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Evaluation of Brahmi (*Bacopa monnieri* L.) genotypes for growth and herbage yield under North Bihar agro-ecological conditions

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Abstract
Brahmi, a member of Scrophulariacea family is a creeping, branched succulent perennial herb distributed in wet and marshy lands throughout Bihar. It is propagated by stem cuttings. The whole herb is the source of the ayurvedic drug 'Brahmi'. It is used in improving memory and intelligence and also in the treatment of dermatosis, anaemia, diabetics and insanity. Bacoposide is considered as the major active ingredient in this plant. In the present study, 14(fourteen) collections (genotypes) of Brahmi, obtained from various places of Bihar were evaluated for their growth and herbage yield traits under north Bihar condition in the herbal garden under AICRP on Medicinal and Aromatic Plants & Betelvine, Faculty of Agriculture, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar, during Kharif season of year 2015-16 to 2017-18. The pooled data of three years result revealed that there were significant variations among the genotypes with respect to vegetative growth and herbage yield. The variation among accessions for all seven characters was statistically significant. Maximum plant height, number of nodes per plant, number of primary branch per plant, leaf length and leaf width was recorded in accession no. IC-0622291. Maximum fresh herbage yield was recorded in the accession no. IC – 0622291 (222.53 q/ha) which was significantly superior to rest of the accession. Minimum was recorded in the accession no. IC – 0622293 (99.51q/ha). On the basis of growth and yield parameter it can be concluded that accession no. IC-0622291was the best genotype among the fourteen genotypes.

Keywords: Brahmi (*Bacopa monnieri* L.) genotypes, North Bihar, agro-ecological conditions

Introduction
Brahmi, a member of Scrophulariacea family is a creeping, branched succulent perennial herb distributed in wet and marshy lands throughout Bihar. Bacopa is a succulent, glabrous, creeping herb, with rooting at nodes. The plant is easily recognized by its spreading habit, sessile and fleshy leaves, and light bluish, purple or white flowers. Leaves are ovate and opposite with dotted lower surface. Flowering occurs chiefly in September–October, sporadically throughout the year. Fruiting occurs simultaneously with flowering. Flowers are solitary, axillary, white or purple-tinged, with short pedicels and two bracteoles. Sepals are five in number, 0.4–0.9 cm long. Corolla tube is cylindrical with spreading lips, twice as long as sepals. Capsule is ovoid in shape, acute, two-grooved and two–valved with numerous seeds that are very minute, pale, and irregular. It is propagated by stem cuttings. The whole herb is the source of the ayurvedic drug 'Brahmi'. It is used in improving memory and intelligence and also in the treatment of dermatosis, anaemia, diabetics and insanity. Bacoposide is considered as the major active ingredient in this plant. The plant is a short duration annual herb, frequent in moist habitat and water edges throughout tropical and subtropical India. It grows best near flowing water and wetlands in plains and foothills, and is particularly abundant in monsoon. Bacopa species are widely distributed in warmer parts of the world and are reported to occur in Asia, Australia and North and South America (Henriques *et al.*, 1984; Al Saadi *et al.*, 1984; Meivor, 1987; Rocha, 1988). B. monnieri, or brahmi is an important component of the traditional as well as modern systems of medicine in India; it is a major constituent of several commercial herbal formulations available in the market. It has been indicated in the treatment of mental disorders like epilepsy and mental retardation, in asthma and as a cardiotonic and diuretic (Chopra *et al.*, 1956; Sharan & Khare, 1991; Moharana & Moharana, 1994; Khanna & Ahmad, 1992; Dar & Channa, 1997). The brahmi extract is known to possess anti cancer and antioxidant properties (Elangovan *et al.*, 1995; Tripathi *et al.*, 1996). Plant's saponins, the bacosides have been indicated for memory enhancing properties (Chatterjee *et al.*, 1963; Kulshreshtha and Rastogi, 1973; Pal & Sarin, 1992; Singh *et al.*, 1988). It is estimated that about one million quintals of brahmi material is collected from the wild every year for commercial use (Ahmad, 1993; Mathur, 1999).

With increasing demands for herbal drugs, the natural populations of B. monnieri are threatened with over exploitation leading to depletion of valuable genetic resources; little work has been done for the conservation of natural variability in the existing germplasm. Towards the desired domestication and cultivation of *B. monnieri* to meet the commercial requirements of the materials, the present study was initiated to select the superior eco-types for their use in breeding programmes. Germplasm from different parts of Bihar was characterized morphologically for the assessment of naturally occurring variability among different accessions.

Materials and methods

Germplasm of B. monnieri was collected from different agroclimatic zones in Bihar. Several plant cuttings of ten to fifty randomly sampled individual plants from each location were brought Dr.RPCAU, Pusa and planted together in the herbal garden, Dr.RPCAU, Pusa. The nursery soil is mixed with well-decomposed FYM (farmyard manure) at the rate of 3 kg/m^2. Planting of shoot cutting was done on first week of June. The freshly collected propagules (shoot cuttings) of 5–10 cm length bearing internodes and rootlets manually embedded in the soil at a distance of 5 cm × 10 cm in the well-prepared nursery beds followed by light irrigation. The propagules develop roots within a week of planting and transplanting in field in about 40 days. For characterization of different accessions, a experiment was carried out in a randomized block design with three replications for each accession. Vegetative characters were measured in all five plants in each replication for all accessions. For floral characters five randomly chosen flowers for each replication in all accessions were used for the measurements. Observations were recorded on all five plants for each replication for all the accessions.

Result and Discussions

The variability observed in 14 accessions of *B. monnieri* collected from northern parts of Bihar is summarized inTables1. The variability observed for characters has been shown semi quantitatively and that for 7 traits measured quantitatively is presented in the form of their statistical parameters in Table 1. It will be seen from the Table that the accessions had branch habit ranging from prostrate to erect with stems showing sparse to very intense anthocyanin pigmentation. Leaf colour varied from green to grayish green and leaf shapes were obovate, oblanceolate, oblong and linear. The above observations demonstrated that the collection of accessions perhaps consisted of many ecotypes carrying distinctive characteristics.

It will be seen from Table-1 that variation among accessions for all seven characters was statistically significant. Plant height ranged from 17.2 to 45.2 cm in different germplasm of Brahmi. Maximum plant height was recorded in IC-0622291 (45.2 cm) which was significantly superior to other germplasm and minimum was recorded in accession no. IC-0622294 (17.2 cm). Number of nodes per plant range form 19.2 to 12.2 in different germplasm of Brahmi. Maximum number of nodes per plant was recorded in IC – 0622291 (19.2) which was at with IC – 0622287 (19.1) and IC – 0622292 (19.0) and minimum was recorded in IC-0622294 (12.2).Number of primary branch per plant was ranged from 35.3 to 16.5. Maximum number of primary branch per plant was recorded in the accession no. IC-0622291 which was significantly superior over all the accession and minimum was recorded with accession no. IC-0622294 (16.5). Leaf length varies from 1.80 cm to 0.91 cm. Maximum leaf length was recorded with the accession no. IC – 0622291 which was at par with the accession no. IC – 0622290 (1.72 cm) and IC – 0622288 (1.62 cm) and minimum was recorded with accession no IC – 0622281 (0.91 cm). Similarly leaf width varies from 0.51 cm to 0.32 cm. Maximum leaf width was recorded with accession no. IC – 0622291 (0.51 cm) which was at par with accession no. IC – 0622288. Minimum leaf width (0.32 cm) was recorded with the accession no. IC – 0622282 (0.32 cm).

Fresh herbage yield varies from 222.53 to 99.51 q/ha in different germplasm evaluated under this investigation. Maximum fresh herbage yield was recorded in the accession no. IC – 0622291 (222.53 q/ha) which was significantly superior to rest of the accession. Minimum was recorded in the accession no. IC – 0622293 (99.51q/ha). Dry herbage yield varies from 44.3 to 20.1 q/ha. Maximum dry herbage yield was recorded with the accession no. IC – 0622291 (44.3 q/ha) which was significantly superior to other accession. Minimum was recorded with the accession no IC – 0622293 (20.1 q/ha).

Conclusion

The three years research revealed that there were significant variations among the genotypes with respect to vegetative growth and herbage yield. The variation among accessions for all seven characters was statistically significant. On the basis of growth and yield parameter it can be concluded that accession no. IC-0622291was the best genotype among the fourteen genotypes.

Table 1: Morphological traits of 14 accessions of brahmi (*Bacopa monnieri*) collected from different parts of North Bihar

Sl. No.	Accession no	Characteristics Branches	Stem	Leaves	Shape	Plant height (cm)	No. Of nodes / plant	No. Of primary branches/ Plant	Leaf length (cm)	Leaf width (cm)	Fresh herbage yield (q/ha)	Dry herbage yield (q/ha)
1	IC-0622281	Suberect	Light green	green	Linear	18.3	13.3	17.8	1.05	0.42	141.20	29.30
2	IC-0622282	Erect	Pale green	Grayish green	Obovate	40.1	15.8	22.8	0.91	0.32	164.30	33.40
3	IC-0622283	Prostrate	Pale green	Grayish green	Oblanceolate	35.3	13.2	21.2	0.99	0.35	131.80	26.10
4	IC-0622284	Suberect	Pale green	Green	Linear	33.4	16.5	19.3	1.01	0.41	119.51	22.50
5	IC-0622285	Suberect	Dark green	Green	Linear	36.2	13.5	16.8	1.23	0.39	120.10	25.10
6	IC-0622286	Suberect	Dark green	Grayish green	Linear	21.5	16.0	17.3	0.98	0.42	141.10	28.20
7	IC-0622287	Suberect	Light green	Grayish green	Oblong	26.2	19.1	18.1	1.54	0.45	101.30	21.10
8	IC-0622288	Erect	Light green	Grayish green	Oblong	19.9	15.2	19.2	1.62	0.49	109.70	22.50
9	IC-0622289	Erect	Light green	Grayish green	Oblong	28.2	15.5	19.2	1.32	0.44	121.80	25.10
10	IC-0622290	Suberect	Light green	Grayish green	Obovate	31.2	16.1	26.3	1.72	0.42	210.80	41.90
11	IC-0622291	Suberect	Light green	Grayish green	Oblong	45.2	19.2	35.3	1.80	0.51	222.53	44.30
12	IC-0622292	Suberect	Dark green	Green	Oblong	21.2	19.0	21.2	1.42	0.44	193.60	39.20
13	IC-0622293	Prostrate	Pale green	Green	Obovate	25.6	13.6	22.3	1.31	0.42	99.51	20.10
14	IC-0622294	Erect	Dark green	Grayish green	Oblong	17.2	12.2	16.5	1.01	0.43	167.74	32.87

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