was however, statistically at par with that of T_2 treatment (179 g). These results are in accordance with the findings of Ma *et al.* (1999) and Garg and Bahla, (2008). The increase in 1000- grain weight with increased level of PM could be due to balanced supply of food nutrients from poultry manure throughout development of plant.

Biological yield was significantly affected by different levels of poultry manure. A perusal of table 1 shows that maximum biological yield (22.2 t ha^{-1}) was obtained in T_6 where 12 t ha^{-1} PM was applied which was statistically equal to that of T_5 (10 t ha^{-1} PM) and T_4 (8 t ha^{-1} PM) treatments giving biological yields of 21.2 t ha^{-1} and 20.3 t ha^{-1}, respectively. The lowest biological yield in T_1 (13.4 t ha^{-1}) was recorded from plot where no PM was applied (control) which was statistically at par with that of T_2 treatment. These results are in line with those of Deksissa *et al*. (2008).

Grain yield is a function of interaction among various yield components that were affected differentially by the growing conditions and crop management practices. It is clear from the table 1 that grain yield was significantly affected by the application of different levels of PM. All the means of data presented clearly show that significantly highest grain yield (5.11 t ha^{-1}) was recorded from T_6 where 12 t ha^{-1} poultry manure was applied, followed by T_5 (10 t ha^{-1} PM) which was statistically equal to that T_4 (8 t ha^{-1} PM), the grain yield produced by these plots were 4.16 t ha^{-1} and 3.60 t ha^{-1}, respectively. Similarly statistically same grain yield was recorded in case of plots of T_2 (6 t ha^{-1} poultry manure) and T_1 (control) treatment. These results are in accordance with the findings of Boateng *et al*. (2006) that poultry manure significantly increased the grain yield.

The physiological efficiency of maize to partition the dry matter into its economic (grain) yield is referred by harvest index. Higher the harvest index, greater was the grain yield. Application of different levels of poultry manure had significant effect on harvest index as shown in table 1. The comparison of treatments' means shows that the maximum harvest index (23.1%) was recorded from maize crop manured @ 12 t ha^{-1} PM which was at par with T_5 (10 t ha^{-1} PM). The lowest harvest index (13.60%) was recorded in plot where no manure was applied (control), it was however statistically at par with that of T_2, T_3 and T_4 treatments.

Table 1: Effect of poultry manure levels on growth, yield and yield components of maize.

Treatments	Plant height (cm)	No. of cobs per plant	No. of rows per cob	No. of grains per row	1000 - grain wt. (g)	Grain yield (t ha^{-1})	Biological yield (t ha^{-1})	HI (%)
T_1 = Control	172 d	1.00	8.0 c	18.1 c	173 d	1.79 d	13.4 d	13.6 c
T_2 = 4 t ha^{-1} PM	200 c	1.00	10.0 bc	21.6 b	179 d	2.33 d	15.6 cd	15.2 bc
T_3 = 6 t ha^{-1} PM	208 bc	1.00	10.7 bc	23.1 b	201 c	2.95 c	17.9 bc	16.5 bc
T_4 = 8 t ha^{-1} PM	212 bc	1.00	12.0 b	27.6 a	205 c	3.60 b	20.3 ab	17.8 bc
T_5 = 10 t ha^{-1} PM	217 ab	1.00	12.0 b	28.4 a	241 b	4.16 b	21.2 a	19.6 ab
T_6 = 12 t ha^{-1} PM	230 a	1.11	16.0 a	29.1 a	254 a	5.11 a	22.2 a	23.1 a
LSD (5%)	16.4	NS	3.23	3.25	5.3	0.572	3.15	4.78
E MS	81.4	-	3.15	3.20	8.71	0.09	2.99	6.90

Means not sharing the same letters in a column differ significantly at 5% probability.
PM= Poultry manure: NS= Non Significant: EMS= Error mean square

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