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Seedling Morphology of Taki, North 24 Parganas, West Bengal

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ABSTRACT: Seedling morphology was studied from different parts of Taki, North 24 Parganas, West Bengal. A total of 139 taxa was described and illustrated. Seedling morphological data are used as taxonomic markers in the systematic consideration of angiosperms. Using these characters, artificial key for the identification of taxa of different seedling groups has been developed which helps in the identification of plants at juvenile stage much earlier before flowering and fruiting stage.

KEYWORDS: cotyledons, seedlings, morphology.

I. INTRODUCTION

Seedling characters are as important and reliable as that of floral one in the delimitation of species, genera and sometimes families. The characters of seedlings are limited in number, but their diversity is large and thus their assemblage serves the purpose of identification. Considerable works have been done on the seedling flora in tropical and temperate regions (Duke, 1965; Burger 1972; Muller, 1978; de Vogel, 1980; Ye, 1983; Hladik & Miquel, 1990; Welling, 2000), but in India, no work has been done on seedling flora, hence an attempt has been made on the proposed topic.

Seedlings have mostly been classified into two main groups, based on the position of para(cotyledons) and whether or not the testa and fruit wall are shed. On germination, the majority of dicotyledons conform to two of several patterns of development. The cotyledons are either extruded from the testa to serve as photosynthetic organs or they remain enclosed. When the cotyledons emerge from the testa, the seedlings are described as phanerocotylar, and when they have not and remain enveloped in the testa as cryptocotylar (Duke, 1965). An alternative terminology, often applied to seedlings, reflects the position of the cotyledons with respect to the soil surface and whether the hypocotyl is developed or not. When the cotyledons are raised above the soil surface and hypocotyl is developed, germination is described as epigeal and when they remain in the soil and hypocotyl is undeveloped, as hypogeal (Ng, 1978).

From the beginning after reclamation, the area became occupied gradually by distribution of different plants through the dispersal and migration of diaspores. Now the study area in question is represented by large population of flowering plants, which were studied floristically in part earlier (Das Gupta, 1973).

Taki is a town and a municipality under Hasnabad police station of Basirhat subdivision in North 24 Parganas district in the Indian state of West Bengal. Taki is located at 22.59°N 88.92°E. It has an average elevation of 5 metres (16 feet) at the bank of Ichamati River. A part of the flora of Taki represent cultivated and avenue trees. Many of them are of medicinal and economic values and some are rare species. They reproduce by seeds giving rise to seedlings. But many of the seedlings decline due to biotic interference. If these seedlings are readily identified in the field, these may be protected or transplanted to safe site depending on their use and necessity. Moreover, the seedling plants to be studied in the area will represent different taxonomic assemblage leading to systematic studies of seedling flora in the area in respect of morphological parameters of seedlings.

II. MATERIALS AND METHODS

Various localities of different sectors of Taki, North 24 Parganas, West Bengal were explored for collections of plant materials including fruits, seeds and/or seedlings of herbs, shrubs and trees during the course of this investigation (Table 1).

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After collection, the specimens were pressed, preserved and mounted on herbarium sheets following the standard and modern herbarium techniques (Jain and Rao, 1977). For identification of adult specimens, these were collected and matched with the specimens at the Central National Herbarium (CAL) and the Calcutta University Herbarium (CUH).

The seeds were grown in experimental-cum-Botanic Garden, of the Department of Botany, Calcutta University. The seedlings were observed during several stages of growth and development. The natural seedlings were compared and studied with those of seedlings raised from seeds in the garden using a stereo-microscope. The specimens were photographed, and documented in the form of herbarium sheets. They were compared and identified with the help of seedlings raised from identified seeds. At least five to ten specimens of each growth forms were studied from various habitats. The voucher specimens have been deposited in the Calcutta University Herbarium (CUH). The specimens were described following the terminology as proposed by Burger (1972), Hickey(1973) and Vogel(1980). Based on the morphological characters, an artificial key was constructed and 138 species were categorized under eight seedling groups. Under each seedling group, a key has been constructed for identification of concerned taxa at seedling stage. In preparing the Group Key and Key to taxa, the concept of Muller(1978) for identification of Seedlings of the North-Western European Lowland Flora has been followed here.

The detail and critical studies of the seedling morphology of 138 species under 112 genera belonging to 38 families (Table 1) provide scope for the construction of artificial keys to be used for the identification of the investigated taxa.

Table 1: List of investigated taxa (Families are arranged alphabetically and the genera under each family are also arranged alphabetically).

Acanthaceae <i>Acanthus ilicifolius</i> L.	Amaranthaceae
<i>Andrographis paniculata</i> (Burm.f.) Wall. ex Nees	<i>Achyranthes aspera</i> L.
<i>Barleria prionitis</i> L.	<i>Amaranthus spinosus</i> L.
<i>Ecbolium viride</i> (Forssk.) Alston	<i>Amaranthus viridis</i> L.
<i>Hemigraphis hirta</i> (Vahl) T. Anderson	Annonaceae
<i>Justicia diffusa</i> Willd.	<i>Polyalthia longifolia</i> (Sonn.) Thw.
<i>Ruellia tuberosa</i> L.	Apocynaceae
<i>Rungia pectinata</i> (L.) Nees	<i>Thevetia peruviana</i> (Pers.) K. Schum.
Aizoaceae	Asclepiadaceae
<i>Trianthema portulacastrum</i> L.	<i>Pergularia daemia</i> (Forssk.) Chiov.
Bignoniaceae	Euphorbiaceae
<i>Millingtonia hortensis</i> L.f.	<i>Acalypha indica</i> L.
<i>Spathodea campanulata</i> Beauv.	<i>Chrozophora plicata</i> (Vahl) A. Juss.
<i>Tabebuia chrysantha</i> (Jacq.) Nichols.	<i>Croton bonplandianum</i> Baill.
<i>Tecoma stans</i> (L.) Juss. ex Kunth	<i>Euphorbia heterophylla</i> L.
Bombacaceae	<i>Euphorbia heyneana</i> L.
<i>Ceiba pentandra</i> L.	<i>Euphorbia hirta</i> L.
Boraginaceae	<i>Jatropha gossypifolia</i> L.
<i>Heliotropium indicum</i> L.	<i>Micrococca mercurialis</i> (L.) Benth.
Capparidaceae	<i>Phyllanthus amarus</i> Schum. & Thonn.
<i>Cleome rutidosperma</i> DC.	<i>Phyllanthus reticulatus</i> Poir.
<i>Cleome viscosa</i> L.	<i>Phyllanthus urinaria</i> L.
	<i>Ricinus communis</i> L.

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Combretaceae	<i>Anisomeles indica</i> (L.) O.Kuntze.
<i>Terminalia arjuna</i> (Roxb. ex DC).Wight & Arn.	<i>Hyptis suaveolens</i> (L.) Poit.
<i>Terminalia bellirica</i> (Gaertn.) Roxb.	<i>Leonurus sibiricus</i> L.
<i>Terminalia catappa</i> L.	<i>Leucas aspera</i> (Willd.) Link
<i>Terminalia chebula</i> Retz.	<i>Leucas cephalotes</i> (Roth) Spreng.
Compositae (Asteraceae)	Leguminosae (Fabaceae)
<i>Ageratum conyzoides</i> L.	<i>Acacia auriculiformis</i> A. Cunn. ex Benth.
<i>Eclipta prostrata</i> (L.)L.	<i>Atylosia scarabaeoides</i> (L.) Benth.
<i>Gnaphalium polycaulon</i> Pers.	<i>Bauhinia purpurea</i> L.
<i>Mikania micrantha</i> Kunth	<i>Butea monosperma</i> (Lam.) Taub.
<i>Parthenium hysterophorus</i> L.	<i>Calliandra umbrosa</i> Benth.
<i>Synedrella nodiflora</i> (L.)Gaertn.	<i>Cassia alata</i> L.
<i>Tridax procumbens</i> L.	<i>Cassia fistula</i> L.
<i>Vernonia cineria</i> (L.)Less.	<i>Cassia siamea</i> Lam.
<i>Xanthium indicum</i> Koen.	<i>Cassia sophera</i> L.
Convolvulaceae	<i>Cassia tora</i> L.
<i>Hewittia sublobata</i> (L.f.) Ktze.	<i>Clitoria ternatea</i> L.
<i>Ipomoea chryseides</i> Ker Gawl.	<i>Crotalaria pallida</i> W.Aiton
<i>Ipomoea pes-tigridis</i> L.	<i>Crotalaria verrucosa</i> L.
<i>Ipomoea quamoclit</i> L.	<i>Dalbergia sissoo</i> Roxb. ex DC.
<i>Porana paniculata</i> Roxb.	<i>Delonix regia</i> (Bojer ex Hook.) Raf.
Cruciferae (Brassicaceae)	<i>Desmodium gangeticum</i> (L.) DC.
<i>Rorippa indica</i> (L.) Hiern	<i>Desmodium triflorum</i> (L.) DC.
Cucurbitaceae	<i>Leucaena leucocephala</i> (Lam.) de Wit.
<i>Coccinia grandis</i> (L.)Voigt	<i>Millettia ovalifolia</i> (Wight & Arn.) Kurz
<i>Mukia maderaspatana</i> (L.) M.J. Roem.	<i>Mimosa pudica</i> L.
Lythraceae	<i>Peltophorum pterocarpum</i> (DC.) Baker ex K.Heyne
<i>Lagerstroemia speciosa</i> (L.) Pers.	<i>Pithecellobium dulce</i> (Roxb.) Benth.
Malvaceae	<i>Pongamia pinnata</i> (L.) Pierre
<i>Malachra capitata</i> (L.)L.	<i>Samanea saman</i> (Jacq.) Merr.
<i>Sida acuta</i> L.	<i>Saraca asoca</i> (Roxb.) De Wilde
<i>Urena lobata</i> L.	<i>Sesbania cannabina</i> (Retz.) Pers.
<i>Urena sinuata</i> L.	<i>Sesbania grandiflora</i> (L.) Poir.
Martyniaceae	<i>Sesbania sesban</i> (L.) Merr.
<i>Martynia annua</i> L.	<i>Tephrosia purpurea</i> (L.) Pers.
Meliaceae	<i>Teramnus labialis</i> (L.f.) Spreng.
<i>Azadirachta indica</i> A. Juss.	Solanaceae
Myrtaceae	<i>Cestrum diurnum</i> L.
<i>Syzygium cumini</i> (L.) Skeels	<i>Datura metel</i> L.
Nyctaginaceae	<i>Nicotiana plumbaginifolia</i> Viv.
<i>Boerhaavia repens</i> L.	<i>Physalis minima</i> L.
Oleaceae	<i>Solanum nigrum</i> L.
<i>Nyctanthes arbor-tristis</i> L.	<i>Solanum sisymbriifolium</i> Lam.
	<i>Solanum torvum</i> Sw.
	<i>Solanum violaceum</i> Ortega
	<i>Solanum virginianum</i> L.
Papaveraceae	<i>Withania somnifera</i> (L.) Dunal
<i>Argemone mexicana</i> L.	Sterculiaceae
Pedaliaceae	<i>Kleinhovia hospita</i> L.

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<i>Pedalium murex</i> L.	<i>Melochia corchorifolia</i> L.
<i>Sesamum indicum</i> L.	<i>Sterculia foetida</i> L.
Piperaceae	Tiliaceae
<i>Peperomia pellucida</i> (L.) Kunth.	<i>Triumfetta rhomboidea</i> Jacq.
Polygonaceae	Verbenaceae
<i>Polygonum orientale</i> L.	<i>Clerodendrum viscosum</i> Vent.
<i>Rumex dentatus</i> L.	<i>Lantana camara</i> L.
Rubiaceae	<i>Lippia nodiflora</i> (L.) Michx.
<i>Oldenlandia corymbosa</i> L.	<i>Tectona grandis</i> L.f.
<i>Oldenlandia paniculata</i> L.	Vitaceae
<i>Spermacocce articularis</i> L.f.	<i>Cayratia trifolia</i> (L.) Domin.
Sapotaceae	Zygophyllaceae
<i>Madhuca longifolia</i> (Koenig) Macbride	<i>Tribulus terrestris</i> L.
<i>Mimusops elengi</i> L.	Tiliaceae
Scrophulariaceae	<i>Triumfetta rhomboidea</i> Jacq.
<i>Bacopa monnieri</i> (L.) Penn.	Verbenaceae
<i>Lindenbergia indica</i> (L.) O. Kuntze	<i>Clerodendrum viscosum</i> Vent.
<i>Lindernia crustacea</i> (L.) F. Muell.	<i>Lantana camara</i> L.
<i>Mazus pumilus</i> (Burm.f.) Steenis	<i>Lippia nodiflora</i> (L.) Michx.
<i>Mecardonia procumbens</i> (Miller) Small	<i>Tectona grandis</i> L.f.
<i>Scoparia dulcis</i> L.	Vitaceae
	<i>Cayratia trifolia</i> (L.) Domin.
	Zygophyllaceae
	<i>Tribulus terrestris</i> L.

III. OBSERVATIONS AND RESULTS

Based on the morphological characters (Table 2), 139 investigated species are categorized under eight seedling Groups (Plate I). Under each seedling group, a key has been constructed for identification of concerned taxa at seedling stage.

Table 2: Different seedling groups based on seedling morphological characters

Seedling Group	Seedling Features	No. of Seedling Taxa Studied Under Each Group Showing Percentage	Examples
Group I	First two leaves simple; subsequent leaves simple; first two and subsequent leaves alternate	46 (33.09%)	<i>Ipomoea pes-tigridis</i> , <i>Polyalthia longifolia</i> , etc.
Group II	First two leaves simple; subsequent leaves simple; first two leaves opposite; subsequent leaves alternate	13 (9.35%)	<i>Acalypha indica</i> , <i>Madhuca longifolia</i> , etc.

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Group III	First two leaves simple; subsequent leaves simple; first two leaves opposite; subsequent leaves opposite	42 (30.21%)	<i>Synedrella nodiflora</i> , <i>Nyctanthes arbor-tristis</i> , etc.
Group IV	First two leaves simple; subsequent leaves compound ; first two and subsequent leaves alternate	1 (0.72%)	<i>Pongamia pinnata</i>
Group V	First two leaves simple, opposite; subsequent leaves compound, opposite	3 (2.15%)	<i>Tecoma stans</i> , <i>Tabebuia chrysantha</i> , <i>Spathodea campanulata</i>
Group VI	First two leaves simple, opposite; subsequent leaves compound, alternate	6 (4.32%)	<i>Clitoria ternatea</i> , <i>Atylosia scarabaeoides</i> , etc.
Group VII	First two leaves compound and subsequent leaves compound; first two leaves alternate	18 (12.94%)	<i>Leucaena leucocephala</i> , <i>Pithecellobium dulce</i> , etc.
Group VIII	First two leaves compound and subsequent leaves compound; first two leaves opposite	10 (7.19%)	<i>Azadirachta indica</i> , <i>Cleome rutidosperma</i> , etc.

Diagnosis of the taxa

Acanthus ilicifolius L.

(Up to 4th leaves stages)

Seedling epigeal, phanerocotylar. Taproot shortly elongating, 3.5cm-4cm long, hardy, whitish-green, straight, glabrous; side roots long, branched. Hypocotyl elongating, 4cm-4.2cm, stout, terete, green, glabrous. Cotyledons two, equal, ovate (0.4cm-0.5cm x 0.2cm-0.3cm), base cuneate, apex rounded, sessile; green, covered by whitish green testa, glabrous, semi-succulent. Internodes terete, brownish-green, glabrous; first internode 5cm-5.2cm, second internode 2.5cm-3cm, next internodes almost same as that of second one. First two leaves opposite, simple, exstipulate, petiolate; petiole 1cm-1.2cm, terete, glabrous; blade lanceolate (6.5cm-6.8cm x 2.1cm- 2.3cm), base cuneate, apex acute, margin undulate; primary vein one, simple craspedodromous; surface glabrous. Subsequent leaves opposite decussate; margin sinuous, spiny after emergence of three to four pairs of leaves gradually increasing in size. Other characters same as that of first two leaves. (Figs. 65: A; Pl. XXI: a)

Andrographis paniculata (Burm. f.) Wall. ex Ness in Wall. Seedling epigeal, phanerocotylar. Hypocotyl strongly elongating, 2.0 cm-3.0 cm long, terete, glabrous. Paracotyledons two, opposite, exstipulate, petiolate; petiole 0.1 cm-0.4 cm, glabrous; blade 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, glabrous. Eophylls opposite to opposite-decussate, simple, exstipulate, petiolate; petiole 0.3 cm-0.4 cm, terete, glabrous; blade ovate to ovate-elliptic (0.6 cm-1.2 cm x 0.4 cm-0.6 cm), base rounded, apex acute, margin entire, glabrous; primary vein one, brochidodromous (Pl. I: a).

Barleria prionitis L., Seedling epigeal, phanerocotylar. Hypocotyl strongly elongating, 3.2 cm-3.5 cm long, terete, glabrous. Paracotyledons two, opposite, exstipulate, petiolate; petiole 0.3 cm-0.5 cm, pubescent; blade suborbicular (0.8 cm-1.0 cm x 0.9 cm-1.0 cm); base oblique, apex obtuse, margin entire; primary vein one, eucamptodromous. Internodes terete, glabrous; Eophylls opposite to opposite-decussate, simple, exstipulate, petiolate; petiole 0.2 cm-0.3 cm, terete, glabrous; blade elliptic (2.6 cm-3.8 cm x 1.0 cm-1.8 cm), base attenuate to cuneate, apex acute to shortly acuminate, margin entire, glabrous; primary vein one, eucamptodromous. (Pl. I: b).

Ecbolium viride (Forssk.) Alston, Seedling epigeal, phanerocotylar. Hypocotyl strongly elongating, 2.8 cm- 4.0 cm, terete, glabrous. Paracotyledons two, opposite, exstipulate, petiolate; petiole 0.1 cm-0.2 cm, glabrous; blade orbicular (0.6 cm-0.8 cm x 0.7 cm-0.9 cm); base unequal, apex rounded, margin entire; primary vein one, brochidodromous, glabrous. Internodes lower cylindrical, upper angular, glabrous; Eophylls opposite to opposite decussate, simple, exstipulate, petiolate; petiole 0.2 cm-0.4 cm, terete, glabrous; blade elliptic (1.5 cm-2.5 cm x 0.6 cm-0.8 cm), base attenuate, apex acuminate, margin entire, minutely hairy; primary vein one, eucamptodromous. (Pl. I: c)

Hemigraphis hirta (Vahl) T. Anders. Seedling epigeal, phanerocotylar. Hypocotyl reduced, 0.1 cm, terete, scabrous. Paracotyledons two, opposite, exstipulate, petiolate; petiole 0.3 cm-0.5 cm, scabrous; blade orbicular (0.4 cm-0.5 cm x 0.4 cm-0.6 cm); base truncate, apex rounded, margin entire; primary vein one, brochidodromous. Internodes terete, glabrous; first internode 0.5 cm-1.5 cm long, second one 2.0 cm-2.6 cm long; next internodes almost same as that of

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first one. *Eophylls* opposite to opposite decussate, simple, exstipulate, petiolate; petiole 0.4 cm-0.8 cm, terete, glabrous; blade ovate (0.8 cm-1.3 cm x 0.6 cm-0.9 cm), base cuneate, apex rounded to obtuse, margin entire, glabrous; primary vein one, brochidodromous. (Pl. I : d)

Justicia diffusa Willd. *Seedling* epigeal, phanerocotylar. *Hypocotyl* shortly elongating, 1.0 cm-1.2 cm, terete, hairy. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.1cm-0.4 cm, hairy; blade orbicular (0.5 cm-0.8 cm x 0.5 cm-0.8 cm); base truncate, apex rounded, margin entire; primary vein one, eucamptodromous. *Internodes* terete, glabrous. *Eophylls* opposite to opposite decussate, simple, exstipulate, petiolate; petiole 0.3 cm-0.4 cm, terete, glabrous; blade ovate to ovate-elliptic(0.4 cm-0.5 cm x 0.4 cm-0.5 cm), base rounded, apex acute, margin entire, glabrous; primary vein one, semicraspedodromous. (Pl. I : e)

Ruellia tuberosa L. *Seedling* epigeal, phanerocotylar. *Hypocotyl* shortly elongating, 0.5 cm-0.7 cm, terete, scabrous. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.3 cm-0.5 cm, glabrous; blade ±orbicular (0.6 cm-0.7 cm x 0.6 cm-0.7 cm); base truncate, apex rounded, margin entire; primary vein three, acrodromous. *Internodes* terete, glabrous. *Eophylls* opposite to opposite decussate, simple, exstipulate, petiolate; petiole 0.4 cm-0.8 cm, terete, glabrous; blade obovate-oblong (1.2 cm-2.4 cm x 0.6 cm-1.0 cm), base attenuate, apex rounded to obtuse, margin entire, glabrous; primary vein one, brochidodromous. (Pl. I : f)

Rungia pectinata (L.) Nees in DC. *Seedling* epigeal, phanerocotylar. *Hypocotyl* shortly elongating, 1.0 cm-1.5 cm, terete, glabrous. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.3 cm-0.5 cm, pubescent; blade wide ovate (0.2 cm-0.3 cm x 0.2 cm-0.3 cm); base subrounded, apex rounded, margin entire; primary vein three, acrodromous. *Internodes* terete, glabrous; *Eophylls* opposite to opposite decussate, simple, exstipulate, petiolate; petiole 0.2 cm-0.3 cm, terete, glabrous; blade ovate (1.8 cm-2.3 cm x 1.1 cm-1.5 cm), base rounded, apex acute to obtuse, margin entire, glabrous; primary vein one, brochidodromous. (Pl. I : g)

Aizoaceae

Trianthema portulacastrum L. *Seedling* epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 1.6 cm-1.9 cm long, purplish, glabrous. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.3 cm-0.5 cm, pubescent; blade linear (1.5 cm-2.3 cm x 0.2 cm-0.4 cm); base cuneate, apex obtuse, margin entire with purple line; primary vein one, hyphodromous. *Internodes* terete, green, soft, glabrous; *Eophylls* opposite to opposite decussate, simple, unequal, succulent, stipulate, petiolate; petiole 0.8 cm-1.1 cm, terete, glabrous; blade obovate to oblong (1.5 cm-2.3 cm x 0.8 cm-1.1 cm), base cuneate, apex acute to rounded, margin entire with purple line, glabrous; primary vein one, brochidodromous. (Pl. I : h).

Amaranthaceae

Achyranthes aspera L. *Seedling* epigeal, phanerocotylar. *Hypocotyl* shortly elongating, 1.2 cm-1.5 cm long, terete, creamish, scabrous. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.3 cm-0.4 cm, glabrous; blade lanceolate (2.4 cm-2.5 cm x 0.5 cm-0.6 cm); base cuneate, apex acute, margin entire; primary vein one, hyphodromous. *Internodes* terete, hirsute. *Eophylls* alternate, simple, herbaceous, exstipulate, petiolate; petiole 0.2 cm-0.5 cm, hirsute; blade elliptic to ovate-elliptic (3.4 cm-5.0 cm x 2.7 cm-2.8 cm), base cuneate, apex obtuse, margin entire to slightly undulate, primary vein one, brochidodromous (Pl. I : i).

Amaranthus spinosus L. *Seedling* epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 2.2 cm-2.5 cm long, terete, creamish, glabrous. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.3 cm-0.4 cm, glabrous; blade lanceolate (0.4 cm-0.5 cm x 0.1 cm-0.2 cm); base cuneate, apex obtuse, margin entire; primary vein one, hyphodromous. *Internodes* terete, hirsute; *Eophylls* alternate, simple, exstipulate, petiolate; petiole 0.8 cm-1.0 cm, glabrous; blade elliptic to ovate-elliptic (1.2 cm-1.3 cm x 0.3 cm-0.5 cm), base cuneate, apex retuse, margin entire, primary vein one, semicraspedodromous. (Pl. II : a).

Amaranthus viridis L. *Seedling* epigeal, phanerocotylar. *Hypocotyl* shortly elongating, 1.2 cm-1.5 cm long, terete, creamish, glabrous. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.3 cm-0.4 cm, glabrous; blade lanceolate (0.4 cm-0.5 cm x 0.1 cm-0.2 cm); base cuneate, apex obtuse, margin entire; primary vein one, hyphodromous. *Internodes* terete, hirsute; *Eophylls* alternate, simple, exstipulate, petiolate; petiole 0.8 cm-1.0 cm, glabrous; blade ovate (1.2 cm-1.3 cm x 0.3 cm-0.5 cm), base cuneate, apex retuse, margin entire, with reddish tinge, primary vein one, semicraspedodromous. (Pl. II : b).

Annonaceae

Polyalthia longifolia (Sonn.) Thw. *Seedling* hypogaeal, cryptocotylar. *Hypocotyl* elongating, subterranean, 0.4 cm-1.0 cm long, terete, moderately hardy, *Cotyledons* two, secund, exstipulate, petiolate; petiole semiterete, yellowish creamy, with a longitudinal groove with the pale creamy brown testa persistent, distinctly clasping the epicotyl in the

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cotyledonary node, ± 0.1 cm long and glabrous, covered by shining brown persistent hard seed coat, ellipsoid (1.2 cm-1.3 cm x 0.3 cm-0.4 cm); veins indistinct. *Internodes* terete, hirsute; *Eophylls* alternate, simple, exstipulate, petiolate; petiole 0.4 cm-0.7 cm, terete, glabrous; blade elliptic-oblong (4.4 cm-5.0 cm x 2.1 cm-2.3 cm), base obtuse, apex acuminate, margin entire; primary vein one, brochidodromous. (Pl. II: c).

Apocynaceae

Thevetia peruviana (Pers.) K. Schum. *Seedling* epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 2.5 cm-3.1 cm long, purplish, glabrous. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.1 cm-0.2 cm, glabrous; blade obovate (2.2 cm-2.3 cm x 0.6 cm-0.7 cm); base cuneate, apex rounded, margin entire; primary vein one, hyphodromous. *Internodes* terete, glabrous. *Eophylls* opposite, simple, herbaceous, exstipulate, petiolate; petiole 0.2 cm-0.3 cm, terete, hairy; blade lanceolate (1.5 cm-2.3 cm x 0.8 cm-1.1 cm), base attenuate, apex acuminate, margin entire, glabrous; primary vein one, brochidodromous. (Pl. II: d).

Asclepiadaceae

Pergularia daemia (Forssk.) Chiov. *Seedling* epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 3.9cm-5.5cm long, terete, reddish, pubescent. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.2 cm-0.3 cm, hairy; blade wide oblong (1.6 cm-1.7 cm x 0.4 cm-0.5 cm); base subtruncate, apex rounded, margin entire; primary vein three, actinodromous. *Internodes* terete, hirsute; *Eophylls* opposite, simple, exstipulate, petiolate; petiole 2.3 cm-2.5 cm, terete, hairy; blade cordiform (3.0 cm-3.3 cm x 2.3 cm-2.8 cm), base cordate, apex acute, margin entire, primary vein three, actinodromous. (Pl. II: e).

Bignoniaceae

Millingtonia hortensis L.f.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 3.6 cm-5.5 cm long, terete, glabrous. *Cotyledons* two, opposite, succulent, exstipulate, petiolate; petiole 0.2 cm-0.3 cm, glabrous; blade lanceolate (1.0 cm-1.5 cm x 0.1 cm-0.2 cm); base cuneate, apex obtuse, margin entire; primary vein one, veins indistinct. *Internodes* terete, glabrous; *Eophylls* first two leaves opposite, compound, trifoliolate, exstipulate, petiolate; petiole 0.5 cm-1.0 cm, terete, glabrous; leaflets ovate-lanceolate (1.5 cm-1.8 cm x 1.3 cm-1.4 cm), base cuneate, apex acute, margin incised, glabrous; primary vein one, brochidodromous. subsequent leaves alternate, apex acuminate, base rounded. (Pl. II: f).

Spathodea campanulata Beauv.

Seedling epigeal, phanerocotylar. *Hypocotyl* shortly elongating, 1.3 cm-1.5 cm long, terete, brownish, hairy. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.4 cm-0.7 cm, glabrous; blade bilobed, slightly wider than long, (1.1 cm-1.2 cm x 0.9 cm-1.3 cm); base subtruncate, apex emarginate, apex of each lobe rounded, margin entire; primary vein one, hyphodromous. *Internodes* terete, hirsute; *Eophylls* opposite, simple, subsequent leaves compound from eighth- tenth leaved stages, exstipulate, petiolate; petiole 0.2 cm-0.3 cm, terete, pubescent; blade ovate to ovate-elliptic (2.8 cm-3.6 cm x 1.8 cm-2.3 cm), base rounded, apex acute to acuminate, margin serrate, hairy; primary vein one, brochidodromous. (Pl. II: g).

Tabebuia chrysantha (Jacq.) Nichols.

Seedling geal, phanerocotylar. *Hypocotyl* strongly elongating, 2.0 cm-3.0 cm long, terete, brownish, hairy. *Paracotyledons* two, opposite, exstipulate, short petiolate; petiole 0.2 cm-0.3 cm, glabrous; blade bilobed (1.2 cm-1.6cm x 0.9 cm-1.3 cm); base truncate, apex deeply retuse, margin entire; primary vein one, hyphodromous. *Internodes* terete, hirsute; *Eophylls* opposite, simple, herbaceous, exstipulate, short petiolate; petiole 0.1 cm-0.2 cm, terete, pubescent; blade elliptic (3.5 cm-3.8 cm x 1.1 cm-1.3 cm), base cuneate, apex acute, margin entire, hairy; primary vein one, brochidodromous. (Pl. II: h).

Tecoma stans (L.) Juss. ex H.B & K.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 2.5 cm-4.0 cm long, terete, brownish, hairy. *Paracotyledons* two, opposite, exstipulate, subsessile; petiole ± 0.1 cm, glabrous; blade bilobed, much wider than long, (1.0 cm-1.1 cm x 1.7 cm-1.9 cm); base subtruncate, apex broadly emarginate, margin entire; primary vein one, veins inconspicuous. *Internodes* terete, hirsute; *Eophylls* opposite, simple, compound, imparipinnate from 10th-13th leaves stage, exstipulate, petiolate; petiole 0.3 cm-0.5 cm, terete, glabrous; blade ovate to elliptic oblong (2.1 cm-3.3 cm x 1.3 cm-1.8 cm), base cuneate, apex acute, margin serrate, hairy; primary vein one, brochidodromous (Pl. II: i).

Bombacaceae

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Ceiba pentandra (L.) Gaertn.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 4.0 cm – 5.5 cm long, terete, reddish, glabrous. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.2 cm-0.3 cm, hairy; blade cordiform (0.8 cm-0.9 cm x 0.8 cm-0.9 cm); base ±cordate, apex acuminate, margin entire; primary vein one, brochidodromous. *Internodes* terete, hirsute; *Eophylls* alternate, compound, trifoliolate to pentafoliolate, herbaceous, stipulate, petiolate; petiole 1.3 cm-1.5 cm, terete, hairy; blade elliptic to elliptic-oblong (0.9 cm-1.3 cm x 1.3 cm-1.8 cm), base rounded, apex acuminate, margin entire, primary vein one, semicraspedodromous (**Pl. III: a**).

Boraginaceae

Heliotropium indicum L. *Seedling* epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 2.0 cm–2.5 cm, terete, reddish, scabrous. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.2 cm-0.3 cm, hairy; blade ±oblong (0.5 cm-0.7 cm x 0.3 cm-0.4 cm); base cuneate, apex rounded, margin entire; primary vein one, brochidodromous. *Internodes* terete, hirsute. *Eophylls* first two leaves opposite, subsequent leaves alternate, simple, chartaceous, exstipulate, petiolate; petiole 0.3 cm-0.5 cm, terete, hairy; blade ovate-elliptic to elliptic-oblong (0.6 cm-1.3 cm x 0.3 cm-0.8 cm), base cuneate to attenuate, apex acute to obtuse, margin undulate, primary vein one, semicraspedodromous. (**Pl. III: b**).

Capparidaceae

Cleome ruidosperma DC.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 1.7 cm-3.5 cm long, terete, reddish-green, glabrous. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.1 cm-0.3 cm, petiole terete, adaxially grooved, scabrous; blade ovate-oblong (0.7 cm-0.8 cm x 0.2 cm-0.6 cm); base obtuse, apex obtuse, margin entire; primary vein one, brochidodromous. *Internodes* terete, glabrous. *Eophylls* first two leaves opposite, subsequent leaves alternate, palmately compound, trifoliolate, exstipulate, petiolate, hairy; petiole 0.1 cm-0.9 cm, terete, pubescent; leaflets subsessile, terminal one larger, obovate (1.0 cm-1.5 cm x 0.6 cm-0.9 cm), base cuneate, apex acute, margin ciliate, hairy; lateral leaflets asymmetrically elliptic (0.5 cm-0.6 cm x 0.2 cm-0.5 cm) primary vein one, eucamptodromous. (**Pl. III: c**).

Pl. III: c.

Cleome viscosa L.

Seedling epigeal, phanerocotylar. *Hypocotyl* shortly elongating, 1.2 cm-1.5 cm long, terete, lower part whitish, upper part green, glabrous. *Paracotyledons* two, opposite, exstipulate, petiolate, subcoriaceous; petiole 0.4 cm-0.5 cm, petiole flat, pubescent; blade oblong (0.4 cm-0.6 cm x 0.2 cm-0.3 cm); base rounded, apex rounded, margin entire; primary vein one, eucamptodromous; surface glabrous. *Internodes* lower part terete, upper part grooved, hairy. *Eophylls* first two leaves opposite, subsequent leaves alternate, palmately compound, trifoliolate, 5-foliolate from 6th–7th leaves stages, exstipulate, petiolate, hairy; petiole 0.7 cm - 0.9 cm, terete, pubescent; leaflets subsessile, terminal one rhombic-obovate (0.5 cm-2.0 cm x 0.4 cm-0.5 cm), base cuneate, apex acute, margin entire, hairy; lateral leaflets obliquely obovate (1.5 cm-1.6 cm x 0.7 cm-0.8 cm) primary vein one, eucamptodromous (**Pl. III: d**).

Combretaceae

Terminalia arjuna (Roxb. ex DC.) Wight & Arn.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 4.5 cm-5.0 cm, terete, brownish, pubescent. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 1.2 cm-1.3 cm, petiole flat, pubescent; blade flabellate (1.7 cm-2.1 cm x 3.0 cm-3.5 cm); base rounded, apex truncate, margin entire; primary vein three, actinodromous; surface glabrous. *Internodes* terete, glabrous; *Eophylls* alternate, simple, exstipulate, petiolate; petiole 0.5 cm-0.6 cm, terete, glabrous; blade 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. (**Pl. III: e**).

Terminalia bellirica (Gaertn.) Roxb.

Seedling hypogeal, cryptocotylar. *Hypocotyl* strongly elongating, 2.5 cm-3.8 cm long, terete, brownish, pubescent. *Cotyledons* two, opposite, exstipulate, petiolate, subcoriaceous; petiole 0.9 cm-1.0 cm, petiole flat, pubescent; blade ovate-ellipsoid, (2.5 cm-2.8 cm x 3.2 cm-3.6 cm); base obtuse, apex obtuse, margin entire; veins indistinct. *Internodes* terete, glabrous; *Eophylls* first two leaves opposite, subsequent leaves alternate, simple, herbaceous, exstipulate, petiolate, subcoriaceous, hairy; petiole 0.7 cm-0.8 cm, terete, pubescent; blade elliptic to ovate-elliptic (4.0 cm-6.4 cm x 1.8 cm-2.5 cm), base obtuse, apex acute, margin entire, glabrous; primary vein one, semicraspedodromous. (**Pl. III: f**).

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Terminalia catappa L.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 6.0 cm-10.4 cm long, terete, brownish, pubescent. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.9 cm-1.0 cm, petiole flat, pubescent; blade flabellate (2.6 cm-2.9 cm x 5.2 cm-5.3 cm); base truncate, apex truncate, margin entire; primary vein three, actinodromous. *Internodes* terete, glabrous. *Eophylls* alternate, simple, herbaceous, exstipulate, short petiolate; petiole 0.7 cm-0.9 cm, terete, glabrous; blade obovate (4.0 cm-6.4 cm x 2.5 cm-3.5 cm), base cuneate, apex acuminate, margin entire, glabrous; primary vein one, semicraspedodromous. (Pl. III: g).

Terminalia chebula Retz.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 2.5 cm-3.8 cm long, terete, brownish, pubescent. *Paracotyledons* two, opposite, exstipulate, petiolate, subcoriaceous; petiole 0.6 cm-1.9 cm, petiole flat, pubescent; blade flabellate (2.5 cm-2.8 cm x 3.2 cm-3.6 cm); base cuneate, apex truncate, margin entire; primary vein three, actinodromous. *Internodes* terete, glabrous. *Eophylls* alternate, simple, herbaceous, exstipulate, petiolate, subcoriaceous, hairy; petiole 1.0 cm-1.1 cm, terete, pubescent; blade elliptic (6.0 cm-7.3 cm x 7.8 cm-8.5 cm), base rounded, apex acute, margin entire, glabrous; primary vein one, eucamptodromous. (Pl. III: h).

Compositae

Ageratum conyzoides L.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 1.6 cm-2.0 cm long, terete, brownish, glabrous. *Paracotyledons* two, opposite, exstipulate, short petiolate; petiole 0.1 cm-0.2 cm, pubescent; blade wide ovate (0.2 cm-0.3 cm x 0.1 cm-0.2 cm); base rounded, apex rounded, margin entire; primary vein one, simple craspedodromous. *Internodes* terete, glabrous. *Eophylls* opposite, simple, herbaceous, exstipulate, short petiolate; petiole 0.1 cm-0.2 cm, terete, glabrous; blade ovate (1.0 cm-1.3 cm x 0.5 cm-0.7 cm), base cuneate, apex acute, margin serrate, hairy; primary vein one, simple craspedodromous. (Pl. III: i).

Eclipta prostrata (L.) L.

Seedling epigeal, phanerocotylar. *Hypocotyl* shortly elongating, 0.6 cm-1.0 cm, terete, soft, lower part whitish, upper part green, glabrous. *Paracotyledons* two, opposite, exstipulate, short petiolate; petiole 0.2 cm-0.3 cm, pubescent; blade oblong (0.3 cm-0.5 cm x 0.2 cm-0.3 cm); base cuneate, apex rounded, margin entire; primary vein one, semicraspedodromous; *Internodes* terete, glabrous; *Eophylls* opposite to opposite decussate, simple, exstipulate, petiolate; petiole 1.5 cm-1.6 cm, terete, glabrous; blade ovate to elliptic, (0.7 cm-1.0 cm x 0.5 cm-0.7 cm), base cuneate to attenuate, apex acute, margin entire, hairy; primary vein one, semicraspedodromous; surface hairy. (Pl. IV: a).

Gnaphalium polycaulon Pers.

Seedling epigeal, phanerocotylar. *Hypocotyl* shortly elongating, 0.6 cm-1.0 cm, terete, soft, lower part whitish, upper part green, glabrous. *Paracotyledons* two, opposite, exstipulate, short petiolate; petiole 0.2 cm-0.3 cm, pubescent; blade oblong (0.3 cm-0.5 cm x 0.2 cm-0.3 cm); base cuneate, apex rounded, margin entire; primary vein one, semicraspedodromous. *Internodes* terete, glabrous; *Eophylls* first two leaves opposite, subsequent leaves alternate, simple, exstipulate, petiolate; petiole 1.5 cm-1.6 cm, terete, glabrous; blade ovate to linear obovate (0.8 cm-1.0 cm x 0.9 cm-1.6 cm), base cuneate to attenuate, apex obtuse, margin entire, hairy; primary vein one, semicraspedodromous. (Pl. IV: b).

Mikania micrantha Kunth in H.B.K.

Seedling epigeal, phanerocotylar. *Hypocotyl* shortly elongating, 0.8 cm-1.0 cm, terete, soft, brownish, glabrous. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.1 cm-0.2 cm, glabrous; blade ovate (0.3 cm-0.5 cm x 0.2 cm-0.4 cm); base cuneate, apex rounded, margin entire; primary vein one, hyphodromous. *Internodes* terete, hirsute. *Eophylls* opposite, simple, herbaceous, exstipulate, petiolate; petiole 0.5 cm-0.9 cm, terete, pubescent; blade ovate to ovate-deltoid (0.4cm-0.7cm x 0.3 cm-0.4 cm), base rounded to cordate, apex acute to acuminate, margin entire to undulate dentate, hairy; primary vein three, actinodromous (Pl. IV: c).

Parthenium hysterophorus L.

Seedling epigeal, phanerocotylar. *Hypocotyl* shortly elongating, 1.0 cm-1.5 cm, terete, glabrous. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.1 cm-0.2 cm, glabrous; blade spatulate (0.3 cm-0.4 cm x 0.2 cm-0.3 cm); base cuneate, apex rounded, margin entire; primary vein one, hyphodromous. *Internodes* terete, hirsute; *Eophylls* first two leaves opposite, subsequent leaves alternate, simple, exstipulate, petiolate; petiole 0.3 cm-0.4 cm, terete, pubescent; blade oblong to pinnately dissected (0.5 cm-0.7 cm x 0.4 cm-0.5 cm), base cuneate to subrounded, apex obtuse, margin entire to incised, hairy; primary vein one, hyphodromous (Pl. IV: d).

Synedrella nodiflora (L.) Gaertn.

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Seedling epigeal, phanerocotylar. *Hypocotyl* shortly elongating, 0.5 cm-1.0 cm, terete, moderately soft, greenish, glabrous. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.1 cm-0.3 cm, pubescent; blade ovate (2.1 cm-2.2 cm x 0.4 cm-0.5 cm); base cuneate, apex obtuse, margin entire; primary vein one, semicraspedodromous. *Internodes* terete, glabrous. *Eophylls* opposite, simple, herbaceous, exstipulate, petiolate; petiole 1.5 cm-1.6 cm, terete, glabrous; blade ovate (1.1 cm-1.5 cm x 0.5 cm-0.8 cm), base obtuse, apex acute to acuminate, margin serrate, hairy; primary vein one, semicraspedodromous. (**Pl. IV: e**).

Tridax procumbens L.

Seedling epigeal, phanerocotylar. *Hypocotyl* shortly elongating, 0.7 cm-1.4 cm, terete, moderately soft, glabrous. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.1 cm-0.2 cm, pubescent; blade orbicular (0.3 cm-0.4 cm x 0.2 cm-0.3 cm); base rounded, apex rounded, margin entire; primary vein one, semicraspedodromous. *Internodes* terete, glabrous. *Eophylls* opposite, simple, herbaceous, exstipulate, short petiolate; petiole 0.5 cm-0.6 cm, terete, glabrous; blade ovate to elliptic (0.9 cm-1.0 cm x 0.3 cm-0.4 cm), base attenuate, apex acute, margin entire to margin dentate in the middle half, hairy; primary vein one, semicraspedodromous. (**Pl. IV: f**).

Vernonia cinerea (L.) Less.

Seedling epigeal, phanerocotylar. *Hypocotyl* very shortly elongating, 0.4 cm-0.5 cm, terete, glabrous. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.1 cm-0.2 cm, glabrous; blade wide ovate (0.2 cm-0.3 cm x 0.2 cm-0.3 cm); base rounded, apex obtuse, margin entire; primary vein one, simple brochidodromous. *Internodes* terete, glabrous. *Eophylls* alternate, simple, herbaceous, exstipulate, petiolate; petiole 0.4 cm-0.5 cm, terete, glabrous; blade ovate (0.7cm-0.9 cm x 0.5 cm-0.7 cm), base rounded to attenuate, apex acute, margin entire, hairy; primary vein one, simple craspedodromous

(**Pl. IV: g**).

Xanthium indicum Koen.in Roxb.

Seedling epigeal, phanerocotylar. *Hypocotyl* shortly elongating, 0.7cm-1.4 cm, terete, glabrous. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.2 cm-0.5 cm, pubescent; blade lanceolate (2.1 cm-2.2 cm x 0.4 cm-0.5 cm); base cuneate, apex acute, margin entire; primary vein one, semicraspedodromous. *Internodes* terete, glabrous. *Eophylls* first two leaves opposite, subsequent leaves alternate, simple, herbaceous, exstipulate, petiolate; petiole 1.5 cm-1.6 cm, terete, glabrous; blade elliptic to ovate-elliptic (4.1cm-4.2cm x 2.1cm-2.4cm), base cuneate, apex acute, margin serrate, hairy; primary vein three, actinodromous. (**Pl. IV: h**).

Convolvulaceae

Hewittia sublobata (L.f.) Ktze.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 3.0 cm – 3.3 cm long, terete, pubescent. *Paracotyledons* two, opposite, exstipulate , petiolate; petiole 0.8 cm-1.1 cm, hairy; blade bilobed (1.7 cm-1.9 cm x 1.8 cm- 2.2 cm); base rounded, apex of each lobe obtuse, depth of each cleft 0.5 cm-0.6 cm, margin entire; primary veins three, actinodromous. *Internodes* terete, tomentose; *Eophylls* alternate, simple, herbaceous, exstipulate, petiolate; petiole 2.5 cm-3.1 cm, flattened, tomentose; blade ovate (2.3 cm-2.4 cm x 1.5 cm-1.8 cm), base cordate, apex acute to cuspidate, margin entire to lobed; primary vein one, semicraspedodromous (**Pl. IV: i**).

Ipomoea chryseides Ker Gawl.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 3.0 cm – 3.3 cm long, terete, pubescent. *Paracotyledons* two, opposite, exstipulate , petiolate; petiole 0.8 cm-1.1 cm, hairy; blade bilobed (1.5 cm-1.6 cm x 1.7 cm- 2.0 cm); base subtruncate, apex emarginate, depth of each cleft 0.5 cm-0.6 cm, margin entire; primary veins three, actinodromous. *Internodes* terete, tomentose. *Eophylls* alternate, simple, herbaceous, exstipulate, petiolate; petiole 2.5 cm-3.1 cm, flattened, tomentose; blade ovate (2.3 cm-2.4 cm x 1.5 cm-1.8 cm), base auricled, apex acute, margin entire; primary vein one, semicraspedodromous. (**Pl. V: a**).

Ipomoea pes-tigridis L.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 4.0 cm–4.3 cm long, terete, pubescent. *Paracotyledons* two, opposite, exstipulate , petiolate; petiole 0.6 cm-1.1 cm, hairy; blade bilobed (1.6 cm-2.3 cm x 1.5 cm- 2.2 cm), each lobe oblong; base truncate, apex emarginate, depth of each cleft 0.5 cm-0.6 cm, margin entire; primary veins three, actinodromous. *Internodes* terete, tomentose. *Eophylls* alternate, simple, exstipulate, petiolate; petiole 1.5 cm-3.1 cm, flattened, tomentose; blade palmately three-seven lobed (3.0 cm-4.0 cm x 2.5 cm-4.8 cm), base cordate, apex of each lobe acute, margin entire; primary vein five, actinodromous. (**Pl. V: b**).

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Ipomoea quamoclit L.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 4.0 cm – 6.3 cm long, terete, lower part whitish and upper part greenish, glabrous. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.8 cm-1.1 cm, hairy; blade bilobed (2.1 cm-2.2 cm x 0.4 cm- 0.5 cm), linear-lanceolate, each lobe placed apart forming 155° angle from middle; base cuneate, apex of each lobe acuminate, margin entire; primary veins one, semicraspedodromous. *Internodes* terete, tomentose. *Eophylls* alternate, simple, herbaceous, exstipulate, petiolate; petiole 1.2 cm-1.3 cm, flattened, glaucous; blade pinnatifid (4.1 cm-4.2 cm x 2.1 cm-2.4 cm), base of each leaflet cuneate, apex acute, margin entire; primary vein one, hyphodromous. (**Pl. V: c**).

Porana paniculata Roxb.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 3.0 cm – 3.3 cm long, terete, moderately hard, brownish, pubescent. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.8 cm-1.1 cm, hairy; blade bilobed (1.7 cm-1.9 cm x 1.88 cm- 2.2 cm); base cordate, apex emarginate, depth of each cleft 0.5 cm-0.6 cm, margin entire; primary veins three, actinodromous. *Internodes* terete, glabrous; *Eophylls* alternate, simple, herbaceous, exstipulate, petiolate; petiole 2.5 cm-3.1 cm, flattened, tomentose; blade cordiform (2.3 cm-2.4 cm x 1.5 cm-1.8 cm), base cordate, apex acuminate, margin entire; primary vein one, semicraspedodromous. (**Pl. V: d**).

Cruciferae

Rorippa indica (L.) Hiern

Seedling epigeal, phanerocotylar. *Hypocotyl* shortly elongating, 0.3 cm-0.5cm, terete, greenish, hirsute. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 1.4 cm-1.5 cm, semiorbicular; hairy; blade orbicular (0.2 cm-0.3 cm x 0.2 cm-0.3 cm); base rounded, apex rounded, margin entire; primary vein one, veins not very prominent, hyphodromous. *Internodes* terete, hirsute; *First two leaves* opposite, simple, exstipulate, petiolate, glabrous; petiole 0.2 cm-0.3 cm, terete, hairy; blade spatulate to elliptic-spatulate, lyratopinnatifid (3.9 cm-5.5 cm x 2.7 cm-3.3 cm), base attenuate, apex obtuse, margin entire, primary vein one, eucamptodromous (**Pl. V: e**).

Cucurbitaceae

Coccinia grandis (L.) Voigt

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 2.0 cm – 2.5 cm long, terete, pale green, glabrous. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.1 cm-0.2 cm, hairy; blade oblong (0.5 cm-0.7 cm x 0.3 cm-0.4 cm); base cuneate, apex rounded, margin entire; primary vein one, brochidodromous. *Internodes* terete, glabrous; *Eophylls* alternate, simple, herbaceous, exstipulate, petiolate; petiole 2.3 cm-2.5 cm, terete, glabrous; blade lobed (2.0 cm-3.3 cm x 2.3 cm-3.8 cm), base cordate, apex acute to acuminate, margin sinuate; primary vein three, actinodromous; tendrils appearing at 5th leaf stages. (**Pl. V: f**).

Mukia maderaspatana (L.) M.J. Roem.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 2.5 cm – 3.0 cm long, terete, scabrous. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.1 cm-0.2 cm, flat, scabrous; blade oblong (0.5 cm-0.7 cm x 0.3 cm-0.4 cm); base cuneate, apex rounded, margin entire; primary vein one, brochidodromous. *Internodes* terete, glabrous; *Eophylls* alternate, simple, subcoriaceous, exstipulate, petiolate; petiole 2.0cm-2.1cm, terete, hispid; blade ovate-deltoid to lobed (1.5 cm-2.3 cm x 1.8 cm-2.8 cm), base cordate, apex acute, margin sinuate, primary vein three, actinodromous; tendrils appearing at 9th to 10th leaf stages (**Pl. V: g**).

Euphorbiaceae

Acalypha indica L.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 1.7cm – 2.5 cm long, terete, glabrous. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.2cm-0.3cm, glabrous; blade wide oblong (0.5 cm-0.6 cm x 0.3 cm-0.4 cm); base rounded, apex rounded, margin entire; primary vein one, hyphodromous. *Internodes* terete, hairy. *Eophylls* opposite, next leaves alternate, simple, herbaceous, exstipulate, petiolate; petiole 0.5 cm-1.0 cm, flattened, hairy; blade ovate (1.2 cm-1.5 cm x 0.9 cm-1.1 cm), base rounded to obtuse, apex rounded to acute, margin entire to serrate; primary vein one, brochidodromous (**Pl. V: h**).

Chrozophora plicata (Vahl) A. Juss.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 1.7 cm–2.2 cm, terete, minutely hairy. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.3 cm-0.4 cm, scabrous; blade lanceolate (0.4 cm-0.7 cm x 0.6 cm-0.7 cm); base cuneate, apex acuminate, margin entire; primary vein one, hyphodromous. *Internodes* terete, hairy, *Eophylls* opposite, simple, stipulate; stipule caducous, petiolate; petiole 0.5 cm-1.0 cm, terete, hairy; blade narrow ovate to

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ovate, lobed, (1.2 cm-1.5 cm x 0.7 cm-1.0 cm), base cuneate, apex acute, margin slightly undulate to irregularly crenate; primary vein three, actinodromous (**Pl. V: i**).

Croton bonplandianum Baill.in Adansonia.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 3.5 cm – 4.2 cm long, terete, stellate hairy. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.1 cm-0.15 cm, stellately hairy on the ventral surface; blade oblong (1.3 cm-1.8 cm x 0.4 cm-0.5 cm); base cuneate, apex obtuse, margin entire; primary vein one, brochidodromous. *Internodes* terete, hairy. *Eophylls* alternate, simple, herbaceous, exstipulate, petiolate; petiole 0.05 cm-0.1 cm, flattened, hairy; blade ovate (1.6 cm-2.0 cm x 1.2 cm-1.4 cm), base cuneate, apex obtuse to acute, margin serrate to serrulate; primary vein one, brochidodromous. (**Pl. VI: a**).

Drypetes roxburghii (Wall.) Hurusawa

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 1.7 cm – 2.0 cm, terete, moderately hard, minutely hairy. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.1 cm-0.15 cm, glabrous; blade ovate (3.4 cm-3.6 cm x 2.6 cm-2.7 cm); base cordate, apex obtuse, margin entire; primary vein three, acrodromous. *Internodes* terete, hairy. *Eophylls* alternate, simple, coriaceous, exstipulate, petiolate; petiole 0.1 cm-0.2 cm, flattened, hairy; blade lanceolate (3.4 cm-4.5 cm x 1.2 cm-1.8 cm), base cuneate, apex acute, margin spiny serrulate; primary vein one, semicraspedodromous (**Pl. VI: b**).

Euphorbia heterophylla L.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 5.5 cm – 6.0 cm long, terete, moderately soft, brownish, glabrous. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.1 cm-0.3 cm, glabrous; blade elliptic (1.1 cm-1.2 cm x 0.5 cm-0.6 cm); base cuneate, apex acute, margin entire; primary vein one, semicraspedodromous. *Internodes* terete, hairy, *Eophylls* first two leaves opposite, subsequent leaves alternate, simple, exstipulate, petiolate; petiole 0.5 cm-0.6 cm, flattened, glabrous; blade lanceolate (2.4 cm-5.1 cm x 1.0 cm-1.5 cm), base cuneate, apex acute, margin entire; primary vein one, brochidodromous. (**Pl. VI: c**).

E. heyneana L., Spreng.

Seedling epigeal, phanerocotylar with milky latex. *Hypocotyl* very shortly elongating, 0.2cm–0.3 cm, terete, minutely hairy. *Paracotyledons* two, opposite, exstipulate, subsessile; petiole 0.08 cm-0.1 cm, glabrous; blade obovate (0.1 cm-0.16 cm x 0.04 cm-0.05 cm); base cuneate, apex rounded, margin entire; primary vein one, hyphodromous. *Internodes* terete, hairy. *Eophylls* opposite, simple, exstipulate, petiolate; petiole 0.03 cm-0.08 cm, hairy; blade obovate to elliptic-obovate (0.2 cm-0.3 cm x 0.1 cm-0.15 cm), base cuneate, apex rounded, margin crenate at upper part; primary vein one, brochidodromous. (**Pl.VI: d**).

Euphorbia hirta L.

Seedling epigeal, phanerocotylar with milky latex. *Hypocotyl* very shortly elongating, 0.4cm–1.0 cm, terete, minutely hairy. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.1 cm-0.15 cm, glabrous; blade ovate (0.15 cm-0.2 cm x 0.1 cm-0.11 cm); base rounded, apex obtuse, margin entire; primary vein one, hyphodromous. *Internodes* terete, hairy, *Eophylls* opposite, simple, exstipulate, petiolate; petiole 0.05 cm-0.1 cm, hairy; blade obovate to elliptic (0.4 cm-0.5 cm x 0.2 cm-0.3 cm), base cuneate, apex rounded, margin entire to serrate; primary vein one, brochidodromous (**Pl. VI: e**).

Jatropha gossypifolia L.

Seedling epigeal, phanerocotylar. *Hypocotyl* shortly elongating, 0.2 cm – 1.5 cm, terete, brownish, hairy. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 1.2 cm-1.3 cm, glabrous; blade oblong (2.0 cm-2.1 cm x 1.6 cm-1.7 cm); base rounded, apex rounded, margin entire; primary vein three, actinodromous. *Internodes* terete, length of *Eophylls* alternate, simple, stipulate(stipule free lateral with glandular trichomes), petiolate; petiole 1.5 cm-3.5 cm, adaxially concave, glandular trichomes on decurrent side; blade ovate (in first leaf 2.3 cm-3.5 cm x 1.5 cm-3.0 cm) to widely ovate usually with 1-3 lobes (3.0 cm-3.7 cm x 2.4 cm-3.5 cm) , lobes widened in the middle part, (0.4 cm-0.5 cm x 0.2 cm-0.3 cm), base cordate, apex acute, margin serrulate with glandular trichomes; primary vein three, actinodromous. (**Pl. VI: f**).

Micrococca mercurialis (L.) Benth. in Hook.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 2.0 cm – 3.0 cm long, terete, whitish, glabrous. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.1 cm-0.3 cm, hairy, blade orbicular (0.4 cm-0.5 cm x 0.3 cm-0.4 cm); base rounded, apex obtuse, margin entire; primary vein one, hyphodromous. *Internodes* terete to slightly angular, hairy. *Eophylls* first two leaves opposite, subsequent leaves alternate simple, herbaceous, exstipulate, petiolate;

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petiole 0.2 cm-0.3 cm, flattened, hairy; blade ovate (0.4cm-0.5cm x 0.3cm-0.4m), base cuneate, apex acute, margin slightly serrate; primary vein one, brochidodromous (**Pl. VI:g**).

Phyllanthus amarus Schum. & Thonn.

Seedling epigeal, phanerocotylar. *Hypocotyl* shortly elongating, 1.2 cm – 1.5 cm, terete, reddish green, glabrous. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.1 cm, glabrous; 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. *Eophylls* alternate, simple, stipulate; stipule triangular lanceolate, apex acuminate, petiolate; petiole 0.05 cm-0.07 cm, terete, glabrous; 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. (**Pl. VI: h**).

Phyllanthus reticulatus Poir.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 1.6 cm – 2.0 cm long, terete, pale brown, glabrous. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.1cm-0.15 cm, glabrous; narrow oblong (0.2 cm-0.3 cm x 0.1 cm-0.15 cm); base rounded, apex obtuse, margin entire; primary vein one, hyphodromous. *Internodes* terete, glabrous, *Eophylls* alternate, simple, herbaceous, stipulate; stipule triangular lanceolate, apex acuminate, short petiolate; petiole 0.1 cm-0.5 cm, terete, hairy; blade obovate to elliptic (0.2 cm-0.4 cm x 0.1 cm-0.3 cm), base cuneate to obtuse, apex rounded to obtuse, margin entire; primary vein one, brochidodromous. (**Pl. VI: i**).

Phyllanthus urinaria L.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 1.6 cm– 2.5 cm, terete, minutely hairy. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.1 cm-0.15 cm, glabrous; blade oblong (0.3 cm-0.4 cm x 0.1 cm-0.2 cm); base cuneate, apex rounded, margin entire; primary vein one, hyphodromous. *Internodes* terete, hairy. *Eophylls* alternate, clustered but ultimately becomes cauline, simple, herbaceous, stipulate; stipule triangular-lanceolate, apex acuminate; short petiolate; petiole 0.05 cm-0.1 cm, hairy; blade obovate (0.5 cm-0.6 cm x 0.3 cm-0.4 cm), base cuneate, apex mucronate, margin entire; primary vein one, brochidodromous.(Figs. 55: A-E; Pl. VII: a).

Ricinus communis L.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 6.0 cm – 12.0 cm long, terete, glabrous. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 1.0 cm-2.2 cm, glabrous; blade ovate-oblong to oblong (3.0 cm-4.5 cm x 1.0 cm-2.2 cm); base rounded to truncate, apex obtuse, margin entire; primary vein five, acrodromous. *Internodes* terete, glabrous. *Eophylls* opposite, simple, herbaceous, exstipulate, petiolate; petiole 3.5 cm-3.7 cm, terete, glabrous; blade palmately lobed (3.8 cm-5.4 cm x 2.9 cm-4.0 cm), base peltate, glandular, lobe apex acute, margin serrate to spiny serrulate with glands; primary vein five, actinodromous. (Figs. 56: A-B; Pl. VII: b).

Lamiaceae

Anisomeles indica (L.) O. Kuntze

Seedling epigeal, phanerocotylar, aromatic. *Hypocotyl* reduced, ± 0.1 cm, terete, green, hirsute. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.4 cm-0.5 cm, hairy; blade orbicular (0.4 cm-0.6 cm x 0.4 cm-0.6 cm); base rounded, apex rounded, margin entire; minutely hairy; primary vein one, brochidodromous. *Internodes* terete, angular, scabrous. *Eophylls* opposite to opposite-decussate, simple, herbaceous, exstipulate, petiolate; petiole 0.2 cm-0.5 cm, hairy; blade ovate (0.6 cm-1.0 cm x 0.5 cm-0.8 cm), base subrounded, apex obtuse to acute, margin distantly serrulate to regularly crenate-serrate, hairy; primary vein one, brochidodromous. (Figs. 57: A-D; Pl. VII: c).

Hyptis suaveolens (L.) Poit.

Seedling epigeal, phanerocotylar, strongly aromatic. *Hypocotyl* strongly elongating, 3.0 cm-3.5 cm long, terete, lower part purplish, upper part green, hirsute. *Paracotyledons* two, opposite, coriaceous, exstipulate, petiolate; petiole 0.4 cm-0.5 cm, adaxially grooved, hirsute; blade deltoid (0.6 cm-1.2 cm x 0.5 cm-1.1 cm); base truncate, apex retuse, margin with minute glandular hairs; primary veins three, palinactinodromous; surface glandular-pubescent. *Internodes* lower terete, upper angular, hairy. *Eophylls* opposite to opposite decussate, simple, subcoriaceous, exstipulate, petiolate; petiole 1.0 cm-1.4 cm, deep purple; narrow ovate (0.6 cm-2.0 cm x 0.4 cm-1.2 cm), base asymmetric rounded to cordate, apex acute, margin serrate, hairy; primary veins one, brochidodromous.; upper surface sparsely hairy, lower surface densely hairy with gland like dots. (Figs. 58: A-G; Pl. VII: d).

Leonurus sibiricus L.

Seedling epigeal, phanerocotylar, aromatic. *Hypocotyl* shortly elongating, 0.7 cm–1.0 cm, terete, hirsute. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.4 cm-0.5 cm, hairy; blade orbicular (0.4 cm-0.7 cm x 0.5 cm-0.6 cm); base cordate, apex slightly retuse, margin entire; minutely hairy; primary vein one, brochidodromous. *Internodes* angular, pubescent. *Eophylls* opposite, heteroblastic development of leaves present simple, exstipulate,

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petiolate; petiole 0.5 cm-0.8 cm, hairy; blade elliptic or elliptic-oblong to palmately lobed to pinnatifid (0.5 cm-1.4 cm x 0.3 cm-1.0 cm), base rounded, apex obtuse, margin crenate, hairy; primary vein one, semicraspedodromous. (Figs. 59: A-E; Pl. VII: e).

Leucas aspera (Willd.) Link

Seedling epigeal, phanerocotylar, aromatic. *Hypocotyl* strongly elongating, 2.2 cm – 3.5 cm, terete, hirsute. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.2 cm-0.3 cm, hairy; blade oblong (0.4 cm-0.6 cm x 0.2 cm-0.4 cm); base cuneate, apex rounded, margin entire; minutely hairy; primary vein one, eucamptodromous. *Internodes* first internode terete, next angular, green, pubescent. *Eophylls* opposite to opposite-decussate, simple, herbaceous, exstipulate, petiolate; petiole 0.3 cm-0.5 cm, hairy; blade lanceolate (1.3 cm-2.9 cm x 0.5 cm-1.0 cm), base cuneate, apex acute, margin serrate, hairy; primary vein one, eucamptodromous; surface hairy. (Figs. 60: A-H; Pl. VII: f).

Leucas cephalotes (Roth) Spreng.

Seedling epigeal, phanerocotylar, aromatic. *Hypocotyl* strongly elongating, 2.5 cm – 3.5 cm, terete, pubescent. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.3 cm-0.4 cm, hairy; blade ovate-oblong (0.7 cm-1.2 cm x 0.3 cm-0.6 cm); base rounded, apex rounded, margin entire; minutely hairy; primary vein one, eucamptodromous. *Internodes* very shortly elongating, terete, scabrous. *Eophylls* opposite to opposite-decussate, simple, exstipulate, petiolate; petiole 0.3 cm-0.4 cm, hairy; blade lanceolate to elliptic-lanceolate (1.5 cm-2.8 cm x 0.5 cm-0.6 cm), base cuneate, apex acute, margin serrate, hairy; primary vein one, eucamptodromous. (Figs. 61: A-D; Pl. VII: g).

Leguminosae

Acacia auriculiformis A. Cunn. ex Benth.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 3.5 cm-4.0 cm long, terete, glabrous. *Paracotyledons* two, opposite, oblique, stipulate, sessile, coriaceous, pubescent; blade ovate-elliptic (0.7 cm-0.8 cm x 0.4 cm-0.5 cm); base deeply cleft & auricled, clasping the axis, apex rounded, margin entire; primary vein one, simple craspedodromous. *Internodes* terete, distantly minutely hairy. *Eophylls* alternate, compound, first uniparipinnate, second biparipinnate, leaflet absent in fifth and onwards leaves, petiole highly flattened to a leaf-like green lanceolate structure (phylloclade). stipulate, petiolate; petiole 0.5 cm-0.6 cm, terete, pubescent; blade leaflet pairs 5-6, leaflet linear oblong (1.0 cm-1.3 cm x 0.5 cm-0.6 cm), base assymmetric, apex acute, margin entire; primary vein one, simple craspedodromous. (Figs. 62: A-E; Pl. VII: h).

Atylosia scarabaeoides (L.) Benth.

Seedling hypogeal, cryptocotylar. *Hypocotyl* reduced, ± 0.1 cm, glabrous. *Cotyledons* two, opposite, oblique, exstipulate, petiolate, fleshy, cream coloured; petiole small, 0.3 cm-0.4 cm, flattened; blade oblong (0.5 cm-0.6 cm x 0.3 cm-0.4 cm); base auricled, apex rounded, margin entire; primary vein indistinct, surface glabrous, covered by thin deep brown seed coat, inner surface plane and outer surface convex. *Internodes* terete, densely hairy. *Eophylls* first two leaves opposite, simple, subsequent leaves alternate, compound, trifoliolate, stipulate (interpetiolar, hairy), petiolate, herbaceous; petiole 0.4cm-0.5cm, terete, pubescent; blade ovate to elliptic (1.6 cm-1.9 cm x 0.8 cm-1.1 cm), base subtruncate to cuneate, apex acute, margin entire; primary vein one, brochidodromous, 0.8 cm-0.9 cm x 0.5 cm-0.6 cm (lateral ones), 0.9 cm-1.0 cm x 0.7 cm-0.8 cm (terminal one). (Figs. 63: A-E; Pl. VII: i).

Bauhinia purpurea L.

Seedling geal, phanerocotylar. *Hypocotyl* reduced, ± 0.1 cm, stout, erect, glabrous. *Paracotyledons* two, opposite, horizontal to slightly oblique, stipulate (stipule reduced to hairy whitish structure), sessile, fleshy; blade oblong (1.7 cm-1.8 cm x 1.3 cm-1.4 cm); base rounded, apex obtuse, margin entire; primary vein seven, actinodromous. *Internodes* first internode terete, next internodes angled, green, soft, hairy. *Eophylls* alternate, simple, stipulate (two, free lateral, lanceolate, deciduous), petiolate, herbaceous; petiole 1.0 cm-1.5 cm long, dorsally slightly grooved, pubescent; blade cordiform (1.3 cm-1.6 cm x 1.0 cm-1.3 cm), base cordate, apex emarginate, cleft length 2.3 cm long, margin entire; primary vein seven, actinodromous; surface hairy. (Figs. 64: A-D; Pl. VIII: a).

Butea monosperma (Lain.) Taub.

Seedling hypogeal, cryptocotylar. *Hypocotyl* ± 0.1 cm, reduced. *Cotyledons* two, secund, horizontal, exstipulate, petiolate; petiole 0.3 cm-0.4 cm, flattened, both the petiole fused on one side forming a boat-shaped structure outside the node and forming the sheath at the node, hairy; blade asymmetrically oblong (2.8 cm-3.0 cm x 1.3 cm-1.4 cm); base cuneate, apex truncate, margin entire; primary vein indistinct, outer surface slightly convex and glabrous, cotyledons firmly adpressed and enclosed within thin papery brown seed coat. *Internodes* terete, densely hairy. *Eophylls* opposite, simple, subsequent leaves alternate, compound, trifoliolate, stipulate (interpetiolar, lanceolate, green, hairy), petiolate,

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coriaceous; petiole 0.4 cm-0.5 cm, terete, pubescent; blade terminal one ovate (6.0 cm-6.9 cm x 6.5 cm-6.6 cm), base rounded, apex acute, margin entire; primary vein one, semicraspedodromous. (Figs. 65: A-C; Pl. VIII: b).

Calliandra umbrosa (Wallich) Benth

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 3.0 cm-4.2 cm long, terete, basal part white and upper part greenish pink, hairy. *Paracotyledons* two, opposite, oblique, exstipulate, petiolate, coriaceous; petiole 0.3 cm-0.4 cm, terete, hairy, green; blade ovate (0.8 cm-1.1 cm x 0.4 cm-0.5 cm); base auricled, apex acute, margin entire; primary vein indistinct. *Internodes* terete, densely hairy. *Eophylls* first two leaves opposite, compound, uniparipinnate, no. of leaflets pair 6-8, subsequent leaves alternate, compound, biparipinnate, stipulate (stipules two, free lateral, lanceolate, green, hairy), petiolate, herbaceous; petiole 0.7 cm-0.8 cm, pubescent, base pulvinate; leaflet blade oblong (1.1 cm-1.2 cm x 0.2 cm-0.3 cm), base oblique, apex rounded, margin entire; primary vein one, simple craspedodromous; (Figs. 66: A-C; Pl. VIII: c).

Cassia alata L.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 4.5 cm-5.0 cm long, terete, hairy. *Paracotyledons* two, opposite, oblique, exstipulate, petiolate, subcoriaceous, green; petiole 0.1 cm-0.2 cm, flattened; blade obovate (2.0 cm-2.1 cm x 1.7 cm-1.8 cm); base cuneate, apex rounded, margin entire; primary vein five, actinodromous. *Internodes* terete, glabrous. *Eophylls* alternate, compound, uniparipinnate, first leaf with two pairs of leaflets, number of leaflets increasing, stipulate (stipule two, small, free lateral, orange), petiolate; petiole 1.2 cm-2.0 cm, terete, pubescent; blade obovate, lower pair smaller in size, 1.5 cm-1.6 cm x 0.9 cm-1.1 cm, (lower pair), 2.8 cm -3.0 cm x 2.2 cm-2.4 cm (upper pair), base asymmetric, apex obtuse, margin entire; primary vein one, semicraspedodromous (Figs. 67: A-D; Pl. VIII: d).

Cassia fistula L.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 6.5 cm-6.6 cm long, terete, lower part brownish and upper part green, hairy. *Paracotyledons* two, opposite, oblique, stipulate, subsessile, coriaceous, green; petiole 1.0-1.2 cm; blade oblong (2.1 cm-2.3 cm x 1.0 cm-1.2 cm); base cuneate, apex rounded, margin entire; primary vein five, actinodromous; *Internodes* terete, densely hairy. *Eophylls* alternate, compound, uniparipinnate, pinnate, stipulate (stipule two, small, free lateral,), petiolate, coriaceous; petiole 0.8 cm-1.2 cm, green, glabrous; blade ovate, lower pair smaller in size, 1.5 cm-1.7 cm x 0.5 cm-0.7 cm (lower pair), 1.8 cm-2.1 cm x 0.5 cm-0.7 cm (upper pair), base cuneate, apex acuminate, margin entire; primary vein one, semicraspedodromous. (Figs. 68: A-B; Pl. VIII: e).

Cassia siamea Lam.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 3.5 cm-4.0 cm long, terete, glabrous. *Paracotyledons* two, opposite, oblique, exstipulate, subsessile, coriaceous,; petiole 0.05 cm-0.1 cm, glabrous; blade orbicular (1.7 cm-1.9 cm x 1.5 cm-1.7 cm); base rounded, apex rounded, margin entire; primary vein five, actinodromous, *Internodes* terete, glabrous. *Eophylls* alternate, compound, uniparipinnate, leaflet pairs two, stipulate (stipule two, small, free lateral), petiolate, herbaceous. First leaf with petiole 1.2 cm-1.3 cm, glabrous; blade elliptic (0.7 cm-0.9 cm x 0.4 cm-0.5 cm), base asymmetric, apex acute, margin entire; primary vein one, semicraspedodromous; (Figs. 69: A-C; Pl. VIII: f).

Cassia sophora L.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 2.5 cm-3.0 cm long, terete, yellowish-green, hairy. *Paracotyledons* two, opposite, oblique, exstipulate, petiolate; petiole 0.1-0.5 cm, flattened; blade oblong (1.3 cm-1.4 cm x 0.7 cm-0.8 cm); base obtuse, apex rounded, margin entire; primary vein five, actinodromous. *Internodes* terete, densely hairy. *First two leaves* alternate, compound, unipinnate, paripinnate, with two pairs of leaflets, stipulate (stipule two, small, free lateral, lanceolate), petiolate, herbaceous; petiole 1.2 cm-1.4 cm, terete, pubescent; blade elliptic (1.3 cm-1.5 cm x 0.5 cm-0.7 cm), base asymmetric with pulvinate, apex obtuse to acute, margin entire; primary vein one, semicraspedodromous. (Figs. 70: A-E; Pl. VIII: g).

Cassia tora Linn.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 4.5 cm-5.0 cm long, terete, lower part dark brown and upper part green, hairy. *Paracotyledons* two, opposite, oblique, exstipulate, petiolate, subcoriaceous; petiole 0.1-0.2 cm, terete, pulvinate; blade orbicular (1.3 cm-1.4 cm x 1.2 cm-1.3 cm); base rounded, apex rounded, margin entire; primary vein five, actinodromous. *Internodes* terete (first), upper internodes slightly angled, densely hairy. *First two leaves* alternate, compound, uniparipinnate, first leaf with two pairs of leaflets and second leaf with three pairs of leaflets, stipulate (stipule deciduous, free lateral), petiolate; petiole 1.2 cm-2.0 cm long, terete, pubescent, pulvinate;

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blade obovate, 1.3 cm-1.7 cm x 0.7 cm-1.2 cm, base cuneate, asymmetric, apex obtuse, margin entire; primary vein one, semicraspedodromous (Figs. 71: A-B; Pl. VIII: h).

Clitoria ternatea L.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 4.0 cm-4.5 cm long, terete, hairy. *Paracotyledons* two, opposite, oblique, exstipulate, petiolate; petiole 0.1 cm-0.2 cm, flattened; blade oblong (1.5 cm-1.6 cm x 0.9 cm-1.2 cm); base oblique, apex rounded, margin entire; primary vein one, semicraspedodromous. *Internodes* terete, densely hairy. *Eophylls* first two leaves opposite, simple, stipulate (two, free lateral), petiolate; petiole 1.2 cm-1.5 cm, terete, pubescent; blade ovate (2.4 cm-2.6 cm x 1.2 cm-1.4 cm), base obtuse, apex acute, margin entire; primary vein one, semicraspedodromous, subsequent leaves alternate, compound, unipinnate, imparipinnate, trifoliolate upto sixth to eighth leaves stages, next leaves with 5-7 leaflets, leaflet blade ovate-elliptic (Figs. 72: A-B; Pl. VIII: i).

Crotalaria pallida W. Aiton

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 4.5 cm-5.0 cm long, terete, lower part light green and upper part deep green, hairy. *Paracotyledons* two, opposite, oblique, exstipulate, petiolate, coriaceous, green; petiole 0.1 cm-0.2 cm; blade oblong (1.1 cm-1.2 cm x 0.4 cm-0.5 cm); base oblique, apex obtuse, margin entire; primary vein one, semicraspedodromous. *Internodes* terete, densely hairy. *Eophylls* alternate, compound, trifoliolate, stipulate (two, free lateral, deciduous), petiolate, herbaceous; petiole 0.5 cm-0.7 cm, terete, pubescent; blade obovate (0.7 cm-0.9 cm x 0.4 cm-0.5 cm-lower pair), (1.0 cm-1.2 cm x 0.6 cm-0.7 cm-upper pair), base cuneate, apex obtuse to retuse, margin entire; primary vein one, semicraspedodromous. (Figs. 73: A-D; Pl. IX: a).

Crotalaria verrucosa L.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 3.0 cm-3.5 cm long, terete, hairy. *Paracotyledons* two, opposite, oblique, exstipulate, petiolate, coriaceous, green; petiole 0.1 cm-0.2 cm, terete, hairy, pulvinous present; blade oblong (1.6 cm-2.1 cm x 0.8 cm-1.1 cm); base obtuse, apex obtuse, margin entire, one side curved; primary vein one, semicraspedodromous. *Internodes* terete, densely hairy. *Eophylls* alternate, simple, stipulate (two, linear-lanceolate, free lateral), petiolate, herbaceous; petiole 0.2 cm-0.5 cm, terete, pubescent; blade ovate (2.5 cm-3.0 cm x 1.5 cm-2.0 cm), base cuneate, apex acute, margin entire; primary vein one, semicraspedodromous. (Figs. 74: A-E; Pl. IX: b).

Dalbergia sissoo Roxb.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 4.0 cm-5.5 cm long, terete, lower part light green and upper part deep green, hairy. *Paracotyledons* two, opposite, oblique, exstipulate, petiolate; petiole 0.1 cm-0.2 cm, flattened; blade oblong (1.5 cm-1.6 cm x 0.8 cm-0.9 cm); base oblique, apex rounded, margin entire; primary vein one, semicraspedodromous. *Internodes* terete, densely hairy. *Eophylls* first two leaves opposite, subsequent leaves alternate compound, imparipinnate, stipulate (two, free lateral), petiolate; petiole 0.2 cm-0.5 cm, terete, pubescent; blade obovate-elliptic, 2.5 cm-2.6 cm x 1.0 cm-1.2 cm, base cuneate, apex mucronate, margin entire; primary vein one, semicraspedodromous. (Figs. 75: A-C).

Delonix regia (Boj.ex Hook.) Raf.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 5.0 cm-5.5 cm long, terete, lower part light green and upper part deep green, hairy. *Cotyledons* two, opposite, oblique, exstipulate, petiolate, fleshy, green; petiole 0.1 cm-0.2 cm, flattened; blade oblong (2.7 cm-2.8 cm x 0.8 cm-0.9 cm); base auricled, apex obtuse, margin entire; primary vein one, semicraspedodromous. *Eophylls* terete, densely hairy. *First two leaves* opposite, compound, uniparipinnate upto third leaf stages, next leaves bipinnate., stipulate (two, free lateral), petiolate; petiole 0.1 cm-0.2 cm, terete, pubescent; blade oblong (1.2 cm-1.3 cm x 0.3 cm-0.4 cm), base oblique, apex obtuse, margin entire; primary vein one, semicraspedodromous. (Figs. 76: A-C; Pl. IX: c).

Desmodium gangeticum (L.) DC.

Seedling epigeal, phanerocotylar. *Hypocotyl* shortly elongating, 0.5 cm-1.0 cm, terete, hairy. *Paracotyledons* two, opposite, oblique, exstipulate, petiolate; petiole 0.1 cm-0.2 cm, flattened; blade oblong (0.5 cm-0.6 cm x 0.2 cm-0.3 cm); base oblique, apex rounded, margin entire; primary vein one, semicraspedodromous. *Internodes* terete, densely hairy. *Eophylls* first two leaves opposite, subsequent leaves alternate, simple, stipulate (two, free lateral), petiolate; petiole 1.2 cm-1.5 cm, terete, pubescent, subcoriaceous, base pulvinate; blade orbicular (0.2 cm-0.4 cm x 0.2 cm-0.4 cm), base rounded, apex rounded, margin entire; primary vein one, brochidodromous, next leaves ovate-oblong (0.7 cm-0.8 cm x 1.0 cm-1.1 cm-third; 0.9 cm-1.0 cm x 1.2 cm-1.3 cm-fourth, 1.4 cm-1.5 cm x 1.4 cm-1.5 cm-fifth; 1.5 cm-1.6 cm x 1.5 cm-1.6 cm-sixth. (Figs. 77: A-E; Pl. IX: d).

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Desmodium triflorum (L.) DC.

Seedling epigeal, phanerocotylar. *Hypocotyl* very shortly elongating, 0.2 cm-0.3 cm long, terete, hairy. *Paracotyledons* two, opposite, oblique, exstipulate, subsessile, fleshy; petiole 0.05 cm-0.1 cm; blade oblong (0.3 cm-0.5 cm x 0.1 cm-0.2 cm); base oblique, apex rounded, margin entire; primary vein one, semicraspedodromous. *Internodes* terete, densely hairy. *Eophylls* first two leaves opposite, subsequent leaves alternate, simple up to fifth leaf stages, next leaves compound, trifoliolate, stipulate (two, free lateral), petiolate, herbaceous; petiole 1.2 cm-1.5 cm, terete, pubescent, subcoriaceous, base pulvinate; blade oblate-elliptic to obovate (terminal leaflet 0.5 cm-0.6 cm x 0.5 cm-0.6 cm, lateral leaflet 0.3 cm-0.4 cm x 0.3 cm-0.4 cm), base cuneate, apex slightly retuse, margin entire; primary vein one, brochidodromous. (Figs. 78: A-D; Pl. IX: e).

Leucaena leucocephala (Lam.) de Wit.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 2.5 cm-4.0 cm long, terete, hairy. *Paracotyledons* two, opposite, erect, later on oblique, exstipulate, petiolate; petiole 0.1 cm-0.2 cm, green, glabrous, flattened; blade oblong (1.5 cm-1.8 cm x 1.0 cm-1.3 cm); base auricled, apex rounded, margin entire; primary vein one, semicraspedodromous. *Internodes* terete, densely hairy. *Eophylls* alternate, compound, uniparipinnate, stipulate (two, lanceolate, green, free lateral), petiolate; petiole 1.0 cm-1.2 cm, terete, pubescent, base pulvinate, glabrous; blade obovate (1.3 cm-1.4 cm x 0.5 cm-0.6 cm), base oblique, apex obtuse, margin entire; primary vein three, actinodromous; leaf rachis distantly hairy, and terminating into an appendage; subsequent leaves leaf-alternate, compound, biparipinnate with single pair of pinna only, petiole \pm 2.0 cm long. (Figs. 79: A-C; Pl. IX: f).

Millettia ovalifolia (Wight & Arn.) Kurz

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 3.4 cm-5.0 cm long, terete, hairy. *Paracotyledons* two, opposite, erect, later on oblique, exstipulate, petiolate; petiole 0.1 cm-0.2 cm, green, glabrous, flattened; blade ovate (1.0 cm-0.8 cm x 0.3 cm-0.4 cm); base cuneate, apex rounded, margin entire; primary vein one, semicraspedodromous. *Internodes* terete, densely hairy. *Eophylls* alternate, simple, subsequent leaves alternate, compound, trifoliolate, stipulate (two, lanceolate, green, free lateral), petiolate; petiole 2.1 cm-2.2 cm long, terete, pubescent, base pulvinate, green, glabrous; blade wide ovate (3.3 cm-3.4 cm x 3.3 cm-3.4 cm), base rounded, apex acute, margin entire; primary vein one, semicraspedodromous (Figs. 80: A-B; Pl. IX: g).

Mimosa pudica L.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 2.5 cm-3.0 cm long, terete, hairy. *Paracotyledons* two, opposite, erect, stipulate, petiolate, coriaceous, green; petiole 0.1 cm-0.2 cm, glabrous, flattened; blade oblong (0.4 cm-0.5 cm x 0.4 cm-0.5 cm) base rounded, apex truncate, margin entire; primary vein one, semicraspedodromous. *Internodes* terete, densely hairy. *Eophylls* first leaf alternate, compound, uniparipinnate, second leaf biparipinnate, no. of leaflet three pairs, fourth leaf with four pairs of leaflets, fifth leaf with five pairs and sixth leaf with 7 pairs of leaflet, basal pair smaller in size; stipulate (lanceolate, green, free lateral), petiolate; petiole 0.7 cm-0.8 cm, terete, pubescent, base pulvinate, glabrous; blade obovate-oblong (1.0 cm-1.1 cm x 0.3 cm-0.4 cm), base oblique, apex mucronate, margin entire; primary vein three, actinodromous; leaves touch sensitive. (Figs. 81: A-D; Pl. IX: h).

Peltophorum pterocarpum (DC.) Backer ex K. Heyne

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 5.0 cm-6.2 cm long, terete, hairy. *Cotyledons* two, opposite, exstipulate, subsessile, fleshy; petiole 0.1 cm-0.2 cm, green, glabrous, flattened; blade oblong (1.8 cm-2.0 cm x 0.6 cm-0.7 cm); base cuneate, apex rounded, margin entire; primary vein one, semicraspedodromous. *Internodes* terete, densely hairy. *Eophylls* first two leaves opposite, subsequent leaves alternate, compound, uniparipinnate, bipinnate from 8th-10th leaves stages, leaflet pairs five to six, exstipulate, petiolate; petiole 0.5 cm-0.6 cm, terete, pubescent, base pulvinate, glabrous; blade oblong (0.7 cm-0.8 cm x 0.3 cm-0.4 cm), base oblique, apex obtuse, margin entire; primary vein one, semicraspedodromous. (Figs. 82: A-E; Pl. IX: i).

Pithecellobium dulce (Roxb.) Benth.

Seedling geal, cryptocotylar. *Hypocotyl* reduced, 0.1 cm, terete, glabrous. *Cotyledons* two, opposite, secund, exstipulate, petiolate; petiole 0.1 cm-0.2 cm, green, glabrous, flattened; blade obovate (1.0 cm-1.8 cm x 0.3 cm-0.4 cm); base cuneate, apex rounded, margin entire; primary vein one, semicraspedodromous. *Internodes* terete, green, soft, densely hairy. *Eophylls* First leaf alternate, compound, unipinnate, bifoliolate, Second leaf biparipinnate, each pinna bifoliolate stipulate (two, lanceolate, green, free lateral), petiolate, herbaceous; petiole 2.1 cm-2.2 cm, terete, pubescent, base pulvinate, green, glabrous; blade oblong (0.8 cm-1.5 cm x 0.3 cm-0.4 cm), base cuneate, apex acute, margin entire; primary vein one, semicraspedodromous. Subsequent leaves alternate, compound, biparipinnate, dimension of leaflet, petiole and spine increasing. (Figs. 83: A-E; Pl. X: a).

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Pongamia pinnata (L.) Pierre

Seedling geal, phanerocotylar. *Hypocotyl* shortly elongating, 1.0 cm-1.2 cm long, terete, hairy. *Cotyledons* two, opposite, secund, exstipulate, sessile, blade asymmetrically oblong (2.3 cm-2.4 cm x 1.8 cm-2.0 cm), sinuate, outer side obtuse, apex rounded, margin entire; no. of veins indistinct; cotyledons covered by thick deep brown seed coat. *Internodes* terete, densely hairy; cataphylls two, opposite, simple, scale-like. *Eophylls* First two leaves alternate, simple upto fifth leaf, from sixth leaf trifoliolate, stipulate (two, scale-like, green, free lateral), petiolate; petiole 1.1 cm-1.2 cm, terete, pubescent, base and apex pulvinate, glabrous; blade wide ovate, 3.8 cm-4.0 cm x 2.1 cm-2.3 cm, base rounded, apex acuminate, margin entire; primary vein one, semicraspedodromous. (Figs. 84: A-E; Pl. X: b).

Samanea saman (Jacq.) Merr.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 3.4 cm-5.0 cm long, terete, lower part glabrous and upper part minutely hairy. *Paracotyledons* two, opposite, erect, stipulate (stipule interpetiolar, very small), subsessile, fleshy; petiole terete, 0.05 cm-0.1 cm, green, glabrous; blade oblong (1.0 cm-0.8 cm x 0.3 cm-0.4 cm); base auricled, apex semitruncate, margin entire; primary vein indistinct; outer surface convex and inner surface plane. *Internodes* terete, densely hairy. *Eophylls* First two leaves opposite, first leaf compound, uniparipinnate, stipulate (two, linear, green, free lateral), petiolate; petiole 0.8 cm-1.0 cm, terete, pubescent, hairy; leaflet three pairs; blade elliptic-obovate, 3.3 cm-3.4 cm x 3.3 cm-3.4 cm, base oblique, apex obtuse, margin entire; primary vein one, semicraspedodromous; upper surface deep green, lower surface pale green, rachis terminating into a appendage. Second leaf bipinnate, with single pair of pinna, each pinna with three pairs of leaflet. Subsequent leaves alternate, compound, third to eight leaves with single pair of pinnae, no. of pinna increasing from 9th leaf stage, blade obliquely rhomboid. (Figs. 85: A-E; Pl. X: c).

Saraca asoca (Roxb.) De Wilde

Seedling geal, cryptocotylar. *Hypocotyl* strongly elongating, 5.0 cm-6.2 cm long, terete, hairy. *Cotyledons* two, secund, later on oblique, exstipulate, subsessile, green; petiole 0.1 cm-0.2 cm, glabrous, flattened; blade oblong (1.8 cm-2.0 cm x 0.6 cm-0.7 cm); base cordate, apex rounded, margin entire; primary vein one, indistinct. *Internodes* terete, densely hairy. *Eophylls* First two leaves alternate, compound, unipinnate, leaflet pairs five to six, paripinnate, exstipulate, petiolate; petiole 0.5 cm-0.6 cm, terete, pubescent, base pulvinate, glabrous; blade elliptic-oblong to linear oblong (0.7 cm-0.8 cm x 0.3 cm-0.4 cm), base obtuse, apex acuminate, margin entire; primary vein one, semicraspedodromous. (Figs. 86: A; Pl. X: d).

Sesbania cannabina (Retzius) Poiret

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 2.8 cm-3.3 cm long, terete, glabrous. *Cotyledons* two, opposite, oblique, exstipulate, petiolate, coriaceous, green; petiole 0.1 cm-0.2 cm, glabrous, semilunar; blade oblong (1.4 cm-1.5 cm x 0.3 cm-0.5 cm); base cuneate, apex rounded, margin entire; primary vein one, semicraspedodromous. *Internodes* terete, densely hairy. *Eophylls* first leaf alternate, unifoliolate, stipulate (two, free lateral, lanceolate), petiolate, coriaceous; petiole 0.4 cm-0.5 cm, terete, pubescent, base pulvinate, glabrous; blade oblong (2.0 cm-2.2 cm x 0.5 cm -0.7cm), base cuneate, apex rounded, margin entire; primary vein one, semicraspedodromous. Second leaf onwards alternate, compound, uniparipinnate, leaflet five pairs, stipulate, petiolate, pulvinate, blade obovate-oblong, upper and lower leaflets smaller in size, base slightly asymmetric, apex rounded, margin entire, primary vein one, semicraspedodromous, leaf rachis terminating into appendage. (Figs. 87: A-C; Pl. X: e).

Sesbania grandiflora (L.) Poir

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 2.8 cm-3.0 cm long, terete, glabrous. *Cotyledons* two, opposite, oblique, stipulate; stipule interpetiolar, hairy, pinkish; petiolate, coriaceous; petiole 0.1 cm-0.2 cm, glabrous, semilunar; blade oblong (1.8 cm-1.9 cm x 0.8 cm-0.9 cm); base cuneate, apex rounded, margin entire; primary vein three, actinodromous. *Internodes* terete, densely hairy. *Eophylls* first alternate, unifoliolate, stipulate (two, free lateral, lanceolate), petiolate; petiole 0.5 cm-0.7cm, terete, pubescent, base pulvinate, glabrous; blade elliptic (2.0 cm -2.4 cm x 1.1 cm-1.6 cm), base rounded, apex rounded, margin entire; primary vein one, semicraspedodromous. Second leaf alternate, compound, uniparipinnate, leaflet three-four pairs, stipulate, petiolate, blade obovate-oblong, upper leaflets smaller, base asymmetric, apex obtuse, margin entire, primary vein one, semicraspedodromous, leaf rachis terminating into appendage. (Figs. 88: A-D; Pl. X: f).

Sesbania sesban (L.) Merrill

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 3.5 cm-3.8 cm long, terete, glabrous. *Cotyledons* two, opposite, oblique, exstipulate, petiolate, green; petiole 0.2 cm-0.3 cm, green, glabrous, semilunar; blade obovate (1.3 cm-1.5 cm x 0.3 cm-0.5 cm); base rounded, apex rounded, margin entire; primary vein three, actinodromous.

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Internodes terete, densely hairy. *Eophylls* first alternate, unifoliolate, stipulate (two, free, lateral, pinkish, lanceolate), petiolate, coriaceous; petiole 0.4 cm-0.5 cm long, terete, pubescent, base pulvinate, green, glabrous; blade ±obovate, 2.0 cm-2.2 cm x 0.5 cm-0.7 cm, base cuneate, apex rounded, margin entire; primary vein one, semicraspedodromous. Second leaf uniparipinnate, leaflet five pairs, stipulate, petiolate, pulvinate, blade oblong, leaflet even paired, base asymmetric, apex mucronate, margin entire, primary vein one, semicraspedodromous, leaf rachis terminating into appendage, lower and upper leaflets smaller in size. (Figs. 89: A-D; Pl. X: g).

Tephrosia purpurea (L.) Pers.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 2.5-2.8 cm long, terete, glabrous. *Paracotyledons* two, opposite, oblique, later on oblique, exstipulate, petiolate, coriaceous; petiole 0.1 cm-0.2 cm long, hairy, semilunar; blade oblong (1.1 cm-1.2 cm x 0.4 cm-0.5 cm); base asymmetric, apex rounded, margin entire; primary vein one, eucamptodromous. *Internodes* terete, densely hairy. *Eophylls* first alternate, unifoliolate, stipulate (two, free lateral, lanceolate), petiolate; petiole 0.4 cm-0.5 cm, terete, pubescent, glabrous; blade obovate, 2.1 cm-2.3 cm x 0.6 cm-0.8 cm, base cuneate, apex retuse, margin entire; primary vein one, semicraspedodromous. Second leaf alternate, trifoliolate, stipulate, petiolate, pulvinate, blade obovate, terminal leaflet 1.6 cm x 0.5 cm, lateral leaflet 1.4 cm x 0.4 cm. Subsequent leaves alternate, compound, imparipinnate, trifoliolate to thirteen foliolate. (Figs. 90: A-C; Pl. X: h).

Teramnus labialis (L.f.) Spreng.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 2.0 cm-2.5 cm long, terete, lower part whitish and upper part green, glabrous. *Paracotyledons* two, opposite, oblique, horizontal, exstipulate, petiolate, coriaceous; petiole 0.1 cm-0.2 cm, green, glabrous, terete; blade oblong (1.0 cm-1.2 cm x 0.4 cm-0.5 cm); base oblique cuneate, apex obtuse, margin entire; primary vein one, semicraspedodromous. *Internodes* terete, hairy. *Eophylls* first two leaves opposite, simple, subsequent leaves alternate, compound, trifoliolate, stipulate (two, free lateral, hairy, lanceolate), petiolate; petiole 1.0 cm-1.2 cm, terete, pubescent, base pulvinate, glabrous; blade ovate-elliptic, 1.5 cm-1.6 cm x 1.2 cm-1.3 cm, base rounded to obtuse, apex acute, margin entire; primary vein three, actinodromous. (Figs. 91: A-D; Pl. X: i).

Lythraceae

Lagerstroemia speciosa (L.) Pers.

Seedling epigeal, phanerocotylar. *Hypocotyl* shortly elongating, 0.5-0.6 cm, terete, glabrous. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.2 cm-0.5 cm, glabrous; blade reniform (0.5 cm-0.7 cm x 0.7 cm-0.9 cm); base rounded, apex obtuse, margin entire; primary vein one, semicraspedodromous. *Internodes* terete, glabrous. *Eophylls* alternate, simple, exstipulate, petiolate; petiole 0.1 cm-0.2 cm, terete, glabrous; blade obovate (1.0 cm-1.7 cm x 0.5 cm-0.6 cm), base attenuate, apex acute, margin entire, glabrous; primary vein one, brochidodromous. (Figs. 92: A-C; Pl. XI: a).

Malvaceae

Malachra capitata (L.) L.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 1.6 cm-2.0 cm, terete, glabrous. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 1.4 cm-1.5 cm, hairy; blade orbicular (0.9 cm-1.0 cm x 0.8 cm-1.1 cm); base truncate, apex rounded, margin entire; primary vein three, actinodromous; *Internodes* terete, hirsute. *Eophylls* alternate, simple, stipulate (free lateral), petiolate; petiole 2.3 cm-2.5 cm, terete, hairy; blade orbicular (2.5 cm-3.0 cm x 1.3 cm-2.0 cm), base truncate, apex rounded, margin sinuate, primary vein three, actinodromous. (Figs. 93: A-C; Pl. XI: b).

Sida acuta Burm. f.

Seedling epigeal, phanerocotylar. *Hypocotyl* shortly elongating, 1.6 cm-2.0 cm, terete, hirsute. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 1.4 cm-1.5 cm, hairy; blade ovate (0.6 cm-0.8 cm x 0.4 cm-0.6 cm); base rounded, apex acute, margin entire; primary vein three, actinodromous. *Internodes* terete, hirsute. *Eophylls* alternate, simple, stipulate (free lateral), petiolate; petiole 0.2 cm-0.3 cm, terete, hairy; blade ovate (0.9 cm-1.5 cm x 0.7 cm-1.3 cm), base cuneate, apex acute, margin serrate, primary vein three, actinodromous. (Figs. 94: A-D; Pl. XI: c).

Urena lobata L.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 3.6 cm-4.0 cm long, terete, pubescent. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.4 cm-1.0 cm, hairy; blade subreniform (1.0 cm-1.5 cm x 1.4 cm-2.1 cm); base truncate, apex rounded, margin entire; primary vein three, actinodromous. *Internodes* terete, hirsute. *Eophylls* alternate, simple, stipulate (free lateral), petiolate; petiole 0.3 cm-1.5 cm, terete, hairy; blade orbicular (2.5 cm-3.0 cm x

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1.3 cm-2.0 cm), slightly lobed, base rounded to truncate, apex acute, margin crenate-serrate, primary vein three, actinodromous. (Pl. XI: d).

Urena sinuata L.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 3.6 cm-4.0 cm long, terete, pubescent. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.4 cm-1.0 cm, hairy; blade subreniform (1.0 cm-1.5 cm x 1.4 cm-2.1 cm); base truncate, apex rounded, margin entire; primary vein three, actinodromous; *Internodes* terete, hirsute. *Eophylls* alternate, simple, stipulate (free lateral), petiolate; petiole 0.3 cm-1.5 cm, terete, hairy; blade orbicular (2.5 cm-3.0 cm x 1.3 cm-2.0 cm), lobed, deeply palmilobed and doubly incised from fifth leaves stages, base rounded to truncate, apex acute, margin crenate-serrate, primary vein three, actinodromous. (Pl. XI: e).

Martyniaceae

Martynia annua L.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 2.5 cm-3.0 cm long, dorsiventrally compressed, minutely pubescent, guarded with curved horny appendage of fruit. *Paracotyledons* two, opposite, fleshy, exstipulate, petiolate; 1.0 cm-1.5 cm, petiole pale green, minutely pubescent; blade oblong (2.0 cm-3.6 cm x 0.8 cm-1.5 cm); base cordate, apex rounded, margin entire, distantly hairy; primary vein three, acrodromous. *Internodes* terete, glabrous. *Eophylls* opposite, simple, exstipulate, petiolate (0.5 cm-1.6 cm), petiole adaxially narrowly grooved, pubescent, purplish green; blade ovate to ovate orbicular (2.0 cm-5.0 cm x 1.5 cm-2.5 cm), base cordate to broadly rounded, apex obtuse; margin entire to irregularly repand-dentate; primary veins three, actinodromous (Pl. XI: f).

Meliaceae

Azadirachta indica A. Juss.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 4.6 cm-7.5 cm long, terete, glabrous. *Cotyledons* two, opposite, exstipulate, petiolate; petiole 0.2 cm-0.3 cm, glabrous; blade spatulate (1.4 cm-1.7 cm x 0.7 cm-0.8 cm); base cuneate, apex obtuse, margin entire; primary vein one, brochidodromous. *Internodes* terete, soft, hirsute. *Eophylls* first two leaves opposite, compound, trifoliolate to pentafofoliate, subsequent leaves alternate, imparipinnate with terminal leaflets and two pairs of sessile leaflets, exstipulate, petiolate; petiole 0.9 cm-1.8 cm, terete, pubescent; terminal leaflets ovate-lanceolate (4.5 cm-7.5 cm x 1.8 cm-2.1 cm), lateral leaflets comparatively smaller (2.5 cm-4.6 cm x 0.6cm-0.9 cm), base of leaflets cuneate, apex acuminate, margin serrate and lobed, hairy; primary vein one, brochidodromous(Pl. XI: g).

Myrtaceae

Syzygium cumini (L.) Skeels

Seedling geal, phanerocotylar. *Hypocotyl* shortly elongating, 0.4 cm-1.0 cm, terete, scabrous. *Cotyledons* two, opposite, exstipulate, sessile; hard fleshy, testa black but green when exposed outside the soil, blade ovate-cordate (0.5 cm-1.1 cm x 0.5 cm-1.0 cm); base assymmetric, apex rounded, margin entire; veins not distinct. *Internodes* terete, hirsute. *Eophylls* alternate, simple, exstipulate, petiolate; petiole 0.3 cm-0.4 cm, terete, pubescent; blade elliptic (4.1 cm-5.7 cm x 2.6 cm-3.2 cm), base obtuse, apex acute, margin entire, hairy; primary vein one, brochidodromous (Pl. XI: h).

Nyctaginaceae

Boerhavia repens L.

Seedling epigeal, phanerocotylar. *Hypocotyl* shortly elongating, 0.4 cm-1.0 cm, terete, scabrous. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 1.0 cm-1.5 cm, glabrous; blade lanceolate (0.7 cm-1.1 cm x 0.8 cm-1.2 cm); base obtuse, apex obtuse, margin entire; primary vein one, brochidodromous. *Internodes* terete, hirsute. *Eophylls* opposite, pair unequal, simple, exstipulate, petiolate; petiole 1.3 cm-2.4 cm, terete, pubescent; blade obovate (1.8 cm-2.7 cm x 1.6 cm-2.2 cm), base cuneate to rounded, apex rounded to obtuse, margin entire to undulate, hairy; primary vein one, brochidodromous(Pl. XI: i).

Oleaceae

Nyctanthes arbor-tristis L.

Seedling epigeal, phanerocotylar. *Hypocotyl* very shortly elongating, 0.2 cm-0.3 cm, terete, hirsute. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 1.4 cm-1.5 cm, semiorbicular; hairy; blade orbicular (3.6 cm-5.8 cm x 2.4 cm-3.6 cm); base attenuate, apex rounded, margin entire; primary vein three, actinodromous. *Internodes* terete, hirsute. *Eophylls* opposite, simple, herbaceous, exstipulate, petiolate, scabrous; petiole 0.2 cm-0.3 cm, terete, hairy; blade ovate (3.9 cm-5.5 cm x 2.7 cm-3.3 cm), base rounded, apex acuminate, margin distantly serrate, primary vein one, semicraspedodromous. (Pl. XII: a).

Papaveraceae

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Argemone mexicana L.

Seedling epigeal, phanerocotylar. *Hypocotyl* very shortly elongating, 0.2 cm-0.3 cm, terete, glabrous. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 1.4 cm-1.5 cm, semiorbicular; hairy; blade linear (2.6 cm-3.0 cm x 0.2 cm-0.3 cm); base cuneate, apex acute, margin entire; primary vein one, hyphodromous. *Internodes* terete, hirsute. *Eophylls* alternate, simple, herbaceous, exstipulate, sessile; blade spatulate (1.5 cm-1.8 cm x 0.7 cm-0.8 cm), base attenuate, apex acuminate, lower part of margin entire, upper part spiny-dentate to sinuately serrate, primary vein one, semicraspedodromous. (Pl. XII: b).

Pedaliaceae

Pedaliium murex L.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 3.0-3.5 cm long, terete, glabrous, succulent, slightly swollen at upper part. *Paracotyledons* two, opposite, exstipulate, subsessile; petiole 0.5-1.5 cm, petiole terete, slightly curved, whitish green, glabrous; blade ovate-oblong (1.0 cm-1.8 cm x 0.5 cm-1.0 cm); base obtuse to cuneate, apex obtuse to truncate, margin entire; primary veins three, acrodromous. *Internodes* terete, glabrous. *Eophylls* opposite to opposite decussate, simple, succulent, exstipulate, petiolate; petiole 0.2 cm-1.5 cm, slightly curved, margin finely hairy; blade obovate to ovate orbicular (1.0 cm-2.4 cm x 0.9 cm-2.3 cm), base cuneate, apex subrounded, margin entire to slightly undulate to repand; primary veins three, actinodromous. (Pl. XII: c).

Sesamum indicum L.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 4.0 cm-5.0 cm long, terete, hairy. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.4 cm-0.6 cm, whitish, hirsute; ovate-oblong (1.0 cm-1.8 cm x 0.5 cm-1.0 cm); base rounded, apex rounded, margin entire; primary veins three, acrodromous. *Eophylls* opposite to opposite decussate, simple, exstipulate, petiolate; petiole 1.0 cm-1.5 cm, blade ovate-elliptic (2.8 cm-3.2 cm x 1.3 cm-1.5 cm), base cuneate, apex acute, margin subentire, pinnately arranged, distantly denticulate to lobed; primary vein one, brochidodromous, veins raised on lower surface; with mucilaginous hair on lower surface. (Pl. XII: d).

Piperaceae

Peperomia pellucida (L.) Kunth

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 2.0-2.5 cm long, terete, glabrous, succulent. *Paracotyledons* two, opposite, exstipulate, petiolate; 0.5 cm-1.5 cm, petiole terete, slightly curved, whitish green, glabrous; blade orbicular (1.0 cm-1.8 cm x 0.5cm-1.0cm); base rounded, apex rounded, margin entire; primary veins one, semicraspedodromous. *Internodes* terete, glabrous. *Eophylls* alternate, simple, succulent, exstipulate, petiolate; petiole 0.2 cm-0.3 cm, slightly curved, margin finely hairy; blade ovate orbicular to broadly rounded (1.0 cm-2.4 cm x 0.9 cm-2.3 cm), base rounded, apex acute, margin entire; primary veins three, actinodromous. (Pl. XII: e).

Polygonaceae

Polygonum orientale L.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 1.8 cm-4.0 cm long, terete, glabrous. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.3 cm-0.5 cm, petiolar bases unite to form a cup, glabrous; blade linear (1.8 cm-2.5 cm x 0.2 cm-0.3 cm); base attenuate, apex acute, margin entire; primary vein one, semicraspedodromous. *Internodes* terete, upper ones angular, hirsute. *Eophylls* alternate, simple, chartaceous, stipulate; stipules ochreate, petiolate; petiole 0.7 cm-1.2 cm long, terete, glabrous; blade elliptic-lanceolate to ovate-lanceolate (2.5 cm-3.2 cm x 0.8 cm-1.1 cm), base cuneate, apex acute, margin entire, hairy; primary vein one, eucamtodromous. (Pl. XII: f).

Rumex dentatus L.

Seedling epigeal, phanerocotylar. *Hypocotyl* reduced, 0.4 cm-0.6 cm, terete, glabrous. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.4 cm-0.5 cm, petiolar bases unite to form a cup, glabrous; blade narrow oblong (1.0 cm-1.5 cm x 0.2 cm-0.4 cm); base cuneate, apex rounded, margin entire; primary vein one, brochidodromous. *Internodes* terete, upper ones angular, green, soft, hirsute. *Eophylls* alternate, simple, leaves gradually becoming radical and hence internodes appearing inconspicuous, stipulate; stipules ochreate, petiolate; petiole 1.0 cm-1.2 cm, terete, glabrous; blade ovate to ovate-lanceolate (1.5 cm-2.2 cm x 0.9 cm-1.0 cm), base cuneate, apex acute, margin entire, hairy; primary vein one, eucamtodromous. (Pl. XII: g).

RUBIACEAE

Oldenlandia corymbosa L.

Seedling epigeal, phanerocotylar. *Hypocotyl* reduced, ± 0.1 cm, terete, glabrous. *Paracotyledons* two, opposite, stipulate, sessile; glabrous; blade ovate (0.5 cm-0.7 cm x 0.7 cm-1.0 cm); base rounded, apex obtuse, margin entire; primary vein one, hyphodromous. *Internodes* terete, upper ones angular, hirsute. *Eophylls* opposite decussate, simple,

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stipulate; stipules minute, 0.6 cm-1.0 cm x 0.1 cm-0.2 cm, green ; short petiole; petiole 0.1 cm-0.2 cm, terete, glabrous; blade ovate to elliptic-lanceolate (2.5 cm-2.8 cm x 1.1 cm-1.3 cm), base cuneate, apex acute, margin entire, hairy; primary vein one, hyphodromous. (Pl. XII: h).

Oldenlandia paniculata L.

Seedling epigeal, phanerocotylar. *Hypocotyl* very shortly elongating, 0.2 cm-0.3 cm, terete, glabrous. *Paracotyledons* two, opposite, stipulate; stipule triangular, acute; petiole; petiole 0.2 cm-0.3 cm, glabrous; blade orbicular (0.1 cm-0.2 cm x 0.1 cm-0.2 cm); base obtuse, apex obtuse, margin entire; primary vein one, eucamptodromous. *Internodes* terete, hirsute. *Eophylls* opposite decussate, simple, stipulate; stipule triangular with truncate base and acute apex; petiole 0.1 cm-0.2 cm, glabrous; blade narrow ovate, ovate elliptic to ovate-oblong (0.6 cm-1.2 cm x 0.4 cm-0.7 cm), base obtuse, apex acute, margin entire, hairy; primary vein one, eucamptodromous. (Pl. XII: i).

Spermacoce articularis L.f.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 2.0 cm-3.0 cm long, terete, scabrous. *Paracotyledons* two, opposite, stipulate(interpetiolar), petiole; petiole 0.1 cm-0.2 cm, glabrous; blade ovate-oblong (0.7 cm-0.9 cm x 0.5 cm-0.6 cm); base attenuate, apex acute, margin entire; primary vein one, hyphodromous. *Internodes* terete, hirsute; first internode 0.3 cm-0.4 cm long, second one 0.5 cm-0.7 cm long; next internodes almost equal to that of first one. *Eophylls* opposite to opposite decussate, simple, stipulate; stipules interpetiolar; short petiole; petiole 0.1 cm-0.2 cm, terete, pubescent; blade elliptic (1.3 cm-1.4 cm x 0.5 cm-1.3 cm), base obtuse, apex acute, margin entire, hairy; primary vein one, hyphodromous. (Pl. XIII: a)

Sapotaceae

Madhuca longifolia (Koenig) Macbride

Seedling epigeal, cryptocotylar. *Hypocotyl* reduced, ± 0.1 cm, terete, scabrous. *Cotyledons* two, oblong-ellipsoid, base obtuse, apex obtuse, succulent, exstipulate, petiole; petiole flattened, encircling the hypocotyl, 1.0 cm-1.6 cm long and glabrous; 3.5 cm-5.2 cm x 4.2 cm-5.9 cm, covered by shining brown persistent hard seed coat. *Internodes* terete, hirsute. *Eophylls* first two leaves opposite, subsequent leaves alternate simple, exstipulate, petiole; petiole 0.4 cm-0.7 cm, terete, pubescent; blade elliptic (4.5 cm-3.2 cm x 4.8 cm-3.5 cm), base attenuate, apex acute, margin entire; primary vein one, brochidodromous. (Pl. XIII: b).

Mimusops elengi L.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 3.3-7.0 cm long, terete, glabrous. *Paracotyledons* two, opposite, exstipulate, short petiole; petiole 0.1 cm-0.2 cm, glabrous; blade ovate-elliptic (2.4 cm-3.1 cm x 1.7 cm-2.0 cm); base rounded, apex rounded, margin entire; primary vein one, brochidodromous. *Internodes* terete, glabrous. *Eophylls* alternate, simple, stipulate; stipules free lateral; petiole; petiole 0.4 cm-0.8 cm, terete, pubescent; blade elliptic (4.3 cm-6.2 cm x 1.2 cm-1.9 cm), base cuneate, apex acuminate, margin entire, hairy; primary vein one, brochidodromous. (Pl. XIII: c).

Scrophulariaceae

Bacopa monnieri (L.) Penn.

Seedling epigeal, phanerocotylar. Adventitious roots arising from the hypocotyls and lower nodes, shortly elongating, 1.5 cm-2.5 cm. *Hypocotyl* shortly elongating, 0.4 cm – 0.6 cm, terete, glabrous. *Paracotyledons* two, opposite, exstipulate, subsessile; petiole 0.05 cm-0.1 cm, glabrous; blade obovate (0.17 cm-0.19 cm x 0.06 cm-0.08 cm); base cuneate, apex obtuse, margin entire; veins inconspicuous. *Internodes* terete, glabrous. *Eophylls* opposite to opposite decussate, simple, exstipulate, petiole; petiole 0.05 cm-0.1 cm, flattened, glabrous; 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.

Lindenbergia indica (L.) O. Kuntze

Seedling epigeal, phanerocotylar. *Hypocotyl* reduced, 0.05 cm-0.1 cm, terete, soft, green, pubescent. *Paracotyledons* two, opposite, exstipulate, petiole; petiole 0.1 cm-0.2 cm; blade wide ovate (0.15 cm-0.19 cm x 0.15 cm-0.19 cm); base cuneate, apex rounded, margin entire; primary vein one, hyphodromous. *Internodes* angular, hairy. *Eophylls* opposite to opposite decussate, simple, exstipulate, petiole; petiole 0.5 cm-0.8 cm; blade wide ovate (0.15 cm-0.2 cm x 0.15 cm-0.2 cm), base rounded, apex obtuse, margin entire to crenate-serrate; primary vein one, eucamptodromous. (Pl. XIV: e).

Lindernia crustacea (L.) F. Muell.

Seedling epigeal, phanerocotylar. *Hypocotyl* very shortly elongating, 0.2 cm – 0.3 cm, terete, scabrous. *Paracotyledons* two, opposite, exstipulate, petiole; petiole 0.2 cm-0.25 cm, glabrous; blade wide ovate (0.2 cm-0.3 cm x 0.2 cm-0.3 cm) ; base rounded, apex obtuse, margin entire; primary vein one, hyphodromous. *Internodes* angular, glabrous.

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Eophylls opposite to opposite decussate, simple, exstipulate, petiolate; petiole 0.2 cm-0.3 cm, blade ovate (0.3 cm-0.5 cm x 0.2 cm-0.3 cm), base subtruncate, apex obtuse, margin serrate; primary vein one, eucamptodromous. (Pl. XIV: f).

Mazus pumilus (Burm.f.) Steenis

Seedling epigeal, phanerocotylar. *Hypocotyl* very shortly elongating, 0.2 cm – 0.3 cm, terete, glabrous. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.1cm-0.2 cm; blade ovate (0.15 cm-0.2 cm x 0.19 cm-0.2 cm) ; base rounded, apex acute, margin entire; primary vein one, hyphodromous. *Internodes* angular, hairy; *eophylls* almost from the node of paracotyledon. *Eophylls* first two leaves opposite, subsequent leaves rosette, simple, exstipulate, petiolate; petiole 0.1 cm-0.2 cm; blade ovate to obovate (0.5 cm-0.6 cm x 0.3 cm-0.4 cm), base rounded, apex obtuse, margin entire to crenate-serrate; primary vein one, semicraspedodromous. (Pl. XIV: g).

Mecardonia procumbens (Miller) Small

Seedling epigeal, phanerocotylar. *Hypocotyl* very shortly elongating, 0.15 cm – 0.3 cm, terete, green, scabrous. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.1 cm-0.2 cm; blade ovate (0.3 cm-0.35 cm x 0.25 cm-0.3 cm) ; base cuneate, apex obtuse, margin entire; primary vein one, hyphodromous. *Internodes* terete, glabrous. *Eophylls* opposite to opposite decussate, simple, exstipulate, petiolate; petiole 0.3 cm-0.35 cm; blade wide ovate (0.6 cm-0.8 cm x 0.5 cm-0.55 cm), base cuneate, apex obtuse, margin undulate or serrate on upper 2/3rd of margin; primary vein one, semicraspedodromous. (Pl. XIV: h).

Scoparia dulcis L.

Seedling epigeal, phanerocotylar. *Hypocotyl* very shortly elongating, 0.2 cm–0.3 cm, terete, scabrous. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.1cm-0.2 cm; blade ovate (0.1 cm-0.15 cm x 0.05 cm-0.06 cm) ; base cuneate, apex acute, margin entire; primary vein one, hyphodromous. *Internodes* angular, scabrous. *Eophylls* opposite to opposite decussate, simple, exstipulate, petiolate; petiole 0.1 cm-0.25 cm; blade wide ovate (0.3 cm-0.35 cm x 0.2 cm-0.25 cm), base cuneate, apex acute, margin serrate to crenate-serrate; primary vein one, semicraspedodromous. (Pl. XIV: i).

Cestrum diurnum L.

Seedling epigeal, phanerocotylar. *Hypocotyl* shortly elongating, 0.8 cm – 1.2 cm, terete, scabrous. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.5 cm-0.6 cm, hairy; blade wide ovate (0.5 cm-0.6 cm x 0.5 cm-0.6 cm); base oblique rounded, apex rounded, margin entire; primary vein one, brochidodromous. *Internodes* terete, scabrous. *Eophylls* alternate, simple, herbaceous, exstipulate, petiolate; petiole 0.3 cm-0.5 cm, hairy; blade ovate to elliptic-oblong (0.8 cm-1.0 cm x 0.3 cm-0.5 cm), base oblique rounded to cuneate, apex obtuse, margin entire; primary vein one, brochidodromous. (Pl. XIII: d).

Datura metel L.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 3.5 cm – 4.0 cm, terete, reddish, lower part glabrous upper part hairy. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.4 cm-0.5 cm, hairy; blade lanceolate (2.4 cm-4.0 cm x 0.7cm-0.8 cm); base cuneate, apex acute, margin entire; primary vein one, hyphodromous. *Internodes* terete, scabrous. *Eophylls* alternate, simple, herbaceous, exstipulate, petiolate; petiole 0.9 cm-1.1 cm, hairy; blade elliptic to ovate-elliptic (2.0 cm-3.0 cm x 1.0 cm-1.3 cm), base oblique cuneate, apex acute to acuminate, margin subentire to sinuate, hairy; primary vein one, brochidodromous. (Pl. XIII: e).

Nicotiana plumbaginifolia Viv.

Seedling epigeal, phanerocotylar. *Hypocotyl* shortly elongating, 0.8 cm – 1.2 cm, terete, pale green, glabrous. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.2 cm-0.4 cm, glabrous; blade wide ovate (0.2 cm-0.3 cm x 0.2 cm-0.3 cm); base rounded, apex rounded, margin entire; primary vein one, brochidodromous. *Internodes* terete, scabrous. *Eophylls* alternate, simple, exstipulate, petiolate; petiole 0.6 cm-0.7 cm, glabrous; blade obovate to spatulate, (2.0 cm-2.5 cm x 0.8 cm-1.0 cm), base attenuate, apex obtuse, margin entire; primary vein one, brochidodromous. (Pl. XIII: f)

Physalis minima L.

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 3.5 cm–4.0 cm long, terete, hairy. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.7 cm-0.8 cm, hairy; blade ovate (0.4 cm-0.5 cm x 0.2 cm-0.3 cm); base rounded, apex acute, margin entire; primary vein one, eucamptodromous. *Internodes* terete, scabrous. *Eophylls* alternate, simple, exstipulate, petiolate; petiole 0.2 cm-0.3 cm, hairy; blade ovate to elliptic-ovate (1.5 cm-1.6 cm x 0.9 cm-1.0 cm), base oblique, apex obtuse to acute, margin sinuately lobed; primary vein one, semicraspedodromous. (Pl. XIII: g).

Solanum nigrum L.

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Seedling epigeal, phanerocotylar. Hypocotyl shortly elongating, 1.0 cm – 1.2 cm, terete, upper part pubescent, lower part glabrous. Paracotyledons two, opposite, exstipulate, petiolate; petiole 0.1 cm-0.6 cm, hairy; blade narrow ovate (0.7 cm-0.9 cm x 0.3 cm-0.5 cm); base cuneate, apex acuminate, margin entire; primary vein one, brochidodromous. Internodes terete, hirsute. First two leaves alternate, simple, exstipulate, petiolate; petiole 0.3 cm-0.4 cm, hairy; blade wide ovate (1.3 cm-1.5 cm x 1.1 cm-1.3 cm), base rounded to oblique, apex acute, margin undulate to irregularly serrate to sinuate; primary vein one, brochidodromous. (Pl. XIII: h).

Solanum sisymbriifolium Lamarck

Seedling epigeal, phanerocotylar. Hypocotyl strongly elongating, 2.0 cm – 2.5 cm long, terete, hairy. Paracotyledons two, opposite, exstipulate, petiolate; petiole 0.8 cm-0.9 cm, hairy; blade narrow-ovate (0.8 cm-0.9 cm x 0.3 cm-0.4 cm); base rounded, apex acuminate, margin entire; primary vein one, brochidodromous. Internodes terete, hispid. Eophylls alternate, simple, exstipulate, petiolate; petiole 0.6 cm-1.2 cm, hairy; first leaf ovate, second leaf wide ovate, blade sinuately lobed to pinnatisect (0.5 cm-0.8 cm x 0.3 cm-0.9 cm), base oblique cuneate, apex acute, margin irregularly incised, hairy; primary vein one, semicraspedodromous, few soft spines present along the veins. (Pl. XIII: i).

Solanum torvum Swartz

Seedling epigeal, phanerocotylar. Hypocotyl shortly elongating, 1.0 cm – 1.5 cm, terete, hispidulous. Paracotyledons two, opposite, exstipulate, petiolate; petiole 0.2 cm-0.3 cm, hairy; blade narrow ovate (0.7 cm-0.9 cm x 0.3 cm-0.4 cm); base cuneate, apex acute, margin entire; primary vein one, semicraspedodromous. Internodes terete, scabrous. First two leaves alternate, simple, exstipulate, petiolate; petiole 0.5 cm-0.6 cm, hairy; blade ovate-elliptic (1.0 cm-1.3 cm x 0.5 cm-0.7 cm), base cuneate, apex obtuse, margin undulate to distantly sinuate; primary vein one, semicraspedodromous. (Pl. XIV: a).

Solanum violaceum Ortega

Seedling epigeal, phanerocotylar. Hypocotyl strongly elongating, 1.6 cm – 2.0 cm long, terete, brownish, hairy. Paracotyledons two, opposite, exstipulate, petiolate; petiole 0.2 cm-0.3 cm, hairy; blade narrow ovate (0.7 cm-1.2 cm x 0.2 cm-0.4 cm); base cuneate, apex acute, margin entire; primary vein one, brochidodromous. Internodes terete, hirsute, spines present. Eophylls alternate, simple, exstipulate, petiolate; petiole 0.3 cm-0.5 cm, hairy; blade ovate, (0.6 cm-1.5 cm x 0.6 cm-1.2 cm), base cuneate to truncate, apex obtuse, margin subentire to sinuate; primary vein one, semicraspedodromous, few soft spines present on the lower surface. (Pl. XIV: b).

Solanum virginianum L.

Seedling epigeal, phanerocotylar. Hypocotyl shortly elongating, 1.0 cm – 1.5 cm long, terete, hairy. Paracotyledons two, opposite, exstipulate, petiolate; petiole 0.2 cm-0.3 cm, hairy; blade 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, green. Eophylls alternate, simple, exstipulate, petiolate; petiole 0.1 cm-0.2 cm, hairy; blade ovate to pinnatisect (0.8 cm-1.0 cm x 0.6 cm-0.7 cm), base oblique rounded to truncate, apex obtuse to acute, margin subentire to sinuately lobed to pinnatifid; primary vein one, semicraspedodromous, frequency of spines at the surface of internodes increasing. (Pl. XIV: c).

Withania somnifera (L.) Dunal

Seedling epigeal, phanerocotylar. Hypocotyl strongly elongating, 3.5 cm–4.0 cm long, terete, hairy. Paracotyledons two, opposite, exstipulate, petiolate; petiole 0.5 cm-0.6 cm, hairy; blade 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. Eophylls subopposite to alternate, simple, exstipulate, petiolate; petiole 0.2 cm-0.3 cm, hairy; blade ovate to elliptic-ovate (1.2 cm-1.3 cm x 1.0 cm-1.1 cm), base rounded, apex obtuse to rounded to acute, margin entire; primary vein one, semicraspedodromous. (Plate XIV: i).

Sterculiaceae

Kleinhovia hospita L.

Seedling epigeal, phanerocotylar. Hypocotyl strongly elongating, 2.0 cm-3.0 cm long, terete. Paracotyledons two, opposite, exstipulate, petiolate; petiole 0.2 cm-0.3 cm, glabrous; blade wide ovate, slightly or more distinctly 3-angular or rhomboid (1.5 cm-1.7 cm x 1.0 cm-1.4 cm); base truncate, apex obtuse, margin entire; primary vein five, actinodromous. Internodes terete, hirsute. Eophylls alternate, simple, stipulate; stipules narrowly 3-angular; short petiolate; petiole 0.1 cm-0.2 cm long, terete, pubescent; blade cordiform, (3.5 cm-3.8 cm x 1.1 cm-1.3 cm), base cordate to rounded, apex acuminate, margin dentate, hairy; primary vein one, brochidodromous. (Pl. II: a).

Melochia corchorifolia L.

Seedling epigeal, phanerocotylar. Hypocotyl strongly elongating, 1.6 cm-2.0 cm long, terete, hairy. Paracotyledons two, opposite, exstipulate, petiolate; petiole 0.1 cm-0.7 cm, pubescent; blade suborbicular (0.5 cm-0.7 cm x 0.4 cm-0.7

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cm); base rounded, apex rounded, margin entire; primary vein one, brochidodromous. *Internodes* terete, hirsute. *Eophylls* alternate, simple, stipulate; stipule free lateral; petiolate; petiole 0.1 cm-0.2 cm long, terete, pubescent; blade wide ovate (0.6 cm-1.1 cm x 0.5 cm-1.3 cm), base rounded, apex obtuse to acute, margin serrate, hairy; primary vein three, actinodromous. (Pl. II: b).

***Sterculia foetida* L.**

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 7.6 cm-12.1 cm long, brownish, hairy. *Cotyledons* two, opposite, exstipulate, succulent, petiolate; petiole 0.3 cm-0.6 cm, hairy throughout; either side of margin curved inwardly towards the midrib, blade folded (4.3 cm-5.1 cm x 0.5 cm-1.1 cm); base cuneate, apex obtuse, margin entire; primary vein one, veins obscure. *Internodes* terete, hirsute. *Eophylls* first two leaves opposite, subsequent leaves palmately compound, stipulate, petiolate; petiole 3.2 cm-3.8 cm, thickened at base, pubescent; blade with six leaflets radiating from the center; leaflets elliptic, sessile, lateral leaflets smaller in size than terminal or mid one, (1.0 cm-5.0 cm x 0.3 cm-1.3 cm), base cuneate, apex acuminate, margin entire, hairy; primary vein one, brochidodromous. (Pl. II: c).

Tiliaceae

***Triumfetta rhomboidea* Jacq.**

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 3.0cm-3.5 cm long, terete, hairy. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.6 cm-0.8 cm, glabrous; blade orbicular (0.8 cm-1.0 cm x 0.7 cm-0.9 cm); base rounded, apex rounded, margin entire; primary vein one, hyphodromous. *Internodes* terete, hirsute. *Eophylls* alternate, simple, stipulate (stipule free lateral), petiolate; petiole 0.5 cm-1.0 cm long, terete, pubescent; blade ovate to ovate-rhomboid (1.5 cm-1.8 cm x 1.3 cm-1.4 cm), base rounded, apex obtuse to rounded, margin serrate to dentate, hairy; primary vein one, brochidodromous. (Pl. II: d).

Verbenaceae

***Clerodendrum viscosum* Vent.**

Seedling hypogaeal, cryptocotylar. *Hypocotyl* reduced, ± 0.1 cm, terete, hirsute. *Cotyledons* two, slightly unequal, second, remaining enclosed within hard testa, exstipulate, subsessile; petiole 0.88 cm-0.9 cm, elliptic (0.5 cm-0.7 cm x 0.2 cm-0.3 cm); base cuneate, apex rounded, margin entire, veins obscure. *Internodes* lower terete, upper angular, hairy. *Eophylls* opposite to opposite decussate, simple, exstipulate, petiolate; petiole 1.0 cm-1.4 cm; wide ovate (1.9 cm-2.9 cm x 1.5 cm-2.5 cm), base obtuse, apex acute, margin dentate, hairy; primary veins one, brochidodromous. (Pl. II: e).

***Lantana camara* L.**

Seedling epigeal, phanerocotylar, aromatic. *Hypocotyl* strongly elongating, 2.8 cm-3.5 cm long, terete, hirsute. *Paracotyledons* two, opposite, exstipulate, petiolate 0.3 cm-0.4 cm hirsute; blade broadly ovate to suborbicular (0.6 cm-1.2 cm x 0.5 cm-1.1 cm); base truncate, apex shallowly retuse, margin with minute glandular hairs; primary veins one, brochidodromous. *Internodes* lower terete, upper angular, hairy. *Eophylls* opposite, to opposite decussate, simple, exstipulate, petiolate; 0.6 cm-0.8 cm, petiole terete, hirsute; blade ovate (1.0 cm-1.2 cm x 0.7 cm-0.8 cm), base rounded, apex acute, margin serrate, hairy; primary veins one, brochidodromous. (Pl. II: f).

***Lippia nodiflora* (L.) L.C. Rich.**

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 3.0 cm-3.5 cm long, terete, scabrous. *Paracotyledons* two, opposite, coriaceous, exstipulate, petiolate ; petiole 0.1-0.2 cm, glabrous; blade obovate (0.2 cm-0.3 cm x 0.1 cm-0.3 cm); base cuneate, apex rounded, margin entire; primary veins one, hyphodromous. *Internodes* lower terete, upper angular, hairy. *Eophylls* opposite to opposite decussate, simple, coriaceous, exstipulate, petiolate; petiole 0.1 cm-0.2 cm, scabrous; blade spatulate(0.4 cm –0.5 cm x 0.2 cm-0.3 cm), base attenuate, apex rounded, margin entire to serrate at upper half towards the apex, lower part entire, hairy; primary veins one, hyphodromous. (Figs. 135: A-E).

***Tectona grandis* L. f.**

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 3.0 cm-3.5 cm long, terete, hirsute. *Paracotyledons* two, opposite, coriaceous, exstipulate, petiolate ; petiole 0.4 cm-0.5 cm, hirsute; blade deltoid (0.6 cm-1.2 cm x 0.5 cm-1.1 cm); base cordate, apex retuse, margin entire; primary veins one, brochidromous; surface glandular-pubescent. *Internodes* lower terete, upper angular, hairy. *Eophylls* opposite, simple, subcoriaceous, exstipulate, petiolate ; petiole 1.0 cm-1.4 cm; elliptic to elliptic-oblong (1.8 cm-2.0 cm x 2.1 cm-2.4 cm), base cuneate, apex acuminate, margin erose, hairy; primary veins one, brochidodromous, lower surface densely hairy with gland like dots. (Figs. 136: A-E; Pl. II: g).

Vitaceae

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Cayratia trifolia (L.) Domin

Seedling epigeal, phanerocotylar. *Hypocotyl* strongly elongating, 3.9 cm-5.5 cm long, terete, pubescent. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.1cm-1.3 cm, hairy; blade deltoid (2.5 cm-2.7 cm x 3.1 cm-3.4 cm); base rounded, apex acute, margin entire; primary vein three, actinodromous. *Internodes* terete, hirsute. *Eophylls* alternate, compound, digitately 3-foliolate, exstipulate, petiolate; petiole 2.3 cm-2.5 cm, terete, hairy; leaflet blade elliptic (3.0 cm-3.3 cm x 2.3 cm-2.8 cm), base cuneate, apex acuminate, margin crenate-dentate, primary vein one, semicraspedromous. (Figs. 137: A-D; Pl. II: h).

Zygophyllaceae

Tribulus terrestris L.

Seedling epigeal, phanerocotylar. *Hypocotyl* shortly elongating, 0.7 cm-1.0 cm long, terete, hairy. *Paracotyledons* two, opposite, exstipulate, petiolate; petiole 0.2 cm-0.3 cm, pubescent; blade obovate (0.8 cm-1.0 cm x 0.9 cm-1.0 cm); base cuneate, apex truncate to shallowly retuse, margin entire; primary vein three, acrodromous. *Internodes* branching radiating from the node of paracotyledons, hispid. *Eophylls* first two leaves alternate, subsequent leaves opposite paripinnately compound, number of leaflets eight, stipulate, petiolate; petiole 0.4 cm-0.5 cm long, terete, glabrous; pinna sessile, asymmetrically oblong (0.4 cm-0.5 cm x 0.1 cm-0.15 cm), base obliquely rounded, apex obtuse, margin ciliate, glabrous; primary vein one, inconspicuous, hypodromous. (Figs. 138: A-D; Pl. II: i).

Based on the morphological characters, 139 investigated species are categorized under eight seedling Groups (Plate IIIII). Under each seedling group, a key has been constructed for identification of concerned taxa at seedling stage. Some important distinguishing features of these groups have been presented in Table 4.

Key to the Seedling Groups Investigated

(Valid for the taxa considered in this investigation).

1. First two leaves simple:
 2. Subsequent leaves simple:
 3. First two leaves alternate.....Group I
 - 3a. First two leaves opposite:
 4. Subsequent leaves alternate.....Group II
 - 4a. Subsequent leaves opposite.....Group III
 - 2a. Subsequent leaves compound:
 5. First two leaves alternate.....Group IV (*Pongamia pinnata*)
 - 5a. First two leaves opposite:
 6. Subsequent leaves opposite.....Group V
 - 6a. Subsequent leaves alternate.....Group VI
 - 1a. First two leaves compound:
 7. First two leaves alternate.....Group VII
 - 7a. First two leaves opposite.....Group VIII

IV.DISCUSSION

Five different conditions of germination are encountered here, considering the two basic types (phanerocotylar and cryptocotylar) of seedling development and also epigeal, geal and hypogeal situations of cotyledons with respect to whether the hypocotyl extends or not. These conditions are cryptocotylar epigeal (e.g. *Madhuca longifolia*), phanerocotylar epigeal (e.g. *Solanum nigrum*), cryptocotylar hypogeal (e.g. *Butea monosperma*), cryptocotylar geal (e.g. *Pithecellobium dulce*) and phanerocotylar geal (e.g. *Syzygium cumini*). However, the phanerocotylar seedlings exhibiting epigeal germination outnumber the other types in angiosperms.

Cotyledons have been observed in cryptocotylar species and also in some phanerocotylar species like *Pongamia pinnata*. In the investigated taxa, two types have been noted i.e. food storing (e.g. *Madhuca longifolia*) and photosynthetic cotyledon or paracotyledon (e.g. *Sesbania grandiflora*) has been observed. The number of para(cotyledons) is always two.

Paracotyledons sometimes help in identifying taxa at family level. Family Bignoniaceae (except *Millingtonia hortensis*) and Convolvulaceae are characterized by bilobed paracotyledons. Family Combretaceae is easily identified by flabellate (Fan-shaped) paracotyledons. It is revealed that same type of paracotyledons may exist in more than one family, which is closely related or distantly related to each other. For example, the investigated taxa of the

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Bignoniaceae and Convolvulaceae reveal almost same type of paracotyledons i.e. bilobed, although these two families are placed in different orders, the former in Lamiales order and the latter in Solanales order in APG II (2003) Classification. Members of Solanaceae (ovate paracotyledons) and Convolvulaceae (bilobed paracotyledons) though being closely related families, the shape of paracotyledon is quite different. Lubbock (1892) and Vogel (1980) recorded unequal paracotyledons (in size) in the seedlings of a number of herbaceous and tree taxa. But the present investigation reveals that most of the herbaceous taxa bear paracotyledons of equal size in the seedlings. Paracotyledons are very important for seedling identification. Paracotyledon exhibits wide diversity in shapes, apex, base and venation pattern.

The phyllotaxy is an important characteristic feature. It may be specific in seedling both for the first two and subsequent leaves. Two types of phyllotaxy have been found in the investigated taxa – opposite (62.0%) and alternate (38.0%). First two leaves are opposite and subsequent leaves are alternate in the species of *Madhuca longifolia* and *Parthenium hysterophorus*. Alternate phyllotaxy of eophylls is found in all the investigated members of the family Leguminosae, Solanaceae, Convolvulaceae, Cucurbitaceae, Malvaceae. Opposite phyllotaxy of eophylls are found in all investigated members Scrophulariaceae, Lamiaceae, Verbenaceae, Oleaceae. The shape of the lamina, apex, base and venation pattern is various. Morphological differences are also noted in the form of base which may be attenuate, cordate, cuneate, rounded, etc and apices of eophylls which include acute, acuminate, obtuse, rounded, mucronate, retuse and truncate. Base balance may be symmetric (*Mimusops elengi*) or asymmetric (*Cestrum diurnum*). Margin of the lamina of the juvenile leaves may be crenate, entire, serrate, lobed, crenate-dentate, dentate to pinnatifid, deeply incised, undulate, etc. The lamina of eophylls display different venation patterns. The number of primary veins varies from one to many. The gross venation exhibits different patterns like brochidodromous, eucamptodromous, hyphodromous, simple craspedodromous and semicraspedodromous. The above diversity of characters is useful as taxonomic markers, and can be used in construction of keys for identification purpose. The occurrence of ovate paracotyledons as predominant character are found in the families Acanthaceae, Cruciferae, Lamiaceae, Malvaceae, Scrophulariaceae, Solanaceae, Sterculiaceae and Verbenaceae. All the above taxa have paracotyledons with acute apex and base cuneate or rounded.

Oblong paracotyledons are represented by the families Aizoaceae, Boraginaceae, Cucurbitaceae, Euphorbiaceae (except *Euphorbia geniculata*, *Phyllanthus amarus*), Fabaceae. It is interesting to note that the families Cucurbitaceae, Euphorbiaceae and Fabaceae are members of Eurosids I (A.P.G 1998).

Family Bignoniaceae (except *Millingtonia hortensis*) and Convolvulaceae are characterized by bilobed paracotyledons. Combretaceae family have flabellate paracotyledons, so far the investigated.

Within this limited scope of studies, it is evident that seedling morphological features are of value in taxonomic delimitation of taxa.

V. CONCLUSION

Seedling morphology helps in easy identification of plants at juvenile stage and thus helps in their conservation.

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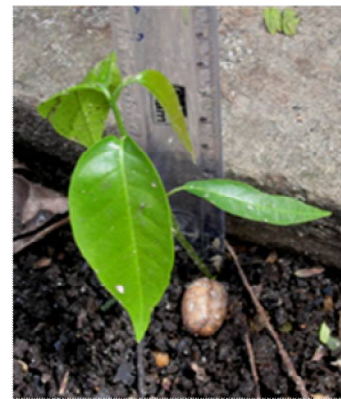
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(a)



(b)



(c)



(d)



(e)



(f)



(g)



(h)



(i)

Plate II : Seedling morphological diversity among the investigated taxa.

(a) *Amaranthus spinosus* (x1)

(b) *Amaranthus viridis* (x1)

(c) *Polyalthia longifolia* (x2)

(d) *Thevetia peruviana* (x1)

(e) *Pergularia daemia*(x2)

(f) *Millingtonia hortensis* (x3)

(g) *Spathodea campanulata* (x2)

(h) *Tabebuia chrysantha* (x2)

(i) *Tecoma stans* (x2)

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(a)



(b)



(c)



(d)



(e)



(f)



(g)



(h)



(i)

Plate III : Seedling morphological diversity among the investigated taxa.

(a) *Ceiba pentandra* (x1)

(c) *Cleome rutidosperma* (x2)

(e) *Terminalia arjuna* (x2)

(g) *Terminalia catappa* (x1)

(i) *Ageratum conyzoides* (x1.5)

(b) *Heliotropium indicum* (x2)

(d) *Cleome viscosa* (x1)

(f) *Terminalia bellirica* (x1)

(h) *Terminalia chebula* (x1)

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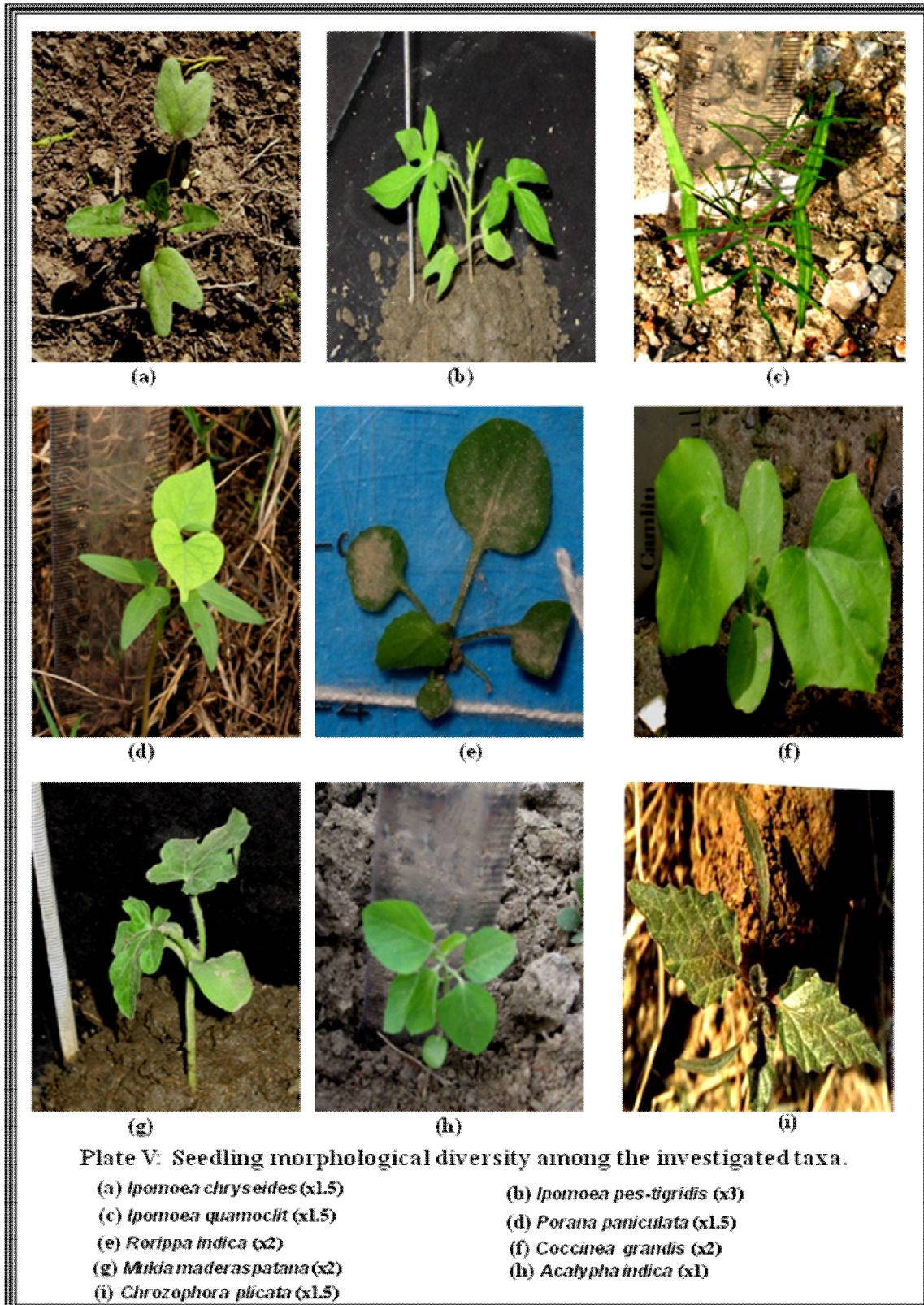


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Plate VII : Seedling morphological diversity among the investigated taxa.

- | | |
|--|--|
| (a) <i>Phyllanthus urinaria</i> (x2) | (h) <i>Ricinus communis</i> (x1) |
| (c) <i>Anisomeles indica</i> (x1) | (d) <i>Hyptis suaveolens</i> (x2) |
| (e) <i>Leonurus sibiricus</i> (x1.5) | (f) <i>Leucis aspera</i> (x2) |
| (g) <i>Leucis cephalotes</i> (x1) | (i) <i>Atylosia scarabaeoides</i> (x1) |
| (i) <i>Atylosia scarabaeoides</i> (x1) | |

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(a)



(b)



(c)



(d)



(e)



(f)



(g)



(h)



(i)

Plate VIII : Seedling morphological diversity among the investigated taxa.

(a) *Bauhinia purpurea* (x1)

(c) *Calliandra umbrosa* (x1.5)

(e) *Cassia fistula* L. (x2)

(g) *Cassia sophera* (x1)

(i) *Clitoria ternatea* (x 1.5)

(b) *Butea monosperma* (x1)

(d) *Cassia alata* (x1.5)

(f) *Cassia siamea* (x1)

(h) *Cassia tora* (x1)

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