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Impact of Different Organic Manures and Biofertilizers on Fresh Yield and Economics of Amaranth *(Amaranthus tricolor)* under Foothill Condition of Nagaland

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Abstract A field experiment was carried out at the experimental farm in 2015 and 2016 to study the impact of different organic manures and biofertilizers on fresh yield and economics of amaranth under foothill condition of Nagaland. The experiments were laid out in randomized block design (RBD) comprising of 7 (seven) treatments with 3 (three) replications. Results revealed that among the different treatments in the production of amaranth, application of Vermicompost 5 t ha^{-1} + PSB + *Azospirillum* (each 5 kg ha^{-1}) significantly recorded the maximum fresh yield (135.24 q ha^{-1}) of amaranth which was found significantly superior over other treatments. Minimum fresh yield (104.61 q ha^{-1}) of amaranth was recorded under recommended Pig manure (15 t ha^{-1}). Among different treatments, maximum B : C ratio (1:4.37) was obtained in the treatment of FYM 20 t ha^{-1}+ PSB + *Azospirillum* (each 5 kg ha^{-1}).

Keywords Amaranth, Organic manures, Fresh yield, Economics.

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Introduction

Amaranth *(Amaranthus tricolor)* belongs to family Amaranthaceae. Many species of the genus *Amaranthus* are best known as opportunistic weeks which have a long history of use as leafy vegetable and are gathered as subsistence food in many parts of the world. Leaves and succulent stem are good sources of iron (38.5 mg/100g), calcium (350-400 mg/100g), vitamin A and vitamin C. High oxalate conten (1-2%) and nitrate (1.88.8 g/kg dry matter) levels are reported from leaves of various species. Short duration, quick response to manures and fertilizers, high yield, easiness in cultivation and availability of diverse types suited to specific agro-climatic conditions makes it a favorite crop of farmers to fit in any cropping systems. However, Amaranth is considered as underutilized crop and has, until recently, received little research attention particularly in the North-Eastern region.

Consumers demand for organically grown produce has increased dramatically over the past decade, most likely because of the perceived benefits to the environment and human health. A major component of organic production is providing organic sources of nutrients to promote plant growth as well as sustain soil quality. Organic crop production in the organic farming system is gradually gaining momentum worldwide. It is based on the minimal cost of the off-farm inputs and management practices that restore maintain and sustain ecological harmony. Organic crop production is not only a holistic approach of

production system that gives quality Organic food, but helps to restore soil fertility on long term basis. It is relatively independent production system compared to conventional agriculture, which depends mostly on synthetically produced inputs i.e. fertilizers, fungicides, insecticides, herbicides, growth regulators. In the organic crop production system, it is observed that there is yield drop during the conversion period as it takes some time for the soil and plants to reach equilibrium. Yield of crops rise again once management systems get established.

Use of organic manures help in mitigating multiple nutrient deficiencies. Application of organic manures to acidic soil reduces the soluble and exchangeable Al temporarily by forming complex and provides better environment for growth and development in addition to improvement in physical, chemical and biological properties of soil [1]. Being environmental friendly and low cost input, greater emphasis has been given on application of bio-fertilizers with organic manures which plays a significant role in plant nutrition. The role of biofertilizers is perceived as growth regulators besides biological nitrogen fixation collectively leading to much higher response on various growth and yield attributing characters [2]. The agro-climatic condition prevailing in the low hills of Nagaland have been found to be highly favorable for amaranth cultivation. But very limited information is available about the nutrient requirement of amaranth in North Eastern region including acidic soils of Nagaland in particular. Taking into account the various facts and aspects, the present investigations was undertaken to study the impact of different organic manures and biofertilizers on fresh yield and economics of amaranth under foothill condition of Nagaland.

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Materials and Methods

The experiment was carried out in the experimental farm, Department of Horticulture, Nagaland University, School of Agricultural Sciences and Rural Development, Medziphema Campus, Nagaland in 2015 and 2016. The field is located at the altitude of 304.8 m above mean sea level with geographical location at 20^0 45´ 43´´ N latitude and 93^0 53´04´´ E longitudes. Plot size measured 2.4 m × 2.0 m and spacing was maintained at 30 × 10 cm. The experiments were laid out in randomized block design (RBD) with three replications. The treatments consisted of T_1-Recommended NPK (100:50:50 kg ha^{-1}), T_2-Vermicompost 5 t ha^{-1}, T_3-FYM 20 t ha^{-1}, T_4-Pig manure 15 t ha^{-1}, T_5-Vermicompost 5 t ha^{-1} + PSB + *Azospirillum* (each 5 kg ha^{-1}), T_6-FYM 20 t ha^{-1} + PSB + *Azospirillum* (each 5 kg ha^{-1}), T_7-Pig manure 15 t ha^{-1} + PSB + *Azospirillum* (each 5 kg ha^{-1}). N, P and K were given through Urea, SSP and MOP respectively. Full dose of P and K and half dose of N were applied at the time of transplanting and remaining half dose of N was given in two equal doses i.e. 30 and 60 days after transplanting. Manures viz., FYM, Pig manure and vermicompost were incorporated as per treatment in respective plot prior to transplanting. Biofertilizers were inoculated to seedling prior to transplanting as seedling dip method @ 5 kg ha^{-1}. Data were recorded on fresh yield of amaranth. Treatment-wise economics was carried out by calculating the cost of cultivation based on prevailing rates of input and output. Gross income was calculated by yield multiplied by whole sale rate of amaranth @ Rs 20 kg^{-1}. Net income was estimated by deducting the total cost of cultivation (fixed cost + treatment cost) from gross income of the particular treatment and benefit cost ratio was worked out by dividing net income from total cost of cultivation. The statistical analysis was carried out.

Results and Discussion

Fresh yield

Table 1 shows the impact of differnt organic manures and biofertilizers on fresh yield of amaranth. As evident from the table, the highest fresh yield of amaranth (135.24 q ha^{-1}) was recorded with application of Vermicompost 5t ha^{-1} + PSB + *Azospirillum* (each 5 kg ha^{-1}). The lowest leaf yield (104.61 q ha^{-1}) was recorded with application of Pig manure (15 t ha^{-1}). Organic manures supply essential nutrient in balanced ratio

Table 1. Impact of different organic manures and biofertilizers on fresh yield economics of amaranth (mean of two year)*FYM (0.5% N) Rs 500 t^{-1}, Pig manure (0.75% N). Rs 700 t^{-1}, Vermicompost (1.5% N) - Rs 10,000 t^{-1}).

Treatments	Fresh yield (q ha^{-1})	Gross income (Rs)	Cost of cultivations (Rs)	Net income (Rs)	B : C
T_1	113.07	226140	43116	183024	1: 4.24
T_2	122.49	244980	86000	158980	1: 1.85
T_3	113.54	227080	46000	181080	1: 3.94
T_4	104.61	209220	46500	180580	1: 3.88
T_5	135.24	270480	87000	183480	1: 2.11
T_6	126.26	252520	47000	205520	1: 4.37
T_7	116.82	233640	47500	186140	1: 3.92
SEm ±	1.84				
CD at 5%	5.03				

and improved physical, chemical and biological properties of soil which helps in better nutrient absorption and utilization by plant resulting higher value of yield attributing characters. The vermicompost would have improved the physical, chemical and biological properties of soil which helps in better nutrient absorption and utilization by plant resulting better plant growth. This might be attributed to certain growth promoting substances secreted by the biofertilizers which in turn might have led to better root development, better transportation of water, uptake and deposition of nutrients. Application of Vermicompost 5 t ha^{-1} + Phoshotika + *Azospirillum* @ each 5 kg ha^{-1} gave the highest amaranth leaf yield (52.29 q ha^{-1}) [3]. These findings are in agreement with Ansari [4], Shukla et al. [5], Sharma and Agarwal [6].

Economics

Application of organic manures and biofertilizers alone or in combination has appreciable effect in the altering of economics of amaranth (Table 1). It is evident from the findings that the most profitable way for cultivating amaranth could be achieved by application of FYM 20 t ha^{-1} + PSB + *Azospirillum* (each 5 kg ha^{-1}) which gave the highest net return of Rs 205, 520 along with cost benefit ratio of 1:4.37 followed by Rs 186,140 with the application of Pig manure 15 t ha^{-1} + PSB + *Azospirillum* (each 5 kg ha^{-1}). The reason of high net economic return (profit) in the treatment of FYM 20 t ha^{-1} + PSB + *Azospirillum* (each 5 kg ha^{-1}) was due to low input cost and high yield. Lowest net return of Rs 158, 980 was obtained in the treatment of Vermicompost 5 t ha^{-1} due to high cost of vermicompost (Rs 10,000 t^{-1}). Similar results were also reported by Patel et al. [7] and earlier results [2].

Conclusion

It can be concluded from the results that FYM 20 t ha^{-1} + PSB + *Azospirillum* (each 5 kg ha^{-1}) may be recommended for sustainable production of Amaranth and to nourish the soil fertility under the foothill condition of Nagaland.

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