

## IDENTIFICATION OF WINGED FRUITS OF SOME WOODY SPECIES FROM NORTHERN WESTERN GHATS

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### ABSTRACT

Plant identification based on floral characteristics is being focused since the history of plant classification and though flowers are usually ephemeral, the fruits and seeds are most significant innovations in angiosperms and are persistent on the plant long after maturity. Till today carpological characters are rarely used in identification. In present study an attempt has been made for identification of winged fruits of some woody species from Northern Western Ghats. It aids identification of dispersed fruits in forest litter and can be used to identify undetermined extant herbarium specimens. The 28 taxa including 2 varieties belonging to 15 genera from 9 families (Ancistrocladaceae, Caesalpiniaceae, Combretaceae, Dipterocarpaceae, Fabaceae, Malphighiaceae, Rhamnaceae, Simarubaceae, Ulmaceae) are distinguished on the basis of symmetry, number of wings, attachment of seed, colour of wing, venation pattern etc. All these species can be divided into five aerodynamic groups on the basis of their morphology.

**Keywords:** Aerodynamic, Diaspore, Dispersal, Samara, Wings

### INTRODUCTION

Identifying plants on the basis of dispersed fruits from forest floor litter is critical. Scientists are interested in dispersal mechanism of plants since many years. Angiosperms produce fruits and seeds as dispersal organs.

Every plant develops its own strategy for dispersal. Most of the species are adapted to certain kind of dispersal mechanism. Among various adaptations winged diaspores is major morphological adaptation for wind dispersal.

Escape from predators, avoiding density-dependent mortality and finding suitable sites for germination are well documented advantages of effective seed dispersal (Clark *et al.*, 2004; Howe and Smallwood, 1982; van der Pijl, 1972).

The winged fruits known to occur in numerous genera belonging to at least 93 families (Dalwitz *et al.*, 2000).

The wing of wind dispersed fruits shows variation in their structure and the wings may be developed from various parts viz., seed coat, outgrowth of ovary, hypanthium, macrescent perianth etc. They may show persistence of accessory floral parts.

The increasing anthropogenic activities affected biotic dispersal and the plants tend towards abiotic dispersal mechanisms (Govindaraju, 1988).

Physical alterations to the habitat caused by logging and silvicultural measures are likely to affect seed dispersal (Khan *et al.*, 2005).

The abiotic seed dispersal mainly includes wind dispersal through winged structure associated with a diaspore.

Winged fruits have many characters which can be potentially useful in identification including size, shape, number of wings, wing venation, position and shape of wing, persistence of style, perianth, pedicel, and position of seed, seed number and ornamentation.

Augspurger (1986) divided winged fruits into five aerodynamic groups. The study illustrates wide array of morphological diversity in species with wind dispersed diaspores. The dispersal potential of the species influences gene flow, distribution and local abundance.

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It also affects local adaptations or speciation (Govindaraju, 1988; Barton and Hewitt, 1989; Harrison and Hastings, 1996).

The dispersal potential of the species may rule the dynamics and long term survival of metapopulations (Saunders *et al.*, 1991; Husband and Barrett, 1996; Poschland, 1996; Poschland *et al.*, 1996; Menges, 2000) and therefore, may become key to the survival (Opdam, 1990).

Morphological adaptations for wind dispersal cause a reduction in rate of descent of fruits and a consequent increase in chance of exposure to horizontal winds which can spread the fruit over a broad area (Green, 1980, 1983; Green and Johnson, 1986; Augspurger, 1986; Matlack, 1987; Wilson, 1993; Mori and Brown, 1994).

We have constructed a key to facilitate identification of species on the basis of the characteristics of mature winged fruit.

This key is applicable to winged fruits which are found in the field as well as preserved in herbarium specimens.

### MATERIALS AND METHODS

The collection of diaspore of 28 wind dispersed taxa were done during 2009 – 2012 from different localities in Northern Western Ghats. The diaspores were collected from the ground immediately beyond the canopy of the plant or manually picked out from the fruiting branches. They were air dried under shade.

Minimum 10 diaspores of each species were used to study different morphological characters. The nomenclature is as per TROPICOS (<http://www.tropicos.org>).

We have constructed a bracketed key to facilitate the identification of species on the basis of carpological characters.

Based upon the morphological characters each species was placed in one of the five aerodynamic categories.

### RESULTS AND DISCUSSION

Among studied 287 wind dispersed taxa 19 species exhibit samara type of fruit while nine species exhibit pod type of fruit. Among studied taxa symmetrical and asymmetrical diaspores are found in 13 and 15 species respectively.

The diaspores in which ovary wall or calyx is extended only on one side are treated as asymmetrical while those in which it is extended on both sides it is treated as symmetrical. In case of asymmetrical diaspores seed is distally located and number of wings ranges from 1 – 5.

In case of symmetrical diaspores seed is centrally located and only single wing is present which is developed from pericarp.

Among 28 taxa six taxa have fin winged fruits *i.e.* having two or more wings along a longitudinal axis which are categorised as tumbler by Augspurger (1986).

The study further documents the wide range of morphological adaptations. The studied taxa are divided into five aerodynamic groups (Table 1). The most common morphological group is autogyros represented by ten species.

A bracketed key is presented for 28 taxa on the basis of morphological characters. The major characteristics of fruits of the species are given in Table 1.

#### Key to the Species

|   |    |
|---|----|
| 1a. Seed in the centre of fruit .....       | 2  |
| 1b. Seed at distal end.....                 | 13 |
| 2a. Fruit fin winged .....                  | 3  |
| 2b. Fruit other than fin winged.....        | 8  |
| 3a. Fruit dehiscent by vertical ridge ..... | 4  |

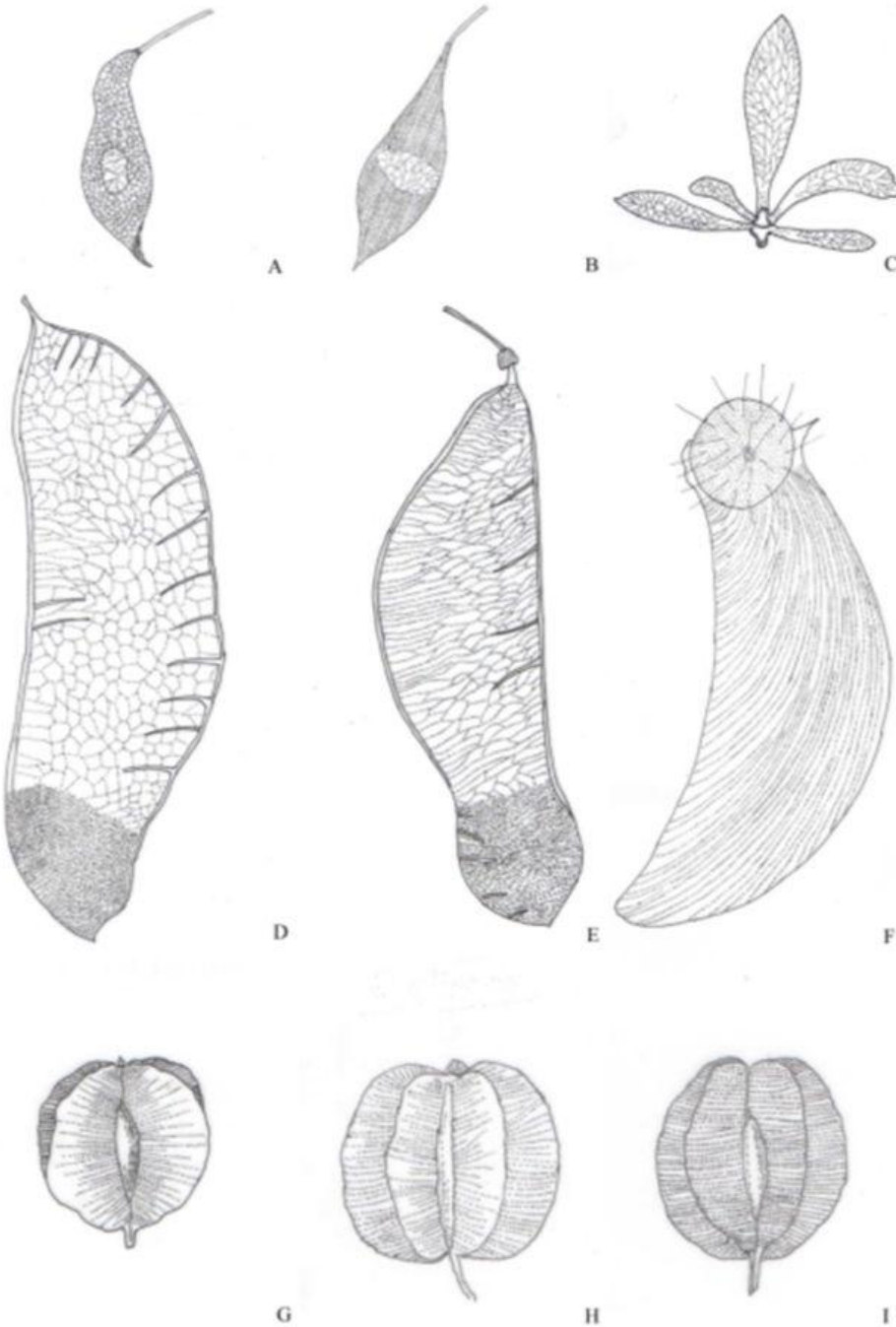
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|   |  |
|---|--|
| 3b. Fruit indehiscent .....                                   | 6  |
| 4a. Fruit 5-winged.....                                       | <i>Combretum album</i>                                 |
| 4b. Fruit 4-winged.....                                       | 5  |
| 5a. Fruit up to 3 cm, pale green-golden brown.....            | <i>Combretum albidum</i>                               |
| 5b. Fruit more than 3 cm, purple.....                         | <i>Combretum latifolium</i>                            |
| 6a. Fruit 3-winged, red .....                                 | <i>Terminalia paniculata</i>                           |
| 6b. Fruit 4-5 winged .....                                    | 7  |
| 7a. Wings with horizontal nerves.....                         | <i>Terminalia elliptica</i>                            |
| 7b. Wings with upward nerves .....                            | <i>Terminalia cuneata</i>                              |
| 8a. Fruit orbicular .....                                     | 9  |
| 8b. Fruit oblong-linear.....                                  | 12   |
| 9a. Fruit with bicuspidate style.....                         | <i>Holoptelea integrifolia</i>                         |
| 9b. Fruit without style .....                                 | 10   |
| 10a. Fruit convex at distal end.....                          | <i>Pterocarpus santalinus</i>                          |
| 10b. Fruit concave at distal end .....                        | 11   |
| 11a. Fruit with pointed raphe.....                            | <i>Pterocarpus dalbergioides</i>                       |
| 11b. Fruit without raphe.....                                 | <i>Pterocarpus marsupium</i>                           |
| 12a. Fruit twisted at base.....                               | <i>Ailanthus excelsa</i>                               |
| 12b. Fruit flattened.....                                     | <i>Ailanthus triphysa</i>                              |
| 13a. Fruit strap shaped .....                                 | 14   |
| 13b. Fruit not strap shaped .....                             | 23   |
| 14a. Fruit echinate.....                                      | <i>Centrolobium parens</i>                             |
| 14b. Fruit not echinate.....                                  | 15   |
| 15a. Fruit with persistent style.....                         | 16   |
| 15b. Fruit without persistent style .....                     | 19   |
| 16a. Fruiting calyx covering more than half of the nut .....  | <i>Ventilago denticulata</i>                           |
| 16b. Fruiting calyx adnate only at the base .....             | 17   |
| 17a. Wings acute at apex .....                                | <i>Ventilago gamblei</i>                               |
| 17b. Wings obtuse at apex .....                               | 18   |
| 18a. Midrib terminated by remnant of bifid style at apex..... | <i>Ventilago madraspatana</i> var. <i>fructifida</i>   |
| 18b. Midrib not as above.....                                 | <i>Ventilago madraspatana</i> var. <i>madraspatana</i> |
| 19a. Fruit parallel veined.....                               | <i>Hardwickia binata</i>                               |
| 19b. Fruit reticulately veined .....                          | 20   |
| 20a. Fruit brick coloured .....                               | 21   |
| 20b. Fruit pale brown coloured.....                           | 22   |
| 21a. Fruit rubigenously tomentose, stalked.....               | <i>Spatholobus parviflorus</i>                         |
| 21b. Fruit glabrous, sessile.....                             | <i>Spatholobus purpureus</i>                           |
| 22a. Pod rounded at base, seed pale orange.....               | <i>Butea monosperma</i>                                |
| 22b. Pod much narrowed at base, seed brown.....               | <i>Butea superba</i>                                   |
| 23a. Fruit 3 winged.....                                      | <i>Hiptage benghalensis</i>                            |
| 23b. Fruit more than 3 winged .....                           | 24   |
| 24a. Seed with coiled endosperm.....                          | <i>Ancistrocladus heyneanus</i>                        |
| 24b. Seed not as above .....                                  | 25   |
| 25a. Fruits with two enlarge calyx lobes.....                 | 26   |
| 25b. Fruits with five enlarge calyx lobes.....                | <i>Shorea robusta</i>                                  |
| 26a. Wing margin crenate.....                                 | <i>Dipeterocarpus indicus</i>                          |

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26b. Wing margin entire.....27  
 27a. Veins much branched .....*Hopea parviflora*  
 27b. Veins not branched .....*Hopea ponga*

Plate I



A. *Ailanthus excelsa* B. *A. triphysa* C. *Ancistrocladus heyneanus* D. *Butea monosperma* E. *B. superba*  
 F. *Centrolobium parensense* G. *Combretum albidum* H. *C. album* I. *C. latifolium*

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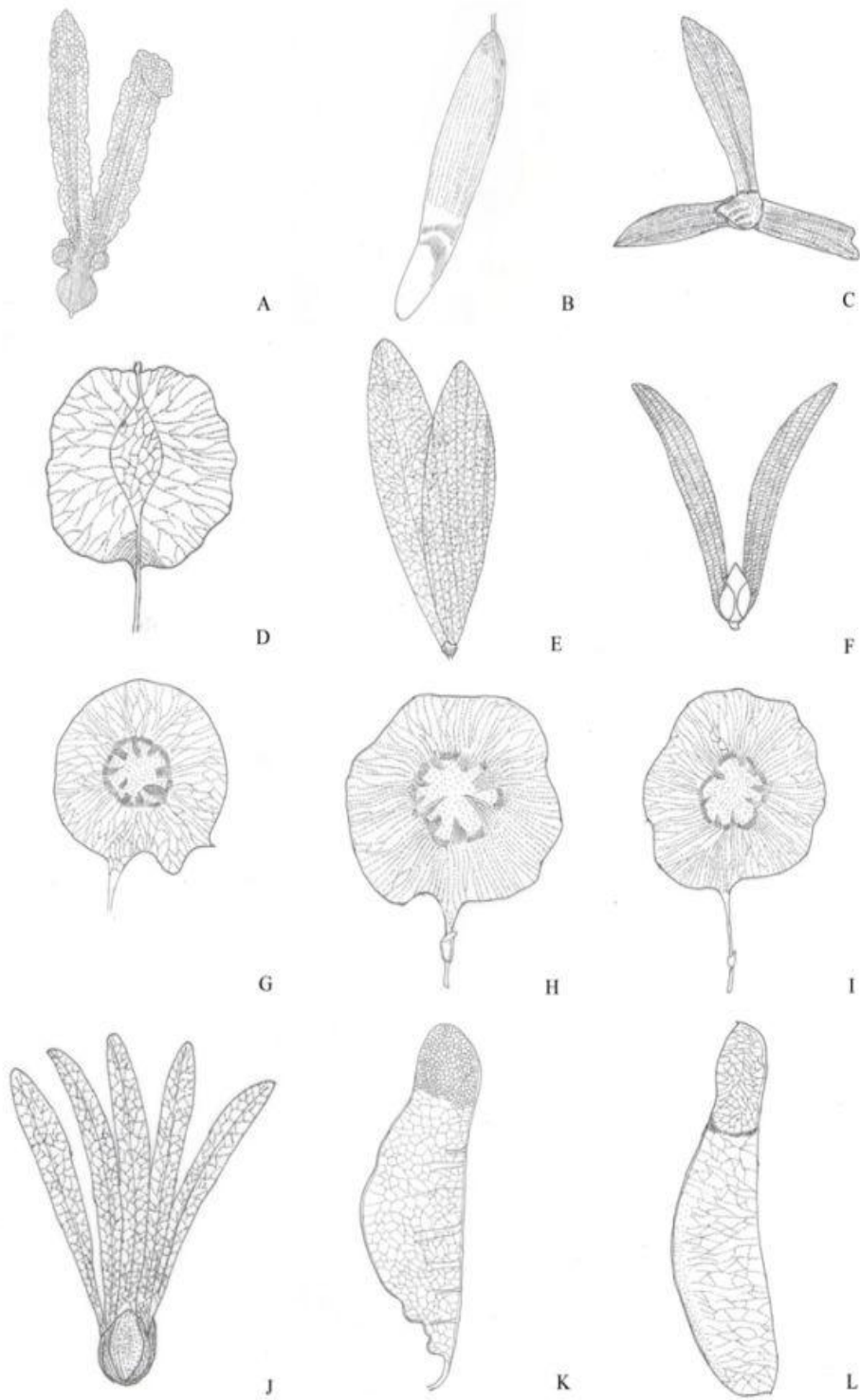
**Table 1: Major Fruit Characteristics of Selected Woody Species from Northern Western Ghats**

| Sr. No. | Name of Taxa                                       | Family             | Symmetry/Asymmetry | Seed | No. of Wings | Wing Venation | Style | Origin of Wing | Aerodynamic Group |
|---------|--|--------------------|--------------------|------|--------------|---------------|-------|----------------|-------------------|
| 1.      | <i>Ailanthus excelsa</i> Roxb.                     | Simarubaceae       | S                  | C    | 1            | R             | –     | Pc             | Rolling autogyros |
| 2.      | <i>Ailanthus triphysa</i> (Dennst.) Alston         | Simarubaceae       | S                  | C    | 1            | P             | –     | Pc             | Rolling autogyros |
| 3.      | <i>Ancistrocladus heyneanus</i> Wall. ex J. Graham | Ancistroclad-aceae | S                  | C    | 5            | R             | √     | Pc             | Helicopters       |
| 4.      | <i>Butea monosperma</i> (Lam.) Taub.               | Fabaceae           | As                 | D    | 1            | R             | –     | Pc             | Autogyros         |
| 5.      | <i>Butea superba</i> Roxb.                         | Fabaceae           | As                 | D    | 1            | R             | –     | Pc             | Autogyros         |
| 6.      | <i>Centrolobium paraense</i> Tul.                  | Fabaceae           | As                 | D    | 1            | P             | –     | Pc             | Autogyros         |
| 7.      | <i>Combretum albidum</i> G. Don                    | Combretaceae       | S                  | C    | 5            | P             | –     | Pc             | Tumblers          |
| 8.      | <i>Combretum album</i> De Wild.                    | Combretaceae       | S                  | C    | 4            | P             | –     | Pc             | Tumblers          |
| 9.      | <i>Combretum latifolium</i> Blume                  | Combretaceae       | S                  | C    | 5            | P             | –     | Pc             | Tumblers          |
| 10.     | <i>Dipterocarpus indicus</i> Bedd.                 | Dipterocarpaceae   | As                 | D    | 2            | R             | √     | Cy             | Helicopters       |
| 11.     | <i>Hardwickia binata</i> Roxb.                     | Fabaceae           | As                 | D    | 1            | P             | –     | Pc             | Autogyros         |
| 12.     | <i>Hiptage benghalensis</i> (L.) Kurz              | Malpighiaceae      | As                 | C    | 3            | P             | –     | Cy             | Helicopters       |
| 13.     | <i>Holoptelea integrifolia</i> Planch.             | Ulmaceae           | S                  | D    | 1            | R             | √     | Pc             | Undulators        |
| 14.     | <i>Hopea parviflora</i>                            | Dipterocarpaceae   | As                 | D    | 2            | R             | –     | Cy             | Helicopters       |

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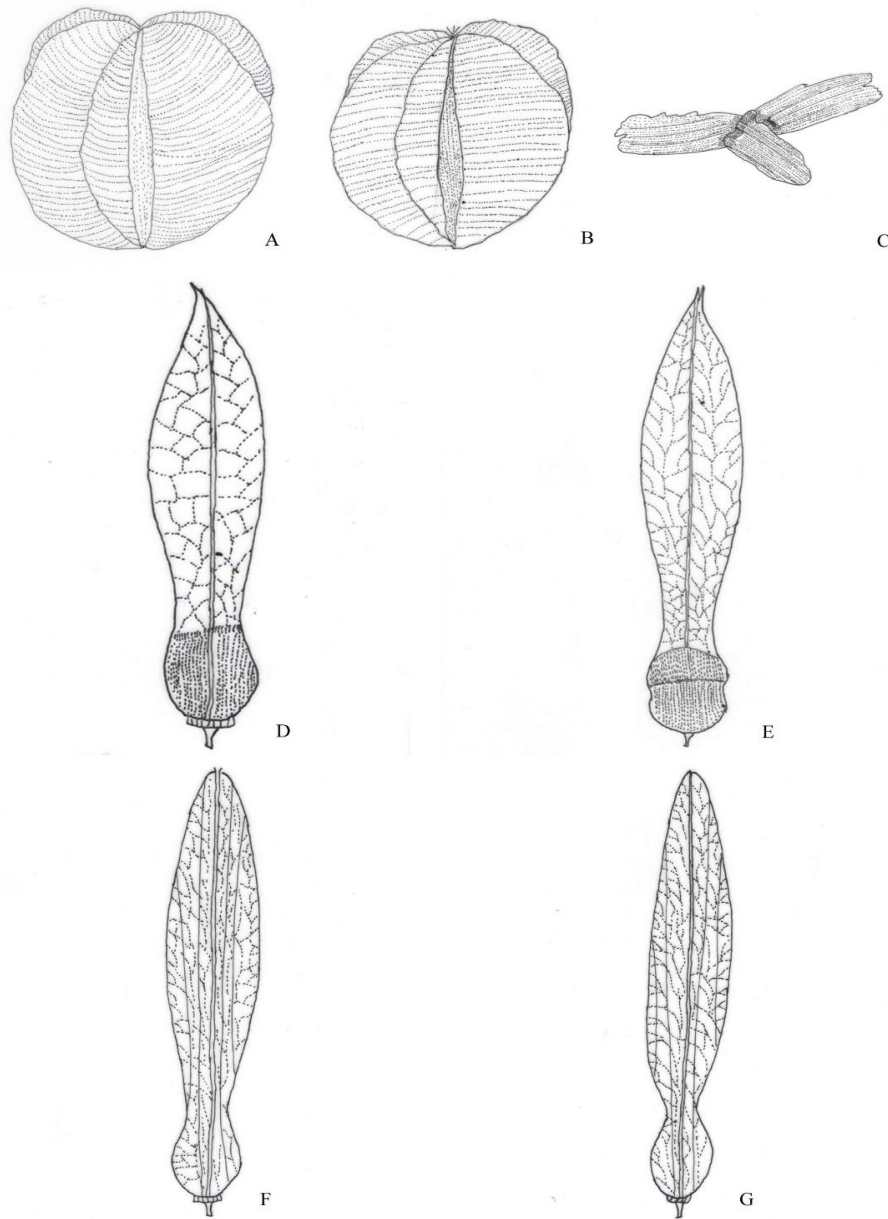
|     |  |                  |    |   |   |   |   |    |             |
|-----|--|------------------|----|---|---|---|---|----|-------------|
| 15. | Bedd.<br><i>Hopea ponga</i><br>(Dennst.) Mabb.                       | Dipterocarpaceae | As | D | 2 | P | – | Cy | Helicopters |
| 16. | <i>Pterocarpus dalbergioides</i> Roxb.                               | Fabaceae         | S  | C | 1 | R | – | Pc | Undulators  |
| 17. | <i>Pterocarpus marsupium</i> Roxb.                                   | Fabaceae         | S  | C | 1 | R | – | Pc | Undulators  |
| 18. | <i>Pterocarpus santalinus</i> L. f.                                  | Fabaceae         | S  | C | 1 | R | – | Pc | Undulators  |
| 19. | <i>Shorea robusta</i><br>Gaertn.                                     | Dipterocarpaceae | As | D | 2 | R | – | Cy | Helicopters |
| 20. | <i>Spatholobus parviflorus</i> (Roxb.)<br>Kuntze                     | Fabaceae         | As | D | 1 | R | – | Pc | Autogyros   |
| 21. | <i>Spatholobus purpureus</i> Benth. ex<br>Baker f.                   | Fabaceae         | As | D | 1 | R | – | Pc | Autogyros   |
| 22. | <i>Terminalia cuneata</i><br>Roth                                    | Combretaceae     | S  | C | 5 | P | – | Pc | Tumblers    |
| 23. | <i>Terminalia elliptica</i><br>Willd.                                | Combretaceae     | S  | C | 5 | P | – | Pc | Tumblers    |
| 24. | <i>Terminalia paniculata</i> Roth                                    | Combretaceae     | S  | C | 3 | P | – | Pc | Tumblers    |
| 25. | <i>Ventilago denticulata</i> Willd.                                  | Rhamnaceae       | As | D | 1 | R | √ | Pc | Autogyros   |
| 26. | <i>Ventilago gamblei</i><br>Suess.                                   | Rhamnaceae       | As | D | 1 | R | √ | Pc | Autogyros   |
| 27. | <i>Ventilago madraspatana</i> var.<br><i>fructifida</i> Santapau     | Rhamnaceae       | As | D | 1 | R | √ | Pc | Autogyros   |
| 28. | <i>Ventilago madraspatana</i><br>Gaertn. var.<br><i>madraspatana</i> | Rhamnaceae       | As | D | 1 | R | – | Pc | Autogyros   |

Plate II



A. *Dipterocarpus indicus* B. *Hardwickia binata* C. *Hiptage benghalensis* D. *Holoptelea integrifolia* E. *Hopea parviflora* F. *H. ponga* G. *Pterocarpus dalbergioides* H. *P. marsupium* I. *P. santalinus* J. *Shorea robusta* K. *Spatholobus parviflorus* L. *S. purpureus*

Plate III



A. *Terminalia cuneata* B. *T. elliptica* C. *T. paniculata* D. *Ventilago denticulata* E. *V. gamblei* F. *V. madraspatana* var. *fructifida* G. *V. madraspatana* var. *madraspatana*

### Conclusion

In majority of the spermatophytes generative form of reproduction is most important. In most of the species in adverse climatic conditions seed is the only form in which the organism exists for several months during unfavorable season. Hence, the seed is very important part on the plant principally forming the link between successive generations. Seeds and fruits exhibit tremendous diversity and most of them have diagnostic values. In spite of their diversity, abundance and importance in identification, they are neglected by botanists. The present investigation will help botanists as well as non-botanists for identification of winged fruits in the field. It will be helpful to forest officials also.



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### ACKNOWLEDGEMENT

The authors are thankful to Head, Department of Botany, Shivaji University, Kolhapur for laboratory facilities and Ministry of Environment and Forests, Government of India, New Delhi for financial support.

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