



Nectar Dynamics and Chemical Composition of an Ornamental Plant *Ixora coccinea* L. (Rubiaceae)

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Abstract

The present paper deals with the study of flowering phenology, flower dynamics, nectar production and chemical composition of *Ixora coccinea* L. (Rubiaceae).

Ixora coccinea L. is an attractive plant cultivated as an ornamental plant. The flowering is throughout the year but the full bloom was observed during August to October and March to June. Flowers are in borne in dense corymbose cymes. The flowers are bright red with long, slender corolla tube. Flowers produce small quantity of nectar. The amount of nectar from flowers was recorded after every two hour interval from 08.00-18.00hrs. Flowers secreted on an average volume of nectar 2-3 μ L. The nectar secretion was maximum in the morning hours. The average nectar sugar concentration was found to be 17-23%. Nectar is composed of presence of two sugars sucrose and fructose. Four amino acids were detected. Sunbirds, and butterflies were found to be the visitors of flowers. Butterflies were the dominant visitors of the flowers. Sunbirds foraged throughout the day but peak foraging activity during morning hours. Sunbirds and butterflies foraged for nectar only.

Keywords: Nectar, Sugars, *Ixora coccinea*, Amino acids

Introduction

Nectar production plays a vital role in the pollination of most ornamental plants. It has therefore been assumed that the sugar constituents are a major factors in determining the attractiveness of flowers to pollinators (Faegri and van der Pijl 1979, Southwick et al 1981). Floral nectars are aqueous sugar solutions, containing mono and disaccharides as well as amino acids, lipids, proteins, mineral salts and vitamins (Baker and Baker, 1983). Nectar sugar concentration may also affect visitor preference or association (Hainsworth and Wolf, 1976; Schondube and Martinez, 2003). Nectar concentration is highly influenced by environmental factors, especially temperature and humidity (Nicolson and Nepi, 2005). Nectar composition may be conservative due to phylogenetic constraints (Galletto et al 1998); however, some nectar traits may be subject to ecological factors imposed by the habitat (Stiles and Freeman 1993; Petanidou, 2005).

The ornamental plant *Ixora coccinea* selected in this study is the most cultivated garden and landscape plants belonging to the family Rubiaceae in the Asian region. *Ixora coccinea* is a native shrub of Southern India, Bangladesh and Sri Lanka but it is widely planted in other Asian regions for its showy corollas (Mouly et al. 2009). *Ixora coccinea* is a green, much branched shrub notable for its bright red coloured flowers which are composed of many small blooms massed together into dense flower heads.

Thus, the aim of the present study was to determine the nectar secretion and nectar composition of *Ixora coccinea*.

Material and Methods

Study Area

The present study was carried out in college campus of Shri Shivaji Arts, Commerce and Science College, Akot situated in Akola district of Maharashtra during November to March 2023.

Floral Phenology

A cultivated plants of *Ixora coccinea* in college campus was chosen for observations.

To determine the phenology of flowers, two individual plants were selected and the flowering period patterns and the peak period of flowering were recorded. From each plant five to ten inflorescence were tagged and observations were made for five days during the flowering period to record the time of anthesis and anther dehiscence.

Nectar Analysis

The time of nectar secretion was noted during the peak flowering period. The amount of nectar from ten flowers was recorded at 2 hrs intervals during the flowering period. Nectar was extracted with microcapillaries and were used to note the amount of nectar secreted. Nectar concentration was determined by using a hand held sugar refractometer (Erma Japan). For the analysis of sugars and amino acids fresh nectar samples were used. The sugars present in nectar were studied by using thin layer chromatography. Nectar sample was loaded on the plate along with standard sugars sucrose, glucose and fructose. Later the plates were run in a solvent prepared by mixing butanol 4 parts + Acetic acid 1 part + distilled water 5 parts (4:1:5). After solvent run the silica gel plate was allowed to dry, sprayed with 1% aniline, 1% diphenylamine and 85% orthophosphoric acid prepared in 100ml acetone. For amino acid detection solvent prepared by mixing n-butanol + acetic acid + water (80:20:20) and sprayed with 0.1% solution of ninhydrin in acetone. A chromatogram for twenty four amino acids was developed as a standard for identification, the colour characters were used to identify the amino acid and sugars present in the nectar.

Insect visitors

Observations were made on the type of flower visitors during the peak flowering period. The duration of visits and number of flowers visited was noted.

Results

Floral Biology

In *Ixora coccinea* flowering occurs throughout the year but the peak periods of flowering was observed during September to November and from March to June. The inflorescence is dense corymbose cyme and produces 60-70 flowers per inflorescence. For each day the number of opened flowers of an inflorescence varies from 10-12 during peak period of flowering. Flowers open daily during 6.00 to 7.00 hrs with its peak at 7.00 hrs. Flowers tetramerous, actinomorphic, bright red and epigynous. Corolla tube long and slender. Anther dehiscence was observed between 7.00 hrs. Anther dehisces by longitudinal slitting. Each flower cluster lasted for three to four weeks.

Nectar Analysis

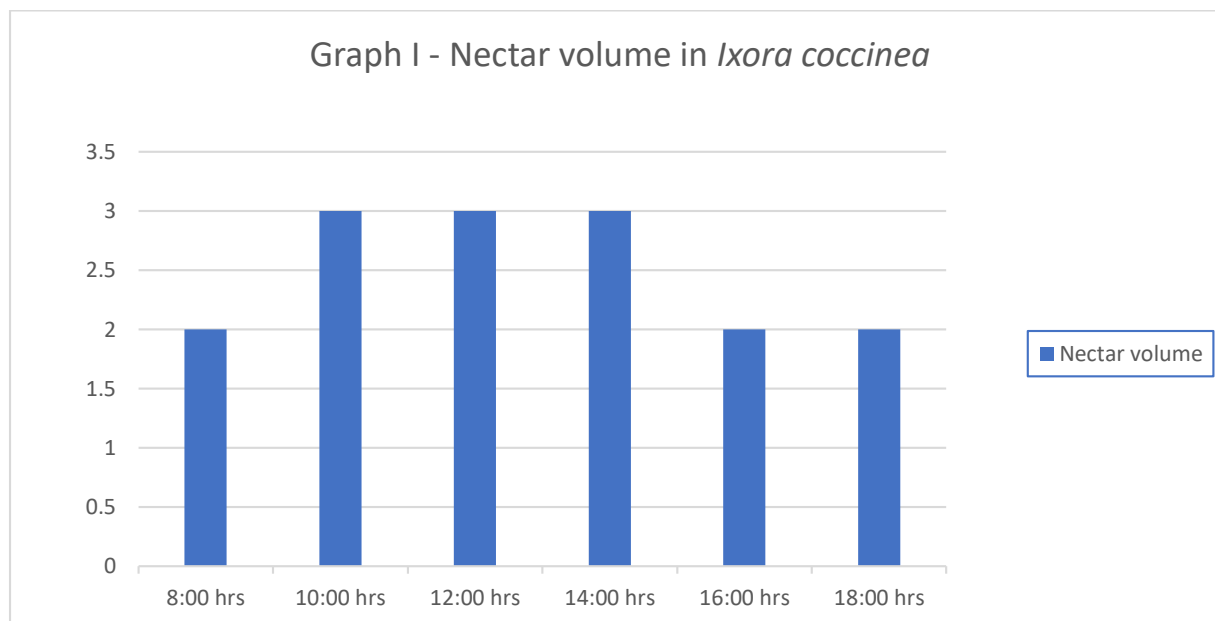
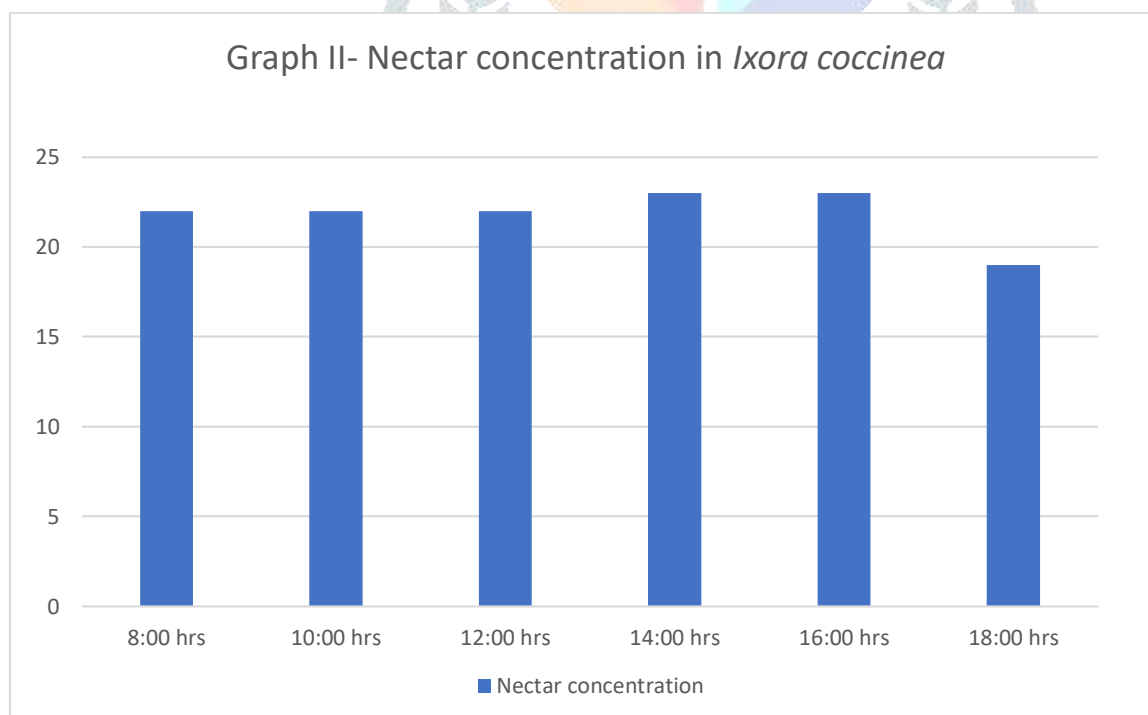
A nectar is secreted from surrounding the basal portion of style and nectar is collected in the corolla tube. Nectar secretion begins during anthesis. The quantity of nectar was measured on the day of flower opening at two hours intervals between 08.00 and 18.00 hrs. Nectar is thin and, on an average, the total amount of nectar measured in flower was 2-3 μ L (Table 1). Maximum nectar production occurred during 11.00-12.00 hrs. In *Ixora coccinea* nectar concentration was observed 19-23 % (Table 1). Fluctuations in the nectar concentration was observed during study. The two nectar sugars sucrose and fructose were identified. Four amino acids DL-alanine-Leucine, DL-Phenylalanine and L-Proline were detected from nectar.

Flower Visitors

In *Ixora coccinea* sunbirds and butterflies were found to be the visitors of flowers. A dense cluster of flowers and dark red colour flowers butterflies are attracted towards the flowers. Most abundant and frequently visiting visitors of the flowers were butterflies. Maximum visitation of butterflies occurred between 09.00 hrs and remains active upto 12.00 hrs. Butterflies forage for nectar and visits 3-4 flowers in one bout. Sunbirds collect the nectar from corolla tube and visits 1-2 flowers in one bout.

Table 1. Nectar volume and nectar concentration in *Ixora coccinea*

Time	Nectar volume	Nectar concentration
8.00 hrs	2 μ L	22%
10.00 hrs	3 μ L	22%
12.00hrs	3 μ L	22%
14.00 hrs	3 μ L	23%
16.00 hrs	2 μ L	23%
18.00 hrs	2 μ L	19%

Graph I - Nectar volume in *Ixora coccinea***Graph II- Nectar concentration in *Ixora coccinea***



Inflorescence of *Ixora coccinea*



Sunbird collecting nectar from flower

Discussion

The results obtained and the observations made in respect of *Ixora coccinea* was discussed. *Ixora coccinea* flowers are actinomorphic, tetramerous, epigynous, tubular and corolla tube is long, slender. *Ixora coccinea* flowers are tubular flowers, which are upto 5cm long and fiery red, open at the mouth into four petals arranged in the form of a cross about a centimetre wide. The entire flower head has a diameter of 8-12 cm. So the butterfly mouthpart fits with the flower structure, this is in conformity with the findings reported by Muthoka and Mananze, Schemske (1976); Weiss (1995) who stated that butterflies were most potent pollinator of flowers like *Lantana* and *Ixora*. From the above study it was seen that butterflies were the most abundant visitors of the flowers. No bees were observed to visit the flowers. Previous studies by Kato et.al. (2008) and Duara (2014) reported a contrast in that lepidoterans from four different families; Papilionidae, Pieridae, Nymphalidae and Lycaenidae were the main flower visitors of *Ixora coccinea*. With their long proboscis, these butterflies could collect nectar from the long tubular *I. coccinea* flowers and therefore visited the flowers to feed. Similar observations were found during the study. Nimbalkar et.al. (2011) argued that butterflies were more likely to visit flowers that have tubular corolla than flowers that have other shaped corollas.

References

- Baker, H.G., Baker I. 1983. A Brief Historical overview of the Chemistry of Floral nectar. B. Bentley and T.S. Ilias. IN: *The biology of nectaries*. Columbia University Press, New York.
- Faegri, L., Van der Pijl, L. 1979. *The Principles of pollination ecology*. IIIrd ed. Pergamon Press, Oxford.
- Galetto, L., Bernardello, G., Sosa C.A. 1998. The relationship between floral nectar composition and visitors in *Lycium* (Solanaceae) From Argentina and Chile: what does it reflect? *Flora* 193 303-314
- Hainsworth, F. Reed, Larry Wolf 1976. Nectar characteristics and food selection by hummingbirds. *Oecologia* 25, 101-113
- Kato, M., Kosaka, Y., Kawakita, A., Okuyama, Y., Koobayashi, C., Phimminith, T. and Thongphan, D. 2008. Plant - pollinator interactions in tropical monsoon forest in Southeast Asia. *American Journal of Botany*, 95(11), 1375-1394.

- Mouly, A, Razafimandimbison, S, Khodabandeh, A, Bremer, B 2009. Phylogeny and classification of the species rich pantropical showy genus *Ixora* (Rubiaceae- Ixoeae) with indications of geographical monophyletic units and hybrids. *American journal of Botany*. 96(3):686-706
- Muthoka,C.N.,Mananze,S.1976.Aspects of the pollination biology of *Lantana camara* (Verbenaceae)
- Nicolson, SW, Nepi, M.2005.Dilute nectar in dry atmospheres: nectar secretion patterns in in *Aloe castanea* (Asphodelaceae). *International journal of plant sciences* 166;227-233
- Nimbalkar, R.K., S.K. Chandekar and S.Khanke 2011.Butterfly diversity in relation to nectar food plants from Bhor Tahsil,Pune District, Maharashtra ,India.*J.Threatened Taxa*,3:1601-1609.
- Petanidou,T.2005.Sugars in Mediterranean floral nectars : an ecological and evolutionary approach.*J.ChemEcol*.31,1065-1088.
- Schondube,Jorge E.,Carolus Martinez del Rio 2003.Concentration -dependent sugar preferences in nectar -feeding birds:Mechanisms and consequences. *Functional Ecology*.17(4):445-453
- Southwick,E.E.,G.M.Lopar and S.A.Sadwick 1981.Nectar production,composition,energetics and pollinator attractiveness in spring flowers of western New York.*Amer.J.Bot*.68;994-1002.
- Stiles Gary F. and Freeman Edward C.1993. Patterns in floral nectar characteristics of some bird visited, plant species from Costa Rica. *Biotropica* Vol 25 PP 191-205.
- Weiss ,M.R.1995.Floral colour change : a widespread functional convergence.*American Journal of Botany* 82:1671-1685.

