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GENETIC RESOURCES OF YAMS OF WESTERN GHATS

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A total of 346 collections belonging to 13 identified and 2 unidentified ones have been collected, conserved, characterised and evaluated. Diversity in the genus in Southern region, their distribution, specieswise morphology and specieswise key for easy identification are also provided.

Key words : *Dioscorea*, yams, diversity, Germplasm collection, evaluation, key to the species

Yams (genus *Dioscorea;* family *Dioscoreaceae*), are tropical and subtropical in distribution in both the hemisphere. Out of 600 species reported, about 50 species occur in the Indian sub-continent (Prain and Burkill, 1936). Despite monumental work (Prain and Burkill, 1936; Jayasurya 1984), taxonomy of the genus is highly confusing. The present paper deals briefly with collection, evaluation and conservation of the genus collected from Western Ghats and its surrounding areas with a view to assess its existing diversity. Morphological characters were also studied to ascertain key to delimit the species.

MATERIALS AND METHODS

Over 500 collections of various *Dioscorea* species, both cultivated and wild have been made in several multicrop and crop specific collection trips carried out during 1980-1992 from Western Ghats and surrounding areas. Of these, 346 collections belonging to 13 identified species and two unidentified species are being maintained at the NBPGR Regional Station, Thrissur. Collections of *D. alata* and *D. esculenta* were annually cultivated and all other species were maintained in pots under partial shade. Table 1 gives the specieswise number of collections maintained alongwith passport data. Observations 28 qualitative and 7 quantitative characters was made during 1988-1992. Results of the study carried out on *D. alata* have already been published (Velayudhan *et al.*, 1991) and on *D. esculenta* has been completed. However, these species have also been included for the sake of their comparison with wild species. Out of 16 species reported from the Southern region, *D. wightii, D. glabra* and *D. kalkaparshadii* could not be collected. The importance of the vegetative characters, both aboveground and underground are emphasized

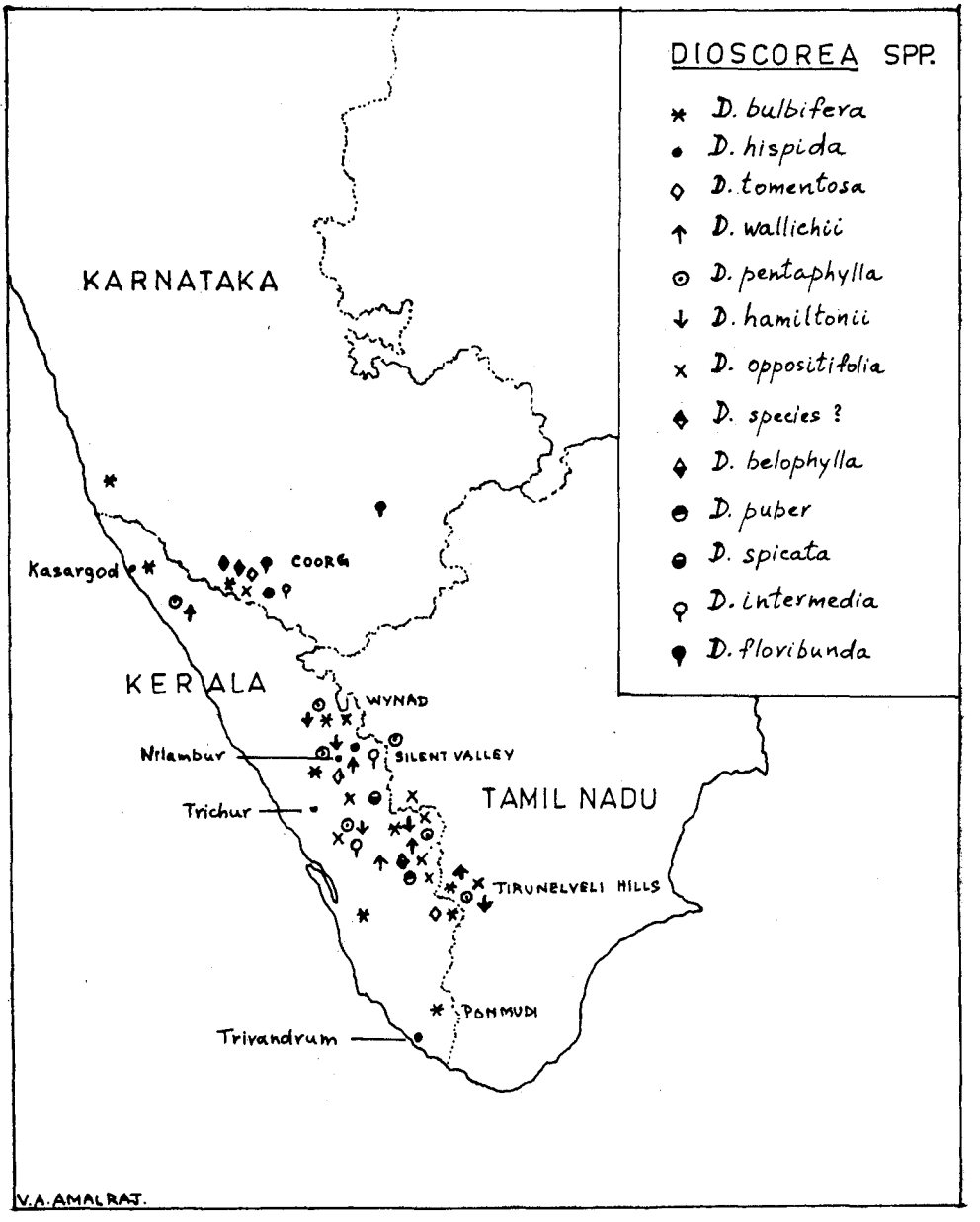

Fig. 1. Distribution map of *Dioscorea* species

and a key based on these is presented. Diagrammatic representation of various leaf and tuber types in the species studied is given. A distribution map (Fig. 1) for all the species except for *D. alata* and *D. esculenta* is given.

RESULTS AND DISCUSSION

The list of the species alongwith passport data and qualitative characters of the stems, bulbils and tubers are presented in Tables 1-5. *D. bulbifera* var. *sativa*, *D. intermedia*, *D. belophylla*, *D. spicata* are restricted in distribution, while others are widely distributed.

Table 1. List of species with and passport information

S. no.	Species name	Local name	Coll. number	Coll. Site	Status	Uses	Altitude (m)	Distribution
1.	*D.oppositifolia*	Kanji Kanjira kizhangu	14	Peechi	Wild	Edible	100-1500	Wide
2.	*D.wallichii*	Narukizhangu	14	Nilambur	Wild	Edible	100-700	Wide
3.	*D.hamiltonii*	Thalikkizhangu	10	Nilambur	Wild	Edible	500-1000	Wide
4.	*D.pentaphylla*	Nuran,Noota	23	Nilambur	Wild	Edible	0-1500	Wide
5.	*D.hispida*	Venni, Poduvakkilangu	7	Nilambur	Wild	Medicinal	100-900	Wide
6.	*D.tomentosa*	Chavali, Inckkachil	6	Parambikulam	Wild	Med.	100-1000	Wide
7.	*D.bulbifera* var. *verosa*	Madhukka, karimadhukka	21	Vaikom	Wild	Med.	0-1000	Wide
	var. *sativa*	Urulakkizhangu kachil	2	Tenkasi	Cult.	Edible	0-200	Restr-icted
8.	*D.puber*	Narikkizhangu	2	Wynad	Wild	Edible	700- 900	Restr-icted
9.	*D.intermedia*	-	3	Silent valley	Wild	Edible	500-1000	Restr-icted
10.	*D. belophylla*	-	1	Gudalur	Wild	Edible	700-900	Restr-icted
11.	*D.spicata*	-	3.	S. Valley	Wild	Edible	1000	Restr-icted
12.	*Dioscorea* sp.1	-	1	Virajpet	Wild	Edible	900	Very "
13.	*Dioscorea* sp.2	-	2	Idukki	Wild	Edible	200-500	Restr-icted
14.	*D.esculenta*	Cherukilangu	51	All over	Cult.	Edible	0- 700	Wide
15.	*D.alata*	Kachil, Kavathu	175	All over	Cult.	Edible	0-700	

Table 2. Characters of *Dioscorea* species

S. No.	Twining of stem	Pubscence on stem	Spines on stem	Ridges, wings on stem	Bulbils on stem	Shape of bulbils	Colour of bulbils
1	Right	Present/ Absent	Absent	Absent	Absent	-	-
2.	Right	Absent	Absent	Absent	Absent	-	-
3.	Right	Absent	Absent	Present	Present	Spherical/ Oblong	Dark brown
4.	Left	Present	Present	Absent	Present	Spherical/ Oblong	"
5.	Left	Present	Present	Absent	Absent	-	-
6.	Left	Present	Present	Absent	Absent	-	-
7(a).	Left	Absent	Absent	Present	Present	Spherical	Dark brown
(b)	Left	Absent	Absent	Present	Present	Spherical	White
8.	Right	Present	Absent	Present	Present	Spherical	White
9.	Right	Absent	Absent	Absent	Absent	Spherical	White
10.	Right		Absent	Present	Present	Spherical	Brown
11.	Right	Absent	Present/ Absent	Absent	Absent	Spherical	-
12.	Right	Absent	Absent	Absent	Absent	Spherical	-
13.	Right	Absent	Absent	Absent	Absent	-	-
14.	Right	Absent	Absent	Present	Absent	Digitate/ Oblong	Dark brown
15.	Left	Present	Present	Absent	Absent	-	-

Characters of the species with respect to the juvenile and mature leaves (Table 3) vary considerably and certain characters such as trifoliate nature, shape of the leaves, vein number and presence of mottlings on leaf and leaf hairiness from the key characters. In entities such as *D. oppositifolia, D. spicata, D. intermedia* and unidentified *Dioscorea* spp. leaves are heterophyllous in nature and the juvenile and the mature leaves vary in shape and size. In *D. tomentosa, D. pentaphylla* and *D. hispida* leaves are trifoliate to pentafoliate. Number of veins on the juvenile and the mature leaves in simple leaf bearing species varies from 7 to 9 and in the mature leaves from 3 to 9. Based on the various criteria, 9 distinct leaf types could be noticed in simple leaf bearing species except *D. alata* and *D esculenta* such as *D. oppositifolia, D. hamiltonii, D. wallichii, Dioscorea* spp., *D spicata* D. pubera, *D. bulbifera, D belophylla* and *D. intermedia.*

Table 3. Characters of juvenile and mature leaves of Discorea germplasm

S. No.	Shape of	Colour of J.leaf	Veins on J.leaf	Shape of M.leaf	Colour of M.leaf	Veins on M.leaf	Veins Prom-inence	Hairi-ness on leaf	Thic-kness of leaf
1	O/C	P/LP	7	O/L/R	G	3-5	P	A/P	M-H
2.	O/C	LP	7	O/C	DG	7	HP	A	M
3.	O/C	LP	7	O/C	DG	7	P	P	L-M
4.	T	LG	-	T	G/DG	-	HP	P	L-M
5.	T	LG	-	T	G	-	HP	P	L-M
6.	T	LG	-	T	G	HP	P	M	
7.	O/C	LG/LP/P	7-9	O/O	G/DG	7-9	H	A	L-M
8.	O/C	VLP	7	O/C	DG	7	P	P	M
9.	O/C	P	7	O/AA/R	DH	5-7	NP	A	M-H
10.	O/C	VLP	9	O/C	DG	9	HP	A	L-M
11.	O/C	LP	7	E/L/AA	G	3-5	NP	A	M-H
12.	O/C	LP/W Sp.	7	E/AA	G/W	3-5	NP	A	M-H
13.	O/C	LG	7	O/C	G	7	NP	A	H
14.	O/C	LG/LP/P	8	O/C	G/DG	7	P	A	M-H
15.	O/C/R	LG	7	O/C/R	G	7	NP	P	L

O=ovate, C=base cordate, E=Elliptic, L=lanceolate, R = rotent, LG= Light green, V=very, P-purple, LP-Light purple, G=Green, W=wight, Sp=spots, A=absent, L=low, M=medium, H=high, T=trifoliate or pentafoliate, R=rotund.round, AA=acute at the base, N=not. J = Juvenile

Table 4 gives details of qualitative and quantitative characters of the underground tubers. Tubers varied in shape, size, outer skin colour, flesh colour and presence of neck, lobes and stalks on tubers. Presence of long stalks that bear tubers as in the case of *D. belophylla, D. esculenta* and an unidentified *Dioscorea* Sp. from Coorg is a significant character. All the species except *D. bulbifera, D. hispida* and certain cultivars of *D. alata,* having spherical and digitate tubers bear oblong/cylindrical tubers. In *D. Wallichii* the tubers are highly branched and fibrous. Tuber colour varies from whitish cream in 9 species to pale yellow, deep yellow and light purple in others. Sometimes purple trace can also be seen in the case of *D. alata.*

Table 5 depicts the range and mean of 7 quantitative characters of 15 species. All the characters vary considerably within and between the species. Among the wild, *D. belophylla* represented by only one collection gave the highest yield of tuber.

Table 4. Characters of Dioscorea germplasm tubers

S. No.	Shape of tuber	Root knot	Tuber bearing stalks	Neck on tuber	Lobes on tuber	Outer skin of tuber	Roots on tuber	Tuber number	Flesh colour of tuber
1.	Oblong/ Cylind.	Absent	Absent	Present/ Absent	Absent	Light brown	L-M	1-2	White/ Pale yellow
2.	"	"	"	Present	Present	"	M-H	2-4	White cream
3.	"	"	"	"	Absent	"	L-M	1-2	"
4.	"	"	"	"	Present/ Absent	Dark brown	M-H	1	White/ pale yellow
5.	Spherical Amorphous	"	"	"	"	"	Low	1	Cream
6.	Oblong/ Cylind.	"	"	:	:	:	L-M	1-3	Yellow
7.	Spherical	"	"	Absent	"	Dark purple /Brown	"	1	Pale yellow
8.	Oblong/ Cylind.	"	"	Present/ Absent	"	Light brown	"	1	Deep Yellow
9.	"	"	"	Absent	"	"	"	1	Cream
10.	"	"	"	"	"	"	M	1-2	Pale Yellow
11.	"	"	"	"	"	"	L-M	1	White purple
12.	Oblong/ cylind.	present	present	Absent	Absent	Light brown	L	3	White
13.	"	Absent	Absent	Present/ Absent	"	Brown	M	1	White
14.	Spherical/Digitate/ Oblong	Absent	Absent	Present	Present/ Absent	Dark brown	L-H	1-3	Cream/ White/ Light purple
15.	Oblong	Present	Present	Absent	"	Light brown /Brown	L-H		

Table 5. Quantitative characters of the genus *Dioscorea*

S.No.		Petiole length	Leaf Length	Leaf Width	Tuber Length	Tuber thickness	Tuber weight	Days to emergence
1.	M	1.9	9.2	3.9	49.9	2.3	85.0	38.3
	R	1.0-4.5	2.8-12.0	1.2-5.9	19.3-69.4	0.6-3.5	25.0-125.0	22.0-6.8
2.	M	6.7	9.4	8.6	52.9	1.7	120.0	74.5
	R	2.9-9.5	5.5-12.5	4.6-12.5	16.5-106.0	0.8-3.0	250.0-275.0	72.0-77.0
3.	M	5.5	9.3	7.7	25.6	3.4	214.0	38.0
	R	3.1-4.7	5.0-8.6	2.9-6.7	20.0-109.0	1.0-2.9	100.0-395.0	36.0-62.0
4.	M	4.0	7.9	3.5	37.3	5.3	170.0	47.5
	R	3.1-4.7	5.0-8.6	2.9-6.7	20.0-109.0	1.0-2.9	100.0-395.0	36.0-62.0
5.	M	6.1	10.0	6.6	7.2	6.4	135.0	72.6
	R	3.1-7.4	8.6-11.3	4.9-8.5	5.7-8.0	5.0-7.1	100.0-170.0	34.0-82.0
6.	M	6.3	10.0	5.3	36.6	2.5	135.0	69.4
	R	4.7-7.8	8.8-11.2	4/2-6.0	29.6-48.3	1.2-3.2	55.0-305.0	39.0-80.0
7.	M	6.2	9.9	8.9	6.9	5.8	92.0	54.3
	R	3.2-11.0	6.6-12.9	5.2-17.8	3.5-9.0	3.6-10.0	45.0-300.0	26.0-76.0
8.	M	3.3	10.5	7.9	27.5	1.8	163.5	122.5
	R	2.9-3.6	9.9-11.1	7.2-8.5	20.0-35.0	1.7-1.9	150.0-177.0	112.0-133.0
9.	M	1.5	7.4	3.6	54.0	2.1	315.0	44.0
	R	-	6.5-8.2	3.5-3.7	37.0-77.0	2.1-2.2	265.0-364.0	-
10.	M	4.0	11.5	5.0	16.5	2.9	220.0	120.9
	R	-	-	-	-	-	-	-
11.	M	3.4	7.5	4.3	59.5	2.2	321.0	77.0
	R	1.8-5.5	6.3-10.0	3.3-5.5	25.0-84.0	1.5-3.5	215.0-523.0	-
12.	M	0.9	6.5	2.0	21.0	3.5	75.0	77.0
	R	-	-	-	-	-	-	-
13.	M	8.5	8.5	7.1	46.3	2.8	250.0	-
	R	-	-	-	-	-	-	-
14.	M	8.9	11.3	10.2	23.1	13.2	1330.0	15.0
	R						500.0-2100.0	9.0-22.0
15.	M	5.8	7.6	4.3	11.8	3.4	249.4	38.0
	R	3.6-7.2	5.1-9.3	2.6-6.7	2.6-6.7	1.2-5.7	260.0-520.0	24.0- 51.0

M = mean R = range

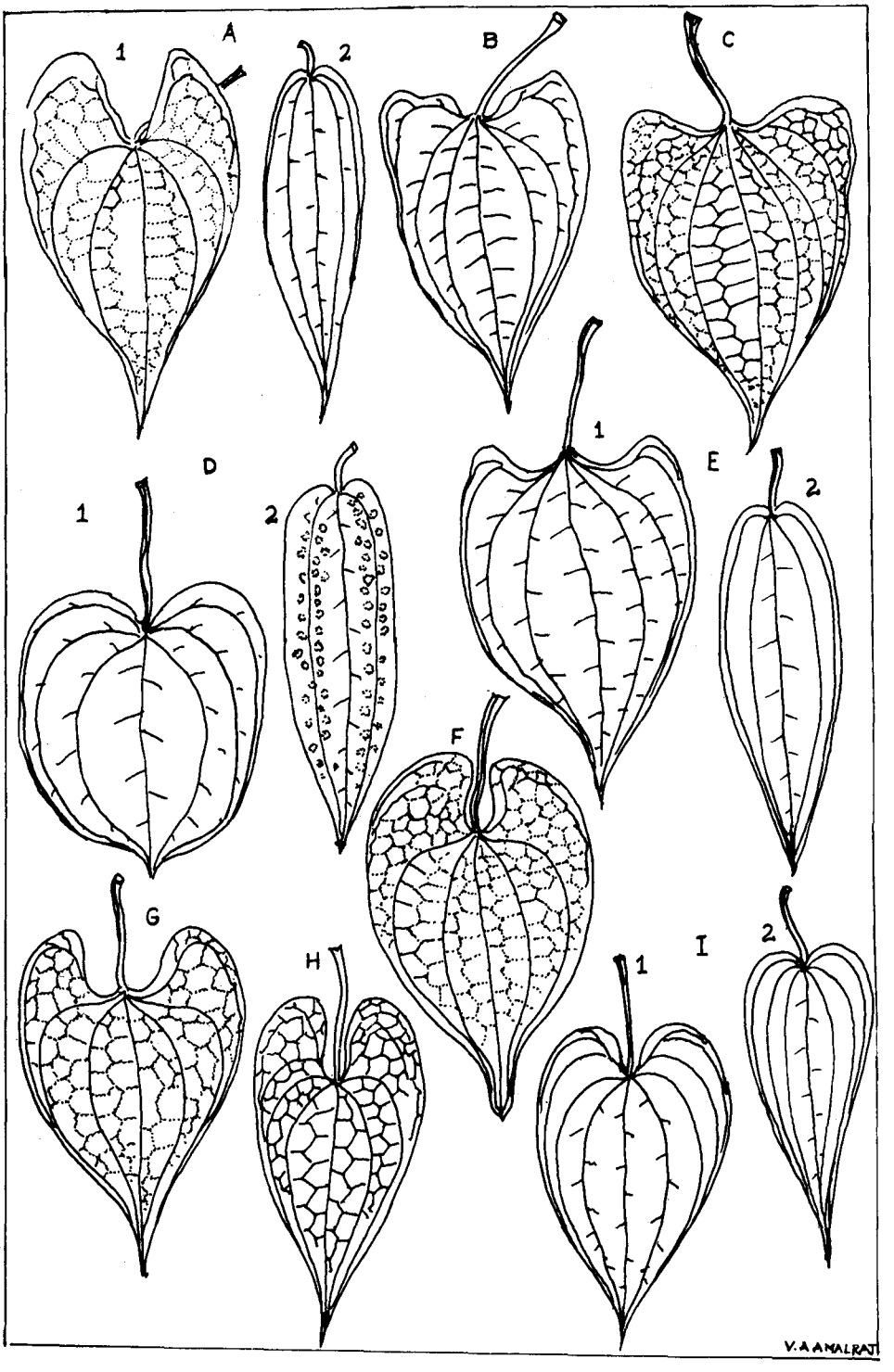

Fig. 2. Diagramatic representation of 9 distinct leaftypes in *Dioscorea* species

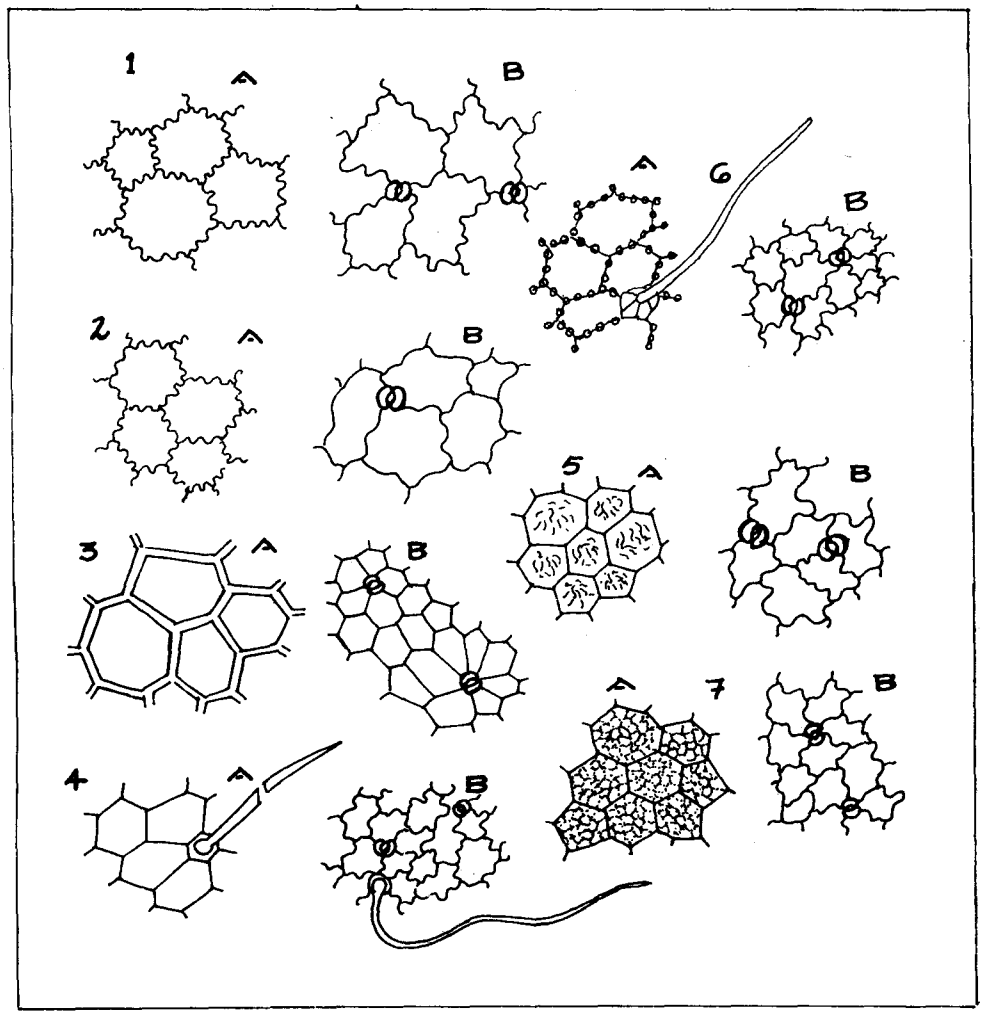

Fig. 3. Diagramatic representation of 7 types of leaf epidermis in *Dioscorea* species

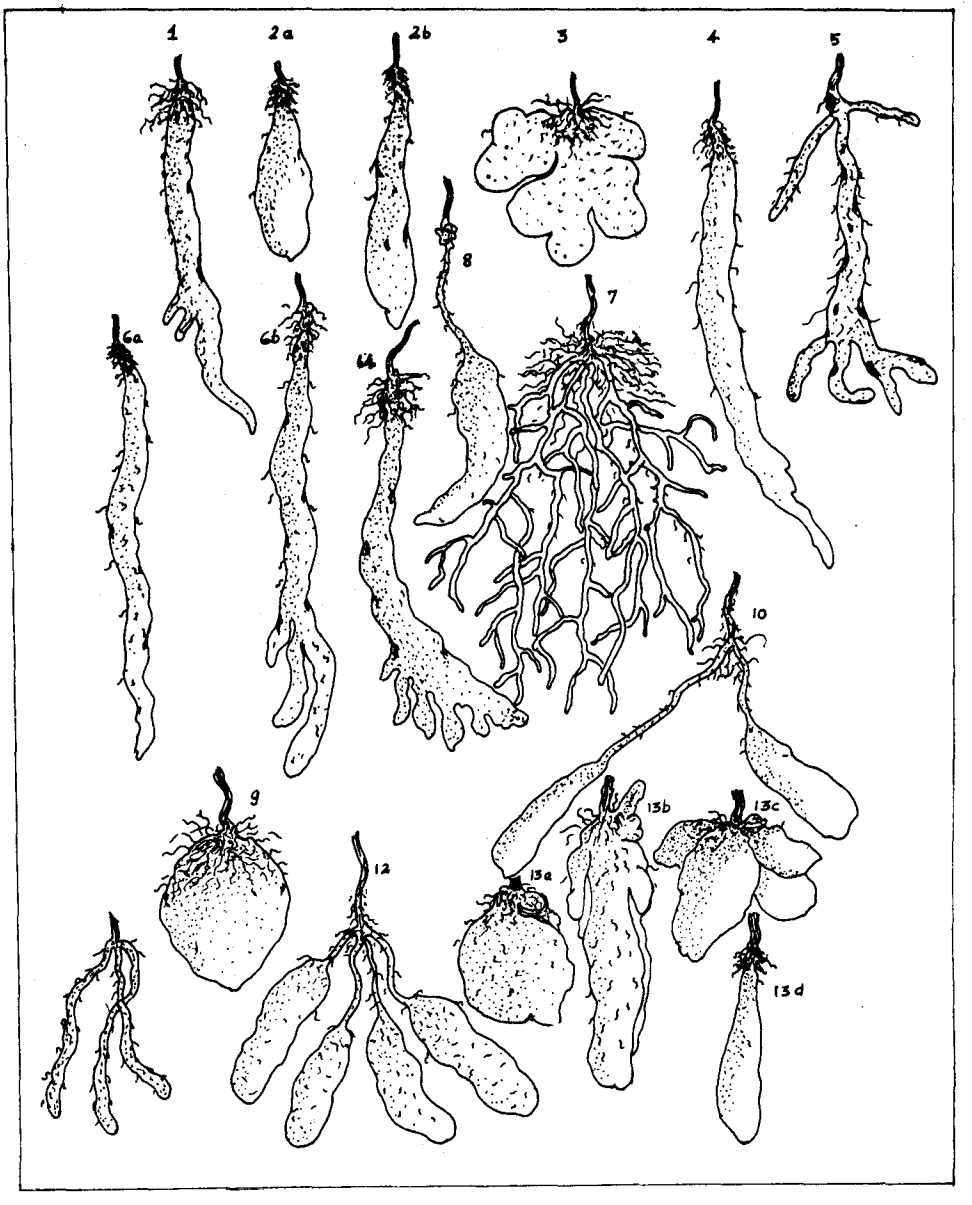

Fig. 4. Diagramatic representation of tuber types in various speciesof *Dioscorea* species

In the species studied, 7 distinct tuber types based mainly on the shape and nature of tubers such as oblong in *D. tomentosa, D. oppositifolia, D. hamiltonii, D. Spicata, D. pubera, D. alata* and *Dioscorea sp.* 1 bottle shaped in *D. pentaphylla* and *D. alata;* bent and stalked in *D. belophylla;* amorphous in *D. hispida; D. wallichii, D. intermedia* and *Dioscorea* sp.2; spherical and digitate in *D. bulbifera* and *D.alata* and branched and stalked in *Dioscorea* sp.1 and *D. esculenta* could be noticed.

In Western Ghat areas of Kerala, Tamilnadu and Karnataka, several tribals depend greatly on wild yams for their food especially during lean periods while, in winter and summer months, the tribals (such as Kadar, Malayar, Mala Arayans, Paniyar, Irular Kurumbar, Cholanaykans, Kurichiar, Muduvans and Kanikkars) practise the oldest mode of food gathering in tropics i.e., excavation of tubers of edible wild yams. While doing so, they leave the parts of the tubers excavated in the pits and cover the latter with soil as a measure of conservation. The most preferred species are *D. pentaphylla, D. oppositifolia, D. hamiltonii* and *D. spicata.* The tubers are consumed after roasting in fire or boiling.

Key to the species

1a. Stems turning to the left :

2a. Leaves simple

Stem winged or ridged, nonspiny .... *D. bulbifera*

Stem round, spiny ..... *D. esculenta*

2b. Leaves compound

3a. Tuber spherical and amorphous ... *D. hispida*

3b. Tubers oblong or cylindrical, skin dark brown,

Tubers lobed at the base, highly rooty, warty, deeply placed ..... *D. tomentosa*

Tubers long or short bottle shaped, with or without necks ..... *D. pentaphylla*

1b. Stems turning to the right :

4a. Mature leaves elliptic ovate or elliptic lanceolate, base rounded or slightly notched, juvenile and mature leaves unlike :

5a. Leaves white spotted :

Tubers 2-d oblong, borne on stalks ..... *Dioscorea* sp.1

Tuber 1 in number, not on stalks ..... *Dioscorea* sp.2

5b. Leaves unspoted :

Male spikes axillary, unbranched, 1-2 from each axil; base of the stem spiny at maturity .... *D. spicata*

Male spikes in or modified terminal stems, branched; stem base non spiny .... *D. oppositifolia*

4b. Mature leaves large ovate, base cordate cordate, juvenile and mature leaves alike :

6a. Lamina thin to medium thick, veins and veinlets reticulation very highly pronounced, leaf surface wavy :

7a. Tubers on long stalks arising from rootknot .... *D. belophylla*

7b. Tubers borne directly from stem base :

Tuber flesh white ... *D. hamiltonii*

Tuber fresh yellow or light orange yellow ... *D. puber*

6b. Lamina medium to very thick, leathery, veins not highly pronounced:

8a. Stem winged or ridged .... *D. alata*

8b. Stem not winged or ridged

Stem base spiny .... *D. wallichii*

Stem base not spiny .... *D. intermedia*

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