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Effect of Integrated Nitrogen Management on Yield, Quality and Economic of Grain Amaranth (*Amaranthus hypochondriacus* L.)

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ABSTRACT

A field experiment was conducted on heavy black soil of College Farm of N. M. College of Agriculture, Navsari Agricultural University, Navsari (Gujarat) during the rabi season 2016-17. The experiment comprising twelve (12) treatment combinations were laid out in factorial randomized block design with factorial concept and replicated three times. The treatment consisted combinations of three levels of nitrogen viz.,20 kg N/ha (N_1), 40 kg N/ha (N_2), 60 kg N/ha (N_3), two levels of organic manures i.e. FYM @ 5 t/ha (M_1) and bio-compost @ 5.0 t/ha (M_2) and two levels of bio-fertilizer viz., No seed inoculation (B_1) and seed inoculation with azotobactor (10 ml/kg of seed) (B_2). Experimental results indicated that significantly highest grain yield (1225 kg/ha) and stover yield (2766 kg/ha) recorded by nitrogen application @ 60 kg N/ha (N_3). Fertilization with 60 kg N/ha recorded significantly highest protein content (15.37 %) and protein yield (188.36 kg/ha). In case of economic same level of nitrogen recorded significantly highest net returns of ₹ 43916/ha and B: C ratio of 2.54. In case of organic manure maximum grain and stover yields of 1040 and 2440 kg/ha, respectively were also recorded with the application of bio-compost @ 5.0 t/ha (M_2). Application of organic manures fails to exert its significant effect on protein content and protein yield. The highest net returns of ₹ 38482/ha with B:C ratio of 2.57 were obtained with an application of bio-compost @ 5.0 t/ha (M_2). In case of bio-fertilizer, grain yield (1059 kg/ha) and stover yield (2487 kg/ha) were recorded significantly highest with azotobacter seed inoculation. Significantly highest protein content (14.37 %), protein yield (154.26 kg/ha) were recorded under seed inoculation with azotobacter (B_2). Significantly highest net income of ₹ 34144/ha with BCR value of 2.22 was obtained with the application of azotobacter (B_2).

Key words: *Azotobacter, Bio-compost, Economic, FYM, Grain amaranth, Protein, Yield.*

INTRODUCTION

Grain amaranth (*Amaranthus hypochondriacus* L.) is a neglected pseudocereal crop belongigng to family *Amaranthaceae*. Amaranth is a quick growing and multipurpose crop. In Gujarat, amaranth locally known as *Rajgira* is grown in Banaskantha, Mehsana, Sabarkantha, Gandhinagar and Kheda districts. The grain contains about 16 per cent protein with high content of lysine.

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Grain amaranth is a new crop that is attracting interest worldwide. If this crop will continue to increase appropriate agronomic practices for high yield and quality have to be developed. This study is therefore conducted to determine the effect of nitrogen fertilizer for maximum yield and quality of grain amaranth varieties.

MATERIALS AND METHODS

A field experiment was conducted on heavy black soil of the College Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari (Gujarat) during the *rabi* season 2016-17. The experiment comprising twelve (12) treatment combinations were laid out in randomized block design with factorial concept and replicated three times. The treatment consisted combinations of three levels of nitrogen *viz.*,20 kg N/ha (N_1), 40 kg N/ha (N_2), 60 kg N/ha (N_3), two levels of organic manures *i.e.* FYM @ 5 t/ha (M_1) and bio-compost @ 5.0 t/ha (M_2) and two levels of bio-fertilizer *viz.*, No seed inoculation (B_1) and Seed inoculation with *azotobactor* (10 ml/kg of seed) (B_2).The recommended dose of phosphorus @ 40 kg P_2O_5/ha was applied uniformly to all the treatment as basal in form of single super phosphate. Nitrogen was applied as per treatment in form of urea. The seeds of amaranthus (GA 2) were first inoculated with *azotobacter* culture and then the treated seeds were utilized for sowing as per treatments. Observations on yield attributes at different growth stages and yield and quality parameters were recorded at harvest. The data were statistically analyzed for individual and results were presented.

RESULTS AND DISCUSSION

Yield and yield attributes:

The data on yield *viz.*, grain yield (kg/ha) and stover yield (kg/ha) are presented in Table 1. Treatment receiving nitrogen @ 60 kg/ha (N_3) produced significantly the higher grain yield (1225 kg/ha) and stover yield (2766 kg/ha) over N_1 and N_2. The percentage increase in grain yield under 60 kg N/ha was to the tune of 68.7 % and 12.6 over N_2 and N_1, respectively. In case of stover yield, it was to the tune of 36.8 % and 15.5 % over N_1 and N_2, respectively. The increase in grain and stover yield might be due to remarkable improvement in the yield attributes such as length of main inflorescence, number of spikelets per spike, test weight and better development of various growth parameters such as plant height, number of leaves per plant, leaf area index, stem girth and dry matter accumulation resulted in higher grain and stover yield. The results were supported by the findings of Chaudhari *et al*.[1] in case of grain yield as well as, Dongare[3], Patel *et al*.[8] in case of stover yield.

Results presented in Table 1 revealed that organic manures did not exerted any remarkable effect on grain and stover yields of grain amaranth. Numerically maximum grain (1040 kg/ha) and stover (2440 kg/ha) yield were recorded with the application of bio-compost @ 5.0 t/ha (M_2) over FYM @ 5.0 t/ha (M_1). Both organic manures supply more or less equal amount of plants nutrients as well as improve the physical, chemical and biological environment of soil, which was reflected in better yield and yield attributing characters of plant. Similar results were obtained by Dongare[3] in grain amaranth.

Significantly highest values of grain yield (kg/ha) and stover yield (kg/ha) were recorded under application of *azotobacter* bio-fertilizer. Favourable effect of *azotobacter* in providing better nutrition throughout the growing period and availability of nitrogen at flowering and grain filling stage might have helped in formation of longer inflorescences and more number of spikelets. This better response of amaranth to *azotobacter* may be attributed to increase nitrogen availability by fixing appreciable amount of molecular nitrogen and made available for plant growth and to synthesize growth promoting enzymes like Indole Acetic Acid (IAA), Gibberelins and Vitamins substances, also alter the microbial balance in the *rhizosphere* and producing metabolites that stimulate plant development. Same trend was reported with Chaudhari *et al.*[1] and Parmar *et al.*[6] in case of test weight and grain yield in grain amaranth.

Quality parameters:

The data on protein content and protein yield are presented in Table 2. It is evident from the data presented in table that protein content and protein yield were increased significantly with increasing levels of nitrogen. Application of nitrogen @ 60 kg/ha (N_3) recorded significantly the highest protein content in grain. These results corroborated the findings of Dongare[3], Patel *et al.*[8] and Mlakar *et al*[5].

The results presented in the Table 2 indicated that the organic manures fail to express its significant effect on protein content and protein yield. These results are in agreement with those reported by Dongare[3] in grain amaranth.

The result revealed that significantly the highest protein content (%) and protein yield (kg/ha) of grain amaranth were recorded with the application of seed inoculation with *azotobacter* (B_2). Significantly the lowest protein yield of grain amaranth was recorded under treatment of no seed inoculation (B_1). These results corroborated the findings of Das and Sheoran[2] in oat.

Economics:

The results presented in Table 2 indicated that treatment receiving 60 kg N/ha (N_3) realized the significantly highest net return of ₹49308/ha with B: C ratio 3.18 followed by 40 kg N/ha (N_2), which recorded net return of ₹42916/ ha with BCR value of 2.90. These results are in agreement with these of Chaudhari *et al.*[1], Dongare[2] as well as Patel *et al.*[8] in grain amaranth.

The data presented in Table 2 indicated that the highest net return of ₹ 43875/ha with BCR value of 3.24 was obtained with the application of bio-compost @ 5.0 t/ha (B_2) followed by application of FYM @ 5 t/ha (B_1) which obtained net return of ₹ 31496/ha and BCR value of 2.04. These results are in accordance with the findings of Dongare[3] in grain amaranth.

The data further in Table 2 indicated that significantly highest net income of ₹ 39536/ha with BCR value of 2.77 was obtained with the application of *azotobacter* (B_2) followed by no seed inoculation (B_1) which obtained net income of ₹ 35835/ha and BCR value of 2.51. These results are in accordance with the findings of Chaudhari *et al.*[1] in grain amaranth.

Table 1: Effect of integrated nitrogen management on grain yield, protein content, protein yield and economic of grain amaranth

Treatments	Grain yield (kg/ha)	Stover yield (kg/ha)	Protein content (%)	Protein yield (kg/ha)	Gross income (₹/ha)	Cost of cultivation (₹/ha)	Net income (₹/ha)	BCR
A. Inorganic nitrogen (N)								
N_1 : 20 kg/ha	744	2022	12.69	94.5	45057	24225	20832	0.84
N_2 : 40 kg/ha	1115	2394	14.04	156.7	67402	24485	42916	1.90
N_3 : 60 kg/ha	1225	2766	15.37	188.4	74055	24747	49308	2.18
S. Em. ±	23	72	0.14	3.5	1411	-	1411	0.10
C.D. at 5%	69	211	0.41	10.2	4137	-	4137	0.30
B. Organic manures (M)								
M_1 : FYM @ 5.0 t/ha	1017	2347	13.87	143.3	61482	29986	31496	1.04
M_2 : Bio-compost @ 5.0 t/ha	1040	2440	14.20	149.8	62861	18986	43875	2.24
S. Em. ±	19	59	0.11	2.8	1152	-	1152	0.08
C.D. at 5%	NS	NS	NS	NS	NS	-	3378	0.24
C. Bio-fertilizer (B)								
B_1 : No seed inoculation	998	2301	13.70	138.8	60319	24485	35835	1.51
B_2 : Seed inoculation with *azotobactor* (10 ml/kg of seed)	1059	2487	14.37	154.3	64024	24487	39536	1.77
S. Em. ±	19	59	0.11	2.8	1152	-	1152	0.08
C.D. at 5%	56	172.44	0.33	8.4	3378	-	3378	0.24
D. Interaction								
N x M, M x B N x B, & N x M x B	NS	NS	NS	NS	NS	-	NS	NS
C. V. %	7.93	10.42	3.43	8.25	7.86	-	15.13	8.38

CONCLUSION

The results revealed that application of 60 kg N/ha + bio-compost @ 5.0 t/ha and seed inoculation with *azotobacter* increased yield, protein content (%), protein yield (kg/ha) and net return (₹/ha) of grain amaranth under south Gujarat condition.

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