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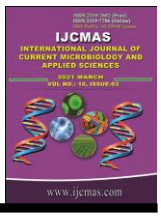

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Performance of Organic Sources and Biofertilizers on Growth and Yield of Finger Millet (*Eleusine coracana* L.)

Ramapuram Kedharnath Reddy*, Rajesh Singh and Wasim Khan

Department of Agronomy, Faculty of Agriculture, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj- 211007, Uttar Pradesh, India

**Corresponding author*

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A B S T R A C T

A field experiment was conducted during *Kharif* season of2020 at SHUATS Model Organic Farm (SMOF), Department of Agronomy, SHUATS, Prayagraj (UP) on sandy loam soil to investigate the influence of bio fertilizers and organic manures on growth and yield of finger millet. The treatment consisted of seed treatment with biofertilizers *viz.*, Azospirillum (seed inoculation @25 g/kg), PSB (Seed inoculation @25 g/kg) and Azospirillum + PSB (Seed inoculation @25 g/kg) and application of organic sources *viz.*, FYM (10t/ha), Poultry manure (2t/ha) and Sheep manure(2t/ha) effect were observed on finger millet (MR-1). The experiment was laid out in randomized block design with ten treatments replicated thrice. Study revealed that with application of Poultry manure (2t/ha) +Azospirillum+PSB(Seed inoculation @25g/kg)recorded significantly higher plant height (94.99 cm), number of tillers/plant (6.55) and maximum plant dry weight (23.45 g) at harvest stage as compared to other treatment combinations. The treatment with application of Poultry manure (2t/ha)+Azospirillum+ PSB (Seed inoculation @25g/kg) also recorded significantly higher number of fingers/ear head (5.22), grain yield (3.23 t/ha) and stover yield (5.58 t/ha) as compared to all the treatment combinations.

Introduction

Finger millet (*Elesuine corocana* L.) is one of the most important species among the other millet, which includes pearl millet (*Pennisetum glacum*), foxtail millet (*Setaria italica*), kodo millet (*Paspalum scorbiculatum L.*), little millet (*Panicum somatrense*), proso millet (*panicum miliaceum*), barnard millet (*Echinocholacrus galli*). Finger millet is largely grown in different parts the world like India, Africa, Ceylon, Malaysia, china, and Japan. It is also known as Mandua or Ragi in India. This crop was originated in Africa from where was domesticated to Asian regions around 5000 BC. Finger millet is cultivated up

to an altitude of 2100 meter above the sea level. In India, it was grown in over an area of 1.19 million hectare with a production of 1.98 million tones with the average productivity of 1661 kg /ha in 2017. Karnataka leads the chart with 56.21 and 59.52% of area and production of finger millet, which is followed by Tamil Nadu (9.94% and 18.27%), Uttarakhand (9.40% and 7.76%) Maharashtra (10.56% and 7.16%). Nutrient composition of finger millet protein (7%), carbohydrates (72-79.5%) (Singh and Singh, 2012).

Organic farming practices are gaining importance as farmers realized benefits in terms of soil fertility, soil health and sustainable productivity. Organic Farming aims at production of quality and safe agricultural Products, which contain no chemical residues following eco-friendly production methods and farming systems that restore and maintain soil fertility. Most of the research on organic production of finger millet was applied with utilization of FYM, green manures, compost, and sheep manure, *etc*. Poultry manure was reported to contain more plants nutrients than all other organic manures. There is need to generate efficient organic manurial sources using on-farm available organic substrates in addition to integrated use of biofertilizer help to more profitable organic farming. Organic fertilizers play a vital role for enhancing crop productivity and sustaining soil fertility, this proves great promise for farmers. Organic manure like FYM, Sheep manure, vermicompost is a rich mixture of macro and micro plant nutrients. It also increases availability of nutrients to plant easily, increasing moisture and improves microbial action in soil (Choudhary *et al.,* 2014). Bio-fertilizers are being essential component of organic farming. These are the preparations containing live or latent cells of efficient strains of nitrogen fixing, phosphate solubilizing or cellulolytic micro-organisms used for application to seed, soil or composting areas with the objective of accelerating microbial processes which augment the availability of nutrients that can be easily absorbed by plants. They are in fact being promoted to harvest the naturally available, biological system of nutrient mobilization (Venkatashwarlu, 2008). Organic manures supply nutrient to the plants, improve physical condition of soil, by organic manures, although in minute amounts. Hence a field experiment was conducted to evaluate the potential of organic sources with biofertilizer to supply efficient nutrition to maximize the yield of crops.

Materials and Methods

The experiment was carried out during *kharif* season of 2020 at SMOF (SHIATS Model Organic Farm), Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj (UP). The soil of the experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.1), low in organic carbon (0.28%), medium in available N (225 Kg/ha), medium available P (19.50 Kg/ha) and medium available K (208.10 Kg/ha). The treatments consisted of organic sources *viz*., Farm Yard Manure (FYM) @10t/ha, Poultry manure (PM)@ 2 t/ha and Sheep manure (SM) @ 2t/ha and biofertilizers *viz., Azospirillum* (seed inoculation @25 g/kg), PSB (Seed inoculation @25 g/kg) and Azospirillum + PSB (Seed inoculation @25 g/kg) effect were observed on finger millet (*var* - MR-1). The experiment was laid out in Randomized Block Design (RBD) with ten treatments replicated thrice. The experiment comprising ten treatment possible combination of above factor, *viz.,* T_1: FYM @ 10 t/ha + *Azospirillum* (Seed inoculation @ 25 g/kg),T_2: Poultry manure @ 2 t /ha + *Azospirillum* (Seed inoculation @ 25 g/kg) +, T_3: Sheep Manure 2 t/ha + *Azospirillum* (Seed inoculation @ 25 g/kg), T_4: FYM10 t/ha + PSB (Seed

inoculation @ 25 g/kg), T_5: Poultry manure 2 t /ha + PSB (Seed inoculation @ 25 g/kg), T_6: Sheep Manure 2 t/ha + PSB (Seed inoculation @ 25 g/kg), T_7: FYM10 t/ha + *Azospirillum* + PSB (Seed inoculation @ 25 g/kg), T_8: Poultry manure 2 t /ha + *Azospirillum* + PSB (Seed inoculation @ 25 g/kg), T_9: Sheep Manure 2 t/ha + *Azospirillum* + PSB (Seed inoculation @ 25 g/kg), T_{10}: Control field observation regarding yield was recorded after harvesting of crop.

The experimental data analysed statistically by applying the technique of analysis of variance (ANOVA) prescribed for the design to test the significance of overall difference among treatments by the F test and conclusion were drawn at 5% probability level. Economics of treatments was also worked out (Gomez and Gomez, 1984)

Results and Discussion

Data pertaining to growth parameters which is plant height (cm), number of tillers/plant, dry weight (g/plant) was recorded and tabulated in Table 1. The significantly maximum plant height was recorded with application of Poultry manure 2 t/ha + Azospirillum + PSB (Seed inoculation @25 g/kg), while in case of number of tillers/plant was found significantly maximum with application of Poultry manure 2 t/ha + Azospirillum + PSB (Seed inoculation @25 g/kg), except T_2: Poultry manure 2 t/ha + Azospirillum (Seed inoculation @25 g/kg), T_7: FYM 10 t/ha + Azospirillum + PSB (Seed inoculation @ 25 gm/kg) and T_9: Sheep Manure 2 t/ha + Azospirillum + PSB (Seed inoculation @25 g/kg) was found to be at par. Data related to plant dry weight was significantly increase by application of organic sources and biofertilizer.

Plant dry weight was recorded at harvest was found significantly superior over all other treatments except treatment T_9: Sheep manure @ 2 t/ha + Azospirillum + PSB (Seed inoculation @25 gm/kg) was followed same trend and found at par. Seed inoculation with biofertilizer along with organic sources improve the soil through microbial activity which might have facilitate better crop growth.

Combined application of poultry manure with biofertilizer efficiently provide nutrients to the crop also enhance moisture in the soil that lead to increase growth, number of tillers and dry matter effectively. These findings are in conformity with Gawde., *et al.,* (2013).

Yield attributes

Number of fingers/ear head and test weight

At Harvest, maximum no. of fingers per plant(5.49) recorded with the application of Sheep manure @ 2 t/ha + Azospirillum + PSB (Seed inoculation @25 g/kg) which was statistically at par with the application of FYM10 t/ha +Azospirillum + PSB (Seed inoculation @25 g/kg) (5.22) and Poultry manure 2 t/ha + Azospirillum + PSB (Seed inoculation @ 25 g/kg) (5.45) except with the other treatments.

This was attributed to higher growth and yield attributing characters in turn improvement in these characters was due to synergistic effect of organic manures resulting in release of nutrients which was in synchrony with crop demand at different growth stages. This was also attributed to the slow and steady rate of nutrient release into soil solution to matchthe required absorption pattern of fingermillet. Higher fingers/plant were due to higher concentration of nutrients add improvement in soil physio-chemical and biological properties by using poultry manure. These findings are conformity with Jagadeesha *et al.,* (2010) (Table 2).

Table.1 Growth attributes of finger millet as influenced by organic sources and biofertilizers

Treatments	Plant Height (cm)	No. of Tillers/ plant	Dry Weight (g)
T_1: FYM (10 t/ha) + Azospirillum (Seed inoculation @ 25 g/kg)	90.03	5.45	15.17
T_2: Poultry manure (2 t/ha) Azospirillum (Seed inoculation @ 25 g/kg)	92.05	6.21	17.34
T_3: Sheepmanure(2 t/ha) + Azospirillum (Seed inoculation @ 25 g/kg)	91.79	6.08	16.00
T_4: FYM10 t/ha + PSB (Seed inoculation @ 25 g/kg)	91.55	5.81	15.79
T_5: Poultry manure 2 t /ha + PSB (Seed inoculation @ 25 g/kg)	91.68	5.74	15.48
T_6: Goat/ Sheep 2 t/ha + PSB (Seed inoculation @ 25 g/kg)	90.64	5.54	18.16
T_7: FYM 10 t/ha + Azospirillum + PSB (Seed inoculation @ 25 g/kg)	92.70	6.19	21.75
T_8: Poultry manure 2 t /ha + Azospirillum + PSB (Seed inoculation @ 25 g/kg)	94.99	6.55	23.45
T_9: Goat/ Sheep 2 t/ha + Azospirillum + PSB (Seed inoculation @ 25 g/kg)	93.82	6.33	22.46
T_{10}: Control	89.42	5.45	16.42
SEm(±)	0.32	0.06	0.48
CD (P=0.05)	0.96	0.18	1.43

Table.2 Yield attributes and yield of finger millet as influenced by organic sources and biofertilizers

Treatment	No. of fingers/ear head	Test weight (g)	Grain yield (t/ha)	Stover yield (t/ha)	Harvest index (%)
T_1: FYM 10 t/ha + Azospirillum (Seed inoculation @ 25 g/kg)	4.28	3.66	2.24	4.57	**36.69**
T_2: Poultry manure 2 t /ha Azospirillum (Seed inoculation @ 25 g/kg)	4.96	3.8	2.83	5.16	**38.23**
T_3: Sheep manure 2 t/ha + Azospirillum (Seed inoculation @ 25 g/kg)	4.68	4.1	2.71	5.06	**37.99**
T_4: FYM10 t/ha + PSB (Seed inoculation @ 25 g/kg)	4.65	3.96	2.53	4.86	**37.51**
T_5: Poultry manure 2 t /ha + PSB (Seed inoculation @ 25 g/kg)	4.34	4.13	2.39	4.74	**37.02**
T_6: Sheep manure 2 t/ha + PSB (Seed inoculation @ 25 g/kg)	4.29	3.	2.29	4.64	**36.73**
T_7: FYM 10 t/ha + Azospirillum + PSB (Seed inoculation @ 25 g/kg)	5.22	3.86	2.96	5.31	**38.45**
T_8: Poultry manure 2 t /ha + Azospirillum + PSB (Seed inoculation @ 25 g/kg)	5.45	4.16	3.23	5.58	**39.03**
T_9: Sheep manure 2 t/ha + Azospirillum + PSB (Seed inoculation @ 25 g/kg)	5.49	3.9	3.06	5.41	**38.67**
T_{10}: Control	4.09	4.06	2.13	4.49	**36.26**
SEm(±)	0.09	0.19	0.05	0.05	**0.13**
CD (P=0.05)	**0.28**	**-**	**0.15**	**0.14**	**0.41**

Treatment with Poultry manure @ 2 t/ha +Azospirillum + PSB (Seed inoculation @ 25 g/kg) was recorded maximum Test weight (4.16 g) which was followed by treatment with Poultry manure @ 2 t /ha + PSB (Seed inoculation @ 25 g/kg)and there was no significant difference among treatments. Macro and micro nutrient are essential nutrients required for the promotion of the meristematic and physiological activities. These activities promote higher photosynthetic activities leading to the production of enough assimilates for subsequent translocation to various sink and there by leading to production of higher sink components like productive tillers m^{-2}, number of fingers $earhead^{-1}$, finger length, weight of grains ear^{-1} and test weight. The results are also in conformity with the findings of Pallavi *et al.,* 2016.

Yield

The ultimate goal of experimental purpose to find out maximize practices which produce more yield. Yield component based on better growth and yield attributes performing under best treatment. Yield evaluated after harvesting of crop so significantly increasing trend by application of organic sources and biofertilizers. Significantly maximum grain yield (3.23 t/ha) was recorded with application of Poultry manure 2 t /ha + Azospirillum + PSB (Seed inoculation @ 25 g/kg), except T_9: Sheep manure 2 t/ha + Azospirillum + PSB (Seed inoculation @ 25 g/kg) was followed similar trend. The maximum grain yield producing treatment Poultry manure 2 t/ha + Azospirillum + PSB (Seed inoculation @ 25 g/kg) was fetched 51.64% more yield over control treatment. Similarly stover yield (5.58 t/ha) also found significantly maximum with application of Poultry manure 2 t /ha + Azospirillum + PSB (Seed inoculation @ 25 g/kg), while in the case of harvest index maximum harvest index (39.03 %) recorded with application of Poultry manure @ 2 t /ha + Azospirillum + PSB (Seed inoculation @ 25 g/kg) but T_9: Sheep manure 2t/ha + Azospirillum + PSB (Seed inoculation @ 25 g/kg) was found to be at par with maximum harvest index recorded treatment *viz.,* Poultry manure @ 2 t /ha + Azospirillum + PSB (Seed inoculation @ 25 g/kg). organic manure along with biofertilizer improve the soil status which leads to release the nutrients efficiently to the crops in available form, which help to mobilize biological and chemical process in plant metabolism. Poultry manure has efficient source of NPK along with beneficial micronutrients enhance plant activity which result better plant stand, more dry matter and more grain filling ultimately resulted more yield. Similar findings were also reported by Gawade *et al.,* (2013) and Pallavi *et al.,* (2016).

From the findings of experiment, application of Poultry manure 2 t /ha +Azospirillum + PSB (Seed inoculation @ 25 gm/kg) obtaining higher yield attributes and yield offinger millet crop useful for eastern Uttar Pradesh condition.

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