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Short Term Red Amaranth Growth With Urea as N Source

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Abstract: The study was conducted at the farm of Banghobondhu Shekh Mogibur Rahman Agriculture University, Gazipur during the period of November to December, 2010 to enhance the production of red amaranth (*Amaranthus tricolor* cv: BARI lal shak 1) through the improvement of growth and yield of red amaranth by optimizing the appropriate levels of nitrogen fertilizer. The experiment was laid out in a Randomized Complete Block Design (RCBD) comprising six treatments with four replication each. The treatment combinations were T_0 (0 kg N ha^{-1}), T_1 (50 kg N ha^{-1}), T_2 (75 kg N ha^{-1}), T_3 (100 kg N ha^{-1}), T_4 (125 kg N ha^{-1}) and T_5 (150 kg N ha^{-1}), respectively. Amounts of N, P, K and S applied from urea, TSP, MOP and gypsum were 68, 23, 17 and 4 kg ha^{-1}, respectively. Data on plant height, leaf number, root-shoot growth and dry weight along with yield and BCR (benefit cost ratio) indicated that urea applied at the rate of 150 kg N ha^{-1} had a significant ($p<0.01$) effect on the short term growth and yield of red amaranth.

Key words: Red amaranth, Short Growth Period, Urea, Yield

Introduction

In general, red amaranth (*Amaranthu tricolor*) belonging to the family Amaranthaceae is a delicious vegetable with its considerable nutritional value around the globe and in particular, in parts of tropical and subtropical Asia, Africa and Central America. However, Chiefly grown during summer and rainy season, amaranth is an important and popular vegetable in Bangladesh because of its cheapest price, quick growing character and higher yield potential (Hossain, 1996). Therefore, in Bangladesh context, it is considered as a potential upcoming subsidiary food crop (Teutonic and Knorr, 1985). Simultaneously, the leaves and stems of amaranth are rich in protein, fat, calcium, phosphorus riboflavin niacin, sodium, iron and ascorbic acid. Additionally, it contains 43 food caloric which is higher than any other vegetables except potato and tomato (Chaudhury, 1967 and FAO, 1972). A part from this, it is processed into table products like soup. Even it seeds are used in making sweet rolls, crepes cookies crackers, etc. (Muthukrishan; Irulappan, 1986; Shanmugavelu, 1989). However, in Bangladesh, its cultivation is increasing day by day (BBS, 2010) although its production is lower than other amaranth producing countries (Talukder, 1999). Mean while, in Bangladesh, nitrogen fertilizer is the most crucial input for crop production and had been recognized as the central element for agricultural production as it imparts a major role on the increase of quality, color and taste of vegetables (Monira, 2007). Available reports also indicate that chemical fertilizers specially the nitrogenous ones are not applied in balanced proportions (Anonymous, 1997) for vegetable production. Additionally, information on the use of appropriate levels of nitrogen fertilizer with particular reference to red amaranth cultivation under specific agro-climatic conditions for short term growth period is lacking in general. These facts suggest that there is an ample scope of increasing red amaranth production with the appropriate use of nitrogen fertilizers. So the experiments presented in this article were conducted to evaluate the contributions of urea on plant height, leaf number, length, breadth, root-shoot growth and yield encompassing BCR as regards of short term growth period.

Materials and Methods

The study was conducted at the farm of BSMRAU campus, Gazipur, Bangladesh during November-December, 2010 in the agro-ecological zone (AEZ 28) of Modhupur tract representing shallow red brown terrace soil. Determined by the methods of Miah *et al.* (1998), the soil characters of the experimental site were silty clay loam having a pH (5.5), total nitrogen (0.054%) and organic matter (1.38%). The experiment was laid out in a Randomized Complete Block Design (RCBD) comprising the treatment combinations T_0 (No nitrogen), T_1 (50 kg N ha^{-1}), T_2 (75 kg N ha^{-1}), T_3 (100 kg N ha^{-1}), T_4 (125 kg N ha^{-1}), T_5 (150 kg N ha^{-1}) with urea as N source and replicated four. Opened with a tractor, the land was ploughed and cross-ploughed for several times with a power tiller followed by laddering to bring the soil under good tilth conditions. However, P, K, and S at 23.0, 17.0 and 4.0 kg ha^{-1} were applied from TSP, MP, and gypsum, respectively during final land preparation. In contrast, nitrogen doses were top dressed at two equal installments at 10 and 25 days after sowing (DAS), respectively. The prepared block consisted of 24 plots where unit plot size, plant accommodation and intercultural operations were maintained by the methods of Choudhury *et al.* (1974) and Waseem and Nadeem (2001). To check insect attack, Malathion 57 EC was applied at 2 mL/L fortnightly. Irrigations were given by watering cane if and when needed. Data on plant height, number of leaves along with length and breadth, root-shoot growth accompanied with dry and fresh weights, yield of red amaranth were recorded from eight plants being randomly selected from each plot encompassing the avoidance of boarder effect and statistical analyses were performed by the method of Gomez and Gomez (1984). Simultaneously BCR based profitability was assessed.

Results and Discussion

Plant height

Red amaranth plants grew well during entire growing period. Heights of the plants were recorded from all of T_0, T_1, T_2, T_3, T_4 and T_5 treatments (Table 1). The application of different treatment combinations comprising various N levels affected plant height significantly ($p<0.01$). The highest plant height (25.93 cm) was recorded in treatment T_5 followed by treatment T_4 (21.77 cm), T_3 (20.99 cm), T_2 (20.78 cm), T_1 (17.15 cm) and T_0 (11.33 cm), respectively. Obtained results on plant height were similar to those reported by Hamid *et al.* (1989) and Roy (2008).

Leaf number, length and breadth

As shown in Table 1, various treatment combinations induced differences among the number of leaves produced (per plant) were significant ($p<0.01$). The highest leaf number (24.66) was found in treatment T_5 and the lowest leaf (14.37) number was obtained in T_0. In the current experiment, recorded data on the number of red amaranth leaves (per plant) were in full agreement with those of Talukder (1999). As for leaf length, significant ($p<0.01$) variation was recorded in different treatment combinations (Table 1). The longest leaf length (7.46 cm) was measured in T_5 and that of the lowest leaf length (4.12 cm) was recorded treatment T_0. Meanwhile, the breath of the leaves of the plant differed significantly ($p<0.01$) among the various treatment combinations (Table 1). The highest leaf breadth (5.41 cm) was measured in treatment T_5. On the contrary, the lowest leaf breadth (3.29 cm) was found in treatment T_0. Thus the data of red amaranth leaf length and breadth coincided with the findings of Hossain (1996) and Rajgopal *et al.* (1977), respectively.

Root length and shoot diameter

The effect of different treatments on root length was not significant (Table 1). The longest root length (6.48 cm) was found in treatment T_5 and the lowest (5.76 cm) was recorded in treatment T_0. On the contrary, the application of different levels of N affected shoot diameter significantly ($p<0.01$). The highest shoot diameter (3.94 cm) was observed in T_5 and that of the lowest (2.55 cm) was recorded in T_0. These sorts of differential effects of various nitrogen levels on root and shoot growth patterns of amaranths were reported by Roy (2008), Hossain (1996) and Talukder (1999).

Table 1: Effect of N on vegetative growth of red amaranth

Treatment	Plant height (cm)	No. of leaves (plant^{-1})	Leaf breadth (cm)	Leaf length (cm)	Root length (cm)	Shoot diameter (cm)	Fresh root weight plant^{-1} (g)	Dry root weight plant^{-1} (g)
T_0	11.33	14.37	3.29	4.12	5.76	2.55	0.47	0.042
T_1	17.15	15.18	3.77	5.10	5.98	2.71	0.71	0.041
T_2	20.78	19.75	4.79	6.62	6.23	2.83	0.87	0.071
T_3	20.99	19.53	4.93	6.21	6.47	3.00	0.90	0.062
T_4	21.77	21.76	5.15	6.63	6.07	3.44	0.96	0.084
T_5	25.93	24.66	5.41	7.46	6.48	3.94	0.89	0.091
CV (%)	9.19	11.24	9.85	6.96	7.05	7.91	3.51	22.26
LSD	3.28	3.92	0.81	0.76	0.79	0.44	0.057	0.057
Level of significance	**	**	**	**	NS	**	**	NS

T_0 = 0 kg N ha^{-1}, T_1 = 50 kg N ha^{-1}, T_2 = 75 kg N ha^{-1}, T_3 = 100 kg N ha^{-1}, T_4 = 125 kg N ha^{-1}, T_5 = 150 kg N ha^{-1}
CV = Co-efficient of variation
LSD = Least Significant Difference
NS = Non-significant
** = Significant at 1% level of probability

Fresh and dry root weight

There was significant ($p<0.01$) effect of different treatments on the production of fresh root weight of red amaranth (Table 1). As for fresh weight, the highest value (0.96 g) was observed in T_4 and that of the lowest (0.47 g) was recorded in T_0 and such pattern of fresh root weight production was similar to those of Talukder (1999). In contrast, the trend of dry weight production was insignificant and rugged in all of T_0, T_1, T_2, T_3, T_4, T_5, respectively with the highest dry root weight (0.091 g) in T_5 and that of the lowest (0.041 g) in T_0 coinciding with those of Roy (2008).

Fresh and dry plant weight

The effect of different treatments on plant fresh weight was significant (p<0.01). As shown in Table 2, highest fresh weight (12.07 g) was measured in T_5 and that of lowest (4.88 g) was found in $T_{0.}$ These sorts of findings indicated that increase in nitrogen doses had a positive effect on the increment of plant fresh weight. On the other hand, increase in nitrogen dose had a significant (p<0.01) influence on the increase in plant dry weight too. Namely, a similar trend of highest (0.74 g) and lowest (0.52 g) dry weights were recorded in T_4 and T_0 treatments, respectively. In response to nitrogen fertilization, such patterns of fresh and dry plant weights for amaranths were reported by Roy (2008).

Yield /plot

As for yield in red amaranth, different treatments showed significant (p<0.01) variation (Table 2). The results indicated that maximum yield (1333.33 g) per plot was observed in T_5 and that of the lowest (350.0 g) was recorded in $T_{0.}$ These high and low yields could be ascribed for the highest nitrogen dose application followed by that received no nitrogen because N is central element for the growth and development of plant (Roy, 2008).

Table 2: Effect of N on the yield attributes of red amaranth

Treatment	Fresh weight (plant^{-1}) (g)	Dry weight (plant^{-1}) (g)	Yield (plot^{-1}) (g)	Yield (t ha^{-1})
T_0	4.88	0.52	350.00	0.87
T_1	7.25	0.68	791.66	1.98
T_2	8.89	0.73	966.66	2.41
T_3	10.23	0.81	1100.00	2.75
T_4	11.49	0.88	1200.00	3.00
T_5	12.07	0.74	1333.33	3.33
CV (%)	4.11	10.30	1014	10.14
LSD	0.68	0.14	176.50	0.44
Level of significance	**	**	**	**

T_0 = 0 kg N ha^{-1}, T_1 = 50 kg N ha^{-1}, T_2 = 75 kg N ha^{-1}, T_3 = 100 kg N ha^{-1}, T_4 = 125 kg N ha^{-1}, T_5 = 150 kg N ha^{-1}
CV = Co-efficient of variation
LSD = Least Significant Difference
** = Significant at 1% level of probability

Yield /hectare

Yield of red amaranth was positively influenced by various treatments (Table 2). However, variation among the treatments corresponding to red amaranth yield per hectare was significant (p<0.01). Generalized trend observed for yield was that yield per hectare increased with the increase in nitrogen dose (T_0> T_1 >T_2 >T_3 >T_4 >T5), respectively. The highest yield (3.33 t/ha) was found in T_5 and the lowest yield (0.87 t ha^{-1}) was recorded in $T_{0.}$ However, such results were in perfect agreement with those of Ara (2005).

Economic performance of red amaranth

The partial budget analysis on the effect of nitrogen doses applied on red amaranth production is presented in Table 3. The highest gross return (Taka 39,960.00 ha^{-1}) was obtained from the treatment T_5 which received N (150 kg ha^{-1}), followed by the treatment T_4 (Taka 36,000.00 ha^{-1}) which received N (125 kg ha^{-1}), T_3 (Taka 33000.00 ha^{-1}) which received N (100 kg ha^{-1}), T_2 (Taka 28,900.00 ha^{-1}) which received N (75kg ha^{-1}) and T_1 (Taka 23, 760.00 ha^{-1}) which received N (50 kg ha^{-1}). All the treatments resulted in higher gross return over the control (Taka 10,440.00 ha^{-1}). On the other hand, highest variable cost (Taka 10,980.00 ha^{-1}) was required in the treatment T_5 which received N (150 kg ha^{-1}) and that of the lowest (Taka 7479.00) was needed in T_0 which received no nitrogen fertilizer. The highest cost benefit ratio (3.66) was recorded in T_4 which was followed by T_5 (3.64).

Table 3: Effect of nitrogen on economic performance of red amaranth cultivation

Treatment	Gross return (Tkha^{-1})	TVC (Tkha^{-1})	Gross margin (Tkha^{-1})	BCR
T_0	10440.00	7479.00	2961.00	1.40
T_1	23760.00	8507.00	15235.00	2.79
T_2	28920.00	9211.00	19709.00	3.14
T_3	33000.0	9544.00	23456.00	3.46
T_4	36000.00	9826.00	26174.00	3.66
T_5	39960.00	10980.0	28980.00	3.64

T_0 = 0 kg N ha^{-1}, T_1 = 50 kg N ha^{-1}, T_2 = 75 kg N ha^{-1}, T_3 = 100 kg N ha^{-1}, T_4 = 125 kg N ha^{-1}, T_5 = 150 kg N ha^{-1}, TVC= Total Variable Cost, BCR= Benefit Cost Ratio

Conclusions

The results indicated that N doses had a positive impact on the growth parameters of red amaranth like plant height, leaf number, fresh and dry weight of plant. Additionally applied nitrogen had significant effect on yield and BCR too. But comparative results of various parameters studied in the present investigation suggested that T_5 was the best treatment because yield was highest (3.33 t ha^{-1}) in T_5 and related BCR in both of T_4 and T_5 treatment combinations were 3.66 and 3.64, respectively with no considerable difference. However, the present study was conducted in winter season of 2010 at BSMRAU research farm only. Therefore, recommendation of T_5 (N 150 kg ha^{-1}) as fertilizer dose necessitates both regional and multi location trials. Finally yield followed by BCR suggests that treatment T_5 had the potentials to be recommended as suitable N dose for short term red amaranth cultivation.

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