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Influence of organic nutrition on the seed yield and quality in *Amaranthus tricolor*

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ABSTRACT A field experiment on the seed production in *Amaranthus tricolor* variety Arun, was conducted in RBD with 12 treatments involving combinations of different sources of nutrients in three replications during December 2009 - March 2010. The results revealed that highest seed yields were recorded in the treatments in which the entire nutrient requirement of the crop was given with organic sources: 100% POP recommendation as organics was highest (607.89 kg ha^{-1}) followed by 150% (517.17 kg ha^{-1}). Economic analysis showed highest benefit cost ratios for inorganic sources despite lower yields on account of the lower cost of nutrient inputs compared to the bulk quantity of organic sources required for the varying levels of substitution. Seed quality characters such as 1000 seed weight and vigour index were also significantly higher for the organically grown seed crop of Amaranthus.

Key words: Cost benefit ratio, organic nutrition, seed crop, yield, quality, vigour index

The need for achieving food security has necessitated increased cultivation and production of food crops in the country. Vegetables form an indispensable component of human diet and leafy vegetables contribute significantly from the nutritional point of view. Non availability of quality seeds in adequate quantities has been identified as one of the bottlenecks for increased and secured production. Less than 25 percent of the seed demand is presently met by authorised agencies and the remaining are mostly farmers' saved seeds, the quality of which is under question. In this background, a field experiment on quality seed production in *Amaranthus tricolor* (L.) was initiated giving emphasis to organic nutrition of the mother crop for seed setting and maturation.

MATERIALS AND METHODS

The experiment was laid out during December, 2009 to March, 2010 in randomized block design with 12 treatments involving different combinations of organic sources of nutrients in three replications. The initial soil chemical properties were pH 5.8, organic carbon 0.56 percent, and available N, P and K 301.3, 43.8, 47.04 kg ha^{-1} respectively. The red variety of Amaranthus, Arun was used and the nutrient doses were based on the package of practices recommendation (POP) of Kerala Agricultural University. The treatments were T1 - 100% POP as chemicals; T2-25% N and K of POP as foliar spray; T3- 50 % of POP N and K as foliar spray; T4-25% N as vermicompost; T5-25% N as poultry manure; T6- 25% N as vermicompost + poultry manure; T7-50% N as vermicompost; T8-50% N as poultry manure; T9-50% N as vermicompost+ poultry manure; T10- 100% POP with organic sources; T11-150% POP as chemical fertilizers; T12-150% POP with organic sources. The crop was harvested for vegetable twice, top dressed and left for flowering and seed setting. The seeds were left to mature on the plants and harvested in a single cut. The harvested crops were dried in sun, threshed manually on silpaulin sheets for seed extraction and observations on seed yield ha^{-1}, germination percentage, 100 seed weight and vigour index were recorded. The observations recorded were statistically analyzed and the economics of Amaranthus seed production under the different nutrient management practices were also compared.

RESULTS AND DISCUSSION

Growth and vegetable yields

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The data on the plant growth characters of Amaranthus at harvest are presented (Table 1). Perusal of the observations reveal better plant height and root growth in the treatments which received 150 percent POP recommendation of NPK as organic sources, a combination of vermicompost, poultry manure, biofertiilzers, neem cake and ash. The effect of the sources of nutrients was significant on plant height alone. The vegetable yields recorded from the first two harvests in response to the different nutrient sources were non significant thought comparatively higher yields have been recorded in the organically grown plants, 13.32 and 12.69 t ha^{-1} respectively in the 100 % and 150 % levels of organic nutrition. The increase in growth and yield components in the present study may be due to the fact that organics enhance microbial activity which might have helped and improved availability of nutrients through mineralisation, eventually leading to better canopy coverage, higher photosynthesis and translocation of photosynthates from source to sink [1]. Vermicompost, poultry manure and farm yard manure in combination would have ensured accumulation and availability of nutrients for longer period and reduced losses through leaching. The increased microbial activity in organic manures and the biofertiilzers applied improved the availability of and uptake of soil phosphorus and nitrogen leading to higher accumulation of photosynthates and their distribution to the developing ovules. These results are in accordance with the findings of [2-4].

Seed yield and quality

The influences of the different sources of nutrients on the seed yield and seed quality parameters are presented (Table 2). In compliance with the data recorded on the growth and vegetable yields, comparatively higher seed yields of 607.89 and 517.17 kg ha^{-1} have been recorded in the organically grown treatments at 100 and 150 % POP recommendations respectively (Fig.1),

Table 1. Growth and yields in Amaranthus seed crop under different sources of nutrients

	Treatment	Plant height (cm)	Root length (cm) length (cm)	Vegetable yield (qha^{-1})
T1	100% POP as chemicals	124.33	16.67	7523.81
T2	25% POP as foliar spray	115.67	14.00	8514.58
T3	50% POP as foliar spray	118.00	15.33	6216.07
T4	25% POP as vermicompost	128.33	14.67	11413.99
T5	25% POP as poultry manure	118.00	13.00	10211.01
T6	25% POP as vermicompost and poultry manure	116.00	15.67	10462.14
T7	50% POP as vermicompost	79.00	16.33	7708.33
T8	50% POP as poultry manure	126.33	17.70	6647.50
T9	50% as vermicompost and poultry manure	131.67	19.00	8927.08
T10	100 % POP as organics	119.67	14.67	13322.02
T11	150% POP as chemicals	91.33	15.33	8601.78
T12	150% POP as organics	141.33	17.67	12691.07
CD (p=0.05)		22.81	NS	NS

Table 2. Effect of different sources of nutrients on the seed yield and quality in of Amaranthus

Treatments	Seed yield kg/ha	1000 seed weight	Moisture content %	Seedling length (cm)	Vigour index
T1 100% POP as chemicals	402.62	2.46	7.00	11.53	983.7
T2 25% POP as foliar spray	376.23	2.09	7.30	11.20	987.9
T3 50% POP as foliar spray	292.01	2.16	8.43	13.20	1163.2
T4 25% POP as vermicompost	345.76	2.03	6.53	13.93	1210.7
T5 25% POP as poultry manure	429.43	2.00	6.46	14.20	1287.3
T6 25% POP as vermicompost and poultry manure	348.91	2.17	6.23	12.53	1133.9
T7 50% POP as vermicompost	481.12	2.11	7.56	15.83	1371.5
T8 50% POP as poultry manure	364.72	1.93	7.63	14.83	1324.7
T9 50% as vermicompost and poultry manure	324.13	1.74	7.13	13.80	1217.3
T10 100 % POP as organics	607.89	2.72	7.33	16.90	1666.3
T11 150% POP as chemicals	362.78	2.41	7.10	13.20	1002.9
T12 150% POP as organics	517.17	2.16	7.36	16.8	1657.5
CD (p=0.05)	NS	NS	0.219	1.22	145.64

however, the effect was non significant. The quality of the seed was evaluated in terms of the germination percentage and vigour index and as germination test was conducted within 30 days after harvest, the treatments did not show any significant variation among them and recorded 90 to 98% germination. Nevertheless, the influence on vigour index was significant, indicating that as planting material , organically produced seeds were significantly superior to integrated use of inorganic and organic sources. Higher seed germination and vigour indices coupled with vigorous seedlings are regarded as indicators of better seed quality. Increased germination percentage may be attributed to the bolder seeds that contained greater metabolites for resumption of embryonic growth during germination. In addition to these metabolites, the increase in seed quality parameters might be due to the changes in metabolism during fruit and seed development which led to the release of enzymes responsible for degradation of macromolecules into micromolecules within the seed. In addition it could also be due to the accumulation of some enzyme or growth promoting substance in the seeds apart from protein that promoted germination. The results fall in line with the findings of [5-7] in different vegetable crops. Seedling vigour index was also higher due to higher seedling length and germination percentage.

Economics of seed production

The economic analyses revealed significant variations in the B: C ratios and the values were recorded to range from 1.41:1 in the

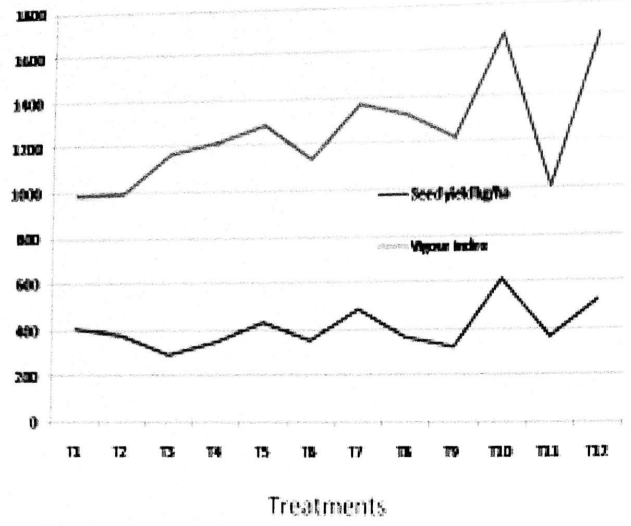

Fig.1. Variations in the yield and vigour index of Amaranthus seeds under varying sources of nutrients

organically grown fields to 2.57:1 in the POP chemical treatment (Fig. 2). Organic nutrition for Amaranthus seed production was found to be less economic than chemical nutrition. This was recorded despite the very high yields in the 150% POP treatment as organics. It is interpreted that the high cost of the organic manures accounted as purchased input is responsible for the higher cost and hence lower net returns. Organic cultivation is a costly affair unless organic manures are produced by the farmer himself. The nutrient contents of these materials vary highly- vermicompost prepared from crop residues such as banana pseudo stem, dry leaves, grasses etc contain less than 0.5 percent nutrients in them. The nitrogen contents of the vermicompost and poultry manure used were 0.20 and 0.14 percent respectively on analysis, thus forcing larger bulks of the material to satisfy the nitrogen requirement of the crop which added to the input cost.

Similar observations on organic farming being profitable when input are produced within the farm, have been made [8]. The study brings to light the potential of organic seed production in Amaranthus. The crop may be harvested for vegetable twice and then left for flowering and seed production,

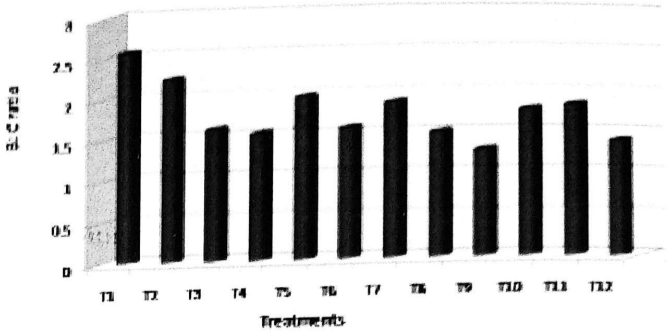

Fig. 2. Variations in B: C ratios of Amaranthus seed crop with different nutrient sources (CD=0.634)

the slow release of nutrients from the organic manures benefitting seed maturation and yields. The cost of cultivation is high as the organic nutrient sources for the cultivation were purchased inputs but will turn out to be highly profitable if they are produced within the farm.

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