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EFFECT OF SEED INOCULANTS AND ORGANIC MANURES ON GROWTH AND YIELD OF ORGANIC PEARL MILLET (*Pennisetum glaucum* L.)

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Abstract – A Field Experiment was conducted during *Kharif 2020* at SHUATS Model of Organic Farming Department of Agronomy, SHUATS, Prayagraj (U.P). The Effect of seed inoculants and organic manures on growth and yield of pearl millet (*Pennisetum glaucum* L.). The experiment consists of 10 treatments which include seed inoculants *viz., Azotobacter* (25 g/kg seeds), *Azospirillum* (25 g/kg seeds), *Azotobacter* + *Azosprillum* and organic manures viz., FYM (12 t/ha), Poultry manure (2 t/ha), Vermicompost (4 t/ha). The experiment was laid out in Randomized Block Design with ten treatments which are replicated thrice. The treatment with the application of *Azotobacter* + *Azospirillum* + (2 t/ha) Poultry manure was produced significantly higher plant height (197.85 cm) and plant dry weight (97.47 g/plant) at harvest stages. The treatment with application of *Azotobacter* + *Azospirillum* + (2 t/ha) poultry manure was produced significantly higher No. of ears/hill (2.64), No. grain/ear (1983.33), Grain yield (4.63 t/ha) and stover yield (6.79 t/ha).

INTRODUCTION

Pearl millet (*Pennisetum glaucum* L.) is the fifth most important cereal crop in the world after rice, wheat, maize and sorghum. Pearl millet is rightly termed as "nutria-cereal" as it is good source of energy, carbohydrates, protein, fat, ash, dietary fiber, iron and zinc, it is the millet and is mainly grown on drought prone areas and marginal soils. Pearl millet excels all other cereals due to its unique features – C_4 plants with high photosynthesis efficiency. Organic farming is a production system which favors maximum use of organic source like crop residues, legumes crop rotation with BNF, non-symbiotic N2 fixation, animal dung and urine, compost, green manures, plantbased nutrients, mineralization of nutrients, nutrients transformation, are the greater options available with us on the farm. These manures have the capacity of fulfill nutrients demand crop adequately and promote the activity of beneficial macro and micro flora in the soil (Arun Sharma, 2005). Good quality of FYM is perhaps the most valuable organic manure. FYM is well decomposed at the 5-10 t/ha every year is helping in maintaining soil health, increase the availability of nutrients and reduce toxic effects of chemicals and fertilizers, Further it stimulates the activity of microorganisms that makes the plant to get the macro and micro nutrients throughout the biological decomposition. Continuous application of FYM on long term basis can lead to increase the content of N, P, K, Ca, Mg and other soluble ions in soil (Hao and Chang, 2003; He *et al.,* 2008; Watts *et al.,* 2010). Poultry manure is an important organic nutrient source used to increase pearl millet grain and stover yield. Farmers using poultry manure recognize its value for soil improvement and crop productivity. Poultry manure contains higher concentration of N, P and K than cattle manure. (Maman and Mason, 2013). Vermicompost improves the physical and biological properties of soil includes supply of almost all the essential plant nutrients for growth and development of plant. It also provides secondary elements like ca, Mg, and S and fairly high amount of micro nutrients to the plants. *Azospirillum* is benefit to plants by mechanisms related to enhancement of plant

growth, increase the mineral uptake, increase the dry matter, improve the water absorption and improve the yield. The carrier based *Azospirillum* inoculation for non-leguminous crops are becoming increasing popular in india in recent years. *Azospirillum* is a rhizosphere bacterium colonizing the root of the crop plants making use of root exudates and fixes substantial amount of nitrogen. They exert beneficial effects on growth and yield of many economically important crop (Okon and Vanderleyden, 1997). *Azotobacter* is a free-living nitrogen fixation bacteria which has been reported to fix about 20 kg N/ha in non-legumes (Subbarao, 1982)

MATERIALS AND METHODS

A Field experiment was conducted at SMOF (Shuats Model of Organic Farming), SHUATS during *kharif* 2020 on sandy loam in texture, nearly neutral in soil reaction (pH 7.3), low in organic carbon (0.57%), available N (230 kg/ha), P (32.10 kg/ha) and available K (346 kg/ha). The treatment comprised of T_1- *Azotobacter* + 12 t/ha of FYM, T_2- *Azotobacter* + 2 t/ha of poultry manure, T_3- *Azotobacter* + 4 t/ha of vermicompost, T_4- *Azospirillum* + 12 t/ha of FYM, T_5- *Azospirillum* + 2 t/ha of poultry manure, T_6- *Azospirillum* + 4 t/ha of vermicompost, T_7- *Azotobacter* + *Azosprillum* +12 t/ha of FYM, T_8- *Azotobacter* + *Azosprillum* + 2 t/ha of poultry manure, T_9- *Azotobacter* + *Azosprillum* + 4 t/ha of vermicompost, T_{10}- control (RDF FYM 10 t/ha). These are replicated thrice in Randomized Block Design. Seeds are placed in row to row spacing 45cm and plant to plant spacing 15cm.

Statistical analysis

Experiment data collected was subjected to statistical analysis by adopting Fishers method of Analysis of variance (ANOVA) as outlined by Gomez and Gomez (1984). Critical Difference (CD) values were calculated the 'F' test was found significant at 5% level.

Plant sampling

Growth attributes

Plant height was recorded at 20, 40, 60, 80 and at harvest stage five plants were selected randomly from each plot which was tagged for observation the height was measured in cm. Number of leaves per plant were counted on the five tagged plants in each plot at 20, 40, 60, 80 and at harvest stages and the mean was determined for each treatment for all growth stages. Dry weight per plant was recorded with roots at an interval of 20, 40, 60, 80, and at harvest stages by uprooting 5 plants randomly from each plot. These plants were first air dried then wrapped with paper and then kept in oven drying at 70 ^{o}C for 24-48 hours. The dry weight of sample was recorded, average and expressed as g/plant.

Yield attributes

Number of ears/hill was recoded from five tagged hills in each plot at 90 DAS. Thereafter, the mean was calculated treatment-wise. Number of grains/ear grains from five ears were counted separately which were obtained randomly from the tagged hills and their average were recorded. Test weightone thousand grains were randomly counted from each ears obtained from each plot and weighted and recorded as test weight (g) at approximate 14% moisture. Grain yield grains from harvest area (1.0 m^2) were dried in sun, cleaned and weighted separately from each plot for calculating the grain yield in t/ha.Stover yield straw from the harvested area (1.0 m^2) were dried in sun, bundled, tagged and weighted separately from each plot for calculating straw yield in t/ha.

RESULTS AND DISCUSSION

Effect of Seed inoculants and Organic manures on Growth attributes of Organic Pearl millet

Plant height (cm)

At harvest stage the maximum plant height (197.85 cm) was recorded with the application of *Azotobacter* + *Azospirillum* + 2 t/ha Poultry manure. However, treatment with the application of *Azotobacter* + *Azospirillum* + 4 t/ha of Vermicompost and *Azotobacter* + *Azospirillum* + 12 t/ha of FYM were statistically at par with application of *Azotobacter* + *Azospirillum* + 2 t/ha of poultry manure as compared to other treatments. Higher plant height was observed in PM treated plots combination of seed inoculants than the other treatments. This might due to higher nitrogen content (NPK and other micro nutrients) and higher organic matter content of PM which are essential for plant growth. Similar results also reported by Zaid *et al.,* 2015, who also found higher plant height when poultry manure is used either alone or in combination with seed inoculants.

Number of leaves/plant

At harvest stage the maximum number of leaves (22.31) was recorded with application of *Azotobacter* + *Azospirillum* + 2 t/ha of poultry manure and minimum number of leaves (16.02) was observed with the application of *Azotobacter* + 4 t/ha of vermicompost as compared to other treatments. The reason for better growth and development under these treatments might be increased availability of nutrients of plant initially through organic manure like poultry manure. Majumdar and pal (1998) (Halepyati, 2001 and Deshmuk *et al.,* (2010) observed the application of poultry manure was found most effective in increasing number of leaves.

Dry weight

At harvest stage the maximum plant dry weight (97.47g/plant) was recorded with the application of *Azotobacter*+ *Azospirillum* + 2 t/ha of poultry manure. Treatment with the application of *Azotobacter* + *Azospirillum* + 12 t/ha FYM and *Azotobacter* + *Azospirillum* + 4 t/ha of vermicompost were statistically at par with application of *Azotobacter* + *Azosprillum* + 2 t/ha of poultry manure. The increase in dry matter was found due to increase in plant height, number of leaves/plant. This might be due to application of poultry manure and bio fertilizers there by increase in soil microorganism and due to better moisture and nutrient availability. Similar findings were reported by Singh *et al.,* (2001) and Sharma *et al.,* (2017)

Effect of Seed inoculants and Organic manures on Yield attributes and Yield of Organic Pearl millet

The maximum Number of ears/hill (2.64) was recorded significantly with the application of *Azotobacter* + *Azospirillum* + 2 t/ha of poultry manure. However, treatments with the application of *Azotobacter* + *Azospirillum* + 12 t/ha of FYM and *Azotobacter* + *Azospirillum* + 4 t/ha of vermicompost were statically at par with the application of *Azotobacter* + *Azospirillum* + 2 t/ha of poultry manure. The maximum number of grains/ear (1983.33) was recorded significantly with the application of *Azotobacter* + *Azospirillum* + 2 t/ha of poultry manure. However, the treatments with the application of *Azotobacter* + *Azospirillum* + 12 t/ha of FYM and *Azotobacter* + *Azospirillum* + 4 t/ha of vermicompost were statistically at par with the application of *Azotobacter* + *Azospirillum* + 2 t/ha of poultry manure. Test weight with the application of *Azospirillum* + 12 t/ha of FYM showed highest test weight (8.6 g) and the treatment with that application of *Azotobacter* + *Azospirillum* + 4 t/ha of vermicompost showed the lowest test weight (7.99 g) there is no significant difference among the treatments. This increasing in yield attributes could be the higher availability of nutrients under poultry manure, *Azotobacter*+ *Azospirillum* application. The increment in supply of essential nutrients, their availability, acquisition, mobilization and influx in to the plant tissue increasing and thus improved yield component and finally yield. These results are in conformity with those of and Singh and Sinisinwar, 2006 and Data *et al.,* 2009. And due to availability of nutrients which in turn promoted growth as well as yield attributing characters, physiological role of N and

Table 1. Effect of seed inoculations and organic manures on growth attributes of pearl milletEffect of seed inoculants and organic manures on yield attributes and yield of organic pearl millet

Treatments	Plant height (cm)	No. of leaves/ plant	Dry weight (g)
1. *Azotobacter* + 12 t/ha of FYM	182.42	18.12	90.22
2. *Azotobacter* + 2 t/ha of poultry manure	185.56	17.81	91.15
3. *Azotobacter* + 4 t/ha of vermi compost	188.00	16.02	88.54
4. *Azospirillum* + 12 t/ha of FYM	189.79	17.80	89.24
5. *Azospirillum* + 2 t/ha of poultry manure	185.89	18.80	90.00
6. *Azospirillum*+ 4 t/ha of vermicompost	188.00	21.44	92.20
7. *Azotobacter* + *Azospirillum* + 12 t/ha of FYM	192.79	17.41	94.38
8. *Azotobacter* + *Azospirillum* + 2 t/ha of poultry manure	197.85	22.31	97.47
9. *Azotobacter* + *Azospirillum* + 4 t/ha of vermicompost	191.62	18.26	95.03
10. control (RDF FYM-10 t/ha)	177.49	17.06	92.96
F-Test	S	NS	S
SEm (±)	2.33	1.28	1.29
CD (P=0.05)	6.94	-	3.84

Table 2. Effect of seed inoculations and organic manures on yield attributes and yield of Pearl millet.

Treatments	No. of ears/ hill	No. of Grains/ ear	Test weight (g)	Grain yield (t/ha)	Stover yield (t/ha)	Harvest index (%)
1. *Azotobacter* + 12 t/ha of FYM	2.12	1855.78	8.38	4.12	6.17	39.99
2. *Azotobacter* + 2 t/ha of poultry manure	2.07	1866.44	8.36	3.84	6.39	37.60
3. *Azotobacter* + 4 t/ha of vermicompost	1.97	1848.52	8.33	4.03	6.59	37.93
4. *Azospirillum* + 12 t/ha of FYM	2.23	1854.17	8.60	3.82	6.03	38.84
5. *Azospirillum* + 2 t/ha of poultry manure	1.91	1884.50	8.41	4.08	6.31	39.27
6. *Azospirillum* + 4 t/ha of vermicompost	1.99	1850.05	8.53	4.17	6.53	39.00
7. *Azotobacter* + *Azospirillum* + 12 t/ha of FYM	2.46	1947.00	8.12	4.41	6.29	41.24
8. *Azotobacter* + *Azospirillum* + 2 t/ha of poultry manure	2.64	1983.33	8.50	4.63	6.79	40.54
9. *Azotobacter* + *Azospirillum* + 4 t/ha of vermicompost	2.34	1937.66	7.99	4.39	6.66	39.70
10. control (RDF FYM 10 t/ha)	2.09	1908.66	8.39	3.80	6.01	36.27
F-Test	S	S	NS	S	S	NS
SEm (±)	0.10	17.47	0.22	0.14	0.13	1.02
CD (P=0.05)	0.31	51.92	-	0.42	0.38	-

P supplied by poultry manure in enhancing growth parameter might have lead to increased yield attributes and there by yield of crop at application of organic manures. These findings are in accordance with the findings of Patel *et al.,* 2014 and patil *et al.,* 2013. Choudhary and Kumar (2013) also reported that organic source of nutrients increased the growth, yield attributes and yield as well as nutrient uptake by maize crop.

The maximum Grain yield (4.63 t/ha) was recorded significantly with the application of *Azotobacter* + *Azospirillum* + 2 t/ha of poultry manure. However, treatment with the application of *Azotobacter* + *Azospirillum* + 12 t/ha of FYM and *Azotobacter* + *Azospirillum* + 4 t/ha of vermicompost were statistically at par with the application of Azotobacter + *Azospirillum* + 2 t/ha of poultry manure. The maximum stover yield (6.79 t/ha) was recorded significantly with the application of *Azotobacter* + *Azospirillum* + 2 t/ha of poultry manure. However, treatments with the application of *Azotobacter* + 4 t/ha of vermicompost, *Azospirillum* + 4 t/ha of vermicompost and *Azotobacter* + *Azospirillum* + 4 t/ha of vermicompost were statistically at par with the application of *Azotobacter* + *Azospirillum* + 2 t/ha of poultry manure. Harvesting index treatment with the application of *Azotobacter* + *Azopsirillum* + 12 t/ha FYM showed higher harvest index (41.24 %) and the treatment with control (RDF -FYM-10 t/ha) showed lowest harvesting index (36.27%).

Increase in grain yield may be ascribed to better root growth and development, resulting in more nutrient uptake and higher dry matter accumulation per plant and its subsequent translocation to the developing panicle. And relate to the release of essential nutrient elements by the poultry litter and increase of nutrient availability. Application of biofertilizer like *Azotobacter* and *Azospirillium* provides the nitrogen to the crop. The ability to fix atmospheric nitrogen is a vital physiological characteristics of *Azotobacter*. *Azotobacter* cells are usually not present on the root surface but are abundant in the rhizosphere and protect the roots from other pathogens present in soil. The result was in agreement with the findings of Udom *et al.,* 2007; Silva *et al.,* 2003; Rathore *et al.* (2004) and Parveen *et al.* (2007).

CONCLUSION

On the basis of one season experimentation application of *Azotobacter* + *Azospirillum* + 2 t/ha of poultry was found to be more productive (4.63 t/ha).

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