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Variation in Morphological and Anatomical Characteristics of some Morning Glory Accessions (*Ipomoea nil* sp.) Collected in Vietnam and China

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Abstract **– A study was conducted to evaluate the variation in morphological, anatomical characteristics among 10 *Ipomoea nil* sp. accessions collected in different regions of Viet Nam and China. Results from the study showed that plants are variable in different stem color, leaf shape, leaf pubescence, leaf lobing patterns, corolla color and size. The significant difference in lateral root diameter, stem diameter, midrib diameter and in tissue thickness such as epidermis, parenchyma, collenchyma of root, stem, leaf midrib and leaf blade anatomy can be used as useful parameters for accession differentiation. Leaf morphology was found among the most variable traits. Leaf shape can be grouped into three categories: (1) simple, ovate cordate, acuminate leaf (GB2, GB5, GB6, GB9, GB10); (2): shallowly lobed, acuminate leaf (GB3, GB4, GB7); (3): deeply lobed, acuminate leaf (GB2 and GB8). Corolla color of all Morning glory accessions can be grouped into three types: (1): blue violet; (2): White; (3): yellow. Leaf blade of all accessions have upper epidermis thickness mostly ranged from 20 to 26 µm (80% of all accessions) and 20% of all accessions have upper epidermis less than 20 µm thick. Parenchyma thickness in stem mostly ranged from 30-40 µm (80% of the accessions). 20% of *Ipomoea nil* sp. accessions were detected with parenchyma thickness less than 30 µm.**

Keywords **– Ipomoea Nil Sp., Morphology, Variation.**

I. Introduction

Convolvulaceae approximately comprises about 60 genera and more than 1650 species [1]. Most of them are ornamental, pharmaceutical important. Convolvulacea includes *Calonyclion, Merremia, Poramia* and *Ipomoea. Ipomoea nil* sp. belongs to *Impomoea* genus, is one of the most common and useful plants with medicinal meaning in Convovulaceae family. *Ipomoea nil* sp. has been known as several common names such as Morning Glory, Japanese morning glory, Pecotee morning glory and Ivy morning glory. In Chinese traditional medicine, *Ipomoea nil* sp. seeds has been used as a key medicine to get rid of edema, sputum, stasis and bloating. Seeds of *Ipomoea nil* sp. were also recognized with the use as purgative drug in folk medicine [2]. Recent biochemical studies of this plant have revealed the existence of medicinal compounds including glycosides [6], gibberellins, flavonoids, chlorogenic acid derivatives [8] and anthocyanins [9] in its seed and flower. In Vietnam, it has also been used in traditional medicine for a long time ago, especially in medicinal dose of treating diuretic, detoxcification, diabetes, less urinating, edema.

Although being recognized with major benefits, this species has not yet been cultivated and studied extensively. Since it mostly developed wildly in nature, productivity and quality of Morning Glory (*Ipomoea nil* sp.) isn't guaranteed. Therefore, understandings of morphological, anatomical characteristics among different morning glory accessions will provide precious information for varitety classification and discrimination among the accessions. The objectives of this research were to examine the variation in morphology of stem, leaf and flower, evaluate the difference in anatomical characteristics of root, stem, and leaf of 10 *Ipomoea nil* sp. accessions.

II. Materials and Methods

Plant Materials

10 Morning Glory (*Ipomoea nil* sp.) accessions collected in different regions in both Viet Nam and China were used in this study (table 2.1)

Experiment Design and Plant Maintenance

The experiment was designed following Randomized Complete Block Design (RCBD) with three replications. An area of $5m^2$ was counted as one replication. Soil was plowed well, free of weed. Good and uniform seeds were selected, completely dried, treated with distill water in 2 hours. Each plot was sowed with 100 seeds. Seedlings were then thinned to maintain a density of 12 plants per $1m^2$. Fertilization was applied with 60 kg N, 120 kgP_2O_5 and120kg K_2O ha^{-1}. Before sowing, 100% of P2O5, 30 % of N, 30% of K2O were applied (basal application).

Top dressing application was divided into: (1) 50% N, 50% K20 (1month after sowing); (2) with: 20% N, 20% K2O (2 months after sowing).

Table 2.1. Information of 10 Morning Glory (*Ipomoea nil* sp.) in the study

Accession	Place of collection
GB1	Phu Tho, Viet Nam
GB2	Bac Ninh, Viet Nam
GB3	Ha Noi, Viet Nam
GB4	Ha Noi, Viet Nam
GB5	China
GB6	Hoa Binh, Viet Nam
GB7	Bac Ninh, Viet Nam
GB8	Hoa Binh, Viet Nam
GB9	Bac Giang, Viet Nam
GB10	China

Measurements

Mature stem color, stem description, leaf blade color, leaf margin and shape, leaf pubescence of fully expanded leaves were recorded at 30DAS. Corolla shape and color were evaluated at peak flower stage and seed color was recorded at harvest. Lateral roots, stem, leaf midrib and leaf blade of

fully expanded leaves were collected at 30DAS and used for root, stem, leaf midrib and leaf blade anatomical measurements.

Data Analysis

- All data collected in the study were subjected to Analyses of Variance (ANNOVA) using EXCEL and IRRISTAT (version 5.0).

III. Results and Discussions

3.1 Morphological Characteristics of some Ipomoea nil sp. *Accessions*

Morphological study is believed to play a central role in species identification and discrimination. Among morning glory species, this is done based on an array of traits and characteristics such as vine production, leaf shape, leaf lobing, stem color, leaf margin and reproductive characteristics [3]. Mature plants of all accessions are categorized with twining stem, densely covered with white hairs and funny-shaped corolla [7], [11]. Results from the study revealed the morphological variation among accessions in stem, leaf and flower (table 3.1). Young stems of all Morning glory accessions were mostly green. However, as the plant reached its maturity, degree of violet color in leaf varied among accessions. Mature stem color among 10 accessions in the study can be classified into 4 main categories: violet green (v>g, includes GB1, GB3, GB5), green violet (g>v, includes GB2, GB7, GB10), violet green (v=g, includes GB8, GB9) and green (GB4). Mature stem color is considered a trait controlled by both genetic material and environmental factors. And thus, this is not seen as a useful trait for species identification and discrimination [3]. Most of the accessions have stem covered with white hair. However, GB4 stem is hairless.

Among three major parts of the plant body, leaf was seen with highest level of morphological variation. Though a similarity in term of leaf blade color (mostly green) and leaf margin (all entire) was recorded in all accessions, high variation was observed in leaf shape and leaf pubescence. Based on leaf shape, three distinct categories were observed: (1) simple, ovate cordate, acuminate leaf (GB2, GB5, GB6, GB9, GB10); (2): shallowly lobed, acuminate leaf (GB3, GB4, GB7); (3): deeply lobed, acuminate leaf (GB2 and GB8). In addition, leaf pubescence was also variable among 10 accessions of *Ipomoea nil* sp. Dense pubescence (both in adaxial and abaxial leaf surface) was seen in GB3 and GB4. However, leaf of GB7 (both in adaxial and abaxial leaf surface) is hairless. Corolla color of all Morning glory accessions can be grouped into three types: (1): blue violet; (2): White; (3): yellow. While the majority of the accessions produced flower with blue-violet corolla, white corolla was observed in GB4 and yellow corolla was recorded in GB7. In recent studies, corolla color and size are more reliable trait used in species identification and discrimination compared to sepal shape [3], [10].

Table 3.1. Morphological characteristics of some *Ipomoea nil* sp. accessions

Accession	Mature stem color	Stem description	Leaf					Corolla shape and color	Seed color
			Blade color	Margin	Shape	Adaxial surface pubescence	Abaxial surface pubescence		
GB1	violet green (v>g)	Vine, medium pubescent	Green	Entire	Deeply lobed, 3 lobes, acuminate	Light	Medium	Funnel shaped. Blue-violet	Dark brown
GB2	green violet (g>v)	Vine, light pubescent	Green	Entire	Simple, ovate cordate, acuminate	Light	Light	Funnel shaped, Funnel shaped, Blue-violet	Dark brown
GB3	violet green (v>g)	Vine, medium pubescent	Green	Entire	Shallowly lobed, 3lobes, acuminate	Dense	Dense	Funnel shaped, blue-violet	Dark brown
GB4	green	Vine, medium pubescent	Green	Entire	Shallowly lobed, 3lobes. acuminate	Dense	Dense	Funnel shaped, White	Dark brown
GB5	violet green (v>g)	Vine, light pubescent	Light green	Entire	Simple, ovate cordate, acuminate	Light	Light	Funnel shaped, blue-violet	Dark brown
GB6	violet green (v>g)	Vine, light pubescent	Green	Entire	Simple, ovate cordate, acuminate	Light	Medium	Funnel shaped, blue-violet	Dark brown
GB7	green violet (g>v)	Vine, hairless	Green	Entire	Shallowly lobed, 3lobes, acuminate	Hairless	Hairless	Funnel shaped, yellow	Light Brown
GB8	green violet (v=g)	Vine, light pubescent	Green	Entire	Deeply lobed, 3 lobes, acuminate	Light	Light	Funnel shaped, blue-violet	Dark brown
GB9	green violet (v=g)	Vine, light pubescent	Green	Entire	Simple, ovate cordate, acuminate	Light	Light	Funnel shaped, blue-violet	Dark brown
GB10	green violet (g>v)	Vine, light pubescent	Green	Entire	Simple, ovate cordate, acuminate	Light	Light	Funnel shaped, blue-violet	Dark brown

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Fig. 4.1. Stem morphological characteristics of some *Pharbitis nil* sp. accessions

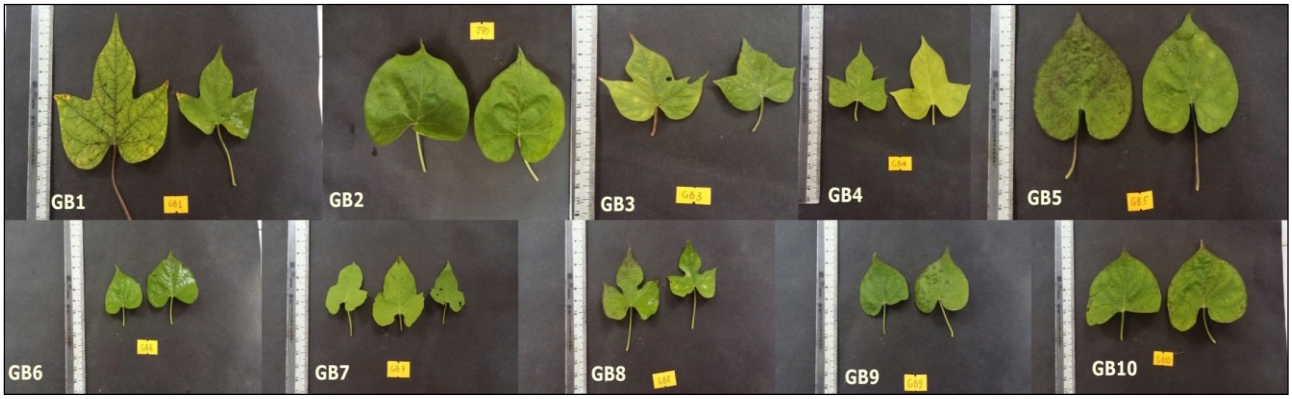

Fig. 4.2. Stem morphological characteristics of some Ipomoea nil sp. accessions

3.2. *Anatomical Characteristics of some Ipomoea Nil sp. Accessions*

Root Anatomy

Ipomoea nil sp. has a typical tap-root system of dicots. Young roots are white, turns brown when mature [11]. The plant is believed to have an extensive root system which can penetrate the soil up to 1m or more. Data in table 3.2 showed the variation in mean diameter, cork cambium thickness, parenchyma thickness, phloem thickness, no. of vascular bundle and xylem thickness of 10 *Ipomoea nil* sp. accessions in the study. Largest lateral root diameter was found in GB4 (2002.75 µm) and smallest value was found in GB7 (666.67 µm), the rest ranged from 666.67 to 1405 µm. Plants were observed with cork cambium thickness ranged from 8.90 to 18.87 µm, parenchyma thickness ranged from 91.10 to 180.00 µm, phloem thickness of 34.43 to 121.67 µm and xylem of 29.43 to 83.33 µm thick. Data from table 3.2 also revealed that number of vascular bundle root^{-1} was among the most variable traits in lateral root anatomy of *Ipomoea nil* sp. accessions in this study. Highest number of vascular bundle was obtained in GB5 (36.00), followed by GB2 (27.67), GB3 and GB9 (25.33). GB6 was the accession with lowest number of vascular bundle root^{-1}.

Stem Anatomy

Stem and root are important in performing functions critical for the growth and survival of plants. Among these, water uptake and xylem transport are greatly important in water loss prevention during transpiration and continued photosynthetic activities [5]. *Ipomoea nil* sp. is characterized by the twisting stem which can trail around the ground surface or spirally twinning around standing objects. The stem of *Ipomoea nil* sp. is believed to be vigorous and rapidly growing and can reach up to 3m in length. Rich and moist soil is considered the favorable condition for the fast and rapid growth of the plant. However the plant can adapt well with most environments. Data regarding stem diameter, epidermis thickness, collenchyma thickness, parenchyma thickness and pith parenchyma thickness were presented in table 3.3. Stem diameter varied among 10 accessions in the study. Largest stem diameter (1902.75 µm) was recorded in GB4 and smallest stem diameter was seen in GB10 (973.67 µm). Stem of 10 *Ipomoea nil* sp. accessions in the study were observed with epidermis thickness ranged from 16.67µm (in GB7) to 40.03 µm (in GB9). Collenchyma and parenchyma thickness are among the most variable stem anatomical traits in this study. Collenchyma thickness of *Ipomoea nil* sp. mostly ranged from 20 to 30 µm. However, lowest value was obtained in GB7 (16.67 µm) and highest value was recorded in GB9 (40.03 µm). Parenchyma thickness mostly ranged from 30-40 µm (80% of the accessions). 20% of *Ipomoea nil* sp. accessions were detected with parenchyma thickness less than 30 µm.

Leaf Anatomy

Data regarding leaf midrib anatomy were presented in table 3.4. A high variation in midrib diameter, upper and lower epidermis thickness, upper collenchyma and lower collenchyma thickness was recorded in all *Ipomoea nil* sp. accessions. Leaf midrib of *Ipomoea nil* sp. was characterized by having midrib diameter ranged from

1583.33 to 2733.33 µm, upper epidermis thickness of 17.77 to 35.00 µm, lower epidermis thickness of 12.77 to 20.00 µm. Largest value of upper collenchyma thickness was found in GB2 and GB5 (211.67 µm), and lowest value was recorded in GB9 (133.33 µm). Lower epidermis thickness of all accessions varied from 12.77 µm (in GB3) to 20.00 µm (in GB8).

Table 3.2. Lateral root anatomy of some *Ipomoea nil* sp. accessions.

Accession	Lateral root anatomy					
	Mean diameter (µm)	Cork cambium (µm)	Parenchyma (µm)	Phloem (µm)	No. of vascular bundle root^{-1}	Xylem (µm)
GB1	772.25	12.77	134.47	55.03	17.33	67.97
GB2	948.67	13.90	101.70	71.13	27.67	76.10
GB3	779.17	12.80	116.67	48.87	25.33	51.10
GB4	2002.75	12.23	91.67	71.10	21.00	48.03
GB5	1405.58	17.80	129.47	121.67	36.00	83.33
GB6	940.25	8.90	180.00	52.20	16.00	53.87
GB7	633.33	18.33	116.13	34.43	14.00	29.43
GB8	784.75	18.33	156.10	63.33	15.33	60.00
GB9	666.67	18.87	91.10	48.87	25.33	51.10
GB10	777.75	17.77	108.90	50.57	15.00	56.70
$LSD_{0.05}$	130.31	4.04	34.56	21.22	3.02	15.88
$CV_{(\%)}$	43.86	1.36	11.63	7.14	1.02	5.34

Table 3.3. Stem anatomy of some *Ipomoea nil* sp. accessions.

Accession	Stem diameter (µm)	Mean thickness (µm)			
		Epidermis	Collenchyma	Parenchyma	Pith Parenchyma
GB1	1562.50	11.13	20.80	33.90	500.00
GB2	1263.83	12.23	36.10	38.90	438.87
GB3	1472.17	10.57	25.57	26.10	471.10
GB4	1902.75	11.13	23.33	31.67	590.00
GB5	1204.17	11.70	28.90	31.67	429.43
GB6	1245.83	15.57	30.57	39.43	391.10
GB7	1102.83	12.23	16.67	41.10	300.57
GB8	1309.75	12.23	22.80	42.77	449.97
GB9	1295.83	10.57	40.03	31.70	416.10
GB10	973.67	10.00	23.33	23.90	341.10

Data regarding leaf blade anatomy of *Ipomoea nil* sp. was given in table 3.5. Results from the table revealed that leaf blade anatomy can be seen with a high variation in upper epidermis and lower epidermis thickness, chlorenchyma and spongy mesophyll thickness. Leaf blade of all accessions have upper epidermis thickness mostly ranged from 20 to 26 µm (80% of all accessions) and 20% of all accessions have upper epidermis less than 20 µm thick. Lower epidermis thickness was largest in GB6 (22.23 µm) and lowest in GB9 (11.7 µm).

Table 3.4. Leaf midrib anatomy of some *Ipomoea nil* sp. accessions.

Accession	Mean thickness (µm)				
	Midrib diameter	Upper epidermis	Upper Collenchyma	Lower collenchyma	Lower Epidermis
GB1	2179.17	17.77	203.33	40.00	13.30
GB2	2391.67	31.13	211.67	43.90	19.43
GB3	2058.33	22.23	180.00	36.10	12.77
GB4	1858.33	20.57	143.33	40.00	14.47
GB5	2170.83	29.47	211.67	27.20	15.00
GB6	1683.33	20.53	135.00	26.67	13.37
GB7	1583.33	23.30	203.33	49.47	15.57
GB8	2566.67	35.00	206.67	43.33	20.00
GB9	1670.83	25.57	133.33	31.67	16.67
GB10	2733.33	35.00	198.33	74.43	18.90
$LSD_{0.05}$	505.08	8.50	50.52	20.03	4.77
$CV_{(\%)}$	170.00	2.86	17.00	6.74	1.61

Table 3.5. Leaf blade anatomy of some *Ipomoea nil* sp. accessions.

Accession	Mean thickness (µm)			
	Upper Epidermis	Chlorenchyma	Spongy Mesophyll	Lower Epidermis
GB1	18.90	44.43	70.53	13.90
GB2	20.00	38.87	66.10	15.00
GB3	21.10	46.10	53.33	15.00
GB4	26.13	46.70	95.57	18.33
GB5	24.47	36.13	73.90	16.10
GB6	23.87	42.20	84.47	22.23
GB7	22.23	30.57	53.87	15.57
GB8	24.43	41.13	77.23	18.33
GB9	23.33	48.30	38.30	11.70
GB10	17.77	40.00	51.70	14.97
$LSD_{0.05}$	4.20	13.14	22.05	5.00
$CV_{(\%)}$	1.41	4.42	7.42	1.68

IV. CONCLUSIONS

A high variation in morphological characteristics was found in 10 *Ipomoea nil* sp. accessions in the study. Plants existed in different stem color, leaf shape, leaf pubescence, leaf lobing patterns, corolla color and size. Regarding to anatomical variation, the significant difference in lateral root diameter, stem diameter, midrib diameter and in tissue thickness such as epidermis, parenchyma, collenchyma of root, stem, leaf midrib and leaf blade can be used as useful parameters for accession differentiation. Leaf morphology was found among the most variable traits. Leaf shape can be grouped into three categories: (1) simple, ovate cordate, acuminate leaf (GB2, GB5, GB6, GB9, GB10); (2): shallowly lobed, acuminate leaf (GB3, GB4, GB7); (3): deeply lobed, acuminate leaf (GB2 and GB8). Corolla color of all Morning glory accessions can be grouped into three types: (1): blue violet; (2): White; (3): yellow. Leaf blade of all accessions have upper epidermis thickness mostly ranged from 20 to 26 µm (80% of all accessions) and 20% of all accessions have upper epidermis less than 20 µm thick. Parenchyma thickness mostly ranged from 30-40 µm (80% of the accessions). 20% of *Ipomoea nil* sp. accessions were detected with parenchyma thickness less than 30 µm.

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