

PHENOLOGICAL STUDIES OF BILATIDHONIA (*ERYNGIUM FOETIDUM L.*) AT DIFFERENT GROWTH STAGES

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Abstract

The study was conducted at the Horticulture Research Field of Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur during November, 2006 to August 2007 under upland condition to observe the phenological characteristics of Bilatidhonia (*Eryngium foetidum L.*). Bilatidhonia plants are sciophilus (shade-loving), erect perennial herb, grow up to 90 cm when flowering. Plants 8-40 cm high form a basal rosette. Root is thin and spindle-shaped. Tap root with few branching, fusiform with fibrous roots. The main root length increased up to 21.8cm at 180 days after sowing (DAS). The stem is reduced, weak, green, solid and covered by leaf sheath, usually not visible before flowering in standing plant. An indeterminate umbel, crowded into dense heads surrounded by a whorl of rigid bracts. Inflorescence divaricately trifurcate; lateral branches often continuing to form a monochasium, heads numerous, short-pedunculate. Flowers are pentamerous, minute, greenish white; each flower is surrounded by a bract. Small flowers closely arranged in dense umbels, greenish calyx with white corolla, accent, appearing in April to December. Fruit small, globose head or ovoid-globose, 1.1-1.3 mm, covered with tubercles greenish in younger stage, mature to brown. Fruit appears in clusters of small green globes which mature to brown. Seeds surrounded with hairy coverings that hinder to observe its actual shape.

Key words: Bilatidhonia, Phenology, growth stage, study.

Introduction

Bilatidhonia (*Eryngium foetidum*) is a tropical herb, also known as long Coriander, Chandon beni, Culantro, Fitweed, Mexican coriander, Wild coriander, Recao, Spiritweed, Ngo gai, Saw-leaf herb and commonly as

Culantro belongs to the family Apiaceae. In Bangladesh, generally it is called Bilatidhonia (Islam *et al.*, 2003) or Bangladhonia while in Sylhet region it is called "Bandhula" which means wild coriander where coriander is called "Dhula" (Rashid, 1999). There

are as far as 228 species under the genus *Eryngium* (Lawrence, 1967). *Bilatidhonia* (*E. foetidum*) is a popular green herb prized for the serrate, spatulate-shaped leaves that are used in many culinary dishes (Ramacharan, 2000). It is mainly cultivated for its leaves as condiments and for its essential oils (Ignacimuthu *et al.*, 1999). The essential oil from the leaves of *Bilatidhonia* is rich in aliphatic aldehyds, most of which are α , β unsaturated. The important co-members of *Bilatidhonia* under the family Apiaceae are coriander and parsley used as condiments, are highly nutritious (Rubatzky *et al.* 1999). It is used in the folk medicine to treat anti-inflammatory disorders (Garcia *et al.*, 1999). Medicinally, the leaves and roots are used in tea to stimulate appetite, improve digestion, combat colic, soothe stomach pains, eliminate gases and as an aphrodisiac.

The crop is an important in respect to nutritional, medicinal and economic aspect. Very few researches have been done to study the morphological feature, flowering habit, propagation and cultivation procedure to increase yield and quality of *Bilatidhonia*. Reports on morphological features, growth and development, seed production, storage of seeds and use of

Bilatidhonia are very much scarce. With a view to investigate the phonological aspects of *Bilatidhonia*, the present studies were therefore, undertaken to investigate morphological characteristics of *Bilatidhonia* at different growth stages.

Materials and Method

The study was conducted at the Horticulture Research Field of Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Salna, Gazipur during November, 2006 to August 2007 under upland condition. The location of experimental site was about 40 km North to Dhaka city with 24°09' North latitude and 90°26' East longitude and an elevation of 8.20m from the sea level (Anon., 1989).

For morphological study, six raised (15cm) plots of 3x1m size were prepared in two rows keeping 50cm bed to bed and bed to ail distance for drainage. Plots are prepared carefully to have very good tilth as *Bilatidhonia* seeds are very small and responsive to the physical condition of the beds (Moniruzzaman, 2000). Manures and fertilizers were applied @ coddung 15 ton, urea 350 kg, TSP 350 kg and MOP 200 kg per hectare (Islam *et al.*, 2003). The entire amount of coddung 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 Bilatidhonia germplasm (BD003) were sown @ 3g/m^2 by broadcasting on 08 December 2006 and mixed with soil at 0.1- 1.0 cm depth. After sowing the plots were covered with dry rice straw to make the soil uniformly moist for better germination. After sowing, black colored mosquito (nylon) nets was hanged up to 1.5 meter over the experimental plots to maintain approximately 50% PAR (photosynthetically active radiation), with the help of GI wire no. 12 and bamboo poles.

An acceptable number of seeds of all plots sprouted at 20 days after sowing. Then straw were removed, weeding was done and irrigation was done after weeding with the help of water cane having fine shower. Weeding was done once before germination, frequently after germination when weeds grew up before harvest and after every harvest. Irrigation and other cultural practices had been done as and when necessary. Light irrigation was given twice in a week and flood irrigation was given to the plants after each top dressing of urea and MP. Flower pruning was done

whenever seen in the crop field for leaf production.

Damping off and leaf blight diseases were seen in the crop field in early and late season respectively. For the control of damping off and leaf blight, Ridomil gold (0.2%) was sprayed twice at 10 days interval.

Data on plant height, number of leaves per plant, individual plant weight, individual leaf area, individual leaf weight, leaf dry weight, plant dry weight were recorded. These parameters were taken from 10 plants at different days after emergence (DAE) from each plot at 15 days interval. More over plant height, number of leaves/plant, length of leaves, individual leaf area, fresh weight/plant, and fresh weight/leaf were calculated from the average of 6 harvests and considered as yield contributing characters. Days to first flowering and 50% flowering were also taken. Leaf area was measured by using green leaf area meter (model GA-5). Dry weight of leaves was taken by drying 10 leaves in oven at 72°C for 72 hours and the average leaf dry weight was calculated. The individual plant dry weight was recorded following the techniques used for leaves dry weight. Individual plant performances were recorded from the average of last 6 harvests. By using data

of leaf dry weight and leaf area, specific leaf weight (SLW) was calculated with the following formula (Schoch, 1972).

SLW = Leaf dry weight (mg) ÷ Area of leaf (cm²)

All the data were compiled properly and analyzed statistically by using MS-Excell program.

Results and Discussion

General characteristics

Bilatidhonia (*Eryngium foetidum* L.) is a tropical perennial and annual herbaceous horticultural crop belongs to the same plant family as coriander, *Apiaceae* (Umbelliferae) but the plant's shape does not bear much resemblance. Yet the long, tough leaves exemanate a fragrance very much similar to coriander's aroma and thus suggest themselves as a substitute or alternative for the former. Experimental observation seems the aroma of *Bilatidhonia* increased with the increase of plant height and leaf expansion up to 105 days after emergence then remain stable up to flowering then declined. Well expanded, succulent leaves before flowering contain highest aroma.

Growth habit

E. foetidum plants are sciophilus (shade-loving), erect perennial herb, grow up to 90 cm when flowering. Plant

height ranged from 8 to 40 cm from the basal rosette. It grows in the forests, stream banks, moist places, roadsides; hills of 100-1500 m. Native to Central America; now a widespread weed in tropical and subtropical regions (Ignacimuthu *et al.*, 2006). Most are spiny ornamental herbs with thick roots and fleshy waxy leaves with blue flowers in cymose heads.

Root

Root is thin and spindle-shaped. Tap root with few branching, fusiform with fibrous roots. Fig. 1 shows that the main root length increased up to 21.8cm at 180 days after sowing (DAS). Root length increase was high at the early stage of the seedlings but slowed after 120 DAS. The polynomial regression equation showed a positive correlation ($R^2 = 0.9929$) of main root length with growing period. This result also corroborates the report of Morton (1981) who stated that the main tap root penetrates downward up to 15 to 30 cm deep into the soil. This long tap root helps to survive the plant in dry period. Morean (1988) reported that *Eryngium foetidum* is a tap-rooted biennial herb with long, evenly branched roots.

The diameter of root and number of root branch per plant increased with

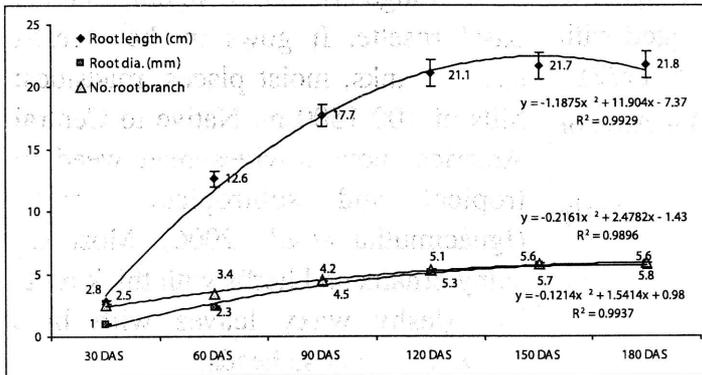


Fig. 1 Root length, diameter and number of root branch per plant at different days after sowing.

time up to a certain limits. A number of branch root formed near the base of the plant maintaining a moderate correlation

Stem

Stem is reduced, weak, green, solid and covered by leaf sheath, usually not visible before flowering in standing plant. During the reproductive cycle the stem elongates and at the top divides into three to five branches. Tender green stems are covered with numerous basal leaves that's petioles are short or obsolete (Ignacimuthu *et al.*, 2006).

Leaf

Leaves are the main economic parts of *Bilatidhonia*. Leaves are simple, radical, grown in rosette forms, sharply serrated, oblong to linear lanceolate, spatulate-shaped, narrow at the base and rounded at the apex. The

oblanceolate leaves arranged spirally around the short thick stem, form a basal rosette. Ignacimuthu *et al.*, (2006) reported that the basal leaves of *E. foetidum* are numerous; petioles are short or obsolete, sheath up to 3 cm; blade lanceolate or oblanceolate, entire, 15-25x1.2-4 cm, venation

pinnately reticulate, base cuneate to decurrent, apex obtuse, callous-margined, crenate to finely spinulose-serrate. The leaf margin is serrated, each tooth of the margin containing a small yellow spine. Fig. 3 showed the number of leaves per plant, leaf length and width of leaves at different DAS. The number of leaves increased with

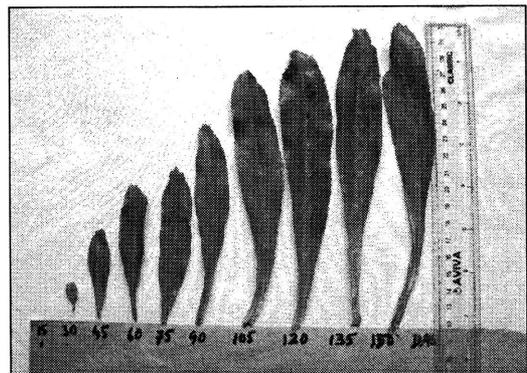


Fig. 2 Leaf shape at different days after emergence

age of the plant. There is a very good positive correlation ($R^2 = 0.9958$) between number of leaves with time. The number of leaves/plants increased up to 150 days (8.5/plant) after sowing then remains unchanged up to 165 days and declined thereafter. Bilatidhonia leaf size varied due to soil fertility and productivity, environmental condition, irrigation, fertilizer application and age of seedlings. Fig. 2.3 shows the increase of leaf length, width and length-width ratio of Bilatidhonia leaves increase with a stable rate up to 120 days. After 120 days the rate of increase became slower. Length of leaves increased up to 165 days (18.8 cm) and width of leaf increased up to 135 DAS (2.8cm) then declined. The polynomial regression equation showed both length and width of leaf have a good correlation with time ($R^2 = 0.9899$ and 0.9908 , respectively). This result also lies between the range reported by Ignacimuthu *et al.*, (2006) that the oblanceolate leaves increased as much as 30 cm long and 4 cm broad. Upper leaves sessile, opposite deeply

spinulose-serrate to parted. Lower leaves are fanlike, the upper leaves become spiny at the time of flowering or when exposed in direct sunlight. The leaves are used as a flavoring (similar to *Coriandrum sativum*), and the species has reputed medicinal value.

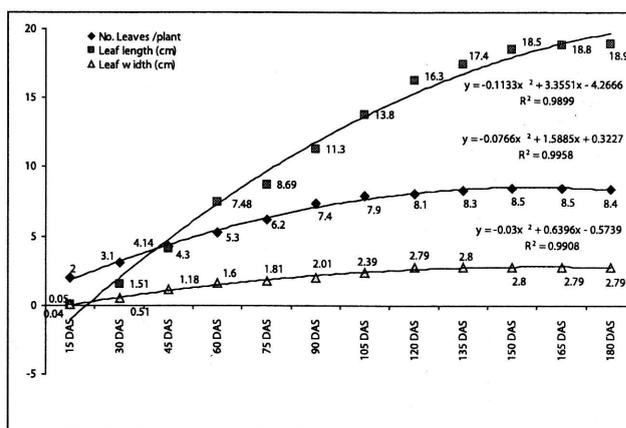


Fig. 3 Number of leaves/plant, length and width of leaves at different DAS.

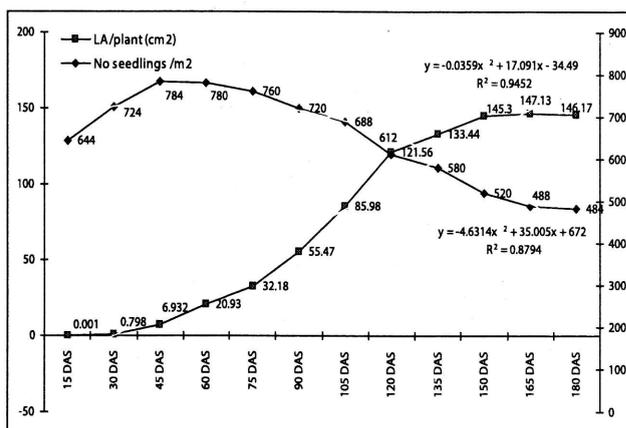


Fig. 4 Leaf area/plant and no. of plants/m² at different DAS.

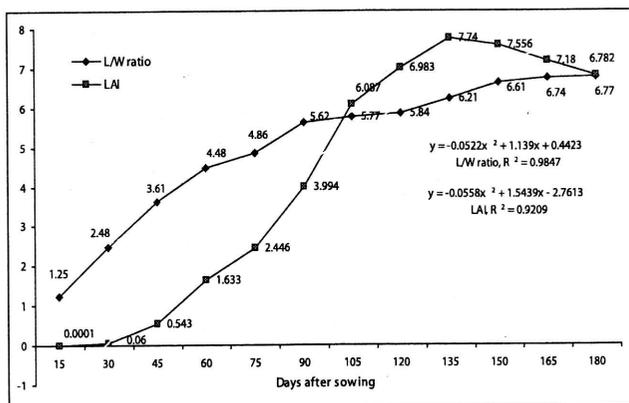


Fig 5 Relation of length/width ratio and LAI with different DAS.

Observation showed that the flavor of the leaf was less at the seedling stage, increased up to 120 DAS then remain unchanged up to 135 days and decreased with the advancement of flowering and seed maturation.

Inflorescence

Under long day and normal conditions, Bilatidhonia plant tends to bolt and flower profusely, resulting in reduced leaf growth and market value and increased production costs. An indeterminate umbel, crowded into dense heads surrounded by a whorl of rigid bracts. Inflorescence divaricately trifurcate; lateral branches often continuing to form a monochasium, heads numerous, short-pedunculate. Flower stalks are almost cylindrical, erect, midribs hollow, dimorphic (Ramacharan, 2000). First internodes

are very long and shorten gradually with increasing number of branches.

Flower

The plant produces a well-branched cluster of flower heads in spikes forming the characteristic umbel inflorescence on a long stalk arising from the center of the leaf rosette (Morton 1981; Moran 1988). The calyx is

green while the corolla is creamy white in color. Flowers are pentamerous, minute, greenish white, each flower is surrounded by a bract. Small flowers closely arranged in dense umbels, greenish calyx with white corolla, accent, appearing in April to December. Flower heads cylindrical, 5-12 x 3-5 mm; bracts 4-7, foliaceous, lanceolate, 1.5-3.5 x 0.4-1 cm, spreading to reflexed, margin 1-3-spinulose-serrate; bracteoles lanceolate, 1.5-1.8 x ca. 0.6 mm, brightly scarious-margined. Calyx teeth ovate-lanceolate, 0.5-1 mm, acute, equaling petals. Petals white or pale yellow. Styles erect, ca. 1.1 mm, exceeding calyx teeth (Ignacimuthu *et al*, 2006).

Fruits and seeds

Fruits are small, globose head or ovoid-globose, 1.1-1.3 mm, covered with

tubercles greenish in younger stage and brownish at maturity (Rubartzky *et al.* 1999 and Randle, 1979). Fruit appears in clusters of small green globes. Seeds are surrounded by hairy coverings that hinder to observe its actual shape.

less suitable for eating. Flower pruning is an essential part to encourage leaf production. Flowers produced on shaded plants were leaf like appearance and less woody and spiny than normal flowers.

Fresh weight of leaves, stem and root

Fig 6 shows the fresh weight of leaves, stem and roots per plant at different days after planting. Leaf and root weight increased at a steady speed up to 120 DAS. When *Bilatidhonia* begins to produce (120 DAS) flowers, the stem elongated and weight of stem increased but weight of leaves remain stable.

Pruning of flower

When *Bilatidhonia* begins to produce flowers, the leaves become tough and

Shading

Although cultivation of *E. foetidum* is possible in full sun, the plants tend to flower sooner than shade-grown plants and have an inferior quality due to decreased leaf size and a loss of succulence. Plants grown under shade produce larger and greener leaves that are more marketable because of their better appearance, texture and pungent aroma. The crops where reproductive growth is not very important, performed well under shade (Singh, 1994). Partial shade increases succulence and delicacy of structure. Under long day and normal conditions, *Bilatidhonia* plant tends to bolt and flower profusely, resulting in reduced leaf growth and market value and increased production costs (Ramacharan, 2000). So, shading delays flowering and encourages more leaves in plants. When *Bilatidhonia* is grown in the field without shade, bolting occurs producing only two or three

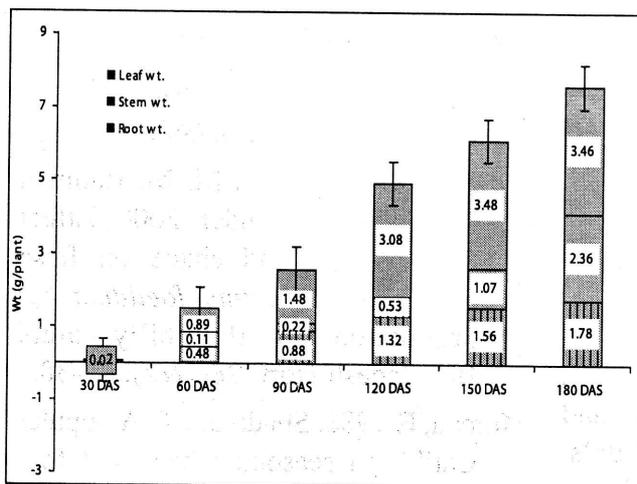


Fig 6 Fresh weight of leaves, stem and roots/plant at different DAS.

leaves and results in poor yield. Under shaded habitat, Bilatidhonia produces dense green, soft and succulent leaves. The aroma (sweet flavour) is also increased under shade. Sheldrake and Saxena, (1979) reported that diffuse light promotes the development of vegetative structures while intense light favors the development of flowers, fruits and seeds. Under shade condition leaf senescence is delayed which might prolong the reproductive phase of shade grown plants (Anderson *et al.*, 1993).

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