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CHARACTERIZATION AND EVALUATION OF STEM AMARANTH GENOTYPES IN SUMMER SEASON

A. U. Ahammed, M. M. Rahman* and M. M. Hossain

Department of Horticulture, Bangabandhu Sheik Muzibur Rahman Agricultural University, Salna, Gazipur 1703, Bangladesh.

Abstract

An investigation on characterization and evaluation of stem amaranth genotypes was carried out at the experimental field, Department of Horticulture, Bangladesh Agricultural University (BSMRAU), Gazipur, Bangladesh during summer, 2007. Stem pigmentation varied from light and yellow green to green, pale red to deep red and purple to red purple. Leaf pigmentation varied from light yellow, purplish green to green, pale red to deep red and light red to purple. The genotypes SA005, SA011, SA018, SA027, SA033 and SA037 had no branch and the genotype SA039 produced maximum (5.10) number of branches. The thickest stem was observed in SA040 (27.63 mmdia) and the thinnest from SA001 (16.71 mm). The highest stem weight/plant was recorded in SA039 (465.80 g) closely followed by SA040 (431.03 g) and the lowest was found in SA013 (166.98 g). The genotype SA039 produced the highest stem yield (155.11 t/ha) closely followed by SA040 (123.63 t/ha), SA033 (124.25 t/ha), SA023 (123.63 t/ha), SA037 (122.05 t/ha), SA018 (120.50 t/ha), SA019 (119.79 t/ha). The genotypes SA026 (35.3 days), SA033 (37.7 days) were the flower earlier and SA020 (79.0 days) and SA013 (62.0 days) were late. The genotypes SA003, SA005, SA007, SA011, SA015 and SA027 were not flowered during summer season. The highest edible (%) was found in the genotype SA040 (74.20%). The lowest fibre (%) was observed in the genotype SA029 (0.60%) at 44 days after sowing. On the basis of yield and quality traits, the genotypes SA039, SA040, SA033, SA023, and SA037 were found promising for stem production during summer season.

Keywords: Characterization, evaluation, stems amaranth genotypes, summer season, and yield.

Introduction

Amaranth (*Amaranthus tricolor* L.) belongs to the genus *Amaranthus* and the family Amaranthaceae. The amaranth is said to be native to India (Nath, 1976). The centers of diversity of

*Corresponding address:

amaranths are central and South America, India, South-East Asia and the second diversity is in West Africa and East Africa (Grubben, 1977). It is the cheapest source of protein, vitamin and minerals. The leaves and tender stems of amaranth are rich in protein, fat, calcium, phosphorous, iron, riboflavin, niacin, sodium, β-carotene and ascorbic acid than any other common vegetables (Chowdhury, 1967; FAO, 1972).

Stem amaranth is a popular summer vegetable in Bangladesh. Its cultivation and uses are wide in summer and rainy season and it is found to cultivate in every homestead in Bangladesh. The amaranth is being cultivated in an area 10463.56 ha with a total production 67358 tons and the average yield is only 6.88 t/ha (BBS, 2011). Only two recognized stem amaranth varieties viz. BARI Danta-1 and BARI Danta-2 are available in the country. There are various types of stem amaranth are grown by the farmers in the different parts of the country with various local names such as Aus, Aman, Baromashy etc. Significant variation of plant type, stem color of stem, leaf, petiole, vein, inflorescence, seed and shape and size of leaves, stems were found among the genotypes (Hossain *et al.* 1997; Hamid *et al.* 1989; Hossain and Rahman, 1999; Mahmud, 2011). They also found differences in yield and yield attributes among the genotypes.

Before going for improvement of this crop it is required to collect the available germplasm and their characterization is important for identification and utilization in breeding program. Characterization and evaluation will provide their rapid, reliable and efficient mean of information for their proper utilization. Collection, conservation and maintenance of germplasms are important to develop new varieties (Kallo, 1988). Stem amaranth is an important vegetable crop but little importance has given for its improvement. Hence the present investigation was, therefore, undertaken to characterize and evaluate the existing genotypes of Bangladesh.

Materials and methods

An experiment was conducted at the experiment field, Department of Horticulture, Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur, Bangladesh during summer, 2007. The soil of the experimental plot was in Salna series of Shallow Red Brown Terrace Soil (Brammer, 1971; Shaheed, 1984). Twenty two genotypes of stem amaranth were included in the study. Among the 22 amaranth genotypes, 5 (SA033, SA035, SA037, SA039 and SA040) were collected from Plant

Genetic Resource Center (PGRC) of Bangladesh Agricultural Research Institute (BARI), 2 (BARI Danta 1 and BARI Danta 2)from vegetable section, Horticulture Research Center, BARI, Gazipur and the remaining 15 were from different parts of the country. All the genotypes were grown in a Randomized Complete Block Design (RCBD) with three replications during April 2007 to July 2007. The size of the unit plot was 1.5 m x 1.5 m. The seed drilling was done between rows about 30 cm apart and the seed were sown continuously in the rows. Seed lings were thinned maintaining a spacing of 30 cm x 10 cm after 15 days of sowing. The crop was manure and fertilized @ 20 tons CD per hectare, Urea, TSP and MP @ 200, 100 and 200 kg per hectare respectively (Rashid, 1999). All the recommended package and practices were followed to raise good crop. The crop was harvested when started flowering. The data from 22 amaranth genotypes were recorded on the basis of IBPGR descriptor (Grubbed and Sloten, 1981). Data were recorded during harvesting time on stem pigmentation, leaf pigmentation, leaf shape, leaf margin, inflorescence color, seed color, seed shape, days to germination, plant height, leaves/plant, number of branches/plant, leaf weight/plant, stem weight/plant, leaf-stem ratio, stem diameter, stem yield (t/ha), edible (%), fibre (%), dry matter (%), days to first flowering, terminal inflorescence stalk length, axillary inflorescence length and 1000 seed weight from ten randomly selected plants in each plot. Recorded quantitative data on different parameters were analyzed statistically and the means were separated by DMRT (Gomez and Gomez, 1984).

Results and discussion

Stem pigmentation

Seven types of stem colour was noticed in this study (Table 1) of which 27.26% red purple, 18.18% purple, 18.18% yellow green, 13.46% green, 13.64% pale red, 4.55% deep red and 4.55% light green . Hamid *et al.* (1989) reported stem colour of amaranth varied from green to reddish green and red to deep red colour. Stem pigmentation ranged from green (24) to purple (12) and green with purple streak at the base (10) (Varalaksmi, 2007). The variation in stem colour of amaranth might be due to their genetic constitution.

Stem shape

Two types of stem shape were noticed in this study (Table 1). The maximum number of genotypes 13 (59.09%) had round and smooth shape stem while 9 (40.91%) genotypes had round and ridged shape stem. The

variation of stem shape might be due to their genetic make up.

Leaf pigmentation

Seven types of leaf pigmentation was noticed in the present study (Table 1) of which purplish green 5 (22.73%), light red purple 5 (22.73%), light green 4 (18.17%), yellow green 3 (13.64%), pale red 2 (9.09%), green 2 (9.09%) and deep red 1 (4.55%). Hossain *et al.* (1997) reported leaf colour of amaranth varied from green to reddish green, pale red and red to deep red.. Leaf colour ranged from green (37) to purple (5), leaf veins and margin pigmented (2) and pinkish green (2) as mentioned by Varalaksmi, 2007. In the present findings the leaf colour varied from light green to green, yellow green, purplish green, pale red to red and deep red and light red purple. From the above reports it was concluded that there is wider variation in leaf colour of amaranth genotypes. Hence the present findings were close to above findings.

Leaf shape

Five types of leaf shape was found in the present investigation (Table 1) of which 9 elliptical (40.91%), 6 ovatainate (27.27%), 4 lanceolate (18.18%), 2 rhombic (9.09%) and 1 obovate (4.55%) The germplasm showed a wide range of variability in leaf shape ranged from lanceolate (43) to cuneate (3) and obovate (1) as mentioned by Varalaksmi, 2007. The present investigation was similar to the above investigation. The variation in leaf shape among the genotypes might be due to their genetic constitution.

Photo period sensitivity

Two types of photo period sensitivity was observed in the study of which 16 (72.73%) and 6 (27.27%) genotypes had day neutral and short day type of photoperiod sensitivity respectively (Table 1). The day neutral type genotypes initiate flower both in the summer and in the winter season. The short day type genotypes are SA003, SA005, SA007, SA011, SA015 and SA027 and did not initiate flowers in the summer season.

Akbar (1987) observed that *Brassica* genotypes collected from temperate zone (long day plant) did not flower during winter season and those flowered during winter season were considered as short day genotypes. The present study had similarity with his findings as observed in case of amaranth genotypes.

The early flowering types could fit well on crop rotation when a short growing season is available before the subsequent main crop. Late flowering types may be preferred for main season cropping especially for stem purpose

(Hossain, 1996). Talukder (1999) reported that the cultivar Bashpata did not initiate flowers and seeds during the summer season. In the present study as the genotypes SA003, SA005, SA007, SA011, SA015 and SA027 did not initiate flowers in the summer season so these genotypes should be preferred for main season cropping specially for stem purpose but for seed production it must be planted in winter season.

Inflorescence colour

Three types of inflorescence colour was observed in the present study (Table 1) of which 8 genotypes (50.00%) had pink colour inflorescence, 8 genotypes (43.75%) had green colour inflorescence and 1 genotypes (6.25%) had red colour inflorescence. Inflorescence colour ranged from green (36) to pink (5), pinkish green (3), greenish pink (1) and light pink (1) (Varalaksmi, 2007). Islam (2002) reported that inflorescence colour ranged from green (33), yellow (5), pink (130) and red (61). In the present study inflorescence colour varied from pink to red and green which was similar to the above findings.

Seed colour

Black and pink types of seed colour were noticed in the present study (Table 1). Among them the maximum 14 (87.50%) genotypes had black colour seed and 2 (12.50%) genotypes had pink colour seed .Islam (2002) reported that seed colour ranged from black (228), brown (47) and yellow orange (4). In the present study, seed colour varied from black to pink which was more or less similar to the above finding.

Seed shape

Ellipsoid (Ovoid) and round types of seed shape were observed in the present study (Table 1). Among them 10 (62.50%) genotypes had round and 6 (37.50%) genotypes had ovoid shape seed (Table 1). Islam (2002) reported that seed shape ranged from round (270) and ovoid (9). In our present study the seed shape varied from round and ellipsoid (Ovoid) which was similar to the above investigation.

Days to germination

Significant variation was observed among the genotypes in days to visible germination (Table 2). The earliest visible germination was observed in SA003 (3.00 days) followed by SA001 (3.33 days), SA005 (3.67 days) and SA015 (3.67 days) and the late in SA006 (5.00 days) and SA040 (5.00 days). Hossain (1996) and Talukder (1999) reported that visible germination of stem amaranth ranged from 4.00 to 5.50 and 4.13 to 4.40 days respectively. In the present study the days to visible

germination ranged from 3.00 to 5.00 days which was similar to the above investigations.

Plant height

Significant differences were observed in the plant height of stem amaranth (Table 2). Maximum plant height was recorded from SA033 (145.00 cm) while it was minimum in SA014 (101.30 cm). Hamid *et al.* (1989) reported that plant height of some exotic and local lines varied from 70.20 to 131.60 cm at 49 DAS. The germplasm of amaranth showed a wide range of variability in plant height from 31 to 81.5 cm (Varalaksmi, 2007). In the present study the plant height ranged from 101.30 to 145.0 cm which was higher and more or less similar to the above findings. The variation in plant height appears due to ecological variation accompanied by inherent genotypic variability of different genotypes as used in this study.

Leaves per plant

Variable number of leaves per plant was found in the present study (Table 2). The highest number of leaves per plant (30) was found in SA039 and the lowest in SA028 (11.11). Hossain *et al.* (1997) found that the leaves per plant at 45 DAS was varied from 22.35 to 37.10 and at 55 DAS was varied from 32.40 to 56.70. Talukder (1999) reported that the leaves per plant at 44 DAS were varied from 25.60 to 26.43. In the present study at 45 DAS leaves per plant ranged from 11.11 to 30.00 which were more or less similar to the previous findings.

Table 1. Qualitative characteristics of 22 stem amaranth genotypes

Genotype	Stem pigmentation	Stem Shape	Leaf pigmentation	Leaf shape	Photo-period sensitivity	Inflorescence colour	Seed colour	Seed shape
SA001	Light green.	Round and smooth	Light green.	Rhombic	Day neutral	Green	Black	Round
SA003	Yellow green	Round and ridged	Yellow green	Lanceolate	Short day	-	-	-
SA005	Purplish green	Round and smooth	Purplish green	Elliptical	Short day	-	-	-
SA006	Light green	Round and ridged	Light green	Rhombic	Day neutral	Pink	Pink	Ellipsoid
SA007	Deep red	Round and ridged	Deep red	Elliptical	Short day	-	-	-
SA011	Yellow green	Round and ridged	Yellow green	Elliptical	Short day	-	-	-
SA013	Purplish green	Round and smooth	Purplish green	Elliptical	Day neutral	Green	Black	Ellipsoid
SA014	Light red purple	Round and smooth	Light red purple	Ovatainate	Day neutral	Pink	Black	Round
SA015	Purplish green	Round and ridged	Purplish green	Elliptical	Short day	-	-	-
SA020	Pale red	Round and smooth	Pale red	Ovatainate	Day neutral	Green	Black	Round
SA023	Light red purple	Round and smooth	Light red purple	Elliptical	Day neutral	Pink	Black	Round
SA026	Green	Round and smooth	Green	Lanceolate	Day neutral	Green	Black	Ellipsoid
SA027	Yellow green	Round and ridged	Yellow green	Elliptical	Short day	-	-	-
SA028	Green	Round and smooth	Green	Ovatainate	Day neutral	Green	Black	Ellipsoid
SA029	Purplish green	Round and ridged	Purplish green	Lanceolate	Day neutral	Pink	Black	Round
SA033	Pale red	Round and ridged	Pale red	Lanceolate	Day neutral	Pink	Pink	Round
SA035	Purplish green	Round and ridged	Purplish green	Elliptical	Day neutral	Red	Black	Round
SA037	Light red purple	Round and smooth	Light red purple	Ovatainate	Day neutral	Pink	Black	Ellipsoid
SA039	Light green	Round and smooth	Light green	Ovatainate	Day neutral	Green	Black	Round
SA040	Light red purple	Round and smooth	Light red purple	Ovatainate	Day neutral	Pink	Black	Ellipsoid
BARI Danta-1	Light red purple	Round and smooth	Light red purple	Obovate	Day neutral	Pink	Black	Round
BARI Danta-2	Light green	Round and smooth	Light green	Elliptical	Day neutral	Green	Black	Round

Primary branches per plant

Significant variation was observed among the genotypes of stem amaranth for primary branches per plant (Table 2). Maximum branches was recorded in SA039 (5.10) closely followed by SA001 (4.89), SA035 (4.67) and the minimum (0.00) was in SA005, SA011, SA018, SA027, SA033 and SA037was non branched type.Hossain *et al.* (1997) reported that number of branches per plant in amaranth ranged from 0.00 to 4.80 and 0.30 to 8.90 at 35 and 45 DAS respectively. Islam (2002) reported that number of primary branches per plant ranged from 2.50 to 31.04. In the present study the number of primary branches per plant ranged from 0.00 to 5.10 which were much lower than the previous findings.

Stem weight per plant

The genotypes of stem amaranth differed significantly for stem weight per plant (Table 2). The highest stem weight per plant was obtained from the genotype SA039 (465.80 g) closely followed by SA040 (431.03 g) and the lowest in SA013 (166.98 g).

In the present study stem weight ranged from 166.98 to 465.80 g which were higher than the stem weight per plant of Hossain (1996) who found stem weight per plant at 35 DAS was 28.50 to 40.25 g, at 45 DAS was 39.22 to 89.93 g and at 55 DAS was 84.68 to 247.02 g.and more or less similar to Rajagopal *et al.* (1977) who found 112 to 130 g at 35 DAS and 220 to 270 g at 40 DAS.. The ranges of variation for stem weight seem to be due to the remaining genotypic variation available in the materials which had expressed under the prevailing climatic conditions during the growing season.

Leaf: stem ratio

Significant variation was observed among the genotypes of stem amaranth for leaf: stem ratio (Table 2). The highest leaf: stem ratio was recorded in SA003 (0.43) and the lowest in SA018 (0.23).

Hossain *et al.* (1997) reported that leaf: stem ratio ranged from 0.59 to 2.27, 0.49 to 1.18 and 0.27 to 0.75 at 35, 45 and 55 DAS respectively. Rajagopal *et al.* (1977) observed leaf-stem ratio on amaranth was 0.90 to 8.20 at 35 DAS and 0.50 to 10.20 at 40 DAS. In the present study the leaf: stem ratio ranged from 0.23 to 0.43 at 45 DAS and was much lower than the previous investigations. The decreasing trend of leaf: stem ratio indicates that stem portion contribute more over leaf portion towards the yield. The leaf:stem ratio showed a negative relation with yield indicating that a high yielder have a low leaf:stem ratio and vice versa. These results confirm the findings of previous workers (Mohideen and Subramanian, 1974; Shanmugavelue,

1989; Hossain and Rahman, 1999) reported that stem portion contributes more towards the yield as compared to leaf portion. Leaf:stem ratio is a useful parameter which can be considered in selecting high stem yielding genotypes.

Table 2. Yield and yield attributes of stem amaranth genotypes

Genotype	Days to germination	Plant height (cm)	Leaves/ plant	Primary branches /plant	Stem weight/ plant (g)	Leaf :stem ratio	Stem iameter (mm)
SA001	3.33de	134.7 a-d	12.56 kl	4.89 ab	235.42 gh	0.27 fgh	16.71f
SA003	3.00e	124.7 c-h	16.20 h-j	3.10 de	177.53 e	0.43 a	19.02 c-f
SA005	3.67 cde	142.9 ab	24.89 b	0.001	324.28 b-e	0.27 fgh	20.23 b-f
SA006	5.00 a	130.7 a-f	22.33 bc	3.43 cde	331.33 bcd	0.38 abc	22.86 bcd
SA007	4.00 bcd	117.2 e-h	17.22 hi	3.56 cd	251.75 fgh	0.42 ab	20.32 b-f
SA011	4.00 bcd	118.9 d-h	22.77 bc	0.001	289.78 d-g	0.37 bcd	21.85 bcd
SA013	4.00 bcd	115.3 f-i	16.00 ij	1.67 fgh	166.98 i	0.34 cde	17.29 ef
SA014	4.33 abc	101.3 i	18.11 f-i	0.44 hi.	266.27 e-h	0.29 e-h	22.28 bcd
SA015	3.67 cde	138.6 abc	17.67 ghi	1.44 fgh	286.91 d-g	0.28 fgh	19.99 c-f
SA020	3.67 cde	130.6 a-f	20-91 c-f	3.67 bcd	295.98 d-g	0.31 def	23.09 bc
SA023	4.00 bcd	127.7 b-g	18.45 e-i	2.56 def	371.27 b	0.27 fgh	22.01 bcd
SA026	4.67 ab	130.2 a-g	19.22 d-h	3.78 bcd	303.64 c-f	0.27 fgh	18.59 def
SA027	4.00 bcd	127.6 b-g	14.22 jk	0.001	277.20 dgh	0.29 e-h	21.05 b-e
SA028	4.00 bcd	125.0 c-g	11.11 l	1.11 ghi	224.49 hi	0.24 gh	17.31 ef
SA029	4.00 bcd	134.2 a-d	16.78 h-j	3.33 de	334.47 bcd	0.28 fgh	20.91 b-f
SA033	4.33 abc	145.0 a	21.67 cd	0.001	373.13 b	0.26 fgh	19.54 c-f
SA035	4.67 ab	132.2 a-e	16.50 h-j	4.67 abc	289.70 d-g	0.28 fgh	19.90 c-f
SA037	4.00 bcd	128.0 b-g	21.33 cde	0.001	366.50 b	0.28 fgh	22.80 bcd
SA039	4.00 bcd	139.3 abc	30.00 a	5.10 a	465.80 a	0.37 bcd	22.33 bcd
SA040	5.00 a	109.0 hi	18.67 e-i	2.22 efg	431.03 a	0.31 ef	27.63 a
BARI Danta 1	4.33 abc	114.0 ghi	18.44 e-i	0.001	361.87 bc	0.23 h	24.40 ab
BARI Danta 2	3.67 cde	137.3 abc	20-44 c-g	1.68 fgh	359.73 bc	0.25 fgh	19.66 c-f
CV (%)	10.63	6.65	8.33	12.38	10.68	10.59	10.33

Means followed by same letter(s) in a column did not differ significantly from each other by DMRT at 5% level.

Stem diameter

Significant variation was observed among the genotypes for stem diameter (Table 2). The thickest stem was observed in genotype SA040 (27.63 mm) closely followed by SA018 (24.40 mm) while the thinnest was in SA001 (16.71 mm). Hamid *et al.* (1989) stated that stem diameter of the local germplasm was varied from 5.30 to 9.30 mm at 49 DAS. Islam (2002) reported that stem diameter of amaranth

ranged from 3.00 to 38.0 mm. In the present investigation stem diameter ranged from 16.71 to 27.63 mm which was in agreement with the findings of Islam (2002) and higher than the findings of Hamid *et al.* (1989). This variation might be due to difference of genotypes as well as the difference of growing environment.

Stem yield (t/ha)

The genotypes differed significantly for stem yield per hectare (Fig. 1). Maximum yield (t/ha) was contributed by the genotype SA039 (155.11t/ha) closely followed by SA040 (143.53t/ha) while the lowest was in SA013 (55.60t/ha).

Hossain (1996) reported that yield per hectare was 9.56 to 19.31, 25.53 to 41.76 and 27.85 to 81.24 t/ha at 35, 45 and 55 DAS, respectively. Mohideen *et al.* (1985) observed that yield of Co.3 amaranth varied from 19.43 to 30.72 t/ha. Hamid *et al.* (1989) found in twelve germplasm of amaranth (8 local and 4 exotic) yield varied from 42.80 to 234.40 t/ha at 49 DAS under Bangladesh condition. In the present study the stem yield per hectare ranged from 55.60 to 155.11 t/ha which was higher than the above findings except Hamid *et al.* (1989). This higher stem yield might be due to either differences in genotypes or to the favourable climatic condition and better management of the experiment or both.

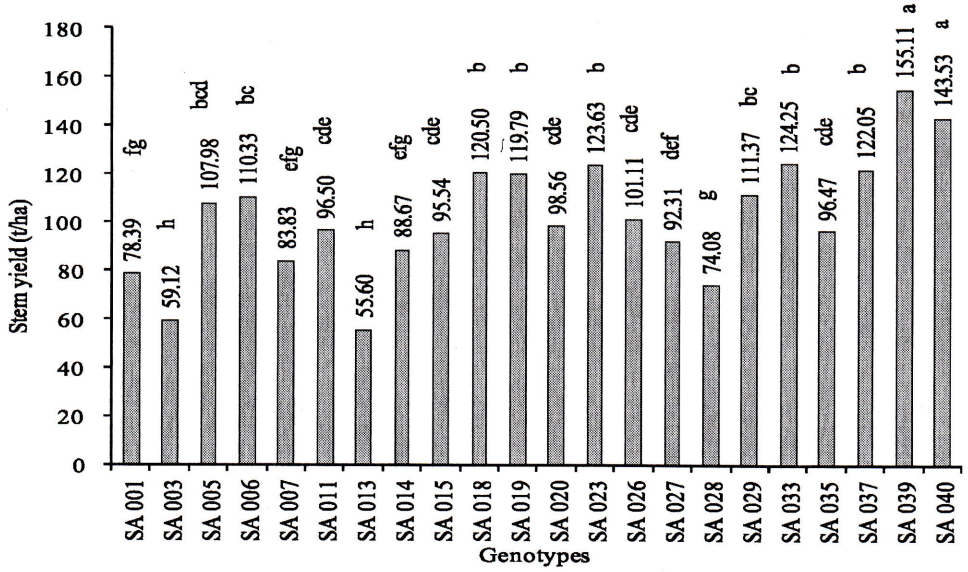

Figure 1. Stem yield (t/ha) of 22 stem amaranth genotypes during summer season.

Edible portion (%)

Significant differences were observed in the edible portion (%) of stem amaranth genotypes (Table 3). It ranged from 57.14 to 74.20%. The highest edible potion (%) was obtained from the genotypes SA040 (74.20 %) closely followed by the genotype SA014 (72.63%) while the lowest was in SA019 (57.14%). This variation in edible percent might be due to their genetic constituents.

Fibre content

The genotypes showed wide range of differences in fibre content at harvesting(Table 3). It ranged from 0.60 to 0.91. The highest fibre (%) was obtained from the genotypes SA013 (0.91 %) followed by the genotype SA001 (0.84%), SA005 (0.84%), SA028 (0.85%) and SA035 (0.86%) while the lowest was in SA029 (0.60%).

Dry matter

Significant variation was observed in the dry matter content of stem amaranth genotypes (Table 3). It ranged from 6.12 to 12.97% was similar to Hossain (1996) who obtained 7.26 to 10.07% DM and lower than George *et al.* (1989) who found 16.92% DM. It was assumed that minimum photosynthesis occur for dry matter formation due to rainy season or due to differences in genotypes used in the present study.

Days to first flowering

Significant variation was observed among the genotypes for days to first flowering of stem amaranth (Table 3). It ranged from 35.30 to 79.00 days. Hossain (1996) reported that the duration of flowering in amaranth ranged from 57.00 to 113.00 days after sowing. Talukder (1999) reported that the duration of flowering ranged from 50.86 to 51.87 days. Islam (2002) reported that days to first flowering ranged from 34.00-106.00 days. In the present study the duration of days to first flowering ranged from 35.30 to 79.00 days which was similar to the above findings. Late flowering or non flowering genotypes may be preferred for main cropping season as vegetable, especially for stem purpose (Hossain, 1996).

Terminal Inflorescence stalk length

Significant variation was observed in the terminal inflorescence stalk length of stem amaranth (Table 3). The highest terminal inflorescence stalk length was recorded from SA035 (17.83 cm) while it was the lowest in SA014 (10.50 cm). Islam (2002) reported that the terminal inflorescence stalk length ranged from 2.00-34.10 cm. The amaranth germplasm showed a wide

range of variability in terminal inflorescence stalk length (Varalaksmi, 2007). In the present study the terminal inflorescence stalk length ranged from 10.50 to 17.83 cm which was with in the range of above findings.

Table 3. Qualitative and inflorescence characteristics of 22 stem amaranth genotypes

Genotype	Edible (%)	Fibre (%)	Dry matter (%)	Days to first flowering	Terminal inflo. stalk length (cm)	Axillary inflo. length(cm)	1000 seed weight (g)
SA001	61.34d-g	0.84 abc	6.68 jk	40.7 d-h	12.93 cd	9.39 abc	0.75 bcd
SA003	63.64c-g	0.76 b-f	11.80 a-d	-	-	-	-
SA005	64.66c-f	0.84 abc	12.97 a	-	-	-	-
SA006	64.57c-f	0.72 c-g	7.54 ijk	42.0 def	14.22 bcd	8.32 bcd	0.68 cd
SA007	60.96d-g	0.65 fg	11.12 cde	-	-	-	-
SA011	68.54abc	0.83 a-d	8.32 hi	-	-	-	-
SA013	63.09c-g	0.91 a	12.83 ab	62.0 b	13.00 cd	4.78 e	0.67 d
SA014	72.63ab	0.74 b-f	9.97 efg	40.7 d-h	10.50 d	6.83 de	0.70 cd
SA015	64.66c-f	0.78 a-f	6.62 k	-	-	-	-
SA020	60.52efg	0.75 b-f	9.43 fgh	79.0 a	14.11 bcd	4.94 e	0.87 a
SA023	67.75bcd	0.74 b-f	8.77 ghi	38.0 ghi	17.50 ab	10.70 ab	0.77 a-d
SA026	63.3c-g	0.86 ab	8.68 ghi	35.3 i	15.33 abc	8.39 bcd	0.68 cd
SA027	64.45c-f	0.67 fg	8.40 hi	-	-	-	-
SA028	66.78b-f	0.85 abc	10.71 def	39.3 fgh	16.61 abc	8.49 a-d	0.73 bcd
SA029	58.11fg	0.60 g	7.39 i-k	48.0 c	13.58 cd	7.61 cd	0.73 bcd
SA033	68.64abc	0.81 a-e	9.58 fgh	37.7 hi	14.17 bcd	8.33 bcd	0.77 bcd
SA035	61.69d-g	0.86 ab	10.59 def	39.7 e-h	17.83 a	10.83 a	0.74 bcd
SA037	66.59b-e	0.77 b-f	8.12 hij	41.7 d-g	16.33 abc	9.50 abc	0,76 bcd
SA039	64.24c-f	0.68 efg	10.89 def	43.3 de	14.00 bcd	8.63 a-d	0.82 ab
SA040	74.2a	0.70 d-g	12.46 abc	43.7 d	11.00 d	8.33 bcd	0.73 bcd
BARI Danta	169.18abc	0.65 fg	11.41 b-e	40.0 d-h	13.78 cd	6.81 de	0.78 abc
BARI Danta 2	57.14g	0.72 c-g	6.12 k	38.3 f-i	13.72 cd	8.07 cd	0.70 cd
CV (%)	5.32	9.30	8.50	4.50	13.35	15.79	8.31

-Genotypes SA003, SA005, SA007, SA011, SA015 and SA027 did not initiate flower during summer season. Means followed by some letter(s) in a column did not differ significantly from each other by DMRT at 5% level.

Axillary inflorescence length

Significant variation was observed among the genotypes for axillary inflorescence length of stem amaranth (Table 3). Maximum axillary inflorescence length was obtained from SA035 (10.83 cm) closely followed by SA023 (10.70 cm) while it was minimum in SA013 (4.78 cm). The germplasm of amaranth showed a wide range of variability in length of axillary inflorescence 0.2-5.0 cm (Varalaksmi, 2007). The axillary inflorescence length ranged from 4.78 to 10.83 cm which was higher than the above investigation. This might be due to their genetic constitution or ecological variation.

1000 seed weight

Significant variation was observed in 1000 seed weight of stem amaranth (Table 3). Maximum seed weight was recorded in SA020 (0.87 g) closely followed by SA039 (0.82 g) and the minimum was in SA013 (0.67 g). Islam (2002) reported that 1000 seed weight ranged from 0.30-1.22 g. In the present investigation 1000 seed weight ranged from 0.67 to 0.87 g which was similar to Islam (2002) or lower than the Talukder's (1999) findings (1.06 to 1.14 g).

Selection of desirable genotypes for summer season

It is revealed from the study that yield was mainly contributed by plant height, number of leaves, leaf weight, stem weight, leaf: stem ratio and stem diameter. The stem weight and stem diameter had maximum direct effect on yield. Considering the above mentioned characteristics 5 amaranth genotypes viz. SA023 SA033, A0S37,SA039and SA040 were selected for summer cultivation in Bangladesh.

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