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Seedling Morphology of two important Medicinal Plant Species of *Wrightia* R.Br. (Apocynaceae) and its Taxonomic Significance

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ABSTRACT

Present study deals with the seedling morphology of two species of *Wrightia* R.Br. namely *W. arborea* (Dennst.) Mabb. and *W. tinctoria* R.Br. of the family Apocynaceae which are medicinally important and endangered in the Vindhyan region. Following parameters have been taken for the entire study such as, type of germination, total size of seedling, size of seedling above collet, root type and colour (primary or main root, lateral roots), morphology of the seedlings including the study of the behaviour, number, size and shape of paracotyledons as well as form, shape and phyllotaxy of the early leaves. On the basis of above mentioned parameters we have compared the seedlings of *W. arborea* and *W. tinctoria*. The study may help in proper identification of these species and in solving their taxonomical problems. This study is also significant becuase only after the identification of seedlings it will be possible to make *ex situ* or *in situ* conservation attempts of these two species.

Key-words: Seedling morphology, *Wrighita*, Taxonomy.

INTRODUCTION

The Vindhyan region is the home of very rich biodiversity including trees and wildlife. Though, there has been major degradation in the natural environment due to human interventions leading to a vast array of ecological problems. These demand attention and steps to restore the natural ecosystem. So, the seedling method is very useful scientific method for the conservation of biodiversity. A seedling is a juvenile plant stage developing out of a plant embryo from a seed. The knowledge of seedling provide taxonomical as well as biodiversity information. It helps in many aspects such as identification of plants at early stages, biodiversity management with the help of *ex situ* and *in situ* conservation, tissue culture of hypocotyl, viability test of seeds, crop management and forestry.

Wrightia R. Br., a genus of about 25 species of shrubs and trees, distributed in tropical Asia, Australia, and Africa. Two species of the genus *W. arborea* (Dennst.) Mabb. (Syn. *W. tomentosa* Roem. & Schult) and *W. tinctoria* R. Br. are found in Vindhyan forest of India which are endangered or likely to become endangered in the region (Bose et al. 1998, Dubey et al. 2007). Both the species are of medicinal importance and have anti-bacterial, anti-dysenteric, anti-inflammatory, anti-nociceptive and wound or cut healing properties (Anusharaj et al. 2013, Nahar et al. 2013, Saha et al. 2013, Rajalakshmi & Jyoti 2012, Khyade & Vaikos 2011). Moreover, *W. arborea* and *W. tinctoria* have many other medicinal properties i.e., anti-oxidant, anti-tumor, skin allergy, antidote in scorpion sting, menstrual problems, renal troubles (Zahan et al. 2013, Maurya & Seth 2014, Sharma et al. 2013, Paul

et al. 2011) and analgesic, anthelmintic, anti-cancer, anti-diabetic, anti-fungal, anti-pyretic, anti-ulcer, anti-viral, jaundice curative, treatment of psoriasis (Anusharaj et al. 2013) respectively. Apart from medicinal properties, *W. arborea* has good phytoremediation capability for arsenic (Kumar et al. 2015). Both the plant species has also good quality of wood which is fairly hard and white. They are used in toy making industries. Owing to high demand of these industries, over exploitation takes place for its ivory like wood which resulted the species to come in endangered criteria (Nagalakshmi et al. 2014, Aggarwal et al. 2013). Therefore, aim to conserve these plant species is needed to stop their extinction from the region. In this regard, this study has been done to provide proper identification and protection at seedling stage. This can be done by the studies on seedling morphology, which provide identification keys to distinguish from other unwanted plant seedlings.

In the recent past, Das & Paria (1999) studied seedling morphology of *Bauhinia acuminate, B. diphylla, B. malabarica, B. purpura, B. retusa, B. rufescens, B. tomentosa, B. vahlii,* and *B. variegata* on the basis of germination pattern. Singh (2012) has conducted an investigation based on seedling morphology of *Ocimum americanum, O. basilicum, O. gratissimum* and *O. tenuiflorum.* Khan et al. (2014) studied the seedling characteristics of *Erythrina suberosa* in detail and Malik and Anand (2014) studied the seedling morphology of *Anisomeles ovate.* Malik et al. (2014) have done a morphotaxonomic study on *Eremostachys superb* seedlings. Singh (2015) has studied the morphology of 15 common dicot weed seedlings such as *Achyranthes aspera, Alternanthera paronychioides, Amaranthus viridis, Argemone mexicana, Chenopodium album, Digera muricata, Euphorbia hirta, Lathyrus aphaca, Medicago polymorpha, Melilotus indica, Oldenlandia aspera, Oxalis corniculata, Parthenium hysterophorus, Solanum nigrum* and *Spergula fallax.* Sanyal and Paria (2015) studied the seedling morphology of 25 taxa belonging to 18 genera viz., *Acacia auriculiformis, Atylosia scarabaeoides, Bauhinia purpurea, Butea monosperma, Calliandra umbrosa, Cassia alata, Cassia fistula, Cassia siamea, Cassia sophera, Cassia tora, Crotalaria pallid, Dalbergia sissoo, Delonix regia, Leucaena leucocephala, Millettia ovalifolia, Mimosa pudica, Peltophorum pterocarpum, Pithecellobium dulce, Pongamia pinnata, Samanea saman, Saraca asoca, Sesbania cannabina, Sesbania grandiflora, Sesbania sesban* and *Tephrosia purpurea.* Meena and Datta (2015) studied four economically important tree seedlings of *Acacia* i.e., *A. nilotica* sub sp. *indica, A. senegal, A. raddiana* and *A. catechu.* Khan et al. (2015a, 2015b) studied the seedling characteristics of *Pongamia pinnata* and *Bauhinia racemosa.*

The seedling morphology has not yet been studied for the genus *Wrightia.* The present study may be a useful contribution in this regard and also for conservation of endangered plant species from a taxonomic aspect.

MATERIAL AND METHODS

Plant material and collection of seeds and seedlings: The seeds and seedlings of two *Wrightia* species i.e., *W. arborea* and *W. tinctorea* were collected from their natural habitat and also from different parts of the Vindhyan region in the monsoon season.

Germination of seeds and study of seedling morphology : Seedlings were grown in the earthen pots in the Roxburgh Botanical Garden (Department of Botany, University of Allahabad, Allahabad) and the development stages of seedlings were systematically recorded. For the authentication of morphological data and its various forms in different parts of seedlings such as root, hypocotyl, cotyledons, epicotyl and first leaves have been studied in detail. Further, length and width of the different parts of the seedlings were also measured in centemer scale. Ten to fifteen seedling specimens of both the species were analyzed randomly for statistical analysis. The seedlings were photographed one by one and then preserved in herbarium sheets.

Preparation of line diagrams : Line diagrams of the selected seedlings have been prepared to show the exomorphic features. The exomorphic features of the seedlings which have studied in the present investigation would be helpful to identify the plants.

Terminologies used for the leaf and leaf like cotyledonary leaves architecture : Terminologies of Lawrence (1951), Burger (1972), Vogel (1980), Paria (1996a, 1996b), Kamilya & Paria (1993, 1994, 1995, 1997a, 1997b), Kamilya et al. (1995) and Singh (2012) were used to describe the seedling morphology.

OBSERVATION

Wrightia arborea (Dennst.) Mabb. (Figure 1a, c & Figure 2)

Seedling type is phanerocotylar epigeal foliaceous (PEF), total size 8.81 ±0.911 cm, 5.93 ±0.557 cm above collet. Roots off white; primary root slightly flexuous, thicker than lateral ones; lateral roots very numerous, flexuous, slightly branched. Hypocotyl epigeous, erect, straight, 4.68 ±0.292 cm long, 1.46 ±0.046 mm thick, base glabrous, sometimes slightly hairy, light green, white at base, at top disciform. Cotyledons epigeous, two, equal, foliaceous, opposite, petiolate; petiole very short 2.93 ±0.053 mm long and 1.55 ±0.05 mm thick, channeled, pale green, slightly hairy; blade 1.81 ±0.109 cm long, 1.93 ±0.136 cm wide, green, entire, heart shape, having an acute-obtuse top and a cordate base, thin, slightly hairy, flat, unicostate nerved, slightly prominently, nerved on both surfaces, green above, dull green beneath. Epicotyl 1.31 ±0.238 cm long, 1.71 ±0.093 mm thick, erect, straight, slightly hairy, green. First two leaves equal, smooth haired, simple, opposite, entire, having an acuminate top and obtuse base, thin, blade 2.41 ±0.277 cm long, 0.71 ±0.074 cm wide, petiolate; petiole 1.05 ±0.095 mm long and 0.91 ±0.04 mm thick, venation green colored clear, unicostate, pale green above, dull green beneath. Top of seedling is green, soft haired.

Wrightia tinctorea R. Br. (Figure 1b, d & Figure 2)

Seedling type is Phanerocotylar Epigeal Foliaceous (PEF), total size 9.25 ±0.518 cm, 6.23 ±0.491 cm above collet. Roots white, turning off white; primary root moderately flexuous, thicker than lateral ones; lateral roots numerous, flexuous, slightly branched. Hypocotyl epigeous, erect, straight, 6.63 ±0.183 cm long, 1.89 ±0.061 mm thick, base gradually thicket, glabrous, sometimes slightly hairy, light green, at top

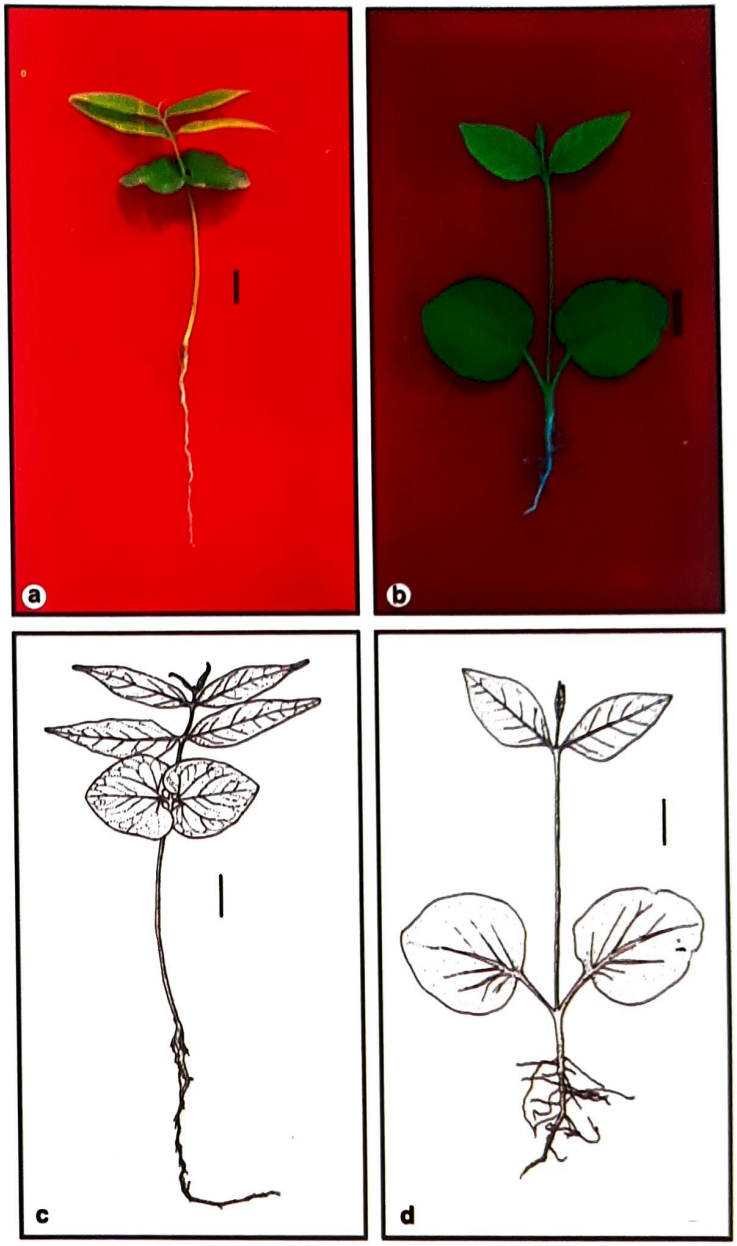
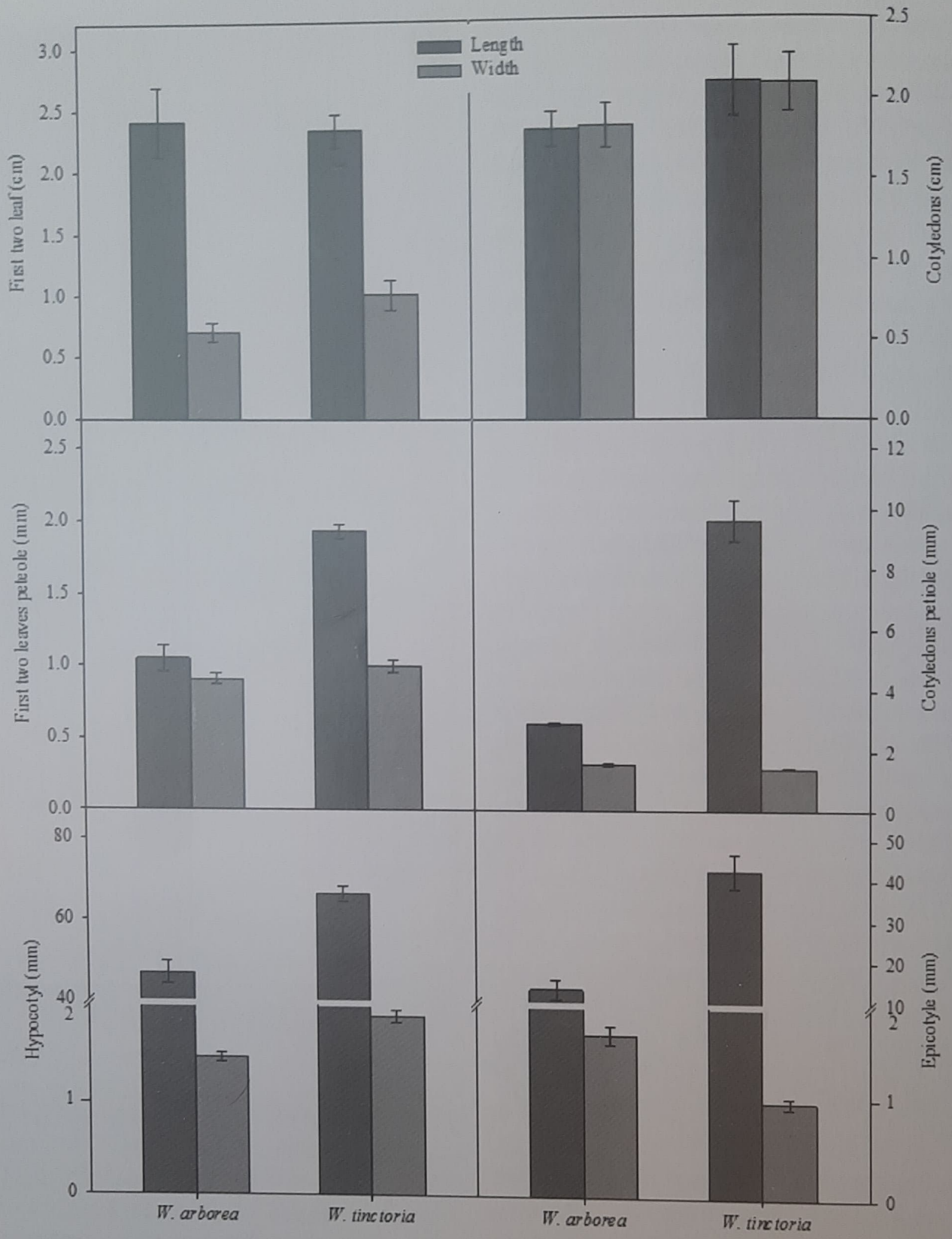


Figure 1. Seedling and line diagram: *Wrightia arborea* (a, c), *Wrightia tinctoria* (b, d). **Scale bar** = 1 cm.

disciform. Cotyledons epigeous, two, equal, foliaceous, opposite, petiolate; petiole 9.63 ±0.653 mm long, 1.44 ±0.046 mm thick, channeled, pale green, slightly hairy; blade 2.10 ±0.221 cm long, 2.09 ±0.178 cm wide, green, entire, having an acute-obtuse top and a cordate base, thin, slightly hairy, flat, unicostate nerved, slightly prominent, nerved on both surfaces, green above, dull green beneath. Epicotyl 4.23 ±0.439 cm long, 1.01 ±0.058 mm thick, erect, straight, slightly hairy, green, on top at joint of first two leaves disciform. First two leaves equal, yellowish green, smooth haired, simple, opposite, entire, having an acuminate top and obtuse



Text Figure 2. Comparative morphological measurements of *Wrightia arborea* and *Wrightia tinctoria*.

base, thin, blade 2.33 ±0.136 cm long, 1.01 ±0.12 cm wide petiolate; petiole 1.93 ±0.045 mm long and 1.0 ±0.042 mm thick, venation green colored, clear, unicostate, green above, dull green beneath. Top of seedling is green, soft haired.

Key for seedling identification

1a. Total size with first two leaves 8.81 ±0.911 (cm) 2a

1b. Total size with first two leaves 9.25 ±0.518 (cm) 2b

2a. Size above collet with first two leaves 5.93 ±0.5570 (cm) 3a

2b. Size above collet with first two leaves 6.23 ±0.4913 (cm) 3b

3a. Primary root off white, slightly flexuous 4a

3b. Primary root white turning off white, moderately flexuous 4b

4a. Hypocotyl size 46.8 ±2.92 x 1.46 ±0.046 (mm) 5a

4b. Hypocotyl size 66.3 ±1.83 x 1.89 ±0.061 (mm) 5b

5a. Petiole size of cotyledons 2.93 ±0.053 x 1.55 ±0.05 (mm) 6a

5b. Petiole size of cotyledons 9.63 ±0.653 x 1.44 ±0.046 (mm) 6b

6a. Blade size of cotyledons 1.81 ±0.109 x 1.83 ±0.136 (cm) 7a

6b. Blade size of cotyledons 2.10 ±0.221 x 2.09 ±0.178 (cm) 7b

7a. Epicotyl with rounded top..... 8a

7b. Epicotyl with disciform top 8b

8a. Petiole size of first two leaves 1.05 ±0.095 x 0.91 ±0.04 (mm) 9a

8b. Petiole size of first two leaves 1.93 ±0.045 x 1.00 ±0.042 (mm) 9b

9a. Blade size of first two leaves 2.41 ±0.277 x 0.71 ±0.074 (cm) ..... *W. arborea*

9b. Blade size of first two leaves 2.33 ±0.136 x 1.01 ±0.120 (cm) ..... *W. tinctoria*

DISCUSSION AND CONCLUSION

It is a well established fact that seedling study is one of the most important disciplines in plant systematics. Only after the identification of seedlings it will be possible to make *ex situ* or *in situ* conservation attempts of these species. The present study has several scopes which may be helpful such as to establish and protect these endangered plant species of the Vindhyan region. Plans can be made to conserve the biodiversity depletion of this region by such type of seedling study, which have various other advantages. The present study will be helpful to document the morphologically important medicinal trees of the Vindhyan region and to catalogue the endangered plant species of the region. This may provide important data for the conservation of biodiversity of medicinally important tree species of the Vindhyan region.

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