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THE IMPACT OF ORGANIC AMENDMENTS FOR SUSTAINABLE AMARANTHUS (Var. *Arka suguna*) PRODUCTION

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ABSTRACT

Amaranthus (*Amaranthus sp.*) is now widely grown as vegetables both in tropics and sub-tropics area of the world. It can be grown throughout the year and can be harvested in a very short time. For vegetables and seed production, amaranth is the best grown in winter. As one of the nutritious and delicious vegetables, amaranth is a popular vegetable in India. The pure organic cultivation is complete exclusion of inorganic fertilizers and pesticides, but advocates the use of organic manures and biological pest control methods. In India, only 30% of total cultivable area is covered with fertilizers where irrigation facilities are available and in the remaining 70% of arable land, which is mainly rain-fed, negligible amount of fertilizers is being used. They normally grow for their own consumption and have little surplus since organically grown vegetables are lower in yield compared to the use of inorganic fertilizers. This is mainly due to the lack of standardized production technology for organic cultivation. In order to standardization of production technology for organic cultivation of amaranthus this study was framed. The amaranth variety Arka Suguna from IIHR, Bangalore recorded highest leaf yield of 190.24 q ha^{-1} in the treatment T5 (Vermi compost @ 5t ha^{-1} +PSB+ Azospirillum @ 5kg ha^{-1} each). Yield under inorganic fertilizer treatment (Full RDF as per Crop production Guide) was 141.92 q ha^{-1}. No serious pest and diseases were recorded during the crop growth period [RDF: Apply FYM 25 t ha^{-1}, *Azospirillum* 2 kg and *Phosphobacteria* 2 kg ha^{-1}, N 75 kg and K 25 kg ha^{-1} as basal dose]. The shelf life of the produce was highly influenced by the organic inputs compared to the inorganic amendments. The increased shelf life of the produce was obtained in the treatment T5 (Vermi compost @ 5t ha^{-1} +PSB+ Azospirillum @ 5 kg ha^{-1} each) with 3.40 days.

(**Key Words:** Amaranthus, Organic amendments, Vermicompost and Leaf yield)

INTRODUCTION

The genus *Amaranthus* belongs to the family Amaranthaceae. The genus contains about 60 species and three main species that appear to be superior for use as vegetable are *A.cruentus, A. dubius and A. tricolor* (Daloz and Munger, 1980). Amaranthus is viewed as an important crop for arid regions due to their relatively low water requirement and photosynthetic efficiency, and being C_4 plants which makes efficient use of CO_2. They can photosynthesize at higher rates even under high temperature and hence can grow rapidly during warm season. Amaranthus grows well in both hot humid and hot dry climates between 25 and 30°C. It is photoperiod-sensitive and most species will flower when day lengths are shorter than 12 hours. It can be grown in a wide variety of soils with an ideal pH of 5.5-7.5.

There is a huge potential for these rapidly maturing crops that fit into multiple cropping systems. These species can play a special role in relieving protein malnutrition because they have higher lysine content than other cereals. Thus, amaranthus is a prime crop for cultivation by the small farmers of the less developed countries where protein deficiencies are often major nutritional problems (Khan *et al.,*2008).

Amaranthus leaves and succulent stems contain high levels of vitamins, including â-carotene (precursor of vitamin A), vitamin B6, vitamin C, and dietary minerals such as calcium (350-400 mg 100 g^{-1}), iron (38 mg 100 g^{-1}), magnesium, phosphorus, potassium, zinc, copper and manganese (Makus and Davis, 1984 and Susan and Anne, 1988). Despite these nutritional benefits, the vegetable is known to contain high content of anti-nutrients such as nitrates (1.8-8.8 g kg^{-1} dry matter), oxalates (1-2%), cyanides and alkaloids that might undermine these nutritional benefits (Aletor and Adeogun, 1995). The significance of nitrates in human health derives from the fact that exposure to large amounts of nitrates can lead to formation of carcinogenic nitrosamines and gastric cancer (Mirvish, 1983). The

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European Commission in 1997 set an Acceptable Daily Intake (ADI) for nitrate ion at 3.65 mg kg^{-1} body weight. It is therefore, of importance to know the levels of nitrate in the accessions of *Amaranthus* which are available in this area and be able to identify accessions with low levels of nitrate (Mnkeni *et al*., 2007). Hence, there is a need to develop varieties with low anti-nutrients and high biomass production.

The $capita^{-1}$ consumption of green leafy vegetables ranged between 48 and 66 grammes (Prabha and Nath, 2009). The $capita^{-1}$ consumption of green leafy vegetables was less than 14 g as against a figure of 50-100 g recommended by ICMR. Hence, there is a scope for crop improvement of green leafy vegetables in order to meet the nutritional requirement of the population. Many technologies were adopted to increase the yield and quality of amaranthus till now but production of pesticide free produces are difficult to the farmers. Since lack of organic inputs and standardization of organic manure for amaranthus cultivation is not done. Hence, the research was focused on standardization of organic inputs for the yield and yield contributing characters of amaranthus.

MATERIALS AND METHODS

The field experiments on "The impact of organic amendments for sustainable amaranthus production" were carried out at College Orchard, Department of Horticulture, Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal, U.T. of Puducherry. The Arka Suguna, amaranthus variety chosen for the study and the experiment was conducted for three seasons viz., 2016 to 2019. The crop was raised in the college orchard in a RBD design with three replications. Different treatments of organic amendments were taken for the experiments viz., Full dose of RDF, Vermicompost, FYM, Poultry manure, Vermicompost, Phosphobacteria and Azospirillum at the experimental plot, PAJANCOA & RI. Each treatment was applied in a separate plot with the size of 3x3 m^2 with spacing of 10 x 5 cm (Table 1).

Table1. Treatment details

Sr. No.	Treatments	Details
1.	T1	Full RDF as per Crop production Guide. [RDF: Apply FYM 25 t ha^{-1}, *Azospirillum* 2 kg and *Phospho bacteria* 2 kg ha^{-1}, N 75 kg and K 25 kg ha^{-1} as basal dose]
2.	T2	Vermi compost-2 t ha^{-1}
3.	T3	FYM @ 20 t ha^{-1}
4.	T4	Poultry manure @ 5 t ha^{-1}
5.	T5	Vermi compost @ 5 t ha^{-1} +PSB+ Azospirillum @ 5 kg ha^{-1} each
6.	T6	FYM @ 20 t ha^{-1} + PSB + Azospirillum @ 5 kg ha^{-1} each
7.	T7	Poultry manure @ 5 t ha^{-1} +PSB+ Azospirillum @ 5 kg ha^{-1} each

RESULTS AND DISCUSSION

Results indicated that all three year yield traits *viz*., Fresh leaf yield kg $plot^{-1}$, total leaf yield kg ha^{-1} and Shelf life of the produces (days), the fresh yield of the amaranthus had significant effect on different type of treatment applications. Whereas the control plot was apparently lower [T1 - RDF: Apply FYM 25 t ha^{-1}, *Azospirillum* 2 kg and *Phospho bacteria* 2 kg ha^{-1}, N 75 kg and K 25 kg ha^{-1} as basal dose]. The amaranth variety *Arka suguna* from IIHR, Bangalore recorded highest leaf yield of 205.00 q ha^{-1} during the third year trail and in case of pooled analysis it has recorded 190.24 q ha^{-1}. In the treatment T5 which was having Vermi compost @ 5t ha^{-1} +PSB+ Azospirillum @ 5kg ha^{-1} each. Followed by the treatment T6 (FYM @ 20t ha^{-1} + PSB + Azospirillum @ 5kg ha^{-1} each) recorded highest in leaf yield of 171.56 q ha^{-1}. Yield under inorganic fertilizer treatment was 141.92 q ha^{-1} in pooled data analysis for all three years (Table 2). Similar result was also reported by Miah *et al.* (2013) in amaranthus and Amanullah and Imran Khan, (2017) in Maize as the organic amendment compost increased the yield and yield related characters compared to the inorganic fertilizers.

Leaf yield is an important component that helps to determine the input efficiency. The increase in yield related traits *viz*., plant height, no. of leaves and individual plant weight of amaranth plants amended with organic is probably due to release of nutrients which promoted vigorous plant growth through efficient photosynthesis (Sanni, 2016). Nitrogen fertilization had a tendency to increase plant height by that way highest yield as nitrogen involves in cell division and cell elongation of plants (Mazumder *et al*., 2019). The treatment T5 (Vermi compost @ 5t ha^{-1} +PSB+ Azospirillum @ 5kg ha^{-1} each) of this study includes large quantity of vermicompost and which was influence the yield of amaranthus through slow release of nitrogen and other nutrient to the crops. Combined effect of NPK (25%) and vermicompost (75%) give higher yield of

Table 2. Effect of different organic manures on leaves yield (kg plot^{-1}), green leaves yield (q ha^{-1}) and shelf life of the amaranthus

Sr. No.	Treatments	Details	Leaves yield (kg plot^{-1})			Green leaves yield (q ha^{-1})			Shelf life (Days)			Pooled mean		
			I Year	II Year	III Year	I Year	II Year	III Year	I Year	II Year	III Year	**Leaves yield (kg plot^{-1})**	**Green leaves yield (q ha^{-1})**	**Shelf life (Days)**
1.	T1	Full RDF as per Crop production Guide	13.34	12.12	13.40	148.22	134.66	148.88	2.7	2.6	2.40	12.60	141.92	2.80
2.	T2	Vermicompost 2 t ha^{-1}	12.76	11.46	12.55	141.77	127.33	139.44	2.6	2.5	2.00	12.89	130.10	2.45
3.	T3	FYM @ 20 t ha^{-1}	13.82	12.13	13.00	153.55	134.77	144.44	2.4	2.3	2.10	13.25	140.40	2.40
4.	T4	Poultry manure @ 5 t ha^{-1}	10.02	9.43	9.20	111.33	143.66	102.22	2.0	1.9	2.00	10.6	120.20	1.89
5.	T5	Vermicompost @ 5t ha^{-1} +PSB+ Azospirillum @ 5 kg ha^{-1} each	15.53	16.84	18.45	172.55	187.11	205.00	3.8	3.6	3.90	17.89	190.24	3.40
6.	T6	FYM @ 20t ha^{-1} + PSB + Azospirillum @ 5kg ha^{-1} each	14.20	15.38	16.35	157.77	170.88	181.66	3.2	3.1	3.20	15.6	171.56	3.28
7.	T7	Poultry manure @ 5t ha^{-1}+PSB+ Azospirillum @ 5 kg ha^{-1} each	10.65	14.15	15.20	118.33	157.22	168.88	3.0	2.8	2.60	14.65	149.20	2.59
		S Ed (±)	**0.68**	**0.21**	**0.58**	**8.58**	**9.01**	**8.04**	**0.02**	**0.02**	**0.02**	**0.68**	**8.62**	**0.02**
		CD (5%)	**1.44**	**0.43**	**1.24**	**16.02**	**17.24**	**16.43**	**0.05**	**0.06**	**0.04**	**1.32**	**17.82**	**0.05**

tomato, cabbage, okra compared to recommended dose of full amount of NPK and control (Islam *et al*., 2017, Farjana *et al*., 2019 and Akhter *et al*., 2019). Changes in the number of leaves are bound to affect the overall performance of amaranth as the leaves serve as photosynthetic organ of the plant. The similar results were found with Miah *et al*. (2013) in amaranthus and Sarkar (2017) in Strawberry as the combination of organic amendments may be effective on the yield and quality parameters viz., Plant height, no. of suckers, no. of fruits plant^{-1} and other yield parameters.

The shelf life of the produce is highly influenced by the organic inputs compared to the inorganic amendments. The increased shelf life of the produce was obtained in the treatment T5 (Vermi compost @ 5t ha^{-1} +PSB+ Azospirillum @ 5kg ha^{-1} each) with 3.40 days followed by the treatment T6 (FYM @ 20t ha^{-1} + PSB + Azospirillum @ 5kg ha^{-1} each) with 3.28 days. The control with recommended dose of fertilizers recorded lowest shelf life of the produce as compared to T5 (Vermi compost @ 5t ha^{-1} +PSB+ Azospirillum @ 5kg ha^{-1} each) and T6 (FYM @ 20 t ha^{-1} + PSB + Azospirillum @ 5kg ha^{-1} each) with 2.80 days. Lowest shelf life of the produce was recorded in T4 (Poultry manure @ 5 t ha^{-1}) with 1.89 days. Similar results were reported by Islam *et al*. (2017) as the higher number of fruits plant^{-1} (73.7) and plant height (73.5 cm) were obtained from mixed fertilizers (organic 2/3 + inorganic 1/3) or IPNS (integrated plant nutrient system) in Roma VF than other treatments and Farjana *et al*. (2019) reported that the combination of organic and inorganic fertilizer had the highest growth (plant height, stem length, root length, number of roots etc.) and yield (105.93 t ha^{-1}) in cabbage. The yield was 63.92% higher from the combined effect of organic fertilizer with vermicompost as compared to control. Application of organic manures might have reduced the rate of respiration and transpiration resulting in reduced ethylene production during storage of produces and also other vegetables, increasing the shelf-life. Similar findings were observed in amaranthus and tomato by Ranjit *et al*. (2013) and the results from the study revealed that the shelf life, total soluble solids, total sugar, vitamin A and vitamin C contents were significantly influenced by the application of different sources of organic nutrients. Also, substitution of 25% inorganic nitrogen with organic manure along with microbial amendment influenced shelf life and nutritional qualities of tomato.

REFERENCES

Akhter, A., M.A. Islam and M.R. Karim, 2019. Effects of nutrient management and netting on the growth and yield of okra. Fundam. Appl. Agric., **4**(1): 627-631.

Aletor, V.A. and O.A. Adeogun, 1995. Nutrients and anti-nutrient components of some tropical leafy vegetables. Food Chem. **53:** 375-379.

Amanullah and Imran Khan, 2017. Compost and Nitrogen application influence phenology, growth and biomass yield of spring maize under deep and conventional tillage system. J.Soils and Crops, **27** (1) 1-6.

Daloz, C.R.and H.M.Munger, 1980. Amaranth – an unexploited vegetable crop. Hort Sci. **15 :** 383.

Farjana, S., M.A. Islam and T. Haque, 2019. Effects of organic and inorganic fertilizers, and mulching on growth and yield of cabbage (*Brassica oleracea* var. Capitata L.). J. Hortic. Postharvest Res.**2**(2): 1-10

Islam, M.A., S. Islam, A. Akter, M.H. Rahman and D. Nandwani, 2017. Effect of organic and inorganic fertilizers on soil properties and the growth, yield and quality of tomato in Mymensingh, Bangladesh J. Agril. Res. **7** :18.

Khan, M.S., N.C. Shil and S. Noor, 2008. Integrated nutrient management for sustainable yield of major vegetable crops in Bangladesh, Bangladesh J. Agril. Res. **4**: 81

Makus, D.J. and D.R. Davis, 1984. A mid-summer crop for fresh greens or canning: vegetable amaranth. Ark. Farm Res. **33**:10.

Mazumder, N., T. Sultana, P. Paul, M.M. Noor, 2019. Influence of NPK fertilizer and spacing on growth parameters of onion (*Allium cepa* L. Var. BARI piaz-1). Res. Agric. Livest. Fish, **6** (1): 19-25.

Miah, M.Y., P.K. Roy, M.S. Islam and K.I Fazal, 2013. Stem amaranth yield in response to organic manuring. J. Environ. Sci. Nat. Resour. **6** (2): 19 -23.

Mirvish, S.S. 1983. The etiology of gastric cancer: Intra-gastric nitrosamide formation and other theories. J. Natl. Cancer Inst. **71**: 631.

Mnkeni, A.P., P. Masika and M. Maphaka, 2007. Nutritional quality of vegetable and seed from different accessions of *Amaranthus* in South Africa. Water SA, **33**: 377-380.

Prabha, R. and K.G. Nath, 2009. Intrafamily distribution of green leafy vegetables. J. Dairying Foods and Home Sci. **28** (3/4): 237-240.

Sanni, K.O. 2016. Effect of compost, cow dung and NPK 15-15-15 fertilizer on growth and yield performance of Amaranth (*Amaranthus hybridus*). Int. J. Adv. Sci. Res. **2 : 76** - 82.

Sarkar, Anemesh, 2017. Efficacy of vermicompost and aoatobactor on growth, yield and quality of strawberry cv.Festival. J. Soils and Crops, **27** (2) 1-5.

Susan,M.and P.Anne, 1988. Tropical and sub-tropical food. 2nd edition. Macmillan Publisher.England, pp.102 - 106.

Ranjit Chatterjee, J.C. Jana and P.K. Paul, 2013. Vermicompost substitution influences shelf life and fruit quality of tomato (*Lycopersicon esculentum* Mill.), American J. Agric. Sci. and Tech. **1 :** 69-76.

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