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

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***Abstract*:** A field experiment was conducted during *rabi* season of 2022-23 to study the effect of integrated nutrient management on growth and yield of grain amaranth. Growth and yield attributes such as plant height, dry matter accumulation per plant, length of inflorescence, test weight, grain and stalk yield were recorded significantly higher by the application of 100% RDF + vermicompost @ 1 t/ha + seed inoculation with *Azotobacter* and PSB followed by 75% RDF + vermicompost @ 1.5 t/ha + seed inoculation with *Azotobacter* and PSB and 100% RDF + FYM @ 2.5 t/ha + seed inoculation with *Azotobacter* and PSB. It also recorded significantly higher returns.

***Keywords*:** *Azotobacter*, economics, farm yard manure, grain amaranth, grain yield, PSB, Vermicompost,

INTRODUCTION

Grain amaranth (*Amaranthus hypochondriacus* L.) called a pseudocereal is an under exploited tropical novel crop with a high nutritive value. Amaranth locally known as *Rajagira* and it is grown during *rabi* season. Amaranth is a quick growing, bushy plant with thick stalk. The unique features are lower water and input requirement, tolerance to moisture stress with short growing period. Imbalance use of fertilizers has been one of the key factors in declining the crop productivity and depleting the soil fertility. Balanced and optimum nutrition required for getting the maximum grain yield and quality. Organic manures are good complementary source of nutrients and improve the efficiency of the applied mineral nutrients on one hand and physical and biological properties of soil on the other hand (Chaudhary *et al*., 2004). Application of different organics with *azospirillium* favourably influence the soil physical, chemical and biological environment such as bulk density, water holding capacity, organic carbon and available nitrogen (Kannan *et al*., 2005). Use of biofertlizer not only fixes the biological nitrogen but also solubilizes the insoluble phosphate in soil by PSB and thus improves fertilizer use efficiency (Gogoi, 2008). Therefore, any nutrient management practice that can improve organic matter status of soil is important. A judicious and combined use of organic and inorganic sources of plant nutrients is essential to maintain soil health and to augment the efficiency of nutrients. Additionally, such integration of organic manures, biofertilizers and inorganic nutrients source plays an important role in economizing the use of fertilizers under escalating cost which is restricting their use to an optimum level. Integration of cost-effective and eco-friendly biofertilizers with chemical fertilizers and organic manures is the alternate way for saving N fertilizers (Chaudhary *et al*., 2009). Hence, the present experiment was undertaken to find out the effect of integrated nutrient management on grain yield, quality and uptake of N and P by grain amaranth.

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MATERIALS AND METHODS

A field experiment was carried out during *rabi* season of 2022-23 at Agronomy Instructional Farm, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar. The experiment was conducted on loamy sand soil having low inorganic carbon (0.18%) and kg/ha), medium in available P2O5 (34.2 kg/ha) and potassium (239.5 kg/ha) with soil pH of 7.4. The experiment consisted of ten treatments *viz*., T1: 100% RDF, T2: 100% RDF + FYM @ 2.5 t/ha + seed inoculation with *Azotobacter* and PSB, T3: 75% RDF + FYM @ 5 t/ha + seed inoculation with *Azotobacter* and PSB, T4: 50% RDF + FYM @ 7.5 t/ha + seed inoculation with *Azotobacter* and PSB, T5: 100% RDF + vermicompost @ 1 t/ha + seed inoculation with *Azotobacter* and PSB, T6: 75% RDF + vermicompost @ 1.5 t/ha + seed inoculation with *Azotobacter* and PSB, T7: 50% RDF + vermicompost @ 2 t/ha + seed inoculation with *Azotobacter* and PSB, T8: 100% RDF + vermiwash @ 10% foliar spray at 30, 45 and 60 DAS, T9: 75% RDF + vermiwash @ 10% foliar spray at 30, 45 and 60 DAS and T10: 50% RDF + vermiwash @ 10% foliar spray at 30, 45 and 60 DAS. The experiment was laid out in randomized block design with three replications. The nutrient sources, *viz*. FYM (0.44% N, 0.19% P2O5, 0.42% K2O), vermicompost (0.65% N, 0.77% P2O5, 0.40% K2O) and required quantity of N and P in the form of urea and diammonium phosphate were applied as per treatments, respectively. Foliar spray of vermiwash @ 10% was done at 30, 45 and 60 DAS as per treatments. The seeds of amaranth were treated with *Azotobacter* and phosphorus solubilizing bacteria (PSB) @ 5 ml/kg seed just before sowing of the seeds. Amaranth variety GA-3 was sown @ 2.0 kg/ha seed rate at an inter-row spacing of 45 cm on 26th Oct, 2018. The recommended dose of fertilizer for grain amaranth is 60:40 kg N:P/ha. Full dose of phosphorus and half dose of nitrogen were applied at the time of sowing and remaining half dose of nitrogen was applied in two equal splits at 25 and 45 DAS as per treatments. Five random plants/plot were selected in the net plot area and tagged for recording growth and yield attributes. The crop was manually harvested, threshed and grain yield was recorded.

RESULTS AND DISCUSSION

Growth and yield attributes

Application of 100% RDF along with vermicompost @ 1.0 t/ha + seed inoculation with *Azotobacter* and PSB resulted in significantly taller plants. However, the plant height in the plots treated with 75% RDF + vermicompost @ 1.5 t/ha + seed inoculation with *azotobacter* and PSB and 100% RDF + FYM @ 2.5 t/ha along with seed inoculation of *azotobacter* and PSB was similar (Table 1).This may be owing to adequate and continuous supply of N and P2O5 through inorganic fertilizers along with vermicompost as well as seed inoculation with biofertilizers in combination which enhanced cell RDF + vermicompost @ 1.5 t/ha + seed inoculation with *azotobacter* and PSB as well as plot received 100% RDF + FYM @ 2.5 t/ha + seed inoculation with *azotobacter* and PSB. In present study, better nutrition of the plants owing to integration of either vermicompost or FYM with inorganic fertilizers and biofertilizers (*Azotobacter* and PSB) might have resulted in improvement in the length of inflorescence. In association with soil microorganisms, organic manures are known to help in synthesis of certain phytohormones and vitamins which promote growth and development of crops. The slow release of nutrients associated with vermicompost / FYM and adequate supply of N and P through inorganic fertilizers might have resulted in higher concentration of nutrients in plant cells resulting in higher dry matter accumulation. The highest dry matter accumulation per plant at harvest was recorded with 100% RDF + vermicompost @ 1.0 t/ha + seed inoculation with *azotobacter* and PSB followed by 75% RDF + vermicompost @ 1.5 t/ha + seed inoculation with *azotobacter* and PSB. These results are in accordance with the findings of Deshmukh *et al*. (2013) and Yadav *et al*. (2017). Significantly higher test weight was recorded with application of 100% RDF + vermicompost @ 1 t/ha + seed inoculation with *azotobacter* and PSB being at par with treatments 75% RDF + vermicompost @ 1.5 t/ha + seed inoculation with *azotobacter* and PSB, 100% RDF + FYM @ 2.5 t/ha + seed inoculation with *azotobacter* and PSB and 50% RDF + vermicompost @ 2.0 t/ha + seed

Table 1: Effect of integrated nutrient management on growth, yield attributes, yield and economics of grain amaranth

Treatments	*Plant height (cm)*	*Length of inflorescence (cm)*	*Dry matter at harvest (g/plant)*	*1000 grain weight (g)*	*Grain yield (kg/ha)*	*Cost of cultivation (₹/ha)*	*Net returns (₹/ha)*	*B : C ratio*
100% RDF	118.1	47.9	37.5	0.67	1335	25687	53401	3.08
100% RDF + FYM @ 2.5 t/ ha + *Azotobacter* and PSB	132.3	54.1	44.8	0.79	1953	28839	86351	3.99
75% RDF + FYM @ 5.0 t/ha + *Azotobacter* and PSB	124.2	48.8	41.8	0.69	1597	31263	63028	3.02
50% RDF + FYM @ 7.5 t/ha + *Azotobacter* and PSB	127.2	48.9	41.9	0.70	1656	33687	64225	2.91
100% RDF + VC @ 1.0 t/ha + *Azotobacter* and PSB	153.8	56.4	48.5	0.81	2109	32079	92399	3.88
75% RDF + VC @ 1.5 t/ha + Azotobacter and PSB	144.5	56.1	47.4	0.80	1971	34613	81726	3.36
50% RDF + VC @ 2.0 t/ha + *Azotobacter* and PSB	127.5	52.6	42.1	0.76	1670	37147	61738	2.66
100% RDF + vermiwash @ 10% at 30, 45 and 60 DAS	121.8	48.3	40.1	0.68	1368	26399	54604	3.06
75% RDF + vermiwash @ 10% at 30, 45 and 60 DAS	108.3	46.4	34.0	0.66	1268	25802	49383	2.91
50% RDF + vermiwash @ 10% at 30, 45 and 60 DAS	105.6	45.4	32.7	0.64	1192	25207	45456	2.80
S.Em.±	8.66	2.36	2.15	0.03	121.17			
C.D.(P = 0.05)	25.70	7.0	6.4	0.10	359			
C.V. (%)	11.87	8.09	9.08	8.06	13.02			

inoculation with *azotobacter* and PSB. Further, higher assimilating surface at reproductive development stage resulted in more production of metabolites and their translocation towards seed as evident from nutrient concentration and their uptake might have increased weight of individual grain of amaranth. Similar findings were also reported by Singh and Chauhan (2016).

Yield

Application of 100% RDF + vermicompost @ 1 t/ha + seed inoculation with *azotobacter* and PSB resulted in significantly higher grain and stalk yield followed by 75% RDF + vermicompost @ 1.5 t/ha + seed inoculation with *azotobacter* and PSB and 100% RDF + FYM @ 2.5 t/ha + seed inoculation with *azotobacter* and PSB. Increase in grain yield with 100% RDF + vermicompost @ 1 t/ha + seed inoculation with *azotobacter* and PSB, 75% RDF + vermicompost @ 1.5 t/ ha + seed inoculation with *azotobacter* and PSB and 100% RDF + FYM @ 2.5 t/ha + seed inoculation with *azotobacter* and PSB was 57.98, 47.64 and 46.29%, respectively over application of RDF only. Kushare *et al*. (2010) reported that significantly higher length of main inflorescence and seed yield per plant lead to higher seed yield of amaranth. It is obvious that phosphate solubilizing bacteria produced higher quantity of organic acids which dissolved insoluble phosphate and made it available to plants. These findings indicated that combined use of organic sources (vermicompost/FYM and biofertilizers) and inorganic fertilizers proved more superior over application of chemical fertilizer (RDF) only (Singh *et al*., 2015).

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