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Effect of Integrated Nutrient Management on Yield and Economics of Grain Amaranth (*Amaranthus hypochondriacus* L.)

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ABSTRACT: Grain Amaranth (*Amaranthus hypochondriacus* L.), a quick growing and upcoming subsidiary food crop of the future, belonging to the family Amaranthaceae and genus *Amaranthus*. Although, general package of practices for Grain Amaranth is available at all India level, there are limited studies on Integrated Nutrient Management. Hence, the field experiment was carried out to investigate the impact of integrated nutrient management on grain amaranth (*Amaranthus hypochondriacus* L) yield and economics at the field unit AICRP on Potential Crops, MRS, Hebbal, UAS, GKVK, Bengaluru during late *kharif*-2017. Twelve treatments were replicated three times in the RCBD design of the experiment. Bio-fertilizers and various combinations of organic and inorganic nutrition sources are used in treatments. The maximum net return per hectare was Rs. 47851 when 100% RDF and bio-fertilizers were applied. This resulted in significantly higher grain production (1681 kg ha^{-1}) and yield component, including panicle length (48.50 cm), panicle weight (53.73 g), and yield per plant (27.70 g plant^{-1}). Application of 100% N equivalent through vermicompost + bio-fertilizers resulted in a lower net return of Rs. 170.

Keywords: Economics, Grain Amaranth, Integrated Nutrient Management.

INTRODUCTION

Grain amaranth (*Amaranthus hypochondriacus* L.), a fast growing and potential future food crop, belongs to the genus Amaranthus and family Amaranthaceae. The seeds are very nutritious and popularly called as 'Dantina Beeja' in Kannada and 'Rajgira' in Hindi. It is a hardy plant with thick stalks and suitable for arid and semiarid tropics. Its excellent competitive ability, resistance to pests and diseases, and competitiveness enable its cultivation with minimal crop care.

In India, it is grown across the Himalayan hilly regions as well as the plains, in Southern India, and in some areas of Gujarat, Maharashtra, Orissa, and Eastern Uttar Pradesh (Bhag, 1994). Amaranth seed is well known for being extremely nutrient-dense and good in quality with its high protein content (14–16%) and lysine. The grain is also rich in calcium, phosphorus and iron when compare to other major cereals like rice, maize and wheat.

The productivity of the crop must be increased in order to get better yields, hence good nutrient management is crucial. Due to the rising price of fertilizers and their constrained supply, production costs rose dramatically, lowering profits. Integrating chemical and organic sources and managing them well has shown a lot of potential. The combined use of organic manures and fertilizers not only increases yields but also improves production stability (Narain, 1999). Now a days, integrated nutrient management is becoming more significant. As a substitute for utilising chemical fertilizers and organic manures to save nitrogen fertilizers, Chaudhari *et al.* (2009) advised utilising affordable and environmentally friendly bio-fertilizers. Bio-fertilizers are acknowledged as a crucial element of sustainable agriculture.

MATERIAL AND METHODS

The field experiment was carried out at the field unit AICRN, potential crops, MRS, Hebbal, UAS, GKVK, Bengaluru, in late *kharif*-2017 to examine integrated nutrient management affects on grain amaranth's economics and yield (*Amaranthus hypochondriacus* L.) This chapter presents specifics of the tools utilised and procedures used. The farm is located in the Eastern Dry Zone of Karnataka at latitude 13° 04' North, longitude 77° 58' East, and an elevation of 880 metres above mean sea level. The test site's soil type was sandy loam. Before the experiment, composite soil samples were randomly selected from the experimental site and their chemical composition was examined.

The experiment was set up using a Randomized Complete Block Design (RCBD) with three replications, and it included twelve treatments: T_1: 100% of the recommended fertilizer dose; T_2: 50% of the recommended fertilizer dose + 50% of the equivalent nitrogen from farm yard manure; T_3: 50% of the recommended fertilizer dose + 50% of equivalent nitrogen from vermicompost; T_4: 50% of the recommended fertilizer dose + 25% of the equivalent nitrogen from both FYM and VC; T_5: 75%+25 per cent N equivalent through FYM, T_6: 75% of the recommended fertilizer dose +25% nitrogen equivalent through VC; T_7: 50% nitrogen equivalent through farm yard manure + 50% nitrogen equivalent through VC; T_8: 100% nitrogen equivalent through farm yard manure; T_9: 100% nitrogen equivalent through VC; T_{10}: 100% nitrogen equivalent through FYM plus bio-fertilizers; T_{11}: 100% nitrogen equivalent through VC plus bio-fertilizers; T_{12}: 100% recommended dose of fertilizers plus bio-fertilizers. To record the observations on the following yield components, five randomly chosen plants were used. In order to determine the panicle length, the length from base to the tip of each randomly chosen plant was measured and expressed in centimetres (cm). Panicles from randomly chosen plants were separated from one another, the grains were air dried, and the mean grain weight per plant was noted. Weight of 10 ml grain from net plot yield was weighed and stated in grams. The amount of well-cleaned, sun-dried grain produced from the net plot area was measured in kg, and grain yield was worked out and stated as kilogram per hectare (kg ha^{-1}). Ratio of economic yield to biological yield that is harvest index. Was calculated as suggested by Donald (1962).

$$\text{Harvest index (HI)} = \frac{\text{Economic yield (kg ha}^{-1})}{\text{Biomass production (kg ha}^{-1})}$$

Cost of cultivation was calculated by taking current prices of inputs used and labour cost has taken into account for computing the cost of cultivation and which was stated in rupees (Rs.) per ha. The gross return was calculated by considering product price that was prevailing in the market at the time of harvest and was expressed in rupees per ha. The net return was calculated by deducting treatment wise total cost of cultivation from the gross returns and expressed in rupees per ha.

Net returns (Rs. ha^{-1}) = Gross returns (Rs.ha^{-1}) - Cost of cultivation (Rs.ha^{-1})

Benefit cost ratio (B:C) was worked out treatment wise as follows.

$$\text{B : C ratio} = \frac{\text{Gross returns}}{\text{Cost of cultivation}}$$

The data taken from the experimental site was statistically analysed by following the procedure as described by Gomez and Gomez (1984). The level of significance used in 'F' and 't' test was P=0.05. Critical differences were calculated wherever 'F' test was significant.

RESULTS AND DISCUSSION

Panicle length, panicle weight, 10 ml seed weight and grain yield per plant of grain amaranth as influenced by different INM practices are perusal in Table 1.

Significantly higher panicle length (48.50 cm) was recorded with treatment imposed by 100 % RDF with bio-fertilizers (T_{12}) and it was found on par with application of 100 % RDF (48.09 cm), 75 % RDF + 25 % N equivalent via vermicompost (46.98 cm) and 75 % recommended fertilizer dose + 25 % N equivalent through farm yard manure (46.68 cm). The significantly lower panicle length (37.02 cm) was found under plot received with 100 % N equivalent through farm yard manure (T_8).

Table 1: Panicle length, panicle weight, 10 ml seeds weight and grain yield (g $plant^{-1}$) of grain amaranth as influenced by different integrated nutrient management practices.

Treatments		Panicle length (cm)	Panicle weight (g)	10 ml seeds weight (g)	Grain yield (g $plant^{-1}$)
T_1 :	100% Recommended dose of fertilizers (RDF)	48.09	53.57	8.73	26.94
T_2 :	50% RDF + 50% N equivalent through FYM	42.10	44.07	8.53	20.81
T_3 :	50% RDF + 50% N equivalent through vermicompost	44.10	45.10	8.56	22.07
T_4 :	50% RDF + 25% N equivalent through FYM + 25% N equivalent through vermicompost	43.07	44.57	8.54	21.50
T_5 :	75% RDF + 25% N equivalent through FYM	46.68	48.67	8.60	25.77
T_6 :	75% RDF + 25% N equivalent through vermicompost	46.98	49.17	8.63	26.00
T_7 :	50% N equivalent through FYM + 50% N equivalent through vermicompost	39.54	38.79	8.54	18.01
T_8 :	100% N equivalent through FYM	37.02	37.30	8.48	14.90
T_9 :	100% N equivalent through vermicompost	40.05	38.87	8.52	18.87
T_{10}:	100% N equivalent through FYM + bio-fertilizers	37.62	37.87	8.48	16.17
T_{11}:	100% N equivalent through vermicompost + bio-fertilizers	40.60	44.00	8.58	20.12
T_{12}:	100% Recommended dose of fertilizers + bio-fertilizers	48.50	53.73	8.76	27.70
S.Em±		**1.42**	**2.03**	**0.08**	**1.04**
CD (P=0.05)		**4.18**	**5.96**	**NS**	**3.04**

Application of 100 % RDF + bio-fertilizers (T_{12}) has recorded significantly higher panicle weight (53.73 g). However it was on par with application of 100 % RDF (53.57 g), 75 % recommended dose of fertilizer + 25 % N equivalent through vermicompost (49.17 g) and 75 % RDF + 25 % N equivalent through FYM (48.67 g). The lowest Panicle length (37.30 g) was recorded with application of 100 % N equivalent through FYM (T_8).

10 ml seeds weight (test weight) did not found significantly among the different INM practices. However, numerically higher 10 ml seeds weight (8.76 g) was found with application of 100 % RDF + bio-

fertilizers. Whereas, application of 100 % N equivalent through farm yard manure (T_8) 100 % N equivalent through farm yard manure with bio-fertilizers were recorded with lower 10 ml seed weight (8.48 g).

Different INM practices had significant influence on grain yield per plant. Significantly higher grain yield per plant (27.70 g plant^{-1}) was recorded with application of 100 % RDF + bio-fertilizers (T_{12}) and was found on par with application of 100 % RDF (26.94 g plant^{-1}), 75 % RDF + 25 % N equivalent through vermicompost (26 g plant^{-1}) and 75 % RDF + 25 % N equivalent through FYM (25.77 g plant^{-1}). The lowest panicle length (14.90 g plant^{-1}) was recorded with application of 100 % N equivalent through FYM (T_8).

Yield and yield components differed significantly and application of 100 % RDF with bio-fertilizers observed significantly higher panicle length, panicle weight and grain yield per plant of grain amaranth. This was mainly due to the fact that better availability of nutrient which in-turn higher uptake of nutrients by crop plants thereby better growth parameters of grain amaranth. Thus, helped to production and translocation of more photosynthates from source to sink to produce longer panicles, maximum panicle weight and finally more grain yield per plant. The above results are in line with the findings of Barik and Khanda (1999); Jyothi *et al.* (2021); Anand *et al.* (2021); Arya and Singh (2001).

Grain yield, stover yield and harvest index of grain amaranth as influenced by various INM practices are presented in Table 2. Grain yield (kg ha^{-1}) varied significantly among different INM practices. Plot which received 100 % RDF + bio-fertilizers (T_{12}) recorded significantly higher grain yield (1681 kg ha^{-1}) and was found on par with 100 % recommended dose of fertilizer (1620 kg ha^{-1}), 75 % recommended dose of fertilizer + 25 % N equivalent through vermicompost (1577 kg ha^{-1}) and 75 % recommended dose of fertilizer + 25 % N equivalent through FYM (1571 kg ha^{-1}). The lowers grain yield (899 kg ha^{-1}) was recorded with 100 % nitrogen equivalent through FYM (T_8).

Significantly higher stover yield (2901 kg ha^{-1}) was found under application of 100 % RDF + bio-fertilizers (T_{12}), followed by the application of 100 % RDF (2819 kg ha^{-1}), 75 % RDF + 25 % N equivalent through vermicompost (2803 kg ha^{-1}) and 75 % RDF + 25 % N equivalent through FYM (2770 kg ha^{-1}). The significantly lower stover yield (1786 kg ha^{-1}) was recorded with 100 % N equivalent through FYM (T_8).

Harvest index of grain amaranth due to different INM practices were found to be non-significant. However, plot which was received with 100 % RDF with bio-fertilizers (T_{12}) and 100 % RDF (T_{11}) recorded higher values of harvest index (0.37). And the lower harvest indices were recorded with treatments (T_8, T_{10}, T_7, T_9 and T_{11}) which supplemented nitrogen equivalent through different organic sources.

The treatment receiving 100 % RDF with bio-fertilizers found higher grain and stover yield. This was mainly due to better availability of major nutrients which are required in adequate amount thus directly help plant to recorded higher growth. And also increased in yield components like longer panicle length and higher panicle weight resulted for significantly higher grain and stover yield. This result was similar as reported by Chaudhari *et al.* (2009); Ganesh (2011). Neeraja and Patel (2015) reported that the INM practices has achieved higher grain and stover yield of grain amaranth due to its influence on crop growth and development. The result obtained might also be due to beneficial response of the crop due to bio-fertilizers. Bio-fertilizers colonize the rhizosphere or the interior of the plant and promote growth by enhancing the supply or availability of macro and micronutrients to the host plants. Vesicular Arbuscular Mycorhhiza is known to enhance the uptake and transport the nutrients from the soil directly into host plant roots. 6 t of FYM was also applied as part of RDF as per package, the combined effect of FYM, inorganic source of nutrients and bio-fertilizers had significant positive influence on grain and stover yield. Similar results were reported by Sandeep *et al.* (2014). Thus, the application of RDF along with bio-fertilizers was observed to be the best for grain amaranth productivity.

Table 2: Grain yield, stover yield and harvest index of grain amaranth as influenced by different integrated nutrient management practices.

Treatments		Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Harvest index
T_1 :	100% Recommended dose of fertilizers (RDF)	1620	2819	0.37
T_2 :	50% RDF + 50% N equivalent through FYM	1260	2200	0.36
T_3 :	50% RDF + 50% N equivalent through vermicompost	1300	2300	0.36
T_4 :	50% RDF + 25% N equivalentthrough FYM + 25% N Equivalent through vermicompost	1280	2250	0.36
T_5 :	75% RDF + 25% N equivalent through FYM	1571	2770	0.36
T_6 :	75% RDF + 25% N equivalent through vermicompost	1577	2803	0.36
T_7 :	50% N equivalent through FYM + 50% N equivalent through vermicompost	1062	2101	0.34
T_8 :	100% N equivalent through FYM	899	1786	0.33
T_9 :	100% N equivalent through vermicompost	1185	2120	0.36
T_{10}:	100% N equivalent through FYM + bio-fertilizers	926	1853	0.33
T_{11}:	100% N equivalent through vermicompost + bio-fertilizers	1225	2150	0.36
T_{12}:	100% Recommended dose of fertilizers + bio-fertilizers	1681	2901	0.37
S.Em±		**99.46**	**101.02**	**0.02**
CD (P=0.05)		**291.70**	**296.29**	**NS**

Higher gross returns was obtained under application of 100% recommended dose of fertilizer + bio-fertilizers (Rs. 67,233 ha^{-1}) and lower gross returns was obtained under application 100% N equivalent through FYM (Rs. 35,948 ha^{-1}). Highest net returns of Rs. 47,851 per ha was obtained with application of 100% RDF + biofertilizers and lowest net return of Rs. 170 per hectare was found in application 100% N equivalent through vermicompost + bio-fertilizers. Higher B-C ratio of 3.61 was recorded in application of 100% RDF. While, lower B-C ratio (1.00) was found under application of 100% N equivalent through vermicompost and 100% N equivalent through vermicompost + bio-fertilizers.

Analysis of treatments in terms of economic traits noticed that the cost of cultivation, gross returns, net returns and (B-C) ratio varied due to integrated nutrient management practices. Among the various INM practices, higher cost of cultivation of Rs. 48,850 ha^{-1} was obtained to the treatment 100% N equivalent through vermicompost + bio-fertilizers (T_{11}) followed by 100% N equivalent through vermicompost (T_9: Rs. 47,150 ha^{-1}). Higher cost of cultivation recorded in these treatments was due to its increased cost of vermicompost.

Higher net returns of Rs. 47,851 per hectare was achieved under application of 100% RDF + biofertilizers and lowers net returns of Rs. 17 per hectare was achieved with application 100% N equivalent through vermicompost + bio-fertilizers. Maximum net return might be due to higher grain yield and lesser cost of cultivation. This was attributed to higher net return realized because of higher yield of grain amaranth, which also fetched higher price in the market. Similar results are earlier reported by Pratap and Manoranjan (2010). These results are in conformity with the findings of Patel *et al.* (2005) who had reported similar trend of results in grain amaranth. The accrued benefits of application of organic manures are beneficial effects on soil over a period of time is not accounted while calculating the returns.

Table 3: Cost of cultivation, gross returns, net returns and B: C ratio of grain amaranth as influenced by different integrated nutrient management practice

Treatments		Cost of cultivation (Rs. ha^{-1})	Gross return (Rs. ha^{-1})	Net return (Rs. ha^{-1})	B:C ratio
T_1:	100% Recommended dose of fertilizers (RDF)	17942	64815	46873	3.612
T_2:	50% RDF + 50% N equivalent through FYM	17395	50405	33010	2.898
T_3:	50% RDF + 50% N equivalent through vermicompost	32895	51999	19104	1.581
T_4:	50% RDF + 25% N equivalent through FYM + 25% N equivalent through vermicompost	25145	51215	26070	2.037
T_5:	75% RDF + 25% N equivalent through FYM	42958	62854	19896	1.463
T_6:	75% RDF + 25% N equivalent through vermicompost	25413	63072	37659	2.482
T_7:	50% N equivalent through FYM + 50% N equivalent through vermicompost	32350	42484	10134	1.313
T_8:	100% N equivalent through FYM	16850	35948	19098	2.133
T_9:	100% N equivalent through vermicompost	47150	47386	236	1.005
T_{10}:	100% N equivalent through FYM + bio-fertilizers	18290	37037	18747	2.025
T_{11}:	100% N equivalent through vermicompost + bio-fertilizers	48850	49020	170	1.003
T_{12}:	100% Recommended dose of fertilizers + bio-fertilizers	19382	67233	47851	3.469

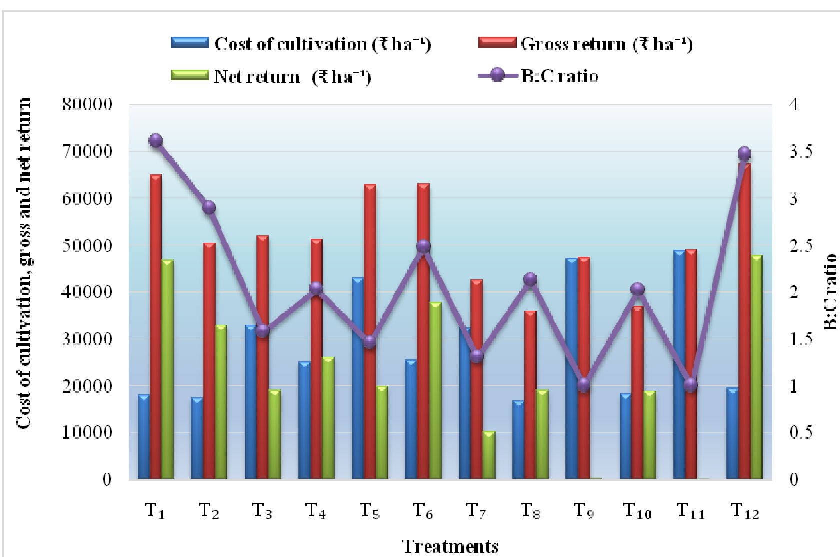

Fig. 1. Cost of cultivation, gross returns, net returns and B-C ratio Grain amaranth.

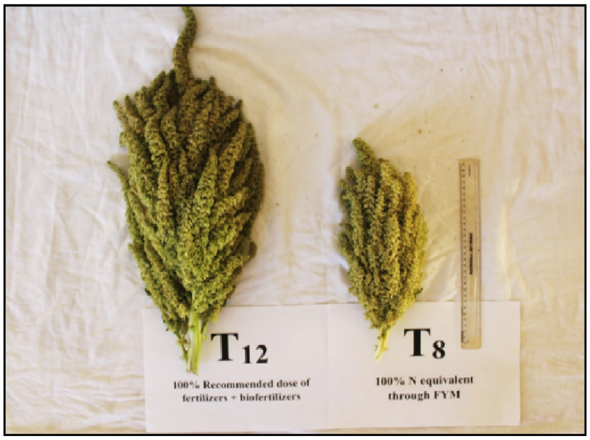

Fig. 2. Comparison of panicle length between different INM practices at harvest.

CONCLUSIONS

Higher yield, yield traits, and economics in the production of grain amaranth can be attained under integrated nutrient management practice. On the basis of results obtained under present investigation and possible reasons for their jaggedness having discussed, the following conclusions were drawn. Application of 100 % recommended dose of fertilizer along with bio-fertilizers are needed for optimization of higher grain yield (1681 kg ha^{-1}) and yield component *viz.* panicle length (48.50 cm), panicle weight (53.73 g) and yield per plant (27.70 g $plant^{-1}$), maximum net return of Rs. 47851 per ha.

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Conflict of Interest. None.

REFERENCES

Anand, S. R., Niranjana Murthy, J., Ashwini Jain and Prithviraj, S. K. (2021).Quinoa (*Chenopodium quinoa* Willd.) aClimate Resilient Wonder Grain. *Mysore Journal of Agriculture Science, 55*(1), 1-8.

Arya, M. P. S. and Singh, R. V. (2001). Response of Amaranth (*Amaranthus hypochondriacus* L.) to Levels and Time of Nitrogen Application. *Indian Journal of Agronomy, 46*(1), 186-189.

Barik, K. C. and Khanda, C. M. (1999). Response of Grain amaranth (*Amaranthus hypochondriacus* L.) to Nitrogen and Phosphorus. *Indian Journal of Agriculture Research, 33*(1), 28-30.

Bhag, M. (1994). Underutilized Grain Legume and Pseudo-cereals – Their Potential in Asia. FAO, RAPA Publication No. 14, 162-165.

Chaudhari, P. P., Patel, P. T. and Desai, L. J. (2009). Effect of Nitrogen Management on Yield, Water use and Nutrient Uptake of Grain amaranth Under Moisture Stress. *Indian Journal of Agronomy, 54*(1), 6273.

Donald, C. M. (1962). In Search of Yield. *Journal of Australian International Agriculture Sciences, 28*, 171-178.

Ganesh, K. G. (2011). Studies on Integrated Nutrient Management in Grain Amaranth (*Amaranthus hypochondriacus* L.). *M.Sc. (Agri)* Thesis submitted to University of Agricultural Sciences Bangalore.

Gomez, K. A. and Gomez, A. A. (1984). Statistical Procedures for Agricultural Research. IRRI, *Willey-Inter Science publications*, New York, UAS, pp. 680.

Jyothi Jadipujari, S. R. Anand, Niranjana Murthy, K. Kalyana Murthy and G. E. Rao (2021). Response of Quinoa (*Chenopodium quinoa* Willd.) to Different Dates of sowing and Crop geometry Under Protective Irrigation. *Mysore Journal of Agriculture Science, 55*(2), 29-34.

Narain, P. (1999). Balanced Fertilizers Use in Dryland Agriculture: Issue and concerns in fifty years of Dryland Agriculture Research in India, CRIDA, Hyderabad, 4: 345-355.

Neeraja, C. R. and Patel, M. V. (2015). Integrated Nutrient Management in Grain Amaranth (*Amaranthus hypochondriacus* L.) Under Middle Gujarat Conditions. *Indian Journal of Agriculture Research,7*(1), 57-61.

Patel, B. M., Ravindrababu, Y., Patel, P. G. and Patel, M. M. (2005). Effect of Integrated Nutrient Management in Light textured soil on Grain amaranth (*Amaranthus hypochondriacus* L.). *Journal of Soils and Crops, 15*(2), 260-263.

Pratap Tej, Dutta, and Manoranjan (2010). Integrated Nutrient Management in Grain amaranth. *Journal of Hill Agriculture, 2*(1), 45-47.

Sandeep Kumar, Ripudaman, S., Saquib, M., Dharmendra, S. and Awadhesh, K. (2014). Effect of different combinations of Vermicompost, Biofertilizers and Chemical fertilizers on Growth, Productivity and Profitability in Chickpea. *Plant Archives, 14*(1), 267-270.

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