

## MORPHO-PHYSIOLOGICAL CHARACTERIZATION AND PETAL COLOR ANALYSIS OF *GLORIOSA* AS A POTENTIAL CUT FLOWER

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### Abstract

The study was conducted at Horticulture Farm, Sher-e-Bangla Agricultural University, Dhaka, during the period of January-December, 2021 to observe the morpho-physiological characteristics of *Gloriosa* lily with respect to growth and flowering. Thirty tubers were used in this experiment and data on morphological attributes were recorded. The colors of flowers petals were measured from three floral parts and expressed as L\* (lightness), a\* and b\* (two Cartesian coordinates) including C\* and h<sub>ab</sub> (Chroma & Hue angle) based on CIE Lab scale with standard observer 100 and standard illumination D65. On the basis of flower length (7.7 cm), flower diameter (13.5 cm), leaf number per stem (26-28), flower per plant (13-15), vase life (10-12 days) explore the criteria of a cut flower and obviously this flower has the potential edition for flower industry. The study provides key indicators of *Gloriosa* to be a potential cut flower for which research be directed.

**Keywords:** CIE Lab, Floral character, Flower industry, *Gloriosa rothschildiana*.

### Introduction

*Gloriosa* is an eye-catching climber with unusual and charming red-yellow colored flower which looks like flame. *Gloriosa rothschildiana* species belongs to *Gloriosa* genus of Colchicaceae family. *Gloriosa* refers to full of 'glory'. *Gloriosa* lily has some other common names like glory lily, fire lily, flame lily, climbing lily, creeping lily, and cat's claw or tiger's claw. The origin of this flower mostly is in the jungle of Asia and Africa. *G. rothschildiana* is mainly known as a major high value medicinal crop. Seeds and tubers of *Gloriosa* species contain valuable alkaloids viz., colchicine and colchicoside, which are used to treat gout and rheumatism. But now it has become a popular ornamental flower in many homes and gardens. The important species found in Bangladesh are *G. superba* and *G. rothschildiana*. The physical characteristics of this flower has quite disparity than most other flowers. It is a nodding flower where petals are upward and backward leaving the stamen and ovary hanging at the bottom. However, it has already verified itself as a new cut flower in the floriculture industry. Several genera of Colchicaceae such as *Gloriosa* plants recently become popular worldwide as cut flowers because of their beautiful, unique flowers and good vase life (Nakamura *et al.*, 2005). Preliminary studies have indicated that in cooler conditions it may be possible to produce stems with the good length, strength, flower color and vase life which make

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*Gloriosa* suitable as a cut flower (Morgan *et al.*, 2003; Eason *et al.*, 2001). Flower cultivation has emerged as a lucrative business in Bangladesh also along with other agricultural crops. Demand for cut flowers in our local market as well as international market is flourishing gradually (Rakibuzzaman *et al.*, 2018). The positive attitude of respondents toward flowers, multipurpose uses of flowers, increasing uses of flower made products and an unsatisfied demand of some flowers are all positive indicators of the business boom (Mou, 2012). Evaluation of various cut flowers is now time demanding and need them to explore the flower industry (Uddin *et al.*, 2013). It is quite suitable for flower arrangements in bouquet and it has quite good vase life (7-8 days) also. In Bangladesh, no precise or systemic research has been done yet about *Gloriosa* lily as a cut flower. The objectives of this experiment were to study the morpho-physiological characteristics and petal color of *G. rothschildiana* and to find the quality of cut flower which could be valuable to future cut flower industry in Bangladesh.

## Materials and Methods

The experiment was conducted at the Horticulture Research Field of Sher-e-Bangla Agricultural University, Dhaka, from January to December, 2021. The location of the site was 23<sup>0</sup>74' N latitude and 90<sup>0</sup>35' E longitudes with an elevation of 8.2 meter from sea level and in the Agro-Ecological Zone of Madhupur Tract (AEZ No. 28). Thirty *G. rothschildiana* tubers, weighing 10-15 g, were planted in furrows of at a distance of 30 cm apart and covered with soil. The soil pH was 6.0-6.5. Cowdung @ 8 t ha<sup>-1</sup> and vermicompost @ 5 t ha<sup>-1</sup> were applied in the furrows. Management included irrigation as required. The selected plants were labeled for observing the characters that included morphological study. The stems of flower were harvested just above the second branch when the second flower had reached to anthesis and some were kept in plants where hand pollination was done to produce seed. Observations were made on several morpho-physiological characters viz., plant height, number of branch, number of leaf/stem, leaf length, leaf breadth, number of flower/plant, fruit length, number of seeds, tuber weight, number of tepal, length of tepal, breadth of tepal, number of stamen, length of stamen, length of style, pedicel length, flower diameter, flower weight, chlorophyll content, vase life, seed content in fruit, fruit weight. Measurement of the petal color attribution was conducted using CIE Lab colorimeter. The colors of the *Gloriosa* lily were measured and expressed through L\* (lightness), a\* and b\* (two Cartesian coordinates) including C\* and h<sub>ab</sub> (Chroma & Hue angle) based on CIE Lab color scale with standard observer 100 and standard illumination D65 by using precision colorimeter IWAVE WF32.

## Results and Discussion

### Plant observation

*Gloriosa rothschildiana* was semi-woody herbaceous, fibrous root, deciduous, summer growing, durable creeper with an average height of 2.0-3.0 m at mature stage (Table 1). It developed from tuberous underground stem during the rainy season. The dimensions and branching pattern of the plants were strongly correlated with tuber weight. As being climber glory lily required support in the form of trellis.

### Leaf observation

The woody plant leaves were deciduous in characters found shiny bright green, sessile, 1-2 cm long, leaf feel smooth, simple types and were tipped in a short tendril (Fig.1A) which readily clung to anything as it touched and assisted the plant to climb up over vegetation. Leaves were alternately arranged and whorled with a prominent midrib, ovate-lanceolate in shape (Fig.1B), leaves were 26.0-28.0 in number on average where no hairs found, leaf length 12.3 cm, leaf breadth 2.8 cm, SPAD value of leaves measured ranges 39.3-43.3 (Table 1).

### Tuber

The fresh tuber weighed in the range of 40-60 g in this study (Table-1). *Gloriosa* tubers sprouted within 10 days after planting. Two to four stems developed from single V-shaped fleshy cylindrical tubers which looked like a plough and tubers had hairy roots (Fig. 2A). Flower number, pod number and number of seed per pod were highly related to tuber size and weight.

### Days for completion flower phase

Completion of flowering phases started from bud to mature flower was found to be 17-21 days, on average (Table 1).

**Table 1.** Plant morphology and floral morphology of *Gloriosa rothschildiana*

Plant Morphology		Flower Morphology	
Characters	Dimensions	Characters	Dimensions
Plant height (m)	2.0 - 3.0	Number of tepal/rays	6.0
Number of branch	3.0 - 4.0	Length of tepal (cm)	6.8
Number of leaf/Stem	26.0 - 28.0	Breadth of tepal (cm)	2.1
Leaf length (cm)	12.30	Number of stamen	6.0
Leaf breadth (cm)	2.80	Length of stamen (cm)	5.1
SPAD value	39.3 - 43.3	Length of style (cm)	5.2
Days to flowering from bud initiation (days)	17 - 21	pedicel length (cm)	11.2
Number of Flower/plant	13.0 - 15.0	Flower length (cm)	7.7
Fruit length (cm)	5.0 - 5.6	Flower diameter (cm)	13.5
Number of Seeds/fruit	25 - 35	Flower weight (g)	1.65
Tuber Size (cm)	12	Vase Life (days)	10-12
Tuber weight (g)	40.0 - 60.0		

### Flower observation

Flowers bloomed during morning hours after the onset of sun and Lily like flowers on long stalks, 6-parted, yellow or red with wavy margins. The perianth segments become reflexed after anthesis (Fig. 3A). The beautiful-looking petals reflexed at 180<sup>0</sup> from bud to blooming stage (Fig. 3B). In this investigation on floral morphology, the flower was both self and cross pollinated. To overcome the barrier of pollination flowers developed fully on a branch and they opened in a sequential manner (Rajamani *et al.*, 2015).

The top half of the tepal remained orange-red and from the middle to base was yellow in pollinated flowers. As the flower aged, the tepals became entirely reddish orange (Fig. 3B). It takes 17-21 days to withering as flowers from bud initiation. The average number of flowers 13-15 was per plant. Flowers were harvested at both young and mature stage for further observation. It had striking orange-yellow bi-colored with their wavy, curling margins, and they looked like fire flames (Fig.1A) at mature stage. The flower weight was 1.65 g, and flower inflorescences was mainly flower head where head diameter was recorded (13.5cm) with 6 tepals (3 sepal + 3 petal) having the length of 6.8 cm (on average), breadth of petal 2.1 cm, bearing 6 stamens (on average 5.1 cm), oblong - linear anthers and a style (5.2 cm) which split into 3 short segments at the tip, vase life in normal water recorded 10-12 days (Table 1) make cup shape and (Fig 4. A-B). The style and stamen bent almost 90<sup>0</sup> at the attaching point of ovary. The flower had greenish 12.2 cm long pedicel (Table-1) which also bent almost 90<sup>0</sup> ending at the ovary. The green ovary enlarged as seeds produced inside. Flower number varied from 13-15 in numbers (Table- 1).

### Fruits

*Gloriosa* fruits were large, fleshy, oblong and 3 valve capsules (Fig. 2B) which were recorded as 5.0-5.6 cm long and 1.8 cm wide that turned from green to yellow and eventually dark brown as they matured (Table-1). It also looked like Jalapeno peppers. These fruits contained numerous seeds approximately 25-35 in number. Seeds were generally 4-5 mm in diameter, rounded or egg-shaped and surrounded by a fleshy, red cover (Fig. 2B).

### Colorimetric measurement using CIELab colorimeter

The colorimetric measurement of the *Gloriosa* lily under study was conducted using a precision colorimeter IWAVE WF32 (Shenzhen Wave) and L\* (lightness), a\* and b\* (two Cartesian coordinates) including C\* and hab (Chroma & Hue angle) based on CIELab color scale with standard observer 100 and standard illumination D65 (Mc Guire, 1992) (Table 2). The major anthocyanidins control the color variation of lisianthus petals and their cumulative quantities by extending chromas to individual color direction (Uddin *et al.*, 2002).



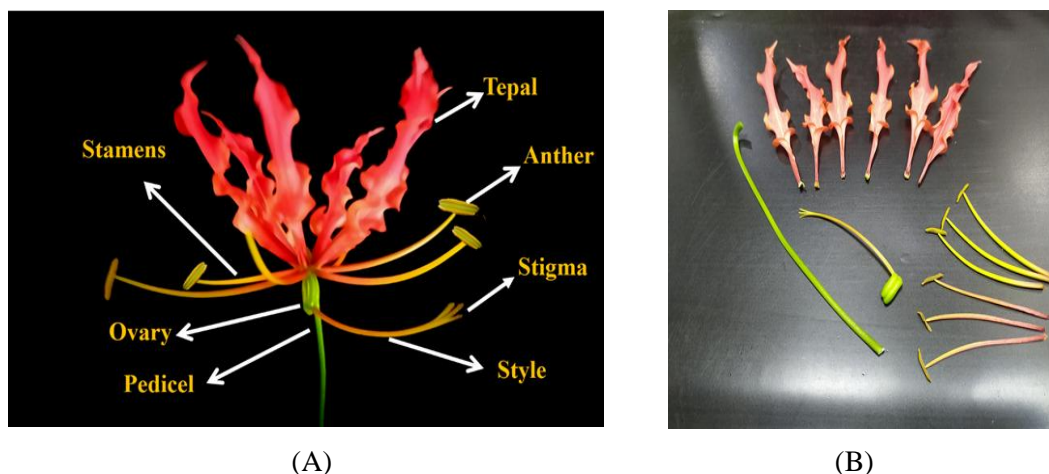
**Fig. 1.** A) Single stem with flower and leaves of *Gloriosa*, B) Leaves with tendrils at different stages



**Fig. 2.** A) Single tuber of *Gloriosa rothschildiana*, B) Seeds of *Gloriosa rothschildiana* fruit






**Fig. 3.** A-B) Flower developmental stages of gloriosa, C) Petal reflexed at 180° from bud to full boom



**Fig. 4.** A) Different parts of *G. rothschildiana*, B) Dissection of the *G. rothschildiana* flower

**Table 2.** Tepal color attributes in *Gloriosa rothschildiana*

L*	a*	b*	c*	hab	Color Name	Illustration
37.10	36.13	30.30	47.15	39.99	Reddish Orange	
43.32	54.96	56.52	78.83	45.81	Light Brown	
42.29	42.82	26.89	50.56	32.13	Bright Yellow	

## Conclusion

From the above morphological and colorimeter analysis, it can be concluded that *Gloriosa* has potential quality as cut flower and therefore, could be popularized as commercial flower. Furthermore, having demand of colorful, new flower and several morphological traits would be the excellent edition in flower sector for researchers for more research as well as flower industry in local market and international market.

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