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Stem Amaranth Yield in Response to Organic Manuring

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Abstract: Field investigations are important tools for confirmation of the effectiveness of the organic manures on crop yield. As different N sources, this work presents a comparative study of the effects of urea, cow dung and poultry manure on plant height, stem length and diameter, leaf length, breadth and number accompanied with the fresh weight of plant, stem, leaf coupling stem leaf ratio and gross yield of stem amaranth (Amaranthus tricolor Var. BARI Data 1). With an imposition of eight treatments, a field study was conducted at the farm of BSMRAU campus, Gazipur during February-April, 2007 in a Randomized Complete Block Design (RCBD). Treatments were control and seven N sources namely, urea (107 kg N ha -1), cow dung (23.75 t ha-1), poultry manure (9.3 t ha-1), half cow dung and half urea, half poultry manure and half urea, three fourth cow dung and one fourth urea and three fourth poultry manure and one fourth urea, respectively with four replications ensuring the 107 kg N ha^{-1} supply from all sources of N used. Compared with cow dung and poultry manure, urea resulted in higher plant height, broader stem length and diameter, more fresh weight of plant, stem and leaf accompanied with maximum gross yield. However, data on the studied parameters varied significantly ($p < 0.05$). So cow dung and poultry manure applied at 23.75 t ha^{-1} and 9.3 t ha^{-1}, respectively were compatible to urea as N source for stem amaranth production.

Key words: Cow dung, Poultry manure, Stem amaranth yield and urea.

Introduction

As one of the nutritious and delicious vegetables, amaranth (*Amaranthus tricolor)* is a popular vegetable in Bangladesh because of its cheapest price, quick growing character and higher yield potential. Additionally it is considered as a potential subsidiary food crop (Tutonic and Knorr, 1995). Thus Amaranth plays a predominant role both in nutrition and food security. A part from this, it is processed into table products like soup (Shanmugavelu, 1989). However, at present amaranth is cultivated in an area of 8647.77 ha with a total production 58095 tone of green amaranth (BBS, 2010) which is lower than other amaranth producing countries (Talukder, 1999) and Bangladesh runs with an acute shortage of vegetables. Mean while, nitrogen is the most crucial input for increasing crop production and has been recognized as the central element for agricultural production (Monira, 2007). However, use of chemical nitrogen fertilizers leads to the environmental pollution. Therefore, in addition to improved soil health, application of organic manures is a better option for chemical nitrogen fertilizers in crop production (Monira *et al.* 2007). These facts suggest that there is an ample scope to increase stem amaranth yield in per unit area with appropriate use of organic nitrogen as organic manures exert a major role on crop production (Gaur *et al.,* 1984). Further organic manure like cow dung is a good source of plant nutrients (Solaiman and Rabbani, 2006) and cow dung and poultry manure could be beneficially applied in agronomic and horticultural crop production (Noor *et al.* 2001, Rahman *et al.* 2005). Under these circumstances, the present study was under taken to verify the compatibility among cow dung, poultry manure and urea with respect to stem amaranth production. Therefore, current experiments demonstrate the contribution of cow dung and poultry manure, on plant height, stem length and diameter, leaf length, breadth and number accompanied with the fresh weight of plant, stem, leaf, stem-leaf ratio and gross yield of stem amaranth compared to urea.

Materials and Methods

The study was conducted at the farm of BSMRAU campus, Gazipur, Bangladesh during February-April, 2007 in the agro-ecological zone (AEZ 28) of Modhupur tract representing shallow red brown terrace soil. 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%). Physico-chemical of the used cow dung were pH (7.1), total nitrogen (0.82%) and organic carbon (26.52%) and those of the poultry manure were pH (6.1), total nitrogen (1.2%) and organic carbon (40.5%), respectively. The experiment was laid out in a Randomized Complete Block Design (RCBD) comprising the treatment combinations T_1 (-cow dung, -poultry manure -urea), T_2 (urea), T_3 (cow dung), T_4 (poultry manure), T_5 (50% cow dung + 50% urea), T_6 (50% poultry manure + 50% urea), T_7 (75% cow dung + 25% urea), and T_8 (75% poultry manure + 25% urea) 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. The amounts of N (107 kg ha^{-1}) were supplied from cow dung, poultry manure and urea, respectively. While those of P, K, S and Mo at 23.28, 52, 5.82 and 1 kg

ha^{-1} were applied from TSP, MP, gypsum and sodium molybdate, respectively. However, cow dung, poultry manure, TSP, gypsum and sodium molybdate were applied during final land preparation. In contrast, urea and MP were top dressed at two equal installments at 15 and 35 days after sowing (DAS), respectively. The prepared block consisted of 32 plots with a unit plot size 6 m^2 that accommodated 20 plants maintained at row to row and plant to plant distances of 20 cm and 15 cm, respectively. To check insect attack, Malathion 57 EC was applied at 2mL/L fortnightly. Irrigations were given by watering cane if and when needed. Data on plant height and weight, stem length, diameter and weight, leaf weight, stem-leaf ratio and gross yield of stem amaranth were recorded from eight plants being randomly selected from each plot encompassing the avoidance of boarder effect and soil properties and statistical analyses were performed by the methods of Miah *et al.* (1998) and Gomez and Gomez (1984).

Results and Discussion

Plant height, stem length and diameter

In different treatments, the plant height of stem amaranth varied significantly ($p \leq 0.05$) (Table 1). As a results, plants grew well during the growing period in all of the treatments (T_1, T_2, T_3, T_4 , T_5, T_6, T_7 and T_8). However, the plant height ranged from 49.97 cm recorded in T_1 to the highest 85.07 cm attained in T_2 indicating the dominant role of urea as N source on plant growth. This sort of urea induced highest plant height observed in T_2 is similar to that reported by Monira *et al.* (2007) and Solaiman and Rabbani (2006). On the contrary, plant height remained statistically similar in T_2, T_3, T_4, T_5, T_6, T_7 and T_8, respectively. These sorts of findings indicated that combinations of urea with cow dung and poultry manure are compatible among themselves for plant height enhancement other than T_1 treatment as their effects were higher than control (T_1). Additionally, plant height data recorded in the current experiments coincided with those reported by Hamid *et al.* (1989), Mohideen *et al.* (1974) and Rajgopal *et al.* (1977). As for stem length and diameter, significant ($p< 0.05$) variation among the treatments was observed. Namely, urea (T_2) produced the longest stem length (80.10 cm) with that of the shortest (44.37 cm) in control (T_1). However, cow dung or poultry manure alone or their combinations with urea showed statistically similar effect on stem length production with all the treatments yielding higher stem length than the control. Mean while, stem diameter (base and middle portion) differed significantly ($p< 0.05$). However, such stem diameter variation in T_3, T_4, T_7 and T_8 was statistically similar suggesting that both of the cow dung and poultry manure as N sources having the organic origin induce similar pattern of stem diameter and are in conformity with those of Islam *et al.* (2005) and Monira *et al.* (2007). Thus significant ($p \leq 0.05$) variations between stem length and diameter of stem amaranth lied in the suggestions of Rajgopal *et al.* (1977), Hossain (1996) and Talukder ((1999).

Table 1. Effect of different treatments on plant height, stem length and diameter (base and middle) of stem amaranth

Treatment	Plant height (cm)	Stem length (cm)	Stem Diameter (mm)	
			Base	Middle
T_1: (Control)	49.97	44.37	14.69	11.71
T_2: (N_{107}, $P_{23.28}$, K_{52} ,$S_{5.82}$)	85.07	80.10	21.63	17.12
T_3: ($CD_{23.75}$)	75.67	72.43	19.51	15.66
T_4: ($PM_{9.3}$)	75.67	71.27	19.54	16.27
T_5: ($CD_{11.86}$+$N_{53.5}$)	78.27	72.37	18.80	15.11
T_6: ($PM_{4.65}$+$N_{53.5}$)	76.30	70.37	20.67	16.25
T_7: ($CD_{17.81}$+$N_{26.75}$)	78.60	73.27	19.45	14.76
T_8: ($PM_{6.98}$+$N_{26.75}$)	74.47	69.33	19.12	15.11
CV (%)	6.94	7.80	7.68	8.34
LSD (0.05)	8.75	9.22	1.87	2.19

Legends: N = Nitrogen, P = Phosphorus, K = Potassium, S = Sulfur (kg/ha), CD = Cowdung, PM = Poultry manure (t/ha), $LSD_{(0.05)}$ = Least significant difference ($p<0.05$), CV = Co-efficient of variance

Leaf length, breadth and number

The effect of the different treatments (T_1, T_2, T_3, T_4, T_5, T_6, T_7, T_8) on leaf length, breadth and number of stem amaranth are presented in Table 2. The variations of the effects of various treatments in terms of leaf length and breadth production in stem amaranth were significant ($p \leq 0.05$). As for leaf length, the obtained data of T_2, T_3, T_4, T_5, T_6, T_7 and T_8 showed significance difference only when compared with control (T_1). However, the effects of T_2, T_3, T_4, T_5, T_6, T_7 for leaf length were statistically similar. Even for leaf breadth, similar pattern of effect of the various treatments was noticed. But all the treatments recorded higher leaf length and breadth over control. Thus the treatment effect oriented variable leaf length and breadth production in stem amaranth coincided with the findings of Hossain (1996) and Rajgopal *et at.* (1977) as they reported that the increase or decrease of leaf length and breadth in stem amaranth varies according to N sources applied. At the same time, the production of leaf number in various treatments showed no significant difference. However, the highest number of leaf (15.80) in T_2 reflected the dominant effect of urea as N source on production of leaf number in stem amaranth. Furthermore, the similar pattern of insignificant leaf number production in all the treatments revealed that neither of the N sources nor their combinations applied played a remarkable role on leaf number production and thus was similar to those reported by Talukder (1999).

Table 2. Effect of different treatments on leaf length, breadth and number of stem amaranth

Treatments	Leaf		Leaf Number
	Length (cm)	Breadth (cm)	
T_1: (Control)	6.51	4.30	12.91
T_2: (N_{107}, $P_{23.28}$, K_{52}, $S_{5.82}$)	11.36	7.68	15.80
T_3: ($CD_{23.75}$)	10.58	6.63	14.61
T_4: ($PM_{9.3}$)	11.17	7.52	13.17
T_5: ($CD_{11.86}$+$N_{53.5}$)	10.85	7.53	13.07
T_6: ($PM_{4.65}$+$N_{53.5}$)	10.64	7.29	14.51
T_7: ($CD_{17.81}$+$N_{26.75}$)	10.60	7.17	14.48
T_8: ($PM_{6.98}$+$N_{26.75}$)	10.40	6.90	14.48
CV (%)	9.50	8.87	8.41
LSD (0.05)	1.26	0.92	NS

Legends: N = Nitrogen, P = Phosphorus, K = Potassium, S = Sulfur (kg/ha), CD = Cow dung, PM = Poultry manure (t/ha), $LSD_{(0.05)}$ = Least significant difference ($p<0.05$), CV = Co-efficient of variance, NS= Not significant

Fresh weight of plant, stem, leaf, stem-leaf weight ratio and gross yield

The fresh weight of individual plant, stem, leaf, stem-leaf weight ratio and gross yield of stem amaranth associated with the effects of various treatments are show in Table 3. Among the treatments, the maximum fresh weight of individual plant, stem, leaf along with gross yield was found in T_2 encompassing those of minimum in T_1. However, for all of these parameters, the treatment effect was significant ($p \leq 0.05$) when the obtained data of T_2, T_3, T_4, T_5, T_6, T_7 and T_8 were compared with control (T_1) only. Conversely, the effects of T_2, T_3, T_4, T_5, T_6, T_7 for these parameters were statistically similar. But all the treatments recorded maximum data on fresh weight of individual plant, stem, leaf, stem-leaf weight ratio and gross yield over control. With respect to fresh weight of individual plant, stem, leaf and gross yield of stem amaranth coincided with those reported by Rajagopal *et al.* (1977) and Hossain (1996). Additionally, plant height enhancement and fresh weight production as regards to cow dung, poultry manure and urea as different N sources were compatible (Gaur et al., 1984 and Monira *et al.*, 2007). Relevantly, the effect of different treatment on stem leaf ratio was also significant ($p \leq 0.05$). The highest stem-leaf ratio (3.05) was recorded in T_1 (control) with that of the lowest in T_3. So the data suggest that the treatments affected better growth over control led to such a remarkable stem-leaf ratio (3.05) in control.

Table 3. Effect of different treatments on fresh weight of plant, stem, stem-leaf weight ratio and gross yield of stem amaranth

Treatment	Fresh weight (g)			Stem leaf Ratio	Gross Yield (t/h)
	Plant	Stem	Leaf		
T_1: (Control)	80.33	54.17	17.83	3.05	22.49
T_2: (N_{107}, $P_{23.28}$, K_{52} ,$S_{5.82}$)	194.00	118.33	53.33	2.22	53.95
T_3: ($CD_{23.75}$)	167.67	95.33	21.5	1.91	47.13
T_4: ($PM_{9.3}$)	171.00	92.00	19.5	1.97	47.42
T_5: ($CD_{11.86}$+$N_{53.5}$)	148.83	92.67	19.67	2.28	41.21
T_6: ($PM_{4.65}$+$N_{53.5}$)	171.67	107.67	20.67	2.22	47.60
T_7: ($CD_{17.81}$+$N_{26.75}$)	140.67	93.00	18.43	2.35	38.92
T_8: ($PM_{6.98}$+$N_{26.75}$)	160.00	99.67	20.33	2.37	44.80
CV (%)	12.98	14.98	14.56	9.00	13.04
LSD(0.05)	33.46	23.56	4.67	0.36	9.35

Legends: N = Nitrogen, P = Phosphorus, K = Potassium, S = Sulfur (kg/ha), CD = Cow dung, PM = Poultry manure (t/ha), $LSD_{(0.05)}$ = Least significant difference ($p<0.05$), CV = Co-efficient of variance

Conclusion

The above results suggested that cow dung and poultry manure appeared to be compatible to urea for stem amaranth cultivation in terms of plant height, fresh weight, stem length, diameter and fresh weight, leaf length, breadth and number production accompanied with the gross yield.

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