J Indian bot Soc Vol 76 (1997) 63-68

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

P. KAMILYA AND N. PARIA
Department of Botany, University of Calcutta, 35, Ballygunge Circular Road, Calcutta-700 019, India.
(Accepted May, 1997)

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 relatively 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 fallax 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 1.9-2.2 cm. long, hairy. Paracotyledons two, opposite, exstipulate, petiolate; petiole semiterete; blade suborbicular, base subrounded, apex subtruncate, primary veins three. First two leaves opposite, stipulate, blade narrowly ovate, base truncate, apex acute, margin entire, primary veins three. Subsequent leaves alternate, stipulate, elliptic; other features same as first two leaves.

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

Acalypha indica Linn. (Fig. 3)

Received November, 1996

Seedling epigeal, phanerocotylar, glabrous. Hypocotyl 1.3-1.6 cm. long, glabrous. Paracotyledons two, opposite, exstipulate, petiolate; petiole terete; blade obovate, base acute, apex subtruncate, primary veins three. First two leaves opposite, exstipulate, blade ovate, base and apex acute, margin entire, primary veins three. Subsequent leaves alternate, exstipulate, 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, exstipulate, 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 (Tamilnadu), *Kamilya* 602.

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

Seedling epigeal, phanerocotylar, hairy. Hypocotyl 1.0-3.1 cm. long, hairy. Paracotyledons two, opposite, exstipulate, petiolate; petiole terete; blade ovate, base rounded, apex obliquely rounded, primary veins three. First two leaves alternate, exstipulate, blade ovate-lanceolate, base subcordate, apex subacute, margin entire, primary veins five. Subsequent leaves alternate, exstipulate, 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, exstipulate, 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 subserrate, 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 5.0-6.8 cm. long, hairy. Paracotyledons two, opposite, exstipulate, petiolate; petiole adaxially flattened; blade triangular, deltoid, base acute, apex subtruncate, primary veins three. First two leaves alternate, exstipulate, blade ovate-lanceolate, base subrounded, apex acuminate, margin serrate, primary veins three. Subsequent leaves alternate, exstipulate, 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, exstipulate, 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, exstipulate, petiolate; petiole channelled at the adaxial side; blade triangular-obovate, base and apex truncate, primary veins five. First two leaves alternate, exstipulate, blade ovate, base truncate, apex acute, margin serrate, primary veins three. Subsequent leaves alternate, exstipulate, 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)

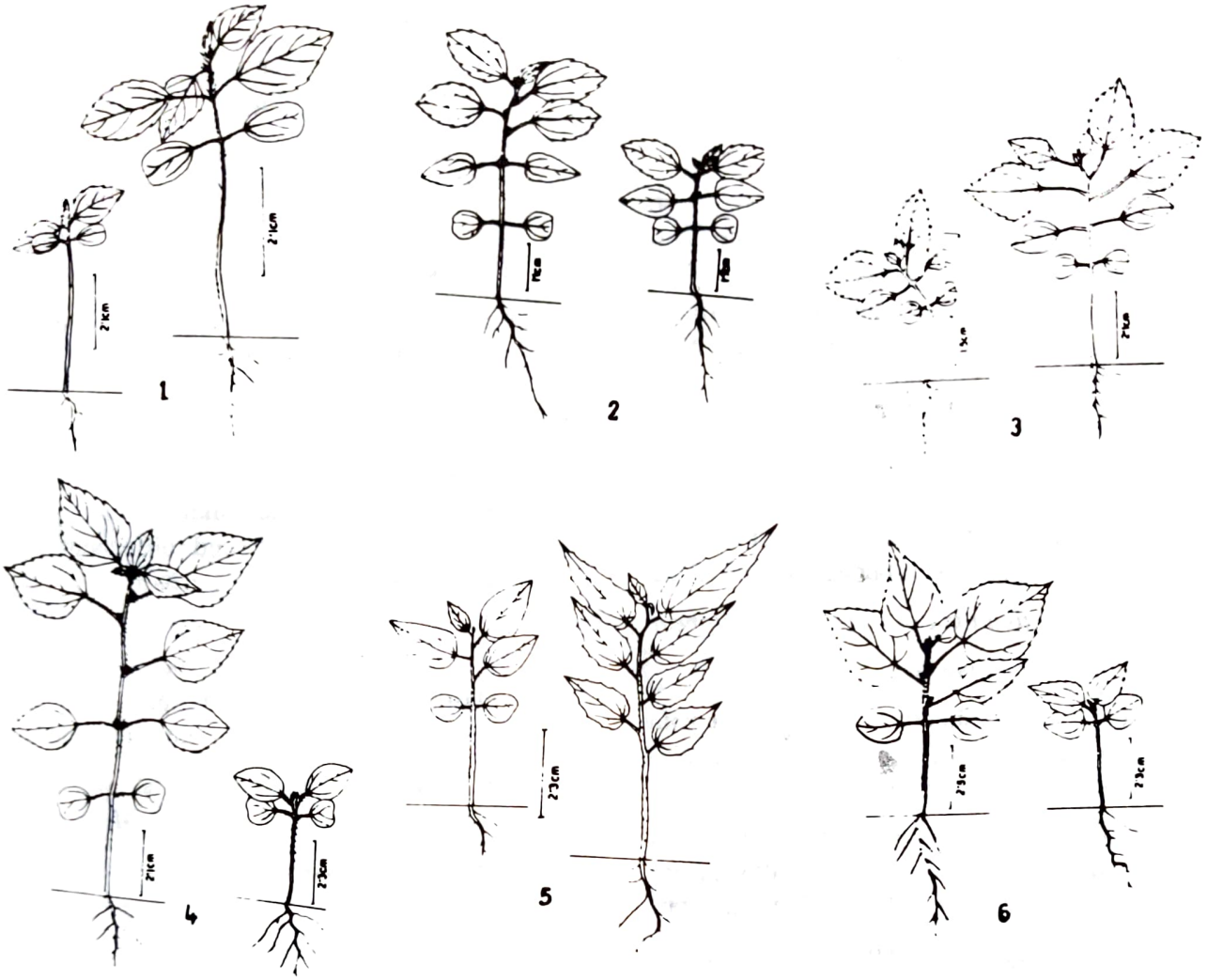

Figure 1. *Acalypha fallax*, 2. *Acalypha fruticosa*, 3. *A. indica*, 4. *A. lanceolata*, 5. *Macaranga denticulata*, 6. *M. peltata*

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 : Barrackpore (West Bengal), *Kamilya* 560;

Jhargram (West Bengal), *Kamilya* 602; Ghatsila (Bihar), *Kamilya* 362.

Micrococca 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 *Micrococca (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, Micrococca* 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, Micrococca and *Ricinus* can be distinguished based on number of primary veins and shape

Figure 7. *Mallotus oblongifolius*, 8. *M. peltatus*, 9. *M. philippensis*, 10. *M. repandus*, 11. *Micrococca mercurialis*, 12. *Ricinus communis*, 13. *Trewia nodiflora*.

of eophylls, etc. The investigated species of *Acalypha* and *Micrococca 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 nodifilora* 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

Burger Hzn 1972 *Seedlings of some tropical trees and shrubs, mainly of South East Asia.* PUDOC, Wageningen, 399 pp.

Hans A S 1973 Chromosomal conspectus of the Euphorbiaceae. *Taxon* **22** 591-636.

Hegnauer R 1989 Euphorbiaceae. Chemotaxonomic der Pflanzen **8** 440-474. Birkhauser Verlag, Basel.

Hickey L J 1973 Classification of the architecture of dicotyledonous leaves. *Amer J Bot* **60** 17-33.

Jensen U, I Vogel-Bauer & M Nitschke 1994 Legumin-like proteins and the systematics of the Euphorbiaceae. *Ann Missouri Bot Gard* **81** 160-179.

Kamilya P & N Paria 1993 Seedling morphology of some members of the Polygonaceae and its taxonomic implications. *Rheedea* **3(1)** 29-34.

Kamilya P & N Paria 1994 Seedling morphology of some Indian species of some *Jatropha* and its implications in taxonomy. *Acta Botanica Indica* **22** 251-256.

Kamilya P & N Paria 1995 Seedling morphology of some members of Combretaceae and its implications in taxonomy and ecology. *Proc Front Pl Sc Res,* Hyderabad (In press).

Paria N, B Bhattacharyya & M Ghosh 1990 Seedling morphology of some members of Malvales with a note on their cytology. *J Natl Bot Soc* **44(4)** 1-11.

Punt W 1962 Pollen morphology of the Euphorbiaceae with special reference to taxonomy. *Wentia* **7** 1-116.

Verdus M C 1976 L'evolution pseudocyclique des plantules des Euphorbiaceae. *Taxon* **25(1)** 99-107.

Vogel E F de 1980 *Seedlings of Dicotyledons.* PUDOC, Wageningen, 465 pp.

Webster G L 1994 Classification of the Euphorbiaceae. *Ann Missouri Bot Gard* **81** 3-32.