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Response of Grain Amaranth (*Amaranthus cruentus* L.) Genotypes to Different Levels of Fertilizers (NPK) under Eastern Dry Zone of Karnataka

S. R. Anand, Niranjana Murthy and S. K. Prithviraj
AICRN on Potential Crops, University of Agricultural Sciences, GKVK, Bengaluru-560 065
e-mail : anuagron80@gmail.com

Abstract

The experiment was carried out during *kharif* 2016 and 2017 for two years at Main Agricultural Research Station (MRS), Hebbal, University of Agricultural Sciences, Bangalore to study the effect of different levels of NPK on grain amaranth genotypes. The soil of the experimental field was sandy loam in texture and low in organic carbon (0.39%), low in available nitrogen, moderately high in available P_2O_5, very low in available K_2O and neutral in soil reaction with normal electrical conductivity. The experiment was laid in split plot design with genotypes were in main plots and fertilizer levels in sub plots. The pooled data of two years revealed that among the genotypes, significantly higher grain and straw yield were recorded in SKGPA-74 (1582 and 1812 kg/ha, respectively) as compared to KBGA 4 and KBGA 1. Among the fertilizer levels, significantly higher grain and straw yield were recorded with application of 125 per cent RDF (1626 and 1800 kg/ha, respectively) which was on par with 100 per cent RDF (1516 and 1623 kg/ha, respectively) as compared to 75 per cent RDF and control. However, economics also differed significantly with genotypes and fertilizer levels. Among the genotypes, higher gross returns, net returns and B:C ratio were recorded in SKGPA 74 (Rs.79072/ha, Rs.54611/ha and 3.22, respectively) compared to KBGA 4 and KBGA 1. Significantly higher gross returns, net returns and B:C ratio were recorded with application of 125 per cent RDF (Rs.81288/ha, Rs.55112/ha and 3.11, respectively) which was on par with RDF as compared to 75 per cent RDF and control. Interaction of genotypes and fertilizers did not found significant.

Keywords: Grain amaranth, Genotypes, Fertilizer levels, Grain yield, Economics

Grain amaranth (*Amaranthus* spp.) a lesser known nutri rich crop is grown either as a grain crop or as a leafy vegetable in India. It produces significant edible cereals grain but known as 'pseudo-cereals' to distinguish it from other cereal producing crops which belongs to the family Amaranthaceae and is widely distributed throughout the world. It is a multipurpose crop with good potential for exploitation as grain, vegetable and fodder. Considerable variation has been observed for different nutritional constituents. Its grain has higher protein (14%) with higher lysine and a good balance of other essential amino acids. Being an excellent source of iron and carotene, it can help in reducing iron and vitamin A deficiency, especially among rural populations. The presence of a higher amount of folic acid can help in increasing the blood haemoglobin. Amaranth is used as an important ingredient in food by people from the entire Himalayan region and to some extent in the states of Gujarat, Maharashtra, Karnataka and eastern parts of Uttar Pradesh (UP). Amaranth can be utilized to manufacture products such as baby cereal foods, candies and snacks, protein drinks and particularly hypoallergenic foods, thus value-addition can make this crop more attractive. These were introduced to world in 19th century by European settlers. The domesticated vegetable and grain types of amaranth are grown mostly in the tropics and sub-tropics but appear to perform equally well as warm season temperate zone crops. In India, presently amaranth is commonly grown in Gujarat, Himachal Pradesh and on the hills of Uttar Pradesh for both grain and vegetable. In Karnataka, grain amaranth is being grown by tribal communities in BR hills of Chamarajnagara district. Since, it is a lesser known crop to the farmers of Karnataka, the benefits of this crop needs to be popularized.

Fertilizer management is one of the important cost effective agronomic factors to improve the production of any crop. Among the major nutrients, nitrogen is one of the most important and expensive nutrients and has very marked effect on plant growth. Nitrogen plays an important role in the synthesis of chlorophyll as well as amino acids. The response of N as chemical fertilizer generally increases when it is used in combination with FYM, vermicompost etc. and saves N fertilizer. Unlike nitrogen, phosphorus is vital for strong growth. Insufficient phosphorus in the soil will cause stunted, spindly crops. Potassium, the third of three elements in healthy soil nutrition, can greatly increase crop yields. It aids in water absorption and retention, also encourages strong roots, sturdy stems and healthy full grown crops that have longer shelf life. In this context, grain amaranth is one of the important nutri rich ancient food crop needs to be brought under cultivation. Unlike other crops, optimum fertilizer dose for growth and yield of grain amaranth is very essential. Hence, the experiment was planned to find out optimum fertilizer dose for grain amaranth crop.

Material and Methods

The experiment was carried out for two years during *kharif* 2016 and 2017 at MRS, Hebbal, University of Agricultural Sciences, Bangalore, to study the effect of different levels of fertilizers on grain amaranth genotypes. The soil of the experimental field was sandy loam in texture and low in organic carbon (0.39%), available nitrogen (220.70 kg/ha), moderately high in available P_2O_5 (48.79 kg/ha), very low in available K_2O (121.70 kg/ha) and neutral in soil reaction (pH 7.56) with normal electrical conductivity (0.25 dS/m). The experiment was laid in split plot design having three genotypes in main plots, *viz.,* V_1- KBGA-4, V_2- SKGPA-74 AND V_3- KBGA-1 and four fertilizer levels in subplots, *viz.,* F_1- control, F_2- 45:30:30 (75% RDF) NPK kg/ha, F_3- 60:40:40 (100% RDF) NPK kg/ha and F_4- 75:50:50 (125% RDF) NPK kg/ha. Totally there were 12 treatment combinations which were replicated thrice. The source of NPK were urea, DAP and MOP. About 50 per cent of nitrogen and 100 per cent of phosphorus and potassium were applied at the time of sowing. Remaining 50 per cent of nitrogen was top dressed after hand weeding and before inter cultivation at 30 DAS. Necessary plant protection measures were taken during the infestation of sucking pests and defoliates. No disease infestation was observed during the investigation. Protective irrigation was given when there was moisture stress due to deficit rainfall. The growth and yield parameters were recorded at the time of harvesting. Statistical analysis was done as per the formula given by Gomez and Gomez (1966).

Results and Discussion

Effect of different levels of fertilizers on growth parameters

It is evident from the results that, plant height and test weight were not influenced by genotypes and fertilizers (Table 1). The pooled data of two years revealed that the plant height, number of leaves per plant and panicle length were significantly higher in KBGA-4 (166.56cm, 131.78 and 56.27 cm, respectively), but on par with KBGA-1 (161.71 cm, 116.85 and 52.98 cm, respectively) as compared to SKGPA-74 (152.36 cm, 103.92 and 39.74 cm, respectively) in main plots. Among fertilizer levels, plant height, number of leaves per plant and panicle length were significantly higher with 125 per cent RDF (172.29 cm, 120.80 and 59.26 cm, respectively), on par with 100 per cent RDF (165.18cm, 107.96 and 54.36 cm, respectively) as compared to other treatments. This could be mainly due to sufficient availability of fertilizer especially nitrogen for growth and development of the crop as nitrogen is responsible for photosynthetic activity of crop plants. This could also be attributed to a mere fact that higher rates of nitrogen may have caused rapid cell division and elongation. The similar results were also obtained by Sarwargaonkar *et al*. (2008) and Shivay & Singh (2000) they reported significant increase in the plant height and number leaves per plant of *kharif* maize with 100 per cent recommended fertilizer dose (RFD) compared to 75 per cent RFD.

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TABLE 1

Growth parameters of Grain Amaranth as influenced by genotypes and fertilizer levels

Treatment details	Plant height (cm)			Number of leaves per plant			Panicle length (cm)		
	2016	2017	Mean	2016	2017	Mean	2016	2017	Mean
Main Plot (Genotypes)									
V_1- KBGA-4	164.87	168.25	166.56	135.25	128.32	131.78	55.28	57.25	56.27
V_2- SKGPA-74	154.58	150.14	152.36	109.16	98.68	103.92	39.32	40.15	39.74
V_3- KBGA-1	162.92	160.50	161.71	125.45	108.26	116.85	54.72	51.23	52.98
S.Em±	3.82	3.50	3.66	3.86	3.25	3.555	1.87	1.75	1.81
CD @5%	10.01	12.35	11.18	12.25	10.45	11.35	7.34	6.85	7.10
Subplots (Fertilizers)									
F_1	141.67	145.12	143.40	85.14	83.25	84.19	39.47	35.45	37.46
F_2	158.67	155.25	156.96	98.25	92.45	95.35	46.36	40.25	43.31
F_3	168.33	162.02	165.18	113.45	102.48	107.96	53.58	55.14	54.36
F_4	174.49	170.08	172.29	125.35	116.26	120.80	58.36	60.15	59.26
S.Em±	2.54	2.25	2.40	4.25	4.65	4.45	1.28	1.12	1.20
CD @%	7.53	7.12	7.33	13.65	14.28	13.96	3.79	3.25	3.52
Interactions (MxS)									
S.Em±	5.40	4.56	4.98	5.25	5.33	5.29	2.68	2.45	2.57
CD @5%	NS	NS	NS	NS	NS	NS	NS	NS	NS

Note: F_1: Control, F_2: 75% RDF, F_3: 100% RDF (60:40:40 NPK kg/ha), F_4: 125% RDF

Effect of different levels of fertilizers on yield and yield parameters

Grain and straw yield were found significantly differed with different genotypes and fertilizer levels (Table 2). Among the genotypes, significantly higher grain and straw yield were recorded in SKGPA-74 (1582 and 1812 kg/ha, respectively) compared to KBGA-4 and KBGA-1. Among the fertilizer levels, significantly higher grain and straw yield were recorded in 125 per cent RDF (1626 and 1800 kg/ha, respectively) and on par with 100 per cent RDF (1516 and 1623 kg/ha, respectively) compared to 75 per cent RDF and control. Whereas, 10 ml seed weight due to genotypes and fertilizer levels did not found significant. Interaction effects were not found significant. This could be due to adequate availability of major nutrients which are required in larger quantity thus directly help the plants to register higher yield. The above results were in agreement with the findings of Parmar and Patel (2009) and Gunjal (2011). Similar type of observation has been reported by Khurana *et al.* (2016), they reported that the application of Nitrogen at the level up to 125 kg/ha can be recommended to get higher total green yield. A similar effect of fertilizer levels on maize yield and its components were reported by Bakht *et al*. (2007) and Maqsood *et al*. (2000).

Economics

Among the genotypes, significantly higher gross returns, net returns and B:C ratio were recorded with SKGPA-74 (Rs.79,072/ha, Rs.54,611/ha and 3.22, respectively) as compared to KBGA 4 and KBGA 1 (Table 3). Among fertilizer levels, significantly higher gross returns, net returns and B:C ratio were recorded with application of 125 per cent RDF (Rs.81,288/ha, Rs.55,112/ha and 3.11, respectively) which was on par with 100 per cent RDF (Rs.74,293/ha, Rs.49,154/ha and 2.95, respectively) as compared to 75 per cent

TABLE 2

Yield and yield parameters of Grain Amaranth as influenced by genotypes and fertilizer levels

Treatment details	Grain yield (kg/ha)			Straw yield (kg/ha)			10 ml seed weight (g)		
	2016	2017	Mean	2016	2017	Mean	2016	2017	Mean
Main plot (Genotypes)									
V_1-KBGA-4	1299	1325	1312	1401	1455	1428	8.58	8.15	8.37
V_2- SKGPA-74	1505	1658	1582	1748	1876	1812	8.67	8.76	8.72
V_3-KBGA-1	1154	1265	1210	1239	1384	1312	8.50	8.65	8.58
S.Em±	66	62	64	111	102	107	0.17	0.18	0.18
CD @5%	258	252	255	436	425	431	NS	NS	NS
Sub plots (Fertilizer levels)									
F_1	1015	1105	1060	1146	1214	1180	8.11	8.21	8.16
F_2	1281	1325	1303	1424	1545	1485	8.22	8.26	8.24
F_3	1468	1564	1516	1556	1689	1623	8.78	8.76	8.77
F_4	1574	1678	1626	1725	1875	1800	9.22	8.89	9.06
S.Em±	37	32	35	48	45	47	0.11	0.12	0.12
CD @%	110	107	109	136	138	137	NS	NS	NS
Interactions (MxS)									
S.Em±	86	82	84	99	95	97	0.23	0.25	0.24
CD @5%	NS	NS	NS	NS	NS	NS	NS	NS	NS

Note: F_1: Control, F_2: 75%RDF, F_3: 100% RDF (60:40:40 NPK kg/ha), F_4: 125% RDF

TABLE 3

Economics of Grain Amaranth as influenced by genotypes and fertilizer levels

Treatment details	Cost of cultivation (Rs./ha)			Gross returns (Rs./ha)			Net returns (Rs./ha)			B : C Ratio		
	2016	2017	Mean	2016	2017	Mean	2016	2017	Mean	2016	2017	Mean
Mail Plot (Varieties)												
V_1-KBGA-4	23467	25456	24462	64950	66250	65600	41464	40794	41129	2.75	2.60	2.68
V_2- SKGPA-74	23467	25456	24462	75244	82900	79072	51777	57444	54611	3.18	3.26	3.22
V_3-KBGA-1	23467	25456	24462	57706	63250	60478	34239	37794	36017	2.44	2.48	2.46
S.Em±	-	-	-	3290	3100	3195	3290	3156	3223	0.14	0.12	0.13
CD @5%	-	-	-	12919	12600	12760	12919	10156	11538	0.55	0.46	0.51
Subplots (P levels)												
F_1	20256	21589	20923	50731	55250	52991	30475	33661	32068	2.50	2.56	2.53
F_2	23456	24587	24022	64048	66250	65149	40592	41663	41128	2.73	2.69	2.71
F_3	24589	25689	25139	70385	78200	74293	45796	52511	49154	2.86	3.04	2.95
F_4	25567	26785	26176	78676	83900	81288	53109	57115	55112	3.08	3.13	3.11
S.Em±	-	-	-	2856	2564	2710	2650	2758	2704	0.09	0.08	0.09
CD @%	-	-	-	9477	8115	8796	8477	9264	8870	0.28	0.25	0.27
Interactions (MXS)												
S.Em±	-	-	-	4304	4156	4230	4304	4015	4159	0.18	0.15	0.17
CD @5%	-	-	-	NS	NS	NS	NS	NS	NS	NS	NS	NS

Note: F_1: Control, F_2: 75%RDF, F_3: 100% RDF (60:40:40 NPK kg/ha), F_4: 125% RDF

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RDF and control. It might be due to lower cost of cultivation and also higher grain yield of grain amaranth that resulted in maximum net returns. Similar results were reported by Basavaraju (2007) and Rathore (2016). Interaction of varieties and fertilizer levels was not found significant.

It can be concluded that all the genotypes performed well under higher dose fertilizer. It is evident from the results that 60:40:40 NPK kg/ha is optimum for higher grain yield in amaranth crop as this treatment had given on par results with 125 per cent. Plant height, number of leaves per plant and panicle length were not directly responsible for higher grain yield in grain amaranth. It may be articulated that panicle girth and number of spike lets per spike is most responsible for higher grain yield in grain amaranth crop. Since, it is a new crop and also nutrient rich crop, fetches higher market price and results in higher net returns and B:C ratio.

References

Bakht, J., Siddique, M. F. and Shafi, M., 2007, Effect of planting methods and nitrogen levels on the yield and yield components of maize. *Sarhad Journal of Agriculture*, **23** (3): 553-559.

Basavaraju, S. D., 2007, Integrated nitrogen management in maize (*Zea mays* L.) in a vertisol of malaprabha command area. *M.Sc. (Agri.) Thesis* submitted to the University of Agricultural Sciences, Dharwad (Karnataka).

Gomez, K. A. and Gomez, A. A., 1984, Statistical procedures for agricultural research (2 ed.). *John wiley and sons, NewYork*, pp. 680.

Gunjal, G. K., 2011, Studies on integrated nutrient management in grain amaranth (*Amaranthus hypochondriacus* L.) *Ph.D. thesis* submitted to the University of Agricultural Sciences, Bengaluru (Karnataka).

Khurana, D. S., 2016, Performance of amaranthus genotypes for growth and yield under different nitrogen levels, *Indian J. Hort*., **73**(1): 137-140.

Maqsood, M., Ali, R., Nawaz, N. and Yousaf, N., 2000, The effect of NPK application in different proportions on the growth and yield of spring maize. *Pakistan Journal of Biological Sciences*, **3** (2) : 356–357.

Parmar, J. K. and Patel, J. J., 2009, Effect of nitrogen management on growth and yield of grain Amaranthus (*Amaranthus hypochondriacus* L.) grown on loamy sand soil. *Asian Journal of Soil Science,* **4** (1) : 106-109.

Rathore, S. K., 2016, Integrated nutrient management in *kharif* sorghum under rainfed condition. *M.Sc. (Agri.) Thesis* submitted to the Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, College of Agriculture, Indore (Madhya Pradesh).

Sarwargaonkar, G. L., Shelke, D. K. Shinde, S. A. and Kshirsagar, S., 2008, Performance of *kharif* maize based legume intercropping system under different fertilizer doses. *International Journal of Agricultural Sciences*, **4** (1): 152–155.

Shivay, Y. S. and Singh, R. P., 2000, Growth, yield attributes, yields and nitrogen uptake of maize (*Zea mays*) as influenced by cropping systems and nitrogen levels. *Annals of Agricultural Research*, **21**(4): 494–498.

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