

**SEEDLING MORPHOLOGY OF FOUR SPECIES OF *OCIMUM* L.
(LAMIACEAE) AND ITS TAXONOMIC SIGNIFICANCE**

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The genus *Ocimum* (family Lamiaceae, subfamily Nepetoideae, tribe *Ocimeae*) is cultivated for its remarkable essential oil which exhibit many herbs, culinary, perfume for herbal toiletries, aromatherapy treatment and as flavouring agent. The *Ocimeae* are essentially a tropical tribe and *Ocimum* occurs naturally in tropical America, Africa and Asia. In the state of Uttar Pradesh, India to which the present study area belongs, the genus *Ocimum* is represented by only 5 species, namely, *Ocimum americanum* L., *O. basilicum* L., *O. gratissimum* Guerke, *O. kilimandscharicum* Guerke and *O. tenuiflorum* L. (Rao, 1994; Khanna *et al.*, 1999). Although, a number of studies have been made in recent years on phylogenetic diversity of *Ocimum* species (Paton *et al.*, 2004; Singh *et al.*, 2004; Mustafa and Badr, 2006), the significance of seedling morphology in taxonomy of *Ocimum* species has not been probably studied.

Seedlings of four *Ocimum* species, viz. *O. americanum* L., *O. basilicum* L., *O. gratissimum* L. and *O. tenuiflorum* L. were collected from different parts of Varanasi district, Uttar Pradesh, India (25°18' N, 83°1' E) during the months of July to September 2008. Seeds of these four species were also collected in January and February 2009, and grown during July to August 2009 in the greenhouse of the Experimental Botanic Garden of the Department of Botany, Udai Pratap Autonomous College, Varanasi, India to ensure correct identification of seedling species. The different stages of development of each species were considered for preparing a complete description out of ten individuals. All the specimens at different leaf stages were documented in the form of herbarium sheets which have been deposited in the Herbarium, Department of Botany, Udai Pratap Autonomous College, Varanasi, Uttar Pradesh, India. The gross morphological features of seedlings were described following the terminology proposed by de Vogel (1980). For seedling description, Ahammed and Paria (1996) and Singh (2009) were followed.

Investigated species show affinity with regard to type of seedling, the morphological characters of collet, hypocotyl, paracotyledon, epicotyl and leaves. Paracotyledons of all these species are similar from a morpho-taxonomic point of view. Some morphological characters of seedlings, viz. secondary root surface, collet and number of leaf veins are found suitable to distinguish the investigated species at their juvenile stage. Findings of the present study reflect possibilities for taxonomic considerations of seedling morphology. Therefore, it is suggested that seedling morphology should be taken into consideration in a comprehensive way to distinguish the species and in solving taxonomic and phylogenetic implications.

A key to the species of *Ocimum* based on seedling morphology is given below.

- | | |
|---|-----------------------|
| 1. Collet without distinct ring, lowermost side veins opposite in 1st leaf. | O. basilicum |
| - Collet with distinct ring, all veins alternate in 1st leaf. | 2 |
| 2. Secondary roots smooth. | O. gratissimum |
| - Secondary roots with parallel striations. | 3 |

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3. First leaf with 7 distinct veins, mid-vein reaches to apex. **O. americanum**
 - First leaf with 9 distinct veins, mid-vein not reaching to apex. **O. tenuiflorum**

***Ocimum americanum* L. (Fig. 1, A-C)**

Primary root fibrous, taproot; secondary roots with parallel striations. Collet distinct with brown swollen ring. Hypocotyl green, surface strigose, nearly terete. Paracotyledons 2, opposite, isocotylar, leafy, petiolate, blade deltoid, base subcordate, apex retuse, margin entire, adaxial surface dark green, abaxial surface light green, both sides strigose, venation not distinct. Epicotyl green, strigose, quadrangular. First leaf simple, opposite, exstipulate, petiolate, blade ovate, base attenuate and slightly oblique, apex acute, margin dentate, both surfaces dark green, strigose, many pits on abaxial side, 7 veins distinct, mid-vein reaches to the apex. Subsequent leaves same as that of 1st leaf.

***Ocimum basilicum* L. (Fig. 1, D-F)**

Primary root non-fibrous, taproot; secondary roots smooth. Collet without distinct ring, smooth. Hypocotyl purplish-green, surface pubescent, terete. Paracotyledons 2, opposite, isocotylar, leafy, petiolate, blade deltoid, base subcordate, apex retuse, margin entire, adaxial surface dark green, abaxial surface light green, both sides pubescent, venation not distinct. Epicotyl reddish-green, pubescent, quadrangular. First leaf simple, opposite, exstipulate, petiolate, leaf blade ovate, base rounded, apex acute, margin dentate, adaxial surface dark green, abaxial surface light green, both sides pubescent, many pits on abaxial side, 9 veins distinct, lowermost side veins opposite. Subsequent leaves same as that of 1st leaf.

***Ocimum gratissimum* L. (Fig. 1, G-I)**

Primary root non-fibrous, taproot; secondary roots smooth. Collet distinct with yellow ring, smooth. Hypocotyl green above and white below, pubescent, terete, 3.9 cm long at 5th leaf stage. Paracotyledons 2, opposite, isocotylar, leafy, petiolate, blade deltoid, base subcordate, apex retuse, margin entire, adaxial surface dark green, abaxial surface light green, both sides pubescent, venation not distinct. Epicotyl green, pubescent, quadrangular, 6.9 cm long at 5th leaf stage. First leaf simple, opposite, petiolate, leaf blade ovate, base attenuate, apex acute, margin denticulate, adaxial surface dark green, abaxial surface light green, both surfaces pubescent, few pits on abaxial side, 7 veins distinct, all veins alternate. Subsequent leaves same as that of 1st leaf, but leaf margin dentate after 2nd or 3rd leaf stage.

***Ocimum tenuiflorum* L. (Fig. 1, J-L)**

Primary root non-fibrous, taproot; secondary roots with parallel striations. Collet distinct with brown ring, smooth. Hypocotyl whitish green to purple, surface velutinose, terete, 1.6 cm long at 5th leaf stage. Paracotyledons 2, opposite, isocotylar, leafy, petiolate, blade deltoid, base subcordate, apex retuse, margin entire, adaxial surface dark green, abaxial surface light green, velutinous on both sides, venation not distinct. Epicotyl greenish purple, velutinous, quadrangular, 10 cm long at 5th leaf stage. First leaf simple, opposite, petiolate, leaf blade ovate, base rounded and oblique, apex acute, margin remotely dentate, adaxial surface dark green, abaxial surface light green, both sides velutinous, many pits on abaxial side, 9 veins distinct, mid-vein does not reach the apex. Subsequent leaves same as that of 1st leaf but leaf margin dentate.

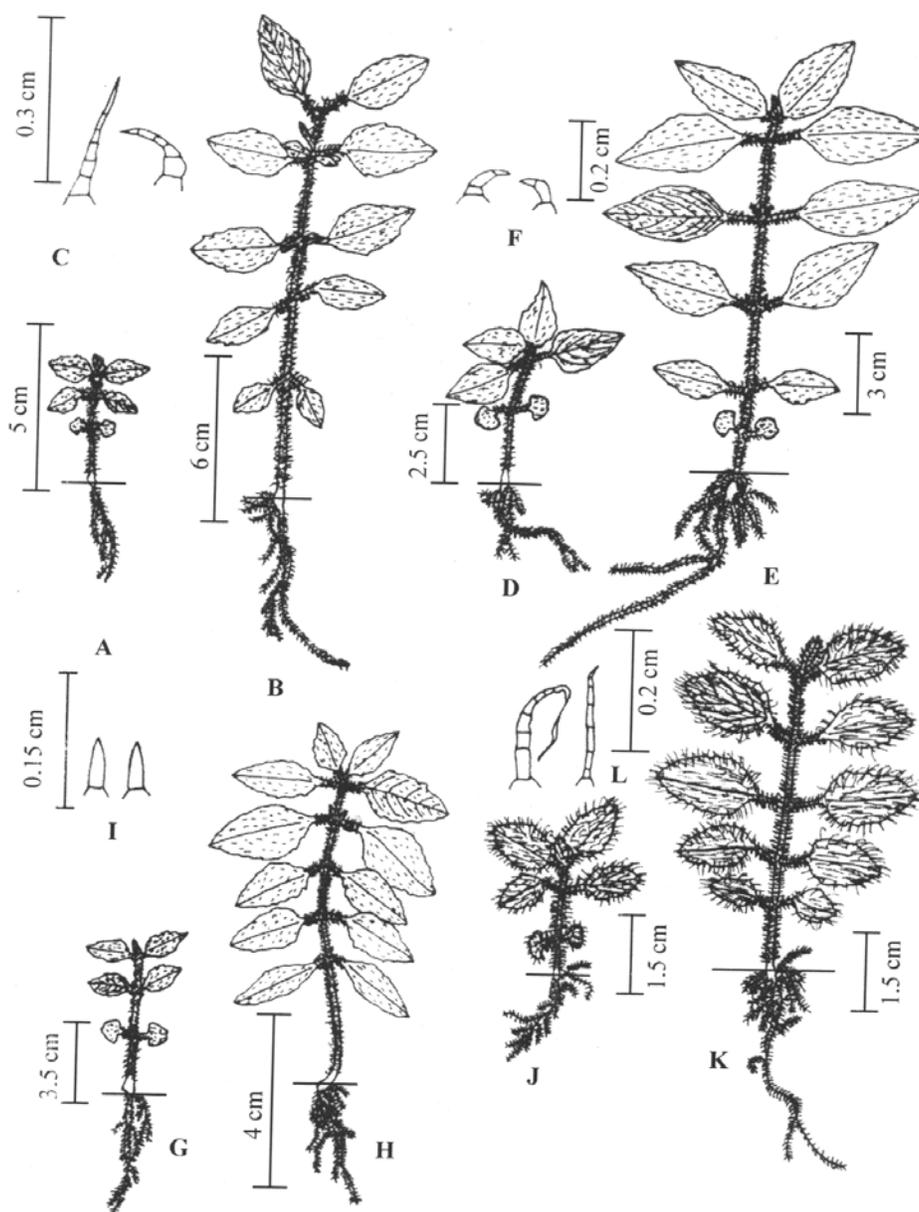


Fig. 1. Seedlings and hairs: *Ocimum americanum* L.- A. Second leaf stage; B. Fifth leaf stage; C. Hairs; *O. basilicum* L.- D. Second leaf stage; E. Fifth leaf stage; F. Hairs; *O. gratissimum* L.- G. Second leaf stage; H. Fifth leaf stage; I. Hairs; *O. tenuiflorum* L.- J. Second leaf stage; K. Fifth leaf stage; L. Hairs.

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