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SEEDLING MORPHOLOGY –AN AID TO IDENTIFICATION OF SOME OVER-EXPLOITED MEDICINAL PLANTS WITH RESPECT TO THEIR PHARMACOGNISTIC USES

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ABSTRACT

Seedling morphology of six over-exploited medicinal plants is described with special reference to their identification which has been discussed in the context of taxonomy. Some juvenile characters of seedlings are found useful in distinguishing taxa studied. A seedling plant is characterized by primary genetic characters before the attainment of secondary growth. Such characters include the behavior, number, form, size and shape and phyllotaxy of the earliest leaves (eophylls). These characters are used as taxonomic markers in the systematic consideration of angiosperms. Using these characters artificial keys for the identification of taxa at the juvenile stage has been developed. Based on initial germination pattern and nature of release of (para) cotyledons from the seed coat, four functional types were recognized: phanerocotylar epigeal, phanerocotylar geal, cryptocotylar hypogeal and cryptocotylar geal. Seedling morphology provide additional potential data source for characterization and identification of the medicinal plants which is very important to conserve these plants permanently to avoid wrong identification and to prevent them from getting extinct due to over-exploitation. Interest and support for the conservation and development of medicinal plants is increasing in all parts of the world. Keeping in view, the need for conservation of plant biodiversity, the study of seedling morphology provides important clues to identify the plants of medicinal plants in the wild much before flowering and fruiting stages, and in doing so, these plants can be protected from biotic interference and natural hazards, before they get disappeared from the wild.

KEYWORDS: Seedling morphology, phanerocotylar, cryptocotylar, medicinal plant.

INTRODUCTION

Plants are the source of raw materials for the medicines manufactured under various systems of pharmacology.[1] As per World Health Organization, WHO[2] estimates, almost 80% of the population of developing countries relies on traditional medicines, mostly plant drugs, for their primary health care needs. Demand for medicinal plants is increasing due to growing recognition of natural products being non-narcotic, having no side-effects, easily available at affordable prices and sometime the only source of health care available to the poor.

Interest and support for the conservation of medicinal plants is increasing in all parts of the world. This is due to growing recognition given to the role of medicinal plants in creating sustainable livelihoods and in the vital conservation of biodiversity. This includes cultivation and procurement of raw material involving the producer to minimize the misidentification and contamination.[3] In modern era, we are losing many important plant species due to high pressure of urbanization, industrialization and deforestation. So the study of seedling morphology is very important to conserve these plants permanently and for easy identification.

Seedling may be defined as a plant produced from seeds, in distinction to plant propagated artificially.[4] After seeds, seedlings typically suffer the highest mortality rate of any life history stage and, therefore, are important in the selection and evolution of species. Moreover, the seedlings of many taxa, particularly herbs, are so small as to escape the attention in their natural habitats.[5] Jackson (1928) emphasized that seedling morphology should be thoroughly investigated for better comprehension of germination, establishment and juvenile growth during the natural regeneration of vegetation. The systematic value of seedlings has been stressed by several workers.[6,5,12] Seedling Functional Types in a lowland Rain Forest in Mexico was studied by Ibarra-Manriquez et al.[7] Paria (1995, 1996, 2001, 2006, 2008, 2010) and his associates have carried out investigation on seedling morphology at the level of genus, individual taxon with reference to their systematic importance. Knowledge of seedlings, will facilitate the correct identification of medicinal plants and this in turn, will help in conserving them.

MATERIALS AND METHODS

In the present investigation, an attempt has been made to study the seedling morphology of some over-exploited medicinal plants. Seedlings of six plants were collected from natural habitats in different places of Kolkata. The seedlings were studied and compared with raised

ones using a Binocular stereomicroscope. Seedlings were photographed, documented on Herbarium sheets. Voucher specimens were deposited in Bethune College Departmental Herbarium, India. The morphology was described following standard terminology.[8,9,10]

OBSERVATIONS

Medicinal use of the plants

The plants (Table 1) are selected in view of the medicinal importance as have been screened with Jain.[11]

Table 1: Medicinal uses of the investigated Taxa

	Scientific name	Common name	Parts Used	Uses
1	*Andrographis paniculata*	Kalmeg	Whole plant	Leaf paste improves digestion and liver function. Whole plant used in fever, dysentery, dyspepsia.
2	*Bacopa monnieri*	Brahmi	Whole plant	Leaves increase memory, cures cold and cough, as astringent, carminative, bronchodilator, emanogogue.
3	*Phyllanthus amarus*	Bhuiamla	Whole plant	Used for treatment of Hepatitis, Jaundice, Gonorrhea, frequent menstruation, diabetes, sores, swelling, and itchiness.
4	*Solanum virginianum*	Kantikari	Roots and seeds	Useful in treating worms, hoarseness of voice, fever, liver enlargement, muscular pain. Nasal administration beneficial in migraine, asthma and headache. Roots and seeds as expectorant .
5	*Terminalia arjuna*	Arjun	Fruit, Bark	Used as astringent, cardiac stimulant, hemostatic, rejuvenative tonic and lithontriptic. antidysenteric and febrifugal. Has great role in hypertension, IHD or ischemic heart disease, cardiac failure.
6	*Withania somnifera*	Aswagandha	Roots, fruits and seeds	Roots for bronchitis, dropsy, heart diseases, breathing troubles. Fruits and seeds as diuretic. Leaves as antipyretic, anthelmentic.

Diagnoses of Seedlings

Andrographis paniculata (Burm. f.) Wall. ex Ness in Wall.

Seedling epigeal, phanerocotylar. Taproot shortly elongating, glabrous. Hypocotyl strongly elongating, glabrous. Paracotyledons two, opposite, exstipulate, petiolate; suborbicular (0.5 cm-1.0 cm x 0.5 cm-1.0 cm); base truncate, apex shallowly retuse, margin entire; primary vein one, brochidodromous. Internodes terete, soft, glabrous; first internode, next internodes almost same as that of first one. First two leaves opposite, simple, exstipulate, petiolate; blade ovate (0.6 cm-1.2 cm x 0.4 cm-0.6 cm), base rounded, apex acute, margin entire, glabrous; primary vein one, brochidodromous. Subsequent leaves opposite decussate, ovate-elliptic,

gradually increasing in size. Other characters almost same as that of first two leaves. (Figs.1:a).

***Bacopa monnieri* (L.) Penn.**

Seedling epigeal, phanerocotylar. Taproot shortly elongating, glabrous. Adventitious roots arising from the hypocotyls and lower nodes, shortly elongating. Hypocotyl shortly elongating, terete, glabrous. Paracotyledons two, opposite, exstipulate , petiolate; obovate (0.17 cm-0.19 cm x 0.06 cm-0.08 cm); base cuneate, apex obtuse, margin entire; veins inconspiquous. Internodes terete, glabrous; first internode 0.5cm-1cm; next internodes same as first one. First two leaves opposite, simple, herbaceous, exstipulate, petiolate; blade obovate (0.3 cm-0.4 cm x 0.1 cm-0.18 cm), base cuneate, apex rounded, margin entire; primary vein one, hyphodromous. Subsequent leaves opposite decussate; gradually increasing in size. Other characters almost same as that of first two leaves.

***Phyllanthus amarus* Schum. & Thonn.**

Seedling epigeal, phanerocotylar. Taproot shortly elongating, glabrous. Hypocotyl shortly elongating, terete, glabrous. Paracotyledons two, opposite, exstipulate, petiolate; ovate (0.2 cm-0.3 cm x 0.2 cm-0.3 cm); base subrounded, apex rounded, margin entire; primary vein one, hyphodromous. Internodes terete, glabrous, first internode 0.4 cm-0.5 cm, internodes same as that of first one. First two leaves alternate, simple, stipulate, petiolate; blade obovate (0.4 cm-0.5 cm x 0.1 cm-0.3 cm), base cuneate, apex subtruncate, margin entire; primary vein one, brochidodromous. Subsequent leaves wide obovate, gradually increasing in size. Other characters almost same as that of first two leaves. (Figs. 1:b).

***Solanum virginianum* L.**

Seedling epigeal, phanerocotylar. Taproot strongly elongating,glabrous. Hypocotyl shortly elongating, hairy. Paracotyledons two, opposite, exstipulate, petiolate, narrow ovate (0.5 cm-0.6 cm x 0.3 cm-0.4 cm); base obtuse, apex acuminate, margin entire; primary vein one, brochidodromous. Internodes terete; first internode 0.2 cm-0.3 cm, next internodes almost equal to first one. First two leaves alternate, simple, exstipulate, petiolate, blade ovate (0.8 cm-1.0 cm x 0.6 cm-0.7 cm), base oblique, apex obtuse, margin subentire; primary vein one, semicraspedodromous. Subsequent leaves blade pinnatisect, apex acute, base truncate, margin sinuately lobed to pinnatifid, spine present. Other characters almost same as that of first two leaves. (Figs. 1:c).

***Terminalia arjuna* (Roxb.ex DC.) Wight. & Arn:** Seedling epigeal, phanerocotylar. Taproot strongly elongating, glabrous. Hypocotyl strongly elongating, pubescent. Paracotyledons two, opposite, exstipulate, petiolate; flabellate (1.7 cm-2.1 cm x 3.0 cm-3.5 cm); base rounded, apex truncate, margin entire; primary vein three, actinodromous. Internodes terete, green, soft, glabrous; first internode 1.0 cm-1.1 cm long, next internodes equal to first one. First two leaves opposite, simple, exstipulate, petiolate, elliptic (3.1 cm-3.2 cm x 0.6 cm-0.7 cm), base cuneate, apex acuminate, margin distantly serrate, glabrous; primary vein one, brochidodromous. Subsequent leaves alternate, gradually increasing in size. Other characters almost same as that of first two leaves. (Figs. 1:d).

***Withania somnifera*(L.) Dunal:** Seedling epigeal, phanerocotylar. Taproot shortly elongating, hairy. Hypocotyl strongly elongating, 3.5 cm–4.0 cm long, hairy. Paracotyledons two, opposite, herbaceous, exstipulate, petiolate, lanceolate (1.1 cm-1.3 cm x 0.2 cm-0.3 cm); base cuneate, apex acute, margin entire; primary vein one, eucamptodromous. Internodes terete, scabrous; first internode 0.3 cm-0.5 cm, next internodes equal to first one. First two leaves subopposite, simple, exstipulate, petiolate; ovate (1.2 cm-1.3 cm x 1.0 cm-1.1 cm), base rounded, apex obtuse, margin entire; primary vein one, semicraspedodromous. Subsequent leaves alternate elliptic-ovate, gradually increasing in size. Other characters almost same as that of first two leaves. (Figs.1:e).

Key to Seedlings

1a. Seedlings with Paracotyledons flabellate……*Terminalia arjuna*

1b. Seedlings with Paracotyledons otherwise

2a. First two leaves obovate

3a. First two leaves alternate, stipulate, apex subtruncate, venation brochidodromous…….……*Phyllanthus amarus*

3b. First two leaves opposite, exstipulate, blade obovate apex rounded, venation hyphodromous……... *Bacopa monnieri*

2b. First two leaves ovate

4a. Paracotyledons suborbicular…*Andrographis paniculata*

4b. Paracotyledons ovate or lanceolate

5a.Subsequent leaves pinnatisect, margin sinuately lobed to pinnatifid, spines present…….....*Solanum virginianum*

5b.Subsequent leaves elliptic-ovate, margin entire, unarmed……*Withania somnifera*

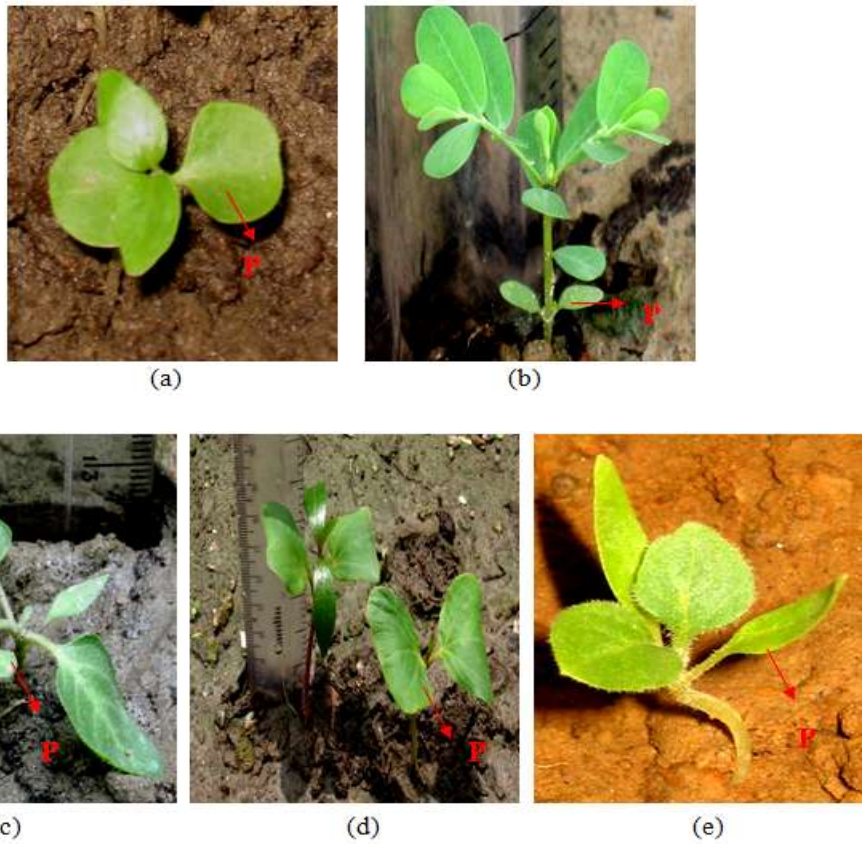

Plate I : Seedling morphological diversity among the investigated taxa

a) ***Andrographis paniculata*** **(x 1.5)**
b) ***Phyllanthus amarus*** **(x 1.5)**
c) ***Solanum virginianum*** **(x 2)**
d) ***Terminalia arjuna*** **(x 1.5)**
e)) ***Withania somnifera*****(x 1.5)**

DISCUSSION

In the present investigation, six seedlings have been taken up for study which has immense medicinal importance (Table. 1) and therefore overexploited. Although the characters of seedlings are limited in number, their diversity is so great that specific combination of characters may serve for seedling identification. With the essence of this idea, the study of seedling morphology of the taxa as considered in this treatment has been exploited for the purpose of identification.

CONCLUSION

The data obtained in the present study help in the demarcation of taxa. With the help of seedling morphology, we can identify these plants easily and establish sustainable use of medicinal plants from wild.

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