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Morphological Variation of Ten *Ipomoea* Species of Bangladesh

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Abstracts: Morphological variations among all the ten species of *Ipomoea* were observed both qualitative and quantitatively. Thirteen quantitative characters were taken into consideration and their mean values were compared statistically. Comparative analysis revealed variations from species to species. Qualitative characters concerned with root/tuber, stem/leaf, flower and capsule/seed were examined. Almost all the species of *Ipomoea* are of herbaceous and climbing habit except *I. aquatica*, it is amphibious in nature. Most of the species showed leaves to be lobed with various shape such as ovate-oblong, cordate, broadly ovate, ovate-cordate etc. except *I. quamoclit* where the leaves were found to be pinnately paired and cut up to the midrib. Flowers were observed to be few in axillary cymes in most of the species and in few species flowers were many in terminal cymes, except *I. pes-tigridis* where the flowers were head like involucre in axillary cymes. On the other hand, seed colours were also found to vary but slightly in the species of *Ipomoea* examined in the present investigation.

Key words: *Ipomoea*, morphological variation

INTRODUCTION

There are 24 species of *Ipomoea* under Convolvulaceae growing in different parts of Bangladesh (Flora of Bangladesh). Several of these are restricted to dry/moist, waste places or occur as weeds in cultivated land and a great many of them are well known for their ornamental, medicinal, food and soil binding values. The genus *Ipomoea* belongs to the family Convolvulaceae including about 40 genera and 1000 species and they are found in all the warmer parts of the world but well developed mostly in tropical Asia, Africa, Australia and America. The genus *Ipomoea* is characterized by herbaceous nature and climbing habit in majority of the species. As far as the species available in Indian sub-continent are concerned, except *I. aquatica* Forsk. all others are typical climbing plants and mostly are cultivated for showy flowers (Sharma and Datta, 1958). *Ipomoea aquatica* (English name: water spinach, native name: kalmishak), as the scientific name implies aquatic in nature, is very popular in Hong Kong. Its fresh young leaves and stems are used as vegetable. The flowers of *Ipomoea* in the wide sense may be salver, bell- or funnel-shaped. They are large and showy with red, blue, yellow or purple corollas and are borne singly or in cluster in the axils of the alternate often cordate leaves. The root of the water spinach is believed to cure hemorrhoids. Because of its high iron content, physicians recommend it to patients suffering from anemia (Vanzi, 1997). The present study was undertaken to distinguish of ten species of *Ipomoea*

by their morphological characters both quantitative and qualitative.

MATERIALS AND METHODS

A total of 10 (ten) species of *Ipomoea* were used as plant materials in the present study. They were found to grow both in cultivated and wild forms of Bangladesh. The collected species under the genus *Ipomoea* belongs to five subgenera out of six (Hooker, 1885). Brief accounts of the studied plants are given below in Table 1.

Methods: Both stem and seeds of the collected species were used for growing them in the Botanical Garden of Rajshahi University in the year of 2000 for multiplying the number of plants. During 2001-2002 a keen morphological study was made on all the ten species of *Ipomoea*. For making morphological observation on all the ten species of *Ipomoea* their following parts were examined and data were recorded to find out the differences among them. The various qualitative characters considered were of root, stem, leaf, flower, capsule and seed. A total of thirteen quantitative characters were considered for this study. Those were internode length, leaf stalk length, leaf length, leaf breadth, peduncle length, flower diameter (top), calyx length, calyx breadth, corolla length, capsule length, capsule breadth, seed length and seed breadth. Data on quantitative characters were recorded from randomly selected 5 plants of each species. Analysis of morphological characters as mean, standard error and

Table 1: A few details of the ten species of *Ipomoea* and their place of collection

Species	Synonym	English name	Native name	Place of collection
<i>I. aquatica</i> Forsk.	<i>I. reptans</i> Poir.	Water spinach	Kalmisak	Rajshahi University campus
<i>I. fistulosa</i> Mart. ex Choisy	<i>I. carnea</i> Jacq.	Shrubby morning glory	Berakalmi	Road side and Marshy land of Naogaon and Rajshahi
<i>I. nil</i> (L.) Roth.	<i>I. hederacea</i> Jacq.	Indian Jalap	Nilkalmi	Rajshahi University camps
<i>I. maxima</i> (L.f.) Don. ex Sweet.	<i>I. sepiparia</i> Koen. ex Roxb.	Not available	Bankalmi	Satkhira, Khulna and Naogaon
<i>I. mauritiana</i> Jacq.	<i>I. paniculata</i> (L.) R. Br., <i>I. digitata</i> Linn., <i>Convolvuloideis palmata</i> Moench.	Giant Potato	Bhui Kumra	Meharchandi at Rajshahi
<i>I. pes-tigridis</i> Linn.	<i>I. pulchella</i> Sensu. <i>I. palmata</i> Forsk.	Tigers foot	Langulilata	Science Laboratory at Rajshahi
<i>I. cairica</i> (L.) Sweet.	<i>Quamoclit pinnata</i> Boj.	Railway creeper	Rellata	Jessore and Rajshahi University Campus
<i>I. quamoclit</i> Linn.	<i>I. muricata</i> (L.) Jacq.	Needle creeper	Tarulata	Department of Botany at Rajshahi University
<i>I. turbinata</i> Lagasca,		Moon flower	Michai	Rajshahi, Naogaon Roadside, Rongpur, Mohastangoar at Bogra
<i>I. turpethum</i> Br. Prodr.	<i>Operculina turpethum</i> *Manso	False Jalap	Dhud Kalmi	Rajshahi University Botanical Garden

*Flora of Bangladesh

range of values were determined from the recorded data following the techniques developed by Zaman *et al.* (1982).

RESULTS AND DISCUSSION

Morphological features among the ten species of *Ipomoea* in the present study were found to show differences. All the studied species of *Ipomoea* characterized by herbaceous in nature and climbing habit are grown both in garden (such as *I. hederacea*, *I. quamoclit* and *I. pulchella*) and in wild habitat (such as *I. maxima*, *I. paniculata*, *I. carnea*, *I. pes-tigridis*, *I. turbinata* and *I. turpethum*). Only the species *I. aquatica*, is amphibious in nature and generally grows in aquatic habitat, as its name implies. However, all these were found to be different from each other with respect to both of the qualitative and quantitative characters. A few characters of taxonomic importance of the studied materials were found to vary to some extent when these were compared to that mentioned in Flora of Bangladesh edited by Khan (1985) and Flora of British-India authored by Hooker (1885) as given in Table 2. However, the morphological characters studied in the present investigation are discussed as follows:

Qualitative characters: In the present study the tuberous roots were found in both the species *I. pulchella* and *I. paniculata*. The later one had a very large tuberous root (Table 3).

On the other hand, in *I. aquatica* and *I. pulchella* the roots were also found to grow at the nodes and rest of the species showed normal roots to grow usually. Present findings agreed well with the descriptions mentioned in Flora of Bangladesh (Table 2). The stems were found to be glabrous twining in *I. maxima*, *I. paniculata*, *I. pulchella* and *I. quamoclit*, erect and shrubby stem in *I. carnea*; hairy stem in *I. hederacea* and *I. pes-tigridis*;

muricated with milky juice stem in *I. turbinata*; quadrangular winged stem in *I. turpethum* and stem trailing or floating on water in *I. aquatica*. Both stem and leaves of milky juice nature were found in *I. carnea* and *I. turbinata*. The leaves were found to be palmately segmented into 7-9 or 10 parts in *I. paniculata* and palmately 5-segments were found in *I. pulchella*. Palmate leaves with 7-9 segments of *I. paniculata* were reported in Flora of Bangladesh.

But in all other cases leaves were observed to be 3-lobed and hairy on both the surfaces of *I. hederacea*, 5-9 lobed and hairy in *I. pes-tigridis*, segments numerous linear, pinnately many pairs cut up to the midrib in *I. quamoclit*, ovate-oblong and base cordate sagittate in *I. aquatica*, ovate-oblong and base cordate in *I. carnea* and broadly ovate and base cordate in *I. maxima* and *I. turbinata*, and ovate-cordate in *I. turpethum*. In case of *I. carnea*, young leaves were puberulent on both the surfaces but sticky and milky juice was found in stem and leaf. The sticky juice is a mentionable character of this species. Milky juice was also found in *I. turbinata*. Present findings agreed well with the features mentioned (Table 2) in Flora of Bangladesh edited by Khan (1985).

Vij and Satpal (1976) observed variations in shape and size of the leaves in different populations of *Convolvulus arvensis*. A number of collections from different localities exhibited variations in the gross morphological characters. They reported that the maximum variability was found in the leaves, which ranged from ovate to almost linear in outline and with auriculated/hestate/cordate/sagittate bases. The collections from bare, open and dry soils possessed small leaves (reduced lamina), whereas the collections from well moist fields possessed larger of various shapes.

Flower number in all the species were found to vary from one-few-two or many in axillary or terminal cymes, except *I. pes-tigridis* where the flowers were head like

Table 2: Comparison between few of the important morphological characters of different *Ipomoea* species with the description mentioned in Flora of Bangladesh and Flora of British-India

Species	Flora of Bangladesh (FB) and Flora of British India (FBI)				Characters obtained in the present study			
	Root/ tuber characters	Stem and leaf characters	Flower characters	Capsule/ seed characters	Root/ tuber characters	Stem and leaf characters	Flower characters	Capsule/ seed characters
<i>I. aquatica</i>	Normal root	Stem trailing on mud or floating on water, leaves ovate, deltoid, base cordate, sagittate or hastate, rooting at the nodes, leaves 7.62-15.24 cm long petiole 2.54-15.24 cm long (FBI)	Flowers 1-few in axillary cymes, funnel shaped, pink or pale lilac, prominent purple eye, rarely white sepals 0.70-1.0 cm long corolla 2.5-5.0 cm long (FB) Peduncles 5.08-17.78 cm long	capsule ovate to globose, glabrous, seeds densely grey pubescent or glabrous, capsule 0.85 cm ovoid (FBI)	Normal root	Stems trailing or floating on water, rooting at nodes leaves ovate-oblong, base sagittate, leaves 7.25-10.75 cm, long and 3-7.5-6.0 cm boardpetiole 8.5-10.75 cm long	Flowers 1-few in axillary cymes, corolla funnel shaped, whitish-pink with purple eye, sepals 0.60-0.66 cm long, corolla 4.0-5.3 cm long, peduncle 4.15-6.75 cm long	Capsule ovate to globose, seeds grey pubescent, capsule 1.55×0.98 cm
<i>I. carnea</i>	Normal root	Stem shrubby and tall milky juice, leaves ovate to ovale-oblong base cordate to truncate, young leaves puberulent both the surfaces petiole up to 15 cm long (FB)	Flowers several to many in axillary and terminal cymes, corolla pink or pale lilac, dark purplish inside towards the base, 7-9 cm long (FB)	Capsule ovate 2-or incomplete 4 celled-4 valved, seeds black	Normal root	Stem erect and shrubby, containing milky juice, sticky, leaves ovate-oblong, base cordate, young leaves puberulent both the surfaces, petiole 6.0-10.0 cm long	Flowers several to many in axillary and terminal cymes, light pink to purplish and dark purplish inside both the surfaces, corolla 6.0-7.5 cm long	Capsule ovate, incomplete 4-celled, 4-valved, seeds grayish black
<i>I.hederacea</i>	Normal root	Stem twiner retroseely hirsute leaves broadly ovate to orbicular, entire or 3 lobed base cordate with short appressed hair, leaves 5.08-12.7 cm long, petiole 2.54-10.16 cm long (FBI)	Flower 1-several in axillary cymes, corolla blue or bright blue, gradually turning red or reddish purple, sepal 1.27-2.54 cm long corolla 3.81-5.08 cm long (FBI)	Capsule globose, 1.0 cm diameter, 3 celled, 3 valved, seeds black	Normal root	Stem hairy, twiner, leaves hairy, ovate-cordate, 3-lobed, base cordate, leaves 8.5-11.5 cm long, petiole 5.5-9.5 cm long	Flowers 1-several in axillary cymes sepals elongated-liner, lanceolate corolla blue, gradually reddish purple with age, outer tube white, sepals 1.5-3.0 cm long, corolla 5.0-6.5 cm long	Capsule ovate-globose 0.90×0.87 cm long, 3-celled, 3-valved, seeds black
<i>I. maxima</i>	Normal root	Stem pilose, leaves-deltoid to broadly ovate, base cordate leaves 3-7×3-6 cm, petiole 2.2-4.0 cm long (FB)	Flowers 2-more in cymes. corolla salver shaped, light purplish or white tinge with rose purple, sepals 0.5-0.7 cm long, corolla 3 cm long, peduncles 3-12 (+20) cm long (FB)	Capsule smooth, spherical, seeds 0.4×0.3 cm long, covered with dense very short greish tomentum (FB) Capsule ovoid glabrous, 4 celled 4-valved, seeds black, wooly sericeous (FBI)	Normal root	Stem twining, glabrous, leaves broadly ovate, base cordate, leaves 5.0-7.0×4.0-7.0 cm, petiole 2.75-4.5 cm long	Flowers 2-or more in cymes, long peduncle, corolla salver-shaped, white tube cylindrical with purplish-orange sepals 0.5-0.6 cm long, corolla 3.37 cm long, peduncles 10-15 cm long	Capsule ovoid, smooth, seeds 0.33×0.30 cm long, covered with dense short greyish tomentum
<i>I. paniculata</i>	Root tuberous (FB)	Stem large, glabrous twining leaves palmately divided usually 7-9 segments (FB) petiole 5.08-12.7 cm long (FBI)	Flowers few to many in axillary to terminal cymes corolla pale, reddish-purple tube darken inside, corolla 3.81-6.35 cm long sepals 0.64-0.85 cm long (FBI)	Capsule ovate glabrous, seeds shortly grey-tomentose (FB)	Root large and tuberous	A large glabrous twiner leaves palmately divided usually 7-9 or 10 segments, some segments again lobed, petiole 2.5-6 cm long	Flowers few to many in axillary or terminal cymes, corolla, reddish-purple and tube dark purple, corolla 5-6 cm long, sepals 0.8-0.9 cm long	Capsule ovoid, 4-celled, 4-valved, seed pale yellow and black to the attached placenta with wooly hairs easily detaching
<i>I. pestigridis</i>	Normal root	Stem twining, patently hirsute (FBI), leaves palmately divided with 5-9 segments. Segments elliptic to elliptic oblong, petiole 2.54-5.08 cm long (FBI)	Flowers few in head like involucrate axillary cymes outer bract very long than inner, corolla white, 3-4 cm long (FB) peduncle 1.27-7.62 cm long (FBI)	Capsule ovate glabrous, seeds shortly grey-tomentose (FB)	Normal root	Stems twining, patently hairy on both surfaces, leaves palmately divided with 5-9 segments, each segments ellipticoblong petiole 12.18-18 cm long	Flowers few in head-like involucrate axillary cymes, outer bract very long than inner, sepals long, corolla white, 3.2-3.8 cm long, peduncle 12.5-16 cm long	Capsule globose-glabrous, 4-celled, 4-valved seeds small, greyish-black
<i>I. pulchella</i>	Root tuberous (FB)	Stem glabrous, twining, leaves palmately cut to the base 5 segments, some segments often again lobed petiole 2.54-5.08 cm long (FBI)	Flowers 1-few in axillary cymes corolla white with purplish tinge, 4.5 to 6.0 cm long (FB)	Capsule smooth 4-valved seeds densely short tomentous with long silky hair (FBI)	Root tuberous and constricted	Stems glabrous twining, roots at nodes, leaves palmately 5-segments, some segments again lobed, petiole 7.5-12.0 cm long	Flowers 1-few in axillary cymes corolla purplish-white with purplish tinge, 5.5-6.5 cm long	Capsule ovoid glabrous, 4-celled, 4-valved, seed brownish-grey with silky hair,
<i>I. quamoclit</i>	Normal root	Stem glabrous twiner, leaves pinnately cut up to the midrib into many pairs, segments numerous linear leaves 7.62-12.7 by 5.08-7.62 cm long (FBI)	Flowers 1-few in axillary cymes, corolla salver shaped with red tube, 2.5-3.5 cm long (FB)	Capsule longitudinally splitting valve, seeds black with minutely hairy	Normal root	Stem glabrous, twiner, leaves pinnately many pairs cut up to the midrib, segments numerous linear, leaves 4.25-6.75 by 3.50-6.25	Flowers 1-few in axillary cymes, corolla salver-shaped with deep red tube, tube 2.75-3.50 cm long	Capsule oblong-ovate to longitudinally splitting valves, seeds black

Table 2: Continued

Species	Flora of Bangladesh (F.B.) and Flora of British India (F.B.I.)				Characters obtained in the present study			
	Root/tuber characters	Stem and leaf characters	Flower characters	Capsule/seed characters	Root/tuber character	Stem and leaf characters	Flower characters	Capsule/seed characters
<i>I. turbinata</i>	Normal root	Stems twiner muricated with milky juice, leaves broadly ovate. 9-20×7-20 cm long (FB)	Flowers 1-few in axillary cymes corolla bluishpurple, 5-7.5 cm long, sepals 1-1.5 cm long. (FB), corolla rose purple (FBI)	Capsule ovoid 1.5-2 ×1.5 cm 4-valved seeds black, glabrous, 0.9×1.0-0.6×0.8 cm (FB), glabrous (FBI)	Normal root	Stems muricated with milky juice, leaves broadly ovate, base cordate, 14-18×13.5-18 cm sepals	Flowers 1-few in axillary cymes, corolla purple, inner tube and outer tube purplish-white, 5.9-6.0 cm long sepals 1.4-1.6 cm long	Capsule ovoid, 1.75 ×1.49, 4-valved, seeds glabrous, pale yellow 0.9×0.71 cm
<i>I. turpethum</i>	Normal root	Stem stout, twining quadrangular leaves cordate 5.08-12.7 cm long petiole 2.54 cm (FBI)	Flower 1-few axillary cymes, corolla white 3.81 cm long, sepals 1.27 cm long peduncle 2.54-10.16 cm long (FBI)	Capsule long globose, 1.27-1.91 cm, 4-seed, smooth black (FBI)	Normal root	Stem quadrangular, winged, leaves ovate-cordate 12-16 cm long, petiole 4.9 (4.0-5.5) cm long	Flower 1-few in axillary cymes, corolla white, 4.5-5.0 cm spals 2.14 cm long peduncle 8.5-11.5 cm long	Capsule large globose 2.25 2.0 cm long 4-seeded, seed black

Table 3: Morphological characters (qualitative) in ten species of *Ipomoea*

Species	Root/Tuber characters	Stem and leaf /petiole characters	Flower characters	Capsule and seed characters
<i>I. aquatica</i>	Normal root	Stems trailing or floating on water, rooting at nodes, leaves ovate to oblong, base sagittate	Flowers 1-few in axillary cymes, corolla funnel shaped, whitish pink with purple tinge.	Capsule ovate to globose, seeds grey pubescent
<i>I. carnea</i>	Normal root	Stem erect and shrubby, containing sticky milky juice, leaves ovate-oblong, base cordate, young leaves puberulent on both the surfaces	Flowers several to many in axillary and terminal cymes, light pink to purplish and dark purplish inside the base.	Capsule ovate, incomplete 4-celled, 4-valved, seeds greyish black
<i>I. hederacea</i>	Normal root	Stem hairy, twiner, leaves hairy, ovate-cordate, 3-lobed, base cordate	Flowers 1-several in axillary cymes, elongated-linear, lanceolate, corolla blue, gradually reddish purple with age, outer tube white	Capsule ovate-globose, 3-celled, 3-valved, seeds black
<i>I. maxima</i>	Normal root	Stem twining, glabrous, leaves broadly ovate, base cordate	Flowers 2-or more in cymes, long peduncle, corolla salver-shaped, white, tube cylindrical with purplish-orange	Capsule ovate, smooth, seeds covered with dense short greyish tomentum
<i>I. paniculata</i>	Root large and tuberous	A large glabrous twiner, leaves palmately divided, usually 7-9or 10 segments, sometimes again lobed.	Flowers few to many in axillary or terminal cymes with long peduncle, corolla reddish-purple and tube dark purple.	Capsule ovoid, 4-celled, 4-valved, seed pale yellow and attaching part of the seed looks black, with woolly hairs easily detaching
<i>I. pes-tigridis</i>	Normal root	Stems twining, patently hairy on both surfaces, leaves palmately divided with 5-9 segments, each segments elliptic-oblong	Flowers few in head-like involucre axillary cymes, outer bract very long than inner, sepals long, corolla white	Capsule globose-glabrous, 4-celled 4-valved seeds small, greyish-black
<i>I. pulchella</i>	Root tuberous and constricted	Stems glabrous twining, roots at the nodes, leaves palmately 5-segments, some segments again lobed	Flowers 1-few in axillary cymes corolla purplish white with purplish tinge.	Capsule ovoid glabrous, 4-celled, 4-valved, seed brownish grey with silky hair.
<i>I. quamoclit</i>	Normal root	Stem glabrous, twiner, leaves pinnately many pairs, cut up to the mid rib, segments numerous linear	Flowers 1-few in axillary cymes, corolla salver-shaped with deep red tube.	Capsule oblong-ovate with longitudinally splitting valves, seeds black.
<i>I. turbinata</i>	Normal root	Stems muricated with milky juice, leaves broadly ovate, base cordate	Flowers 1-few in axillary cymes, corolla purple, inner tube and outer tube purplish-white	Capsule ovoid, 4-valved, seeds glabrous pale yellow
<i>I. turpethum</i>	Normal root	Stem quadrangular, winged, leaves ovate-cordate	Flower 1-few in axillary cymes, corolla white, bracts large oblong.	Capsule large globose, 4-seeded, seed black

involucre in axillary cymes, a mentionable character of this species (Table 3). Flower colors varied species wise. White flower were found in *I. pes-tigridis*, *I. turpethum* and *I. maxima*. But inner tube was observed to be purplish-orange in *I. maxima*. The flower color of *I. maxima* was mentioned as light-purplish or white with rose-purple tinge in Flora of Bangladesh (Table 2). The flower colours were whitish-pink with purple tinge in *I. aquatica*, light pink-purplish in *I. carnea*, blue to reddish purple in *I. hederacea*, reddish purple in *I. paniculata*, purplish-white with purplish tinge in *I. pulchella*, red in *I. quamoclit* and purple in *I. turbinata*. In Flora of British-India the flower color of *I. turbinata* was mentioned as rose-purple and in Flora of Bangladesh

it was described as bluish-purple; but in all other cases, the present findings were more or less similar with the report of Flora of Bangladesh and Flora of British-India.

Four populations of *I. hederacea* differing in their flower colour (white, pink, pinkish-blue and blue) were reported by Kano (1929), Walcott (1937), Ting *et al.* (1957), Sharma and Datta (1958) and Jones (1964). They stated that the structural alterations involving chromosomal repatterning and changes in total chromatin matter played important role in the evolution of *I. hederacea*. Sharma and Datta (1958) also recorded structural rearrangements and total chromatin size variations in the 6-varieties of this species differing in flower colour.

The capsule shape was found to be ovate to globes in all the species, except *I. quamoclit* where the capsule was found to be oblong-ovate to longitudinal. In some cases, the seed colours varied slightly in different species of *Ipomoea*. The seed colour of *I. aquatica* was grey pubescent; greish-black in *I. carnea* and *I. pes-tigridis*; black in *I. hederacea*, *I. quamoclit* and *I. turpethum*; pale yellow and black up to the placenta in *I. paniculata* and pale yellow in *I. turbinata*. The seeds of *I. turbinata* were found with wooly hair, which are detachable easily. *I. turbinata* was reported with black and glabrous seeds in Flora of Bangladesh and only glabrous in Flora of British-India (Table 2). The seeds were found to be covered with greish tomentum in *I. maxima* and with silky hairy in *I. pulchella* in the present study. However, the present findings agreed mostly with the reports of Flora of Bangladesh.

Quantitative characters: Thirteen quantitative characters were found to vary among the ten species of *Ipomoea* in the present investigation (Table 4).

Values in parentheses () indicates the range: In *I. aquatica* the leaf length and peduncle length were found to range from 7.25-10.75 and 4.15-6.75 cm, respectively. The mean value of petiole length was found to be 9.94±0.13 cm in *I. aquatica*. More or less similar value was mentioned in Flora of British-India. Rao (1947), Sharma and Datta (1958) and Krishnappa (1971) reported two morphotypes in *I. aquatica* with broad leaves, hestate versus narrow entire leaves and that possessed chromosome number to be n = 15. They also observed karyotypic differences between the morphovariants. In the present investigations, the narrow leaved type was observed.

Table 4: Mean values (SD±SE) for thirteen quantitative characters in ten species of *Ipomoea*

Species	Leaf length (cm)	Leaf breadth (cm)	Leaf stalk length (cm)	Internode length (cm)	Peduncle length (cm)	Flower diameter (top) (cm)	
<i>I. aquatica</i>	8.96±0.08 (7.25-10.75)	5.41±0.05 (3.75-6.0)	9.94±0.13 (8.5-10.75)	12.05±0.16 (10.0-15.0)	4.47±0.01 (4.15-6.75)	4.50±0.03 (4.0-4.8)	
<i>I. carnea</i>	17.01±0.10 (14.0-18.5)	8.27±0.02 (7.0-10.0)	7.47±0.10 (6.0-10.0)	4.43±0.12 (3.75-6.5)	6.68±0.06 (5.0-8.25)	6.90±0.03 (6.25-7.20)	
<i>I. hederacea</i>	10.73±0.16 (8.5-11.5)	8.55±0.09 (8.0-10.0)	6.96±0.07 (5.5-9.5)	18.35±0.10 (16.25-20.75)	9.39±0.06 (7.25-11.60)	4.47±0.05 (4.20-5.0)	
<i>I. maxima</i>	6.21±0.07 (5.0-7.0)	5.96±0.09 (4.0-7.0)	3.60±0.04 (2.75-4.5)	7.15±0.12 (5.75-9.0)	13.13±0.09 (10.0-15.0)	3.36±0.05 (3.00-3.70)	
<i>I. paniculata</i>	8.34±0.03 (6.25-9.85)	7.35±0.03 (5.75-9.5)	3.67±0.04 (2.5-6.0)	6.13±0.04 (5.50-9.50)	6.99±0.08 (5.5-9.25)	6.04±0.06 (5.5-6.5)	
<i>I. pes-tigridis</i>	12.61±0.18 (9.5-14.5)	16.68±0.08 (14.0-17.5)	16.12±0.10 (12.18-18.0)	20.33±0.32 (16.50-23.0)	14.10±0.08 (12.5-16.0)	2.36±0.03 (2.0-2.6)	
<i>I. pulchella</i>	8.41±0.06 (6.75-10.50)	8.20±0.14 (6.0-10.25)	8.99±0.04 (7.50-12.0)	6.88±0.06 (5.25-8.5)	2.95±0.02 (1.75-3.75)	5.84±0.04 (5.5-6.5)	
<i>I. quamoclit</i>	5.11±0.07 (4.25-6.75)	4.51±0.04 (3.50-6.25)	4.86±0.04 (3.75-6.0)	7.56±0.04 (5.75-8.75)	12.33±0.07x (10.0-14.5)	1.75±0.02 (1.50-2.00)	
<i>I. turbinata</i>	16.72±0.10 (14.0-18.0)	16.86±0.14 (13.5-18.0)	15.15±0.12 (13.0-17.5)	17.72±0.16 (15.0-2.0)	9.78±0.05 (8.15-11.0)	5.60±0.04 (5.30-6.0)	
<i>I. turpethum</i>	14.30±0.05 (12.0-16.0)	13.39±0.06 (11.5-15.75)	4.9±0.05 (4.0-5.50)	12.77±0.10 (11.0-14.75)	10.23±0.06 (8.50-11.5)	5.66±0.05 (5.0-6.20)	
Species	Calyx length (cm)	Calyx breadth (cm)	Corolla length (cm)	Capsule length (cm)	Capsule breadth (cm)	Seed length (cm)	Seed breadth (cm)
<i>I. aquatica</i>	0.64±0.003 (0.60-0.66)	0.32±0.006 (0.28-0.35)	4.57±0.08 (4.0-5.30)	1.55±0.03 (1.40-1.70)	0.98±0.03 (0.80-1.10)	0.49±0.006 (0.45-0.51)	0.46±0.002 (0.40-0.480)
<i>I. carnea</i>	0.62±0.002 (0.60-0.70)	0.58±0.005 (0.50-0.65)	6.62±0.10 (6.0-7.5)	1.35±0.02 (1.20-1.60)	1.10±0.002 (1.0-1.20)	0.73±0.002 (0.68-0.76)	0.54±0.01 (0.50-0.60)
<i>I. hederacea</i>	2.49±0.05 (1.5-3.0)	0.53±0.002 (0.45-0.60)	6.19±0.09 (5.0-6.5)	0.90±0.004 (0.85-0.95)	0.87±0.003 (0.80-0.90)	0.47±0.006 (0.40-0.50)	0.36±0.003 (0.35-0.40)
<i>I. maxima</i>	0.57±0.002 (0.50-0.60)	0.33±0.002 (0.31-0.36)	3.37±0.05 (3.20-3.80)	0.67±0.003 (0.60-0.70)	0.59±0.002 (0.55-0.65)	0.33±0.006 (0.30-0.35)	0.30±0.004 (0.28-0.35)
<i>I. paniculata</i>	0.83±0.008 (0.80-0.90)	0.51±0.006 (0.40-0.60)	5.68±0.07 (5.0-6.0)	1.19±0.03 (1.0-1.3)	1.16±0.02 (1.0-1.25)	0.61±0.001 (0.55-0.65)	0.37±0.01 (0.30-0.45)
<i>I. pes-tigridis</i>	1.03±0.006 (1.01-1.05)	0.38±0.002 (0.37-0.40)	3.37±0.06 (3.20-3.80)	0.69±0.006 (0.60-0.80)	0.66±0.001 (0.62-0.70)	0.36±0.003 (0.30-0.40)	0.32±0.02 (0.30-0.360)
<i>I. pulchella</i>	0.56±0.003 (0.50-0.65)	0.49±0.001 (0.40-0.60)	5.86±0.05 (5.5-6.5)	1.16±0.04 (1.0-1.40)	0.95±0.002 (0.75-1.20)	0.49±0.001 (0.45-0.53)	0.40±0.01 (0.35-0.45)
<i>I. quamoclit</i>	0.55±0.002 (0.52-0.60)	0.22±0.001 (0.20-0.25)	3.25±0.02 (2.75-3.50)	0.68±0.003 (0.60-0.75)	0.59±0.003 (0.50-0.70)	0.53±0.002 (0.50-0.57)	0.25±0.006 (0.20-0.28)
<i>I. turbinata</i>	1.50±0.01 (1.40-1.60)	0.55±0.003 (0.45-0.60)	6.52±0.04 (5.90-7.00)	1.75±0.02 (1.6-1.9)	1.49±0.04 (1.4-1.6)	0.90±0.005 (0.85-0.95)	0.71±0.003 (0.65-0.80)
<i>I. turpethum</i>	2.14±0.01 (1.92-2.40)	1.85±0.02 (1.7-2.1)	4.77±0.03 (4.5-5.0)	2.25±0.02 (2.0-2.6)	2.0±0.04 (1.75-2.25)	0.61±0.002 (0.55-0.65)	0.56±0.004 (0.50-0.60)

In case of *I. paniculata* the petiole length was found to range from 2.5-6.0 cm in the present investigation (Table 4). The values obtained for this character was reported to range from 5.08-12.7 cm in the Flora of British India. Sepal lengths were found to vary from 0.80-0.90 cm long in *I. paniculata*. However, it was slightly higher in the description of Hooker (1885) (Table 2). In case of *I. hederacea*, *I. turbinata* and *I. turpethum* the capsule size were recorded to be 0.90×0.87 cm, 1.75×1.49 cm and 2.25×2.0 cm long, respectively, while the capsule size were reported to be 0.90×0.87 cm in *I. hederacea*, 1.5-2.0×1.5 cm in *I. turbinata* and 1.27×1.91 cm in *I. turpethum* by Hooker (1885) and Khan (1985).

Petiole length of 12.18-18.0 cm and peduncle length of 12.5-16.0 cm were measured for *I. pes-tigridis* (Table 2). *I. pes-tigridis* was characterized by petiole length of 2.54-5.08 cm and peduncle length of 1.27-7.62 cm by Hooker (1885).

In *I. pulchella*, *I. quamoclit* and *I. turbinata* were found to have the leaf, corolla, sepal, capsule and seed characters to be more or less similar with findings reported by Hooker (1885) and Khan (1985). But in case of petiole length the values (7.5-12.0 cm) recorded in case of *I. Pulchella* in the present study differed significantly with the values (2.54-5.08 cm) reported in Flora of British-India by Hooker (1885).

In case of *I. turpethum*, most of the characters were found to be similar with the reports made by Hooker (1885). The leaves were 5.08-12.7 cm in length and the petiole length was 2.54 cm as mentioned by Hooker (1885) and the present findings showed leaves of 12.0-16.0 cm length and that of petiole was 4.0-5.5 cm.

However, the occurrence of the morphological variations qualitative or quantitatively under different environments is dependent upon some ecological and cytogenetical factors. In different species of *Ipomoea* the ecological factors, gene mutation, chromosomal repatterning and possible ploidy level seem to be responsible for morphological diversity, though their genetical diversity attained through a long period of time.

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