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Effect of Organic Manures on Growth and Yield if Finger Millet

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ABSTRACT

Organic farming is an ecological production management system that promotes and enhances biodiversity, biological cycles and soil biological activity. The continuous use of inorganic fertilizers under intensive cropping system has caused widespread deficiency of macro and micronutrients in soil. Healthy soil is a web combination of minerals, water, air, organic matter, microorganisms, insects and earthworms. Keeping in view of sustained crop yields as well as soil health, an experiment was conducted at Agricultural Research Station, Vizianagaram, Acharya N.G. Ranga Agricultural University, Andhra Pradesh, during *Kharif* 2014 to study the effect of use of complete organic method of farming in comparision to conventional method on soil health, yield and quality of finger millet crop. The organic inputs were supplied in the form of farmyard manure, neem cake and biofertilizers (*Azospirillum* and Phosphorus Solubilising Bacteria). The results of both the years revealed that significantly highest grain yields (29.0 q ha^{-1}), straw yields (74.8 q ha^{-1}), N uptake (68.2 kg ha^{-1}), Zn uptake (286.1 gm ha^{-1}), No. of productive tillers/plant (2.2) were recorded in inorganic treated plot when compared with organic treated plot (26.7 q ha^{-1}, 71.8 q ha^{-1}, 61.2 kg ha^{-1}, 242.6 gm ha^{-1} and 1.8 respectively). Whereas the soil available macronutrients and micronutrients were found high in organic treated plot. The soil available phosphorus was found significantly high in organic plot (87.4 kg ha^{-1}) when compared to conventional plot (79.7 kg ha^{-1}).

Key words: *Finger millet, Organic, Conventional, yield, soil fertility and nutrient uptake.*

The high input agriculture has led to self sufficiency in food-grains but it has posed several new challenges. The conversion of modern agriculture into organic agriculture is now widely debated. Growing of high yielding varieties with indiscriminate use of fertilizers, poor water management practices and inefficient plant-protection measures in modern chemical intensive agriculture has resulted into degradation of lands owing to low crop yields with poor quality of produce (Pradhan and Mondal, 1997). The productivity of most of the crops is declining, Increased levels of production can be achieved by increased use of inorganic fertilizers, but may lead to deterioration in soil quality besides pollution problems (Gaur and Kumawat, 2000). Maintaining and improving the soil quality is thus crucial if agricultural productivity and environmental quality are to be sustained for future generations (Reeves, 1997). It is reported that integrated nutrient supply system helps in maintenance and improvement of soil fertility for sustaining crop productivity on long term basis (Babalad, 1999). Good quality farm yard manure and vermicompost are perhaps the most valuable organic manures to improve the yield and other soil properties. Hence, conversion of modern chemically intensive agriculture to a more sustainable form of agriculture like organic farming appears to be an option for maintaining the desirable agricultural production in future (Modgal *et al.*,1995). Therefore, the use of locally available agro-inputs in agriculture by avoiding or minimizing the use of synthetically compounded agro-chemicals appears to be one of the probable options to sustain the agricultural productivity.

Finger millet (locally called as *Ragi or chodi*), is the third most important millet in India next to sorghum and pearl millet, covering an area of 2 million hectares with annual production of 2.15 million tonnes. 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. It is highly valued by traditional farmers as it is nutritious, drought tolerant, short duration and requires low inputs. Finger millet grown on marginal land provides a valuable

resource in times of famine. Its grain tastes good and is nutritionally rich (compared to cassava, plantain, polished rice and maize meal) as it contains high levels of calcium, iron and manganese. The millet straw is also an important livestock feed, building material and fuel. Finger millet contains methionine, an essential amino acid lacking in the diets of hundred millions of the poor who rely mostly on starchy staples. The finger millet contains a low glycemic index and has no gluten, which makes it suitable for diabetics and people with digestive problems. Moreover finger millet seeds can be stored for a long time due its low vulnerability to insect damage (Rurind *et al.*, 2014). In recent years, much emphasis has been given for use of organics to produce adequate amount of high quality food.

Intensive cultivation, growing of exhaustive crops, use of unbalanced and inadequate fertilizers accompanied by restricted use of organic manures have made the soils not only deficient in nutrients, but also deteriorated soil health resulting in decline in crop response to recommended dose of fertilizers. Boosting yield, reducing production cost and improving soil health are three interlinked components of sustainable triangle (Kumar and Yadav, 1995). Therefore there is need to improve soil fertility and quality of economic product by increasing use of organic manures and biofertilizers. The nutritional value or quality of grain is improved by use of organic manures. Keeping thus in view, the present study was taken up to know the effect of manures and inorganic fertilizers on yield and quality of finger millet along with soil fertility.

MATERIAL AND METHODS

The field experiment was conducted from *kharif* 2014 at Agricultural Research Station, Vizianagaram, ANGRAU, to study the effect of organic farming using only organic inputs in comparision with conventional method of farming using inorganic fertilizers on growth parmeters, yield, soil fertility status and nutrient uptake at harvest in finger millet. The soil was sandy loam in texture, neutral in reaction with low soluble salts, low in organic carbon and available nitrogen and high in available phosphorus and potassium. The experiment was laid out with two treatments i.e. organic treated plot and inorganic treated plot (conventional plot). The recommended dose of fertilizer (60:40:30 kg NPK ha^{-1}) was applied to inorganic treated plot and green manure, FYM@ 5t ha^{-1} along with 0.75 t ha^{-1} of Neem cake was applied as top dressing to organic treated plot. Recommended dose of nitrogen was applied through urea in two equal splits as basal and 30 days after transplanting to the conventional plot. Entire dose of phosphorus and potassium were applied through single super phosphate and muriate of potash as basal dose. Moreover green manure (sunhemp) was grown *in situ*, incorporated and biofertilizers in the form of *Azospirillum* and PSB @ 5 kg ha^{-1} were applied in organic plot. The crop was harvested at maturity stage and growth characters like plant height, no. of productive tillers/plant, No. of ear heads/plant,No. of fingers/ear head and yield attributes like grain yield, straw yield were recorded. Plant samples were collected at harvesting stage to determine nutrient content and nutrient uptake. The final soil samples were collected after harvest of the crop and the available macro and micronutrients were determined by adopting standard procedures.

RESULTS AND DISCUSSION

The pooled mean data (Table 1) of both the years recorded significantly higher grain and straw yields in the conventional plot compared to inorganic plot. Among the two treatments, significantly highest grain and straw yields were recorded in conventional plot (29.0 q ha^{-1} and 74.8 q ha^{-1}) compared to the organic plot (26.7 q ha^{-1} and 71.8 q ha^{-1}). Similar results were recorded by Pawar *et al*. (2013). Among the plant growth characters, plant height, No. of productive tillers/ plant and leaf length were found significantly high in inorganic plot (102.6cm, 2.2 and 32.8cm) compared to the organic plot (89.9cm, 1.8 and 27.2cm). Among the yield contributing characters Infloresence length was found highest in organic plot (8.2 cm) compared to the conventional plot (7.9 cm). But the No. of ear heads/plant and No. of fingers/ear were found highest in conventional plot (5.3 and 7.6) compared to the organic plot (4.5 and 6.9). The increase in the growth and yield owing to the application of N – fertilizer may be attributed to the fact that this nutrient being important constituents of nucleotides, proteins, chlorophyll and enzymes involved in various metabolic processes which have direct impact on vegetative and reproductive phase of plants. These findings confirm those of Mengel and Kirby, 1996.

The physicochemical properties (Table 2) were not significantly influenced by both the methods.

The organic carbon % has increased by 0.2% in organic treated plot (0.44%) compared to the initial value (0.42%). The Organic Carbon % was increased with application of FYM and incorporation of green manures. The buildup of Organic Carbon could be attributed to the manures and subsequently addition of leaf residue and debris of plants (Bhandari *et al*., 2002). The soil available Nitrogen, Phosphorus and Potassium were found highest in organic plot (236.4 kg ha $^{-1}$, 87.4 kg ha $^{-1}$ and 314.1 kg ha $^{-1}$) compared to the conventional method (214.7 kg ha $^{-1}$, 79.7 kg ha $^{-1}$ and 305.3 kg ha $^{-1}$). This is due to the enhancement in the efficiency of nutrient use from all the sources through mineralization of soil organic matter, animal excreta, other manures and biofertilizers. The increase in P availability might be due to the release of appreciable quantities of carbon dioxide during decomposition of organic matter which forms the carbonic acid, leading to increased solubility of phosphorous resulting in higher availability (Sedvi *et al*., 2005). Whereas the higher K status in soil might be due to the organic manures on decomposition released the organic acid which might have mobilized the native or non-exchangeable forms of K and charge the soil solution with K ions, so that it may be readily available (Yaduvanshi *et al*., 2013). The soil available Zn and Cu were also found highest in the organic treated plot (1.3 ppm and 1.5 ppm) compared to the conventional plot (1.1ppm and 1.3 ppm).

The N, P and K uptake (Table 3) were found highest in inorganic treated plot when compared to the organic plot. The uptake of nitrogen and zinc were found significantly high in conventional plot (68.2 kg ha $^{-1}$ and 286.1 gm ha $^{-1}$) when compared to organic plot (61.2 kg ha $^{-1}$ and 242.6 gm ha $^{-1}$). This could be primarily due to increased availability of the nutrients in the crop root zone resulted in increased absorption of the elements by the plants as well as higher dry matter production. These results are in consonance with the findings of Singh *et al*. (2009) and Datt *et al*. (2003).

Table 1: Effect of organic and inorganic manures on growth, yield of finger millet

S.no	Particulars	Organic plot	Conventional plot	T value
1	Plant height(cm)	89.9	102.6	5.12*
2	No.of Productive tillers/plant	1.8	2.2	2.29*
3	Leaf length(cm)	27.2	32.8	5.03*
4	Leaf width (cm)	1	1.1	1.15
5	Infloresence length(cm)	8.2	7.9	1.32
6	No.of earheads/plant	4.5	5.3	1.92
7	No. of Fingers/ear	6.9	7.6	1.46
8	Straw yield (q ha^{-1})	71.8	74.8	2.02*
9	grain yield (q ha-1)	26.7	29	1.31*

*Significant at P=0.05 level

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Table 2: Effect of organic and inorganic manures on soil health at harvest

S.no	Particulars	Organic plot	Conventional plot	T value
10	Organic carbon (%)	0.44	0.42	1.07
11	pH	6.7	6.3	2.87
12	EC	0.2	0.2	0.38
13	Available N (kg ha^{-1})	236.4	214.7	2.31
14	Available P_2O_5 (kg ha^{-1})	87.4	79.7	1.35*
15	Available K_2O (kg ha^{-1})	314.1	305.3	1.32
16	Available Zn (ppm)	1.3	1.1	1.19
17	Available Fe (ppm)	9	9	0.026
18	Available Mn (ppm)	4.9	5	0.532
19	Available Cu (ppm)	1.5	1.3	0.412

*Significant at P=0.05 level

Table 3: Effect of organic and inorganic manures on Plant nutrient uptake of finger millet

S.no	Particulars	Organic plot	Conventional plot	T value
1	N Uptake (kg ha^{-1})	61.2	68.2	3.12*
2	P Uptake (kg ha^{-1})	12.5	14.8	1.68
3	K Uptake (kg ha^{-1})	38.6	43.1	1.99
4	Zn Uptake (gm ha^{-1})	242.6	286.1	3.18*
5	Fe Uptake(gm ha^{-1})	1493.7	1673.4	1.62

*Significant at P=0.05 level

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