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Effect of seed inoculants and organic manures on yield and economic of organic pearl millet (*Pennisetum glaucum* L.)

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Abstract

A field experiment was conducted during *kharif* 2020 at SHUATS Model Organic Farm (SMOF), Department of Agronomy, SHUATS, Prayagraj (U.P). The Effect of seed inoculants and organic manures on growth and yield of organic pearl millet (*Pennisetum glaucum* L.). The treatments consisted of seed inoculants *viz.*, *Azotobacter* (25g/kg seed), *Azospirillum* (25g/kg seed), *Azotobacter* + *Azospirillum* and organic manures *viz.*, FYM (12t/ha), Poultry manure (2t/ha), Vermicompost (4t/ha). The experiment was laid out in Randomized Block Design (RBD) there are 10 treatments which are replicated thrice. Application of *Azotobacter* + *Azospirillum* + 2t/ha of Poultry manure recorded significantly higher grain yield (4.63 t/ha) and Stover yield (6.79t/ha). The application of *Azotobacter* + *Azospirillum* + 2t/ha poultry manure was recorded higher gross returns (1,22,268.00 ₹/ha), net return (81,412.70 ₹/ha) and B:C ratio (1.99) among all treatments.

Keywords: pearl millet, organic manures, seed inoculants, yield and economics

Introduction

India is the largest producer of pearl millet, both in terms of area and production. In India, it is annually grown on 7.5 million ha area producing nearly 9.73 million tonnes of grains with productivity of 1305 kg/ha during 2016-17 (Directorate of Millet Development, 2018). The trends in area, production and productivity of pearl millet suggest that area has increased marginally (2%) during last two years and productivity has gone up by 19 % (Yadav, 2011)^[17]. The major pearl millet growing states in India are Rajasthan, Maharashtra, Gujarat, Uttar Pradesh, Karnataka, Madhya Pradesh, Tamil Nadu and Andhra Pradesh. Pearl millet accounts for almost half of global millet production, with 60% of the cultivation areas in Africa, followed by 35% in Asian countries. European countries represent 4% of millet cultivation and North America only 1%, mainly for forage. Today millet is a staple food for more than 500 million people. Areas planted with pearl millet are estimated at 15 million hectares in Asia. In India, annual planting area is around 10 million ha producing nearly 7.5 million tonnes of grains. Global production exceeds 10 million tonnes a year (National Research Council, 1996) Organic farming is a production system which favours maximum use of organic sources like crops residues, legume crop rotations with BNF, non-symbiotic N₂ fixation, animal dung and urine, composts, green manures, plant based nutrients, mineralization of nutrients, nutrient transformations, etc. are the greater options available with us on the farm. These manures have the capacity to fulfill nutrient demand of crops adequately and promote the activity of beneficial macro and micro flora in the soil (Arun sharma, 2005)^[1]. In organic farming, the first and foremost characteristic is protecting fertility and nutrition management (nitrogen self-sufficiency). The total nutritional consumption (NPK) from chemical fertilizers is about 20.34 million tonnes in India.

FYM stimulates the activity of microorganisms that make the plants to get the macro and micronutrients 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)^[3,4,16].

Poultry manure is an important organic nutrient source used to increase pearl millet grain and stover yields. Farmers using poultry manure recognize its value for soil improvement and crop productivity Poultry manure contains higher concentrations of N, P and K than cattle manure. Most farmers apply side dress nutrients near the crop hill during the first weeding and subsequent thinning operation (Maman and Mason, 2013)^[6]. Vermicompost improves the

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physical and biological properties of soil including supply of almost all the essential plant nutrients for the growth and development of plants. It also provides secondary elements like Ca, Mg, and fairly high amounts of micronutrients to the plants.

Azospirillum is benefit to plants by mechanisms related to enhancement of plant growth, increases the mineral uptake, increases the dry matter, improve the water absorption and improve the yield. The exert beneficial effects on growth and yield of many economically important crops (Okon and Vanderleyden, 1997) [7]. *Azotobacter* is a free-living nitrogen fixing bacteria which has been reported to fix about 20 kg N/ha in nonlegumes (Subba Rao, 1982) [13]. The nitrogen which is being fixed by the *azotobacter* in soil near root zone (rhizosphere) was absorbed by the roots that might have improved the growth parameters of the crop (Rathore and Gautam, 2003; Kumar *et al.*, 2012) [9, 5].

Materials and Methods

The present investigation was carried out during *kharif*, 2020 at SMOF (SHUATS Model Organic farm), Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj. The farm situated at 25 57 N latitude, 87 50 E longitude and at an altitude of 98 meter above mean sea level. This area is situated on the right side of the river Yamuna and opposite side of Prayagraj city. All the facilities required for crop cultivation are available. The experimental site was uniform in topography and sandy loam in texture, nearly neutral in soil reaction (p^H 7.3), organic carbon (0.57%), N (230 kg/ha), P (32.10 kg/ha) and K (346 kg/ha). The seeds of Pearl millet (*Pennisetum glaucum* L.) variety "Manipuri" were sown on 22nd July 2020 with spacing adopted was 45 x 15 cm and the seeds were sown at 5 cm depth. Recommended doses of N, P, K were applied. The experiment was laid out in Randomized block Design comprised of 3 replications and total 10 treatments viz. Treatment 1- *Azotobacter* + 12 t/ha of FYM, Treatment 2- *Azotobacter* + 2 t/ha of Poultry manure, Treatment 3- *Azotobacter* + 4 t/ha of Vermicompost, Treatment 4- *Azospirillum* + 12 t/ha of FYM, Treatment 5, *Azospirillum* + 2 t/ha of Poultry manure, Treatment 6 - *Azospirillum* + 4 t/ha of Vermicompost, Treatment 7- *Azotobacter* + *Azospirillum* + 12 t/ha of FYM, Treatment 8 - *Azotobacter* + *Azospirillum* + 2t/ha of Poultry manure, Treatment 9- *Azotobacter* + *Azospirillum* + 4t/ha of Vermicompost, Treatment 10. (Control) (Recommended FYM – 10 t/ha).

Results and Discussion

Effect of seed inoculants and organic manures on yield attributes and yield organic pearl millet

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 *Azospirillum* + 4 t/ha of vermicompost and *Azotobacter* + *Azospirillum* + 4 t/ha of vermicompost which are statistically at par with the application of *Azotobacter* + *Azospirillum* + 2 t/ha of poultry manure and maximum stover yield (6.79 t/ha) was recorded significantly with the application of *Azotobacter* + *Azospirillum* + 2t/ha of poultry manure. However, treatment with the application of *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.

The nitrogen which is being fixed by the *azotobacter* in soil near root zone (rhizosphere) was absorbed by the roots that might have improved the growth parameters of the crop (Rathore and Gautam, 2003; Kumar *et al.*, 2012) [9, 5]. They exert beneficial effects on growth and yield of many economically important crops (Okon and Vanderleyden, 1997) [7]. The reason for 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 essential nutrient elements by the poultry litter and increase of nutrient availability. Application of biofertilizer like *Azotobacter* and *Azospirillum* provides the nitrogen to the crops. The ability to fix atmospheric nitrogen is a vital physiological characteristic 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 agree with findings of Udom *et al.*, 2007 [15], Silva, *et al.*, 2003 [12], Rathore *et al.* (2004) [10] and Praveen *et al.* (2007) [8].

Effect of seed inoculants and organic manures in economics of organic pearl millet

Cost of cultivation increased with increasing levels of manures and seed inoculants. Maximum gross returns (1,22,68.00 INR/ha), net returns (81,412.00 INR/ha) and B:C ratio (1.99) of pearl millet were recorded with the application of *Azotobacter* + *Azospirillum* + 2 t/ha of poultry manure.

The higher value of gross returns, net returns, B:C ratio might be ascribed to the higher grain and stover yield recorded in *Azotobacter* + *Azospirillum* + 2 t/ha of poultry manure. Corroborative findings were also reported by Rathore *et al.* (2005) [11] and Sonawane *et al.* (2007) [14].

Table 1: Effect of seed inoculants and organic manures on yield attributes, yield and economics of organic pearl millet

Treatments	Grain yield (t/ha)	Stover yield (t/ha)	Total Cost of cultivation (INR/ha)	Gross return (INR/ha)	Net return (INR/ha)	B:C ratio
1. <i>Azotobacter</i> + 12 t/ha of FYM	4.12	6.17	44675.00	109174.00	64499.30	1.44
2. <i>Azotobacter</i> + 2 t/ha of poultry manure	3.84	6.39	40675.00	103828.00	63152.80	1.55
3. <i>Azotobacter</i> + 4 t/ha of vermicompost	4.03	6.59	48675.00	108456.00	59780.60	1.23
4. <i>Azospirillum</i> + 12 t/ha of FYM	3.82	6.01	44635.00	102149.00	57513.50	1.29
5. <i>Azospirillum</i> + 2 t/ha of poultry manure	4.08	6.31	40635.00	108810.00	68175.30	1.68
6. <i>Azospirillum</i> + 4 t/ha of vermicompost	4.17	6.53	48635.00	111529.00	62894.30	1.29
7. <i>Azotobacter</i> + <i>Azospirillum</i> + 12 t/ha of FYM	4.41	6.29	44855.00	116023.00	71168.30	1.59
8. <i>Azotobacter</i> + <i>Azospirillum</i> + 2 t/ha of poultry manure	4.63	6.79	40855.00	122268.00	81412.70	1.99
9. <i>Azotobacter</i> + <i>Azospirillum</i> + 4 t/ha of vermicompost	4.39	6.66	48855.00	116712.00	67857.00	1.39
10. control (RDF-FYM 12 t/ha)	3.80	6.66	42455.00	103640.00	61185.00	1.44
F-Test	S	S	-	-	-	-
SEm (±)	0.14	0.13	-	-	-	-
CD	0.42	0.38	-	-	-	-

Conclusion

It can be concluded that for obtaining higher yield and Economics with better quality of pearl millet crop the application of *Azotobacter* + *Azospirillum* + 2 t/ha of Poultry manure is recommended to the farmers.

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