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Taxonomical characterization of *Bixa orellana* L. growing in Ranchi district

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Abstract- *Bixa orellana*, commonly known as sinduri or the lipstick tree, belongs to the family Bixaceae. It is widely utilized in the dye, textile, paint, cosmetic, and food industries. The present study was conducted to investigate the morphological and anatomical characteristics of *Bixa orellana* L. The results revealed that the plant is a shrub or small tree reaching a height of 10-20 ft, with simple leaves and pedicellate, terminal inflorescences. The flowers are actinomorphic and hypogynous with numerous stamens, while the seeds are covered with soft spines. Anomocytic stomata are present on both surfaces of the leaves, and calcium oxalate crystals were also observed in the plant tissues. The significance of this study lies in providing an accurate identification, anatomical and morphological characterization helps prevent adulteration and ensures the reliability of raw plant material used in various industries.

Keywords: Taxonomical characters, Stomata, maceration

INTRODUCTION

Researchers are particularly interested in traditional medicinal plants because they can be used to create new medications and therapeutic products.¹ One such plant is *Bixa orellana*, which is used by many ethnic communities as a natural dye and as a traditional medicinal species.² Often called achiote, lipstick tree, or annatto, it is a member of the Bixaceae family. Usually reaching a height of 3 to 10 meters, this shrub or small perennial tree produces reddish-brown fruits, pink or white flowers, and reddish triangular seeds.^{3,4} Traditionally, *Bixa orellana* has been used in folk medicine to treat skin ailments, wounds, fevers, stomach disorders, and infections. Its leaves, seeds, and roots were applied as poultices, teas, or decoctions for inflammation, digestive issues, respiratory problems, and urinary infections.^{5,6}

The scientific investigation of this plant is still lacking in Jharkhand. Therefore the aim of the present study is to identify and examine the morphological and anatomical characteristics of *Bixa orellana* L. from Ranchi.

METHODS

Collection and authentication

The plant used in this research was collected from Birsa Agriculture University, Kanke, Ranchi, Jharkhand with coordinates of latitude 23.444730 and longitude 85.313917 during the flowering and fruiting seasons from September to November 2022-2023. The collected sample verified in the form of herbarium from the Central National Herbarium, Botanical Survey of India, Howrah, West Bengal.

Macroscopic Study

Healthy plant parts were collected from their natural habitat, and the morphological characteristics of each part including leaf arrangement, floral structures, fruits, and seeds, were observed and systematically recorded.

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Microscopic Study

Plant material was sectioned with a razor blade, transferred to water, the thinnest section was selected and placed on a slide, stained by safranin, covered with a slip to avoid air bubbles, and observed under a microscope.⁷

Maceration

Thin layer of stem cut and boiled into 10% nitric acid and 10% chromic acid and then washed with distilled water and studied into a microscope.⁸

Stomatal Index

The ventral and dorsal leaf surfaces (apex, middle, and base) were peeled with a blade and brush, stained with safranin, mounted in glycerin, and the number of stomata and epidermal cells on both sides were counted under a compound microscope at 40 X × 10 X magnifications. Stomatal index per square millimeter were also investigated by this formula.⁹

$$S.I. = \frac{S}{S + E} \times 100$$

Where, S.I. = Stomatal Index

S = Number of Stomata per unit area

E = Number of Epidermal cells per unit area

RESULT

Plant details

Scientific Name: - *Bixa orellana* L.

Common Name: - Lipstick tree, sinduri, sindur

Botanical classification : -

Kingdom	Plantae
Phylum	Streptophyta
Class	Equisetopsida
Subclass	Magnoliidae
Order	Malvales
Family	Bixaceae
Genus	<i>Bixa</i>
Species	<i>Bixa orellana</i>

Taxonomical Characters

Habitat: it is an evergreen shrub or small tree, about 15-20ft in height, trunk upto 20 to 50 cm in diameter.

Leaf: leaves simple, stipulate, ovate, 21.71±1.73 cm in length and 12.92±1.00 cm in breadth, shallowly cordate at base, acute at the apex, dark green in abaxial side and light green in adaxial side of leaf, reticulate venation, petiole and size 8.98±0.91 cm long.

Bark: it is light to dark brown in colour, smooth, tough, lenticellate. Inner side of bark red or orange in colour

Flower: white-pinkish colour, 8-15 flowered, corymbose panicles, scaly, pedicel 3.94±0.35 cm long, bisexual, actinomorphic. Corolla - 5 petals, quincuncial (2 internal, 2 external and one partly), unequal shape, corolla rotate, 2.5cm long. Calyx- 5 sepals, concave covered with reddish brown colour scales, 1.5±0.33 cm long.

Androecium- numerous stamens, filaments filiform, united at base with yellow base and pinkish apex, 1.00±0.44 cm long, anther ditheous, basifixed.

Gynoecium- style thickened upwards, 12-15mm long, one celled, superior ovary, Parietal placentation, 2 locule, numerous ovule, ovary more or less globose.

Fruits- Fruits covered with aril or capsule. Premature aril green and mature aril reddish in colour. spherical or broadly elongated ovoid capsule, numerous seed present in capsule, smooth, angular and flattened apex 2-4 * 3-2.5 mm size of seed.



Fig. 1:- Habitat



Fig. 2:- Adaxial leaf



Fig. 3:- Abaxial leaf



Fig. 4:- Bark (Outer)



Fig. 5:- Bark (Inner)



Fig. 6:- Fruit

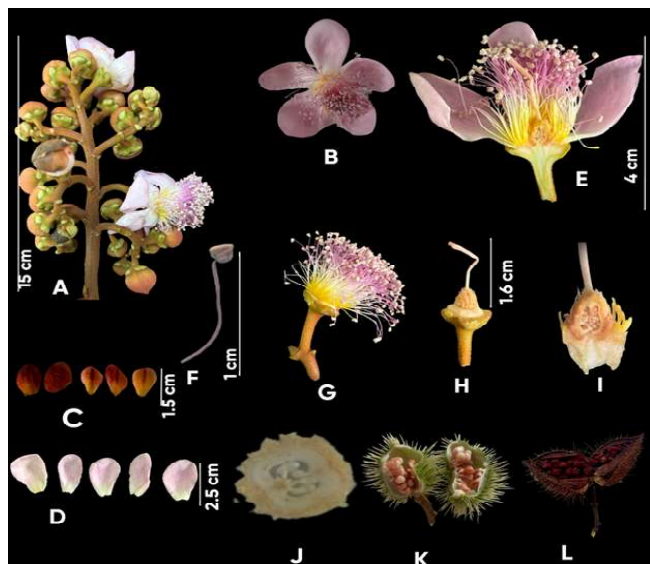


Fig. 7:- (A) Inflorescence, (B) Flower, (C) Calyx, (D) Corolla, (E) L.S. of Flower, (F) Anther, (G) Androecium, (H) Gynoecium, (I) L.S. of Ovary, (J) T.S. of Ovary, (K) Pre-mature fruit, (L) Mature fruit

Anatomical study

(i) Transverse section of leaf

In transverse section, epidermal cells were compactly arranged, covered with thick cuticle, Palisade cell just below the epidermis and compactly arranged, 2-4 layers of collenchymatous cells and 6-9 layers of parenchymatous cells. Phloem situated at the periphery and xylem toward the centre and this vascular bundles surrounded by sclerenchymatous cells. Calcium oxalate present in leaf region (fig. 8 & 9).

(ii) Transverse section of petiole

In transverse section of petiole, single and thin layered barrel shaped epidermal cells. Cortical region enlarge at centre which consist of two to three layered of collenchymatous cell and five to six parenchymatous cell. Vascular bundles were arranged in concentric ring, phloem surrounded by xylem. Calcium oxalate are seen in petiole (fig. 10 & 11).

(iii) Transverse section of stem

The upper epidermal cell was compact with parenchymatous cell, rectangular shape and it covered with thick cuticle layer. Collenchyma tissue was just under the epidermis. The cortex was consisting of parenchymatous tissue with air spaces. Vascular bundles conjoint, collateral and open type. Pith was large parenchymatous and contains some crystal deposition at the corners of the cells (fig. 12 & 13).



Fig. 8:- T.S. of leaf (10x)



Fig. 9:- T.S. of leaf (40x×10x)

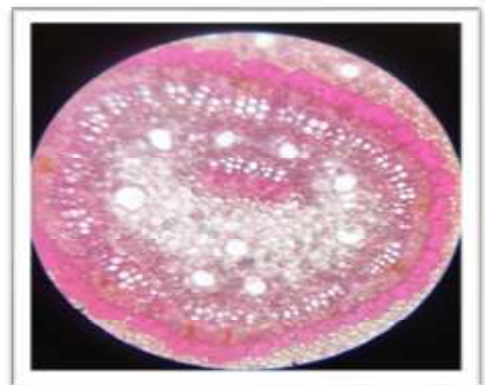


Fig. 10:- T.S. of petiole (40x×10x)



Fig. 11:- T.S. of petiole (40x×10x)



Fig.12:- T.S. of stem(10x)

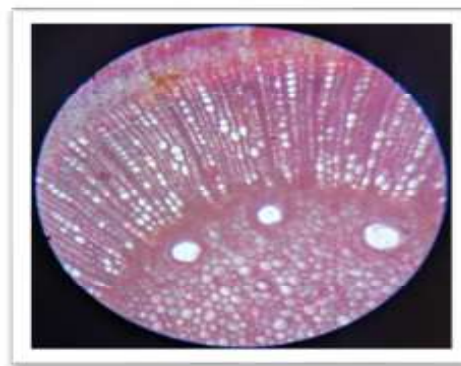


Fig. 13:- T.S. of stem(40x10x)

Stomata and Stomatal index

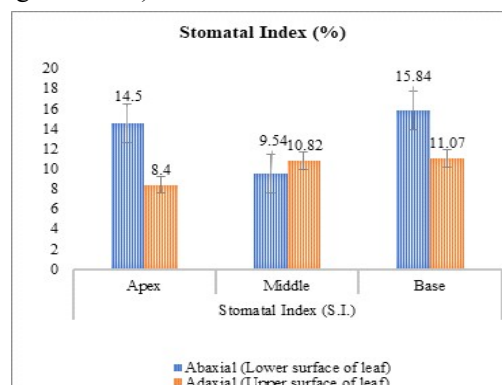
The abaxial surface of stomatal index of *Bixa orellana* leaf shows that stomata observed in apex, middle and base region. The apex region of stomatal index is 14.50 ± 1.20 , middle region of stomatal index is 9.54 ± 0.50 and base region of stomatal index is 15.84 ± 0.41 . The maximum number of stomatal index shows base region followed by apex and middle.

The stomatal range in adaxial surface of leaves also observed in apex, middle and base region are 8.4 ± 0.91 , 10.82 ± 0.68 and 11.07 ± 0.73 respectively. The maximum stomatal index shows base region followed by middle and apex (Table 1 & Graph 1).

Anomocytic type of stomata has been found in the leaves of both surfaces. The abaxial surface of stomata of apex region is highest in comparison to the middle and base (fig. 14 & 15).

Table 1- Stomatal index of abaxial and adaxial surface of leaf

Stomata Values	Region	Abaxial (Lower surface of leaf)	Adaxial (Upper surface of leaf)
Number of Stomata	Apex	20.2 ± 1.49	7.3 ± 0.66
	Middle	13.4 ± 0.85	9.8 ± 0.59
	Base	20.8 ± 0.72	9.9 ± 0.79
Number of Epidermal cell	Apex	119.1 ± 4.14	80.5 ± 3.34
	Middle	127 ± 5.46	80.9 ± 1.32
	Base	110.5 ± 3.28	79.5 ± 3.42
Stomatal Index	Apex	14.50 ± 1.20	8.4 ± 0.91
	Middle	9.54 ± 0.50	10.82 ± 0.68
	Base	15.84 ± 0.41	11.07 ± 0.73



Graph1:- Stomatal index of abaxial and adaxial surface of leaf (apex, middle and base)

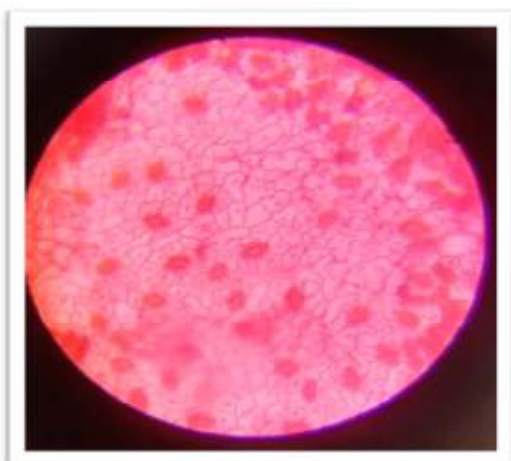


Fig. 14:- Upper leaf of stomata

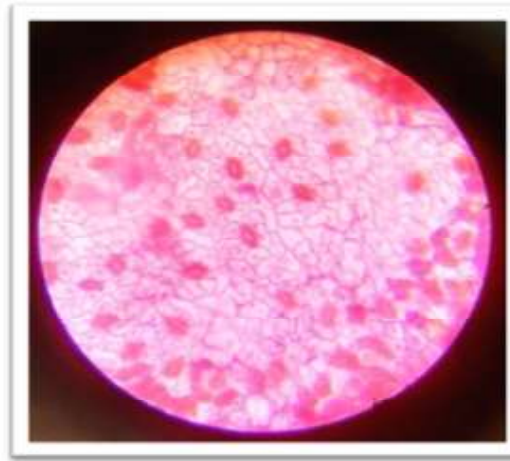


Fig. 15:- Lower leaf of stomata

Maceration of plant tissue

Maceration material of stem showed the presence of perforated pit apparatuses, tracheids, trichomes, phloem vessels and xylary fibers.



Fig. 16:- Xylary Fiber (40X×10X)

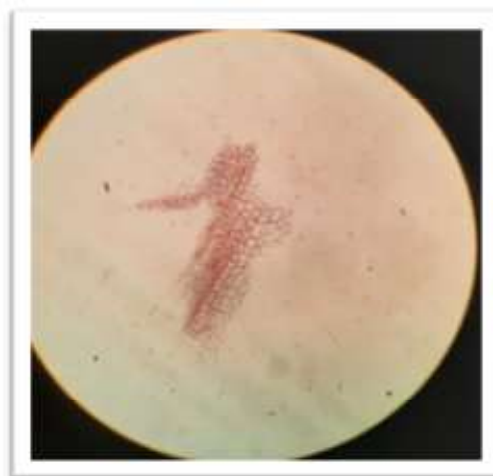


Fig. 17:- Epidermal layers of cells (40X×10X)



Fig. 18:- Fibers (40X×10X)

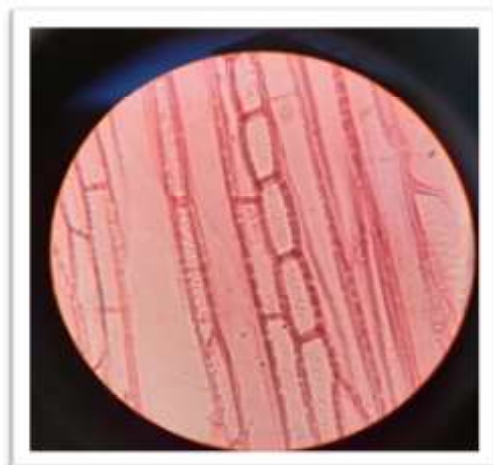


Fig. 19:- Perforated xylem fibers(40X×10X)

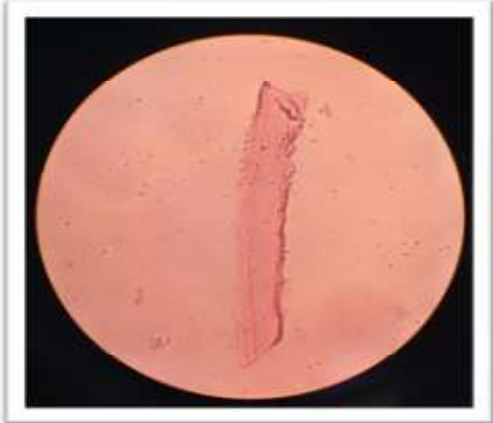


Fig. 20:- Perforated vessels (100X)

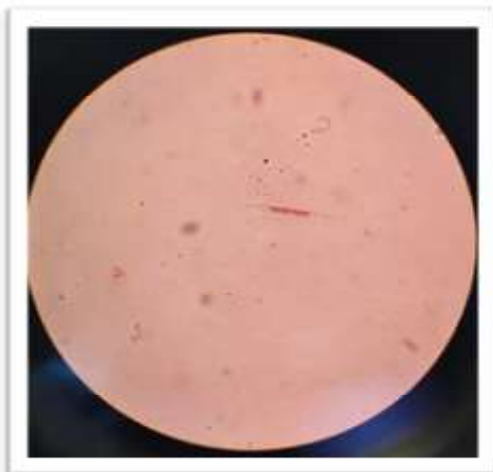


Fig. 21:-Tracheids showing simple pit (100X)

CONCLUSION

The taxonomical characterization of *Bixa orellana* in this study established its systematic position within the Bixaceae family. It is characterized by its evergreen shrub

or small tree habitat, leaves simple, pinkish white flower with numerous stamens, and spiny capsule fruits that contains many reddish seed. Crystal calcium oxalate were seen in all stem, petiole and leaves, while macerated plant tissue displayed fibers, perforated vessels and simple pitted tracheids, the plant displayed anomocytic-type stomata.

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