SEEDLING TAXONOMY OF SOME MEMBERS IN THE TRIBE ACALYPHEAE (EUPHORBIACEAE)

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The taxonomic implication of seedling morphology has been emphasized from an investigation of some thirteen members of the Tribe Acalypheae (Euphorbiaceae). The seedlings are basically epigeal and phanerocotylar, which display two distinct categories based on phyllotaxy of first two leaves. Within each category, the constituent taxa can be easily identified with the help of various seedling characters, e.g. shape of paracotyledons and number of their primary veins; characters of eophylls, hypocotyl; phyllotaxy of subsequent leaves, etc. The seedling morphological data of the investigated taxa can be used like other botanical disciplines in drawing taxonomic correlation.

**Key Words**: Acalypheae - Phanerocotylar - Seedling taxonomy.

The Euphorbiaceae, one of the largest dicot families and distributed throughout the tropics, have been neglected by taxonomists from view point of seedling morphology. Verdus (1976) studied the seedling characters of 131 species of the Euphorbiaceae and showed a pseudocyclic evolution in cotyledon size. Seedling morphology of five species from the genus *Jatropha* has been studied by the present authors (1994). This work is a further contribution to the seedling taxonomy of the Indian Euphorbiaceae in the context of the tribe Acalypheae.

**MATERIALS AND METHODS**

In the present investigation, seedlings of thirteen species belonging to six genera of the tribe Acalypheae of the subfamily Acalyphoideae under the family Euphorbiaceae have been collected from different regions of India (viz., Bihar, Kerala, Orissa, Tamil Nadu and West Bengal). Seeds of all these taxa were also collected and grown in the green house of the Experimental Botanic Garden of the Department of Botany, University of Calcutta to ensure correct identification of seedling taxa. The different stages of development of a single taxon were considered for preparing a complete description out of ten individuals. The seedlings were photographed from natural habitats as well as from dried well-pressed specimens. All the specimens were documented in the form of herbarium sheets which have been deposited in the Calcutta University Herbarium (CUH). The gross morphological features of the seedlings were described following the terminology as proposed by Burger (1972), Hickey (1973) and Vogel (1980). For method of description of seedlings, Paria *et al.* (1990) and Kamilya and Paria (1993, 1994, 1995) were followed.

**OBSERVATIONS**

*Acalypha fallar* Muell.-Arg. (Fig. 1)

Seedling epigeal, phanerocotylar, hairy. Hypocotyl hairy, 2.5-2.9 cm. long. Paracotyledons two, opposite, exstipulate, petiolate; petiole semi-terete; blade obovate, base rounded, apex slightly notched, primary veins three. First two leaves opposite, stipulate, blade broadly ovate to rhombic, base subrounded, apex obtuse, margin serrate, primary veins three. Subsequent leaves alternate, stipulate, broadly ovate; other features same as first two leaves.

Specimens examined: Botanical Garden, Howrah (West Bengal), *Kamilya 328*.

*Acalypha fruticosa* Forsskal (Fig. 2)

Seedling epigeal, phanerocotylar, hairy. Hypocotyl hairy, 2.5-2.9 cm. long. Paracotyledons two, opposite, exstipulate, petiolate; petiole semi-terete; blade obovate, base rounded, apex slightly notched, primary veins three. First two leaves opposite, stipulate, blade broadly ovate to rhombic, base subrounded, apex obtuse, margin serrate, primary veins three. Subsequent leaves alternate, stipulate, broadly ovate; other features same as first two leaves.

Specimens examined: Trivandrum (Kerala), *Kamilya 528*; Trichi (Tamilnadu), *Kamilya 701*.

*Acalypha indica* Linn. (Fig. 3)

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Seedling epigeal, phanerocotylar, glabrous. Hypocotyl 1.3-1.6 cm. long, glabrous. Paracotyledons two, opposite, extipulate, petiolate; petiole terete; blade obovate, base acute, apex subtruncate, primary veins three. First two leaves opposite, extipulate, blade ovate, base and apex acute, margin entire, primary veins three. Subsequent leaves alternate, extipulate, ovate; other features same as first two leaves.

**Specimens examined**: Hazaribagh (Bihar), Kamilya 628; Calcutta (West Bengal), Kamilya 637; Balasore (Orissa), Kamilya 523.

*Acalypha lanceolata* Willd. (Fig. 4).

Seedling epigeal, phanerocotylar, hairy. Hypocotyl 1.5-1.9 cm. long, hairy. Paracotyledons two, opposite, extipulate, petiolate; petiole terete; blade suborbicular, base subrounded, apex subtruncate, primary veins three. First two leaves opposite, stipulate, blade broadly ovate, base cuneate, apex acute, margin slightly serrate. Subsequent leaves alternate, stipulate, broadly ovate; other features same as first two leaves.

**Specimen examined**: Trichi (Tamil Nadu), Kamilya 602.

*Macaranga denticulata* (Bl.) Muell.-Arg. (Fig. 5)

Seedling epigeal, phanerocotylar, hairy. Hypocotyl 1.0-3.1 cm. long, hairy. Paracotyledons two, opposite, extipulate, petiolate; petiole terete; blade ovate, base rounded, apex obliquely rounded, primary veins three. First two leaves alternate, extipulate, blade ovate-lanceolate, base subcordate, apex subacute, margin entire, primary veins five. Subsequent leaves alternate, extipulate, ovate-lanceolate to subpeltate to peltate; other features same as first two leaves.

**Specimen examined**: Jalpaiguri (West Bengal), Kamilya 661.

*Macaranga peltata* (Roxb.) Muell.-Arg. (Fig. 6)

Seedling epigeal, phanerocotylar, hairy. Hypocotyl 2.5-4.5 cm. long, hairy. Paracotyledons two, opposite, extipulate, petiolate; petiole semiterete; blade ovate, base subcordate, apex rounded, primary veins three. First two leaves alternate, stipulate, blade ovate-lanceolate to broadly ovate, base subcordate to cordate, apex acute to acuminate, margin scarcely serrate to sub serrate, primary veins three. Subsequent leaves alternate, stipulate, broadly ovate to slightly triangular-ovate to peltate; other features same as first two leaves.

**Specimens examined**: Trivandrum (Kerala), Kamilya 721; Coonoor (Tamil Nadu), Kamilya 238.

*Mallotus oblongifolius* (Miq.) Muell.-Arg. (Fig. 7)

Seedling epigeal, phanerocotylar, hairy. Hypocotyl 5.0-5.8 cm. long, hairy. Paracotyledons two, opposite, extipulate, petiolate; petiole adaxially flattened; blade triangular, deltoid, base acute, apex subtruncate, primary veins three. First two leaves alternate, extipulate, blade ovate-lanceolate, base subrounded, apex acuminate, margin serrate, primary veins three. Subsequent leaves alternate, extipulate, oblong-lanceolate; other features same as first two leaves.

**Specimens examined**: Coonoor (Tamil Nadu), Kamilya 783; Jalpaiguri (West Bengal), Kamilya 774.

*Mallotus peltatus* (Geisel.) Muell.-Arg. (Fig. 8)

Seedling epigeal, phanerocotylar, hairy. Hypocotyl 4.5-6.0 cm. long, hairy. Paracotyledons two, opposite, extipulate, petiolate; petiole semiterete; blade suborbicular, base subrounded, apex rounded, primary veins three. First two leaves alternate, stipulate, blade ovate, base cordate, apex acuminate, margin dentate, primary veins three. Subsequent leaves alternate, stipulate, ovate-elliptic to peltate; other features same as first two leaves.

**Specimen examined**: Jalpaiguri (West Bengal), Kamilya 556.

*Mallotus philippensis* (Lam.) Muell. (Fig. 9)

Seedling epigeal, phanerocotylar, hairy. Hypocotyl 4.0-4.2 cm. long, hairy. Paracotyledons two, opposite, extipulate, petiolate; petiole channelled at the adaxial side; blade triangular-obovate, base and apex truncate, primary veins five. First two leaves alternate, extipulate, blade ovate, base truncate, apex acute, margin serrate, primary veins three. Subsequent leaves alternate, extipulate, ovate; other features same as first two leaves.

**Specimens examined**: Jalpaiguri (West Bengal), Kamilya 555; Jhargram (West Bengal), Kamilya 655.

*Mallotus repandus* (Willd.) Muell.-Arg. (Fig. 10)
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Seedling epigeal, phanerocotylar, hairy. Hypocotyl 4.1-4.3 cm. long, hairy. Paracotyledons two, opposite, exstipulate, petiolate; petiole adaxially channelled; blade obovate, base cuneate, apex rounded, primary veins five. First two leaves alternate, exstipulate, blade ovate-lanceolate, base truncate to subcordate, apex acuminate, margin dentate, primary veins five. Subsequent leaves alternate, ovate-lanceolate; other features same as first two leaves.

Specimens examined: Rahara (West Bengal), Kamilya 316; Trivandrum (Kerala), Kamilya 776.

Ricinus communis Linn. (Fig. 12)

Specimens examined: Barrackpore (West Bengal), Kamilya 560;
Jhargram (West Bengal), Kamilya 602; Ghatisila (Bihar), Kamilya 362.

Micrococoa mercurialis (Linn.) Benth. (Fig. 11)

Seedling epigeal, phanerocotylar, hairy. Hypocotyl 2.9-3.4 cm. long. Paracotyledons two, opposite, exstipulate, petiolate; petiole adaxially channelled; blade suborbicular, base and apex rounded, primary veins three. First two leaves opposite, exstipulate, blade ovate, base and apex acute, margin serrate, primary veins three. Subsequent leaves alternate, exstipulate, ovate; other features same as first two leaves.

Specimens examined: Rahara (West Bengal), Kamilya 316; Trivandrum (Kerala), Kamilya 776.

Ricinus communis Linn. (Fig. 12)

Seedling epigeal, phanerocotylar, glabrous. Hypocotyl 6.0-12.5 cm. long. Paracotyledons two, opposite, exstipulate, petiolate; petiole adaxially channelled; blade oblong, base cordate, apex rounded, primary veins five. First two leaves opposite, exstipulate, blade palmately-lobed, base peltate with median to submedian glands on petiole, lobe apex acute, margin serrate, primary veins seven. Subsequent leaves alternate, exstipulate, palmi-lobed; other features same
as first two leaves.

_Specimens examined_: Trivandrum (Kerala), Kamilya 786; Calcutta (West Bengal), Kamilya 288.

_Trewia nodiflora_ Linn. (Fig. 13)

Seedling epigeal, phanerocotylar, hairy. Hypocotyl 9.2-11.4 cm. long, glabrous. Paracotyledons two, opposite, exstipulate, petiolate; petiole semiterete; blade elliptic, base and apex rounded, primary veins three. First two leaves alternate, stipulate, blade ovate, base subcordate, apex acuminate, margin slightly serrate, primary veins three. Subsequent leaves alternate, stipulate, ovate; other features same as first two leaves.

_Specimens examined_: Jalpaiguri (West Bengal), Kamilya 518; Midnapore (West Bengal), Kamilya 322.

**Key to the investigated taxa of the tribe Acalypheae**

1. First two leaves opposite:

2 Paracotyledons suborbicular to obovate with three primary veins; eophylls not palmately-lobed, glands absent on petiole:

3 Paracotyledons with subtruncate to slightly notched-apex; eophylls stipulate (except _A. indica_) _Acalypha_ spp.

3a Paracotyledons with rounded apex; eophylls exstipulate

_Micrococa_ (mercurialis)

2a Paracotyledons oblong with five primary veins; eophylls palmately-lobed with median to submedian glands on petioles

_Ricinus_ (communis)

1a First two leaves alternate:

4 Hypocotyl glabrous; subsequent leaves at the adult stage opposite _Trewia (nodiflora)_

4a Hypocotyl hairy; subsequent leaves always alternate:

5 Paracotyledons ovate, always with three primary veins _Macaranga_ spp.

5a Paracotyledons otherwise with 3 or 5 primary veins _Mallotus_ spp.

**Key to the species of _Acalypha_**

1. Seedlings glabrous; first two leaves ovate

   _A. indica_

1a Seedlings hairy:

2 First two leaves narrowly ovate, entire; subsequent leaves elliptic

   _A. fruticosa_

2a First two leaves broadly ovate to rhombic, serrate; subsequent leaves broadly ovate:

3 Paracotyledons suborbicular; hypocotyl small (1.5-1.9 cm) _A. lanceolata_

3a Paracotyledons obovate; hypocotyl long (2.5-2.9 cm) _A. fallax_

**Key to the species of _Mallotus_**

1 Paracotyledons triangular-deltoid or obovate:

2 Paracotyledons triangular-deltoid, petiole terete; first two leaves and subsequent leaves with subrounded to acute base

   _M. oblongifolius_

2a Paracotyledons obovate, petiole adaxially clasping; first two leaves and subsequent leaves truncate to subtruncate to cordate base:

3 Primary veins five in first two leaves

   _M. repandus_

3a Primary veins three in first two leaves

   _M. philippensis_

1a Paracotyledons suborbicular

   _M. peltatus_

**Key to the species of _Macaranga_**

1 First two leaves with entire margin and five primary veins; subsequent leaves lanceolate

   _M. denticulata_

1a First two leaves with serrate margin and three primary veins; subsequent leaves broadly ovate to slightly triangular ovate to peltate

   _M. peltata_

**DISCUSSION**

In the present contribution, seedling morphology of thirteen species under six genera of the tribe Acalypheae (sensu Webster, 1994) has been evaluated. Six genera have been placed in two different categories. Category I includes the taxa _Acalypha, Micrococa_ and _Ricinus_ where the phyllotaxy of first two leaves is opposite. Category II having the alternate phyllotaxy of first two leaves consists of _Macaranga, Mallotus_ and _Trewia._

_Acalypha, Micrococa_ and _Ricinus_ can be distinguished based on number of primary veins and shape.
of eophylls, etc. The investigated species of Acalypha and Micrococa mercurialis have suborbicular to obovate paracotyledons with three primary veins, eophylls of various shapes and without glands at petioles while Ricinus communis possesses oblong paracotyledons with five primary veins and palmately-lobed eophylls with median to submedian glands at petioles. Further, the species of Acalypha can be
differentiated with the help of some characters, viz., seedling surface, shape of first two leaves and paracotyledons, relative length of hypocotyl.

In the category II, Trewia nodiflora appears isolated from Macaranga and Mallotus in having glabrous hypocotyls and opposite phyllotaxy for subsequent leaves. The species of Macaranga possess ovate paracotyledons with three primary veins and the species of Mallotus have paracotyledons of various shapes and provided with 3 to 5 primary veins. Four species of the genus Mallotus are distinctive in paracotyledon and eophyll characters. Two species of the genus Macaranga are also separable from one another.

The seedling morphological characters are significant like other botanical disciplines. It is revealed that Mallotus philippensis and Trewia nodiflora are included under the same subtribe Rottlerinae (Webster, 1994). These two taxa exhibit differences in their seedling morphological features, although in chemical (Hegnauer, 1989), palynological (Punt, 1962), and cytological (Hans, 1973) characters, these taxa appear to be closely related. Further, the cytological (Hans, l.c.), serological (Jensen et al., 1994), and palynological (Punt, l.c.) differences between Ricinus communis and Mallotus spp. are also supported by seedling morphological features (e.g. seedling surface, phyllotaxy of first two leaves, shape of paracotyledons, etc.).

Within this limited scope of studies, it is evident that seedling morphological features are of value in taxonomic delimitation of various taxa, and as such these may be considered for systematic studies within the other members of the family Euphorbiaceae.

REFERENCES


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