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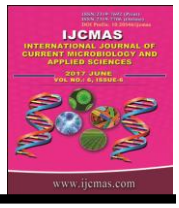

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Effect of Organic Inorganic Bio Fertilizer and Seed Inoculation on Soil Properties, Growth and Yield of Maize (*Zea mays* L.) Var. Hybrid MM-2255

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A B S T R A C T

A field experiment was conducted during kharif season 2016-17 to study the "Effect of organic, inorganic, bio-fertilizer and seed inoculation on soil properties, growth and yield of maize (*Zea may* L.) Var. hybrid MM-2255" on Crop Research Farm Department of Soil Science and Agricultural Chemistry, Naini Agricultural Institute, Allahabad. The design applied for statistical analysis was carried out with 3x2x2 factorial randomized block design having three factors with three levels of nitrogen 50, 75, and 100 % ha^{-1}, two level of FYM and *Azotobacter* 0, 100% respectively. The best treatment was T11 –N2F1 A1 (@ 100% nitrogen ha^{-1}+100% FYM and *Azotobacter*) that showed the significant increase on enrichment of soil fertility status. Nitrogen, FYM and *Azotobacter* in combination resulted in a slight Increase in pH 7.50, EC 0.36 dSm^{-1}. In post soil combination of nitrogen, FYM and *Azotobacter* fertilizers observations were resulted in significant increase in organic carbon 0.73%, particle density 2.85g/cc, bulk density 1.30g/cc, porespace55.91%, water holding capacity 51.32% and available N 330.5 kg ha^{-1}, available P 32.76 kg ha^{-1}, available K 212.88 kg ha^{-1}. Significant increase in case of nitrogen (kg ha^{-1}), FYM (kg ha^{-1}) *Azotobacter* (kg ha^{-1}) in treatment combination T11 –N2 F1 A1 (@ 100% nitrogen ha^{-1}+ 100% FYM ha^{-1} and 100% *Azotobacter*). The maximum cost benefit ratio was recorded 1:2.73 and maximum net return (Rs. 63689.3) ha^{-1} and maximum yield (45.58 q ha^{-1}) in treatment combination T11 –N2 F1 A1 (@ 100% nitrogen ha^{-1}+ 100% FYM ha^{-1} and 100 % *Azotobacter*).

Introduction

Maize is one of the important cereal crops in the world agricultural economy both as food grains for human and fodder and feed for cattle and poultry. Maize grain contains about 72% starch, 10% protein, 4.8% oil, 5.8% fiber, 3.0% sugar and 1.7% ash (Choudhary, 1993). Along with this, it is rich in vitamin A, vitamin E, nicotinic acid, riboflavin and contains fairly high phosphorus than rice and sorghum. Its fodder and hay contains 7-10% protein, 15-36% fiber, 2.09 to 2.62% ether extract, 0.42-0.70% calcium, 0.28-0.29% phosphorus, 0.45% magnesium, 1.34% potassium and 56% carbohydrate. Therefore, it has very nutritive fodder and hay. Besides food grain, fodder and feed, it has prime importance in textile, starch and dye industries.

In India, area and production is 9.2 million per hectare and 24.17 million tones with productivity 2.56 tons per hectare (DMR,

Annual report 2014-15). In Uttar Pradesh, the area and production is 0.71 million per hectare and 1275 million tones with productivity of 1791 kg ha^{-1}. (Department of Agriculture, Govt. of UP 2014-15).

Integrated nitrogen management on yield and uptake of nutrients by maize

The treatments includes supply of nitrogen through inorganic with distillery yeast sludge (DYS), farm yard manure (FYM) and press mud (PM) which contain 1.45% 0.58% and 1.12% of nitrogen, respectively. Calculated quantity of nitrogen was applied to all eleven treatments with P and K as common application. The highest N (285 kg ha^{-1}) uptake was recorded in the treatment receiving 100% recommended dose of nitrogen (RDN) through fertilizer. Significantly higher available nitrogen (286 kg ha^{-1}) was recorded in the treatment with 100% RDN through DYS at the harvest of crop. Significantly higher available P (35.7 kg ha^{-1}) was recorded in the treatment receiving 100% RDN through FYM, whereas K availability did not show marked differences among the treatments at harvest. The high uptake values resulted in high maize yield (Hebsur *et al.,* 2009).

Effect of organic and inorganic sources of nutrient alone and in combination on growth, quality and yield of fodder maize

Application of recommended dose of fertilizer coupled with farm yard manure has recorded highest green and dry matter yield of maize. Substitution of N through FYM to the extent of 25 percent (and remaining 75 percent through urea+50 kg P+50 kg K) was recorded the best treatment amongest different combination of N through FYM and urea (73.3 q ha^{-1} of dry matter and 278.7 qha^{-1} green fodder yield). Similarly the quality parameters like dry matter content, crude fat, crude protein, nitrogen free extract etc. shows significant difference with the sources of N through FYM and urea (Bhagade *et al.,* 2008).

Effect of nitrogen with and without *Azotobacter* inoculation on yield and nutrient uptake by maize crop

Grain yield increased with increasing levels of nitrogen and maximum grain yield of 4.3 mg ha^{-1} was obtained by use of 150 kg N ha^{-1} with FYM @ 5t ha^{-1} and *Azotobacter* inoculation. Significant uptake of nitrogen, phosphorus and potassium was recorded under application of 150 N kg ha^{-1} over the control. Protein content in maize grain increased significantly by conjoint use of organic manure and biofertilizers with each level of nitrogen application, over application of each nitrogen level alone (Meena *et al.,* 2013).

Materials and Methods

A field Experiment was conducted on research farm of Department of Soil Science and Agricultural Chemistry, Sam Higginbottom University of Agriculture, Technology and Sciences Allahabad, U.P. The soil of experimental area falls in order Inceptisol and the experimental field is alluvial in nature. The design applied for statistical analysis was carried out with 3x2x2 factorial randomized block design having three factors with three levels of N P K @ 50, 75, and 100 percent ha^{-1}, two levels of FYM and *Azotobacter* 0 and 100% ha^{-1} respectively. The source of nitrogen, phosphorus, potassium, FYM, *Azotobacter* as Urea, SSP, MOP, FYM and *Azotobacter* respectively. Basal dose of fertilizer was applied in respective plots according to treatment allocation unifurrows opened by about 5cm. depth before sowing seeds in soil at the same time sowing of seeds was sown on

well prepared beds in shallow furrows, at the depth of 5cm, row to row distance was maintained at 50cm and plant to plant distance was 20 cm, During the course of experiment, observations were recorded as mean values of the data.

Physical and chemical analysis

Physical analysis pre observations result was done by Bouyoucous hydrometer method. Thetexture sand, silt and clay (%) was recorded 60, 26, 14 respectively. Bulk density 1.33 g/cc, particle density 2.45 g/cc, percentage pore space 49.33% and water holding capacity 43.50% was determined by cylinder method. Black (1965), chemical analysis pre observations result of soil viz, pH 7.39, EC 0.19 (dS m^{-1}), organic carbon 0.54 %, available nitrogen 290.26 (kg ha^{-1}), available phosphorous 25.05 (kg ha^{-1}) and available potassium 157.62 (kg ha^{-1}) of soil was determined using pH and EC (dS m^{-1}) by Jackson (1958) and Walkley and Black (1934) method; alkaline permanganate method (Subbiah and Ashija, 1956) Olsen`s colorimetric method (Olsen *et al.*, 1954) and flame photometric method (Blancher, 1986).

Results and Discussion

Physical properties

The results given in table 1 indicate some of the important on physical properties on maize crop (Fig. 1). The interactive effects of nitrogen generally influenced the important in physical properties on maize crop. The effect of nitrogen fertilizer on pore space and bulk density, particle density, water retaining capacity was significant. The maximum particle density (g/cc), bulk density (g/cc), pore space (%), water retaining capacity (%) of after crop harvest soil was recorded 2.66, 1.27, 50.59, 53.56 (@ nitrogen 120 kg ha^{-1}) respectively, with FYMF1 (FYM@ 10t ha^{-1}) 2.58, 1.24, 53.65 was found to be significant and increasing level of farm yard manure and pore space 50.37 was found non- significant. *Azotobacter* A1 (@ 200 gm/10kg seed) 49.70, 2.58, 52.91 was found significant and bulk density (%) 1.26 was found significant. Similar findings were reported by Brar *et al.*, (2015).

Chemical properties of post soil

During the course of study, it was observed that the highest pH (dS m^{-1}) was recorded is 7.50, treatment T11 (N2F1 A1@ 120 nitrogen kg ha^{-1} + FYM@ 10t ha^{-1} + *Azotobacter* @ 200 gm/10kg seed) and the lowest of 7.12 was recorded with the application of treatment T7 (N2F1 A1@ 90 nitrogen kg ha^{-1} + FYM@ 0 t ha^{-1} + *Azotobacter* @ 200 gm/10kg seed). If we compare the pH of pre sowing soil sample which was 7.39 with that of after crop harvest soil, there is increase in pH after crop harvest.

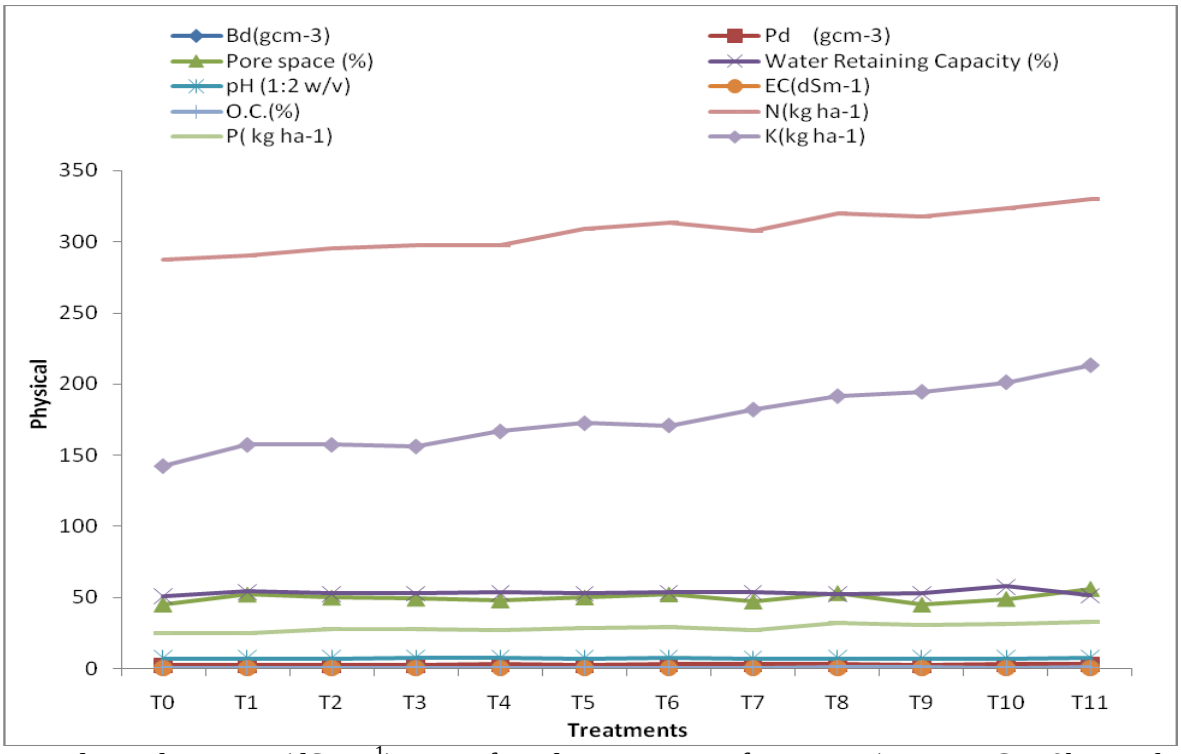
Decrease dose of nitrogen, FYM and *Azotobacter* slightly increasing the soil pH of the post-harvest soil. The increase in pH (dS m^{-1}) might be due to higher growth of crops as respiration is more. Respiration evolves carbon dioxide and reacts with water to form carbonic acid in soil. The electrical conductivity (dS m^{-1}), organic carbon (%), available nitrogen, available phosphorus and available potassium (kg ha^{-1}) of soil after crop harvests: The chemical properties were significantly affected by different treatment combination of nitrogen, FYM and *Azotobacter*.

The effect of nitrogen, FYM and *Azotobacter* on organic carbon percent, phosphorus, potassium (kg ha^{-1}), electrical conductivity (dS m^{-1}), available nitrogen significant the maximum chemical properties of after crop harvest soil was recorded electrical conductivity (dSm^{-1}), organic carbon (%), available nitrogen, available phosphorus, available potassium (kg ha^{-1}) 0.189, 0.668, 322.74, 31.59, 199.85 respectively.

Table.1 Effect of different levels of nitrogen, FYM and *Azotobacter* Chemical properties of soil after harvest mays crop

Treatment combinations	Bd(g/ cc)	Pd (g/cc)	Pore space (%)	Water retaining capacity (%)	pH (1:2 w/v)	EC(dS m^{-1})	O.C. (%)	N (kg ha^{-1})	P(kg ha^{-1})	K(kg ha^{-1})
T_0 (N_0+F_0+A_0)	1.14	2.22	44.85	50.87	7.20	0.178	0.56	287.16	24.73	142.32
T_1(N_0+F_1+A_0)	1.24	2.52	51.84	54.00	7.31	0.188	0.60	290.21	24.71	157.10
T_2(N_0+F_0+A_1)	1.18	2.31	49.78	52.64	7.31	0.170	0.60	294.80	27.78	157.18
T_3(N_0+F_1+A_1)	1.25	2.41	48.90	52.88	7.50	0.190	0.60	297.38	27.97	156.03
T_4(N_1+F_0+A_0)	1.20	2.73	47.78	53.28	7.37	0.197	0.54	297.50	27.16	166.57
T_5(N_1+F_1+A_0)	1.22	2.52	49.87	52.85	7.18	0.180	0.63	309.02	28.36	172.26
T_6(N_1+F_0+A_1)	1.23	2.64	51.96	53.59	7.40	0.190	0.56	313.51	29.17	170.72
T_7(N_1+F_1+A_1)	1.25	2.64	46.94	53.70	7.12	0.188	0.56	307.70	27.09	181.83
T_8(N_2+F_0+A_0)	1.28	2.64	52.97	52.45	7.30	0.191	0.70	319.69	31.81	191.24
T_9(N_2+F_1+A_0)	1.27	2.52	44.72	52.73	7.27	0.173	0.69	317.50	30.68	194.27
T_{10}(N_2+F_0+A_1)	1.23	2.62	48.75	57.75	7.18	0.190	0.55	323.71	31.12	200.99
T_{11}(N_2+F_1+A_1)	1.30	2.85	55.91	51.32	7.50	0.200	0.73	330.05	32.76	212.88
F- test	S	S	S	S	NS	NS	S	S	S	S
S. Em (±)	0.02	0.05	0.62	0.37	0.25	0.024	0.02	1.64	0.26	0.24
C. D. at 5%	0.04	0.10	1.26	0.74	0.50	0.050	0.04	3.33	0.52	0.49

Fig.1 Effect of different levels of nitrogen, FYM and *Azotobacter* on chemical properties of soils after harvest mays crop



Electrical conductivity (dS m^{-1}), was found non-significant (nitrogen@120kg ha^{-1})

respectively, with FYM in level F1 (FYM@ 10t ha^{-1}) 0.188, 0.601, 311.19, 29.31, 179.94 electrical conductivity (dS m^{-1}) and phosphorus was found non-significant and organic carbon (%), available potassium (kg ha^{-1}) and available nitrogen (kg ha^{-1}) available found to be significant, with *Azotobacter* in level A1 (@ 200 gm/10kg seed) 0.187, 0.636, 308.34, 28.59, 179.94 electrical conductivity (dS m^{-1}), was found non-significant and organic carbon percent available phosphorus (kg ha^{-1}) available potassium (kg ha^{-1}) and available nitrogen (kg ha^{-1}) found to be significant. Similar findings were reported by Reddy *et al.,* (2005).

It was concluded from trail that the various levels of integrated nutrients use from different sources in the experiment, the combined application of nitrogen fertilizers N@ 120 $kgha^{-1}$ + FYM@ 10t ha^{-1}, *Azotobacter* @ 200 gm/10kg seed found to be the best in increasing plant height (183.07cm), number of leaves per plant (14.40), cob length (19.11 cm), number of grain per cob(362.87) test weight (215.20g) grain yield (45.58 q ha^{-1}) and the physical and chemical properties of soil such as bulk density (1.30 g/cc), particle density (2.85g/cc), percent pore space (55.91%), water retaining capacity (51.32%), EC (0.200dSm^{-1}), pH (7.50), percent organic carbon (0.73%), available N (330.05 kg ha^{-1}), available P (32.76 kg ha^{-1}), available K (212.88 kg ha^{-1}) found that any other treatment combination. The maximum net return (Rs. 63689.3) ha^{-1}. Since the result is based on one season experiment, further trial is needed to substantiate the results.

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