THE GENUS *Dioscorea* L. IN ANDAMAN AND NICOBAR ISLANDS, INDIA

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**ABSTRACT**

*Dioscoreaceae* is one of the most important families of flowering plants in Andaman and Nicobar Islands. The genus *Dioscorea* L. (*Dioscoreaceae*) is distributed mainly in the tropical and sub-tropical regions of the world. The present survey enumerates nine species and provided baseline data on distribution of different species of *Dioscorea* in Andaman and Nicobar Islands which may help in finding out the species/varieties or races for agricultural planning and other related activities in the Union territory.

**Keywords:** *Dioscorea*, Distribution, Andaman and Nicobar Islands

**INTRODUCTION**

The genus *Dioscorea* (yam) belongs to the family *Dioscoreaceae*. It comprises 350–400 species (Caddick *et al*., 2002) and is distributed throughout the tropics and subtropic regions especially in West Africa, parts of Central America and the Caribbean, the Pacific islands and Southeast Asia. A few species extend into temperate regions (Caddick *et al*., 2002; Mabberley, 2008). *Dioscorea* has been suggested to have nutritional superiority when compared with other tropical root crops. They are reported as good sources of essential dietary nutrients (Bhandari *et al*., 2003; Shanthakumari *et al*., 2008; Maneenoon *et al*., 2008; Arinathan *et al*., 2009). *Dioscorea* sp. is eaten by the Indian tribal people of Andaman Islands. Taxonomically it is an interesting genus as it exhibits many dicotyledonous characters. It is also a part of lineage that is relatively closely related to the phylogenetically derived group containing the grasses. Therefore, it represents an important biological link between eudicots and grasses, which contain all the model flowering plants. Thus it has the potential to add to the knowledge of plant biology and evolution (Hodeba *et al*., 2013). It is a critically important but neglected crop, which is likely to be increased in importance as climate change leads to necessary changes in global food system (Hodeba *et al*., 2013).

In the northeastern part of India some species of *Dioscorea* are essentially a crop of subsistence agriculture especially in tribal areas (Sharma and Hore, 1995). Some of the species are with high medicinal value (Nayar *et al*., 1989; Ghosh, 2014). During the last few decades the genus becomes one of the most important sources of diosgenin, a plant sapogenin used for the synthesis of steroidal drugs (Martin, 1969; Asolkar and Chadha, 1979). The growing demand for steroidal drugs like cortisone, corticosteroids, contraceptive pills (Ghosh, 2014a), sex hormones, etc. and the high cost of obtaining those from animal sources makes the genus commercially very important. In India the genus *Dioscorea* is represented by about 50 species (Anonymous, 1951; Karthikeyan *et al*., 1989). However, proper documentation of the genus in Andaman Islands is yet to be accomplished. The present work deals with 9 species of *Dioscorea* belonging to their nomenclatural status, taxonomy, ecology and with their distribution within the state of Andaman and Nicobar Islands and world.

**MATERIALS AND METHODS**

The Andaman and Nicobar islands, a landmass of 572 islands, isles, rocks and reefs, about 1200 km from the mainland India, is located between the latitude of 6° to 14°N and longitude of 92° to 94°E, covering an area of 8249 km² and it covers South, Middle, North, Little Andaman and Nicobar Islands.

The present work is the outcome of extensive field survey during 2001-2004, carried out to document the species of *Dioscorea* L. occurring in different parts of Andaman and Nicobar Islands. The collected specimens were processed into mounted herbarium sheets following standard herbarium techniques (Jain and Rao, 1977). Collected tubers were also introduced into the Botanical Garden, Botany Department,
RESULTS AND DISCUSSION

Taxonomy, ecology and distributional status of the genus Dioscorea L. in Andaman and Nicobar Islands has been described and discussed here.


Herbaceous climbers, twining, rarely erect. Underground parts rhizomatous, rhizome frequently short, subtending one to several tubers which are often rich in steroidal saponins, coverd with fine roots, trichomes simple to stellate or T- shaped, most prevalent on young vegetative and reproductive shoots. Stems annual, usually twining to the left or to right, rarely erect or creeping, terete or winged, often armed with prickles or similar structures, especially towards base; bulbils present in axils of some species. Leaves opposite to alternate, entire, lobed, or compound, base often cordate, venation reticulate; petiole usually thickened at base and apex, lateral nodal flanges (“stipules”) present at petiole bases in some species; cataphylls present towards stem base, mainly in right- twinning species. Plants dioecious but vestigial male/female parts usually present. Inflorescences simple or compound, partial inflorescences usually pendent, spicate or racemose, male flowers solitary or paired, sometimes in cymules, female flowers usually solitary or paired. Male flowers pendent to patent in inflorescence axis, with 3 or 6 stamens, inner or outer whorls sometimes staminodial, pistillode often present, sometimes with sepal nectaries; anther dehiscence intorse, pollen monobisulcate, rugulatereticulate, or perforate, occasionally geminate or striate. Female flowers pendent at first, later patent, frequently ascending as capsules mature, usually with 3 or 6 staminodes. Ovary inferior, 3-angled , and trilocular, sepal nectaries present in some species, ovules 2 per locule, styles 3, variably fused at the base and free towards the apical stigmatic surfaces. Fruit usually 3-winged capsule, dry and dehiscent at maturity, rarely a fleshy berry or one winged samara. Seeds usually 6. 2 per locule, occasionally fewer if ovules abort during development; usually lenticular to ovoid-lenticular, rarely ovoid, most winged all around margin or at base or apex only, a few wingless; endotesta crystalline; endosperm thick walled.

Distribution: 350-400 species, in all tropical and subtropical world regions, with maximum diversity in seasonally wet climates, where they die back to the tuber during the dry season. A few species extend into temperate regions (Caddick et al., 2002). Nine species found in Andaman and Nicobar Islands.

Key to the species of Dioscorea L. in Andaman and Nicobar Islands:

1. a. Stem twining to right.................................................................2
   b. Stem twining to left......................................................................5
2. a. Stems with spines........................................................................3
   b. Stems with no spines.................................................................4

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3. a. Stems narrowly winged, wings usually 4 .................................................. 1. D. alata
   b. Stems terete or with 4-8 low, longitudinal ridges ........................................ 2. D. belophylla
4. a. Leave base sagittate or hastate or cordate; veins 7-11; petiole 4-12 cm; male spike 2-5 cm ............................................................... 9. D. wallichii
   b. Leave base obtuse-rounded; veins 5; petiole 2-3.5 cm; male spike 10-30 cm .......... 6. D. oppositifolia
5. a. Stems with spines ....................................................................................... 6
   b. Stems with no spines. .................................................................................... 8
6. a. Leaves simple, heart shaped ................................................................. 4. D. esculenta
   b. Leaves compound; .................................................................................... 7
7. a. Leaves trifoliolate; no bulbils ................................................................. 5. D. hispida
   b. Leaves 3-7 foliolate; present bulbils .......................................................... 7. D. pentaphylla
8. a. Leaves simple, heart shaped ................................................................. 3. D. bulbifera
   b. Leaves compound; deeply trilobed ............................................................ 8. D. tomentosa


Climber, tubers variable, usually globose or conical (when cork brown or purplish black and transverse section purplish white), or oblate or cylindric, much branched (when cork brown or grayish yellow and transverse section white). Stem twining to right, glabrous, ridged, with 4 narrow, membranous wings, prickly at base. Bulblets present, variable in shape. Leaves alternate basally on stem, opposite distally on stem, simple; leaf blade green or purplish red, broadly ovate-cordate, 6-15(-20) × 4-13 cm, papery, glabrous, base sagittate to deeply cordate, apex shortly acuminate or caudate, 5-6 secondary nerves, campydomoromous, membranous, dark green, glabrous; petiole green or purplish red, 4-15 cm, glabrous. Male spikes solitary or a few together, 1.5-4 cm, sometimes forming a panicle; rachis obviously zigzagged. Male flowers: outer perianth lobes broadly ovate, 1.5--2 mm; stamens 6. Female spikes solitary or 2 or 3 together. Female flowers: staminodes 6. Capsule not reflexed, oblate, sometimes obcordate, 1.5-2.5 cm; wings 1.2-2.2 cm wide. Seeds 2, inserted near middle of capsule, winged all round.

Flower: November-January.

Fruit: December-February.

Ecology: Common, found in semi-evergreen forest, 210 mt. above, growing on black soil; it climbs on Lagerstomia sp, and associated climbers are Strychnos acuminata, Teteracera sermentosa and Calamus viminalis.

Distribution: India, Bangladesh, Pakistan, China, Thailand, Malaysia and Sri Lanka.

Andaman Island: North Andaman Islands.

Specimen examined: N. Andaman: Ramnagar (05.11.2002) A. Ghosh.672 (CHU).


Tubers cylindric, developed from short, thick rhizome; cork deciduous; transverse section white, drying light yellow. Stem twining to right, glabrous, prickly at base. Leaves alternate basally on stem, opposite distally on stem, simple; leaf blade drying blackish, usually ovate or long elliptic-ovate to lanceolate, 5-17(-24) × 0.5-10(-13) cm, glabrous, basal veins 5-9, base cordate to truncate or rounded, rarely sagittate or hastate, apex acuminate or caudate. Male spikes solitary or 2-4 together, 1-2.5 cm, usually in narrow, axillary panicles to 14 cm; rachis straight. Male flowers: outer perianth lobes orbicular, 1 mm, inner ones obovate, smaller but thicker than outer; stamens 6, infllosed. Female spikes solitary or paired, to 25 cm. Capsule not reflexed, oblate, 1.5-2.5 cm; wings 1.2-2.2 cm wide. Seeds 2, flat, inserted near middle of capsule, winged all round.

Flower: September-December.

Fruit: December-January.
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Ecology: Not frequent, evergreen broad-leaved forests, scrub forests, mountain slopes, valley sides, roadsides and associated climber are Argyreia sp.

Distribution: India, Bhutan, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Thailand, and Vietnam

Andaman Island: North Andaman Islands.

Specimen examined: N. Andaman:


Tubers usually solitary renewed annually, ovoid or pear-shaped, 4-10 cm thick; cork black; roots fibrous. Stem twining to left, glabrous, smooth. Bulblets purplish brown with orbicular spots, globose or ovoid, variable in size, weight to 300 g. Leaves alternate, simple; leaf blade broadly cordate, 8-15(-26) × 2-14(-26) cm, margin entire or slightly undulate, base deeply cordate, apex caudate-acuminate, 5-7 nerved, campylodromous, glabrous; petiole 2.5-5.5 cm. Male spikes usually clustered in leaf axils or along leafless, axillary shoots, drooping, sometimes branched. Male flowers: solitary, contiguous along rachis; bract and bracteole ovate; perianth purple, lobes lanceolate; stamens 6, inserted at base of perianth, filaments nearly as long as anthers. Female spikes often 2 or more together, similar to male ones, 20-30 cm. Female flowers: staminodes 6, 1/4 as long as perianth lobes. Capsule reflexed or drooping, straw-colored, densely purplish dotted, oblong-globose, 1.5-3 cm, glabrous, base and apex rounded; wings 0.25-0.7 cm wide. Seeds many, inserted near apex of capsule, dark brown; wing pointing toward capsule base, oblong, 1.2-1.6 × 0.5 cm.

Flower: July-October.

Fruit: August-November.

Ecology: Not frequent, deciduous forests, forest margins, river banks; near sea level to 350 m, growing on moist clay loam under shade, it also climbs on Canarium manii, Artocarpus chaplasha and associated climber is Ipomoea sp.

Distribution: India, Bhutan, Cambodia, Japan, Korea, Myanmar, Thailand, Vietnam; Africa, Oceania

Andaman Island: North and South Andaman Islands.


Tubers usually 4-10, produced from apical branches of rhizome; cork light yellow, smooth; thorny roots protecting crown of rootstock. Stem twining to left, with T-shaped, soft hairs, proximally prickly, distally so only at nodes. Leaves alternate, simple; petiole 5-8 cm; leaf blade broadly cordate, to 15 × 17 cm, with T-shaped hairs especially abaxially, basal veins 9-3, base cordate, apex acute. Male spike solitary, dense, 15 cm. Male flowers: usually solitary, rarely in cymules of 2-4, sessile or subsessile; bract ovate; perianth shallowly cupular, puberulent, outer lobes broadly lanceolate, 1.8 mm, inner ones slightly shorter than outer; stamens 6, inserted in perianth tube, slightly shorter than perianth lobes. Female spike solitary, pendent, to 40 cm. Capsule very seldom maturing, 3 cm, base truncate, apex slightly emarginate; wings 1.2 cm wide. Seeds inserted near middle of capsule, winged all round.

Flower: April onwards.

Fruit: June onwards.

Ecology: Not frequent, forests, forest edges, river banks, open area; near sea level to 150 m, growing on moist clay loam, it also climbs on Dinochloa scandens.
Distribution: India, Malaysia, Papua New Guinea, and Thailand.

Andaman Island: North and South Andaman Islands.


5. Dioscorea hispida


Tubers brown, ovoid or irregularly shaped, variable in size, poisonous; transverse section white. Stem twining to left, to 30 cm, terete, stout, pubescent when young, glabrescent, prickly. Leaves alternate, palmately 3-foliolate; petiole to 30 cm, hairy; middle leaflet ovate to elliptic, 6-12(-17.5) x 4-12 cm, adaxially sparsely hispid, glabrescent, abaxially hispid, palmately veined, apex acuminate; lateral leaflets ovate-elliptic or nearly broadly oblong, oblique, smaller than middle leaflet, margin entire. Male spikes in axillary panicles to 50 cm with 2 levels of branching, most parts densely tomentose. Male flowers: in dense clusters; perianth ca. 1 mm, outer lobes 0.15 x 0.1 cm, inner ones linear, 0.15 x 0.1 cm. Stamens 6, inserted, filament 0.5 mm, incurved; anthers subequal, globose, triangular, 0.75 x 1.5 cm, subequal. Female spikes in axillary panicles to 40 cm. Capsule long ellipsoid, 3.5-7 cm, leathery, densely pubescent; wings 1.2-1.5 cm wide. Seeds inserted near apex of capsule; wing pointing toward capsule base.

Fruit: April-May.

Flower: July-September.

Ecology: Not frequent, scrub forests, forest margins; near sea level to 350 m, growing on moist clay loam under shade, it thrive well even under adverse environmental conditions and associated climber is Ipomoea sp.

Distribution: India, Native China, Bhutan, Indonesia, Sikkim, and Thailand.

Andaman Island: North Andaman Islands.


6. Dioscorea oppositifolia


Climbers, branch terete, unarmed, stem twining to right, glabrous. Leaves subopposite, simple, ovate-sub orbicular, 3-10.5 x 1.5-9.5 cm, base obtuse-rounded, apex subacute-obtuse, 5 secondary veins, campylodromous, margin entire, thin coriaceous and glabrous; petiole 2-3.5 cm long, stout, glabrous. Male spike axillary panicked, clustered, 10-30 cm; peduncle 2-3 cm, glabrous; bracteoles scarious, triangular, 0.75-1.5 cm, subequal. Male flowers: flower 0.2 cm across, bracts linear, 0.3 cm; bracteoles scarious, triangular, 0.75-1.5 cm, subequal. Perianth lobes ob lanceolate; outer one 0.25 x 0.1 cm, inner ones linear, 0.15 x 0.1 cm. Stamens 6, inserted, filament 0.5 mm, incurved; anthers subequal, globose, oblong; staminodes 6; pistillode short. Female spikes simple or branched, solitary axillary, 6-9 cm; peduncle 1-2 cm, glabrous; bracteoles 1.5 mm. Flowers distant, 5 mm, 2 mm across, outer perianth lobes ovate, 1.5 mm; inner ones 0.5-1 mm. Ovary oblong, 3-4 mm, 3-celled; ovules 2 in each cell; style 0.5; stigma capitulate. Capsule obovoid, 2.5-3 x 2-2.8 cm, stipitate, glabrous. Seeds 3-4, orbicular 1 x 0.4 cm, winged throughout.

Flower and Fruit: Throughout the year.

Ecology: Few found in deciduous forest, 500 nt. above, growing on brick red soil; it climbs on Celtis wightii, and associated climbers are Strychnos acuminata, Hiptage benghalensis and Calamus palaustris.

Distribution: India, Bangladesh and Sri Lanka.

Andaman Island: North Andaman Islands.

Specimen examined: N. Andaman: Radhanagar (11.11.2001) A. Ghosh.25 (CHU).

7. Dioscorea pentaphylla


Tubers irregular, usually long ovoid; transverse section white when fresh, becoming brown; roots fibrous. Stem twining to left, sparsely puberulent, glabrescent, and prickly. Bulblets present. Leaves alternate, palmately 3-5-foliolate; 5-10 cm, terminal leaflets elliptic-ovate, 4.5-8.5 x 1.5-3.5 cm, lateral ones
inequilateral, 3.5-7.5 x 1.8-3 cm, base subacute, apex acute, margin entire, 3-5 nerved at base, acrodromous, adaxially, thin coriaceous, glabrous, abaxially appressed pubescent, sometimes glabrescent; petiole 3-5.5 cm, grooved, densely reddish brown pubescent; petiolule 0.7-1 cm, tomentose, apex acute. Male spikes in axillary panicles to 50 cm, often with long, lateral branches; parsely prickled, 4-15 cm, axis brown pubescent; peduncle 0; pedicel 1.5-2 mm. Male flowers: sessile or subsessile; bract and bracteole reniform, forming an involucel around perianth, sparsely hairy, apex cuspitate; perianth lobes coriaceous, pubescent, outer one ovate, 1.5 mm, inner ones lanceolate, broad at base, 1 mm. Stamens 3, staminodes 3. Female spikes simple or branched, 4-15 cm; peduncle 3-4 cm, brown puberulent. Female flowers: distinct, 4-6 x 1.5-2 mm; bracts 2-2.5 mm; bracteoles 1-1.5 mm; perianth lobes ovate, 1-1.5 mm. Ovary oblong, 4 mm, tomentose, ribbed; style 1 mm; stigma capitate. Capsule oblong, 2 x 1 cm deeply angled, winged, 0.5-0.6 cm wide, black at maturity, thinly leathery glabrescent-glabrous. Seeds 5-6, subquadrate, 6-8 x 4-5 mm, inserted near apex of capsule; apically winged.

**Flower:** August-October.

**Fruit:** November-February.

**Ecology:** Rare, 100-250 m. Scrub forests, forest margins, growing on loose swampy soil, found in near stream and also in secondary forest, it climbs up *Streblus asper* (dead logs), *Diospyros pyrrhocarpa*; associated climber is *Tinospora glabra*, *Tetracera sarmentosa* and *Dinochloa andamanica*.

**Distribution:** India, Bangladesh, Indonesia, Japan, Laos, Malaysia, Myanmar, Nepal, New Guinea, Philippines, Vietnam; Africa, Australia and Pacific Islands.

**Andaman Island:** North Andaman Islands.

**Specimen examined:** N. Andaman: Ganasnagar (06.12.2001) A. Ghosh.72 (CHU). Krishorinagar (23. 02.2002) A. Ghosh.479 (CHU).


Climber, stem twining to left, stout, tomentose. Leaves alternate, compound, trifoliate, 5-15 cm; leaflets broadly elliptic-lanceolate, 4-13 x 1.5-3.5 cm, base oblique, inequilateral, obtuse-subacute, apex acute, mucronate, margin entire, secondary veins 3-5, brochododromous, coriaceous and dense tomentose; petiole 4-12 cm, tomentose; petiolule 0.5 cm, tomentose. Male spike axillary or (terminal), solitary, 5-12 cm, branches-axes alternately 2, tomentose; peduncle 2-2.5 cm, tomentose. Male flowers: 1.5 cm across, bracts linear, 2 mm; bracteoles ovate, 1.5 mm, tomentose; perianth lobes coriaceous, tomentose; outer one 1.5 mm; inner ones linear, 1 mm. Stamens 3, inserted, filament 1 mm, incurved; anthers small, globose, oblong; staminodes 3; pistillode short. Female spike simple or branched. Female spike axillary, paired, 5-15 cm; peduncle 3-5 cm, tomentose; bracteoles 3 mm. Flowers 3 mm. across, velvety; perianth lobes fleshy, ovate, 1.5 mm. Ovary oblong, 3-7 mm, 3-celled; ovules 2 in each cell; style 3, 0.5; stigma capitate. Capsule oblong, 2-3 x 1-2 cm, base narrow, apex broad, tomentose, glabrescent latter. Seeds 3, obvoid, 1 x 0.4 mm, epically winged.

**Flower:** July-October.

**Fruit:** August onwards.

**Ecology:** Not frequent, growing on hill creaks, slopes 40%, found in near stream and associated climber is *Argyreia* sp.

**Distribution:** India, Bangladesh, Malaysia, Myanmar, Sri Lanka and Malaysia.

**Andaman Island:** North Andaman Islands.

**Specimen examined:** N. Andaman: Ganesnagar (19.11.2002) A. Ghosh.480 (CHU).


Tubers palmately branched, cylindric. Stem twining to right, stout, glabrous. Leaves opposite or alternate, simple; leaf blade orbicular or ovate, 6-18 x 6-22 cm, glabrous, basal veins 7-11, base cordate to deeply so with narrow sinus and basal lobes rounded, margin entire, apex acute or shortly acuminate, petiole 4-12 cm. Male spike 2-5 cm, in delicate, axillary panicles 4-10 cm; rachis straight. Male flowers: bracts
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triangular-ovate; perianth purplish red dotted, outer lobes elliptic-ovate, inner ones broadly obovate; stamens 6; staminodes large, subglobeose. Female spikes simple or branched. Female flowers: perianth lobes fleshy, outer ones ovate, inner ones broadly ovate. Capsule (immature) not reflexed, drying blackish, oblate, 2-2.7 cm, glabrous, base truncate, apex emarginate to truncate; wings 1.7-2 cm wide. Seeds 6, inserted near middle of capsule, winged all round, much glabrous, dotted.

Flower: July-September.
Fruit: October onwards.
Ecology: Not frequent, growing on loose swampy soil, 100-250 m, found in near stream and also in secondary forest; it climbs up Shorea robusta and associated climber is Ipomoea sp.
Distribution: India, Bangladesh, Malaysia, Myanmar, Thailand and Malaysia.
Andaman Island: North Andaman Islands.

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