

Seedling morphology of some medicinal plants of euphorbiaceae of Tripura, North-east India

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Abstract

Seedling morphology of five medicinal plants of Euphorbiaceae were studied from different parts of Tripura, North-east India. Seedling characters are important and promising from the taxonomic as well as evolutionary point of view. Seedling morphology of five species of Euphorbiaceae has been investigated on the basis of their germination pattern, position of cotyledon, hypocotyl, epicotyl, and paracotyledon and eophylls development. An artificial key has been constructed for easier identification of plants in their juvenile stage. Phenogram has been prepared to investigate the correlation between the investigated taxa.

Keywords: seedling morphology, taxonomy, euphorbiaceae

1. Introduction

Seedling is a critical phase in life cycle of an individual^[1]. The term *seedling* can be used loosely to cover very young individuals^[2]. Seedling characters are as reliable as floral one. Critical examination of correlation between group of characters of both the adult as well as the juvenile plant has repeatedly shown results in better understanding of taxonomically difficult taxa^[3]. The study of seedling morphology, which had been a less explored field in flowering plants, particularly in angiosperms, has now emerged as an essential discipline for taxonomic research at present. Moreover, the world-wide loss of biodiversity is a symptom of indiscriminate human exploitation of natural resources and developing land for human use^[4]. So, proper studies on seedling and their morphology will be helpful for their early identification and conservation of natural resources which in turn shall help in conservation of biodiversity. Seedling morphology is a less explored work in India, so in this study an attempt has been made to study seedling morphology of some Euphorbiaceae plants. In this study five medicinal plants of family Euphorbiaceae has been selected for the seed and seedling morphological study. These are *Croton bonplandianus* Baill., *Euphorbia hirta* L., *Jatropha curcas* L., *Jatropha gossypifolia* L., and *Ricinus communis* L. which are variously used as medicine in different treatments. *Croton bonplandianus* used in Cough, eczema and ringworm.^[5] *Euphorbia hirta* leaf paste and *Achyranthus aspera* (Apang) along with sulfur (gandhi), copper sulphate (Tutta) and mustard oil (6:2:1:1:2) is applied on the skin one hour before bath for any types of skin disease.^[6] *Jatropha curcas* The sap is applied locally in gum infections. Raw leaves are used in high blood pressure^[7]. *Jatropha gossypifolia* used in diabetes.^[8] *Ricinus communis* leaf juice is taken to prevent piles. Paste of the leaves is used for the treatment of ulcer.^[9] The key prepared

in the present study is completely a new initiative for the early identification and conservation of the studied taxa. The phenogram presented in this study is the first report of implication of seedling morphological character in phenetic analysis of the members of the family Euphorbiaceae found in Tripura.

2. Materials and Methods

2.2 Study area

Tripura is a state in North-East India and considered as a biodiversity hotspot. (<http://www.bsienviis.nic.in/>)^[10]. It borders Bangladesh, Mizoram and Assam. Tripura is surrounded by Bangladesh on its north, south and west: the length of its international border is 856 km (84% of its total border). The state lies between 22° 56' to 24° 32' North latitudes and 91° 09' to 92° 20' East longitudes with an aerial extent of 10,491.69 sq. km.

2.3 Methodology

The mature seed and seedling specimens *Croton bonplandianus* Baill., *Euphorbia hirta* L., *Jatropha curcas* L., *Jatropha gossypifolia* L., and *Ricinus communis* L were collected from different localities of Tripura. The specimens were photographed and documented in the form of herbarium sheets. They were compared and identified with the help of seedling raised from identified seeds. At least eight to ten specimens of each growth form were studied from various habitats. Morphological observation and description of seedlings were done according to Duke^[11], Burger^[2], Bokdam^[3], Vogel^[12] and Paria^[13]. Artificial keys were prepared for the identification of investigated taxa in juvenile stage. Phenogram were prepared based on UPGMA method in PAST software. Soil pH, electrical conductivity^[14], organic carbon^[15], available phosphorus^[16, 17], and available potash^[18], has been calculated to correlate soil properties with seedling.

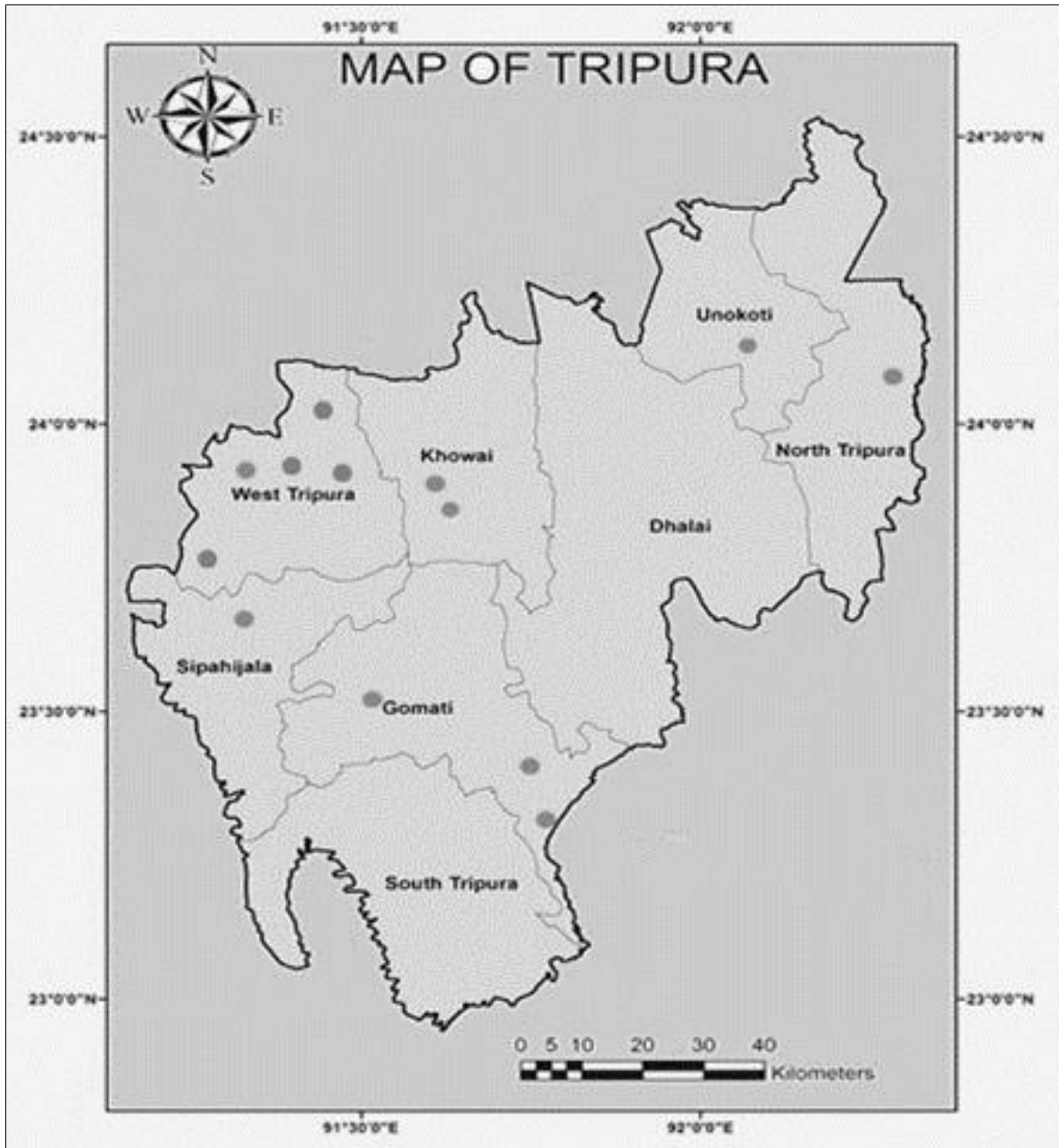


Fig 1: Map of Tripura showing the different areas visited during the field survey.

Table 1: GPS data of the site of sample collection.

S.NO.	Voucher number	Species	Locality	GPS location	
				Latitude	Longitude
1.	TUH 2161	<i>Croton bonplandianus</i>	Karimganj	23.7901	91.2670
2.	TUH 2175	<i>Euphorbia hirta L.</i>	Suryamaninagar	23.76	91.26
3.	TUH 2121	<i>Jatropha curcas L.</i>	Bhubanban	23.86	91.27
4.	TUH 2122	<i>Jatropha gossypifolia L.</i>	Pandabpur	23.76	91.26
5.	TUH 2112	<i>Ricinus communis L.</i>	Karimganj	23.61	91.33

3. Results and Discussion

Diagnoses and key to identification of the investigated taxa.

1. *Croton bonplandianus* Baill. *Adansonia* 4: 339 (1864). (Plate 1)

Seed morphology: Fruit capsule. Seed smooth, carunculate, thick, elliptical in outline measuring 1.2 mm in horizontal and 1.5 mm in vertical plane.

Seedling Morphology: (Up to 10th leaf stage) *Germination* epigeal, phanerocotylar. *Roots* tap, reduced. *Hypocotyl* elongating, soft. *Paracotyledon* opposite exstipulate, leaf

shape elliptic, apex obtuse, margin entire, leaf base cuneate, venation pattern pinnate, lamina balance symmetric. *Epicotyl* green, moderately woody, glands present. *Eophylls* simple, alternate, shape of lamina elliptic, base cuneate, apex acute, margin of lamina serrate, venation pattern pinnate, glands present, surface of blade upper glabrous, lower glandular. *Next leaves* simple, petiolate, glandular, alternate, elliptic, cuneate, acute, serrate, pinnate, glands present, upper glabrous, lower glandular, other characters are more or less same as that of first two leaves except measurements.

2. *Euphorbia hirta* L. Sp. Pl. 1: 454 (1753). (Plate 1)

Seed morphology: Fruit capsule. Seeds oblong, four-sided, slightly wrinkled, pinkish brown, caruncle absent.

Seedling Morphology: (Up to 10th leaf stage) *Germination* epigeal, phanerocotylar. *Roots* tap, reduced, *Hypocotyl* terete, glabrous, reduced, soft. *Paracotyledon* opposite, exstipulate, leaf shape oblong, apex obtuse/rounded, margin entire, base rounded/cuneate, venation pattern pinnate, surface of blade glabrous both surfaces, lamina balance symmetric. *Epicotyl* reddish green, pubescent/soft. *Eophylls* simple, opposite, soft/pubescent, exstipulate, petiolate, lamina obovate, base cuneate, apex rounded, margin entire, venation pattern pinnate, surface of blade hairy both surfaces. *Next leaves* simple, exstipulate, opposite, obovate, cuneate/ oblique, obtuse, asymmetric, entire, pinnate, hairy both surfaces. *Subsequent leaves* simple, petiolate, glabrous, opposite, elliptic, oblique, obtuse, serrate, pinnate, hairy both surfaces, other characters are more or less same as that of first two leaves except measurements.

3. *Jatropha curcas* L. Linnaeus, Sp. Pl. 2: 1006. 1753. (Plate 1)

Seed morphology: Fruit capsule. Seeds are three per fruit, large, oblong, 2 cm long.

Seedling Morphology: (Up to 10th leaf stage) *Germination* epigeal, phanerocotylar. *Roots* tap, elongating. *Hypocotyl* elongating, moderately woody. *Paracotyledon* opposite, leaf shape elliptic/oblong, apex rounded, margin entire, base auriculate/truncate, venation pattern palmate, surface of blade glabrous, lamina balance symmetric. *Epicotyl* green, moderately woody. *Eophylls* simple, alternate, petiolate, shape of lamina ovate, base cordate, apex acuminate, margin Serrate, venation pattern palmate, surface of blade glabrous both surfaces. *Next leaves* simple, petiolate, alternate, ovate, cordate, acuminate, symmetric, serrate, palmate, other characters are more or less same as that of first two leaves except measurements.

4. *Jatropha gossypifolia* L. Species Plantarum (1753). (Plate 1)

Seed morphology: Fruit capsule. Seeds oblong, with orange caruncles, hilum basal, hilum yellow/ orange, number of seeds per fruit 3.

Seedling morphology: (Up to 6th leaf stage)

Germination epigeal, phanerocotylar. *Roots* tap, reduced. *Hypocotyl* elongating, soft. *Paracotyledon* opposite, leaf oblong, apex rounded/truncate, margin entire, base attenuate, venation pattern palmate, soft, dark green, glabrous. *Epicotyl* reduced. *Eophylls* simple, leaf shape trilobed, base cordate, apex acute, margin ciliate, venation pattern palmate, glands present at leaf surface, glabrous. *Next leaves* simple, trilobed, alternate, trilobed, cordate, acute, symmetric, ciliate, palmate, actinodromous, glabrous, other characters are more or less same as that of first two leaves except measurements.

5. *Ricinus communis* L. Sp. Pl. 2: 1007 (1753). (Plate 1)

Seed morphology: Fruit a capsule. Seed 7-12 mm, grayish, caruncle depressed-conical, 2-3 mm wide.

Seedling morphology: (Up to 6th leaf stage)

Germination epigeal, phanerocotylar. *Roots* tap. *Hypocotyl* upper half green lower half pink, elongating, soft. *Paracotyledon* opposite, leaf shape elliptic, apex obtuse, margin entire, base truncate, venation pattern palmate, glabrous. *Epicotyl* green, moderately woody. *Eophylls* simple, opposite, petiolate, glabrous, leaf shape ovate, base peltate, apex acute, margin doubly serrate/lobed, venation pattern palmate, glands on petiole, veins prominent, glabrous. *Next leaves* simple, ovate, alternate, ovate, peltate, acute, doubly serrate/lobed, palmate, glands on petiole, glabrous, other characters are more or less same as that of first two leaves except measurements.

3.1 Key to the investigated taxa

1. Hypocotyl reduced..... *Euphorbia hirta*
2. Hypocotyl elongating.....2.
3. (1) Paracotyledon leaf shape elliptic.....3.
4. Paracotyledon leaf shape oblong.....4.
5. (2) Paracotyledon venation pattern pinnate.....
Croton bonplandianus
6. Paracotyledon venation pattern palmate.....*Ricinus communis*
7. (2) Epicotyl is reduced..... *Jatropha gossypifolia*
8. Epicotyl is elongating..... *Jatropha curcas*

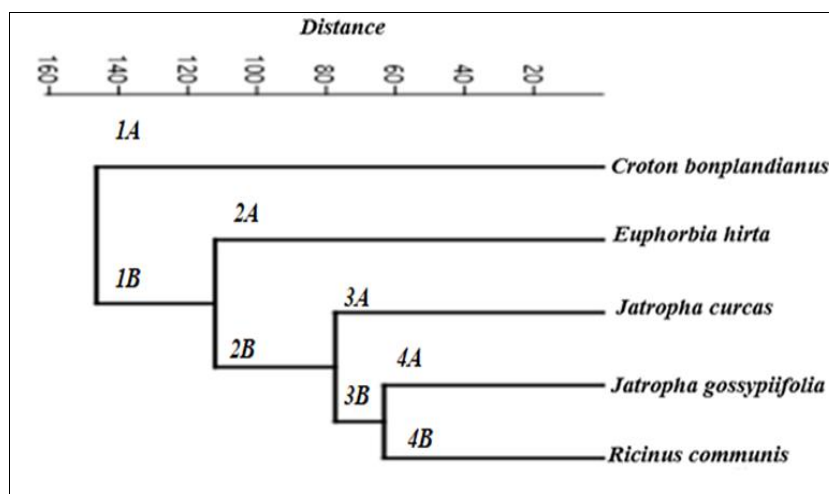


Fig 2: Phenogram based on Seedling morphological data (UPGMA method) to draw affinities between the studied genera in family Euphorbiaceae.

Table 2: Showing soil characteristics where seeding grown.

S. no.	Species	pH	EC	Organic carbon	Phosphorus	Potash
1.	<i>Croton bonplandianus</i>	±6.14-6.25	±0.39-0.45	±0.83-0.86	±25.5-27	±176-180
2	<i>Euphorbia hirta</i>	±7.60-7.7	±0.140.16	±0.49-0.55	±3.17-3.3	±270-274
3	<i>Jatropha curcas</i>	±4.62-4.7	±0.31-0.36	±0.76-0.8	±36.2-38	±382-390
4	<i>Jatropha gossypifolia</i>	±6.38-6.45	±0.30-0.5	±0.81-0.85	±71.6-76	±297-306
5	<i>Ricinus communis</i>	±5.12-5.2	±0.61-0.8	±1.70-1.8	±21.7-24	±367-375

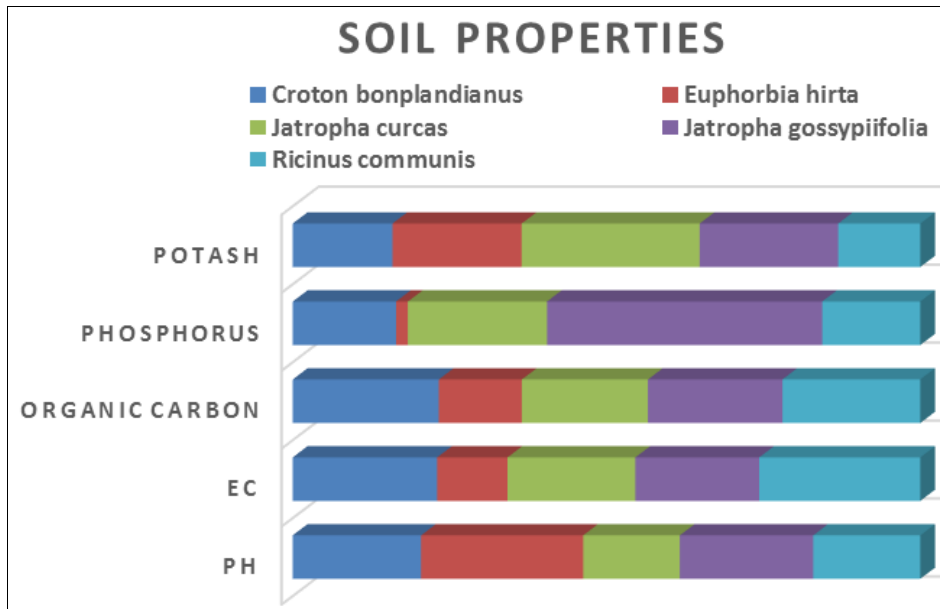


Fig 3: Showing soil characteristics where seeding grown.

In this investigation, five medicinal plants of family Euphorbiaceae has been described based on seedling morphological characters. These seedling characters can serve as marker character for identification of taxa. All five studied taxa showed Phanerocotylar Epigeal Foliaceous (PEF) type of germination. PEF type of germination is advantageous over other types of germination as they generally grow faster than when exposed to increased light [19]. Multivariant phenetic analyses have been used in classifying many plants and interpreting results of taxonomic studies. [20]. Seedling features are often distinctive at the species level and correlate well with the data from other source with regard to sectional and sub sectional placement of species with genus. [21]. Mundhra and Paria [22]. studied the seedling morphology of five *Jatropha* species. Seedling characters like germination pattern, nature of root, hypocotyl, shape, size, color, apex, base, margin of paracotyledons and eophylls has been considered in this investigation. Root of *Croton bonplandianus*, *Euphorbia hirta*, and *Jatropha gossypifolia* is reduced while *Ricinus communis* and *Jatropha curcas* have elongating roots. Hypocotyl of *Croton bonplandianus*, *Jatropha curcas*, *Jatropha gossypifolia* and *Ricinus communis* was elongating while *Euphorbia hirta* has reduced hypocotyl. *Croton bonplandianus* and *Ricinus communis* has elliptic paracotyledon, *Euphorbia hirta*, *Jatropha curcas*, *Jatropha gossypifolia* has oblong paracotyledon. Eophylls of *Croton bonplandianus* was elliptic, *Euphorbia hirta* has obovate, *Jatropha curcas* and *Ricinus communis* has ovate leaf, *Jatropha gossypifolia* has lobed leaves. Based on these seedling characters artificial key has been constructed for the easier identification of plants in their juvenile stage. A phenogram has been constructed using UPGMA method to draw correlation

between the taxa. Phenogram includes two cluster. Cluster 1A contains *Croton bonplandianus* which may be based on presence of glands on hypocotyl. Cluster 1B contains two sub cluster. Sub cluster 2A contains *Euphorbia hirta* which may be based on reduced hypocotyl. Sub cluster 2B contains two sub cluster. Sub cluster 3A contains *Jatropha curcas* and sub cluster 3B contains *Jatropha gossypifolia* and *Ricinus communis* which shows *Jatropha gossypifolia* has more similarity to *Ricinus communis* than *Jatropha curcas*. *Euphorbia hirta* has been found to be growing in alkaline soil and rest four species has been growing in acidic soil. All taxa have been growing in low soil salinity. Soil organic carbon of *Euphorbia hirta* was medium but rest four species has been growing in high soil organic carbon. An increase in SOC can increase soil aggregate stability, water retention capacity, water infiltration, plant available water, soil microbial and macro fauna biomass and activity, and cation exchange. *Euphorbia hirta* has lowest available phosphorus and *Jatropha curcas* has highest available phosphorus. Deficiency of P in soil severely affects the plant metabolism and in turns their yields. *Croton bonplandianus* has lowest available potassium and *Jatropha curcas* and *Ricinus communis* has highest available potassium. Potassium is extremely important in many ways to the productivity of plant. It improves nitrogen use efficiency.

5. Conclusion:

This work shows that seedling character of Euphorbiaceae plant is related to each other and the artificial key is extremely useful for early identification and restoration of plants. Seedling morphological studies of medicinal plants help to restore the wild medicinal plants in early stage of their life cycle. These types of study are extremely useful

for safeguarding of biodiversity and to draw the evolutionary relationship among medicinal properties of plants.

6. Acknowledgement

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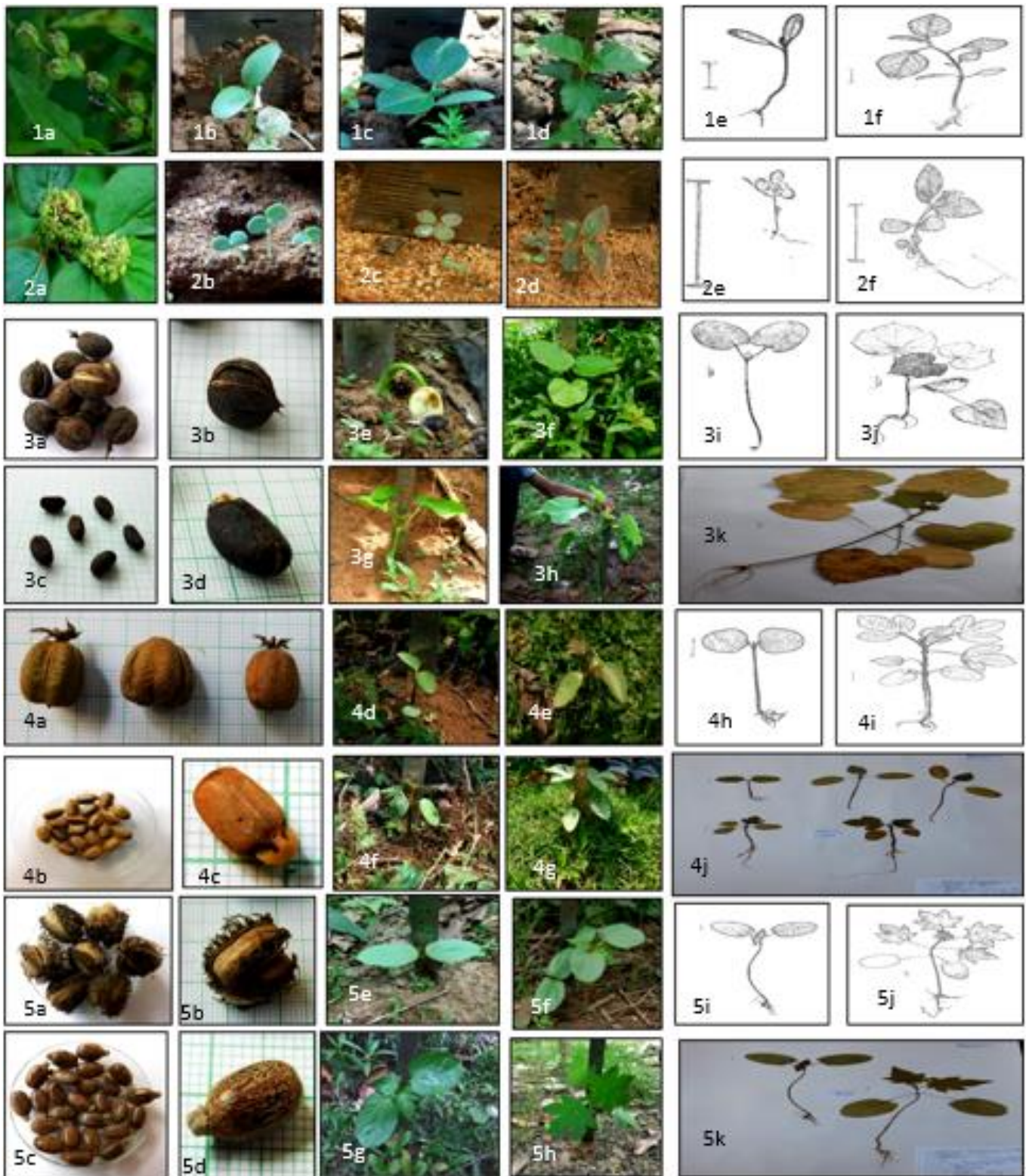


Fig 4: 1(a-f) *Croton bonplandianus* (a). Fruit (b) Paracotyledon (c-d) Different Seedling stages (e-f) Sketches of seedling. 2(a-f) *Euphorbia hirta* (a). Fruit (b) Paracotyledon (c-d) Different Seedling stages (e-f) Sketches of seedling. 3(a-k) *Jatropha curcas* (a-b). Fruit (c-d) Seed (e) Paracotyledon (f-h) Different Seedling stages (i-j) Sketches of seedling (k) Dried herbarium specimen with different seedling stages. 4(a-j) *Jatropha gossypifolia* (a). Fruit (b-c) seed (d) Paracotyledon (e-g) Different Seedling stages (h-i) Sketches of seedling. (j) Dried herbarium specimen with different seedling stages 5(a-k) *Ricinus communis* (a-b). Fruit (c-d) Seed (e) Paracotyledon (f-h) Different Seedling stages (i-j) Sketches of seedling (k) Dried herbarium specimen with different seedling stages.

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