Seed Res., Vol. 42(2): 141-146 December 2014

Nutrient management for quality seed production in amaranth (*Amaranthus tricolor*)

Sheeba Rebecca Isaac*
Farming Research System Station, Kollam, Kerala
sheebarebecca@yahoo.co.in

ABSTRACT A field experiment was conducted in Kollam district, southern Kerala during 2009-2010 to study the influence of different nutrient sources on the seed production in red Amaranth (*Amaranthus tricolor*) variety Arun. The NPK dose of 112.5:50:62.5 kg ha^{-1} was given in 12 combinations of different sources of nutrients. The results revealed that significant higher seed yields of 607.89 kg ha and 517.17 kg ha^{-1} were recorded in the treatments in which the nutrient and were supplied through organic sources at 100 and 150 percent of recommended dose. Seed quality traits such as 1000 seed weight and vigour index were also significantly higher in organically grown seed crop. Higher B:C ratio was observed in inorganic treatments, despite lower yields as compared to organic treatments. This can be attributed to the lower cost of nutrient inputs, compared to the bulk quantity of organic sources required for the varying levels of substitution.

Keywords: Amaranth, organic nutrition, seed yield, 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 towards nutritional security [1]. Limited availability of quality seeds has been identified as one of the bottlenecks for increased and secured production. About 30 percent of the seed demand is presently met by authorized agencies and the remaining are mostly farmers' saved seeds, the quality of which is under question. Seed yield and quality are much dependent on several agronomic practices, among which, plant nutrition plays an important role [2]. Keeping in view of the above, a field experiment on quality seed production in *Amaranthus tricolor* (L.) was initiated to assess the influence of nutrient sources on the seed yields and quality.

MATERIALS AND METHODS

The experiment was laid out during 2009-2010 in randomized block design consisting of 12 treatments, involving different combinations of nutrient sources with 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 Amaranth cv. Arun was used and the recommended dose of nutrients 112.5:50:62.5 NPK kg ha^{-1} was applied. The experiment constited of twelve treatments *viz.*, T_1-100% RD of fertilizers; T_2-25% RDN and K as foliar spray; T_3-50% RDN and K as foliar spray; T_4-25% RDN as vermicompost; T_5-25% RDN as poultry manure; T_6- 25% RDN as vermicompost + poultry manure; T_7-50% RDN as vermicompost; T_8-50% RDN as poultry manure; T_9-50% RDN as vermicompost + poultry manure; T_{10}-100% RD as organic sources; T_{11}-150% RD as chemical fertilisers; T_{12}-150% RD as organic sources. The chemical fertilizers and organic manures were applied alone or in combinations as per treatments in three splits, basal, one month after sowing and after the first harvest. Full dose of phosphorus was applied at the time of sowing. The crop was harvested for vegetable twice, top dressed and left for flowering and seed setting. Seed crop were harvested at maturation in a single cut, dried under sun and threshed manually on

*Corresponding author

Received: January 2014 Revised: November 2014 Accepted: November 2014

paulin sheets for extraction. The observations on seed yield ha^{-1}, germination percentage, 100 seed weight and vigour index were recorded and statistically analysed as per standard procedures [3]. The benefit cost ratios of seed production under the different nutrient management practices were also compared.

RESULTS AND DISCUSSION

Growth and leaf yield

The data on the plant growth characters at harvest are presented in Table 1. The perusal of the data revealed better plant height and root growth in the treatments which received 150 percent recommended dose of NPK through organic sources, a combination of vermicompost, poultry manure, biofertilisers, neem cake and ash. The effect of the sources of nutrients was significant on plant height alone.

The leaf yield recorded from the first two harvests in response to the different nutrient sources were non-significant, though comparatively higher yields have been recorded in the organically grown plants, 13.32 and 12.69t ha^{-1} respectively in the 100 and 150 percent levels of organic nutrition. Higher leaf yields in amaranth with organic nutrition have been reported [4].

The increase in plant height may be due to the fact that organics matter improved availability of nutrients through mineralisation, eventually leading to better canopy coverage, higher photosynthesis and translocation of photosynthates from source to sink [5]. Vermicompost, poultry manure and farm yard manure in combination would have ensured accumulation and availability of nutrients for longer period and reduced the losses through leaching. The increased microbial activity in organic manures and bio-fertilisers 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 previous findings [6-8].

Table 1. Growth and yield in amaranth seed crop under different sources of nutrients

Treatment		Plant height (%)	Root length (cm)	Vegetable yield (t/ha^{-1})
T_1	100% RD as chemical fertilisers	124.33	16.67	7.52
T_2	25% RDN & K- foliar	115.67	14.00	8.51
T_3	50% RDN & K -foliar	118.00	15.33	6.22
T_4	25%RDN as VC	128.33	14.67	11.41
T_5	25% RDN as PM	118.00	13.00	10.21
T_6	25% RDN as VC+PM	116.00	15.67	10.46
T_7	50% RDN as VC	79.00	16.33	7.71
T_8	50%RDN as PM	126.33	17.70	6.65
T_9	50% RDN as VC+PM	131.67	19.00	8.93
T_{10}	100 % RD as OM	119.67	14.67	13.32
T_{11}	150% RD as chemical fertilisers	91.33	15.33	8.60
T_{12}	150% RD as OM	141.33	17.67	12.69
CD (p=0.05)		22.81	NS	NS

*OM- Organic manures VC- Vermicompost PM- Poultry manure

Seed yield and quality

The influence of the different sources of nutrients on the seed yield and quality parameters are presented in Table 2. Comparatively higher seed yield of 607.89 and 517.17 kg ha^{-1} was recorded in the organically grown treatments at 100 and 150% NPK recommendation, respectively (Fig. 1), but the treatment effect was non-significant.

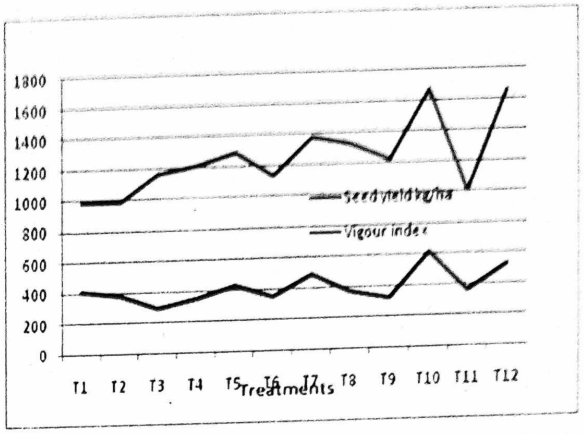

Fig. 1 Variations in the seed yield and vigour index of *amaranthus* seed under varying sources of nutrients

The quality of the seed was evaluated in terms of the germination percentage and vigour index. The treatments did not show any significant variation for germination percentage. Nevertheless, the influence on vigour index was significant, indicating that organically produced seeds were significantly superior to integrated use of inorganic and organic sources.

The increased germination percentage may be attributed to the bolder seeds that contained high 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 macro molecules into micro molecules within the seed. It could also be due to the accumulation

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

Treatments		Seed yield kg/ha^{-1}	1000 seed seed weight	Germination Moisture content (%)	Seedling length (cm)	Vigour index
T_1	100% RD as chemical fertilisers	402.62	2.46	7.00	11.53	983.7
T_2	25% RDN & K- foliar	376.23	2.09	7.30	11.20	987.9
T_3	50% RDN & K -foliar	292.01	2.16	8.43	13.20	1163.2
T_4	25%RDN (VC)	345.76	2.03	6.53	13.93	1210.7
T_5	25% RDN (PM)	429.43	2.00	6.46	14.20	1287.3
T_6	25% RDN (VC+PM)	348.91	2.17	6.23	12.53	1133.9
T_7	50% RDN (VC)	481.12	2.11	7.56	15.83	1371.5
T_8	50%RDN (PM)	364.72	1.93	7.63	14.83	1324.7
T_9	50% RDN (VC+PM)	324.13	1.74	7.13	13.80	1217.3
T_{10}	100 % RD (OM)	607.89	2.72	7.33	16.90	1666.3
T_{11}	150% RD (Chemical fertilisers)	362.78	2.41	7.10	13.20	1002.9
T_{12}	150% RD (OM)	517.17	2.16	7.36	16.8	1657.5
CD (p=0.05)		NS	NS	0.219	1.22	145.64

*OM- Organic manures VC- Vermi compost PM- Poultry manure

of some enzyme or growth promoting substance in the seeds, apart from protein that promoted germination. The results fall in line with the previous findings in different vegetable crops [9-11]. Seedling vigour index was also higher due to higher seedling length and germination percentage.

Soil properties

Significant variations in soil chemical properties was recorded, except for available P. soil pH was found to decline to very strongly acidic ranges (4.5-5.0) from the moderately acidic range (5.5-6.0); available status of nitrogen and phosphorus decreased, whereas that of potassium increased. The organic manures release organic acids on decomposition and inorganic fertilisers add to soil acidity, the combined effect would have caused the decline in pH values. Mineralisation of organic manures and subsequent release of organic acids leading to decrease in pH has been reported [12]. The increased uptake of nutrients for higher biomass production would have led to lower nutrient contents in soil. Increase in pH of soil is known to increase K fixation [13] while the lowering of pH as noted in the present study would have been responsible for higher status of available K in soil.

Economics of seed production

The economic analysis revealed significant variations in the benefit cost ratios and the values recorded ranged from 1:1.41 in the organically grown fields to 1:2.57 in the chemical fertilizer treated plots (Fig. 2) and such trend of higher B:C in 100 percent recommended dose of chemical fertilizer in leafy vegetables was recorded earlier [4]. Organic nutrition for amaranth seed production was found to be less economical than chemical nutrition. This was recorded, despite the very high yields in the 150 percent NPK application as organics. It is interpreted that the cost of organic manures, accounted

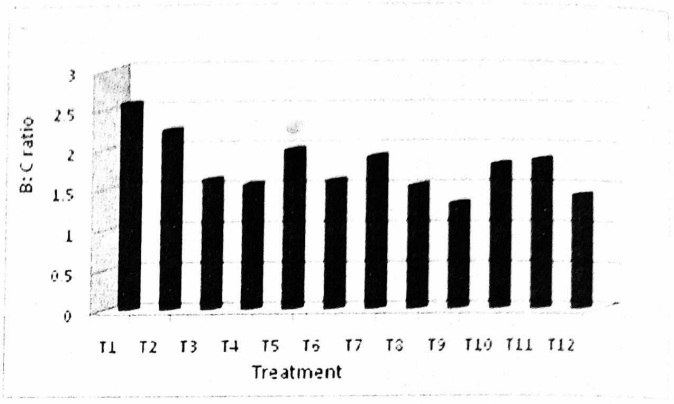

Fig. 2. Variations in B:C ratios of amaranth seed crop with different nutrient sources (CD-0.634)

as purchased input, is responsible for the higher cost of cultivation and hence lower net returns. Organic cultivation is a costly affair unless organic manures are produced by the farmer himself. The nutrient content of these materials vary; vermi-compost prepared from crop residues such as banana pseudostem, dry leaves, grasses etc., contain less than 0.5 percent nutrients. The nitrogen content of the vermi-compost and poultry manure used were 0.20 and 0.14 percent, respectively, thus forcing larger bulks of the material to satisfy the nitrogen requirements of the crop which added to the input cost significantly. Similar observations on organic farming being profitable when inputs are produced within the farm have been made [14].

CONCLUSION

The study emphasises to potential of organic seed production in amaranth. The crop may be harvested for vegetable twice and left for flowering and seed production, the slow release of nutrients from organic manures facilitate seed maturation and higher yields. The cost of cultivation was high, as the organic nutrient sources were purchased inputs but will be highly profitable, if they are produced within the farm.

ACKNOWLEDGEMENT

The paper forms part of the research project of the SRS Scheme of the Kerala State Council

Table 3. Effect of different nutrient sources on soil chemical properties

Treatments	pH	Organic C %	Available N kg/ha^{-1}	Available P kg/ha^{-1}	Available K kg/ha^{-1}
T_1	4.62	1.59	269.77	24.73	108.41
T_2	4.64	1.37	240.15	23.43	102.56
T_3	4.43	1.39	270.07	25.63	105.12
T_4	4.75	1.89	241.97	29.70	100.60
T_5	4.44	1.73	238.35	30.87	101.69
T_6	4.64	1.45	227.99	23.53	99.06
T_7	4.70	1.52	243.00	24.51	91.83
T_8	4.52	1.50	237.72	27.41	88.24
T_9	4.39	1.38	255.86	31.30	102.05
T_{10}	4.68	1.68	239.59	34.77	109.28
T_{11}	3.82	1.81	247.01	25.01	93.99
T_{12}	4.91	1.86	232.66	30.05	106.36
CD	0.014	0.013	42.61	NS	37.33

for Science Technology and Environment, Thiruvananthapuarm, Kerala and the financial assistance received is acknowledged.

REFERENCES

1. SANGEETHA IM (2004). Influence of micronutrient and harvesting stages on seed yield and quality in cluster bean *M.Sc. (Agri) Thesis* University of Agricultural Sciences, Dharwar.

2. GOMEZ KA AND GOMEZ AA (1984). Statistical Procedures for Agricultural Research. John Wiley and Sons, Inc. pp. 680.

3. LATHA, MADHAVI P, JOSHI VEENA, SIRESHA K AND VIJAYA M (2013). Performance of organic leafy vegetables production under hyderabad conditions. *Veg Sci* **40** (2): 243-5.

4. JEEVANSAB(2000). Effect of nutrient sources on growth, yield and quality of capsicum cv.California Wonder grown under different environments. *M.Sc. (Agri) Thesis*, University of Agricultural Sciences, Dharwad, Karnataka, India.

5. CHAVAN PJ, SYEDISMAIZ GB, BAIG MI AND MALEWAR G (1997). Effect of variousnitrogen levels through FYM and urea on yield, uptake of nutrients and ascorbic acid content in chilli (*Capsicum annuum*. L.). *J Ind Soc Soil Sci* **45** (4): 833-5.

6. SHASHIDHARA GB (2000). Integrated nutrient management for chilli (*Capsicum annuum* L.) in Alfisops of Northern Transition Zone of Karnataka. *M.Sc. (Agri) Thesis*, University of Agricultural Sciences, Dharwad, Karnataka, India.

7. SUTAGUNDI RB (2000). Effect of mulches and nutrient management on growth and yield of chilli (*Capsicum annuum* L.). *M.Sc. (Agri) Thesis*, University of Agricultural Sciences, Dharwad, Karnataka, India.

8. BALARAJ R (1999). Investigations of seed technological aspects in chilli (*Capsicum annuum* L.). *Ph.D. Thesis*, University of Agricultural Sciences, Dharwad, Karnataka, India.

9. ADEDIRAN AJ, TAIWO BL, AKANDE OM, SOBULE AR AND IDOWU JO (2004). Application of organic and inorganic fertilizer for sustainable maize and cow pea yields. *Nigeria J Pl Nutri* **27**: 1163-81.

10. GOGOI D, HAZARIK AS AND KOTOKY U (2004). Effect of bio-fertilisers on productivity and soil characteristics in banana. *Ind J Hort* **61** (4): 354-6.

11. SHEELA KR, LAKSHMI S, SHEHANA RS, PUSHPA KUMARI R AND NANDA KUMAR C (2010). Performance of intercrops as influenced by sources and levels of nutrients in coconut based cropping systems. *Geo bios* **37** (1): 13-6.