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Morphological characterization of Bhabri Tulsi (*Ocimum basilicum* L.)

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Abstract

Taxonomist faces various problems in proper nomenclature of the genus *Ocimum* due to lack in information about morphological features pertaining to different *Ocimum* species. Thus, *Ocimum basilicum* L. (Basil) commonly known as bhabri was chosen to carry out a profound study in the morphological characters. The morphology of the species includes detailed description of various characters of the basil such as roots, stem, leaves, flowers and seeds. Beside the following characters other quantitative studies were also taken under consideration like plant height, number of branches, length and width of root, stem, leaf and also quantitative size and length of floral parts such as flower, calyx, corolla, androecium, gynoecium, fruit and seed. The morphology also includes description of matured inflorescences and average weight of 1000 seeds in gram.

Keywords: *Ocimum basilicum*, basil, bhabri, inflorescence, morphology

Introduction

Ocimum is one of the most important genera of the family Liliaceae. It is originally native to India and other regions of Asia, Africa, South America and the Mediterranean region. It is extensively cultivated in Southern, Central and Eastern Europe, North Africa, and in USA, particularly California (Kruger, 1992; Singh and Panda, 2005) [6, 7]. It is commercially important crop and a great source of aromatic oils and medicines. There are more than 150 species found in this genus and which is broadly distributed over the tropical regions of the world (Evans, 2001 and Kumar, 2009) [3, 8]. *Ocimum* shows lots of variation in habit, growth pattern, physiological appearance, chemical composition. It grows in a wide range of soil and climatic conditions. All *Ocimum* species yield essential oils that help in the therapeutic uses like antimicrobial, antioxidant, antifungal and anti-inflammatory activities. Out of these 150 species, *Ocimum basilicum* L. commonly known as sweet basil or bhabri was selected for the present studies because of its economic importance as a ornamental, spice, culinary and therapeutic purpose. Because of its royal fragrance, it is also called king of the herb (Grieve, 1931) [4]. *Ocimum basilicum* is a small, erect and herbaceous perennial plant. Stem is erect, quadrangular and profusely branched. The leaves are ovate-lanceolate, acuminate, toothed or entire, glabrous on both surfaces, arranged in decussate manner and light green in colour. The terminal peduncle unbranched and height of the plant ranged from 52.34 to 74.34 cm (Hugh, 2005) [5]. About 6 to 10 small flowers are arranged in whorls at the nodes of the inflorescence and purplish white in colour. Both the calyx and corolla are blipped and bell-shaped. There are two pairs of stamens and the style is forked. The fruit consists of four nutlets enclosed in the mature calyx which are ellipsoid and black in colour (Purohit and Vyas, 2008) [14] the present investigation were planned to bring out more information about the morphology *Ocimum basilicum* L. This would be an attempt to proper delimitation of this species in the genus *Ocimum* of the family Liliaceae and even more such acquaintance would be supportive to specialists in different aspects of biology of such plant

Materials and Methods

The present study was carried out on *Ocimum basilicum* L. (Sweet basil or Bhabri). Seeds were collected from the Department of Forest Products, Nauni, Solan (Himachal Pradesh) and sown in the experimental field. The field work was carried during the year of 2017-18 and 2018-19 to acquire the plant material for the study of morphological characters of the plant. The sowing of the seeds was done during the month of April and trial includes three replicates represented by one plot with spacing 30 x 45 cm a part.

All field practices were carried out as recommended for the basil crop in the vicinity. The qualitative and quantitative characters were recorded and analyzed through computer Microsoft Office-Excel 2007 software.

Results

Qualitative Characters

Habit: Small size herbaceous perennial plant.

Stem: Erect, branched, quadrangular, light greenish colour, slightly pubescent with grey hairs and epidermal glands on the younger parts.

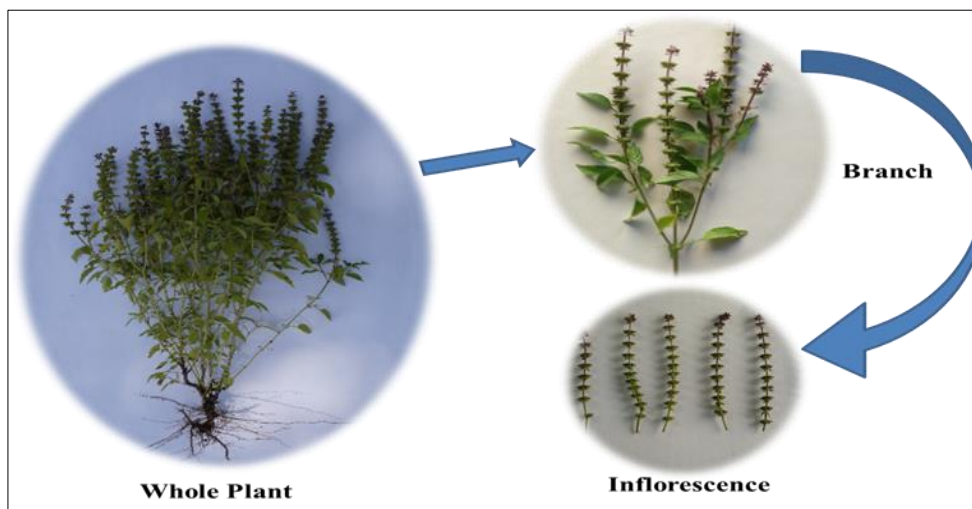


Fig 1: *Ocimum basilicum* L. plant and its branching pattern

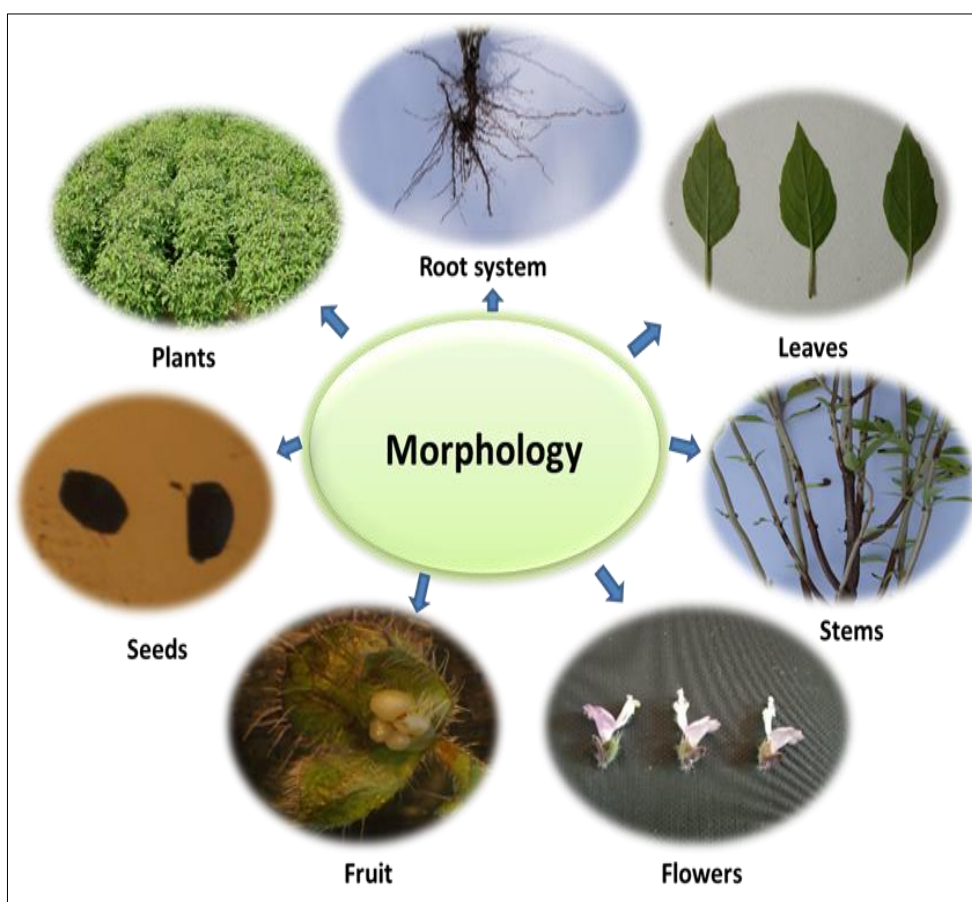


Fig 2: Different morphological parts of *Ocimum basilicum* L

Root: Tap root system consisting of fibrous rootlets in light brown colour. Leaf shape and arrangement- Gradually smaller towards the terminal tip. Basal leaves were petiolate, small size and ovate-lanceolate in shape. The apical and basal leaves were widely serrated and acuminate apex with multi-cellular glands on lower sides of leaves. The leaves were light

green in colour. The apical and basal leaves were observed in the arrangement of opposite and decussate where the opposite leaves of the adjacent nodes were rotated at right angle giving an appearance of four vertical rows of leaves on the stem.

Inflorescence: It comprised of verticillasters possessing of 3-6 flowers arising from the axil and the terminal peduncle was unbranched.

Floral characters: Bracteates, hermaphrodite, pentamerous, hypogynous with zygomorphic symmetry. The flowers were purplish white in colour

- **Calyx:** Five, gamosepalous, bilabiate where anterior lip (upper lip) was of single sepal and posterior lip (lower lip) was fused with four sepals, persistent, irregular. The upper lobe orbicular and lower lobe deltoid-mucronate, protruding beyond the upper. The surface which was faced on the upper lipped had a pinkish tinge while the rest part had a light greenish colour covered by glandular and simple trichomes.
- **Corolla:** Five, gamopetalous, bilabiate where anterior lip (upper lip) was fused with four petals and posterior lip (lower lip) was of single petals. The upper lip had a light purplish white colour and the lower lip had the whitish colour.
- **Androecium:** Stamens were four, posterior stamen absent, didynamous, two stamens with short filament and long connective, one lobe was fertile and other was sterile. The other two anterior stamens have long filament. The filaments had whitish while the anther lobes had off-white colour on maturation.

Gynoecium: Bicarpellary, syncarpous, tetralocular due to false septum (replum), superior with bifurcated stigma. Style gynobasic, stigma positioned in the upper lip labiate having purplish tinge. Ovary tetralocular with one anatropous ovule in each locule with axile placentation

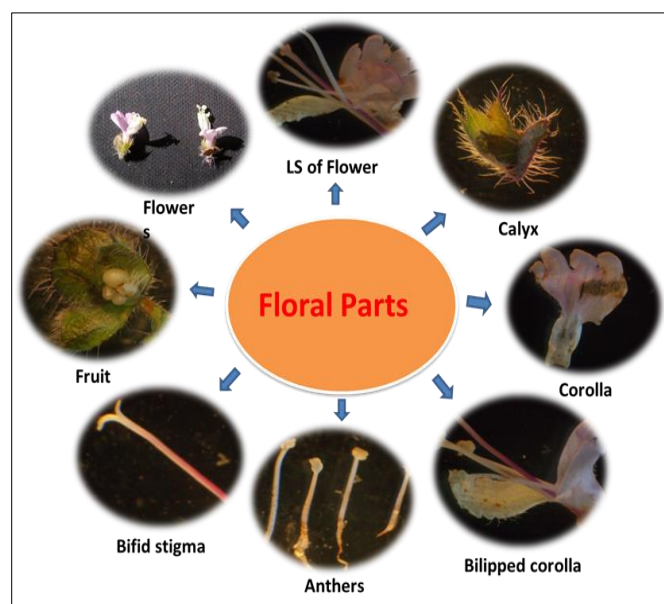


Fig. 3: Floral parts of *Ocimum basilicum* L

Fruit: The fruit was schizocarpic, carcerulus (4 nutlets). The colour gradually turned into dark brownish colour from light green colour on maturity.

Seed: Black in colour and round to oval in shape with smooth surface

Quantitative characters

The qualitative characters were shown in the Table 1

Table 1: Quantitative characters of *Ocimum basilicum* L.

Sr. No.	Parameters	Dimension/Number (Mean \pm)
1.	Plant height	62.69 \pm 7.18 cm
2.	Number of branches per plant	136.99 \pm 31.15
3.	Plant spread	24.25 \pm 4.03 cm
4.	Root	
	Length	13.60 \pm 4.42 cm
	Diameter	1.06 \pm 0.08 cm
5.	Stem	
	Length	62.69 \pm 7.18 cm
	Diameter	1.11 \pm 0.16 cm
6.	Leaf	
	Leaf length	3.83 \pm 0.39 cm
	Leaf width	1.74 \pm 0.25 cm
	Petiole length	1.30 \pm 0.20 cm
	Number of leaves per plant	786.65 \pm 116.56
7.	Inflorescence	
	Peduncle length	13.97 \pm 2.35 cm
	Number of peduncles per plant	94.65 \pm 12.60
8.	Flower length	6.30 \pm 0.30 mm
9.	Calyx length	
	Upper lip	2.38 \pm 0.09 mm
	Lower lip	2.51 \pm 0.08 mm
10.	Corolla length	
	Upper lip	6.05 \pm 0.07 mm
	Lower lip	5.91 \pm 0.09 mm
11.	Androecium	
	Filament length (Long)	6.23 \pm 0.03 mm
	Filament length (Short)	0.90 \pm 0.13 mm
	Anther length	0.82 \pm 0.04 mm
12.	Gynoecium	
	Style length	10.13 \pm 0.03 mm
	Stigma length	0.93 \pm 0.10 mm
	Ovary length	2.07 \pm 0.11 mm
	Ovary width	1.27 \pm 0.21 mm
13.	Fruit	
	Length	2.28 \pm 0.35 mm
	Diameter	1.35 \pm 0.24 mm
14.	Seed	
	Length	1.72 \pm 0.19 mm
	Diameter	1.04 \pm 0.11 mm
	1000 Seed weight	1.00 \pm 0.14 g

Discussion

During the course of the present studies, the morphological features matched perfectly with similar earlier reports of Rawat *et al.* (2016) [3] and Kumar (2012) [8]. The results of these studies are also in accordance of Mohamed *et al.* (2013) [11] Christian 2012 and Prabhu *et al.*, 2009 [14]. Morphological variability in holy basil was earlier reported by Malav *et al.*, 2015 [9]. The quadrangular transaction is frequently described for Lamiaceae (Metcalf and Chalk, 1988; Barroso, 1991) [10, 1]. Most of the morphological description studied in Basil plant is in harmony with that recorded by Kruger (1992) [6], Singh and Panda (2005) [7] and Purohit and Vyas (2008) [14]. Earlier studies confirmed great morphological variability available in *Ocimum basilicum* (Nurzynska-Wierdak, 2013; Negi *et al.*, 2015; Rawat *et al.*, 2016) [13, 12, 11]. Thiselton (1979) [3] also reported that height 1-2 ft long; leaves are petiolated, ovate,

oblong, 2.54-5.08 cm in length, pedicel very short, and calyx 6.3 mm in length, corolla 8.46-12.70 mm and white in colour. However, Mohamed *et al.* (2013) [11] have reported that the plant attains its maximum height being 78 cm. The root system is mainly composed of a stout tap root developing a large number of lateral roots of different branching degrees and so on. Stem is obtusely quadrangular. Leaves are light green, simple, and opposite, petioled, exstipulate, ovate-lanceolate, acuminate, almost entire or slightly toothed, glabrous on both surfaces. The stalked leaves are arranged in a decussate manner. Flowers are purplish-white in colour or much branched racemes observed in the axils of uppermost leaves on the main stem and on each of the developed lateral branches. The calyx has two lips and the upper lip is usually broad, the lower lip usually has four narrow pointed teeth and such lip is not curved backwards. The corolla also has two lips with a longer lower lip. The corolla is 7 to 9 mm long and white in color. Ovary superior, tetralocular, axile placentation, gynobasic style and stigma bifid. The nutlets are ellipsoid, very small in size (fine) where the weight of 1000 nutlets being about 1.4 grams, black-brown in colour, each comprised of one seed with a thin testa. There are some minor variations in the qualitative and quantitative characters which may be due to varying ecological conditions and differences in stages of observations.

Conclusions

Ocimum basilicum was found to be small size herbaceous perennial plant with a typical quadrangular stem, growing up to the height of 62.69 ± 7.18 cm. Stem was represented by erect, branched glabrous, light green in colour. Roots were found to be tap root system. Leaves were gradually smaller towards the terminal tip and basal leaves were petiolate having 1.30 ± 0.20 cm long petiole, small size and ovate-lanceolate in shape. The leaves were light green coloured. The apical and basal leaves were observed in the arrangement of opposite and decussate manner. Inflorescence comprised of verticillasters possessing of 3-6 flowers arising from the axil and the terminal peduncle was unbranched. Flowers were bracteates, hermaphrodite, pentamerous, hypogynous with zygomorphic symmetry and purplish white in colour. Calyx five, gamosepalous, bilabiate where anterior lip (upper lip) was of single sepal and posterior lip (lower lip) was fused with four sepals, persistent, irregular, light greenish colour covered by glandular and simple trichomes. Corolla five, gamopetalous, bilabiate where anterior lip (upper lip) was fused with four petals and posterior lip (lower lip) was of single petals. The upper lip had a light purplish white colour and the lower lip had the whitish colour. Stamens were four, posterior stamen absent, didynamous, two stamens with short filament and long connective, one lobe was fertile and other was sterile. The other two anterior stamens have long filament. The filaments had whitish while the anther lobes had off-white colour on maturation. Gynoecium bicarpellary, syncarpous, tetralocular due to false septum (replum), superior with bifurcated stigma. Style gynobasic, stigma positioned in the upper lip labiate having purplish tinge. Ovary tetra locular with one anatropous ovule in each locule with axile placentation. The fruit was schizocarpic, carcerulus (4 nutlets). Fruits on maturation gradually turned into dark

brownish colour from light green colour. Seeds were black in colour and round to oval in shape with smooth surface.

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