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Diversity Of Fruit And Seed Morphology In Shivan Malai Flora Of Eastern Ghats Of Salem District In Tamilnadu, India

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Abstract: *Diversity of seeds based on their morphology across vegetation and seasons in Shivan Malai of Salem district, Tamilnadu India was studied in the present research. Fruit type and colour, seed number per fruit, length and breadth of seed, seed weight, seed sculpturing pattern, seed shape, seed colour, hilum, modification of seed / fruits were studied. The study resulted in 11 different types of fruits dominated with capsule and 22 different shapes of seeds dominated with ovate shape, 4 different coloured seeds (yellow, reddish black, pale yellow and greenish brown) dominated with black and brown coloured seeds, 12 different types of seed sculpturing pattern (chagrenate, Scabrate, Reticulate, Echinate, Regulate, Cicatricose, Corrugate, Baculate, Striate, Piliferous, Granular, Clavate) and 4 different hilum (terminal, sub terminal, lateral and basal). Seed shape is extremely variable since it depends on the form of the ovary, size, shape of the embryo and amount of endosperm present.Structural modification of Fruits and Seed showed winged, parachute mechanism, Hooked and Balloon fruit. Seed size and number are inversely related like many small seeds or a few large ones. This relationship is an important factor in reproduction and spatial distribution of a plant concerns along with seed weight. Helum is not only important in taxonomic classification it also determines the seed distribution through wind based on their direction at different season.*
Keywords: *Seed, fruit, Colour, shape, hilum, etc.*

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I. Introduction

In gymnosperms and angiosperms of plant kingdom seed form an important phenomenon in development of reproduction and spread of them relative to more primitive plants such as ferns, mosses and liverworts, which do not have seeds and use other means to propagate (Reven *et al*., 2013). Plant reproduction is the production of new individuals or offspring in plants accomplished through sexual and asexual means. Sexual reproduction produces offspring by the fusion of gametes, result in offspring genetically different from their parents, asexual reproduction produces new individuals without the fusion of gametes, genetically identical to the parent plants and each other except when mutation. In seed plants the offspring can be packaged in a protective seeds.

Natural vegetative reproduction is mostly a process found in herbaceous and woody perennials plants, and typically involves structural modifications of the stem or roots and in a few species leaves. However plants require seeds to reproduce so than they do not die off and become extinct. Seed are an energy efficient mechanism that is durable and doesn't cost the plant much in the way of resources to produce. Man requires seeds for food production. Either seeds of edible plants are collected and sown for food (such as vegetables and fruits) or the seed its self is used for food (such as rice, wheat corn etc.)

A seed is a fertilized or ripened ovule, protecting dormant embryo within and serve the function of preparation dispersal and reproduction of the parent plant. In angiosperms, the seeds are enclosed within fruits, whereas in gymnosperms seeds are exposed or naked. Seeds are enormously variable in shape, size, structure and period of viability. Seed coats help protect the embryo from injury and also from drying out. Seed coat can be thin and soft as in beans or think and hard as in locust or coconut seeds. Endosperm a temporary food supply is packed around the embryo in the form of special leaves called cotyledons or seed leaves these generally are the first parts visible when the seed germinates. Observation in many plant groups have shown that seed morphology and anatomic feature are rather conservation, which makes them taxonomically important. In addition to vegetative and reproduction characteristics the features of the seeds have long been employed as an important taxonomic feature examination are concerned with general shape and size rather than details or surface ornamentation. Most systematic agree that data concerning the macro and micro structure of seeds are very significant for the classification of angiosperms taxa.

Heywood (1971) drew attention to the importance and impact of scanning electron microscopy in this study of systematic problems as very valuable information has been provided by using this technique. Recently the application of SEM to the study of the seed coat has become widespread. Vaughan and Whitehouse (1971) studied macro and micro morphological characters of approximately 90 genera and 200 species of Brassicaceae and paid special attention to the relationships between structure and existing taxonomy.

Morphology of seed coat has been identified as important taxononomic character and also to trace their evolutionary pathway (Koul *et al*., 2000; Zeng *et al*., 2004; Moazzeni *et al*., 2007; Pınar *et al*., 2007; 2009; and Duran, 2009). The present investigations were carried out on the morphological characters of seed in the more species from shivan malai of southern Eastern Ghats. Morphology of seeds is an effective parameter in identification of species and their phylogentic relationships with other plants (Bona, 2013).

II. Methodology

In the present investigation fruit type and seed characteristics were studied at Shivan malai area, by collecting mature fruits and seeds from Vinayaka mission's 1008 Sivalayakailayam is located near Ariyanoor. It is about 21 km west of Salem city. It is situated between 78°3" lat E and 11°80" lat N. The region falls dry under tropical monsoon climate receiving both south west monsoon and north East retreating monsoon. The vegetation is tropical dry deciduous thorny forest. The maximum temperature is range from 26.4°c to 35.3°c and minimum temperature range from 21.0°c to 20.4°c. The average rainfall of the area is 65.51mm and the relative humidity of the area fluctuates from 74 to 85%. The soil is red and poor in nitrogen content plant nutrient, low to medium to high in potassium. The moisture holding capacity is poor.

Fruits such as Capsule, Pod, Mericarps, Utricle, Follicle, Caryopsis, Berry, Drupe, Achene, Samara, Nutlets were recorded in the study area. 3-5 individuals plants per species were chosen randomly and at least 5 fruit per plant were counted for their seeds and the average number of seeds per fruit was calculated. However in few cases less number of fruits was examined. 25 or 100 seeds were weighed separately and the average weight of the seeds per fruit was calculated (10 seeds in case or less material). Length and breadth of seeds (seed size) was measured, under the dissection microscope. The average length and breadth in mm was calculated.

The sculpturing pattern was studied by an Olympus photomicrograph at the Department of Botany VICAS. The surface was studied by directly transferring the seeds to a slide. Shapes of the seeds were analyzed such as chagrenate, psilate, clavate, reticulate, scubrate, echinate, corrugate, verrucate, regulate, faveolate, gemmate, straite, fossutate, baculate, cicatricose, canaliculate. Seed surface, colouring pattern, size, shape of hilum and modification of fruits and seeds were recorded.

III. Result and Discussion

The present study at Shivan malai showed vegetation 160 species belonging to 51 families in which 90 species seeds were collected in different seasons which belong to 75 genera and 31 families. Habit wise analysis showed the vegetation is dominated by herb followed by shrub and tree species. Fabaceae, Euphorbiaceae, Malvaceae, Amaranthaceae, (27 Species) dominate in total number of species. Wereas Capparidaceae, Lythraceae, Rhamnaceae, Sterculiaceae, Zygophyllaceae, Passifloraceae, Rubiaceae, Sapotaceae, Onagraceae, Ulmaceae, Bixaceae, Menispermaceae, Cucurbitaceae, Graminae, Geraniaceae, least in the total number of species (Table 1).

Apart from taxonomic classification fruit and seed morphology and modifications also ensure effective disposal depending upon their habitat, agroecologial conditions, their nature of sexual reproduction, etc. Morphological characters are important in consumer choice among the available taxa which determine their success in their dispersal (Gautier-Hion et al., 1985). Variety of characters of fruits is co-adopted with preference of their dispersal agent as food and cosmetics (Morden-Moore and Willson 1982; Moermond and Denslow, 1983; Sorenson, 1983; Hladik 1981; Milton 1981; Thompson 1981). In the present study 11 different characters were recorded in which capsule and pod characterized fruits are dominant (Table 2). However, most of the fruits drupes with dry flesh were identified as dehiscent pods orapsules (Knight and Siegfried, 1983). Fruit medications is one another process through which plant species attract the consumers for the disposal of their seeds these modifications occur in their cell wall fruit content and its associated smell (Goulao and Oliveira, 2008). However, there are other physical modifications also occur in fruit of plant species such as forming balloon as in *Cardiospermum helicacabum* L., surface spines as in *Datura metal* L. and D. discolor and wings as in *Holoptela integrifolia*, pl. and *Dodonae viscose, L.* These physical features support in disposal of seeds through wind and physical hanging. And also protect the seed from consuming. Each plant ensures their unique disposal mode which is adapted based on their size, growth pattern, environmental conditions in which they establish (Venable and Brown, 1993; Willson, 1992; Willson *et al*., 1990; Hughes *et al*., 1994). The present study recorded hook in *Martynia annua* L., wings in *Tribulus terrstria* L., *Tabebuia rosea*, (Bertol.) DC., *Xanthium indicum*, Roxb. and *Albizzia odoratissima*.Benth.and Parachute structure in *Wrightia tinctoria*, (

Roxb)., *Calotropis gigantean,* R. Br., *Calotropis procera,* R. Br., *Nerium odorum*, sol. and *Tridax procumbens*, L.

Seed is an important genetic material between successive generations of plant and dispersal (Armstrong, 1999). Seed posses' important characters that is used for identify the plant species at different levels (Corner, 1976; Ahmed and Qaiser, 1989; Omer and Qaiser, 1995; Abid and Qaiser, 2009; Ather *et al*., 2010; Kanwal *et al*., 2010).Among the seed characteristics hilum is an important character that determine the period of seed detachment and dispersal in the present study 43 species showed terminal, 1 species sub terminal, 17 species lateral, 9 species basal and 20 species undistinguished positions. Seed weight is also an important parameter which not only taken for classification but also for their dispersal but not many of them studied (Gautier-Hion *et al*., 1985). For species which grow in more stable environments with closed vegetation wide dispersal may be of less importance than the ability to establish seedlings in a highly competitive environment. In these species priority is given to seed size rather than number Salisbury (1942). Seed size has been shown to be correlated with a number of environmental factors. The larger seeds are associated with drier habitats Baker (1972). Present research showed that heavy seeds are represented in shrubs from 0.001 to 1g weight followed by climber which ranged from 0.01 to 9.6mg, herbs ranged from 0.001 to 7.1mg, and trees from 0.002 to 2.2mg weight. Among the 31 family large seeds are represented by Pedaliaceae with 2 species, which ranged from 0.1mg to 1g followed by Acanthaceae with 6 species which ranged from 0.001mg to 10.6mg, Convolvulaceae with 2 species ranged from 0.7 to 9.6mg, Malvaceae with 5 species ranged from 0.003 to 7.1mg, Lamiaceae with 5 species ranged from 0.4 to 5.1mg and Fabaceae with 11 species ranged from 0.005 to 2.2mg (Table 3). Sculpturing pattern is useful in identification of plants at species levels (Koul *et al*., 2000) and also even at landraces level (Gopinath, 2004). The present study showed 11 different sculpturing pattern (Chagrenate, Scabrate, Reticulate, Echinate, Regulate, Cicatricose, Corrugate, Baculate, Striate, Piliferous, Granular exine and Clavate) domidated by Chagrenate in 28 taxa followed by Scabraate in 11 taxa and Reticulate in 11 taxa (Table 4). Small seeds are characteristics of species which have persistent dormant seed banks in the soil (Thompson and Grime, 1979). A reduction in seed size has also been shown to be associated with predator avoidance Janzen (1969). Seed shape extremely variable such as ovate, spherical, oblong, rhomboid, obtriangular, semi-angular, heart shape, cuneate, bean, kidney shape, reniform, snail shape, linear, ellipsoid, sub globose, deltoid, cordate, 5 winged among these ovate (28), rhomboid (11), spherical (10) shape recorded in most of species. Shape seeds are extremely variable it depends on the form of the ovary, the condition under which the parent plant is growing during the seed formation. The other factors which determine the size and shape are the size of the embryo, the amount of endosperm present and to what extent other tissue participates in the seed structure. Seed surface colour range black, brownish black, yellow, greenish brown, reddish black, reddish brown, pale yellow, brown, dark brown and black with white. In the study black to brown colour recorded in most of species, whereas reddish black, yellow recoded with least number of species.

IV. Conclusion

Shivan malai of Salem district in Tamilnadu, India showed high diversity of vegetation falling in Eastern Ghats with 160 species belonging to 51 families. Seeds of 90 species are representing 75 genera in 31 families showed high diversity of both fruit and seed characteristics depicting their significance in taxonomic identification at species level and also at landraces level. However, overall vegetation is dominated by fabaceae, capsule fruit type with three different fruit and seed modifications. Position of the vegetation is dominated with terminal position, seed weight is higher in shrubs and climbers and dominated with Chagrenate sculpturing pattern.

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Table : 1 List of plants recorded in the study area

S. NO	BINOMIAL	VERNACULAR NAME	FAMILY	HABIT
1.	*Abrus precatorius*, L.	Gundumani	Fabaceae	Climber
2.	*Abuluda mutica*, L.	-	Poaceae	-
3.	*Abutilon indicum*, G. Don.	Thuthi	Malvaceae	Herb
4.	*Acacia leucophloea*, willd.	Velvel (or)velvelam	Fabaceae	Tree
5.	*Acalypha indica*, L.	Kuppaimeni	Euphorbiaceae	Herb
6.	*Achyranthes aspera*,L.	Nayurivi	Amaranthaceae	Herb
7.	*Aegle marmelos*, Corr.	Villuvam	Rutaceae	Tree
8.	*Aerva lanata*, Juss.	Poolampoo	Amaranthaceae	Shrub
9.	*Ailanthus excels* Roxb.	Perunaram	Simarubaceae	Tree
10.	*Albizzia amara*, Boivin.	Arapumaram	Mimosaceae	Tree
11.	*Albizzia lebbeck*, Benth.	Vagai	Mimosaceae	Tree
12.	*Albizzia odoralissima*, Benth.	Porasamaram	Mimosaceae	Tree
13.	*Alternanthera pungens*, kunth.	Odramul	Amaranthaceae	Herb
14.	*Alternanther atriandra* Lamk.	Ponnangannikerrai	Amaranthaceae	Shrub
15.	*Alysicarpus monilifer* DC.	Sithirabarani	Fabaceae	Prostrate herb
16.	*Amarantus viridis* L.	Kuppaikkeerai	Amaranthaceae	Herb
17.	*Andrographis echioides* Nees.	Goburamthangi	Acanthaceae	Herb
18.	*Andrographis paniculate*,L	Nelavempu	Acanthaceae	Shrub
19.	*Anisochilus carnosus* Wall.	Sethubunsedi	Lamiaceae	Herb
20.	*Annona squamosa* L.	Sitapalam	Annonaceae	Tree
21.	*Aristolochia indica* L.	Eesvaramoole	Aristalochiaceae	Twiner

22.	*Azadirachta indica,* Juss.	Vepamaram	Meliaceae	Tree
23.	*Bambusa arundinaceae* Willd.	Mungil	Poaceae	Tree
24.	*Barleriabuxifolia*, L.	Kattimullu	Acanthaceae	Shrub
25.	*Bauhinia racemosa* Lam.	Arikka	Fabaceae	Tree
26.	*Biophytum sensitivum,* DC.	Velisuruingi	Oxalidaceae	Herb
27.	*Blepharis maderaspatensis*, Roth.	Naethirapoondu	Acanthaceae	Herb
28.	*Boerhaavia diffusa* L.	Mukarattekirai	Nyctaginaceae	Herb
29.	*Boerhaavia erecta,* L.	Puinnarkava	Nyctaginaceae	Herb
30.	*Borassus flabellifer* L.	Panai	Palmaceae	Tree
31.	*Calotropis gigantea,* R.Br.	Erukku	Asclepidaceae	Shrube
32.	*Calotropis procera* R.Br.	Vel erukku	Asclepiadaceae	Shrub
33.	*Cardiospermum helicacabum* L.	Mudakkathan	Sapidaceae	Climber
34.	*Cassia auriculata* L.	Aavarampoo	Leguminosae	Tree
35.	*Cassia occidentalis* L.	Payaveivai	Caesalpinaceae	Herb
36.	*Cassia spectabilis,* L.	Manjalkonrai	Caesalpinaceae	Small tree
37.	*Catharanthus rosus (*L). *Don.*	Nethiyakalyani	Apocynaceae	Herb
38.	*Chloris barbata* SW.	-	Poaceae	Grass
39.	*Cissus quadrangularis* L.	Pirandai	Vitaceae	Shrub
40.	*Cissus xavierensis* L.	Oolaiperandai	Vitaceae	Climber
41.	*Citrullus colocynthis*, schrad	Curumathankai	Cucurbitaceae	P.herb
42.	*Cleome viscosa*L.	Naivalai	Capparidaceae	Herb
43.	*Clitoria ternatea* L.	Sangupoosedi	Fabaceae	Climber
44.	*Coccinia indica* W & A	Kovaikai	Cucurbitaceae	Climer
45.	*Cocculus hirsutus,* Diels.	Kattukodi	Menispermaceae	Climber
46.	*Coccus nucifera* L.	Tenga	Palmaceae	Tree
47.	*Commelina benghalensis* L.	Adutinnathalai	Commelinaceae	Herb
48.	*Commiphora berri*, Engle.	Mulkiluvai	Burseraceae	Tree
49.	*Commiphora caudate*, Engle.	Kiluvai	Burseraceae	Tree
50.	*Corollocarpus epigaeus*, Hk.f.	Aakasakarutan	Cucurbitaceae	Climber
51.	*Crotalaria verrucosa*L.	kelukelupai	Fabaceae	Herb
52.	*Croton sparsiflorus*, Morong.	Railpoondu	Euphorbiaceae	Herb
53.	*Cynodon dactyon* , Pers.	Arugampullu	Poaceae	Herb
54.	*Cypreus compressus* L.	Kunnagorai	Poaceae	Herb
55.	*Datura discolor* L.	Karuoomathai	Solanaceae	Herb
56.	*Datura metel* L.	Oomathai	Solanaceae	Herb
57.	*Delonix elata,* Gamble.	Vadanarayanan	Caesalpiniaceae	Tree
58.	*Dendrophthoe falcate* Ettingsh	-	Loranthaceae	parasitic
59.	*Dichroslachys cinerea,* L.Wight&Arn.	Vedatharai	Mimosaceae	Tree
60.	*Diospyros ebenum*, J.koneingex.sprengle.	Tumbi	Ebnaceae	Herb
61.	*Dodonaea viscosa,* L.	-	Sapindaceae	Small tree
62.	*Eclipta alba*, Hassk.	Karisilakanni	Compositaceae	Annual herb
63.	*Eleusine aegyptiaca,* Desf.	-	Poaceae	Herb
64.	*Emblica officinalis*, Gaertn.	Periyanellikai	Euphorbiaceae	Tree
65.	*Eremopogan foueolatus* L.		Poaceae	Herb
66.	*Eupatorium glandulosum* R.King&H.Robinson.	-	Asteraceae	Shrub
67.	*Euphorbia cyathophora,* murray.	Kattupapale	Euphorbiaceae	Herb
68.	*Euphorbia heterophylla* L.	Palsedi	Euphorbiaceae	
69.	*Euphorbia hirta*, Linn.	Ammanpacharuse	Euphorbiaceae	Herb
70.	*Euphorbia tirucalli* L.	Tirucalli	Euphorbiaceae	Small tree
71.	*Evolvalus alsinoides* L.	Visnukarandi	Euphorbiaceae	Perennial herb
72.	*Ficus bengalensis,* L.	Aalamaram	Moraceae	Tree
73.	*Ficus religiosa,* L.	Arasamaram	Moraceae	Tree
74.	*Fimbristylis falcate (*Vahl) Kumth.	Korai	Cyperaceae	Herb
75.	*Flacourtia spiaria* Roxb.	Karaikai	Flacourtiaceae	Tree
76.	*Fleusine aegyliace*	-	Poaceae	Herb
77.	*Flueggea leucopyrus,* willd.	Pulaa	Euphorbiaceae	Shrub
78.	*Gmelina asiatica* L.	-	Amaranthaceae	Climber
79.	*Gymnena sylvestre* ,R.Br.exRoemeo&schuttes.	Shirukurunjan	Aclepiadaceae	Climber
80.	*Helotropium zeylanicum* (Lamk)	-	Boranginaceae	Herb
81.	*Hemides musindicus,* R.Br.	Nannari	Aslepidaceae	Twinning shrub
82.	*Holoptelea integrifolia,* planch.	Ayamaram	Ulmaceae	Tree
83.	*Hypanthus enneaspermus* (L.) F.muell.	Orithalthambarai	Violaceae	Herb
84.	*Hyptis suaveolens,* L.poit.	Gangathulasi	Lamiaceae	Herb
85.	*Inchnocarpus frutescens,* L.	Udargodi	Apocynaceae	Shrub

86.	*Indicofera aspelathoides*, Vahl.	Sivanarvambu	Fabaceae	Herb
87.	*Indicofera astragalina* Dc.	-	Fabaceae	Herb
88.	*Indicofera tinctoria* L.	karuneele	Fabaceae	Herb
89.	*Ipomoea biloba* L.		Convolulaceae	Climber
90.	*Jasminum auriculatum*, Vahl.	Udigai	Oleaceae	Shrub
91.	*Jatropha curcas* L.	Kattamanuku	Euphorbiaceae	Tree
92.	*Jatropha glandulifera* Roxb.	Aathalai	Euphorbiaceae	Shrub
93.	*Jatropha gossypifolia* L.	Kattamanakku	Euphorbiaceae	Shrub
94.	*Justicia micrantha*, Wallichex.C.B.Clarke.	-	Acanthaceae	Herb
95.	*Justicia simplex* D.Don.	Odivuatake	Acanthaceae	Herb
96.	*Justicia tranquebarensis* L.f.	Ponnakupoondu	Acanthaceae	Herb
97.	*Lantana camara* L.	Unnisedi	Verbenaceae	Shrub
98.	*Lawsonia innermis* L.	maruthani	Lythraceae	
99.	*Leucas aspera* wils Link.	Thumbai	Lamiaceae	Herb
100.	*Lippia nodiflora* (L)A,Rich.	Poduthalai	Verbenaceae	Prostrate herb
101.	*Ludwigia sps.*	Sevangasedi	Onagraceae	Herb
102.	*Mangifera indica* L.	Maamaram	Anacardiaceae	Tree
103.	*Martynia annua* L.	Thelkodukukai	Pediaceae	Herb
104.	*Melothria maderaspatana* Cogn.	Musumusukai	Cucurbitaceae	Climber
105.	*Merremia tridenta* Hallier f.	Muthiyarkoondal	Convolulaceae	Prostrate herb
106.	*Mimusops elengi*,L.	makelam	Sapotaceae	Tree
107.	*Mollugo cerviana* Ser.	Verrichatarasi	Molluginaceae	Herb
108.	*Mollugo nudicalis*, Lam.	Parpadagam	Molluginaceae	Herb
109.	*Mollugo pentaphylla* L.	-	Molluginaceae	Herb
110.	*Morinda tinctoria*, Roxb.	Nuna	Rubiaceae	Tree
111.	*Nerium indicum L.*	Arali	Apocynaceae	Shrub
112.	*Nerium odorum*, Sol.	Arali	Apocynaceae	Shrub
113.	*Ocimum basilicum*	Thirunetrupachilai	Lamiaceae	Sub shrub
114.	*Ocimum canum* (Sims)	Naithulasi	Lamiaceae	Herb
115.	*Ocimum sanctum* L.	Thulasi	Lamiaceae	Herb
116.	*Parthenium hysterophorous* L.	-	Asteraceae	Herb
117.	*Passiflora foetida* L.	Poonaibalam	Passifloraceae	Climber
118.	*Pavoni aodorata*, Willd.	Peramutti	Malvaceae	Herb
119.	*Pavonia zeylanica*, Cav.	Sidhamutti	Malvaceae	Herb
120.	*Pedalium murex*, L.	Aanaineruchil	Pedaliaceae	Herb
121.	*Peltophorum pterocarpum* Dc.	Eayalvagai	Caesalpiniaceae	Tree
122.	*Pergularia extensa* N.E.Br.	Veleparuthi	Asclepidaceae	Climber
123.	*Phyllanthus amarus* L.	Keelanelli	Euphorbiaceae	Herb
124.	*Phyllanthus leucopyrus*,W	venpoola	Euphorbiaceae	Herb
125.	*Phyllanthus maderaspatensis* L.	Maylanelli	Euphorbiaceae	Herb
126.	*Phyllanthus niruri*, L.	Keelanelli	Euphorbiaceae	Herb
127.	*Physalis minima* L.	Sodakuthakale	Solanaceae	Herb
128.	*Polygala arvensis* ,Willd.	-	Polygalaceae	
129.	*Polygala erioptera*, Dc.	-	Polygalaceae	Herb
130.	*Pongamia glabra* Vent.	pongamaram	Fabaceae	Tree
131.	*Portulaca wightiana*, wallich.ex.wight& Am.	-	Portulaceae	Herb
132.	*Prosopis cineraris*, L	Vannimaram	Mimosaceae	Tree
133.	*Prosopis juliflora* DC.	Vivasayamaram	Mimosaceae	Tree
134.	*Protuloca tubarosa*, Roxb.	-	Portulacaceae	P.Herb
135.	*Psidium guajava* L.	Koiya	Myrtaceae	Tree
136.	*Randia dumentoram*, Lam.	Kaarimul	Rubiaceae	Shrub
137.	*Randia malabaricum* ,Lam.	Kaarai	Rubiaceae	Shrub
138.	*Ricinus communis*, L.	Aamanaku	Euphorbiaceae	Shrub
139.	*Ruellia patula*, Jacq.	-	Acanthaceae	Herb
140.	*Ruellia tuberose*,L.	Kirainthinayagam	Acanthaceae	Herb
141.	*Santalum album*, L.	Santhanamaram	Santalaceae	Tree
142.	*Sarcostemma intermedium*, Dene.	Kodicalli	Asclepidaceae	Climber
143.	*Sida cordifolia* ,L.	Nilatuthi	Malvaceae	Herb
144.	*Sida rhombifolia* L.	Aathibala	Malvaceae	Herb
145.	*Stachytarpheta indica* Vahl.	seemainaiuruvi	Verbenaceae	Herb
146.	*Tabebuia rosea* (Bertol.)DC.	-	Bignoniaceae	Tree
147.	*Tamarindus indica* L.	Puliyamaram	caesalpiniaceae	Tree
148.	*Tecoma stans* (L.)Kunth.	Sornapatty	Bignoniaceae	Tree
149.	*Tecotona grandis* L.f.	Thekku	Verbenaceae	Tree
150.	*Tephrosia purpurea* L.	Kaatukolingji	Fabaceae	Sub shrub
151.	*Tinospora cordifolia* Miers.	Seenthilkodi	Menispermaceae	Climber
152.	*Tribulus terrestis* L.	-	Zygophyllaceae	Herb
153.	*Tridax procumbens* L.	Kinetturupasan	Asteraceae	Herb

154.	*Vitex negundo*L.	vennochchi	Verbenaceae	Tree
155.	*Waltheria indica* L.	Sengalipoondu	Sterculiaceae	Sub shrub
156.	*Wattakaka volubilis*, L.	Kodippalai	Asclepidaceae	Herb
157.	*Wrightia tinctoria* R.Br.	vetpalai	Apocynaceae	Tree
158.	*Xanthium indicum*,Roxb.	-	Asteraceae	
159.	*Ziziphuso enoplia*,Mill.	Nareelanthai	Rhamnaceae	Tree
160.	*Zizuphus trinervia* Roxb.	Sooraimul	Rhamnaceae	Tree

Table: 2 Types of fruits recorded in the study area.

S. No.	FRUIT TYPE	No. of TAXA
1.	Capsule	25
2.	Pod	20
3.	Drupe	9
4.	Mericarps	7
5.	Utricle	5
6.	Follicle	4
7.	Caryopsis	1
8.	Berry	2
9.	Achene	6
10.	Samara	1
11.	Nutlets	4
Total		84

Table: 3 Average seed weight of species based on families.

S. No.	FAMILY	No. OF. SPECIES	WEIGHT
1.	Fabaceae	11	0.005mg – 2.2mg
2.	Euphorbiaceae	6	0.008mg – 0.6mg
3.	Asteraceae	4	0.0003mg – 0.6
4.	Aizoaceae	2	0.3mg – 0.6mg
5.	Rubiaceae	1	0.03mg
6.	Apocynaceae	2	0.002mg – 0.006mg
7.	Passifloraceae	1	0.009mg
8.	Mimosaceae	2	0.03mg – 0.1mg
9.	Moraceae	2	0.1mg – 0.3mg
10.	Convolvulaceae	2	0.7mg – 9.6mg
11.	Bixaceae	1	0.06mg
12.	Amaranthaceae	5	0.001mg – 0.14mg
13.	Malvaceae	5	0.003mg – 7.1mg
14.	Acanthaceae	6	0.001mg – 10.6mg
15.	Asclepidaceae	4	0.007mg – 0.01mg
16.	Ulmaceae	1	0.01mg
17.	Santalaceae	1	0.3mg
18.	Cucurbitaceae	1	0.01mg
19.	Geraniaceae	1	0.2mg
20.	Sapindaceae	2	0.01mg – 0.03mg
21.	Solanaceae	3	0.01mg – 0.4mg
22.	Lamiaceae	4	0.4mg – 5.1mg
23.	Caesalpinaceae	3	0.01mg – 0.6mg
24.	Capparidaceae	1	0.8mg
25.	Poaceae	2	0.0007mg – 0.0009mg
26.	Verbenaceae	3	0.01mg – 0.6mg
27.	Onagrceae	1	0.0007mg
28.	Pedaliaceae	2	0.1mg – 1g
29.	Sapotaceae	1	0.3mg
30.	Rhamnaceae	1	0.05mg
31.	Lythraceae	1	0.001mg

Table: 4 Sculpturing pattern of the seeds.

S. No	Sculpturing pattern	No.of.Taxa
1.	Chagrenate	28
2.	Scabrate	11
3.	Reticulate	11
4.	Echinate	7
5.	Regulate	6
6.	Cicatricose	6
7.	Corrugate	5

8.	Baculate	5
9.	Striate	5
10.	Piliferous	3
11.	Granular exine	2
12.	Clavate	1

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