



The
**Flowering Plants
Handbook**

A practical guide to families
and genera of the world

James W. Byng

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From the war of nature, from famine and death, the most exalted object which we are capable of conceiving, namely, the production of the higher animals, directly follows. There is grandeur in this view of life, with its several powers, having been originally breathed into a few forms or into one; and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved.

Charles Darwin *On The Origin of Species* (1859)

The Flowering Plants Handbook

A practical guide to families and genera of the world

James W. Byng

eBook version

DEDICATION

This work is a dwarf standing on the shoulders of giants and is dedicated to the many botanists, both past and present, for the huge body of knowledge that exists today. Particular reference is made to the vision and works of the Angiosperm Phylogeny Group members (Kåre and Birgitta Bremer, Mark Chase, Mike Fay, James Reveal, Doug and Pam Soltis and Peter Stevens); the inspirational morphological works by Al Gentry, John Hutchinson, Armen Takhtajan, Cornelis Gysbert Gerrit Jan van Steenis and Dick Brummitt; and finally the great collectors whose many herbarium specimens I viewed at Kew, notably Terry Pennington, Ghilleen Prance, Martin Cheek, Mark Coode and John Dransfield, whose fieldwork makes everything else possible.

PREFACE

This book was a complete accident and grew to become far more comprehensive than I ever intended. It came about due to my desire to understand more about the plant diversity of the world, particularly during fieldwork for my PhD and several surveys in Zambia. Another reason for compiling such a book is there are no really *practical* field guides or handbooks on the market to both families and genera which are comprehensive, not to mention comprehensive for teaching and learning. Notable exceptions are the *Generic Tree Flora of Madagascar* (Schatz, 2001) and *A Field Guide to the Families and Genera of Woody Plants of Northwest South America* (Gentry, 1993) but both are geographically restricted and slightly out-of-date. I persevered adding and tidying notes I generated teaching botany at the University of Aberdeen over several summers and this work is the result of many days teaching both specialists and non-specialists how to identify plants, much of which I was teaching myself as I was going along. This is the first edition and comments are appreciated to improve future versions.

Identifying plants is extremely important and probably understated at universities these days. Botany and plant taxonomy is very much thought of as being done in the past and cells and biotechnology is what we should be doing now. But plant names and understanding their classification is still of profound importance because taxonomy is the baseline data for all science. Once you have a name of a species all the information associated with it (i.e. its uses, its distribution, its conservation status and threats) becomes accessible. The classification system acts as a retrieval system for identification. However, recent changes following molecular work mean that it is often confusing for many users what the classification system (particularly at the generic level) actually looks like and how to identify plants to it because the characters needed are scattered across hundreds of papers, books and websites.

In addition, names are constantly changing as new information comes to light and hundreds of new species are described each year. We still know we know so little about most of the worlds species and what is particularly alarming is that many species severely threatened with extinction due to deforestation and other anthropogenic activities. There is a strong possibility that many plant species will disappear before we have even had a chance to find out the most basic thing about them so identifying plants correctly is a necessity rather than a luxury.

This book aims to make possible the identification to genus and family of all flowering plants of the world or at least guide the user from everything with a flower and (usually) green to fewer potential groups. At the family level, this means following the currently accepted Angiosperm Phylogeny (APG) III classification (strictly) which is now widely accepted. At the generic level, I have attempted to synthesise currently accepted names from the literature, often taking into account future changes. No new combinations nor attempts to reclassify any families are made in this first edition. It is solely a synthesis of the literature. There is no similar single-body of knowledge on the worlds flora available on the web or in the bookshops which is practical, aimed at both specialists and non-specialists, mobile, easy to use, comprehensive, up-to-date, illustrated and with global coverage.

I must state that work of this kind is often difficult to compile due to existing errors in published literature, the large quantity of existing literature, sometimes differing opinions on the taxonomy (so called 'lumping' and 'splitting') and finally the simple fact that there are so many missing gaps in our body of knowledge. Also, it must be stated that the preparation and publication of this work has not received any grants or financial aid from any institution or grant giving body for its compilation but I raised funds for it through my own extra-curricular plant identification courses run in various botanical gardens in the UK, consultancy work and pre-sales of the book through Plant Gateway Ltd. I must thank in particular individuals who ordered pre-order books for showing faith in the work, as well as numerous institutions who purchased copies for their libraries.

This book will be annually updated and this first version contains descriptions to all currently accepted families and so far morphological notes for 6656 genera (complete for 398/413 families). I am still not

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happy with several family treatments and generic synopses and these will be improved and added to in future editions. The second version is anticipated to include a further completed nine families (Acanthaceae, Amaranthaceae, Apocynaceae, Aracaceae, Brassicaceae, Euphorbiaceae, Lamiaceae, Malvaceae and Melastomataceae), improving and correcting the current content and adding exciting new technological features. I would like this first edition to encourage an open, collaborative process where feedback and discussion shape future editions.

The hundreds of plant names and confusing botanical terminology are often seen as factors that put people off from identifying plants or at least from looking at them and the subject more closely. But it's not about how many names you can remember, its just knowing where to look for that information. This book attempts to use simple plain English where possible and if technical terms are unavoidable they are included in the glossary at the back. I have avoided using too many keys (and abbreviations) as these are not always popular but I have included some to provide enough structure to allow identification (and back track during identification where needed), as well as, to help learn about the classification system at the same time.

By making things simple the intention is to encourage more non-specialists to start looking and identifying plants without undermining their opportunity to develop advanced knowledge. This is because I firmly believe that by enabling others to understand the diversity that exists can ultimately help reduce its decline. I hope this is the beginning of my contribution.

Happy botanising!

James W. Byng BSc (Hons) MSc PhD (j.byng@plantgateway.com)

London, October 2014

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INTRODUCTION

For over 250 years flowering plants were arranged in various classification systems according to their morphology and biochemistry. Botanists and biologists from around the world supported and used different systems (e.g. de Candolle, Lindley, Bentham & Hooker, Engler, Hutchinson, Takhtajan, Cronquist, Dahlgren) which caused some confusion and even more debate. In the last twenty years the classification of plants has changed dramatically with the accumulation of molecular data that is unravelling the true evolutionary relationships of plants.

Plants have adapted over millions of years to different pollination syndromes and/or challenging environments (e.g. arid, saline) and this has resulted in some divergence of closely related groups and convergence of distantly related ones. A classification system based on evolutionary relationships has been the aim since Darwin and using DNA sequences reflects genealogy far more accurately than morphological characters alone.

The Angiosperm Phylogeny Group (APG) classification is a modern, mostly molecular-based system and is now widely accepted. The first version was published in 1998, this was superseded in 2003 by the APG II system and the current APG III system was published in 2009. In the APG era this work is the first and only to comprehensively compile practical morphological characters of all APG III families and their genera in the world based on the current literature for identification.

Descriptions and generic notes

The flowering plant families are numerically arranged following the *Linear Angiosperm Phylogeny Group (LAPG) III* (Haston *et al.*, 2009). The generic synopsis of each family is arranged alphabetically, and if there are many genera grouped, then also taxonomically (by subfamilies or tribes), geographically (by continent or region) and/or morphologically. The formal family descriptions contain important characters which are usually easily comparable with each other and useful diagnostic characters are underlined. Morphological synapomorphies, as well as, general characters to help compare similar genera are attempted for each genus listed. All characters used can be seen by the naked eye or with a hand lens, though looking at placentation and ovule number can sometimes be challenging.

Floral formulas

These formulas aid identification and can be useful for noting the number of parts to each whorl. There are several ways of doing floral formulas with a very general one used in this work to allow its use by many users. The formulas consist of four primary symbols (plus some additional secondary symbols) which go from left to right:

<u>Primary:</u>	K	number of sepals - with 'K' representing "calyx". K5 = calyx of 5 sepals.
	C	number of petals - with 'C' representing "corolla". C5 = corolla of 5 petals.
	A	number of stamens - with 'A' representing "androecium".
	G	number of carpels - with 'G' representing "gynoecium". <u>G</u> indicates a superior and \hat{G} an inferior ovary.
<u>Secondary:</u>	(....)	brackets are used here to indicate less often numerical values NOT fusion
	4–5	dashes between numbers are used here to show variation in each whorl
	P	the perianth (i.e. calyx and corolla) and is used when the two whorls are indistinguishable from each other
	+	symbol is used to indicate differentiation within each whorl. For example, two large petals and three small petals would be: C2+3
	°	symbol is used for sterile stamens (= staminodes) or carpels (= pistillodes)

Synonymy

Some families and genera have now been incorporated into other families and/or genera. A comprehensive list of family synonyms is provided based primarily on the paper by Reveal & Chase (2011). Recent or relevant generic synonymy, based on current literature, are included in each of the family treatments except for where extensive changes have taken place and appropriate websites are cited for further information.

Literature

The literature consulted for each family is given at the end of each treatment. General taxonomic works by Stevens (2001-), Mabberley (2008) and Takhtajan (2009) were consulted for all or most family treatments and are not cited for each treatment to avoid repetition but as sources of information they are giants and essential reference works. The 15 largest families are briefly treated in this first version so the literature cited is therefore often minimal.

Images/illustrations

Images and illustrations of families and genera are included to aid identification. Some images are of high quality and some of poorer quality. In the latter case this is often due to the scarcity of images for some rare groups and it is hoped better quality useable images will become available for future versions. Illustrations/images of technical terms and/or 'spot' characters specific to certain families are also included for around a fifth of all families in grey boxes. Herbarium specimens at RBG Kew and RBG Edinburgh are shown where images of living plants were not available. The copyright of all images or illustrations in this work belong to the author unless otherwise stated. Images obtained from wikimedia commons are sometimes in the public domain (and variously noted with PD) or have the following licenses associated with each image:

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Glossary

Where possible botanical terminology is kept to a minimum and a basic glossary is included at the back of the book for any terms used, as well as, common terms which are frequently used in other botanical literature. Also, illustrations of essential and often complex terms are included to aid the non-specialist. For a more comprehensive botanical glossary see *The Kew Plant Glossary* (Beentje, 2010).

Geographical notes

Continental and country levels have generally been favoured in this work with provincial, state or regional (if applicable) data in square brackets or vice versa. Maps with botanically interesting islands and/or island groups are provided in the [Geographical Maps](#) section along with maps of the tropical and subtropical regions. A standard atlas should help with most distributions but the following geographical terms are often used and described below to aid the reader:

Hispaniola – island in the Caribbean comprised of Haiti and the Dominican Republic.

Macaronesia – several island groups off the coast of Africa and Europe: Canary Islands [Spain], the Azores and Madeira [Portugal] and Cape Verde Islands. See MAP D.

Malesia – region of southeast Asia comprised of Malaysia, Indonesia, Brunei, the Philippines and Papua New Guinea. See MAP C.

Mascarenes – group of islands in the Indian Ocean comprised of La Réunion [France], Mauritius and Rodrigues [Mauritius]. See MAP D.

Melanesia – region of Australasia comprised of Papua New Guinea, Irian Jaya [Indonesia], Solomon Islands, Vanuatu, Fiji and New Caledonia [France]. See MAP D.

Micronesia – region of Australasia comprised of the Federated States of Micronesia, Kiribati, Marshall Islands, Nauru, Palau, Northern Mariana Islands [USA], and Guam [USA].

Neotropics – tropical America (i.e. tropical areas of North, Central and South America).

New World – the continents of North America and South America combined.

Old World – the continents of Europe, Asia, Africa and [in this work] Australasia.

Old World tropics – tropical regions of the Old World.

Pantropical – across tropical regions (i.e. in both the Neotropics and Old World tropics).

Polynesia – triangular region of Australasia from Hawaii [USA] to New Zealand and Rapa Nui [Chile].

Subtropics – region of the earth from the Tropics of Cancer/Capricorn to around the 38th parallel. See MAP B.

Tropics – region of the Earth around the equator from the Tropic of Cancer to the Tropic of Capricorn. See MAP A.

Abbreviations and symbols

Few abbreviations are included in the text to make it easier for the user to read. Apart from abbreviations associated with floral formulas, the following abbreviations and symbols are used:

ca. – about/roughly

cm – centimetre

e.g. – for example

i.e. – meaning that is

incl. – including

ined. – unpublished

m – metre

mm – millimetre

mt – mountain/mount

p.p. – *pro parte* (partly)

sect. – section

s.l. – *sensu lato* (broad sense)

s.n. – *sin nombre* (or name missing)

sp. – species (singular)

spp. – species (plural)

s.s. – *sensu stricto* (narrow sense)

subg. – subgenus

subsp. – subspecies

UK – United Kingdom

USA – United States of America

var. – variety

≤ – less than or equal to

≥ – greater than or equal to

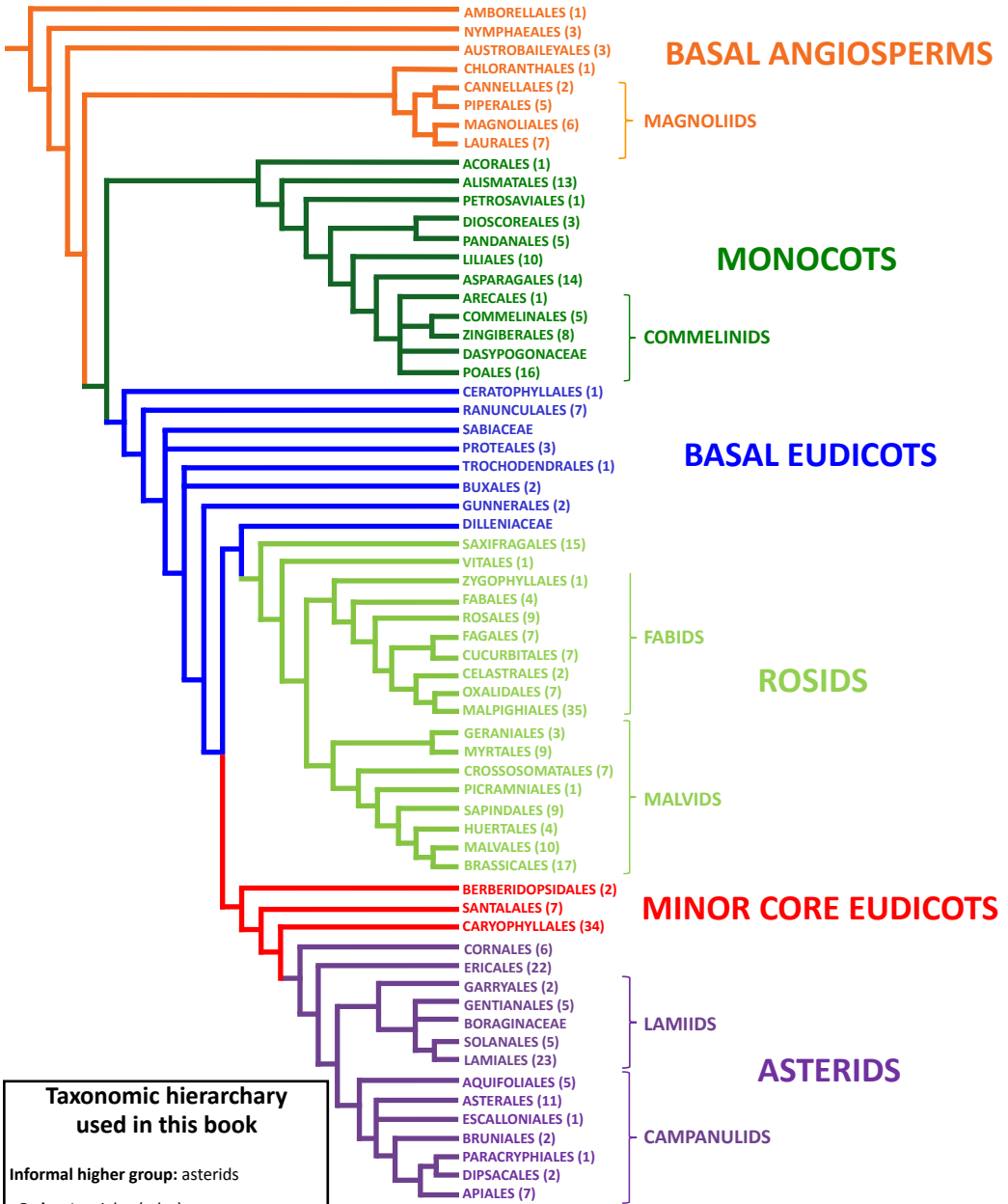
< – less than

> – greater than

± – more or less

Classification of Flowering Plants

Phylogenetic tree showing relationships of accepted orders and unplaced families of flowering plants divided into the six informal higher groups used in this work. Major clades are also highlighted for reference but not discussed further.



Taxonomic hierarchy used in this book

Informal higher group: asterids

Order: Lamiales (-ales)

Family: Gesneriaceae (-aceae)

Subfamily: Didymocarpoideae (-oideae)

Tribe: Trichosporeae (-eae)

Subtribe: Jerdoniinae (-inae)

Genus: *Jerdonia*

Species: *indica*

Traditional family names still accepted

Compositae (= Asteraceae)

Cruciferae (= Brassicaceae)

Gramineae (= Poaceae)

Guttiferae (= Clusiaceae)

Labiatae (= Lamiaceae)

Leguminosae (= Fabaceae)

Palmae (= Arecaceae)

Umbelliferae (= Apiaceae)

Family names end in “-aceae”. However, some of the largest families were traditionally known by previous names and these names are still widely used. It was agreed amongst botanists to keep these names in use, alongside more modern names following the standard “-aceae” ending.

KEY TO MAJOR PLANT GROUPS

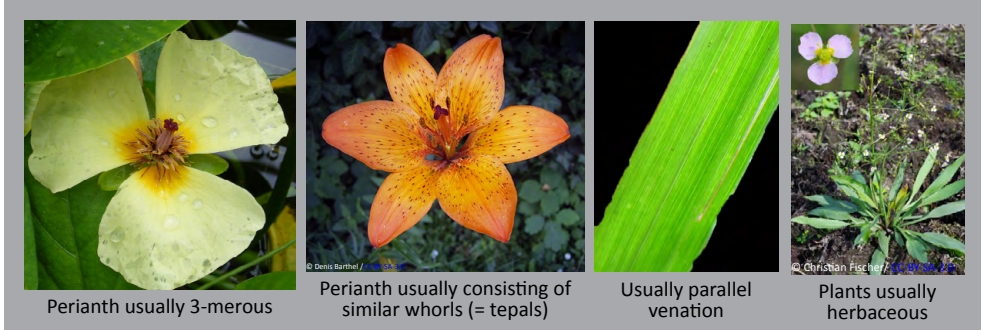
Flowers are needed for flowering plant identification though when there are only fruits present it is still possible but becomes more difficult. In most cases a combination of vegetative and reproductive parts are needed and in some cases a combination of both floral and fruit characters. Plants without a perianth (i.e. both sepals and petals absent) and parasitic plants have evolved several times and are scattered across the following six higher groups. For these plants it is best to try and identify by a process of elimination from the [list of families with diagnostic characters](#) pages.

BASAL ANGIOSPERMS

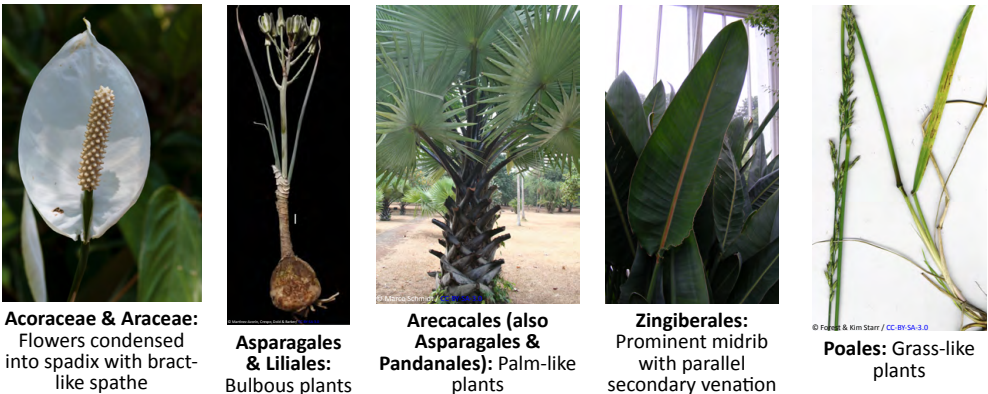
earliest lineages



MONOCOTS



NOTABLE GROUPS IN THE MONOCOTS



AUSTROBAILEYALES

Notes: Plants in the order have a woody habit, superior ovaries, often a many parted and spiralling perianth, many stamens and carpels free or 1. In addition, Schisandraceae have alternate, often gland-dotted and aromatic leaves; Trimeniaceae have opposite, often gland-dotted and aromatic leaves, flowers aggregated and not solitary and staminodes absent; and Austrobaileyaaceae are woody climbers endemic to Australia with opposite leaves and flowers with a rotting-fish smell.

- 1. Leaves opposite.....2
- 1. Leaves alternate..... **7. Schisandraceae**
- 2. Flowers about 5–6 cm in diameter..... **5. Austrobaileyaaceae**
- 2. Flowers less than 1 cm in diameter..... **6. Trimeniaceae**

5. AUSTROBAILEYACEAE

Woody climbers, up to 15 m tall. **Leaves** simple, opposite (rarely sub-opposite); margins entire; petioles present; stipules present? deciduous and small or absent. **Inflorescences** axillary or rarely terminal solitary flowers or 2–3 aggregated; bracteate. **Flowers** 5–6 cm in diameter, bisexual, actinomorphic; bracteolate. **Perianth** tepal-like, imbricate; outer whorl often sepaloid; inner whorl often petaloid, greenish-yellow, sometimes with brown to purple spots. **Stamens** greenish and purple-blotched at the apex; anthers introrse; staminodes smaller than stamens, ±warty purple-spots. **Ovary** superior; carpels free; locules (4–)6–9(–14); ovules several per locule; placentation marginal; stigma 2-lobed. **Fruit** berry-like and orange.



Austrobaileya scandens

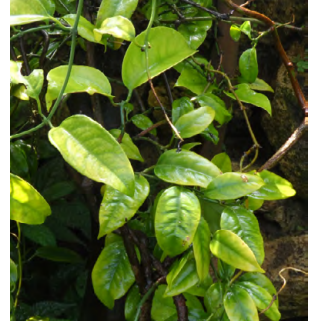
Genus 1/species 2; *Austrobaileya*.

Distribution: Australia [tropical Queensland, Atherton Tableland].

Floral formula: P(9–)12–23(–many) A6–11+6*–16* G(4–)6–9(–14)

Notes: The flowers are fly pollinated and have an odour like rotting fish and the gland-like warts on the stamens and staminodes are thought to produce this unpleasant smell.

Literature: Bailey & Swamy 1949; Endress 1980b, 1993a, 2001.



Habit of *Austrobaileya scandens*

Species synopsis

- *A. maculata* (stamens and staminodes have conspicuous embossed brown to purple spots).
- *A. scandens* (stamen and staminodes lack spots; only found in Daintree Rainforest).

6. TRIMENIACEAE

Trees, shrubs or woody climbers, up to 25 m tall. **Leaves** often gland-dotted, sometimes aromatic, simple, opposite; leaf apex acute to acuminate; margins entire to toothed; petioles present; stipules absent; hairs reddish, woolly or absent. **Inflorescences** cymes, racemes or panicles. **Flowers** ca. 5–7 mm in diameter, bisexual or unisexual, actinomorphic. **Perianth** spirally arranged tepals, imbricate, merging into bracteoles, deciduous; white to cream. **Stamens** many, ca. 4 mm long, spirally arranged; anthers basifixed. **Ovary** superior; carpel 1, rarely 2, reduced to absent in male flowers; locule 1; ovule 1; placentation apical; style absent. **Fruit** a drupe or berry, red to purple or black when mature.

Genus 1/species 8; *Trimenia*.

Distribution: Scattered from Malesia to Pacific Islands and eastern Australia.

Floral formula: P2–many A6–many G1(–2)

Confused with: Austrobaileyaaceae – carpels 3–8; flowers ca. 3–5 mm in diameter.

Notes: The generic name *Piptocalyx* is synonymous with *Trimenia*.

Literature: Endress 2001; Endress & Sampson 1983; Philipson 1986, 1987a, 1993d; Qui *et al.* 1999; Rodenburg 1971; Wagner & Lorence 1999; Whiffin 2007.

Species synopsis

- *T. bougainvilleensis* (Solomon Islands).
- *T. neocaledonica* (leaves obovate; New Caledonia).
- *T. nukuhivensis* (Marquesas Island [Nuku Hiva]).
- *T. macrura* (woody climbers, tepals ≤ 10 ; New Guinea).
- *T. marquesensis* (Marquesas Islands [Hiva Oa and Tahuata]).
- *T. moorei* (woody climbers; tepals < 11 ; northeast New South Wales to southern Queensland [Australia]).
- *T. papuana* (plants polygamous, stamen filaments long and thin; Sulawesi and Moluccas [Indonesia], New Guinea).
- *T. weinmannifolia* (stamen filaments short and broad; Samoa, Fiji).



Trimenia moorei

7. SCHISANDRACEAE

Woody climbers or small **trees** to **shrubs**. **Leaves** usually gland-dotted, aromatic (peppery in *Illicium*) simple, alternate (spiral); margins usually entire, sometimes toothed with chloranthoid teeth; petioles present; stipules absent. **Inflorescences** usually axillary solitary flowers or a few aggregated; sometimes cauliflorous. **Flowers** bisexual (*Illicium*) or unisexual (plants monoecious or dioecious: *Kadsura*, *Schisandra*), actinomorphic; often bracteolate. **Perianth** spirally arranged tepals; outer whorl sepaloïd, bract-like; inner whorl petaloïd, white, yellow to red. **Stamen** filaments free (*Illicium*) or fused basally (e.g. *K. coccinea*, *Schisandra*) or filaments \pm fused (most *Kadsura*); anthers basifixed; often 3–22 staminodes. **Ovary** superior; carpels free; ovule(s) 1 (*Illicium*), 2–3 (*Schisandra*), 2–5(–11) (*Kadsura*); placentation marginal to basal. **Fruit** an aggregation of free carpels which are fleshy (red to yellow when mature) in *Kadsura* and *Schisandra* or star-shaped aggregated follicles (*Illicium*).

Genera 3/species ca. 80.

Distribution: Sri Lanka, east and southeast Asia to western Malesia, southeast USA, eastern Mexico and large Caribbean Islands.

Floral formula: P(5–)9–15(–many) A4–many \underline{G} 5–many

Useful species: *Illicium verum* (star anise).

Notes: The family have spirally arranged tepals, stamens and staminodes. *Illicium* is sometimes treated as a separate family. The flowers of *Illicium floridanum* have a faint but unpleasant odour.

Literature: Endress 2001; Hao *et al.* 2000, 2001; Panero & Aranda 1998; Saunders 1998, 2000; Xia & Saunders 2009; Xia *et al.* 2009.

Generic synopsis

- *Illicium* (trees or shrubs; fruit a follicle; southeast Asia, southeast USA and the Caribbean; ca. 40 spp.).
- *Kadsura* (woody climbers; fruits berry-like and widely separated in a spike; Sri Lanka to the Philippines and from Java [Indonesia] to South Korea and Japan, particularly species rich in southern China; ca. 16 spp.).
- *Schisandra* (woody climbers; aggregated berry-like fruits are close together and often globose; Russian Far East to Java and Bali [Indonesia] and Uttar Pradesh [India] to the west, *S. glabra* from southeast USA and Mexico; ca. 22 spp.).

STAR ANISE FAMILY



Illicium anisatum



Illicium henryi



Aggregated fruits of *Kadsura japonica*



Schisandra chinensis



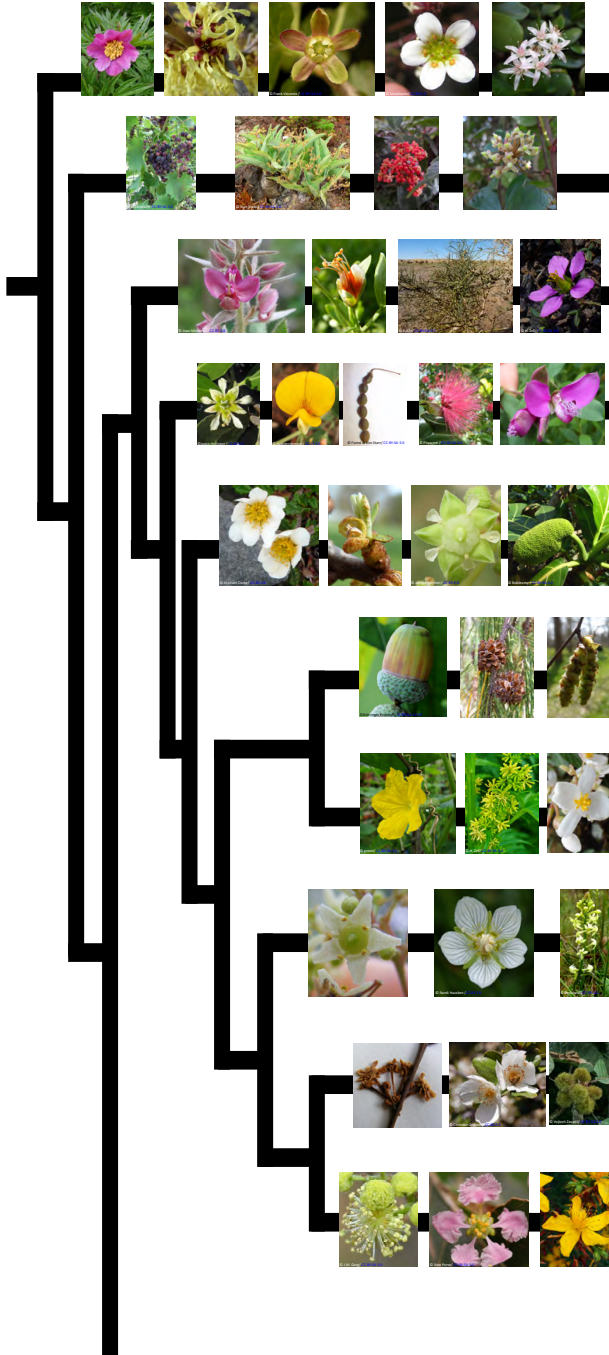
Fruits of *Illicium verum*



Schisandra rubriflora

ROSIDS

Rosids are a diverse group usually with **free petals**, sometimes a **hypanthium and/or nectar disk** present and stamens usually **equal or more than the petals**. They comprise about 25% of all angiosperms diversity with 17 orders and 176 families. Rosid orders are often morphologically diverse but most large families usually have distinctive characters. A few families have a fused perianth which could be confused with many asterids, notably Cucurbitaceae and Thymelaeaceae.



SAXIFRAGALES - Trees, shrubs, woody climbers or herbs, sometimes succulent; flowers bisexual or unisexual; perianth conspicuous or inconspicuous to absent; hypanthium sometimes present; carpels usually 2; fruits often dry. **Variable order.**

VITALES - Woody climbers, shrubs or herbs, often tendrils present; bark often with lenticels; leaf venation palmate venation; stipules usually present; ovary superior; fruit a berry.

ZYGOPHYLLALES - Trees, shrubs, or herbs, often thorny in saline habitats or hemiparasites; stipules present, if absent flowers zygomorphic; ovary superior; fruits dry or a drupe (then plants spiny).

FABALES - Trees, shrubs, woody climbers or herbs; leaves simple or compound with usually carpel 1 and legume fruits; stipules present or rarely absent; flowers often zygomorphic; stamens usually 8-many; ovary superior; fruits dry or fleshy.

ROSALES - Trees, shrubs, woody climbers or herbs; stipules present or absent; usually flowers bisexual with few to many stamens and conspicuous perianth **OR** unisexual with reduced to absent perianth, often wind-pollinated, usually few stamens and sometimes exudates present, stinging hairs or cystoliths present. **Variable order.**

FAGALES - Usually trees or shrubs; stipules present; flowers usually unisexual, often in catkins or spikes, usually wind-pollinated; perianth often reduced to absent; ovary often inferior; fruits dry.

CUCURBITALES - Erect or climbing herbs or shrubs, rarely trees; stipules present or absent; flowers usually unisexual; petals fused, free or absent, often valvate; leaf venation often palmate or 3–9-veined from base; ovary usually inferior (if superior then flowers often bisexual).

CELASTRALES - Trees, shrubs or woody climbers, rarely herbs; stipules present or absent; leaves usually simple; stamens 1-whorled (if 2-whorled then 1-foliolate leaves); usually conspicuous nectar disk present; ovary superior.

OXALIDALES - Trees, shrubs, woody climbers or herbs; leaves compound (if simple then plants carnivorous **OR** with garlic-odour **OR** petals valvate with often fringed apices); stipules present or absent; stamens 1–2-whorled; ovary superior.

MALPIGHIALES - Trees, shrubs, woody climbers or herbs, sometimes succulents; flowers actinomorphic or rarely zygomorphic; stipules often present in most families; petals present or absent; stamens 1–2-whorled; ovary usually superior. **Variable order.**

MALPIGHIALES

Notes: Plants in the order are morphologically diverse ranging from trees, shrubs, woody climbers to herbs, as well as, submerged aquatics (Podostemonaceae), parasites (Rafflesiaceae) and cactus-like succulents (some *Euphorbia* in Euphorbiaceae).

There are few constant macromorphological characters which unite the order, though Malpighiales plants typically have 4–5-merous flowers with free petals, stamens 4–5 (often) to 2-whorled or many, and usually fused carpels with superior ovaries (inferior in Rafflesiaceae and some Rhizophoraceae; part-inferior in some Salicaceae and superior to inferior in Dichapetalaceae). Flowers are usually actinomorphic, though zygomorphic flowers are sometimes present, notably in *Viola* (Violaceae) and Trigonaceae. Stipules are usually present in most families.

Some families have: **petals absent** (Balanopaceae, some Euphorbiaceae, Lacistemataceae, Picrodendraceae, Podostemaceae, Putranjivaceae, Rafflesiaceae, some Salicaceae); **hypanthium present** (Chrysobalanaceae, Dichapetalaceae, Euphroniaceae, Goupiaceae, Passifloraceae, Rhizophoraceae); or are **succulents** (some Euphorbiaceae, some Phyllanthaceae).

Molecular data found the Euphorbiaceae *sensu lato* and Flacourtiaceae were among the few traditionally recognised families not to be found monophyletic. This has resulted in splitting the Euphorbiaceae into several families and the complete breakup of the Flacourtiaceae (see Salicaceae and Achariaceae).

1. Root-holoparasitic herbs without chlorophyll [parasitic on *Tetrastigma*, Vitaceae]
..... **183. Rafflesiaceae**
1. Non-parasitic plants with chlorophyll present..... **2**
2. Aquatic plants with little differentiation between roots, stems and leaves. **213. Podostemaceae**
2. Plants terrestrial, if aquatic then roots, stems and leaves differentiated..... **3**
3. Woody climbers with leafy tendrils..... **197. Lophopyxidaceae**
3. Trees, shrubs or herbs, if woody climbers then leafy tendrils absent..... **4**
4. Stamens many, filaments basally fused in a ring with small warty structures on filaments;
leaves 3-foliolate or (rarely) bi-pinnate; petioles long [Costa Rica to Paraguay]
..... **205. Caryocaraceae**
4. Stamens 1–many, filaments not as above; leaves various, if 3-foliolate then petioles not long..... **5**
5. Ovule 1 per locule; stipules present; ovary ≥ 1 -locular; flowers unisexual; perianth 1–2-whorled
[usually inconspicuous, if conspicuous then exudates often present]..... **6**
5. Ovules ≥ 2 per locule, if 1 ovule then flowers bisexual (if unisexual then stipules absent
with exudates present or perianth conspicuous and exudates absent)..... **7**
6. Plants dioecious; perianth 2-whorled; exudates absent; plants non-succulent; fruits fleshy
..... **180. Pandaceae**
6. Plants monoecious or dioecious; perianth 1–2-whorled; exudates present or absent; plants
succulent or non-succulent; fruits non-fleshy or (rarely) fleshy..... **184. Euphorbiaceae**
7. Style (usually) gynobasic; stipules present..... **8**
7. Style terminal or lateral; stipules present or absent..... **9**
8. Anthers dorsifixed..... **196. Chrysobalanaceae**
8. Anthers basifixed..... **187. Ochnaceae**

212. BONNETIACEAE

Stout-stemmed trees or shrubs. **Leaves** crowded at branch ends, simple, alternate; margins usually minutely toothed to entire; petioles short to absent; stipules absent; resinous exudates present. **Inflorescences** cymes, panicles or solitary flowers (*Ploiarium*, some *Bonnetia*); bracts 2. **Flowers** bisexual, actinomorphic; bracteoles 2. **Sepals** free, imbricate, unequal, persistent. **Petals** free, contorted, free; red to pink. **Stamens** many, filaments are free (*Bonnetia*) or basally fused into bundles; anthers basifixed. **Ovary** superior; carpels fused, 3 (*Bonnetia*) or 5; locules 3–5; ovules many per locule; placentation axile; stigmatic branches 3–5. **Fruit** a septicidal capsule.

Genera 3/**species** 35.

Distribution: Cuba, South America, and Indochina to Malesia.

Floral formula: K5 C5 Amany \underline{G} 3–5

Notes: The family often occurs in sandy savannas, swampy peaty soils, open rocky areas or lowland, or mid to high elevation cerrado or tepuis forests.

Literature: Gustafsson *et al.* 2002; Weitzman 2005; Weitzman & Stevens 1997; Weitzman *et al.* 2007.

Generic synopsis

- *Archytaea* (inflorescences 3–many-flowered; northeast South America; 2 spp.).
- *Bonnetia* (stamen filaments free and not in fascicles; northeast South America [Guiana highlands], *B. paniculata* from the Andes, *B. stricta* from Atlantic coast of Brazil south to Rio de Janeiro or *B. cubensis* from Cuba; ca. 30 spp.).
- *Ploiarium* (inflorescences solitary flowers; Cambodia to Malesia; 3 spp.).



Branch of *Bonnetia*
Herbarium specimen Moreira *et al.* 7503 (K)

213. PODOSTEMACEAE

RIVERWEED FAMILY

Annual or perennial aquatic herbs, often submerged; vegetatively variable: thalloid lichen-like, moss-like to seaweed-like; roots usually flattened, thalloid or filiform. **Leaves** well-developed, reduced or rarely absent, simple or compound; margins entire, lobed or pinnatisect; petioles present or absent; sometimes stipule-like appendages. **Inflorescences** solitary flowers, cymes, spikes or racemes. **Flower** bisexual, actinomorphic or zygomorphic, buds naked (some Tristichoideae, Weddellinoideae), surrounded by a collar-like cup (some Tristichoideae) or enclosed by a spathella (= tube or sac-like envelope; Podostemoideae); bracteolate. **Perianth** 1-whorled, free or basally fused. **Stamens** often 2 basally fused, 1–2-whorled or confined to one side, filaments when whorled free or fused (*Tulasneantha*), often alternating with tepals. **Ovary** superior; carpels fused; locules (1–)2–3; ovules 2–many per locule; placentation free central or axile. **Fruit** a capsule, smooth or ribbed.

Genera 54/**species** ca. 300.

Distribution: Tropical to temperate regions, plants often found attached to rocks in fast-flowing water.

Floral formula: P(0–)2–5(–20) A1–2(–many) \underline{G} (1–)2(–3)

Confused with: When the plant is sterile the family could be mistaken for lichen, moss or algae.

Notes: Plants are submerged when water levels are high but during dry seasons they have a terrestrial existence and this is when they flower. The following generic names are synonymous: *Hydrobryopsis* = *Zeylanidium*; *Lonchostephus* = *Mourera*; and *Maferria* = *Farmeria*.

Literature: Cook & Rutishauser 2006; Cusset 1992; Jäger-Zürn 1997; Kato *et al.* 2004; Kita 2002; Kita & Kato 2001, 2004; Koi & Kato 2012; Koi *et al.* 2009, 2012; Les *et al.* 1997; Moline *et al.* 2007; Philbrick *et al.* 2011; Soltis *et al.* 1999a; Tippery *et al.* 2011; Thiv *et al.* 2009.

Generic synopsis

Podostemoideae (spathella present (= tube or sac-like enveloping immature flower; flowers actinomorphic or zygomorphic; tepals (0–)1–20; stamens 1–40; carpels 2; ovary 1–2-locular; stigmas usually 2)

African distribution

- *Angolaea* (leaves repeatedly forked; stamens 3(–4); stigma 1; capsule valves equal; Angola; 1 sp., *A. fluitans*).
- *Dicraeanthus* (roots star-shaped; leaves linear, fan-like or forked; stamens 2; capsules ribbed longitudinally, valves equal, 3-ribbed; West and Central Africa).
- *Djinga* (leaves entire or forked; stamen 1; capsule valves unequal, 3-ribbed; Cameroon; 1 sp., *D. felicis*).
- *Endocaulos* (leaves simple; stamens 2; capsules asymmetric, unequal and valves 7-ribbed; Madagascar; 1 sp., *E. mangorensis*).
- *Inversodicraea* (leaves repeatedly forked; stamen 1; Ghana to Democratic Republic of the Congo).
- *Ledermannia* (leaves simple, lobed or forked; stamens 1–2(–3); capsule valves usually unequal, 3-ribbed; tropical Africa; ca. 45 spp.).

258. TROPAEOLACEAE

Annual or perennial, climbing herbs. **Leaves** aromatic (mustard odour in sap), often peltate, simple (palmately lobed) or compound (palmate), alternate or rarely opposite; venation palmate; margins toothed to entire; petioles long, usually twining; stipules small to absent. **Inflorescences** axillary solitary flowers or rarely few-flowered and umbel-like; bracteate. **Flowers** bisexual, zygomorphic. **Sepals** fused, petaloid, 1 modified into a conspicuous long to short spur. **Petals** free, imbricate, clawed, upper 2 smaller, often brightly coloured. **Stamens** 2-whorled, filaments free; anthers basifixed. **Ovary** superior; carpels fused; locules 3; ovule 1 per locule; placentation axile to rarely apical; style 1. **Fruit** a 3-lobed schizocarp or rarely a 3-winged samara.

Genus 1/**species** ca. 95; *Tropaeolum*.

Distribution: Mexico to southern South America, often cultivated.

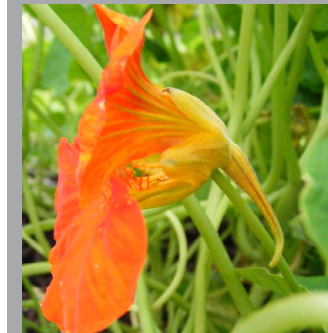
Floral formula: K5 C5 A4+4 \overline{G}_3

Notes: The generic names *Magallana* and *Tropaeastrum* are synonymous with *Tropaeolum*.

Literature: Andersson & Andersson 2000; Bayer & Appel 2002e; Sparre & Andersson 1991; Watson & Flores 2010.



Fruit of *Tropaeolum majus*



Tropaeolaceae character

Conspicuous calyx spur



Frontal view of *Tropaeolum majus*

259. MORINGACEAE

Shrubs to **trees**, rarely subshrubs (*M. pygmaea*), sometimes trunk swollen (see notes). **Leaves** aromatic (mustard or foetid odour), deciduous, compound (bipinnate to odd-pinnate), alternate, leaflets mainly opposite; margins entire; petioles present; stipules and stipels present, sometimes represented by conspicuous glands. **Inflorescences** axillary panicles to thyrses; bracteate. **Flowers** bisexual, zygomorphic; bracteoles 2. **Sepals** free, imbricate, petaloid. **Petals** free, imbricate, outer petals larger than smaller inner 2; yellow, white or red (*M. arborea*, *M. longituba*). **Stamens** opposite petals; anthers dorsifixed; staminodes present. **Ovary** superior, on a stalk; carpels fused; locule 1; ovules many; placentation parietal; style 1; stigma 1. **Fruit** a large capsule, woody, explosively dehiscent and 3-valved.

Genera 1/**species** 13; *Moringa*.

Distribution: Africa, Madagascar, Middle East, India and Pakistan.

Floral formula: K5 C5 A5+3-5° $\overline{G}_{(2-)}3(-4)$

Notes: The genus is variable in habit ranging from small herbs to subshrubs about 5 cm tall (*M. pygmaea*) to trees with swollen trunks. Species often flower before the leaves appear and both are usually needed for identification. Species with swollen trunks include the African *M. drouhardii*, *M. ovalifolia* and *M. stenopetala*, and Madagascan *M. hildebrandtii*.

Literature: Hall *et al.* 2004; Kubitzki 2002h; Olson 2002, 2012; Thulin 1993; Verdcourt 1985.



Moringa ovalifolia



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Moringaceae character

Flowers are transversally zygomorphic (vs. median) which is unusual in angiosperms
Moringa oleifera

Thesioideae (root-hemiparasites, shrubs or perennial herbs; leaves alternate or opposite; flowers bisexual or unisexual (plants dioecious); $K(0-4-5) C(0-4-5) A(4-5) \bar{G}3$)

- *Buckleya* (shrubs; leaves well-developed; flowers unisexual, 4(-5)-merous; fruit a drupe; eastern USA, East Asia).
- *Osyridicarpus* (climbing shrubs; leaves well-developed; flowers bisexual, 5-merous; fruit a drupe; Africa; 1 sp., *O. schimperianus*).
- *Thesium* (herbs or subshrubs; leaves small to scale-like; flowers bisexual, usually 5-merous; fruit a nut or drupe; worldwide; ca. 330 spp.).



Thesium alpinum



Close-up of *Arceuthobium divaricatum*

Viscaoideae (stem-hemiparasites, herbs or shrubs; stem sometimes hairy; leaves opposite, sometimes reduced; flowers unisexual (plants dioecious or monoecious); $K0 C3$ or $4(-6) A2-4 \bar{G}(2-3)-4$, petals 3 in female flowers or 4-6 in males)

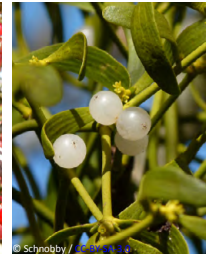
- *Arceuthobium* (dioecious; leaves reduced to scales; parasitises Pinaceae or Cupressaceae species; North and Central America, Asia, Africa; ca. 45 spp.).
- *Dendrophthora* (dioecious or monoecious; leaves developed or scale-like; anthers 1-locular; Caribbean, Mexico, South America; ca. 70 spp.).
- *Ginallia* (leaves well-developed and reduced on same branch; inflorescences spike-like or 1-3-flowered; anthers opening by longitudinal slits; India to Malesia).
- *Korthalsella* (leaves reduced; flowers often < 0.5 mm long; stamens 3; Old World tropics and subtropics).
- *Notothixos* (leaves well-developed, 3-5-nerved; white, golden or brown stellate hairs especially on young growth; flowers usually 4-merous; Sri Lanka to Malesia, Australia).
- *Phoradendron* (monoecious or dioecious; leaves usually developed; anthers 2-locular; Neotropics; ca. 230 spp.).
- *Viscum* (monoecious or dioecious; leaves developed or reduced; inflorescences 3-5-flowered; flowers 4-merous; anthers opening by pores; temperate and tropical Old World; ca. 150 spp.).



Habit of *Arceuthobium cyanocarpum*



Fruits of *Phoradendron californicum*



Viscum album

280. LORANTHACEAE

Shrubs or rarely small trees, usually stem-hemiparasites or rarely root-hemiparasites (\pm *Nuytsia*, *Atkinsonia*, *Gaiadendron*); stems often with swollen nodes. **Leaves** sometimes reduced to scales, often leathery to fleshy, simple, opposite or rarely alternate to whorled; margins entire; venation often inconspicuous; stipules absent. **Inflorescences** cymes, racemes, spikes, fascicles, umbels or solitary flowers. **Flowers** bisexual or rarely unisexual, actinomorphic or sometimes zygomorphic. **Perianth** present or very rarely absent. **Sepals** fused, reduced to a calyculus. **Petals** well-developed, fused or free, valvate, often tubular; often red to yellow. **Stamens** alternating with the sepals, equal in number to petals, filaments attached to petals; anthers basifixed. **Ovary** inferior; carpels fused; locules usually 1; ovules 4-12 per locule; placentation basal. **Fruit** a 1-seeded berry or nut to samara-like (*Nuytsia*).

Genera 76/**species** ca. 950.

Distribution: Tropics to southern hemisphere temperate regions and Italy, the Balkans to central Europe.

Floral formula: $K0 C(0-3-4)-6(-9) A(3-4)-6(-8) \bar{G}3-4(-12)$

Confused with: Olcaceae – leaves alternate. Viscaoideae (Santalaceae) – flowers unisexual, tiny tepals.



Loranthaceae characters
Stem-parasitic plants (A); well-developed petals, often tubular (B: opened flower of *Agelanthus*)

Literature: Balle 1956; Barlow 1966, 1974, 1984a, 1984b, 1997a, 1997b; Barlow & Wiens 1973; Der & Nickrent 2008; Hopper 2010; Kuijt 1986, 1988, 1991, 2011, 2012, 2014; Nickrent 1997-; Nickrent *et al.* 1998, 2010; Polhill & Wiens 1998, 1999a, 1999b; Roldán & Kuijt 2005; Vidal-Russell & Nickrent 2008a, 2008b.

364. OLEACEAE

Trees, shrubs, woody climbers (*Jasminum*, *Myxopyrum*) or **woody herbs** (some *Jasminum*, *Dimetra*); stems sometimes 4-angled. **Leaves** simple or compound, opposite or rarely alternate (*Chrysojasminum*); margins entire to toothed; petioles present; hairs lepidote, stellate or glandular; stipules absent. **Inflorescences** solitary flowers, thyrses, cymes or racemes; sometimes bracts. **Flowers** bisexual or rarely unisexual (plants polygamomonoecious or dioecious), actinomorphic; nectar disk present or absent. **Sepals** fused or absent (some *Fraxinus*), usually valvate. **Petals** fused, rarely free (e.g. *Fontanesia*) or absent (most *Forestiera*, *Fraxinus*, *Nestegis*); usually yellow or white. **Stamens** usually 2, opposite the sepals, filaments attached to petals when petals fused, sometimes heterostylous, rarely 4 stamens (see notes). **Ovary** superior; carpels fused; locules 2; ovules 1–2(–many) per locule; placentation axile. **Fruit** a capsule, samara, berry or drupe.

Genera 26/**species** ca. 600.

Distribution: ± Worldwide, especially East Asia.

Floral formula: K(0–)4(–15) C(0–)4(–12) A2(–4) G2

Useful species: *Olea europaea* (olives).

Confused with: Apocynaceae – exudates (latex) present. Loganiaceae and Rubiaceae – usually stipules present.

Notes: Swollen nodes have no line across like in most other Lamiales families. Several genera are non-monophyletic, including *Olea*, *Osmanthus* and *Chionanthus*, and further work is needed. The generic name *Menodora* is synonymous with *Jasminum*. Four stamens often occur in *Nestegis* and *Osmanthus scortecinii* from Malesia (which is ca. 5 species in total).

Literature: Besnard *et al.* 2009; Filonenko *et al.* 2009; Green 2004; Guo *et al.* 2011; Hong-Wa & Besnard 2013; Kiew & Baas 1984; Kim & Kim 2011; Wallander & Albert 2000; WCSP 2014.

Generic synopsis

Fontanesieae (shrubs or small trees; leaves deciduous, simple and opposite; sepals 4; petals 4; fruit a samara)

- *Fontanesia* (flowers bisexual or polygamous; stamens longer than corolla tube; Sicily [Italy], southwest Asia, China).

Forsythieae (shrubs; leaves deciduous, simple or compound (3-foliolate), opposite; sepals 4; petals 4; fruit a capsule or samara)

- *Abeliophyllum* (petals white to pinkish; stamens inside the corolla tube; fruit a samara; Korea; 1 sp., *A. distichum*).
- *Forsythia* (petals yellow; fruit a capsule; southeast Europe, China, Korea, Japan; ca. 12 spp.).

Jasmineae (shrubs or woody climbers; leaves simple or compound, opposite or alternate; sepals 5–15; petals 5–12, imbricate; fruit a capsule or berry, often with remnant of style)

- *Chrysojasminum* (leaves alternate; corolla yellow; petals valvate; fruit a fleshy berry; Canary Islands [Spain], Madeira [Portugal], Mediterranean region, Central Asia to Himalayas and Myanmar, China, southern India to Sri Lanka; ca. 15 spp.).
- *Jasminum* (leaves opposite; corolla white, yellow or reddish; fruit usually a fleshy berry; tropics to temperate regions; ca. 200 spp.).
- *Menodora* (leaves opposite or alternate; fruit a dehiscent or indehiscent dry capsule; Central America, South America, South Africa).

Myxopyreae (shrubs, small trees or woody climbers; leaves simple and opposite; sepals 4; petals 4–8; fruit a drupe, capsule or schizocarp)

- *Dimetra* (subshrubs; leaves hairy; petals imbricate; fruit a capsule; northern Thailand; 1 sp., *D. craibiana*).
- *Myxopyrum* (woody climbers; stems 4-angled; leaves 3-nerved; fruit a drupe; India to southern China, Philippines and New Guinea; ca. 4 spp.).
- *Nyctanthes* (shrubs or small trees; fruit a schizocarp; India, Thailand, Sumatra, Java [Indonesia]).

Oleae (leaves simple or compound, opposite; sepals 4; petals 4 or absent; fruit a drupe, berry, capsule or samara)

- *Chionanthus* (trees or shrubs; leaves simple; flowers bisexual or unisexual; petals valvate; stamens 2 or 4; fruit a drupe; world-wide; ca. 60 spp.).
- *Comoranthus* (trees or shrubs; leaves simple; flowers bisexual; corolla hairy; fruit a capsule; Madagascar, Comoros).

OLIVE FAMILY



Oleaceae characters
Flowers actinomorphic with usually 2 stamens (arrowed)
Phillyrea latifolia



Forsythia



Jasminum officinale



Nyctanthes arbor-tristis



Fruit of *Nyctanthes arbor-tristis*



Chionanthus virginicus

372. PEDALIACEAE

SESAME FAMILY

Shrubs to **trees** or perennial **herbs**, often xerophytic, rarely annual or aquatic (*Trapella*); stems sometimes swollen. **Leaves** sometimes deciduous, simple, opposite or sometimes alternate (e.g. *Sesamum*); margins entire to lobed or pinnatifid; petioles usually present; stipules absent; conspicuous sticky (**mucilage**) **glandular hairs** (give a slimy clammy feel). **Inflorescences** **axillary** solitary flowers or cymes, rarely raceme-like (*Sesamothamnus*); pedicels with **2(–many) extra-floral nectaries at base** (absent from *Uncarina* and *Trapella*); bracteate. **Flowers** bisexual, **zygomorphic**. **Sepals** fused, blunt-lobed, imbricate, unequal. **Petals** fused, imbricate, spurred (e.g. *Holubia*, *Rogeria longiflora*, some *Sesamothamnus*); white to yellow or rarely red. **Stamens** 4 and unequal or rarely 2 (*Trapella*), opposite the sepals, filaments attached to petals; often staminode 1. **Ovary** superior or inferior (*Trapella*), sometimes a nectar disk below; carpels fused, 2 or rarely 3–4 carpels; locules usually 2; ovules 1–many per locule; placentation **axile**. **Fruit** a capsule, drupe or nut; often **winged, spiny or horned**.

Genera 14/species 70.

Distribution: Subtropical to tropical regions, mostly in coastal or arid habitats in Old World.

Floral formula: K5 C5 A(2–)4+(0–)1* G2(–3–4)

Useful species: *Sesamum indicum* (sesame seeds).

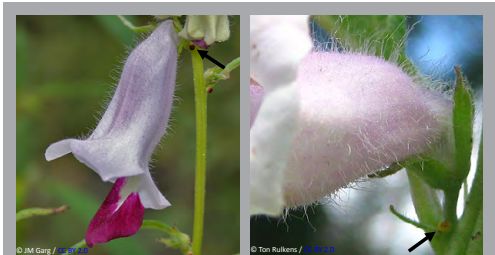
Confused with: *Martyniaceae* – inflorescences terminal.

Notes: There are rarely 3–4 carpels in *Josephinia imperatricis*, *J. grandiflora* and some *Sesamum orientale*.

Literature: Manning 1991; Olmstead *et al.* 2001; Ihlenfeldt 2004b.

Generic synopsis

- *Ceratotheca* (deciduous shrubs or perennial to annual herbs; corolla white, pink or purple; fruits with 2 lateral horns; East to southern Africa).
- *Dicerocaryum* (perennial herbs; flowers longly pedicellate; corolla white, pink, purple or yellow; fruits disc-like with 2 erect conical spines; Madagascar, East to South Africa).
- *Harpagophytum* (perennial herbs; inflorescences 1-flowered; corolla purple, pink or yellow; fruits 4-ridged; southern Africa).
- *Holubia* (annual herbs; inflorescences 1-flowered; corolla yellow-green, with basal sac-like spur; fruits 4-winged, indehiscent; southern Africa; 1 sp., *H. saccata*).
- *Josephinia* (shrubs, subshrubs or annuals; corolla mauve, pink or whitish; carpels 2(3–4); fruits globular with spines; Kenya, Somalia, Malesia, northern Australia).
- *Linariopsis* (perennial herbs or subshrubs; corolla mauve; fruits with tiny warts; tropical Africa).
- *Pedaliodiscus* (perennial herbs; inflorescences 1-flowered; corolla cream; fruits with 4-longitudinal wings; East Africa; 1 sp., *P. macrocarpus*).
- *Pedaliium* (annual herbs; inflorescences 1-flowered; corolla yellow; fruits 4-angled; northeast Africa, widespread pantropical weed; 1 sp., *P. murex*).
- *Pterodiscus* (perennial herbs; inflorescences 1-flowered; corolla yellow, red, orange or purple; fruits with 4-longitudinal wings; Africa).
- *Rogeria* (perennial or annual herbs; inflorescences 2-flowered; corolla white, red or purple; fruits smooth, winged or spiny; southern edge of Sahara, southwest Africa).
- *Sesamothamnus* (trees or shrubs, trunk swollen at base, spines present; corolla white, pink or yellow; fruits smooth; northeast and southern Africa).
- *Sesamum* (deciduous shrubs or perennial to annual herbs; corolla pink, white or purple; fruits smooth; sub-Saharan Africa, India, Sri Lanka; ca. 20 spp.).
- *Trapella* (aquatic perennial herbs; corolla white to pink; stamens 2; staminodes 2; Japan, Russian Far East, Korea, southeast China; 1–2 spp.).
- *Uncarina* (trees or shrubs; inflorescences 1–9-flowered; corolla white, yellow or purple; fruits spiny; Madagascar; ca. 13 spp.).



Pedaliaceae character

Extra-floral nectaries (arrowed) are present at the base of the pedicel



Ceratotheca triloba



Habit of *Harpagophytum procumbens*



Pterodiscus ngamicus



Pedaliium murex



Sesamothamnus rivae



Fruit of *Uncarina* sp.



Habit of *Trapella sinensis*

383. BYBLIDACEAE

Carnivorous subshrubs to **herbs**, up to ca. 60 cm tall. **Traps:** sticky glandular hair ‘flypaper traps’. **Leaves** linear, simple, alternate (spiral); stipules absent. **Inflorescences** axillary solitary flowers. **Flowers** bisexual, actinomorphic to zygomorphic. **Sepals** basally fused, imbricate, lobes longer than tube, persistent. **Petals** basally fused, lobes longer than the tube, apex fringed; purple to lavender or white. **Stamens** opposite the sepals, filaments sometimes attached to petals basally, **filaments twisted** to make flower \pm zygomorphic; anthers fused, basifixed, introrse. **Ovary** superior; carpels fused; locules 2; ovules 2—many per locule; placentation axile; style 1. **Fruit** a loculicidal capsule.

Genus 1/species 7; *Byblis*.

Distribution: Western and northern Australia and southern New Guinea.

Floral formula: K5 C5 A5 $\overline{\text{G}}_2$

Confused with: [Droseraceae](#) – traps active; petals free. [Byblidaceae](#) – anthers free; South African distribution.

Literature: Conran & Carolin 2004; Conran & Dowd 1993; Conran *et al.* 2002; Juniper *et al.* 1989; Lowrie & Conran 1998; W CSP 2014.



Flower of *Byblis filifolia* showing twisted stamens



Sticky glandular leaves of *Byblis filifolia*

Species synopsis

- *B. aquatica* (grows up to 5 cm tall; Darwin to Berry Springs [Northern Territory]).
- *B. gigantea* (Perth area [Western Australia]).
- *B. guehoi* (anthers longer than filaments; pedicels longer than leaves; Kimberley region).
- *B. filifolia* (anthers longer than filaments; sepals 4.5–6.5 cm long; northwest Australia and Northern Territory).
- *B. lamellata* (Geraldton Sandplains and Swan Coastal Plain [Western Australia]).
- *B. liniflora* (Kimberley, Northern Territory, Queensland and extending into southern New Guinea).
- *B. rorida* (sepals 3.5–4.5 mm long; Kimberley region [Western Australia]).

384. MARTYNIACEAE

UNICORN PLANT FAMILY

Annual or rarely perennial **herbs**, rarely fleshy stemmed shrubs (*Holoregmia*). **Leaves** simple, opposite or rarely alternate; margins usually palmately lobed; petioles present; stipules absent; **hairs glandular**. **Inflorescences** **terminal** racemes. **Flowers** bisexual, zygomorphic; bracteolate. **Sepals** free (*Ibicella*, *Martynia*) or fused, blunt-lobed, spathe-like, up to 5.5 cm in *Craniolaria*. **Petals** fused, imbricate; yellow, purple or white. **Stamens** opposite the sepals, filaments attached to petals, 2 stamens in *Martynia*; anthers dorsifixed, introrse. **Ovary** superior; carpels fused; locule 1, though septa sometimes dividing; ovules 4—many; placentation **parietal**. **Fruit** a capsule, usually **woody, horned or beaked**.

Genera 5/species 16.

Distribution: Tropical to subtropical New World regions.

Floral formula: K5 C5 A4+1° (or 2+3°) $\overline{\text{G}}_2$

Confused with: [Pedaliaceae](#) – inflorescences axillary.

Notes: Insects may stick to the very sticky hairs in some species but there is no evidence that the plants are carnivorous.

Literature: Harley *et al.* 2003; Ihlenfeldt 2004a; Rice 2008; Plachno *et al.* 2009.

Generic synopsis

- *Craniolaria* (sepals ca. 5 cm long; corolla white to yellow, up to 15 cm long; horns shorter than fruit body; Puerto Rico, Venezuela, Colombia, southern Brazil to Argentina; ca. 3 spp.).
- *Holoregmia* (shrubs; corolla pale yellow, ca. 4.5 cm long; fruits without horns; Bahia [Brazil]; 1 sp., *H. viscida*).
- *Ibicella* (sepals free; corolla yellow; horns longer than fruit body; Bolivia, southern Brazil to Argentina, *I. lutea* naturalised elsewhere; ca. 3 spp.).
- *Martynia* (sepals unequal; corolla white to pink; stamens 2; staminodes 3; horns shorter than fruit body; Mexico, Caribbean; 1 sp., *M. annua*).
- *Proboscidea* (devil’s claw or unicorn plants; sepals \pm fused; corolla purple, pink, cream, white, orange or yellow; horns longer than fruit body; southern USA to Mexico, *P. louisianica* naturalised elsewhere; ca. 8 spp.).



Martyniaceae character

Horned capsule fruits: As the fruit matures the fleshy exocarp falls off and a woody endocarp appears. The fruits dehisce longitudinally producing two pointed horns.



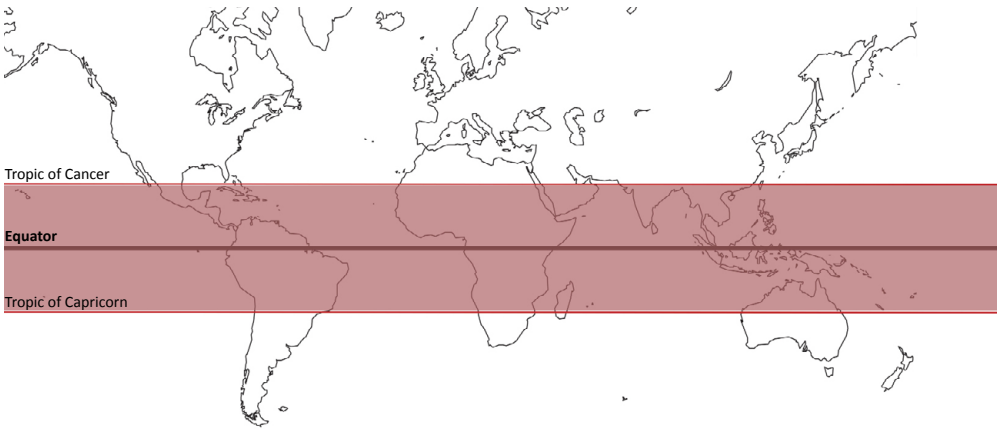
Proboscidea fragrans



Ibicella lutea

GEOGRAPHICAL MAPS

MAP A: Tropical regions of the world



MAP B: Subtropical climatic regions of the world



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MAP C: Malesia region (= area covered by *Flora Malesiana*)

1– Peninsular Malaysia (incl. Singapore); 2– Sumatra; 3– Java; 4– Borneo [Brunei, Sabah, Sarawak, Kalimantan]; 5– Sulawesi; 6– the Philippines; 7– Moluccas; 8– Lesser Sunda Islands [Bali, Lombok, Sumbawa, Flores, Wetar, Sumba, Timor and Babar]; 9– New Guinea [Irian Jaya, Papua New Guinea incl. Bismarck Archipelago].



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