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Yield and economic of Finger millet (*Eleusine coracana* L.) as influenced by organic sources and biofertilizers

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Abstract

A field experiment was conducted during *Kharif* season 2020 at SHIATS Model Organic Farm ((SMOF), Department of Agronomy, SHUATS, Prayagraj (UP) on sandy loam soil to investigate the influence of organic sources and bio fertilizers on yield and economic of finger millet. The treatment consisted of organic sources *viz.*, FYM 10t/ha, Poultry manure 2t/ha and Goat/ Sheep 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 is observed on finger millet (MR-1). The experiment was laid out in randomized block design with ten treatments replicated thrice. Study revealed that treatment with application of with Poultry manure 2 t/ha + Azospirillum + PSB (Seed inoculation @ 25 g/kg) was recorded significantly higher grain yield (3.23 t/ha) and straw yield (5.5 t/ha) as compared to other treatment combinations. The economic analysis clearly indicates that higher B:C ratio (1.52) recorded with application of Poultry manure 2 t/ha + Azospirillum + PSB (Seed inoculation @ 25 g/kg).

Keywords: Finger millet, biofertilizer, organic source, yield and economic

Introduction

Finger millet belongs to Poaceae family and has a chromosome number of $2n = 2x = 36$. It is an annual herbaceous plant, which contains rich amounts of protein, calcium, fiber and energy as compared to other traditional crop like paddy, wheat, oat, and sorghum. The seeds of finger millet are rich in dietary fiber, iron, essential amino acids (riboflavin, thiamine, leucine, isoleucine and trypsin inhibitory factors). The demand of finger millet is increasing due to its nutritional value besides it is also used as a staple food grain in some parts of India especially by tribal and lower income class but its productivity is low due to lack of monetary and nonmonetary inputs, because it is cultivated traditionally mostly by broadcasting. Most important reasons for low production of finger millet is low organic matter in soil, lack of suitable variety and faulty or not suitable establishment methods, low price in market which forced the farmers to shift cash crop cultivation and trend is towards growing cash crops rather than ensuring our own food security. Finger millet occupies 12 per cent of global millet area and is cultivated in more than 25 countries in Africa and Asia. On global basis finger millet is cultivated over an area of about 3.0 M ha with a production of 3.8 MT and productivity of 1.3 q/ha. India alone contributes more than 50 per cent to the world production. Finger millet constitutes an area of 1.27 M ha with average annual production of 1.89 MT and productivity of 1490 kg/ha. Finger millet grown on marginal land provides a valuable resource in times of famine. The most striking feature, which made finger millet an important dry land crop, is its resilience and ability to withstand adverse weather conditions when grown in soils having poor water holding capacity.

Azospirillum species belong to facultative endophytic diazotrophic group which colonize the surface and interior of roots. The organisms are Gram negative curved rods of variable sizes which exhibit spirillar movement and polymorphism. The cells contain poly- β -hydroxy butyrate (PHB) granules and fat droplets. These are associative microaerophilic diazotrophs isolated from the roots and above ground parts of a variety of crop plants like forage grasses, cereals, legumes, millets and soils. Phosphate solubilizing bacteria (PSB) is an environment friendly and cost-effective approach as an alternative strategy to reduce chemical fertilizers

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usage. Phosphate solubilizing bacteria with multiple beneficial traits are important to increase the growth and yield of plants. Phosphate solubilizing bacteria (PSB) plays an important role in dissolving both of fertilizer phosphorus (P) and bound P in the soil that is environmentally friendly and sustainable (Khan et al., 2007) [4]. Nitrogen (N) is typically the nutrient of most concern because it has a strong influence on cereal crop yields. The use of inorganic fertilizers for the past 50 years without any addition of organic manures resulted in the large-scale deficiency of micro nutrients which play an important role in enhancing the quality and quantity of the agriculture produce. Good quality farmyard manure (FYM) is perhaps the most valuable organic manure. Vermicompost has all the characteristic to use it as a most valuable organic manure. Poultry manure is a good source of nutrients for crops. Shankar et al. reported that a judicious use of organic and inorganic combination of fertilizers will maintain long-term soil fertility and sustained higher levels of productivity. Farmyard manure rich in organic matter can be supplemented with NPK fertilizers. Although, it is costlier than chemical fertilizers on nutrient basis but other beneficial effects which it has on soil can compensate for the added cost. It not only provides most of the essential plant nutrients but also improves soil structure through binding effect on soil aggregates. Cation exchange capacity, water holding capacity, fertilizer use efficiency, microbial activity and nutrient availability in soil also get improved due to FYM. Poultry manure is a good source of nutrients for crops. It is also called as chicken manure, is an excellent soil amendment that provides nutrients for growing crops and also improves soil quality when applied wisely, because it has high organic matter combined with available nutrients for plant growth. Which contain higher amount of Nitrogen and Phosphorus compared to other bulky organic manures. The average nutrient content is 3.03 per cent N; 2.63 per cent P₂O₅ and 1.4 per cent K₂O. Sheep manures contain higher nutrients than farm yard manure and compost. On an average, the manure contains 3 percent N, 1 percent P₂O₅ and 2 percent K₂O. Agboola and Aiyelari (2000) [1] indicated that sheep or goat manures have physical and chemical properties that facilitate aggregation with mineral particles especially clay, and in turn modifies soil structure and influences soil water regime thereby encouraging rapid growth. Other than micronutrient fertilizers, FYM may be a good source of essential micronutrients for millet growth. Based on a long-term field experiment in Tamil Nadu, India, it was found that continuous application of 100% NPK + FYM (10 t/ha) increased some of the available micronutrients (Fe, Zn, Mn, and Cu) in a finger millet-maize cropping system.

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), available P (19.50 Kg/ha) and available K (92.00 Kg/ha). The treatments consisted of organic sources *viz.*, FYM 10t/ha, Poultry manure 2t/ha and Goat/ Sheep 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 is observed on finger millet

(MR-1). The experiment was laid out in Randomized Block Design with ten treatments replicated thrice. The experiment comprising ten treatment possible combination of above factor, *viz.*, T₁: FYM 10 t/ha + Azospirillum (Seed inoculation @ 25 g/kg), T₂: Poultry manure 2 t /ha + Azospirillum (Seed inoculation @ 25 g/kg) +, T₃: Goat/ Sheep 2 t/ha + Azospirillum (Seed inoculation @ 25 g/kg), T₄: FYM 10 t/ha + PSB (Seed inoculation @ 25 g/kg), T₅: Poultry manure 2 t /ha + PSB (Seed inoculation @ 25 g/kg), T₆: Goat/ Sheep 2 t/ha + PSB (Seed inoculation @ 25 g/kg), T₇: FYM 10 t/ha + Azospirillum + PSB (Seed inoculation @ 25 g/kg), T₈: Poultry manure 2 t /ha + Azospirillum + PSB (Seed inoculation @ 25 g/kg), T₉: Goat/ Sheep 2 t/ha + Azospirillum + PSB (Seed inoculation @ 25 g/kg), T₁₀: Control field observation regarding yield was recorded after harvesting of crop, While on that basis economic evolution in terms of net return also find out according the technique and analysis of variance.

Results and Discussions

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 T₉: Goat/ Sheep 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 T₉: Goat/Sheep 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 lead to increase 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 was also reported by Gawade *et al.* (2013) [3] and Pallavi *et al.* (2016) [5].

Economics

Economic return of finger millet was evaluated after harvesting of crop was based on market price showed increasing trend as par the increasing the yield trend according treatment. The maximum Gross returns (INR 89120.00 /ha), Net returns (INR 53820.00 /ha) and Benefit cost ratio (1.52) was evaluated under treatment with application of Poultry manure 2 t/ha + Azospirillum + PSB (Seed inoculation @ 25 g/kg).

Table 1: Yield of finger millet as influenced by Organic sources and Biofertilizers

Treatment	Grain yield (t/ha)	Stover yield (t/ha)	Harvest index (%)
T ₁ : FYM 10 t/ha + Azospirillum (Seed inoculation @ 25 g/kg)	2.24	4.57	36.69
T ₂ : Poultry manure 2 t/ha + Azospirillum (Seed inoculation @ 25 g/kg)	2.83	5.16	38.23
T ₃ : Goat/ Sheep 2 t/ha + Azospirillum (Seed inoculation @ 25 g/kg)	2.71	5.06	37.99
T ₄ : FYM 10 t/ha + PSB (Seed inoculation @ 25 g/kg)	2.53	4.86	37.51
T ₅ : Poultry manure 2 t/ha + PSB (Seed inoculation @ 25 g/kg)	2.39	4.74	37.02
T ₆ : Goat/ Sheep 2 t/ha + PSB (Seed inoculation @ 25 g/kg)	2.29	4.64	36.73
T ₇ : FYM 10 t/ha + Azospirillum + PSB (Seed inoculation @ 25 g/kg)	2.96	5.31	38.45
T ₈ : Poultry manure 2 t/ha + Azospirillum + PSB (Seed inoculation @ 25 g/kg)	3.23	5.58	39.03
T ₉ : Goat/ Sheep 2 t/ha + Azospirillum + PSB (Seed inoculation @ 25 g/kg)	3.06	5.41	38.67
T ₁₀ : Control	2.13	4.49	36.26
SEM ±	0.05	0.05	0.13
CD (P=0.05)	0.15	0.14	0.41

Table 2: Total cost of cultivation, Gross returns, Net returns and B:C ratio of Finger millet as Influence by Organic sources and Biofertilizers

Treatment	Total cost of Cultivation (INR)	Gross return (INR)	Net return (INR)	B:C ratio
T ₁ : FYM 10 t/ha + Azospirillum (Seed inoculation @ 25 g/kg)	35200.00	63026.67	27826.67	0.79
T ₂ : Poultry manure 2 t/ha + Azospirillum (Seed inoculation @ 25 g/kg)	35200.00	78485.00	43285.00	1.22
T ₃ : Goat/ Sheep 2 t/ha + Azospirillum (Seed inoculation @ 25 g/kg)	35200.00	75501.67	40301.67	1.14
T ₄ : FYM 10 t/ha + PSB (Seed inoculation @ 25 g/kg)	35200.00	70711.67	35511.67	1.00
T ₅ : Poultry manure 2t/ha + PSB (Seed inoculation @ 25 g/kg)	35200.00	66948.33	31748.33	0.90
T ₆ : Goat/ Sheep 2t/ha + PSB (Seed inoculation @ 25 g/kg)	35200.00	64298.33	29098.33	0.82
T ₇ : FYM 10 t/ha + Azospirillum + PSB (Seed inoculation @ 25 g/kg)	35300.00	82053.33	46753.33	1.32
T ₈ : Poultry manure 2t/ha + Azospirillum + PSB (Seed inoculation @ 25 g/kg)	35300.00	89120.00	53820.00	1.52
T ₉ : Goat/Sheep 2t/ha + Azospirillum + PSB (Seed inoculation @ 25 g/kg)	35300.00	84615.00	49315.00	1.39
T ₁₀ : Control	35100.00	60068.33	24968.33	0.71

Conclusion

It can be concluded that for obtaining higher yield components with better quality of finger millet in organic farming with application of Poultry manure 2 t/ha + Azospirillum + PSB (Seed inoculation @ 25 g/kg).

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