J. Bangladesh Agril. Univ. 11(1): 29–32, 2013 **ISSN 1810-3030**

Nutrient accumulation and their uptake by red amaranth as influenced by different levels of N

M. Y. Miah*, U. S. Monira, K. I. Fazal[1] and P. K. Roy

Department of Soil Science, Bangabandhu Shiekh Mujibur Rahman Aagricultural University, Gazipur-1706, Bangladesh and [1]Department of Agricultural Chemistry, Sher-E- Bangla Agricultural University Dhaka-1207, Bangladesh, *E-mail: miahyunus@ymail.com

Abstract

The study was conducted at the farm of Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur during the period of November to December, 2010 to enhance the production of red amaranth (cv: BARI lal shak 1) through the determination of nutrient accumulations and their uptake by optimizing the appropriate levels of nitrogen (N) from urea. The experiment was laid out in a Randomized Complete Block Design (RCBD) comprising six treatments with four replicate each. There were altogether six levels of N viz. N_0 (0 kg N ha^{-1}), N_{50} (50 kg N ha^{-1}), N_{75} (75 kg N ha^{-1}), N_{100} (100 kg N ha^{-1}), N_{125} (125 kg N ha^{-1}) and N_{150} (150 kg N ha^{-1}), respectively. P, K and S were applied from TSP, MoP and gypsum @ 23, 17 and 4 kg ha^{-1}, respectively. Results revealed that different levels of N significantly influenced the nutrient accumulation and their uptake by red amaranth. Highest nutrient contents in most of the cases were observed when N was applied @ 150 kg ha^{-1} which was identical with the treatment N_{100} and the lowest contents were found in N_0 treatment. Nutrient uptake followed similar trend like nutrient accumulation. The over result suggests that N @ 150 kg N ha^{-1} can be applied to boost up the production of red amaranth cv: BARI lal shak 1 under the agro-climatic conditions of the study area.

Keywords: Red amaranth, Nutrient accumulation, Urea

Introduction

Red amaranth is an important and popular leafy vegetable in Bangladesh because of its cheapest price, quick growing character and higher yield potential (Hossain, 1996). It is also considered as a potential upcoming subsidiary food crop (Tutonic and Knorr, 1985). The leaves and stems of red amaranth are rich in protein, fat, Ca, P, riboflavin, niacin, Na, Fe and ascorbic acid. Additionally, it contains 43 food calorie which is higher than any other vegetables except potato and tomato (Chaudhury, 1967 and FAO, 1972). A part, it is processed into table products like soup. The seeds are used in making sweet rolls, crepes cookies crackers, etc. (Muthukrishan and Irulappan*,* 1986 and Shanmugavelu, 1989). In our country, its cultivation is increasing day by day (BBS, 2010) although its production is comparatively lower than other amaranth producing countries (Talukder, 1999). Mean while, in Bangladesh, N 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 N fertilizer with particular reference to urea as N source for nutrient accumulation and their uptake in red amaranth under specific agro-climatic conditions is lacking in general. These facts suggest that there is an ample scope of increasing red amaranth production with the appropriate use of N nitrogen fertilizers. So the experiment presented in this article was conducted to evaluate the contributions of urea on nutrient accumulation and their uptake by red amaranth.

Materials and Methods

The study was conducted at the farm of Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU) campus, Gazipur, Bangladesh during November-December, 2010 in the agro-ecological zone (AEZ 28) of Modhupur tract representing shallow red brown terrace soil. Soil characters of the experimental site were silty clay loam having 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 six levels of N viz. N_0 (0 kg N ha^{-1}), N_{50} (50 kg N ha^{-1}), N_{75} (75 kg N ha^{-1}), N_{100} (100 kg N ha^{-1}), N_{125} (125 kg N ha^{-1}) and N_{150} (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. P, K and S gypsum @ 23, 17 and 4 kg ha^{-1} were applied from TSP, MoP, gypsum, respectively during final land preparation. In contrast, urea was top dressed in 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 as and when needed. Eight plants were randomly selected from each plot to study the nutrient accumulation and their uptake. N, P, K, Mg, S, and Zn contents in red amaranth were determined (Miah *et al*., 1998) at soil chemistry laboratory of BSMRAU using AAS (Model Z-9000, Hitachi Co., Japan). Nutrient uptake was calculated from nutrient contents and dry matter yield and statistical analyses were performed by the method of Gomez and Gomez (1984).

Results and Discussion

Nutrient accumulation in red amaranth

Nitrogen content: As shown in Table 1, different treatment combinations showed statistically significant ($p<0.01$) increase in nitrogen (N) content in the order $N_0 < N_{50} < N_{75} < N_{100} < N_{125} < N_{150}$. The highest (5.11 %) nitrogen concentration was found in N_{150} and that of the lowest (4.68 %) was recorded in N_0. These data indicated that increase in N doses had positive effect on the increment of red amaranth N content. Such findings could be presumed for two reasons namely, applied N doses were in accordance with the requirement for the vegetative growth of red amaranth and secondly, it might be speculated for harvesting time and harvested organ since in red amaranth harvested leaves are edible portions and harvesting period was 45 days as N accumulation in plant parts depend on N source and growth period (Rauf *et. al.*, 2009).

Table 1. Effect of different levels of N on nutrient accumulation of red amaranth cv. BARI lal shak 1

Treatment	N (%)	P (%)	K (%)	Mg (%)	S (%)	Zn (ppm)
N_0	4.68	0.27	0.45	0.27	0.22	41.66
N_{50}	4.74	0.29	0.46	0.28	0.23	44.43
N_{75}	4.96	0.32	0.45	0.27	0.24	49.00
N_{100}	3.08	0.29	0.46	0.27	0.24	73.66
N_{125}	4.65	0.28	0.44	0.27	0.26	76.00
N_{150}	5.01	0.28	0.44	0.29	0.26	83.66
LSD	0.76	0.02	0.01	0.08	0.01	19.30
CV (%)	15.95	5.97	1.99	6.63	3.28	3.4529.95

N_0 (0 kg N ha^{-1}), N_{50} (50 kg N ha^{-1}), N_{75} (75 kg N ha^{-1}), N_{100} (100 kg N ha^{-1}), N_{125} (125 kg N ha^{-1}) and N_{150} (150 kg N ha^{-1})

Phosphorus content: Phosphorus (P) content of red amaranth after harvest is displayed in Table 1. The trend of P concentration in red amaranth shoot was remarkable. However, treatment combinations induced variations in phosphorus content was not significant. Phosphorus concentration varied from 0.27 to 0.32 (%) across the treatments with the highest concentration (0.32 %) in N_{75}. However, such variation of P concentration range in red amaranth shoot lied in the suggestions of Marschner (1990).

Potassium content: Data on K concentration of red amaranth shoot are shown in Table 1. As for potassium concentration, no remarkable variation among the treatments was observed. Potassium concentration varied from 0.44 to 0.46 (%) irrespective of treatments with the highest concentration (0.46 %) in N_{75}. This sort of K concentration pattern might be credited to the variety used as relations between K accumulation in plant parts and K supply vary from plant to plant (Marschner, 1990).

Magnesium content: Magnesium content of red amaranth at harvest is presented in Table 1. The trend of Mg concentration in red amaranth was statistically identical. In other words, treatment combinations induced variations in Mg content was not significant. Magnesium concentration varied from 0.29 to 0.27 (%) irrespective of the treatments with the highest concentration (0.29 %) in N_{150}. However, such findings of Mg concentrations fell in the generally agreed range (Marschner, 1990).

Sulfur content: As displayed in Table 1, S content among the treatment combinations showed that it was not increased remarkably. So for S concentration, no treatment induced significant increase was noticed. The highest (0.26 %) S concentration was found in N_{150} and that of the lowest (0.22 %) was recorded in $N_{0.}$ These data indicated that increase in N doses had no remarkable effect on the increment of red amaranth S content. However, such sorts of variation in S concentrations were in full agreement with those reported by Marschner (1990).

Zinc content: Data as presented in Table 1 showed that Zn concentrations among the treatment combinations varied significantly. The highest (83.66 ppm) Zn concentration was found in N_{150} and that of the lowest (41.66 ppm) was recorded in $N_{0.}$ These data indicated that increase in nitrogen doses had positive effect on the increment of red amaranth Zn content and in were accordance with those reported by Mengel and Kirkby (2001).

Nutrient uptake

Nitrogen uptake: For various N levels, nitrogen uptake in red amaranth was statistically significant ($p<0.01$) (Table 2). However, variation in N uptake ranged from 41.03 to 170.45 (kg ha^{-1}) with the highest uptake 170.45 (kg ha^{-1}) in N_{150} and were in full agreement with those of Marschner (1990) and Roy (2008). Further such results of N uptake in red amaranth may be attributable to the soil pH as the experimental soil pH was 5.5 which enhances N uptake (Mengel and Kirkby, 2001).

Table 2. Effect of different N levels on nutrient uptake by red amaranth cv. BARI lal shak 1

Treatment	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})	Mg (kg ha^{-1})	S (kg ha^{-1})	Zn (kg ha^{-1})
N_0	41.03	2.42	3.98	19.95	2.41	0.07
$N5_0$	93.93	5.85	9.11	47.98	5.61	0.14
N_{75}	119.98	7.87	10.99	59.55	6.63	0.18
N_{100}	84.96	7.87	12.72	64.03	7.60	0.13
N_{125}	139.83	8.50	13.39	73.70	8.29	0.13
N_{150}	170.45	9.41	14.62	77.50	9.66	0.14
LSD	6.25	5.81	5.44	10.76	1.25	0.06
CV (%)	11.81	10.22	8.97	10.35	10.26	10.33

N_0 (0 kg N ha^{-1}), N_{50} (50 kg N ha^{-1}), N_{75} (75 kg N ha^{-1}), N_{100} (100 kg N ha^{-1}), N_{125} (125 kg N ha^{-1}) and N_{150} (150 kg N ha^{-1})

Phosphorus uptake: The P uptake in red amaranth was significantly ($p<0.01$) influenced by different N levels (Table 2). The N level (N_{150}) showed the highest (9.41 kg ha^{-1}) P uptake with a range from 2.42 to 9.41 (kg ha^{-1}) across the N levels. Thus the findings of the present study are supported by Mengel and Kirkby (2001) and Roy (2008) as they reported a maximum P uptake in plants with the application of highest level of N fertilizer. Further increased rates of P uptake in red amaranth with the increased rates of N levels suggest that various N levels played a positive role in P uptake.

Potassium uptake: It was observed that different levels of N application had significant ($p<0.01$) impact on K up take by red amaranth (Table 2). Potassium uptake varied from 3.98 to 14.62 (kg ha^{-1}) in all of the imposed N levels with the highest uptake (14.62 kg ha^{-1}) in $N_{150.}$ Such K uptake in red amaranth could be attributed to the variety used as relations between K uptake in plant parts and K supply vary from plant to plant (Marschner, 1990) and source of N applied (Roy, 2008). Moreover, these data give some indications that K uptake in plants can not be expressed in general term, rather it depends on crops grown, fertilizer applied and the soil used.

Sulfur uptake: Table 2 summarizes the pattern of quantitative S uptake in red amaranth in relation to various N levels applied. It varied from 1.95 to 8.66 (kg ha^{-1}) in all of N_0, N_{50}, N_{75}, $N_{100,}$ N_{125} and N_{150} with the highest S uptake (8.66 kg ha^{-1}) in $N_{150.}$ In general, the amount of S uptake increased with the elevated levels of N applied. So in full compliance with that reported by Marschner (1990), the data in Table 2 reflect a type of S uptake pattern in red amaranth which created a better impact of elevated levels of N application in the present study.

Magnesium uptake: It is interesting to note that magnesium (Mg) uptake in red amaranth amaranth was significantly (p<0.01) influenced by the various N levels applied (Table 2). However, the ranking of the N levels in respect of Mg uptake was in the order $N_0<N_{50}<N_{75}<N_{100}<N_{125}<N_{150}$. So the trend of Mg uptake in red amaranth of the current experiment was corroborated by the findings of Kirkby and Mengel (1976). However, it remained to be studied whether the application of increased N levels had a positive effect on Mg uptake or not since the crop was grown only for one season which is not enough to conclude on plant nutrient uptake (Miah *et al*., 1998).

Zinc uptake: The application of various N levels had significant (p<0.01) effect on the Zn uptake of red amaranth (Table 2). The highest (0.18 kg ha^{-1}) Zn uptake was found in N_{75} and that of the lowest (0.07 kg ha^{-1}) was recorded in N_0. The increased Zn uptake in red amaranth might be due to the subsequent effect of increased levels of N applied. These results confirm the findings of Mengel and Kirkby (2001).

Conclusion

The application of various N levels had significant effect on accumulation and uptake of N, P, K, Mg, S, and Zn by red amaranth. As for nutrient accumulation, highest nutrient contents were recorded in the treatment receiving 150 kg N ha^{-1} which was identical with that of N_{100}. In contrast, the lowest contents were found in N_0 treatment. However, nutrient uptake in red amaranth followed the similar trend like nutrient accumulation. So in the present study, the N application at 150 kg ha-^{1}showed better performance for the cultivation of red amaranth. The over result suggests that N @ 150 kg N ha^{-1} can be applied to boost up the production of red amaranth cv: BARI lal shak 1 under the agro-climatic conditions of the study area.

References

Anonymous. 1997. Fertilizer Recommendation Guide published by BRAC, Dhaka, Bangladesh.

BBS (Bangladesh Bureau of Statistics). 2010. Yearbook of Agricultural Statistics of Bangladesh. Bangladesh Burea of Statistics. Statistics Division, Ministry of Planning, Bangladesh. Dhaka, Bangladesh, pp. 100-109.

Chaudhury, B. 1967. Vegetables. National Book Trust: New Delhi. India. p.195.

FAO (Food and Agriculture Organization). 1972. Food composition table for use in East Asia. UN and US Department of Health, Education and Welfare. pp. 11-15.

Gomez, K.A. and Gomez., A.A. 1984. Statistical Procedure for Agricultural Research, John Willey and Sons, New York.

Hossain, S. I. 1996. A comparative study on yield and quality of some *Amaranth* genotype. MS thesis, IPSA, Salna, gazipur, pp. 41-44.

Marschner, H. 1990. Mineral nutrition of higher plants. Academic Press, London. pp.195-269.

Mengel, K. and Kirkby, E.A. 2001. Principles of plant nutrition. pp.461-471.

Mengel, K. and Kirkby, E.A. 2001. Principles of plant nutrition. pp.213-234.

Miah, M.Y., Kanazawa, S and Chino, M. 1998. Nutrient distribution across wheat rhizosphere with oxamide and ammonium sulfate as N source. Soil Sci. Plant Nutr., 44: 579-587.

Monira, U.M. 2007. Nutrient status in tomato grown on organic manure treated soil. MS thesis, Dept. of Soil Science, BSMRAU, Salna, Gazipur.

Muthukrisna, C.R. and Irulappan, I. 1986. Amaranthus. pp. 670-679. In: T.K. Bose and M.G. Som (eds.) Vegetable crop in Indian. Naya Prokash, Calcutta-6, India.

Rauf, M.A., Karim, A.J.M., Zpoebich, S. and Hassan, J. 2009. Potential of industrial sludge as a source of nitrogen and its partitioning, uptake and its use efficiency in red amaranth. Intl. J. Bio Res., 7: 474-480.

Roy, P.K. 2008. Effect of organic manures on growth and yield in stem amaranth. MS thesis, Dept. of Soil Science, BSMRAU, Gazipur.

Shanmugavelu, K.G. 1989. Amaranthus. In: production Technology of vegetable Crops. Oxford and IBH Publishing Co. Pvt. Res. Cent., USDA, Albary, California, USA.

Talukder, M.S.A. 1999. Effect of plant density on green yield and seed production in different amaranths. MS Thesis, BSMRAU, Salna, Gazipur.

Teutonico, R.A. and Knorr, D. 1985. Amaranth composition, properties and application of a reddish covered food crop: Food technology, 39: 49-61.

Wasem, K. and Nadeem, A. 2001. Enhance of spinach production by varying sowing dates, row spacing and frequencies of cuttings. On line J. Bio. Sci., Asian Network for Scientific Information, 1: 92-94.