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MORPHOLOGICAL VARIABILITIES IN BANGLADHONIA (*ERYNGIUM FOETIDUM* L.) GERMPLASM AVAILABLE IN BANGLADESH

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Abstract

The experiment was conducted at the Horticulture Field Laboratory of Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur during November 2005 to July 2006. Twelve genotypes of Dangladhonia (*E. foetidum* L.) were collected from different parts of Bangladesh and evaluated them to find out the variations. Most of the yield attributing characters and individual plant performances exhibited no significant differences among the germplasm. All the germplasm had the similar plant and leaf size, number of leaves/plant, weight of leaves/plant, flowering behavior, yields and other qualitative characters.The symmetric performance indicted that all germplasm belonging from the same species of *E. foetidum* L. and there was no major phenotypic or genotypic variation among the germplasm.

Keywords: Morphology, variability, Bangladhonia, genotypes, germplasm.

INTRODUCTION

Bangladhonia (*Eryngium foetidium* L., Apiaceae.), a biennial herb is native to Mexico and South America or continental tropical America and the West Indies (Adams, 1971). Its origin is mainly tropical America, West Indies, Vietnam, Assam and Bangladesh (Nienga, 1995, Rashid, 1999, Rubatzky *et al.*, 1999). About 228 species of the genus *Eryngium* are being reported worldwide (Lawrence, 1967). Among them, *Eryngium foetidum* L. is widely cultivated, domesticated and exported to others countries for consumption as culinary herb as well as medicinal use. It's cultivation and popularity in several parts of the world are increasing due to its attractive strong aroma, medicinal and nutritional values, versatile use and wide adoptability with temperature, soil condition and water stress. In

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Bangladesh, one species of Eryngium (*E. foetidum* L.) is known as bangladhonia or Bilatidhonia which is found more or less in most of the areas of the country. It is more concentrated and commercially cultivated in the Chittagong Hill tracts especially in Kaptai and Kaukhali Upazilla of Rangamati Hilly District. According to on farm investigation on cultivation of bangladhonia; some morphological variation observed in the plants of different places (Mozumder, 2003). Study is required to find out whether the variation is due to environmental or there is any genetic variation. To find out about the variation and performance of the crop it is required to cultivate these germplasm in the same field giving same input supply i.e. fertilizer, irrigation, weeding, shade and other facilities. However, the study was undertaken to collect the germplasm from different places of Bangladesh and to evaluate them in the field giving equal manner.

MATERIALS AND METHODS

The experiment was conducted at the Horticulture Field Laboratory of Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur during November 2005 to July 2006. The location of the experimental site was about 40 km North to Dhaka city with 24.09' North latitude and 90.26° E longitude and an elevation of 8.50 m from the sea level (Anon., 1989). The experimental field belongs to the 'Shallow red brown terrace' soil of Salna series under Madhupur tract to AEZ -28. The pH value of the experimental soil was 5.9. The experiment was laid out in a randomized complete block (RCB) design having twelve Treatment (12 accessions) with three replications. The unit plot size was 3m×1m. Twelve germplasm were collected from Rangamati, Bandarban and Khagrachari districts and one was collected from Gazipur. The places of seed collections are presented in the Table 1.

Table 1. Sources and location of collected bangladhonia germplasm:

Serial no.	Accession number	Location of seed collection
1	BD001	Murali, Wagga, Kaptai, Rangamati
2	BD002	Satparpara, Thanchi, Bandarban
3	BD003	Thanchi Bazar, Bandarban
4	BD004	Wangantam Para, Kaptai, Rangamati
5	BD005	Thanchui Para, Bandarban
6	BD006	Thanchui Para, Bandarban
7	BD007	Rikhai Para, Bandarban
8	BD008	Saungathong Para, Thanchi, Bandarban
9	BD009	Rialidong Para, Thanchi, Bandarban
10	BD010	Sapchhari, Manikchhari, Khargachhari
11	BD011	Doluchhari, Bandarban Sadar, Bandarban
12	BD012	Faokal, Gazipur

The land was carefully prepared by ploughing and cross ploughing followed by laddering because Bangladhonia seeds are very small and responsive to the physical condition of the beds (Moniruzzaman, 2000). Manures and fertilizers were applied @ Cowdung 15 ton, urea 350 kg, TSP 150 kg and MOP 200 kg per hectare. The entire amount of cowdung and TSP with one fourth of urea and MP were applied during final land preparation. The rest of the urea and MP were applied in three equal installments at 45, 75 and 105 days after sowing of seeds (Islam *et al.*, 2003). Seeds of 12 Bangladhonia germplasm were sown @ 40 kg/ha ((12g/plot) by broadcasting on 08 December 2005. After sowing the plots were covered with dry rice straw to make the soil uniformly moist for better germination. After sowing, black mosquito (nylon) nets (2mm loop) was hanged up to 1.5 meter over the experimental plots to maintain approximately 50% PAR, with the help of GI wire and bamboo poles in order to ensure soft, lengthy and succulent leaves (Moniruzzaman, 2006). Straw mulch was removed when germination started and weeding was done carefully. Weeding was done, frequently after germination when weeds grew up before harvest and after every harvest. Sprinkler irrigation was given twice in a week and flood irrigation was given to

the plants after each top dressing of urea and MP. Thinning was done at the time of harvest when longer (leaf) plants were picked up for marketing. A number of flower stalks were produced and it was counted and broken so that more leaves could be produced. For the control of damping off and leaf blight, Ridomil gold (0.2%) was sprayed for three times at 10 days interval. As there was no insect pest, no insecticide was applied. Harvesting was done from May 25 to July 25 with an interval of 20 days when the leaves became most succulent. Data recorded on days to seed emergence, seedlings population/m^2, plant height, leaves per plant, length of leaf (cm), width of leaf (cm), fresh plant weight, days to flower stalk emergence, harvested plants/m^2, thousand seed weight, days to first flowering, flower stalk number. The percentage of flowering and dry matter percentage was calculated using the following formula:

$$\text{Percentage of flower stalk} = \frac{\text{Number of flower stalk/m}^2}{\text{Number of plants/m}^2} \times 100$$

$$\text{Dry matter percentage} = \frac{\text{Dry weight of plants}}{\text{Fresh weight of plants}} \times 100$$

Qualitative and morphological data on leaf, stem, root and flower stalk morphology were recorded according to botanical descriptors (Bandre and Pande, 1999). All the data were compiled properly and analyzed statistically by MSTAT Program. The mean comparison was done following the Duncan's Multiple Range Test (Zaman, *et al.* 1982).

Results and discussion

Performances of collected 12 Bangladhonia germplasm are presented in Table 2, 3, and 4. All parameters except seedlings/m^2 and harvested plants/m^2, leaves/plant, flowering percentage and marketable yield (t/ha) exhibited no difference among the germplasm.

Days to germination

All the germplasm took statistically similar time for germination (Table 2). The genotype BD004 BD009, BD010 and BD011 took more time (17.7 days) to germinate. This result partially corroborates the reports of Mozumder (2003b) that some seeds of *E. foetidum* germinate earlier (15 days) and some took longer time for germination.

Seedlings/m^2

Number of seedlings varied significantly in different genotypes (Fig 1). The maximum number (894/m^2) of seedlings counted in BD004 closely followed by BD003 (883/m^2). The lowest number of seedlings (183/m^2) was recorded in BD012. This variation might be due to the varied germination percentage in seed lots in different germplasm.

Table 2. Performance of 12 bangladhonia genotypes

Geno-types	1000 seed wt (mg)	Days to germinat ion	Days to flower stalk emergence	Plant ht. (cm)	Plant wt. (g)	Leaves /plant	Leaf length (cm)	Leaf width (cm)
BD001	403	17.0	112.7	26.4	6.35	5.67b	18.5	2.28
BD002	407	17.0	113.0	26.4	6.23	5.74b	18.9	2.16
BD003	405	17.3	114.0	26.2	6.22	5.90ab	19.1	2.20
BD004	405	17.7	114.0	26.2	6.22	5.87b	18.7	2.12
BD005	406	17.3	115.7	26.4	6.13	5.87b	18.4	2.25
BD006	402	17.3	113.7	26.5	6.14	5.93ab	18.6	2.06
BD007	403	16.3	113.0	27.0	6.28	5.90ab	19.1	2.17
BD008	402	17.3	112.7	27.2	6.40	5.90ab	19.2	2.14
BD009	403	17.7	114.7	25.7	6.19	5.83b	18.7	2.09
BD010	401	17.7	115.0	26.3	6.26	5.87b	18.8	2.13
BD011	401	17.7	113.7	26.5	6.28	5.77b	18.7	2.19
BD012	395	16.7	110.3	26.4	6.58	6.00a	18.8	2.36
Signi.	ns	ns	ns	ns	ns	*	ns	ns
CV%	1.29	7.96	1.82	3.20	1.66	2.96	2.86	5.17

Means followed by same letter or without letter in a column are not differed significantly at 5% level. * and ** indicates significant at 5% and 1% level, ns = not significant.

Plant height

Plant height was not varied in all germplasm (Table 2). The highest plant height 27.2 cm was found from the genotype BD008 and it was the lowest but statically similar in BD009 (25.7 cm). Moniruzzaman *et al.* (2007b; 2007c) obtained 22.71 cm and 22.41 cm, plant height, respectively.

Leaves per plant

The germplasm exhibited some variation among them in respect of leaves per plant (Table 2). The maximum 6.00 leaves/plant obtained from the germplasm BD012 and it was lowest(5.67/plant) in BD001. Higher number of leaves per plant (8.21 and 7.10) obtained by Moniruzzaman *et al.*, (2007b and 2007c, respectively). Lower

number of leaves is obtained in some plots due to more number of plants/m2. Dense population results the lower number of leaves per plant but increase length of leaves (Anon., 2005).

Length and width of leaf

Data on length and width of leaves are presented in the Table 2. All the genotypes of bangladhonia exhibited statistically similar length and width of leaf. The highest length of leaf (19.2 cm) was recorded in the genotype BD008 and it was lowest (18.4 cm) in BD005. Similar leaf length (20.78 cm) was obtained by Moniruzzaman *et al.* (2007a). The width of leaf was maximum (2.36 cm) in BD012 and it was minimum (2.06 cm) in BD006. This result is an agreement with the reports of Mozumder *et al.* (2009) who found 2.10 cm leaf width with same seed rate and broadcasting system of sowing. The wider leaves in BD012 treatment might be due to the lower plant populations that facilitate more expansion of leaves.

Plant weight

Plant weights of different germplasm are presented in Table 2. All the germplasm showed statistically similar single plant weight. It ranged from 6.13 g/plant (BD006) to 6.58 g/plant (BD012). This value seems to be slight lower than the reports of Mozumder *et al.*, (2008), who obtained 9.60 g/plant at the hill valley of Rangamati.

Days to flower stalk emergence

All the germplasm took the same time for flower stalk production (Table 2). The duration from sowing to flower stalk production ranged from 110.3 days (BD012) to 115.7 days (BD005). Early flowering observed in the plots having less germination or low plant population. Moniruzzaman *et al.* (2007b) obtained early flowering (88.3 DAS) with same shade (colored nylon net).

Harvested plant/m^2

Harvested plants per square meter of land varied in different genotypes (Fig. 1). The maximum number of plants (499/m^2) harvested from the genotype BD004 while it was lowest (156/m^2) in BD012. The maximum number of plants was harvest from the plots where number of seedlings was higher while the plots having minimum number of seedlings gave lowest harvestable plants. The number of harvested plants was reported by Mozumder *et al.*, (2009) was 497 plants/m^2. This number also much higher than the reports of Moniruzzaman *et al.* (2007a) and who obtained 207 plants/m^2.

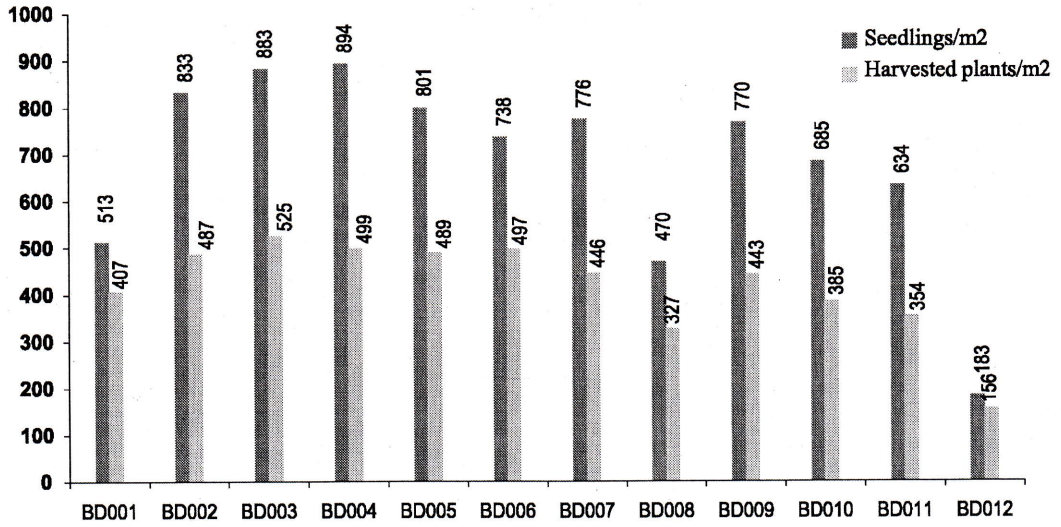

Fig 1. Seedlings and harvested plants/m^2 in different genotypes.

Thousand seeds weight

Seeds of 12 Bangladhonia genotypes were dark brown colored. Size of seed was very small and there was no significant different in 1000 seed weight (Table 2). The thousand seed weight ranged from 395 mg to 407 mg. All seeds were covered with small fuzz or tubercles, ovoid-globose in shape. Seeds surrounded with hairy coverings that hinder to observe its actual shape. This observation is supported by Rubartzky *et al.* (1999) & Randle (1979) who reported that seeds of E. foetidum are small, globose head or ovoid-globose, 1.1-1.3 mm, covered with tubercles greenish in younger stage, mature to brown.

Days to first flowering

The first flowering started from the basal part of the first inflorescence produced at the division point of the flower stalk. Table1.3 showed that almost same times required for first flowering in different genotypes of bangladhonia. Early flowering (121 DAS) was observed in the genotype BD012 and it was delayed (125 DAS) in BD003 and BD007. Closer plant population delayed flowering compared to plants grown in lower density.

Flower stalk number and % flowering

All the genotypes produced statistically similar number of flower stalk per plot as well as per unit area of land but the

percentage of flower stalk over plant population varied significantly in different genotypes (Table 3). The highest number of flower stalk (63.7 /m^2) produced from the plots having genotype BD001 while lowest number of flower stalk (46.7 /m^2) was found in BD012.

The highest percentage (29.94 %) of flowering among the standing plants was observed in the genotype BD012 followed by BD008 (18.13 %) and it was lowest in BD006 (9.80%). Wider plant spacing or plants having more space and nutrition got early flowering while dense populations hinder the flower stalk production. This might be the higher competition for food and photosynthetic products (energy) that lowered the C : N ratio which discourage flowering in dense populated plants.

Flower stalk weight/m^2

Fresh weight of flower stalk did show variation in different genotypes (Table

Table 3. Productive performance of 12 bangladhonia genotypes

Genotypes	Days to flowering	Flower stalk /plot	% flowering	Wt. flower stalk g/m^2	Marketable Yield t/ha	% DM
BD001	123	63.7	15.65bc	156. 7	25.81de	14.98
BD002	122	57.3	11.77c	143. 3	30.33ab	14.69
BD003	125	56.0	10.67c	146. 7	32.61a	15.14
BD004	124	54.0	10.82c	154. 3	31.02a	15.28
BD005	123	56.0	11.45c	142. 3	29.99abc	14.86
BD006	124	48.7	9.80c	143. 7	30.53ab	14.84
BD007	125	54.0	12.11c	148. 7	27.98bcd	14.76
BD008	123	59.3	18.13b	143. 7	20.91g	15.20
BD009	123	51.7	11.67c	145. 7	27.45cd	14.80
BD010	123	54.7	14.21c	142.3	24.07ef	14.92
BD011	124	50.0	14.12c	138.0	22.24fg	14.70
BD012	121	46.7	29.94a	149.0	10.26 h	15.53
Signi.	ns	ns	*	ns	**	ns
CV%	2.31	14.61	15.41	5.41	5.49	3.18

Means followed by same letter or without letter in a column are not differed significantly at 5% level. * and ** indicates significant at 5% and 1% level, ns = not significant.

3). The maximum weight of flower stalk (156.7 g/m^2) was obtained from the genotype BD012 and the lowest (138.0 g/m^2) was found in BD011 genotype.

Marketable yield

Twelve germplasm exhibited significant variation among them in respect to marketable yield (Table 3). The highest marketable yield (32.61 t/ha) was recorded from the germplasm BD003 followed by BD002 (30.33 t/ha) and it was lowest from the germplasm BD012 (10.26 t/ha). This result conformed the result of Mozumder *et al.*, (2008) who obtained 31.68 t/ha fresh marketable yield of bangladhonia. But Moniruzzaman *et al.* (2007c) obtained higher fresh marketable yield (50.13 t/ha) of bangladhonia.

Dry matter percentage (DM%)

All the germplasm had similar dry matter percentage. The dry matter percentage ranged from 14.69 (BD002) to 15.53 (BD012). Comparatively higher DM% obtained the plots where number of plants were lower (156/m^2).

Leaf characteristics

All the germplasm exhibited similar qualitative morphological feature (Table 4). All germplasm showed

Table 4. Morphological features of 12 bangladhonia genotypes

Genotypes	Leaf arrangement	Leaf shape	Leaf apex	Leaf margin	Color of leaf and stem	Stem consistency	hape of flower stalk
BD001	Cluster	Lanceolate	Acute	Dentate	Green	Compact	Cylindrical
BD002	Cluster	Lanceolate	Acute	Dentate	Green	Compact	Cylindrical
BD003	Cluster	Lanceolate	Acute	Dentate	Green	Compact	Cylindrical
BD004	Cluster	Lanceolate	Acute	Dentate	Green	Compact	Cylindrical
BD005	Cluster	Lanceolate	Acute	Dentate	Green	Compact	Cylindrical
BD006	Cluster	Lanceolate	Acute	Dentate	Green	Compact	Cylindrical
BD007	Cluster	Lanceolate	Acute	Dentate	Green	Compact	Cylindrical
BD008	Cluster	Lanceolate	Acute	Dentate	Green	Compact	Cylindrical
BD009	Cluster	Lanceolate	Acute	Dentate	Green	Compact	Cylindrical
BD010	Cluster	Lanceolate	Acute	Dentate	Green	Compact	Cylindrical
BD011	Cluster	Lanceolate	Acute	Dentate	Green	Compact	Cylindrical
BD012	Cluster	Lanceolate	Acute	Dentate	Green	Compact	Cylindrical

cluster type leaf arrangement, lanceolate shape of leaf, acute leaf apex with dentate leaf margins when grown in shade.

Stem and leaf color

Leaf and stem color of the 12 germplasm were similar bright green. Plant having exposed into direct sunlight the color of leaf and stem become slight dark green. A younger leaf seems light green in all the germplasm.

Stem and flower stalk morphology

Collected 12 germplasm had the similar compact and reduced stem before flowering. After flowering the stem elongated and produced compact cylindrical flower stalk in all the germplasm. In apex of the main flower stalk indeterminately produced an inflorescence and divided into two primary branches. The primary branches further produce inflorescence and divided into two secondary branches. In such way the binary flower stalk division is running and stopped when the plant unable to produce more branch depending on the vigor of the plant, nutrient and water availability of the field. At the later stage the main flower stalk become hollow and seeds first become yellowish brown then become black at final stage when seeds are dried and dropped. All the events were observed same in 12 genotypes.

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