

## PHYLOGENY/CLASSIFICATION OF THE FAMILIES OF VASCULAR PLANTS OF NORTH CENTRAL TEXAS

This phylogeny/classification is modified from those of Cronquist (1981, 1988), Lellinger (1985), and Hickman (1993). The synopses of subclasses are from Hickman (1993) and Woodland (1997). A classification system including all families of vascular plants can be found in Mabberley (1987, 1997). Figure 36 (from Cronquist 1988) is a diagram of relationships of subclasses of flowering plants.

<b>FERNS AND SIMILAR PLANTS</b>	<b>GYMNOSPERMS</b>	<b>ANGIOSPERMS</b>
<p style="text-align: center;">SPORE-BEARING</p> <p><b>Divison LYCOPHYTA</b></p> <p>Order Lycopodiales Lycopodiaceae</p> <p>Order Selaginellales Selaginellaceae</p> <p>Order Isoetales Isoetaceae</p> <p><b>Divison SPHENOPHYTA</b></p> <p>Order Equisetales Equisetaceae</p> <p><b>Divison POLYPODIOPHYTA</b></p> <p><b>SUBCLASS OPHIOGLOSSIDAE</b> Ophioglossaceae</p> <p><b>SUBCLASS OSMUNDIDAE</b> Osmundaceae</p> <p><b>SUBCLASS SCHIZAEIDAE</b> Anemiaceae Pteridaceae</p> <p><b>SUBCLASS GLEICHENIIDAE</b> Polypodiaceae</p> <p><b>SUBCLASS HYMENOPHYLLIDAE</b> Dennstaedtiaceae Thelypteridaceae Aspleniaceae Dryopteridaceae Blechnaceae</p> <p><b>SUBCLASS MARSILEIDAE</b> Marsiliaceae</p> <p><b>SUBCLASS SALVINIIDAE</b> Azollaceae</p>	<p style="text-align: center;">"NAKED SEEDS," SEEDS NOT ENCLOSED IN AN OVARY; USUALLY WITH CONES</p> <p><b>Divison GNETOPHYTA</b></p> <p>Order Ephedrales Ephedraceae</p> <p><b>Divison CONIFEROPHYTA</b></p> <p>Order Coniferales Cupressaceae Pinaceae</p>	<p style="text-align: center;">"VESSEL SEEDS," SEEDS ENCLOSED IN AN OVARY; FLOWERS PRESENT</p> <p><b>Divison MAGNOLIOPHYTA</b></p> <p><b>Class DICOTYLEDONAE</b> (MAGNOLIOPSIDA)</p> <p><b>SUBCLASS MAGNOLIIDAE</b> Pistils generally simple; perianth parts and stamens free, generally many, spiralled</p> <p>Order Magnoliales Annonaceae</p> <p>Order Laurales Lauraceae</p> <p>Order Piperales Saururaceae</p> <p>Order Aristolochiales Aristolochiaceae</p> <p>Order Nymphaeales Nelumbonaceae Nymphaeaceae Cabombaceae Ceratophyllaceae</p> <p>Order Ranunculales Ranunculaceae Berberidaceae Menispermaceae</p> <p>Order Papaverales Papaveraceae</p>

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**ANGIOSPERMS** (DICOTS CONTINUED)**SUBCLASS HAMAMELIDAE**

Mostly woody; flowers  $\pm$  in unisexual catkins, without perianth, typically wind-pollinated

- Order Hamamelidales
  - Platanaceae
  - Hamamelidaceae
- Order Urticales
  - Ulmaceae
  - Cannabaceae
  - Moraceae
  - Urticaceae
- Order Juglandales
  - Juglandaceae
- Order Myricales
  - Myricaceae
- Order Fagales
  - Fagaceae
  - Betulaceae

**SUBCLASS CARYOPHYLLIDAE**

Mostly herbaceous; petals free (or absent and sepals petal-like, sometimes fused); placentas basal or free-central; stamens developing from inner to outer—centrifugal

- Order Caryophyllales
  - Phytolaccaceae
  - Nyctaginaceae
  - Aizoaceae
  - Cactaceae
  - Chenopodiaceae
  - Amaranthaceae
  - Portulacaceae
  - Basellaceae
  - Molluginaceae
  - Caryophyllaceae
- Order Polygonales
  - Polygonaceae

**SUBCLASS DILLENIIDAE**

Petals  $\pm$  free, sometimes fused (if 0, sepals not petal-like); pistil usually compound; placentas generally parietal (or axile); stamens developing from inner to outer; leaves mostly simple

- Order Theales
  - Elatinaceae
  - Clusiaceae (Guttiferae)

- Order Malvales
  - Tiliaceae
  - Sterculiaceae
  - Malvaceae
- Order Nepenthales
  - Sarraceniaceae
  - Droseraceae
- Order Violales
  - Cistaceae
  - Violaceae
  - Tamaricaceae
  - Passifloraceae
  - Cucurbitaceae
  - Loasaceae
- Order Salicales
  - Salicaceae
- Order Capparales
  - Capparaceae
  - Brassicaceae (Cruciferae)
- Order Ericales
  - Ericaceae
- Order Ebenales
  - Sapotaceae
  - Ebenaceae
  - Styracaceae
- Order Primulales
  - Primulaceae

**SUBCLASS ROSIDAE**

Petals usually free; stamens more than petals or opposite them, developing from outer to inner—centripetal; pistil compound or sometimes simple; placentas most often axile; leaves compound or simple

- Order Rosales
  - Hydrangeaceae
  - Grossulariaceae
  - Crassulaceae
  - Saxifragaceae
  - Rosaceae
- Order Fabales
  - Fabaceae
- Order Proteales
  - Elaeagnaceae
- Order Haloragales
  - Haloragaceae
- Order Myrtales
  - Lythraceae
  - Onagraceae
  - Melastomataceae

- Order Cornales
  - Cornaceae
  - Nyssaceae
  - Garryaceae
- Order Santalales
  - Santalaceae
  - Viscaceae
- Order Rafflesiales
  - Rafflesiaceae
- Order Celastrales
  - Celastraceae
  - Aquifoliaceae
- Order Euphorbiales
  - Euphorbiaceae
- Order Rhamnales
  - Rhamnaceae
  - Vitaceae
- Order Linales
  - Linaceae
- Order Polygalales
  - Polygalaceae
  - Krameriaceae
- Order Sapindales
  - Sapindaceae
  - Hippocastanaceae
  - Aceraceae
  - Anacardiaceae
  - Simaroubaceae
  - Meliaceae
  - Rutaceae
  - Zygophyllaceae
- Order Geraniales
  - Oxalidaceae
  - Geraniaceae
  - Balsaminaceae
- Order Apiales
  - Araliaceae
  - Apiaceae (Umbelliferae)

**SUBCLASS ASTERIDAE**

Predominantly herbaceous; petals  $\pm$  fused; stamens equal in number to or fewer than petals and alternate them; pistil compound, generally of 2 carpels

- Order Gentianales
  - Loganiaceae
  - Gentianaceae
  - Apocynaceae
  - Asclepiadaceae
- Order Solanales
  - Solanaceae
  - Convolvulaceae
  - Cuscutaceae

**ANGIOSPERMS** (MONOCOTS)

Menyanthaceae  
 Polemoniaceae  
 Hydrophyllaceae  
 Order Lamiales  
 Boraginaceae  
 Lamiaceae (Labiatae)  
 Verbenaceae  
 Phrymaceae  
 Order Callitrichales  
 Callitrichaceae  
 Order Plantaginales  
 Plantaginaceae  
 Order Scrophulariales  
 Buddlejaceae  
 Oleaceae  
 Scrophulariaceae  
 Orobanchaceae  
 Acanthaceae  
 Pedaliaceae  
 Bignoniaceae  
 Lentibulariaceae  
 Order Campanulales  
 Sphenocleaceae  
 Campanulaceae  
 Order Rubiales  
 Rubiaceae  
 Order Dipsacales  
 Caprifoliaceae  
 Valerianaceae  
 Dipsacaceae  
 Order Asterales  
 Asteraceae (Compositae)

**Class MONOCOTYLEDONAE**  
(LILIOPSIDA)**SUBCLASS ALISMATIDAE**

Pistils simple; herbs, ± aquatic

Order Alismatales  
 Alismataceae  
 Order Hydrocharitales  
 Hydrocharitaceae  
 Order Najadales  
 Potamogetonaceae  
 Zannichelliaceae

**SUBCLASS ARECIDAE**

Inflorescence often of many small flowers, enfolded or subtended by prominent bract(s); pistil usually compound; palm-like to minute aquatics

Order Arecales  
 Arecaceae (Palmae)  
 Order Arales  
 Acoraceae  
 Araceae  
 Lemnaceae

**SUBCLASS COMMELINIDAE**

Flowers small and subtended by chaffy bracts, or sepals and petals unlike; generally wind-pollinated; pistil compound

Order Commelinales  
 Xyridaceae  
 Commelinaceae  
 Order Eriocaulales  
 Eriocaulaceae  
 Order Juncales  
 Juncaceae  
 Order Cyperales  
 Cyperaceae  
 Poaceae (Gramineae)  
 Order Typhales  
 Typhaceae

**SUBCLASS ZINGIBERIDAE**

Inflorescences often with showy colored bracts; sepals and petals unlike; flowers usually animal-pollinated; pistil compound

Order Bromeliales  
 Bromeliaceae  
 Order Zingiberales  
 Marantaceae

**SUBCLASS LILIIDAE**

Flowers ± showy, insect-pollinated; sepals and petals generally similar; pistil compound

Order Liliales  
 Pontederiaceae  
 Lilaceae  
 Iridaceae  
 Agavaceae  
 Smilacaceae  
 Dioscoreaceae  
 Order Orchidales  
 Burmanniaceae  
 Orchidaceae

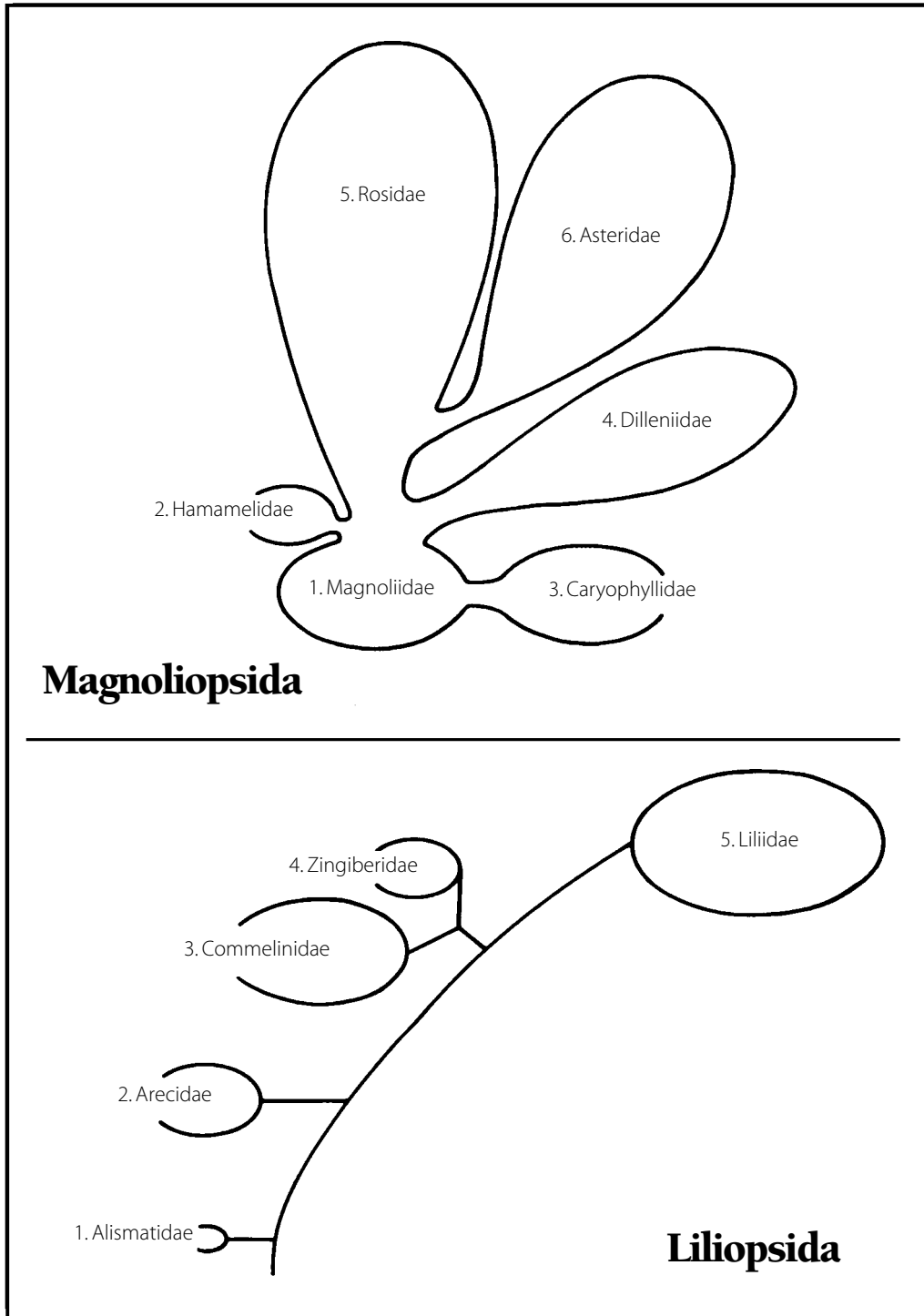


FIG. 36/DIAGRAM OF RELATIONSHIPS OF SUBCLASSES OF FLOWERING PLANTS (FROM CRONQUIST 1988).

# SUBFAMILIAL AND TRIBAL PHYLOGENY/CLASSIFICATION OF NORTH CENTRAL TEXAS POACEAE (GRASS FAMILY)

AS RECOGNIZED BY PETERSON AND WEBSTER (FORTHCOMING)

<p>Subfamily <b>ARISTIDOIDEAE</b></p> <p><b>Aristideae</b></p> <p><i>Aristida</i></p> <p>Subfamily <b>BAMBUSOIDEAE</b></p> <p><b>Bambuseae</b></p> <p><i>Arundinaria</i></p> <p><i>Phyllostachys</i></p> <p>Subfamily <b>CHLORIDOIDEAE</b></p> <p><b>Cynodonteae</b></p> <p><i>Bouteloua</i></p> <p><i>Buchloe</i></p> <p><i>Chloris</i></p> <p><i>Cynodon</i></p> <p><i>Eustachys</i></p> <p><i>Gymnopogon</i></p> <p><i>Hilaria</i></p> <p><i>Schedonnardus</i></p> <p><i>Spartina</i></p> <p><i>Willkommia</i></p> <p><b>Danthonieae</b></p> <p><i>Cortaderia</i></p> <p><i>Danthonia</i></p> <p><b>Eragrostideae</b></p> <p><i>Dactyloctenium</i></p> <p><i>Distichlis</i></p> <p><i>Eleusine</i></p> <p><i>Eragrostis</i></p> <p><i>Erioneuron</i></p> <p><i>Leptochloa</i></p> <p><i>Muhlenbergia</i></p> <p><i>Sporobolus</i></p> <p><i>Tridens</i></p> <p><i>Triplasis</i></p>	<p>Subfamily <b>PANICOIDEAE</b></p> <p><b>Andropogoneae</b></p> <p><i>Andropogon</i></p> <p><i>Bothriochloa</i></p> <p><i>Coelorachis</i></p> <p><i>Dichanthium</i></p> <p><i>Miscanthus</i></p> <p><i>Saccharum</i></p> <p><i>Schizachyrium</i></p> <p><i>Sorghastrum</i></p> <p><i>Sorghum</i></p> <p><i>Stenotaphrum</i></p> <p><i>Tripsacum</i></p> <p><i>Zea</i></p> <p><b>Arundineae</b></p> <p><i>Arundo</i></p> <p><i>Phragmites</i></p> <p><b>Centotheceae</b></p> <p><i>Chasmanthium</i></p> <p><b>Paniceae</b></p> <p><i>Axonopus</i></p> <p><i>Cenchrus</i></p> <p><i>Digitaria</i></p> <p><i>Echinochloa</i></p> <p><i>Eriochloa</i></p> <p><i>Oplismenus</i></p> <p><i>Panicum</i></p> <p><i>Paspalidium</i></p> <p><i>Paspalum</i></p> <p><i>Pennisetum</i></p> <p><i>Sacciolepis</i></p> <p><i>Setaria</i></p> <p><i>Urochloa</i></p>	<p><i>Koeleria</i></p> <p><i>Limnodea</i></p> <p><i>Phalaris</i></p> <p><i>Polypogon</i></p> <p><i>Sphenopholis</i></p> <p><i>Trisetum</i></p> <p><b>Brachypodieae</b></p> <p><i>Brachypodium</i></p> <p><b>Bromeae</b></p> <p><i>Bromus</i></p> <p><b>Diarrheneae</b></p> <p><i>Diarrhena</i></p> <p><b>Meliceae</b></p> <p><i>Glyceria</i></p> <p><i>Melica</i></p> <p><b>Poeae</b></p> <p><i>Aira</i></p> <p><i>Alopecurus</i></p> <p><i>Dactylis</i></p> <p><i>Desmazeria</i></p> <p><i>Festuca</i></p> <p><i>Lolium</i></p> <p><i>Phleum</i></p> <p><i>Poa</i></p> <p><i>Sclerochloa</i></p> <p><i>Vulpia</i></p> <p><b>Stipeae</b></p> <p><i>Nassella</i></p> <p><b>Triticeae</b></p> <p><i>Aegilops</i></p> <p><i>Elymus</i></p> <p><i>Hordeum</i></p> <p><i>Pascopyrum</i></p> <p><i>Secale</i></p> <p><i>Triticum</i></p>
<p>Subfamily <b>ORYZOIDEAE</b></p> <p><b>Oryzeae</b></p> <p><i>Leersia</i></p> <p><i>Zizaniopsis</i></p>	<p>Subfamily <b>POOIDEAE</b></p> <p><b>Aveneae</b></p> <p><i>Agrostis</i></p> <p><i>Avena</i></p> <p><i>Briza</i></p>	



# LIST OF TEXAS ENDEMIC OCCURRING IN NORTH CENTRAL TEXAS

CONTRIBUTED BY BONNIE AMOS, PAULA HALL, AND KELLY MCCOY  
(AMOS ET AL. 1998) ANGELO STATE UNIVERSITY

## DICOTS

### Acanthaceae

*Ruellia drummondiana* (Nees) A. Gray

### Apiaceae

*Daucosma laciniatum* Engelm. & A. Gray

### Asclepiadaceae

*Asclepias linearis* Scheele

*Matelea edwardsensis* Correll

### Asteraceae

*Chaptalia texana* Greene

*Chrysopsis texana* G.L. Nesom

*Cirsium engelmannii* Rydb.

*Palafoxia hookeriana* Torr. & A. Gray

*Palafoxia reverchonii* (Bush) Cory

*Pectis angustifolia* Torr. var. *fastigiata*  
(A. Gray) D.J. Keil

*Senecio ampullaceus* Hook.

*Silphium albiflorum* A. Gray

*Verbesina lindheimeri* B.L. Rob. & Greenm.

### Boraginaceae

*Cryptantha texana* (A. DC.) Greene

*Onosmodium helleri* Small

### Brassicaceae

*Arabis petiolaris* (A. Gray) A. Gray

*Lesquerella densiflora* (A. Gray) S. Watson

*Lesquerella grandiflora* (Hook.) S. Watson

*Lesquerella recurvata*

(Engelm. ex A. Gray) S. Watson

### Campanulaceae

*Triodanis coloradoensis* (Buckley) McVaugh

*Triodanis texana* McVaugh

### Celastraceae

☞ *Evonymus atropurpurea* Jacq.  
var. *cheatumii* Lundell

### Cistaceae

*Lechea san-sabeana* (Buckley) Hodgdon

### Convolvulaceae

*Dichondra recurvata* Tharp & M.C. Johnst.

### Euphorbiaceae

*Chamaesyce angusta* (Engelm.) Small

☞ *Croton alabamensis* E.A. Sm. ex Chapm.  
var. *texasensis* Ginzburg

*Ditaxis aphoroides* (Müll.Arg.) Pax

*Euphorbia roemeriana* Scheele

### Fabaceae

*Astragalus crassicaarpus* Nutt.

var. *berlandieri* Barneby

*Astragalus nuttallianus* DC. var. *pleianthus*  
(Shinners) Barneby

*Astragalus reflexus* Torr. & A. Gray

*Astragalus wrightii* A. Gray

*Dalea hallii* A. Gray

☞ *Dalea reverchonii* (S. Watson) Shinners

*Dalea tenuis* (J.M. Coult.) Shinners

*Desmanthus acuminatus* Benth.

*Galactia canescens* (Scheele) Benth.

*Galactia heterophylla* A. Gray

*Lupinus texensis* Hook.

*Pediomelum cyphocalyx* (A. Gray) Rydb.

*Pediomelum hypogaeum* (Nutt. ex Torr. & A.

Gray) Rydb. var. *scaposum* (A. Gray) Mahler

*Pediomelum latestipulatum* (Shinners) Mahler

var. *appressum* (Ockendon) Ghandi & L.E. Br.

*Pediomelum latestipulatum*

(Shinners) Mahler var. *latestipulatum*

*Tephrosia lindheimeri* A. Gray

*Trifolium bejariense* Moric.

### Fumariaceae

*Corydalis curvisiliqua* Engelm. subsp. *curvisiliqua*

### Garryaceae

*Garrya ovata* Benth. subsp. *lindheimeri*  
(Torr.) Dahling

### Hydrophyllaceae

*Phacelia strictiflora* (Engelm. & A. Gray) A. Gray  
var. *strictiflora*

### Lamiaceae

*Brazoria truncata* (Benth.) Engelm. & A. Gray  
var. *truncata*

*Monarda punctata* L. var. *intermedia*  
(E.M. McClint. & Epling) Waterf.

*Physostegia pulchella* Lundell  
*Salvia engelmannii* A. Gray  
*Teucrium cubense* Jacq. var. *laevigatum*  
 (Vahl) Shinnery

**Malvaceae**

*Malvastrum aurantiacum* (Scheele) Walp.

**Nyctaginaceae**

*Abronia ameliae* Lundell  
*Mirabilis gigantea* (Standl.) Shinnery

**Onagraceae**

*Oenothera coryi* W.L. Wagner

**Oxalidaceae**

*Oxalis drummondii* A. Gray

**Papaveraceae**

*Argemone aurantiaca* G.B. Ownbey

**Polemoniaceae**

*Phlox drummondii* Hook. subsp. *wilcoxiana*  
 (Bogusch) Wherry  
*Phlox pilosa* L. subsp. *latisejala* Wherry  
*Phlox pilosa* L. subsp. *riparia* Wherry  
*Phlox roemeriana* Scheele

**Ranunculaceae**

*Clematis texensis* Buckley

**Rosaceae**

*Prunus serotina* Ehrend. var. *eximia* (Small) Little  
*Rubus apogaeus* L.H. Bailey

**Rubiaceae**

*Houstonia parviflora* Holz ex Greenm.  
*Houstonia subviscosa* (C. Wright ex A. Gray) A. Gray

**Scrophulariaceae**

*Agalinis edwardsiana* Pennell  
*Castilleja purpurea* (Nutt.) G. Don var. *lindheimeri*  
 (A. Gray) Shinnery  
*Penstemon guadalupensis* A. Heller  
*Penstemon triflorus* A. Heller  
 subsp. *integrifolius* Pennell

**Solanaceae**

*Bouquetia erecta* DC.

**Styracaceae**

*Styrax platanifolius* Engelm. ex Torr.

**Valerianaceae**

*Valerianella stenocarpa* (Engelm. ex A. Gray) Krok

**Vitaceae**

*Parthenocissus heptaphylla* (Buckley)  
 Britton ex Small  
*Vitis monticola* Buckley

**MONOCOTS****Agavaceae**

*Nolina lindheimeriana* (Scheele) S. Watson

*Yucca constricta* Buckley

 *Yucca necopina* Shinnery

 *Yucca pallida* McKelvey

*Yucca rupicola* Scheele

**Commelinaceae**

*Tinantia anomala* (Torr.) C.B. Clarke

*Tradescantia edwardsiana* Tharp

*Tradescantia gigantea* Rose

*Tradescantia humilis* Rose

*Tradescantia subcaulis* Bush

**Cyperaceae**

*Carex edwardsiana* E.L. Bridges & Orzell

**Juncaceae**

*Juncus texanus* (Engelm.) Coville

*Juncus validus* Coville var. *fasciatus* M.C. Johnston

**Liliaceae**

*Allium runyonii* Ownbey

**Poaceae**

*Muhlenbergia x involuta* Swallen

[*M. lindheimeri* × *M. reverchonii*]

*Tridens congestus* (L.H. Dewey) Nash

*Willkommia texana* Hitchc.

 Indicates taxa endemic to North Central Texas.

## ILLUSTRATION SOURCES

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- BTT *Brittonia*. 1931/35+. New York Botanical Garden. New York.  
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- BUD Budd, A.C. 1957. *Wild plants of the Canadian prairie* (publication 983). Agriculture Canada. Ottawa.  
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- CGH Contr. Gray Herb. 1891–1984. Harvard University. Cambridge, MA.  
Reproduced with permission of the Library of the Gray Herbarium.
- CHA Chaudhuri, M.N. 1968. *Mededelingen. Botanisch Museum en Herbarium van de Rijksuniversiteit te Utrecht* No. 285. Utrecht.  
Reprinted with permission of Botanisch Museum en Herbarium.
- CHT Chittenden, F.J. 1956. *The Royal Horticultural Society dictionary of gardening*. Royal Horticultural Society. Oxford.  
Reprinted with permission of the Royal Horticultural Society.
- CO1 Correll, D.S. and Correll, H.B. 1972. *Aquatic and wetland plants of southwestern United States*. Environmental Protection Agency. Washington, DC.
- CO2 Correll, D.S. 1950. *Native orchids of North America north of Mexico*. Chronica Botanica Company. Waltham, MA.  
Unable to locate copyright owner.
- COC Cocks, R.S. 1910. *Leguminosae of Louisiana* (Bull. no. 1). Louisiana State Museum. New Orleans.
- COO Cooper, C.S. and Westell, W.P. 1909. *Trees and shrubs of the British Isles native and acclimatised*. J.M. Dent and Company. London.
- COR Cornut, J.P. 1635. *Canadensium plantarum, aliarumque nondum editarum historia*. Simon le Moyne. Paris.
- CUM Contr. Univ. Michigan Herb. 1939+. University Herbarium. Ann Arbor, MI.  
Reprinted with permission of the University of Michigan Herbarium.
- CUR Curtis's Botanical Magazine. 1787+. Royal Botanic Gardens, Kew, England.  
Reprinted with permission of the Royal Botanic Gardens, Kew.
- DAR Darlington, H.T. and Bessey, E.A. 1940. *Some important Michigan weeds*. Michigan State College Agricultural Experiment Station. East Lansing.
- DEL Delessert, B. 1820–1846. *Icones selectae plantarum*. Fortin, Masson and Company. Paris.
- DIL Dillenio, J.J. 1732. *Hortus elthamensis seu plantarum rariorum*. Sumptibus Auctoris. London.
- DOR Dormon, C. 1942. *Wild flowers of Louisiana*. Department of Conservation. New Orleans.
- DUN Dunal, M.F. 1813. *Histoire naturelle, medicale et economique des solanum*. Strasbourg. London.
- EGG Eggers Ware, D.M. *A revision of Valerianella in North America*. Ph.D dissertation.  
Reprinted with permission from Donna Eggers Ware.
- EMO Emory, W.H. 1857–1859. *United States and Mexican boundary survey*. United States Government Printing Office. Washington, DC.
- EN1 Engler, A. 1900–1953. *Das pflanzenreich*. Duncker and Humblot. Berlin.  
Reproduced with permission of Duncker and Humblot GmbH. Verlagsbuchhandlung. Berlin.
- EN2 Engler, A. and Prantl, K. 1887–1915. *Die natürlichen pflanzenfamilien*. Gebrueder Borntraeger. Stuttgart.  
Originally published in "Die Natürlichen Pflanzenfamilien," reprint 1958/60 by J. Cramer in der Gebrueder Borntraeger Verlagsbuchhandlung, D–14129 Berlin D–70176 Stuttgart.

- F&L Field & Lab. 1932–1970. Southern Methodist University Press. Dallas, TX.
- FAW Fawcett, W. 1910–1936. Flora of Jamaica. British Museum (Natural History). London.
- FLN Fl. Neotrop. Monogr. 1967+. New York Botanical Garden. New York.  
Reprinted with permission from *The Alismataceae. Flora Neotropica*, vol. 64, page, 43, fig. 22D,  
Copyright ©1994, Robert Haynes, and The New York Botanical Garden.
- FMC Heller, A.A. 1895. Botanical explorations in southern Texas during the season of 1894.  
The New Era Printing House. Lancaster, PA.
- FUC Fuchs, L. 1542. De historia stirpium commentarii insignes. Isingrin. Basel.
- G&F Gard. & Forest. 1888–1897. The Garden and Forest Publishing Co. New York.
- GAN Gandhi, K.N. and Thomas, R.D. 1989. Asteraceae of Louisiana. Sida, Bot. Misc. 4.
- GAR Gartenflora. 1852–1938. Verlag von Ferdinand Enke. Stuttgart, Germany.
- GAT Gates, F.C. 1941. Weeds in Kansas. Kansas State Board of Agriculture. Topeka.  
Reprinted with permission of the Kansas State Board of Agriculture.
- GBN Great Basin Naturalist. 1939/40+. Brigham Young University. Provo, UT.  
Reprinted with permission of Brigham Young University.
- GEN Gentes Herbarium. 1920+. L.H. Bailey Hortorium. Ithaca, NY. Reprinted with permission of the L.H. Bailey Hortorium.
- GEO Georgia, A.E. 1916. A manual of Weeds. The Macmillan Company. New York.
- GHS Gentry, H.S. 1972. The Agave family in Sonora (Agricultural Handbook no. 399). United States Department of Agriculture. Washington, DC.
- GLE Gleason, H.A. 1952. The new Britton and Brown illustrated flora of the northeastern United States and adjacent Canada. New York Botanical Garden. New York. Reprinted with permission from the *New Britton and Brown Illustrated Flora of the northeastern United States and Adjacent Canada* by Henry A. Gleason, vol. 1, pages 107, 256, 369, 414, 416; vol. 2, pages 44, 51, 57, 67, 69, 90, 91, 104, 105, 109, 111, 113, 136, 140, 143, 144, 161, 179, 217, 222, 239, 245, 279, 280, 358, 376, 393, 403, 405, 409, 413, 432, 438, 453, 456, 463, 475, 476, 480, 515, 518, 519, 521, 522, 525, 526, 533, 535, 542, 566, 569, 571, 577, 579, 584, 593, 595, 602, 633, 645; vol. 3, pages 51, 55, 61, 93, 95, 115, 119, 128, 129, 132, 134, 158, 163, 181, 184, 188, 190, 200, 212, 222, 224, 231, 235, 236, 245, 253, 272, 273, 277, 279, 280, 281, 284, 289, 313, 317, 319, 338, 341, 343, 349, 351, 366, 369, 392, 399, 409, 411, 431, 433, 453, 466, 471, 473, 476, 497, 498, 501, 502, 510, 536, 537, 541, Copyright © 1952, The New York Botanical Garden.
- GO1 Gould, F.W. and Box, T.W. 1965. Grasses of the Texas coastal bend. Texas A&M University Press. College Station.  
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- GO2 Gould, F.W. 1975. The grasses of Texas. Texas A&M University Press. College Station.  
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- GO3 Gould, F.W. 1951. Grasses of the southwestern United States. University of Arizona Press. Tucson.  
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- GO4 Gould, F.W. 1978. Common Texas grasses: An illustrated guide. Texas A&M University Press. College Station.  
Reprinted with permission from Lucille Gould Bridges and Texas A&M University Press.
- GOO Goodspeed, T.H. 1954. The genus *Nicotiana*. Chronica Botanica Company. Waltham, MA.  
Unable to locate copyright owner.
- GR1 Gray, A. 1848–1849. Genera florae americanae boreali-orientalis illustrata. James Munroe and Company. New York.
- GR2 Gray, A. 1852–1853. Plantae wrightianae. Smithsonian Institution Press. Washington, DC.
- GRE Graham, E.H. 1941. Legumes for erosion control and wildlife (miscellaneous publication no. 412). United States Department of Agriculture. Washington, DC.
- GWO Godfrey, R.K. and Wooten, J.W. 1979–1981. Aquatic and wetland plants of southeastern states. University of Georgia Press. Athens. Reprinted with permission of the University of Georgia Press, Copyright © 1979, 1981.
- HAL Hall, H.M. 1928. The genus *Haplopappus*. Carnegie Institute. Washington, DC.
- HE1 Hermann, F.J. 1960. Vetches of the United States – native, naturalized, and cultivated. (Agricultural Handbook no. 168). United States Department of Agriculture. Washington, DC.
- HE2 Hermann, F.J. 1962. A revision of the genus *Glycine* and its immediate allies (Technical Bulletin no. 1268). United States Department of Agriculture. Washington, DC.
- HEA Heagy, L. 1999. Original Illustrations. Published herein by The Botanical Research Institute of Texas. Fort Worth.  
Artist: Linda 'Linny' Heagy. Copyright © 1999.
- HI1 Hitchcock, A.S. 1935. Manual of the grasses of the United States.  
United States Department of Agriculture. Washington, DC.
- HI2 Hitchcock, A.S. 1950. Manual of the grasses of the United States (2nd ed.). United States Department of Agriculture. Washington, DC.

- HIG Hignight, K.W., Wipff, J.K., and Hatch, S.L. 1988. Grasses (Poaceae) of the Texas cross timbers and prairies. Texas Agricultural Experiment Station. College Station.
- HO1 Hooker, W.J. 1829–1840. *Flora boreali-americana*. Treuttel and Wurtz. Paris.
- HO2 Hooker, W.J. 1829–1833. *Botanical miscellany*. John Murray. London.
- HO3 Hooker, W.J. and Arnott, G.A.W. 1830–1841. *The botany of Captain Beechey's voyage*. Henry G. Bohn. London.
- HO5 Hooker's *Icones Plantarum*. 1867/71+. Williams and Norgate. London.  
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- HUM Humboldt, F.W.H.A. von. 1815–1825. *Nova genera et species plantarum*. Librairie Greque-Latine-Allemande. Paris.
- IOW Iowa State J. Sci. 1959–1972. The Iowa State University Press. Ames, Iowa.  
Reprinted with permission of the Iowa State University Press.
- IPL *Icon. Pl.* 1837–1864. Longman, Orme, Brown, Green, and Longmans. London.  
Reprinted with permission of the Royal Botanic Gardens, Kew.
- IVE Ivey, R.D. 1986. *Flowering plants of New Mexico*. Robert Dewitt Ivey. Albuquerque, NM.  
Reprinted with permission from Robert Dewitt Ivey.
- JAA J. Arnold Arbor. 1920–1990. Arnold Arboretum of Harvard University. Cambridge, MA.  
Reprinted with permission of the Arnold Arboretum of Harvard University.
- JAC Jacquin, N. J. 1763. *Selectarum stirpium americanarum historia*. Krausiana. Vindobone.
- JEM J. Elisha Mitchell Sci. Soc. 1884+. North Carolina Academy of Science. Durham, NC.  
Reprinted with permission of North Carolina Academy of Science.
- JEP Hickman, J.C. ed. *The Jepson manual: Higher plants of California*. University of California Press. Berkeley.  
Reprinted with permission of the University of California Press.
- JME Jones, M. E. 1923. *Revision of North American species of Astragalus*. Marcus E. Jones. Salt Lake City, UT.
- JON Jones, F.B. 1982. *Flora of the Texas coastal bend* (3rd ed.). Welder Wildlife Foundation. Sinton, TX.  
Reprinted with permission of the Welder Wildlife Foundation.
- KAR Karsten, H. 1891. *Abbildungen zur Deutschen flora*. R. Friedlander and Sohn. Berlin.
- KEM Kew Mag. 1984+. Royal Botanic Gardens, Kew, England.  
Reprinted with permission of the Royal Botanic Gardens, Kew.
- KER Keraudren, M. 1967. *Flore du Cameroun*. Museum National d'histoire Naturelle. Paris.  
Reprinted with permission of the Museum National d'histoire Naturelle.
- KEW Bull. Misc. Inform. 1887–1942. Royal Botanic Gardens, Kew, England.  
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- KIN Kinch, R.C. 1939. *Nebraska weeds* (Bulletin no. 101). Nebraska Department of Agriculture. Lincoln.
- KUR Kurtziana. 1961+. Museo Botanico. Cordoba, Argentina. Reprinted with permission of Museo Botanico.
- KVM Kerner von Marilaun, A. 1894–1895. *The natural history of plants*. Blackie and Son. London.
- LAM Lamarck, J.B.A.P.M. 1791–1823. *Tableau encyclopedique et methodique des trois regnes de la nature*. Chez Pancouke. Paris.
- LEM Le Maout, E. and Decaisne J. 1876. *A general system of botany* (2nd ed.). Longmans, Green, and Company. London.
- LIH Li, Hui-Lin. 1963. *Woody flora of Taiwan*. The Morris Arboretum. Philadelphia, PA.  
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- LIN Lindleyana. 1986+. American Orchid Society, Inc. West Palm Beach, FL.  
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*Lindleyana* vol. 10, no. 1, page 38, fig. 1, Copyright © 1995, D. Goldman.
- LOU Loudon, J.C. 1838. *Arbortum et fruticetum Britannicum*. Longman, Orme, Brown, Green, and Longmans. London.
- LUN Lundell, C.L. 1961–1969. *Flora of Texas*. Texas Research Foundation. Renner.
- LYN Lynch, D. 1981. *Native & naturalized woody plants of Austin & the Hill Country*. St. Edwards University. Austin, TX.  
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- M&F Moore, R.J. and Frankton, C. 1974. *The thistles of Canada*. Agriculture Canada. Ottawa.  
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- MAC Mackenzie, K.K. 1940. *North American Cariceae*. New York Botanical Garden. New York.  
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- MAG Michigan Agric. Exp. Sta. Bull. 1885+. Michigan State University Press. East Lansing.
- MAR Martius, C.F.P. 1840–1906. *Flora Brasiliensis*. Monachii.

- MAS Mason, H.L. 1957. A flora of the marshes of California. University of California Press. Berkeley. Reprinted with permission of the University of California Press.
- MAT Mathias, M.E. and Constance, L. 1965. A revision of the genus *Bowlesia* Ruiz & Pav. (Umbelliferae-Hydrocotyloideae) and its relatives. University of California Press. Berkeley.
- MEE Meehan, T. 1878–1880. The native flowers and ferns of the United States. L. Prang and Company. Boston, MA.
- MEP Parsons, M.E. 1909. The wild flowers of California. Cunningham, Curtiss and Welch. San Francisco.
- MGH Mem. Gray Herb. 1917+. Harvard University. Cambridge, MA. Reprinted with permission of the Library of the Gray Herbarium.
- MIB Michigan Bot. 1962+. Michigan Botanical Club. Ann Arbor. Reprinted with permission from John Thieret.
- MIC Michaux, A. 1820. Flora boreali-americana. Bibliopola Jouanaux Junior. Paris.
- MIT Mitt. Bot. Staatssamml. Munchen. 1950+. Botanische Staatssammlung. Munchen. Reprinted with permission of Botanische Staatssammlung.
- MNY Mem. New York Bot. Gard. 1900+. New York Botanical Garden. New York. Reprinted with permission from *Memoirs of The New York Botanical Garden* by Rupert C. Barneby, vol. 27, pages 685, 701, 703, 705, 709, 711, 717, 721, 859, 861, 865, 867, 870, plates 46, 54, 55, 56, 57, 58, 62, 64, 133, 134, 136, 137, 139, Copyright © 1977, The New York Botanical Garden.
- MOH Mohlenbrock, R.H. 1976. The illustrated flora of Illinois, sedges, *Cyperus* to *Scleria*. Southern Illinois University Press. Carbondale and Edwardsville. Reprinted with permission: Copyright © 1976 Southern Illinois University Press
- MOR Moris, J.H. 1837–1859. Flora Sardoia. Ex Regio Typographeo. Torino.
- MOS Moss, C.E. 1920. The Cambridge British flora. Cambridge University Press. Cambridge. Reprinted with permission of Cambridge University Press.
- MTB Mem. Torrey Bot. Club. 1889/90+. Torrey Botanical Society. New York. Reprinted with permission of the Torrey Botanical Society.
- MUE Muenschner, W.C. 1935. Weeds. The Macmillan Company. New York.
- MUN Munz, P.A. 1935. A manual of southern California botany. Claremont Colleges. Claremont, CA. Reprinted with permission of the University of California Press.
- NEE Nee, Michael. 1986. Flora de Veracruz (fasciculo 49). Instituto de Ecologia. Xalapa. Reprinted with permission of the Instituto de Ecologia.
- NIC Nicholson, G. 1885–1888. The illustrated dictionary of gardening. L. Upcott Gill. London.
- NVE Nees von Esenbeck, T.F.L. 1843. Genera plantarum florae germanicae. Henry and Cohen. Bonn.
- ORA Oregon Agric. Exp. Sta. Bull. 1914+. Oregon State Univ. Agricultural Experiment Station. Corvallis.
- PAR Parker, K.F. 1972. An illustrated guide to Arizona weeds. University of Arizona Press. Tucson. Artist: Lucretia B. Hamilton. Copyright © 1972. Reprinted with permission of the University of Arizona Press.
- PAX Paxton's Mag. Bot. 1834–1849. W.S. Orr and Co. London.
- PBL Pammel, L.H., Ball, C.R. and Lamson-Scribner, F. 1904. The grasses of Iowa part II. Iowa Department of Agriculture. Des Moines.
- PES Pesman, M.W. 1962. Meet flora Mexicana. Dale Stewart King. Globe, AZ. Unable to locate copyright owner, author deceased.
- PHY Phytologia. 1933+. Michael J. Warnock. Huntsville, TX. Reprinted with permission from Michael J. Warnock.
- PLU Plukenetii, L. 1691–1694. Phytographia, sive stirpium illuftriorum & minus cognitarum. Sumptibus Auctoris. London.
- PNW Hitchcock, C.L., Cronquist, A., Ownbey, M., and Thompson, J.W. 1955–1969. Vascular plants of the Pacific northwest. University of Washington Press. Seattle. Reprinted with permission of the University of Washington Press.
- POW Powell, A.M. 1988. Trees & shrubs of Trans-Pecos Texas. Big Bend Natural History Association, Inc. Alpine, TX. Reprinted with permission from Jim Henrickson and Michael Powell.
- PSE Pl. Syst. Evol. 1974+. Springer-Verlag. Vienna. Reprinted with permission of Springer-Verlag.
- RAD Radford, A.E., Ahles, H.E., and Bell, C.R. 1968. *Manual of the vascular flora of the Carolinas*. University of North Carolina Press. Chapel Hill. From *Manual of the Vascular Flora of the Carolinas* by A.E. Radford, H.E. Ahles and C.R. Bell, Copyright © 1968 by the University of North Carolina Press. Used by permission of the publisher.
- RBM Marcy, R.B. 1853. Exploration of the Red River of Louisiana. United States Government Printing Office. Washington, DC.
- RCA Rep. Commiss. Agric. 1862–1893. United States Government Printing Office. Washington, DC.
- REE Reed, C.F. 1970. Selected weeds of the United States (Agricultural Handbook no. 366). United States Department of Agriculture. Washington, DC.
- RHO Rhodora. 1899+. New England Botanical Club. Cambridge, MA. Reprinted with permission of the New England Botanical Club.

- RKG Godfrey, R.K. 1988. Trees, shrubs, and woody vines of northern Florida and adjacent Georgia and Alabama. University of Georgia Press. Athens.
- ROB Robbins, W.W., Bellue, M.K., and Ball, W.S. 1951. Weeds of California. California State Department of Agriculture. Sacramento.
- ROD Rodriguesia. 1935+. Jardim Botânico. Rio de Janeiro. Reprinted with permission of Jardim Botânico.
- ROE Roedner, B.J., Hamilton, D.A., and Evans, K.E. 1978. Rare plants of the Ozark Plateau. North Central Forest Experiment Station Forest Service - United States Department of Agriculture. St. Paul, MN.
- RUI Ruiz, H. and Pavon, J. 1794. Florae Peruvianaee et chilensis prodromus. en la imprenta de Sancha. Madrid.
- RYD Rydberg, P.A. 1932. Flora of the prairies and plains of central North America. Dover Publications Inc. New York.
- SA1 Sargent, C.S. 1902–1913. Trees and shrubs. Houghton, Mifflin and Company. Boston.
- SA2 Sargent, C.S. 1905. Manual of the trees of North America (exclusive of Mexico). Houghton, Mifflin and Company. Boston.
- SA3 Sargent, C.S. 1890–1902. The silva of North America. Houghton, Mifflin and Company. Boston.
- SBM Syst. Bot. Monogr. 1980+. American Society of Plant Taxonomists. Ann Arbor, MI.  
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- SCB Smithsonian Contr. Bot. 1969+. Smithsonian Institution Press. Washington, DC.
- SCO Scopoli, J.A. 1771–1772. Flora carniolica. Impensis Joannis Pauli Krauss. Wien.
- SHI Shinners, L.H. 1958. Shinners' spring flora of the Dallas-Fort Worth Area Texas. Lloyd Shinners. Dallas, TX.
- SID Sida, Contributions to Botany. 1962+. Botanical Research Institute of Texas. Fort Worth.
- SIL Silveus, W.A. 1933. Texas grasses classification and descriptions of grasses. W.A. Silveus. San Antonio.
- SIN Chein, P. and Chih-tsun, T. (ed.). 1985. Flora reipublicae popularis Sinicae. Academia Sinica. Beijing.  
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- SM1 Small, J.K. 1933. Manual of the southeastern flora. University of North Carolina Press. Chapel Hill.  
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- SM2 Small, J.K. 1895. A monograph of the North American species of the genus *Polygonum* (Mem. Dept. Bot. Columbia Coll. Vol. 1). Columbia University Press. New York.
- SMI Smith, J.E. and Sowerby, J. 1790–1814. English botany. Smith, J.E. London.
- STE Steyermark, J.A. 1963. Flora of Missouri. Iowa State University Press. Ames.  
Reprinted with permission of the Missouri Department of Conservation.
- STP Stephens, H.A. 1973. Woody plants of the north central plains. University of Kansas Press. Lawrence.  
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- STR Strausbaugh, P.D. and Core, E.L. 1978. Flora of West Virginia (2nd ed.). Seneca Books Inc. Grantsville, WV.  
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- STW Steward, A.N. 1958. Manual of vascular plants of the lower Yangtze Valley River. Oregon State University Press. Corvallis.  
Reprinted with permission of the Oregon State University Press.
- SUD Sudworth G.B. 1908. Forest trees of the Pacific slope. United States Government Printing Office. Washington, DC.
- SWN SouthW. Naturalist. 1956+. Southwestern Association of Naturalists. San Marcos, TX.  
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- SYS Syst. Bot. 1976+. American Society of Plant Taxonomists. Laramie, WY.  
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- TAN Taylor, N.P. 1985. The genus *Echinocereus*. Royal Botanic Gardens. Kew, England.  
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- TAX Taxon. 1951+. International Bureau for Plant Taxonomy and Nomenclature. Berlin.  
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- TAY Taylor, W.C. 1984. Arkansas ferns and fern allies. Milwaukee Public Museum. Milwaukee, WI.  
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- TKA Trans. Kansas Acad. Sci. 1868/72+. Kansas Academy of Science. Topeka.  
Reprinted with permission of Kansas Academy.
- TOR Bull. Torrey Bot. Club. 1870+. Torrey Botanical Society. Lancaster, PA.  
Reprinted with permission of the Torrey Botanical Society.
- UCP Univ. Calif. Publ. Bot. 1902/03+. University of California Press. Berkeley.  
Reprinted with permission of the University of California Press.
- UKS Univ. Kansas Sci. Bull. 1902–1996. University of Kansas. Lawrence.  
Reprinted with permission from C.D. Michener and R.C. Jackson.
- USB U.S.D.A. Bull. (1985–1901). 1895–1901. United States Department of Agriculture. Washington, DC.

- USC U.S.D.A. Circ. 1895–1901. United States Government Printing Office. Washington, DC.
- USD Stefferud, A. (ed.). 1948. Grass: The yearbook of agriculture 1948. United States Department of Agriculture. Washington, DC.
- USG Wheeler, G.M. 1878. Report upon United States geographical surveys west of the one hundredth meridian (vol. 6-Botany). United States Government Printing Office. Washington, DC.
- USH Contr.U.S. Natl. Herb. 1890–1974. United States Government Printing Office. Washington, DC.
- UWA Univ. Waterloo Biol. Ser. 1971+. University of Waterloo. Waterloo. Reprinted with permission of the University of Waterloo and J.C. Semple.
- VGI Veroff. Geobot. Inst. ETH Stiftung Rubel Zurich. 1961+. Geobotanischen Institut ETH. Zurich. Reprinted with permission of Geobotanischen Institut ETH.
- VIN Vines, R.A. 1960. Trees, shrubs and woody vines of the southwest. University of Texas Press. Austin. Reprinted with permission of University of Texas Press, Austin.
- WAT Watt, G. 1907. The wild and cultivated cotton plants of the world. Longmans, Green, and Company. London.
- WIG Wight, R. 1838–1853. Icones plantarum indiae orientalis. J.B. Pharoah. Madras.
- WIL Wilbur, R.L. 1963. The leguminous plants of North Carolina (Technical Bulletin No. 151). North Carolina Agricultural Experiment Station. Raleigh.
- WOO Wood, A. 1895. How to study plants. American Book Company. New York.
- YUN South-western Forestry College, Forestry Dept. of Yunnan Provinc. 1991. Iconographia arbororum Yunnanicorum. Southwest Forestry College. Yunnan, CHINA. Reprinted with permission of Southwest Forestry College.
- ZO1 Zohary, M. and Heller D. 1984. The genus *Trifolium*. Israel Academy of Sciences and Humanities. Jerusalem. Reprinted with permission of the Israel Academy of Sciences and Humanities.
- ZO2 Zohary, M. 1965. Monographic revision of the genus *Tamarix*. United States Department of Agriculture. Washington, DC.

## LIST OF SELECTED BOTANICALLY RELATED INTERNET ADDRESSES

The following list of internet addresses is intended to provide an entry point into what is a very large and constantly changing pool of information of interest to botanists; it is by no means an attempt at a comprehensive listing. Some of the addresses will soon be outdated, while others are likely to be constant for significant periods of time. One of the major advantages to botanists of this information explosion is that extensive information is accessible from one's desk even without access to major botanical libraries or institutions. This is particularly important to botanists at small colleges and universities. The addresses below have been obtained from the internet and also from unpublished lists by N.G. Miller, Jorge E. Arriagada, and Rahmona Thompson. Updates to this list can be found at:

**<http://artemis.austinc.edu/acad/bio/gdiggs/inter.addresses.html>**

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AGRICULTURAL RESEARCH SERVICE IMAGE GALLERY (for plant images)

**<http://www.ars.usda.gov/is/graphics/photos/plants.htm>**

ALTAVISTA TRANSLATION SERVICE (to translate material to or from various languages)

**<http://babelfish.altavista.digital.com/>**

AMERICAN SOCIETY OF PLANT TAXONOMISTS (Home page and to find addresses of members)

**<http://www.csdl.tamu.edu/FLORA/aspt/aspthome.htm>**

AQUATIC AND WETLAND PLANT DATABASE

**<http://aquat1.ifas.ufl.edu/database.html>**

ASSOCIATION OF SYSTEMATICS COLLECTIONS STANDARDS

**<gopher://www.keil.ukans.edu:70/11/standards/asc>**

AUTHORS OF PLANT NAMES (standard Brummitt & Powell abbreviations)

**<http://www.rbgekew.org.uk/web.dbs/authform.html>**

BALOGH SCIENTIFIC BOOKS WWW SITES IN BOTANY AND GARDENING

**<http://www.balogh.com/botany.html>**

BIODIVERSITY AND BIOLOGICAL COLLECTIONS WEB SERVER

**<http://muse.bio.cornell.edu/>**

BIODIVERSITY WORLDMAP

**<http://spider.nhm.ac.uk/science/projects/worldmap/>**

BIOLOGICAL NOMENCLATURE IN THE 21ST CENTURY

**<http://www.inform.umd.edu/PBIO/nomcl/indx.html>**

BIOTA OF NORTH AMERICA PROGRAM (BONAP—to access John Kartesz data)

**<http://shanana.berkeley.edu/bonap/>**

BOTANICAL AUTHORS INDEX

**<gopher://gopher.mobot.org:70/11/.Author>**

BOTANICAL COLLECTORS DATABASE

**<http://herbaria.harvard.edu/Data/Collectors/collectors.html>**

BOTANICAL DATABASES AT THE SMITHSONIAN INSTITUTION

**<http://www.nmnh.si.edu/botany/database.htm>**

BOTANICAL LIBRARY LISTING OF HERBARIA WORLDWIDE

**<http://www.helsinki.fi/kmus/botmus.html>**

BOTANICAL RESEARCH INSTITUTE OF TEXAS (BRIT)

**<http://www.brit.org>**

BOTANICAL SOCIETY OF AMERICA

**<http://www.botany.org>**

BOTANICAL SOCIETY OF AMERICA BOTANY RELATED WWW SITES

**<http://www.botany.org/bsa/www-bot.html>**

BOTANY.COM ENCYCLOPEDIA OF PLANTS (horticultural information)

**<http://www.botany.com/>**

BOTANY RESOURCES

**<http://www.keil.ukans.edu/cgi-bin/hl?botany>**

CANADIAN POISONOUS PLANTS INFORMATION SYSTEM

**<http://res.agr.ca/brd/poisonpl/>**

CENTER FOR CONSERVATION BIOLOGY NETWORK

**<http://conbio.rice.edu/network>**

CAREERS IN BOTANY (Botanical Society of America)

**<http://www.ou.edu/cas/botany-micro/careers/>**

CARTOGRAPHIC LINKS FOR BOTANISTS

**<http://www.helsinki.fi/kmus/cartogr.html>**

CHECKLIST OF THE VASCULAR PLANTS OF TEXAS

**<http://www.csdl.tamu.edu/FLORA/taes/tracy/coverNF.html>**

CORNELL UNIVERSITY POISONOUS PLANTS WEBPAGE

**<http://www.ansci.cornell.edu/plants/plants.html>**

COUNCIL ON BOTANICAL AND HORTICULTURAL LIBRARIES

**<http://www.clpgh.org/cmnh/library/cbhl/>**

DELTA (DESCRIPTIVE LANGUAGE FOR TAXONOMY)

**<http://biodiversity.uno.edu/delta/delta>**

DIRECTORIO DE ENLACES RELACIONADOS CON LAS PLANTAS

**<http://www.arrakis.es/~jmanuel/links.htm>**

DRAFT BioCODE (1997): the prospective international rules for the scientific names of organisms

**<http://www.rom.on.ca/biodiversity/biocode/biocode1997.html>**

EXPERT CENTER FOR TAXONOMIC IDENTIFICATION (ETI)

**<http://www.eti.bio.uva.nl/>**

FAMILIES OF FLOWERING PLANTS (for family information)

**<http://biodiversity.uno.edu/delta/angio/index.htm>**

FAMILY NAMES IN CURRENT USE

**<http://www.inform.umd.edu/PBIO/fam/ncu.html>**

FLORA EUROPAEA DATABASE

**<http://www.rbge.org.uk/forms/fe>**

FLORA OF NORTH AMERICA

**<http://www.fna.org>**

FLORA OF TEXAS CONSORTIUM

**<http://www.csdl.tamu.edu/FLORA/ftc/ftchome.htm>**

FLORA2K - BIODIVERSITY ON THE INTERNET (to access nomenclatural and family information)

**<http://www.csdl.tamu.edu/FLORA/kartesz/flora2ka.htm>**

FLOWERING PLANT GATEWAY (for plant family information)

**<http://www.isc.tamu.edu/FLORA/newgate/cronang.htm>**

GENERIC FLORA OF THE SOUTHEASTERN UNITED STATES PROJECT

**<http://www.flmnh.ufl.edu/natsci/herbarium/genflor/>**

GEOGRAPHIC NAMES INFORMATION SYSTEM

**<http://www-nmd.usgs.gov/www/gnis/gnisform.html>**

GERMPLASM RESOURCES INFORMATION NETWORK (GRIN)

**<http://www.ars-grin.gov/npgs/tax/>**

GRAY HERBARIUM CARD INDEX (to find scientific names)

**<http://herbaria.harvard.edu/Data/Gray/search.html>**



GRAY HERBARIUM OF HARVARD UNIVERSITY

<http://www.herbaria.harvard.edu>

ILLUSTRATED TEXAS FLORAS PROJECT

<http://artemis.austinc.edu/acad/bio/gdiggs/floras.html>

INDEX HERBARIORUM (Database of U.S. Institutions)

<http://www.nybg.org/bsci/ih/ih.html>

INDEX NOMINUM GENERICORUM

<http://nrmhwww.si.edu/ing/>

INTEGRATED TAXONOMIC INFORMATION SYSTEM DATABASE QUERY

[http://www.itis.usda.gov/itis/itis\\_query.html](http://www.itis.usda.gov/itis/itis_query.html)

INTERNATIONAL ASSOCIATION FOR PLANT TAXONOMY

<http://bgbm3.bgbm.fu-berlin.de/IAPT/default.htm>

INTERNATIONAL CODE OF BOTANICAL NOMENCLATURE (Tokyo Code)

<http://www.bgbm.fu-berlin.de/iapt/nomenclature/code/tokyo-e/>

INTERNATIONAL ORGANIZATION FOR PLANT INFORMATION

<http://lorenz.mur.csu.edu.au/iopi/>

INTERNET DIRECTORY FOR BOTANY

<http://www.uregina.ca/science/biology/liu/bio/idb.shtml>

<http://herb.biol.uregina.ca/liu/bio/idb.shtml>

<http://www.ou.edu/cas/botany-micro/idb/>

INTERNET DIRECTORY FOR BOTANY - ALPHABETICAL LIST

<http://www.uregina.ca/science/biology/liu/bio/botany.shtml>

<http://herb.biol.uregina.ca/liu/bio/botany.shtml>

<http://www.ou.edu/cas/botany-micro/idb-alpha/>

INTERNET DIRECTORY FOR BOTANY: CHECKLISTS, FLORAS, TAXONOMIC DATABASES, VEGETATION

<http://www.helsinki.fi/kmus/botflor.html>

INTERNET DIRECTORY FOR BOTANY: SEARCH ENGINES

<http://www.helsinki.fi/kmus/botfind.html>

INTERNET DIRECTORY FOR BOTANY: SOFTWARE

<http://www.helsinki.fi/kmus/botsoft.html>

INTERNET DIRECTORY FOR BOTANY: SUBJECT CATEGORY LIST

<http://www.helsinki.fi/kmus/botmenu.html>

<http://www.ou.edu/cas/botany-micro/idb/botmenu.html>

INSTITUTE FOR SCIENTIFIC INFORMATION

<http://www.isinet.com/>

LADY BIRD JOHNSON WILDFLOWER CENTER

<http://www.wildflower.org/>

LIST OF LINKS TO BOTANICAL GARDENS, ARBORETA, AND RELATED TOPICS

<http://www.libertynet.org/~bgmap/links.html>

MAJOR WWW AND INTERNET BOTANY ADDRESSES (numerous sites)

<http://www.inform.umd.edu/PBIO/pb250/weba.html>

MEDICAL AND POISONOUS PLANTS DATABASE

<http://www.inform.umd.edu/PBIO/Medicinals/medicinals.html>

[http://www.inform.umd.edu/EdRes/Colleges/LFSC/life\\_sciences/plant\\_biology/Medicinals/medicinals.html](http://www.inform.umd.edu/EdRes/Colleges/LFSC/life_sciences/plant_biology/Medicinals/medicinals.html)

MISSOURI BOTANICAL GARDEN

<http://www.mobot.org/welcome.html>

MLA (MODERN LANGUAGE ASSOCIATION) (How to cite electronic sources)

<http://www.uvm.edu/~ncrane/estyles/mla.html> or

<http://www.cas.usf.edu/english/walker/mla.html>

NAMES IN CURRENT USE FOR EXTANT PLANT GENERA

<http://www.bgbm.fu-berlin.de/iapt/ncu/genera/>

NATIONAL AGRICULTURAL LIBRARY'S AGRICOLA DATABASE (to search for journal articles, etc.)

[www.nal.usda.gov/ag98/ag98.html](http://www.nal.usda.gov/ag98/ag98.html)

NATIVE PLANT CONSERVATION INITIATIVE

<http://www.aqd.nps.gov/npci/>

NATIVE PLANT SOCIETY OF TEXAS

[http://lonestar.texas.net/~jleblanc/npsot\\_austin.html](http://lonestar.texas.net/~jleblanc/npsot_austin.html)

NATURE CONSERVANCY

<http://www.tnc.org>

NATURAL RESOURCES CONSERVATION SERVICE, U.S. DEPARTMENT OF AGRICULTURE, PLANTS PROJECT

<http://trident.ftc.nrcs.usda.gov/>

NEW YORK BOTANICAL GARDEN

<http://www.nybg.org/>

<http://pathfinder.com/@x@JHYGUAmjqJ7Waw/vg/Gardens/NYBG/index.html>

NEW YORK BOTANICAL GARDEN SPECIMEN CATALOG

<http://www.nybg.org/bsci/hcol/hcol.html>

NORTH CENTRAL CHAPTER OF THE NATIVE PLANT SOCIETY OF TEXAS

<http://www.txnativeplants.org>

ORGANIZATION FOR TROPICAL STUDIES (OTS)

<http://www.ots.duke.edu/>

PHYTOCHEMICAL AND ETHNOBOTANICAL DATABASES

<http://www.ars-grin.gov/duke/index.html>

PLANT CHROMOSOME NUMBERS DATABASE

[gopher://cissus.mobot.org/77/.Chromo/.index/chromo](http://gopher://cissus.mobot.org/77/.Chromo/.index/chromo)

PLANT-LINK (search engine for plant information)

<http://www.plantamerica.com/palink.htm>

PLANT TAXONOMISTS ONLINE (to find addresses)

[gopher://gopher.unm.edu:70/00/academic/biology/pto/address.test](http://gopher://gopher.unm.edu:70/00/academic/biology/pto/address.test)

PLANT TAXONOMY LECTURE NOTES - J.L. REVEAL

<http://www.inform.umd.edu/PBIO/pb250/>

PLANTS FOR THE FUTURE (to search for plant uses)

[http://www.sunsite.unc.edu/pfaf/D\\_search.html](http://www.sunsite.unc.edu/pfaf/D_search.html)

PLANTS NATIONAL DATABASE (USDA)

<http://plants.usda.gov/plants>

PLANT TRIVIA TIMELINE

<http://www.huntington.org/BotanicalDiv/Timeline.html>

POISONOUS PLANT DATABASES

[http://www.inform.umd.edu/EdRes/Colleges/LFSC/life\\_sciences/plant\\_biology/Medicinals/harmful.html](http://www.inform.umd.edu/EdRes/Colleges/LFSC/life_sciences/plant_biology/Medicinals/harmful.html)

ROYAL BOTANIC GARDENS, KEW

<http://www.rbgekew.org.uk>

ROYAL BOTANIC GARDENS, KEW DATABASES

<http://www.rbgekew.org.uk/web.dbs/webdbsintro.html>

SCOTT'S BOTANICAL LINKS

<http://www.ou.edu/cas/botany-micro/bot-linx/>

SHINNERS & MAHLER'S ILLUSTRATED FLORA OF NORTH CENTRAL TEXAS

<http://artemis.austinc.edu/acad/bio/gdiggs/shinners.html>

SIDA, CONTRIBUTIONS TO BOTANY

<http://www.brit.org/sida/scb/>

- SMITHSONIAN INSTITUTION BOTANY DEPARTMENT  
<http://www.nmnh.si.edu/departments/botany.html>
- TAXONOMIC RESOURCES AND EXPERTISE DIRECTORY (TRED)  
<http://www.nbii.gov/tred/>
- TEXAS A&M UNIVERSITY BIOLOGY DEPARTMENT HERBARIUM  
<http://csdl.tamu.edu/FLORA/biolherb/tamuhome.htm>
- TEXAS A&M BIOINFORMATICS WORKING GROUP  
<http://csdl.tamu.edu/FLORA/tamuherb.htm>
- TEXAS A&M UNIVERSITY TRACY HERBARIUM  
<http://www.csdl.tamu.edu/FLORA/taes/tracy/homeNF.html>
- TEXAS DEPARTMENT OF PARKS AND WILDLIFE  
<http://www.tpwd.state.tx.us/>
- TEXAS ENDEMIC CHECKLIST  
<http://www.csdl.tamu.edu/FLORA/endemics/endemic1.htm>
- TEXAS NATURAL RESOURCE CONSERVATION COMMISSION  
<http://www.tnrcc.state.tx.us>
- TIME LIFE PLANT ENCYCLOPEDIA  
[http://www.pathfinder.com/@@UW\\*3PgcAd\\*SYsqOD/cgi-bin/VG/vg](http://www.pathfinder.com/@@UW*3PgcAd*SYsqOD/cgi-bin/VG/vg)
- TROPICOS (Worldwide Nomenclature Database)  
<http://mobot.mobot.org/Pick/Search/pick.html>
- TREE OF LIFE  
<http://phylogeny.arizona.edu/tree/phylogeny.html>
- UCMP WEB LIFT TO TAXA  
<http://www.ucmp.berkeley.edu/help/taxaform.html>
- UNIVERSITY OF MICHIGAN HERBARIUM  
<http://www.herb.lsa.umich.edu/umherb.htm>
- UNIVERSITY OF TEXAS HERBARIA  
<http://www.utexas.edu/ftp/depts/prc/>
- UNIVERSITY OF WISCONSIN-MADISON, DEPARTMENT OF BOTANY  
<http://www.wisc.edu/botany>
- VIRTUAL LIBRARY OF ECOLOGY, BIODIVERSITY AND THE ENVIRONMENT  
<http://conbio.rice.edu/vl>
- WHAT ARE ALL THOSE DEAD PLANTS FOR, ANYWAY?  
[http://ucjeps.berkeley.edu/dead\\_plants.html](http://ucjeps.berkeley.edu/dead_plants.html)
- WHAT IS NEW IN BOTANY  
<http://www.uregina.ca/science/biology/liu/bio/bot-new.html>
- WILDFLOWER LINKS  
<http://www.emergence.com/~tnr/wildflower/links.html>
- WORLD TAXONOMISTS DATABASE  
<http://www.eti.bio.uva.nl/database/txnmsts/default.shtml>
- WORLDWATCH INSTITUTE  
<http://www.worldwatch.org>
- WWW VIRTUAL LIBRARY: BOTANY  
<http://www.ou.edu/cas/botany-micro/www-vl/>
- WWW VIRTUAL LIBRARY: EVOLUTION (Biosciences)  
<http://golgi.harvard.edu/biopages/evolution.html>

## TAXONOMY, CLASSIFICATION AND THE DEBATE ABOUT CLADISTICS

Plant taxonomy is the science that deals with the *identification, nomenclature, and classification* of plants. The term plant systematics (or systematic botany) is often used synonymously with plant taxonomy (as is done here) but sometimes has the connotation of mainly using recently developed techniques such as chromosomal studies, electron microscopy, or molecular biology to answer questions about plant relationships. From the definition of plant taxonomy it follows that the primary goals of the discipline are to:

- 1) identify and describe all the various kinds of plants;
- 2) develop a uniform, practical, and stable system of naming plants—one that can be used by both plant taxonomists and others needing a way to precisely communicate information about plants [The naming system for plants follows the International Code of Botanical Nomenclature (Greuter et al. 1994)]
- 3) arrange plants with common characteristics into groups that reflect their relationships—in other words, to develop a scheme of classification that is useful. Similar species are thus put into the same genus, similar genera into the same family, etc. (Lawrence 1951; Porter 1967; Radford et al. 1974; Jones & Luchsinger 1986).

Since the time of Darwin, a primary goal of plant taxonomists has been to reflect phylogeny or evolutionary history in the system of plant classification. While this basic premise is agreed on by virtually all botanists, in recent years there has been heated debate between two main schools of taxonomists:

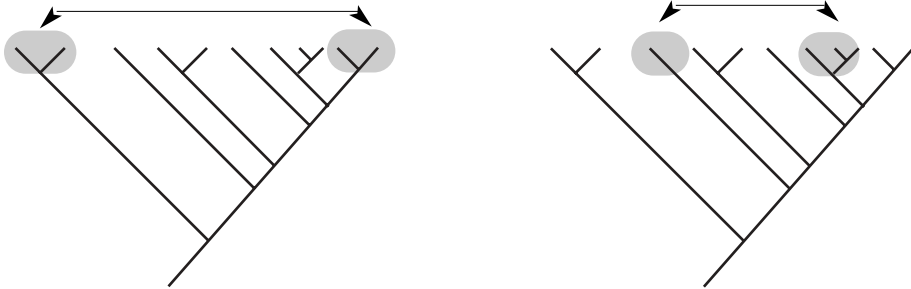
- 1) traditional taxonomists practicing what is sometimes referred to as “Linnaean classification” (Brummitt 1997), a system based on a hierarchy of formal ranks (e.g., family, genus, etc.) and binomial nomenclature (two-part scientific names consisting of a genus name and specific epithet); and
- 2) cladists (whose method of constructing phylogenies is based on the work of the German entomologist Willi Hennig) practicing phylogenetic classification (referred to as cladonomy by Brummitt (1997)). It should be noted that in a clade-based classification system, there are no formal ranks, including the genus, and no binomial nomenclature (de Queiroz & Gauthier 1992; Brummitt 1997; Lidén et al. 1997; Cantino 1998).

In some cases, the classification systems produced by traditional taxonomists and cladists are similar. However, as a result of their different methods, in many instances the classification and nomenclature systems produced are quite different.

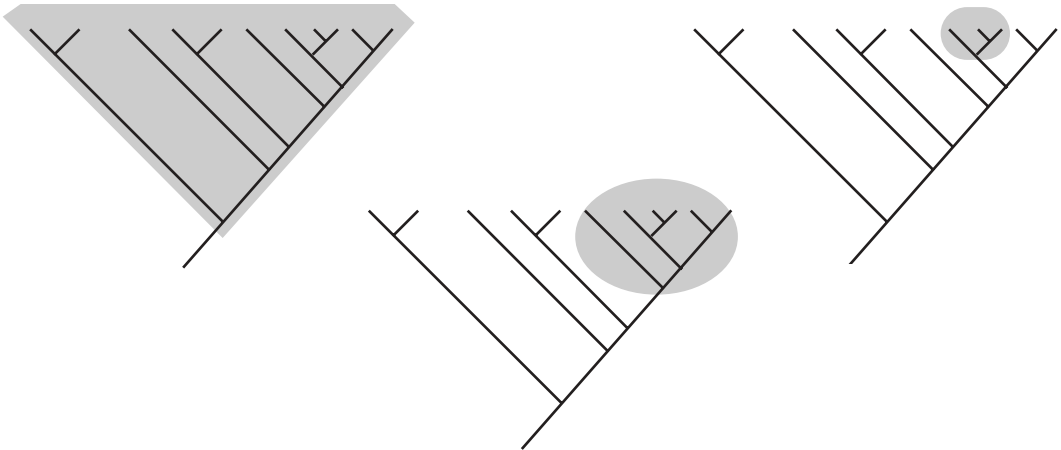
Traditional taxonomists, while attempting to have a classification system based on evolutionary relationships, also try to reflect the amount of evolutionary change undergone by groups. They argue that classification is “... more than just branching patterns of evolution” (Stussey 1997). To use an animal example discussed in more detail below, because birds are so different from other vertebrates (e.g., fly, have feathers), they are treated as a different class of animal even though they evolved *from within* the class known as reptiles. Traditional taxonomists also try to incorporate other goals, including practicality and stability, into the classification system (see Brummitt (1997) for a detailed discussion of traditional classification). An example of a classification system produced by a traditional taxonomist can be seen in the work of Cronquist (1981, 1988) whose classification of flowering plants is given (with modifications) in Appendix I.

The basic goal of cladistics (often referred to as “phylogenetic systematics”), and the only one that is considered important, is that classification should reflect the branching pattern of evolution. Thus one of the central principles of cladistics is that only monophyletic groups (= a common ancestor and all its descendants) should be given taxonomic recognition (Fig. 37). These groupings should be based on shared derived characteristics or character states, which are referred to as synapomorphies. Every organism is a mosaic of *ancestral* characteristics (= plesiomorphies) inherited with little or no change from some remote

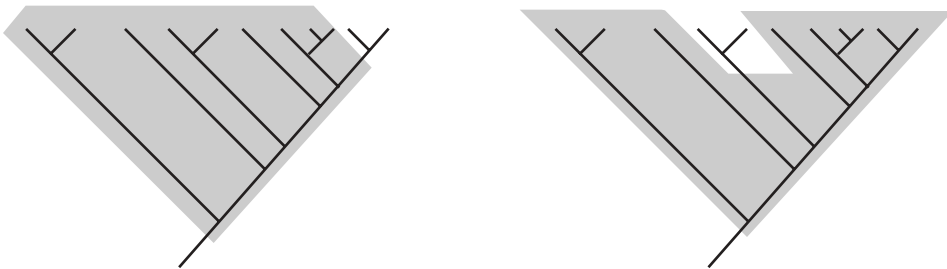
### POLYPHYLETIC GROUPS



### MONOPHYLETIC GROUPS



### PARAPHYLETIC GROUPS

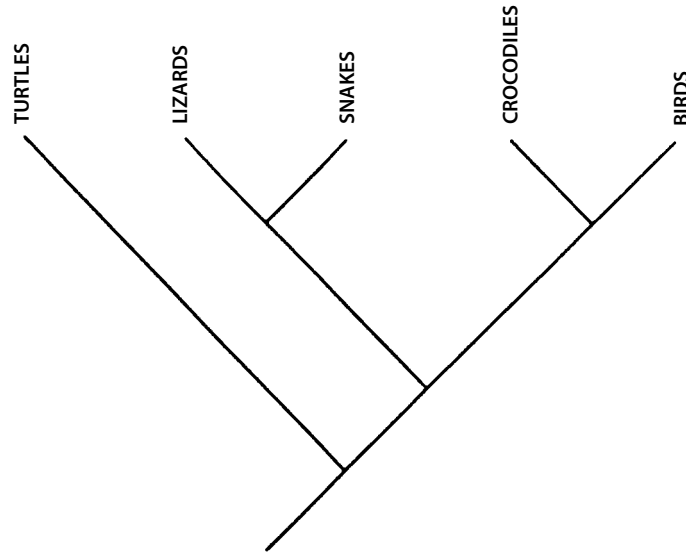


**Fig. 37**/DIAGRAMMATIC REPRESENTATION OF POLYPHYLETIC, MONOPHYLETIC, AND PARAPHYLETIC GROUPS.

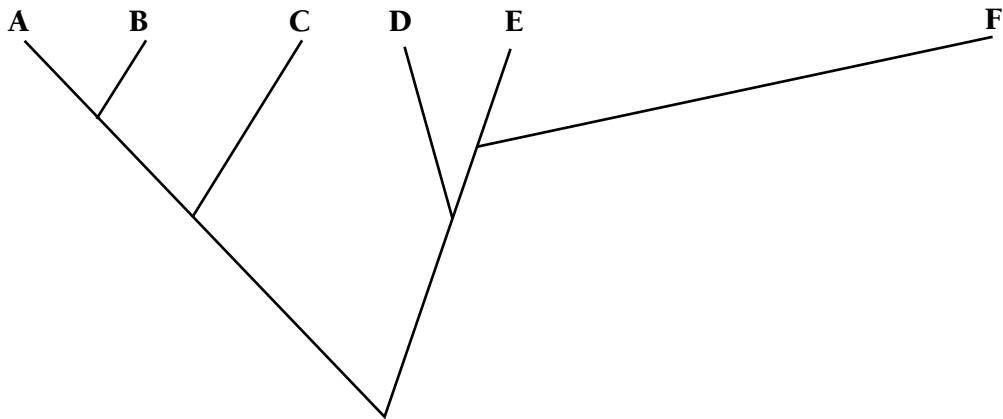
ancestor and *derived* characteristics (apomorphies), which reflect more recent evolutionary change (Futuyma 1986). Apomorphies are thus characteristics that have changed evolutionarily and are different from the characteristics of a distant ancestor. All of the species that *share* an apomorphic characteristic are considered to be derived from a single common ancestor (because they inherited the derived characteristic from that common ancestor). The derived/apomorphic characteristic that they share is referred to as a *synapomorphy*. Mammals are thus considered a monophyletic group because they share a number of synapomorphies (e.g., produce milk, have hair, are warm-blooded) that were inherited from the common ancestor of the mammals. The unique 4+2 arrangement of stamens in the mustard family is another example of a synapomorphy; this derived characteristic occurred in the ancestor of all the mustards and is shared by, and only by, members of that family. According to cladists, only this type of shared derived characteristic provides evidence of phylogenetic relationships and therefore only these characteristics should be used in developing a classification system. They say that shared ancestral characteristics—those characteristics two organisms share because they have been retained from a distant common ancestor—do not accurately reflect recent relationships and should therefore not be used. For example, humans and lizards share the ancestral characteristic of four limbs; snakes, however, have no limbs—legs were lost relatively recently in the evolutionary line leading to snakes. Just because humans and lizards have retained the four limbs found in our common vertebrate ancestor does not mean lizards are more closely related to us than lizards are to snakes. In fact, lizards and snakes are closely related (Fig. 38) and have a number of shared derived characteristics that link them.

According to cladists, polyphyletic groups (containing taxa descended from more than one ancestor) and paraphyletic groups (including the common ancestor and *some, but not all*, of its descendants) should not be recognized (see Fig. 37 for these situations). Further, relationships based on overall similarity (a methodology referred to as phenetics) are not formally recognized—just because two groups appear similar does not necessarily mean they are closely related evolutionarily. For example, the cacti (Cactaceae) and euphorbs (Euphorbiaceae) both have large, desert-adapted, succulent species that are superficially almost indistinguishable but are very distantly related evolutionarily. These similarities are due to convergent evolution, a process by which distantly related, or even unrelated, species evolve similar adaptations in the face of similar selection pressures (such as desert-like conditions).

As indicated above, traditional taxonomists since the time of Darwin have attempted to reflect phylogeny in their systems of classification. However, they have used somewhat different methods than cladists; not only shared derived characteristics, but also shared ancestral characteristics have been utilized. Further, in addition to monophyletic groups, paraphyletic groups often have been recognized if they could be defined phenetically. In fact, our current plant classification system contains numerous examples of paraphyletic groups. The evolutionary tree in Figure 39 is a theoretical example of this situation. Species A, B, C, D, and E are all similar morphologically; species F, however, because of adaptation to some extreme environment (e.g., desert), has become very different morphologically. This phenetic difference of species F is reflected in Figure 39 by its distance from the other species. Traditional taxonomists have in general placed species A, B, C, D and E in one genus, and species F in another. Cladists would argue that this is unacceptable because E and F are more closely related than any of the others (they share the most recent common ancestor); the group A, B, C, D, and E is unacceptable because it is paraphyletic. Either A, B, and C have to be put in one genus and D, E, and F in another, or all six have to be put in the same genus. Traditional taxonomists might counter that these solutions do not reflect the tremendous amount of evolutionary change undergone by species F; they in some cases argue that because F is so different phenetically, it should be recognized as a separate group. An actual example can be seen in the case of the Asclepiadaceae (milkweeds) and Apocynaceae (dogbanes), two families recognized by traditional taxonomists (Fig. 40). The milkweeds, like our theoretical species F, are quite distinctive morphologically and, indeed, are widely recognized as monophyletic. However, when cladistic methods are applied, it becomes readily apparent that the Asclepiadaceae are a monophyletic branch derived from within the Apocynaceae, making the dogbane family (with milkweeds excluded) paraphyletic (like our group A, B, C, D, and E or like the reptiles with the birds removed). From the cladistic standpoint, the two families thus have to be lumped together into a single more inclusive



**Fig. 38**/DENDROGRAM SHOWING RELATIONSHIPS OF SOME VERTEBRATE GROUPS. NOTE THE PARAPHYLETIC NATURE OF THE "REPTILIA."



**Fig. 39**/PHENETIC DISTANCE DIAGRAM; HORIZONTAL DISTANCE BETWEEN SPECIES INDICATES PHENETIC DIFFERENCE. NOTE THAT SPECIES **F**, WHILE MOST CLOSELY RELATED PHYLOGENETICALLY TO SPECIES **E**, IS QUITE DIFFERENT IN TERMS OF PHENETICS.

Apocynaceae (the choice of which name to use is based on the rules of botanical nomenclature) (Judd et al. 1994). To the distress of many traditional taxonomists, the name Apocynaceae is thus used in a very different sense than previously. Traditional taxonomists argue that confusion results from such name changes and that clearly defined and easily recognized groups such as the Asclepiadaceae should be retained. The cladists on the other hand emphasize that the methods used by traditional taxonomists result in groups that do not reflect, and in fact actually distort, our understanding of evolutionary history. Cladists further stress that there are specific objective rules by which their characters are chosen and used. Consequently, they consider the results of their analyses repeatable, and in comparison with traditional taxonomy, less subjective. However, it should be noted that numerous assumptions have to

be made in carrying out a cladistic analysis. In particular, because assumptions have to be made as to which character states are derived and which are ancestral, cladistic analyses are subject to various interpretations. Further, in several recent articles (e.g., Brummitt 1997; Sosef 1997) the argument has been made that in a hierarchical system of classification such as that used by plant taxonomists, paraphyletic taxa are inevitable and that a completely cladistic system of classification would be impractical to the point of being nonsensical.

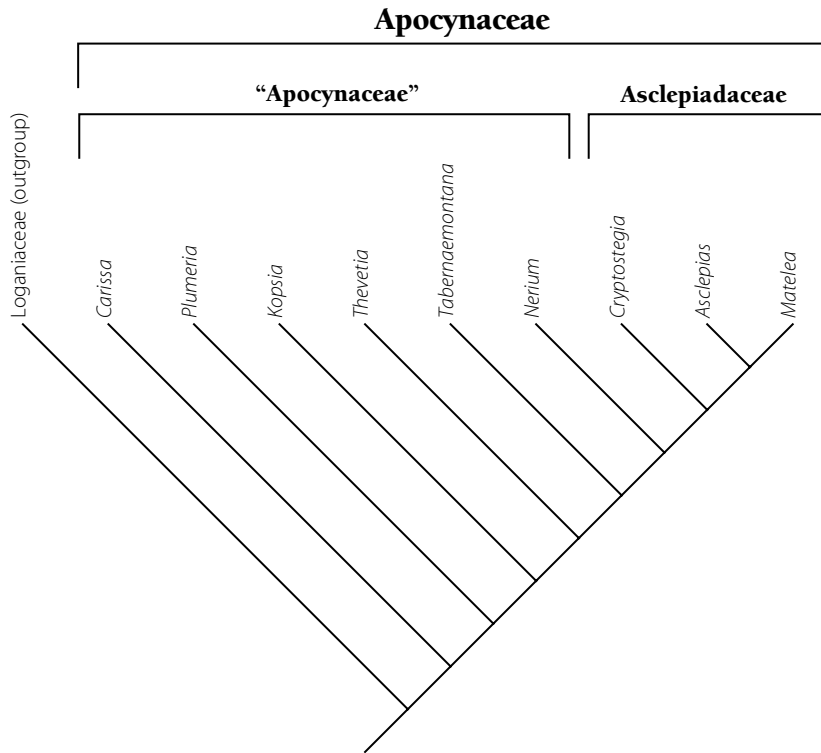
The results of these differing viewpoints are perhaps even more dramatically seen in the case of well known major animal groups. The widely recognized class Reptilia (reptiles) is actually paraphyletic with turtles representing an early branch and birds arising from within the main body of the group (Fig. 38). Even though birds are very different from other members of the group in many ways (e.g., warm-blooded, have feathers, fly, lack teeth), birds and crocodiles are more closely related to one another than crocodiles are to other reptiles; in other words, from an evolutionary standpoint we should no longer recognize a formal group Reptilia. Some traditional taxonomists argue that the amount of evolutionary change, practicality, stability, and tradition in such cases should override phylogeny, while cladists stress the overwhelming importance of accurately reflecting evolutionary history. In any case, at the very least the recognition of the paraphyletic Reptilia de-emphasizes evolutionary history, such as the close relationship between crocodiles and birds.

This controversy over cladistics is currently very heated with clearly articulated positions on both sides. Welzen (1997) for example argued that the outdated "Linnaean system" should be abandoned, and de Queiroz (1997) stated, "The Linnaean hierarchy has become obsolete." De Queiroz (1997) also indicated that the "... next stage in the process of evolutionization [of taxonomy] will extend a central role for the principle of descent into the realm of biological nomenclature." Cantino stated that "Phylogenetic nomenclature is the logical culmination of a revolution that began with Darwin ...." On the other side of the controversy, Brummitt (1997) and Sosef (1997) argued (as indicated above) that paraphyletic taxa are inevitable and that cladistics is unable to cope with the reticulate evolutionary relationships seen in some groups. They further stated (Brummitt & Sosef 1998) that "... attempts to eliminate paraphyletic taxa from Linnaean classification are logically untenable." For a discussion of some of the methodological, conceptual, and philosophical problems associated with cladistics see Stuessy (1997); for a discussion of the importance of consistently applying cladistic methods and thus bringing an evolutionary perspective to biological classification and nomenclatural systems see de Queiroz (1997).

Three things seem clear regarding the controversy:

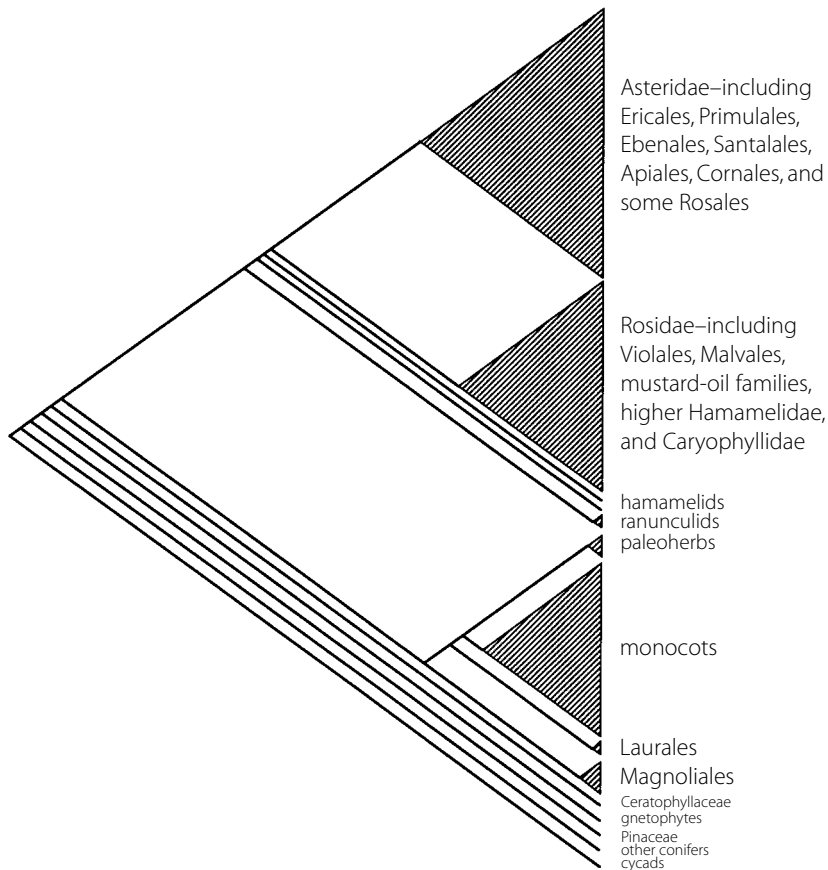
- 1) This argument over cladistics will not easily or quickly be laid to rest and thus a clear understanding of cladistic methodology and results is important. Further explanation of cladistics can be found in standard works on plant taxonomy such as Zomlefer (1994), Walters and Keil (1996), and Woodland (1997), or in evolutionary biology texts such as Ridley (1996).
- 2) The implementation of cladistic methodology would result in systems of classification and nomenclature radically different from those currently used; all the implications are not yet clear, but levels in the current hierarchy such as family or genus would no longer have meaning. In fact, if cladistic principles are consistently applied, it will be necessary for the binomial system of nomenclature to be abandoned (de Queiroz & Gauthier 1992; Lidén et al. 1997; Cantino 1998). The potential loss of nomenclatural stability is particularly disturbing to many taxonomists. Detailed discussions of some of the implications can be found in recent articles (e.g., Brummitt 1997; Crane & Kendrick 1997; de Queiroz 1997; Kron 1997; Lidén et al. 1997; Nicolson 1997; Sosef 1997; Stuessy 1997; Welzen 1997; Freudenstein 1998; Backlund & Bremer 1998; Brummitt & Sosef 1998; Cantino 1998; Sanders & Judd 1998; Schander 1998a, 1998b; Welzen 1998).
- 3) Our knowledge of phylogenetic relationships, despite the advances of molecular biology, is still incomplete and thus all the necessary information for a completely phylogenetic classification system is not yet available. In fact, many groups are poorly known and for some "... cladistic analysis can yield only the most tentative of hypotheses, subject to drastic change as new relatives are encountered" (Stuessy 1997). There are also methodological problems concerning how the characters used in cladistic analyses are chosen and analyzed (Stuessy 1997). The result can be instability in classification, and more problematically, in nomenclature, if it is linked to a rapidly changing cladistic classification system.





**Fig. 40**/DENDROGRAM SHOWING RELATIONSHIP OF TWO CLOSELY RELATED FAMILIES, THE “APOCYNACEAE” AND THE ASCLEPIADACEAE (MODIFIED FROM JUDD ET AL. (1994); USED WITH PERMISSION OF THE PRESIDENT AND FELLOWS OF HARVARD COLLEGE AND W.S. JUDD.)

Because of both philosophical and practical implementation problems, Brummitt (1997) pointed out that while the controversy should be debated, it seems unlikely that “Linnaean classification” will soon be abandoned. Brummitt (1997) suggested that both a “Linnaean classification” system and a clade-based phylogeny are desirable because they have different functions. He argued that both be allowed to exist side by side and that the nomenclature of the two should be easily recognized as different (Brummitt 1997). In summarizing his ideas he stated, “. . . we should not follow traditional practices just because they are traditional, but neither should we adopt new ideas just because they are new. We need to understand the possibilities and appreciate the different objectives and functions of the different options. In the meantime, it seems to me and to many others that the compromise of maintaining Linnaean classification but trying to eliminate paraphyletic taxa is nonsensical and should be abandoned before any more damage is done to existing classifications and nomenclature.” Lidén et al. (1997) indicated, “If applied consistently, Phyllis [cladistic methodology] will cause confusion and loss of information content and mnemonic devices, without any substantial scientific or practical advantage. . . . any attempts to make Phyllis formal would be disastrous. We can find no conclusive, valid arguments against keeping the body of our current system intact.” An interesting point was also made by Stuessy (1997) when he said, “. . . in this urgent climate of seeking to inventory the world’s biota (Anonymous 1994), and requesting funds from the rest of society to do so, it would be highly counterproductive to simultaneously recommend whole-scale change of names of organisms for any reason.” While strongly supporting a cladistic system, Welzen (1998) also noted that a compromise between the two types of classification is impossible. He also understood that because of practical reasons it is impossible to abandon Linnaean classification “. . . because too few cladograms are available to replace the existing system with a complete phylogenetic classification. Moreover, quite a few cladograms will not be that trustworthy due to the many homoplasies [result of convergent evolution] that have evolved; they will



**Fig. 41**/MAJOR CLADES OF SEED PLANTS BASED ON DNA SEQUENCE DATA (FROM CHASE ET AL. 1993). NOTE THAT THE MONOCOTS ARISE FROM WITHIN THE DICOTS, MAKING THE DICOTS PARAPHYLETIC. USED WITH PERMISSION OF THE MISSOURI BOT. GARD. AND M.W. CHASE.

therefore, provide an unstable classification at best.” Welzen (1997) went on to say, “I think, therefore, that the best solution is to choose the second option that Brummitt (1997) provides in his paper, namely, ‘retaining Linnaean classification, with paraphyletic taxa, but developing alongside it an independent clade-based dichotomous system with its own separate nomenclature.’”

At present there is no complete, generally accepted, higher level cladistic analysis of the flowering plants; consequently in Appendix 1 we have given family, order, and subclass relationships based largely on the work of Cronquist (1981, 1988). While imperfect from the cladistic standpoint, it is a practical and effective way to organize thinking about plant relationships. Steps are currently being taken toward a new consensus on angiosperm relationships based on both cladistic analyses and much new evidence from molecular systematics; one such scenario is seen in Figure 41. One of the most important implications of this figure is that the monocots appear to be derived from within the dicots, making the dicots paraphyletic and thus according to cladists inappropriate for formal recognition. It might also be noted that the placement of the paleoherb families (such as the Aristolochiaceae, Piperaceae, and Nymphaeaceae) as branches off the line leading to monocots makes sense in terms of characteristics such as their unusual 3-merous perianth and androecium.

It is important for students to gain some understanding of the phylogenetic relationships of the various plant families. As a result we have added notes at the end of many family descriptions (e.g., Asclepiadaceae, Apocynaceae, Brassicaceae, Capparaceae) concerning the implications of cladistics. However, while we believe this understanding is essential, we do not feel it is appropriate or even desirable to undertake a familial rearrangement on cladistic grounds in a largely floristic work such as this; consequently in most cases traditional family boundaries have been maintained.

## CATEGORIES OR RANKS IN THE HIERARCHICAL SYSTEM OF PLANT CLASSIFICATION

The system of classification used by traditional plant taxonomists and reflected in the International Code of Botanical Nomenclature (Greuter et al. 1994) results in the placement of plants into a hierarchical system with the different categories or ranks given such names as class, family, or genus. Every plant species is thus classified in the higher categories. For example, a bluebonnet (*Lupinus texensis*) is in the family Fabaceae (bean family), the subfamily Papilionoideae, the tribe Genisteae, etc. The various categories or ranks are listed below (a number of additional categories can be inserted as needed). Note that not all categories are always used; while every plant species is classified in the categories given below in all capitals (DOMAIN, KINGDOM, CLASS, SUBCLASS, FAMILY, GENUS, and SPECIES), those categories in lower case letters (Subfamily, Tribe, Subspecies, Variety, Form) are often not used.

**DOMAIN** (sometimes referred to as SUPERKINGDOM; all eukaryotic organisms—those with nuclei in their cells—are in Eukaryota; the other two Domains are Archaea and Eubacteria)

**KINGDOM** (the Kingdoms include Plantae, Animalia, Fungi, etc.)

**DIVISION** (equivalent to Phylum in animal classification; there are nine living divisions of vascular plants; flowering plants are the Division Magnoliophyta)

**CLASS** (there are 2 classes of flowering plants: Monocotyledonae & Dicotyledonae)

**SUBCLASS** (there are 11 subclasses of flowering plants; see Fig. 36 in Appendix 1)

**ORDER** (this level shows relationships between families; it is rarely used by anyone except professional botanists)

**FAMILY** (there are ca. 387–685 families of flowering plants depending on the system of classification used; 149 of these are found in North Central Texas)

**Subfamily** (this level is important for some families such as the Fabaceae; in other families it is not used)

**Tribe** (this level is important for some families such as the Asteraceae; in other families it is not used)

**GENUS** (the genus name is the first part of the two-part or binomial scientific name given to each species)

**SPECIES** (the genus name and the specific epithet together make up the scientific name of a species)

**Subspecies** (a subdivision of a species; many species are not divided into subspecies)

**Variety** (many subspecies are not divided into varieties; sometimes varieties are treated in the same sense as subspecies; in other instances the subspecies category is used for grouping varieties within a species)

**Form** (used for minor differences such as flower color)

When studying plants, the most important levels in terms of organizing your thinking are:

- 1) **Division**—Of the nine divisions of vascular plants, is the plant under study a member of Psilophyta (whisk-ferns), Lycophyta (club-mosses), Equisetophyta (Horsetails), Pteridophyta (Ferns), Cycadophyta (Cycads), Ginkgophyta (Ginkgos), Gnetophyta (Joint-firs and relatives), Pinophyta (Conifers), or Magnoliophyta (Flowering plants)?
- 2) **Class**—If a plant is a flowering plant, is it a monocot (in general: herbs, flower parts in 3s, parallel-veined leaves, 1 cotyledon—seed leaf; examples include grasses, lilies, irises, and orchids) or a dicot (in general: herbs to vines, shrubs, or trees, flower parts in 4s or 5s, net-veined leaves, 2 cotyledons; examples include roses, oaks, blueberries, and sunflowers)?
- 3) **Subclass**—According to the Cronquist system (Fig. 36 in Appendix 1), within the dicots there are six subclasses and within the monocots there are five subclasses. These groups can be useful in understanding the relationships among families.

- 4) **Family** — Most botanists consider this the most important level in the classification hierarchy in terms of learning about flowering plants. The first thing a botanist tries to do with an unknown plant is to figure out what family it belongs to. As indicated above, there are ca. 387–685 families of flowering plants depending on the system of classification used (Cronquist 1988; Reveal 1993). Cronquist (1988) recognized 387, while Mabberley (1997) recognized 405. According to the International Code of Botanical Nomenclature (Greuter et al. 1994), with the exception of eight families with long-established names, all families are named after one of the genera in the family and all have the ending -aceae. Even for these eight families, use of alternative names ending in “-aceae” is permitted. These are Compositae (Asteraceae), Cruciferae (Brassicaceae), Gramineae (Poaceae), Guttiferae (Clusiaceae), Labiatae (Lamiaceae), Leguminosae (Fabaceae), Palmae (Arecaceae), and Umbelliferae (Apiaceae).
- 5) **Genus** — Many plants are easily recognized to genus (e.g., oaks—*Quercus*, maples—*Acer*, etc.). The genus name and the specific epithet are always underlined, italicized, or set off in some other matter. Note that the term specific epithet is used for the second part of the binomial referring to the species; the name of a species is a combination of the genus name and the specific epithet. Each binomial is followed by the authority or person who named the plant. For example, the common sunflower was first named botanically by Linnaeus (abbreviated L.) and the full citation of the scientific name includes the genus, specific epithet, and authority: *Helianthus annuus* L.

The following is an example of the hierarchical system of classification using *Lupinus texensis*, the Texas bluebonnet. Note that subspecies, variety, and form are not given; not all species are divided below the level of species.

**Domain** Eukaryota  
**Kingdom** Plantae  
**Division** Magnoliophyta  
**Class** Dicotyledonae  
**Subclass** Rosidae  
**Order** Fabales  
**Family** Fabaceae  
**Subfamily** Papilionoideae  
**Tribe** Genisteae  
**Genus** *Lupinus*  
**Species** *texensis*  
**Subspecies**  
**Variety**  
**Form**

## CHANGES IN THE SCIENTIFIC NAMES OF PLANTS

One of the most important goals of plant taxonomy is to develop a uniform, practical, and stable system of naming plants—one that can be used by both taxonomists and others needing a way to communicate information about plants. The internationally accepted system of giving scientific names to plants is set forth in the *International Code of Botanical Nomenclature* (Greuter et al. 1994), often referred to simply as the Code.

Why then do names keep changing? Names of plants are changed for three main reasons:

- There are changes due to *legalistic reasons involving the accepted rules of nomenclature* as outlined in the Code. For example, the oldest validly published name for a species must be used unless a later name is officially conserved (this is referred to as the “rule of priority”). While such changes may be inconvenient, without strict application of nomenclatural rules, scientific names would become as inexact and useless for communication as common names. It should be kept in mind that a particular plant species can have numerous common names in a small geographic area (e.g., a state) and dozens of different common names in different languages and different countries.
- There are changes resulting from *shifts in taxonomic philosophies*, such as those exemplified by “splitters” and “lumpers,” or the rejection of paraphyletic groups (for more details see appendix 6 on Taxonomy, Classification, and the Debate about Cladistics).
- Most important, however, are those *changes resulting from an increased understanding of the plant species themselves*. Initial hypotheses on what species exist, and what their diagnostic characteristics are, are sometimes based on a limited number of specimens, little or no experience with the species in the field, and little additional information. These hypotheses are tested whenever more specimens become available for examination, when field work is carried out, or when additional studies are done (including molecular studies, electron microscopy, breeding studies, etc.). Sometimes the initial hypotheses are supported and no name changes are necessary. In other instances the hypotheses need to be modified to reflect the new evidence (e.g., a plant actually belongs in a different genus). This in turn can affect the scientific nomenclature. On-going name changes therefore do not indicate simple equivocation on the part of taxonomists, but rather are an accurate reflection of the dynamic nature of our scientific understanding of the plant kingdom.

In order to minimize the impact of nomenclatural changes on users of this book, we have typically given taxonomic synonyms (particularly commonly used ones) for those species whose names have changed in the recent past. Such synonyms can be found in brackets, [], near the end of the species treatments and can be reached using the index.

This write up was modified from one written by B. Ertter (pers. comm.).



## COLLECTING HERBARIUM SPECIMENS

### WHAT IS AN HERBARIUM?

A collection of pressed and dried plant specimens is known by botanists as an herbarium (plural herbaria). The word herbarium, as originally used, referred to a book about medicinal plants. Pitton de Tournefort (early French botanist and physician) around 1700 used the term for a collection of dried plants and his usage was taken up by Linnaeus (Arber 1938; Stearn 1957; Birdson & Forman 1992). Largely through Linnaeus' influence the word herbarium thus replaced such earlier terms as *hortus siccus* (dry garden) or *hortus hyemalis* (winter garden) (Arber 1938; Stearn 1957; Shinnars 1958a). Luca Ghini (1490?-1556), a botany professor at the University of Bologna, Italy, is considered to have been the first person to dry plants under pressure, mount them on paper, and thus preserve them as a permanent record (Arber 1938; Birdson & Forman 1992). The usefulness of such specimens was soon apparent and his technique was disseminated over Europe by his pupils (Arber 1938). By the time of Carl Linnaeus (1707-1778), this method was well known and widely used (Stearn 1957). The oldest surviving herbarium is that of Ghini's pupil Gherardo Cibo, who began to collect plants at least as early as 1532 (Arber 1938). Other early herbaria were developed in various countries including England, France, Germany, and Switzerland and, in all, more than twenty 16th century collections survive in different European cities (Arber 1938; Valdés 1993). According to Stearn (1957), "The older herbaria consisted of specimens on sheets bound into [book-like] volumes. Linnaeus never adopted this inelastic and expensive procedure but mounted his specimens on loose sheets stored horizontally which could be easily re-arranged and to which other specimens could be added when necessary. Probably due to Linnaeus' example and teaching this method became general during the second half of the 18th century." Modern herbaria still utilize Linnaeus' basic system of mounting specimens individually on loose sheets. Today about 16,000 specimens that were at one time in Linnaeus' personal herbarium survive in England, Sweden, and France and can still be studied (Stearn 1957). From these beginnings, Holmgren et al. (1990) reported 2,639 herbaria worldwide with an estimated 272,800,926 specimens.

### WHAT ARE HERBARIA USED FOR?

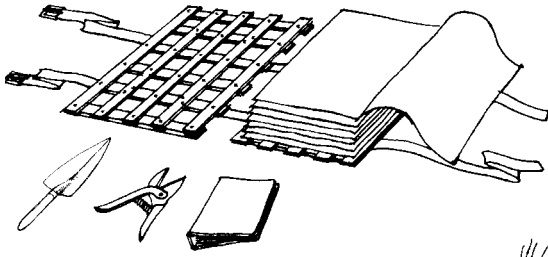
Herbaria are among the most important tools in studying the plants of a given area, with the reasons for this importance being quite diverse (Benson 1979; Birdson & Forman 1992; Valdés 1993). Specific ways in which herbaria are used include: 1) Herbaria are invaluable *reference collections* used as means of identifying specimens of unknown plants. Even experienced botanists frequently need to refer to herbarium specimens in order to definitively identify a plant in question. In this way botanists are able to identify material for such organizations or individuals as poison centers, medical researchers, ranchers, law enforcement agencies, agricultural extension agents, or gardeners. 2) Herbarium specimens, which have an indefinite life if properly protected (the oldest in existence go back almost 500 years), also provide a valuable *historical record* of where plants occurred in the past in both space and time. A local example can be seen in Julien Reverchon's collections from the late 1800s and early 1900s made in the Dallas area. Because the natural vegetation of Dallas has been almost completely destroyed, without Reverchon's specimens we would have almost no knowledge of the previous richness of that flora. Also, herbarium specimens provide early documentation of the introduction of foreign weeds or the previous geographic limits of native plants (Shinnars 1965). These examples demonstrate the importance of herbaria as a special type of museum and as such they are important storehouses of irreplaceable data. In a real sense, herbaria serve as "... a source of primary information about man's explorations and observations of the earth's vegetation..." (Radford et al. 1974) and as "... the raw data underpinning our scientific knowledge of what kinds of plants exist, what their diagnostic features are, what range of variation exists within each, and where they occur" (B. Ertter, pers. comm.). To work with the actual

specimens collected by Carl Linnaeus, Alexander von Humboldt, Asa Gray, or Charles Darwin not only provides us with valuable data, but also links us in a tangible way with the origins of modern science and our own disciplines. 3) Further, because many plants are available for only a small part of the year and because it is impossible to have live specimens of thousands of species from different regions readily available for study, herbaria provide the only practical way to have material of numerous species to compare and study—they thus are important *research tools*. Without a major herbarium such as BRIT (the official abbreviation of the herbarium of the Botanical Research Institute of Texas), a book such as this would have been impossible to produce. In addition, herbaria serve as a record or repository of the specimens upon which all taxonomic articles or books are usually based (Boom 1996). In this way, other botanists can recheck and judge the validity of the work; these are critical steps in the scientific process. Also, because of the wealth of information contained in herbaria, they are essential research tools not only for taxonomists, but also for such diverse fields as ecology, endangered species research, entomology, environmental science, horticulture, medical botany, mycology, and palynology. 4) Finally, herbaria serve an important *educational purpose*. This ranges from their use by advanced undergraduates or graduate students learning taxonomic botany to grade school students learning about the importance of plants and the natural environment in their lives.

### COLLECTING AND PRESSING SPECIMENS

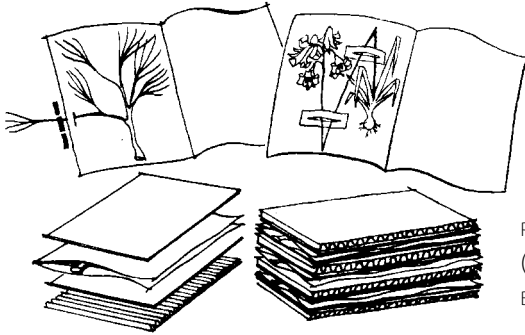
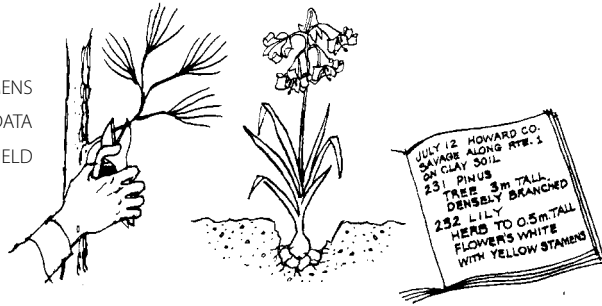
One of the most important considerations regarding plant collecting is to *secure appropriate permission*, whether on private or public land. This is critical in order to maintain a working relationship between landowners and botanists. It is particularly important to be sensitive to such landowner concerns as not damaging fences and properly closing gates. On public lands, such as parks and wildlife refuges, there are often strict collecting regulations with legal sanctions for not following these rules.

When selecting plants, collectors need to be sensitive to whether the plant to be collected is rare and whether the population will be adversely affected by having one or several individuals removed. Because populations of many native plants have been dramatically reduced by human activities, this concern is more important now than ever before. A rule of thumb sometimes given is the “1 to 20” rule—for every plant collected, there should be at least 20 others left in the population (Simpson 1997). Collectors should also bear in mind that certain plants (e.g., cacti, orchids) have special legal protection. Once it is ascertained that there is an adequate population for collecting, individuals representative of the range of variation in the population should be chosen. Individuals with herbivore or pathogen damage should not be ignored (Condon & Whalen 1983; McCain & Hennen 1986a, 1986b) and in fact should often be purposefully selected because such specimens are “information-rich” (J. Hennen, pers. comm.)—that is they often contain fungi, gall-inducing insects, or other pathogens and show characteristic plant responses to such organisms. Ideally, the entire plant, including roots or other underground structures, should be collected or, in the case of trees, shrubs, vines, or other large species, ample material representative of the plant should be obtained. Slender plants can be bent or folded to form a V, N, or even W shape on the sheet in order for them to fit (sometimes the point of the V can be stuck through a slit in the bottom of the newspaper to hold the plant in place). For tiny plants, it is appropriate to collect a number of individuals for each specimen needed. A general rule of thumb is that the folded half-sheet of newspaper being used in the pressing process (a full sheet torn in half) should be reasonably well-covered by plant material without excessive overlap or crowding. The best specimens have both flowers and fruits—while this is often not possible, all specimens should have some reproductive structures (either spores, cones, flowers, or fruits). Because most taxonomic keys are based on reproductive characters, sterile specimens are often useless. In fact, many botanists collect extra flowers or fruits to use in identification. Seeds, fruits, or other parts that become easily detached and are in danger of being lost should be put in small envelopes or bags and kept with the specimen. Extremely large structures (e.g., pine cones, large fruits) cannot be pressed and have to be carefully numbered (to match the specimen from which they were detached) and stored separately.



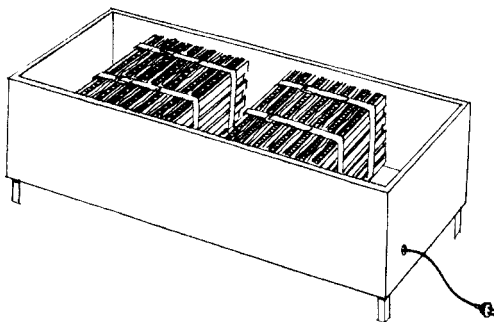
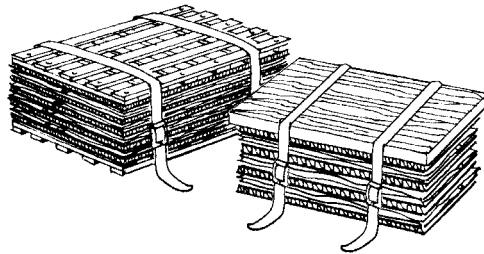
FIELD PRESS,  
CUTTING OR DIGGING TOOLS,  
AND FIELD BOOK

COLLECTING SPECIMENS  
AND RECORDING DATA  
IN THE FIELD



PRESS MATERIALS: FOLDS OF NEWSPAPER  
(INTO WHICH SPECIMENS ARE PLACED),  
BLOTTERS, AND CORRUGATED CARDBOARDS

PLANT PRESSES — THE PRESS AT THE LEFT  
HAS END BOARDS MADE OF WOOD LATTICE;  
THE ONE AT RIGHT HAS PLYWOOD END BOARDS



PLANT DRYER WITH LIGHT BULBS  
AS HEAT SOURCE

Fig. 42/PLANT PRESSING EQUIPMENT (MODIFIED FROM SMITH 1971).



The highest quality specimens are probably obtained by carrying a lightweight press into the field and doing preliminary pressing there. Such a press is usually referred to as a “field press” and generally consists only of straps, lightweight end boards, two or three cardboards, and newspapers (Fig. 42). Because of the absence of blotters and most cardboards, a field press is much lighter than a regular press and is thus suitable for carrying some distance in the field. Specimens pressed in this way can later be rearranged (leaves flattened, etc.) before being put between blotters and cardboards for final pressing and drying. However, instead of using a field press, practicality sometimes dictates that plastic bags be used to transport the plants back to a car, kitchen table, laboratory, etc., for pressing. We have found that carrying a number of large zip-type bags (which can be reused) inside a plastic trash bag works well. Plants collected in this way and sprinkled with water can often be stored overnight in the plastic bag in a refrigerator with little loss of quality. In the past, botanists temporarily stored specimens in a metal container (called a vasculum) in folds of wet paper.

The pressing process begins by putting the plant in a single half-sheet of newspaper (22" × 14") folded crosswise (the folded half-sheet of newspaper should thus measure 11" × 14"). While this size may seem arbitrary, all subsequent steps in the collecting/herbarium process are tied to this size—these include plant dryers, cardboards and blotters for drying, specially designed herbarium storage cases, certain size shipping boxes, etc. The leaves, flowers, and other structures should be arranged in as natural a manner as possible on the newspaper while at the same time trying to avoid excessive overlap. Folding or bending the plant is often necessary as is the trimming off of excess material. When trimming is done (e.g., excess leaves removed), it should be carried out in a way that makes it clear that material was removed (e.g., a portion of the petiole of a removed leaf should be left). In order to insure the best possible results, delicate structures such as flowers can be given additional padding with small pieces of blotter or pads made of folded pieces of newspaper or paper towels. Another consideration is that leaves should be arranged so that both surfaces can be seen (hair characters of the lower surface are often important); likewise, all parts of the plant, especially reproductive structures, should be accessible for study. At least some flowers should be spread open so that the internal structures will be visible for examination. A number (corresponding to a number in a collecting notebook) is written on the lower corner of the half-sheet of newspaper on the left edge or bottom adjacent to the folds. Permanent, bold red felt-tip markers are very handy for marking newsprint. An absorbent felt or thick paper blotter is then placed on each side of the fold of newspaper containing the specimen and this “sandwich” is placed between two pieces of corrugated cardboard. Additional plants are treated in the same fashion until all have been put in the press. The result is the following sequence: cardboard, blotter, fold of newspaper with plant, blotter, cardboard, blotter, fold of newspaper with plant, etc. (Fig. 42). While it may at first seem a waste of space, specimens of only one species should be placed in each fold of newspaper—this prevents getting “mixed collections” that are often confusing. It is also necessary to treat each species separately because, as discussed below, it is important to accurately record detailed written information about each one. After the plant material has been placed in newspaper between blotters and cardboards, wooden (or other stiff material) end boards are put on each side of the entire stack and straps are used to apply pressure, thus “pressing” the plants (Fig. 42). In this manner, as the plants dry they do not shrivel and high quality specimens can be obtained. The blotters wick moisture away from the plants and the corrugations in the cardboards allow water to easily escape the press. Some botanists use only cardboards (no blotters), with little loss of specimen quality; this is frequently done when the weight of the press is an important consideration or when a source of blotters is not available. In order to speed the drying process (a necessity in humid areas such as many places in the tropics), a heat or forced air source is often necessary. An easy way to heat a press is to leave it in the back seat or trunk of a car. A roof rack is also an excellent place for a plant press. Plant dryers utilizing light bulbs as a heat source are easy and inexpensive to build and are usually used by professional botanists; however, care should be taken to avoid the danger of fire (Fig. 42). Thick materials (e.g., fruits, very thick stems, material of plants such as cacti) may be sliced in order to allow appropriate drying and to prevent unwieldy structures in the press.

Plants should stay in the press until they are dry. The time necessary is quite variable depending on whether a heat source or forced air source is used, the type of plant, the humidity of the ambient air, etc. If upon touching the plant any moisture can be sensed, it needs additional drying. Removing plants too quickly from the press will result in wrinkling or possibly molding. Likewise, leaving plants in a heated press for too long a period will cause damage (e.g., browning or fading of colors). A good rule of thumb is that most plants are dry after one or two days in a heated press while five to ten days is typical for plants in a press without any heat source. Be sure to tighten the press daily to prevent wrinkling. Also, without heat or forced air, it is often good to change blotters daily.

### MAKING A LABEL

Just as important as the plant specimen itself is a properly done label. All data needed to make the label should be written down in a small notebook or “field book” at the time the plant is collected (e.g., Simpson 1997). Of crucial importance is accurate location data so that the site can be relocated by a stranger in the future. Most important are the state and county; also detailed location information such as landmarks, accurate distances, nearby towns or cities, adjacent streams, rivers, and lakes, or any other data to help relocate the site should be recorded. Other important information includes habitat (e.g., field, forest, weedy roadside, shallow water, soil type, whether the plant is growing in shade or sun), associated plants, collector, collection number, the date the plant was collected, and who was with the collector (these individuals could possibly help in the relocation of the site). The date should be given as 8 May 1996 because 08/05/96 usually means 5 August 1996 in the United States and 8 May 1996 in Europe. It is also very important to record information that will be not be obvious from the specimen (e.g., size or height of plant, in the case of trees diameter-at-breast-height—DBH, appearance of the bark, manner of growth—erect, climbing, prostrate, etc., were the flowers closed at a certain time of the day, pollinators observed, etc.) or that may be lost upon drying (flower color, odor, color of sap, presence of stinging hairs, sticky feel due to glandular hairs). Common names used locally or information on edibility or local uses are also valuable. Latitude and longitude and elevation are particularly valuable for researchers and should be recorded. These can be obtained from standard maps of most areas. However, recent technological advances have made getting such information much easier—inexpensive and accurate Global Positioning System (GPS) units are now readily available and give very accurate information. Specimens with such location data are especially valuable because they can be entered into databases with applications from the local to national levels—in Texas and elsewhere, major database projects are currently underway and GPS locations on specimens are highly recommended. Because all of the other information discussed above is recorded in the field notebook, only the collection number needs to be put on the fold of newspaper in the press. A unique number should be given to each collection that a botanist makes and these numbers should increase sequentially throughout his or her lifetime. Thus, if *Lipscomb 3491* is a collection of *Quercus alba*, there will never be a different *Lipscomb 3491*. If two or more specimens of *Quercus alba* are collected at the same time and same place by the same collector (such specimens are termed “duplicates”), they are given the same number. Such “duplicates” are often distributed to several herbaria so that there is more than one record of a particular collection. Because herbarium specimens are in essence museum collections that need to last hundreds of years, the labels should be printed on acid-free paper with permanent ink. Do not use “white-out” or other correction techniques that will be lost over time. There is no standard label size, but in general a 4" × 4" label should accommodate all necessary information without taking up excessive space on the mounting paper the specimen will ultimately be attached to (such a size will also allow 4 labels to be made from a single 8 1/2" × 11" sheet of paper). The following are two examples of labels containing appropriate information:

**Austin College Herbarium, Sherman, Texas**Plants of **TEXAS****Cnidoscolus texanus** (Müll.Arg.) Small Euphorbiaceae**GRAYSON County:** Southwestern corner of county, ca. 4 km south of Tioga, just off (east of) Hwy 377, ca. 200 meters from southern edge of eastern arm of Lake Ray Roberts.Open, sandy, weedy field with *Cenchrus spinifex* and *Monarda punctata*.

Plants herbaceous, ca. 1/2 to 1 m tall, common. Locally known as bull-nettle. Flowers white, sweet-scented; sap milky; foliage with glass-like hairs which break off in the skin and cause an intense burning sensation.

33° 26' 36.1" N 96° 55' 25.8" W (GPS)

Elevation: ca. 190 m

24 Sept. 1980

Coll: Delzie Demaree with Robert Kral  
and Donna Ware

No.: 65,967

**Austin College Herbarium, Sherman, Texas****Cnidoscolus texanus** (Müll.Arg.) Small Euphorbiaceae**Texas, Grayson Co.,** southwestern corner of county, ca. 4 km south of Tioga, just east of Hwy 377, ca. 200 meters from southern edge of eastern arm of Lake Ray Roberts in open, sandy, weedy field with *Cenchrus spinifex* and *Monarda punctata*. Plants herbaceous, ca. 5–10 dm tall, common. Locally known as bull-nettle. Flowers white, sweet-scented; sap milky; foliage with glass-like hairs that break off in the skin and cause an intense burning sensation.

33° 26' 36.1" N 96° 55' 25.8" W (GPS); ca. 190 m.

24 Sept. 1980

Delzie Demaree 65,967  
with Robert Kral and Donna Ware**PUTTING SPECIMENS IN PERMANENT COLLECTIONS**

Once a specimen is dried and has an appropriate label, it can be studied or given to an herbarium for permanent storage and use in research and teaching. The proper method of donating specimens is to leave the specimen in the original half-sheet (fold) of newspaper in which it was pressed and insert the label; neither the specimen nor the label should be attached to the newspaper in any way—gluing, stapling, taping, or any other attachment method frequently damages the specimen and sometimes completely destroys its usefulness. Mounting the specimens and labels to museum quality paper for permanent storage and use in the herbarium is done by herbarium personnel properly trained in these techniques—for example, special attachment procedures and long-life glues are used. There are a number of major herbaria in Texas with the largest including those at the University of Texas in Austin, the Botanical Research Institute of Texas (BRIT) in Fort Worth, and Texas A&M University in College Station. Many other schools or organizations have valuable collections; of particular note in North Central Texas are the herbaria at Baylor University in Waco, Fort Worth Museum of Science and History, Fort Worth Nature Center, Howard Payne University in Brownwood, the University of North Texas, and the University of Texas at Arlington. BRIT welcomes the donation of herbarium specimens and botanists there can be contacted at (817) 332-4441 or info@brit.org or Botanical Research Institute of Texas, 509 Pecan Street, Fort Worth, TX 76102-4060. Such specimens will be scientific contributions, will have permanent protection, and will be important resources for the future.

## GETTING STARTED COLLECTING PLANTS

How do you get started collecting plants? Unfortunately, pressing plants between the pages of books is usually not successful because the plants dry too slowly, lose their color, seldom dry flat, and tend to damage the book. Therefore one of the first steps is to make or buy a plant press (including two end boards, corrugated cardboards, blotters, and two straps). A simple press can be made by cutting two 12" × 18" pieces out of 3/8" or 1/2" plywood and then rounding the corners and sanding the surfaces to avoid injury from splinters. The 12" × 18" size is slightly larger than a folded half-sheet of newspaper and is thus ideal for making the correct size specimens. Other types of end boards can be made out of nearly any reasonably lightweight, sturdy material. Cardboards the same size as the press can be cut from boxes, paper towels can be substituted for blotters, and simple ropes at least 4 feet long can be used as straps. With such a simple system and proper care, excellent specimens can be made. Alternatively, ready-made, convenient presses can be purchased from the sources listed below. Probably the most important parts of the press are the straps—straps that can be easily tightened and thus ensure appropriate pressure increase both the quality of the specimens and the convenience of the process. We thus recommend that a pair of straps be purchased. Because herbaria are museums whose collections are intended to last hundreds of years, the other thing that needs to be purchased is acid-free paper for the labels; this can either be special archival paper or 100% cotton rag bond. Such quality paper will last indefinitely ensuring long-term use of the specimens. Appropriate paper can be obtained from the sources listed below or can often be purchased from or at least ordered through office supply stores. For reasons of clarity, if possible, labels should be typed on a typewriter or printed using a computer (as is now done by most botanists because of speed and practicality). A hand lens (10 power) is another extremely useful tool in working with and identifying plant specimens. Many plant parts are quite small including specialized hairs or scales and moderate magnification is often essential for accurate identification; hand lenses can also be purchased from the sources below.

Herbarium Supply Company  
3483 Edison Way  
Menlo Park, CA 94025-1813  
1-800-348-2338 or  
650-366-5492  
herbsupp@aol.com

Carolina Biological Supply  
2700 York Road  
Burlington, NC 27215  
1-800-334-5551  
FAX 1-800-222-7112

Pacific Papers  
15702 119th NE  
Bothell, WA 98011  
1-800-676-1151  
FAX 425-482-0534

Information for this appendix was obtained from Shoiners (1958a), Smith (1971), Radford et al. (1974), Benson (1979), Birdson and Forman (1992), MacFarlane (1994), and Simpson (1997). More detailed information about plant collecting techniques can be gained from these sources. Birdson and Forman (1992) in their *Herbarium Handbook*, also provided an extensive treatment of herbarium techniques and management. Stuessy and Sohmer (1996), in a recent edited volume, gave a historical overview of the documentation of plant diversity, an analysis of societal and scientific needs from plant collections, and comprehensive information on collecting, documenting, storing, and preserving plant specimens.

## LIST OF CONSERVATION & ENVIRONMENTAL ORGANIZATIONS IN NORTH CENTRAL TEXAS

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### FEDERAL

Balcones Canyonlands National Wildlife Refuge

10711 Burnet Road, Suite 201

Austin, TX 78732

512/339-9432

*INTERNET:* [http://www.gorp.com/gorp/resource/us\\_nwr/tx\\_balco.htm](http://www.gorp.com/gorp/resource/us_nwr/tx_balco.htm)

Caddo and Lyndon B. Johnson National Grasslands (Fannin and Wise counties)

U.S. Forest Service

P.O. Box 507

1400 N. US 81/287

Decatur, TX 76234

940/627-5475

*OR* Caddo Work Center (Field Office)

U.S. Forest Service

Rt. 2

Honey Grove, TX 75446

903/378-2103

Fort Hood Center for Cooperative Ecological Research (Bell and Coryell counties)

(Cooperative agreement between Department of Defense and The Nature Conservancy of Texas)

254/287-2885

FAX 254/288-5039

*E-MAIL:* [lsanchez@tnctexas.org](mailto:lsanchez@tnctexas.org)

*INTERNET:* [www.tnctexas.org](http://www.tnctexas.org)

Hagerman National Wildlife Refuge (Grayson County)

6465 Refuge Road

Sherman, TX 75092-5917

903/786-2826

*E-MAIL:* [r2rw\\_hg@mail.fws.gov](mailto:r2rw_hg@mail.fws.gov)

*INTERNET:* [http://www.gorp.com/gorp/resource/us\\_nwr/tx\\_hager.htm](http://www.gorp.com/gorp/resource/us_nwr/tx_hager.htm)

Pat Mayse State Wildlife Management Area (Lamar County)

Pat Mayse Project Office

U.S. Army Corps of Engineers

P.O. Box 129

Powderly, TX 75473

903/732-3020

U.S. Army Corps of Engineers (Environmental Division)

P.O. Box 17300

819 Taylor St.

Fort Worth, TX 76102-0300

817/978-2201

**1390 APPENDIX NINE**/LIST OF CONSERVATION ORGANIZATIONS

INTERNET: <http://www.swf.usace.army.mil>  
U.S. Environmental Protection Agency (Region 6-EN-XP)  
1445 Ross Ave.  
Dallas, TX 75202-2733  
214/665-2258

INTERNET MAIN SITE: <http://www.epa.gov>

INTERNET REGION 6 SITE: <http://www.epa.gov/earth1r6/index.htm>

EPA Office of Planning and Coordination  
Contact: Robert D. Lawrence, Chief  
EPA Region 6-EN-XP  
214/665-2258

INTERNET: <http://www.epa.gov/earth1r6/6en/xp/enxp1.htm>

EPA Ecosystems Protection Branch  
Contact: Richard Hoppers, Chief  
EPA Region 6-WQ-E  
214/665-7135

EPA Marine and Wetlands Section  
Contact: Becky Weber, Chief 214/665-6680  
OR Richard Prather, Wetlands Coordinator 214/665-8830  
OR Norm Sears, Texas State Lead 214/665-8336

EPA Watershed Management Section  
Sharon Parrish, Chief  
214/665-7145

 **STATE**

TEXAS AGRICULTURAL EXTENSION SERVICE: (county offices in each county)  
Texas Agricultural Extension Service Stephenville Research and Extension Center  
Route 2, Box 1  
Stephenville, TX 76401  
254/968-4144

INTERNET: <http://stephenville.tamu.edu>

Texas Agricultural Extension Service Dallas Research and Extension Center  
17360 Coit Road  
Dallas, TX 75252  
972/231-5362

Texas Department of Parks and Wildlife  
4200 Smith School Road  
Austin, TX 78744

1-800/792-1112 - General Information Line

INTERNET MAIN SITE: <http://www.tpwd.state.tx.us/>

INTERNET LIST OF TEXAS STATE PARKS: <http://www.tpwd.state.tx.us/park/parklist.htm>

STATE PARKS IN NORTH CENTRAL TEXAS:

Bonham State Park (Fannin Co.), RR 1 Box 337, Bonham, TX 75418 903/583-5022

Cedar Hill State Park (Dallas Co.), P.O. Box 2649, Cedar Hill, TX 75104 972/291-3900

Cleburne State Park (Johnson Co.), 5800 Park Road 21, Cleburne, TX 76031 817/645-4215

Cooper Lake State Park (Delta and Hopkins cos.), Rt 1 Box 231-A15, Cooper, TX 75432 903/395-3100

Dinosaur Valley State Park (Somervell Co.), P O Box 396, Glen Rose, TX 76043 254/897-4588  
 Eisenhower State Park (Grayson Co.) RR 2 Box 50K, Denison TX 75020 903/465-1956, *E-MAIL*: [espc@texoma.net](mailto:espc@texoma.net)  
 Lake Brownwood State Park (Brown Co.), RR 5, Box 160, Lake Brownwood, TX 76801 915/784-5223  
 Lake Mineral Wells Park (Parker Co.), RR 4 Box 39 C, Mineral Wells, TX 76067 940/328-1171  
 Lake Whitney State Park (Hill Co.), Box 1175, Whitney, TX 76692 254/694-3793  
 Meridian State Park (Bosque Co.), Rt. 2, Box 2465, Meridian, TX 76665 254/435-2536  
 Mother Neff State Park (Coryell Co.), 1680 Texas 236 Hwy, Moody, TX 76557-3317 254/853-2389  
 Possum Kingdom State Park (Palo Pinto Co.), P.O. Box 70, Caddo, TX 76429 940/549-1803  
 Ray Roberts Lake State Park (Cooke and Denton cos.), 100 PW 4137, Pilot Point, TX 76258-8944 940/686-2148  
 Granger Wildlife Management Area (Williamson Co.) Rt.2, Box 501, Burnet, TX 78611 512/859-2668 OR 512/756-2945

Texas Natural Resource Conservation Commission

P.O. Box 13807

Austin, TX 78711

512/239-1000

*INTERNET*: [www.tnrcc.state.tx.us](http://www.tnrcc.state.tx.us)

 **PUBLIC**

Dallas Nature Center

7171 Mountain Creek Parkway

Dallas, TX 75249

(972) 296-1955

FAX (972) 296-0072

Dallas County Park and Open Space Program

411 Elm Street, 3rd Floor

Dallas, TX 75202-3301

214/653-6653

FAX 214/653-651

Harry S. Moss Park (City of Dallas)

Contact: Ruth Andersson May

214/361-7772

Fort Worth Nature Center and Refuge

9601 Fossil Ridge Road

Fort Worth, TX 76135

817/237-1111

FAX 817/237-1168

Parkhill Prairie Preserve

Collin County Parks and Open Space Program

7117 County Road 166

McKinney, TX 75070-7317

972/548-4141

River Legacy Living Science Center

P.O. Box 150392

Arlington, TX 76015

817/860-6752; FAX 817/860-1595

*E-MAIL*: [rlegacy@startext.net](mailto:rlegacy@startext.net)

*INTERNET*: <http://www.riverlegacy.com>

 PRIVATE

Austin College and its Center for Environmental Studies

900 North Grand Avenue

Sherman, TX 75090

903/817-2000 general number

903/817-2342 Science Area Secretary

GENERAL INTERNET: <http://www.austinc.edu/>

BIOLOGY DEPT. INTERNET: <http://www.austinc.edu/academics/MathSci/Biology/index.html>

CENTER FOR ENVIRONMENTAL STUDIES INTERNET: <http://artemis.austinc.edu/acad/envstud/EnvStudies/index.htm>

Botanical Research Institute of Texas

509 Pecan Street

Fort Worth, TX 76102-4060

817/332-4441; FAX 817/332-4112

E-MAIL: [info@brit.org](mailto:info@brit.org)

INTERNET: <http://www.brit.org>

Heard Natural Science Museum and Wildlife Sanctuary

One Nature Place

McKinney, TX 75069-8840

972/562-5566

E-MAIL: [heardmuseum@texoma.net](mailto:heardmuseum@texoma.net)

INTERNET: <http://www.heardmuseum.org>

Lady Bird Johnson Wildflower Center

(previously National Wildflower Research Center)

4801 Lacrosse Ave.

Austin, TX 78739

512/292-4200

E-MAIL: [wildflower@wildflower.org](mailto:wildflower@wildflower.org)

INTERNET: <http://www.wildflower.org/>

Native Plant Society of Texas (NPSOT)

State Office

Coordinator: Dana Tucker

P.O. Box 891

Georgetown, TX 78627

512/238-0695

FAX 512/238-0703

E-MAIL: [dtucker@io.com](mailto:dtucker@io.com)

INTERNET: [http://lonestar.texas.net/~jleblanc/npsot\\_austin.html](http://lonestar.texas.net/~jleblanc/npsot_austin.html)

LOCAL NPSOT CHAPTER CONTACTS IN NORTH CENTRAL TEXAS:

Belton (Tonkawa)—Marie Kline, 134 Woodland Trail, Belton, TX 76513, 817/780-1715

Collin County—Betsy Farris, 4205 Tynes Drive, Garland, TX 75042, 972/494-2241

Dallas—Hannah Larson, 1020 N. Cedar Hill Rd., Cedar Hill, TX 75104, 972/291-7545

Denton—Lou Kraft, 1933 Laurelwood, Denton, TX 76201, 817/387-7725

North Central Texas—Jim Leavy, 4115 Bellaire Dr. S., Fort Worth, TX 76109, 817/923-4189

Waco—Bob Chapman, 441 Lindenwood W., Hewitt, TX 76643, 817/666-7046



## Native Prairies Association of Texas

Contact: S. Lee Stone  
 3503 Lafayette Avenue  
 Austin, TX 78722-1807  
 512/327-5437  
 FAX 512/476-1663  
*E-MAIL:* leeprairie@aol.com

Natural Area Preservation Association  
 (a land trust; accepts land to preserve in perpetuity)

4144 Cochran Chapel Road  
 Dallas, TX 75209  
 214/823-1848  
*INTERNET:* <http://www.cep.unt.edu/vol/napa.html>

## The Nature Conservancy of Texas

State Office  
 P.O. Box 1440  
 San Antonio, Texas 78295-1440  
 210/224-8774  
*E-MAIL:* txfo@tnc.org  
*INTERNET:* <http://www.tnc.org>

The Nature Conservancy of Texas  
 North Texas/Blackland Prairies Regional Office

Contact: James Eidson  
 Clymer Meadow Preserve  
 County Road 1140  
 Celeste, TX 75423  
 903/568-4139

## Texas Committee on Natural Resources

5952 Royal Lane, Suite 168  
 Dallas, TX 75230  
 214/368-1791  
 FAX 214/265-1260  
*E-MAIL:* tconr@mindspring.com

## Texas Organization for Endangered Species (TOES)

P.O. Box 12773  
 Austin, TX 78711  
*INTERNET:* <http://riceinfo.rice.edu/armadillo/Endanger/AOS/toes.html>

## Thompson Foundation

2801 Turtle Creek—2W  
 Dallas, TX 75219  
 214/522-6142  
*E-MAIL:* blair1189@aol.com

# LARVAL HOST PLANTS OF LEPIDOPTERA OF NORTH CENTRAL TEXAS

COMPILED BY JOANN KARGES

I. BUTTERFLIES  
II. MOTHS [PG. 1400]

## I. LARVAL HOST PLANTS OF NORTH CENTRAL TEXAS BUTTERFLIES



PLANT	BUTTERFLY
CUPRESSACEAE <i>Juniperus ashei</i>	OLIVE-GREEN HAIRSTREAK ( <i>Callophrys gryneus</i> )
POACEAE <i>Festuca</i> spp.	SACHEM ( <i>Atalopodes campestris</i> )
<i>Poa pratensis</i>	LEAST SKIPPER ( <i>Ancyloloxphyha numitor</i> ) FIERY SKIPPER ( <i>Hylephila phyleus</i> ) ROADSIDE SKIPPER ( <i>Amblyscirtes vialis</i> ) WHIRLABOUT ( <i>Polites vibex</i> )
<i>Chasmanthium latifolium</i>	BELL'S ROADSIDE SKIPPER ( <i>Amblyscirtes belli</i> )
<i>Phragmites australis</i>	BROADWING SKIPPER ( <i>Poanes viator</i> )
<i>Tridens</i> spp.	COMMON WOOD NYMPH ( <i>Cercyonis pegala</i> )
<i>Nassella</i> spp.	COMMON WOOD NYMPH ( <i>Cercyonis pegala</i> )
<i>Eleusine</i> spp.	SACHEM ( <i>Atalopodes campestris</i> )
<i>Cynodon dactylon</i>	JULIA'S SKIPPER ( <i>Nastra lherminier</i> ) ORANGE SKIPPERLING ( <i>Copaeodes aurantiacus</i> ) SOUTHERN SKIPPERLING ( <i>Copaeodes minimus</i> ) WHIRLABOUT ( <i>Polites vibex</i> ) SACHEM ( <i>Atalopodes campestris</i> ) EUFALA SKIPPER ( <i>Lerodea eufala</i> )
<i>Bouteloua curtipendula</i>	ORANGE SKIPPERLING ( <i>Copaeodes aurantiacus</i> )
<i>Bouteloua gracilis</i>	GREEN SKIPPER ( <i>Hesperia viridis</i> ) DOTTED SKIPPER ( <i>Hesperia attalus</i> )
<i>Leersia oryzoides</i>	LEAST SKIPPER ( <i>Ancyloloxphyha numitor</i> )
<i>Zizaniopsis miliacea</i>	BROADWAY SKIPPER ( <i>Poanes viator</i> )
<i>Digitaria</i> spp.	SACHEM ( <i>Atalopodes campestris</i> ) NYSA ROADSIDE SKIPPER ( <i>Amblyscirtes nysa</i> )

PLANT	BUTTERFLY
POACEAE ( <i>continued</i> )	
<i>Stenotaphrum secundatum</i>	CLOUDED SKIPPER ( <i>Lerema accius</i> ) WHIRLABOUT ( <i>Polites vibex</i> ) SACHEM ( <i>Atalopodes campestris</i> ) ROADSIDE SKIPPER ( <i>Amblyscirtes vialis</i> )
<i>Paspalum setaceum</i>	WHIRLABOUT ( <i>Polites vibex</i> ) NYSA ROADSIDE SKIPPER ( <i>Amblyscirtes nysa</i> )
<i>Panicum</i> spp.	LEAST SKIPPER ( <i>Ancyloxypha numitor</i> ) DELAWARE SKIPPER ( <i>Anatrytone logan</i> ) BROADWING SKIPPER ( <i>Poanes viator</i> )
<i>Dichanthelium</i> spp.	NORTHERN BROKEN DASH ( <i>Wallengrenia egremet</i> )
<i>Echinochloa crus-galli</i>	EUFALA SKIPPER ( <i>Lerodea eufala</i> )
<i>Setaria</i> spp.	COMMON WOOD NYMPH ( <i>Cercyonis pegala</i> ) AROGOS SKIPPER ( <i>Atrytone arogos</i> ) DELAWARE SKIPPER ( <i>Atrytone logan</i> ) DUSTED SKIPPER ( <i>Atrytonopsis hianna</i> )
<i>Schizachyrium scoparium</i>	RED SATYR ( <i>Megisto rubricata</i> ) SWARTHY SKIPPER ( <i>Nastra lherminier</i> ) COBWEB SKIPPER ( <i>Hesperia metea</i> ) MESKE'S SKIPPER ( <i>Hesperia meske</i> ) AROGOS SKIPPER ( <i>Atrytone arogos</i> ) DUSTED SKIPPER ( <i>Atrytonopsis hianna</i> )
<i>Sorghum</i> spp.	EUFALA SKIPPER ( <i>Lerodea eufala</i> )
<i>Zea mays</i>	EUFALA SKIPPER ( <i>Lerodea eufala</i> )

NOTE: All of the grasses used as larval host plants both by Hesperinae and by Satyrinae (including *Cercyonis pegala*, *Megisto rubricata*, and *Megisto cymele*, the most common satyrs in the area) are not recorded.

CYPERACEAE	<i>Carex</i> spp.	BROADWINGED SKIPPER ( <i>Poanes viator</i> ) DUN SKIPPER ( <i>Euphyes vestris</i> )
AGAVACEAE	<i>Yucca</i> spp.	GIANT YUCCA SKIPPER ( <i>Megathymus yuccae</i> )
CANNACEAE	<i>Canna</i> spp.	BRAZILIAN SKIPPER ( <i>Calpododes ethlius</i> )
SALICACEAE	<i>Populus deltoides</i>	TIGER SWALLOWTAIL ( <i>Papilio glaucus</i> )
	<i>Salix</i> spp.	TIGER SWALLOWTAIL ( <i>Papilio glaucus</i> ) VICEROY ( <i>Liminitis archippus</i> ) RED-SPOTTED PURPLE ( <i>Liminitis arthemis astyanax</i> ) MOURNING CLOAK ( <i>Nymphalis antiopae</i> )

PLANT		BUTTERFLY
MYRICACEAE	<i>Myrica cerifera</i>	RED-BANDED HAIRSTREAK ( <i>Calycopis cecrops</i> )
JUGLANDACEAE	<i>Juglans</i> spp. <i>Carya</i> spp.	BANDED HAIRSTREAK ( <i>Satyrium calanus</i> ) STRIPED HAIRSTREAK ( <i>Satyrium liparops</i> )
FAGACEAE	<i>Quercus</i> spp.	CALIFORNIA SISTER ( <i>Adelpha bredowi</i> ) BANDED HAIRSTREAK ( <i>Satyrium calanus</i> ) WHITE M-ALBUM ( <i>Parhassius m-album</i> ) NORTHERN HAIRSTREAK ( <i>Fixsenia favonius</i> ) JUVENAL'S DUSKYWING ( <i>Erynnis juvenalis</i> ) HORACE'S DUSKYWING ( <i>Erynnis horatius</i> ) SLEEPY DUSKYWING ( <i>Erynnis brizo</i> )
ULMACEAE	<i>Ulmus</i> spp.	TIGER SWALLOWTAIL ( <i>Papilio glaucus</i> ) RED-SPOTTED PURPLE ( <i>Limenitis arthemis astyanax</i> ) MOURNING CLOAK ( <i>Nymphalis antiope</i> ) QUESTIONMARK ( <i>Polygonia interragationis</i> )
	<i>Celtis</i> spp.	HACKBERRY BUTTERFLY ( <i>Asterocampa celtis</i> ) TAWNY EMPEROR ( <i>Asterocampa clyton</i> ) QUESTIONMARK ( <i>Polygonia interragationis</i> ) SNOUT BUTTERFLY ( <i>Libytheana carinenta</i> )
MORACEAE	<i>Morus</i> spp.	MOURNING CLOAK ( <i>Nymphalis antiope</i> )
URTICACEAE	<i>Urtica chamaedryoides</i>	RED ADMIRAL ( <i>Vanessa atalanta</i> )
VISCACEAE (LORANTHACEAE)	<i>Phoradendron tomentosum</i>	GREAT PURPLE HAIRSTREAK ( <i>Atlides halesus</i> )
ARISTOLOCHIACEAE	<i>Aristolochia tomentosa</i>	PIPEVINE SWALLOWTAIL ( <i>Battus philenor</i> )
CHENOPODIACEAE	<i>Chenopodium album</i>	HAYHURST'S SCALLOPWING ( <i>Staphylus hayhurstii</i> ) COMMON SOOTYWING ( <i>Pholisora catullus</i> )
AMARANTHACEAE	<i>Amaranthus</i> spp.	COMMON SOOTYWING ( <i>Pholisora catullus</i> )
BRASSICACEAE	<i>Arabis</i> spp., <i>Brassica</i> spp., <i>Draba</i> spp., <i>Lesquerella</i> spp., <i>Sisymbrium</i> spp.	The following are on all five of these Brassicaceae genera: CHECKERED WHITE ( <i>Pontia protidice</i> ) CABBAGE WHITE ( <i>Pieris rapae</i> ) OLYMPIA MARBLE ( <i>Euchloë olympia</i> ) FALCATE ORANGETIP ( <i>Anthocaris midea</i> )

PLANT	BUTTERFLY
ROSACEAE <i>Prunus mexicana, Prunus gracilis</i>	The following are on both of these <i>Prunus</i> spp.: RED-SPOTTED PURPLE ( <i>Limenitis arthemis astyanax</i> ) GRAY HAIRSTREAK ( <i>Strymon melinus</i> ) BANDED HAIRSTREAK ( <i>Satyrium calanus</i> ) CORAL HAIRSTREAK ( <i>Satyrium titus</i> ) [larvae eat fruit] STRIPED HAIRSTREAK ( <i>Satyrium liparops</i> )
FABACEAE <i>Acacia</i> spp.	OUTIS SKIPPER ( <i>Cogia outis</i> )
<i>Mimosa (Schranksia)</i> spp., <i>Desmanthus</i> spp., <i>Prosopis</i> spp.	The following are on all three of these Fabaceae genera: HENRY'S ELFIN ( <i>Incisalia henrici</i> ) REAKIRT'S BLUE ( <i>Hemiargus isola</i> ) CERAUNUS BLUE ( <i>Hemiargus ceraunus</i> ) EASTERN TAILED BLUE ( <i>Everes comyntas</i> ) MARINE BLUE ( <i>Leptotes marina</i> )
<i>Cercis canadensis</i>	HENRY'S ELFIN ( <i>Incisalia henrici</i> )
<i>Chamaecrista fasciculata</i>	CLOUDLESS SULPHUR ( <i>Phoebis sennae</i> ) LITTLE SULPHUR ( <i>Eurema lisa</i> )
<i>Senna roemeriana</i>	SLEEPY ORANGE ( <i>Eurema nicippe</i> )
<i>Sophora</i> spp.	HENRY'S ELFIN ( <i>Incisalia henrici</i> )
<i>Baptisia</i> spp.	CLOUDED SULPHUR ( <i>Colias philodice</i> ) ORANGE SULPHUR OR ALFALFA BUTTERFLY ( <i>Colias eurytheme</i> ) EASTERN TAILED BLUE ( <i>Everes comyntas</i> ) WILD INDIGO DUSKY-WING ( <i>Erynnis baptisiae</i> )
<i>Lupinus texensis</i>	CLOUDED SULPHUR ( <i>Colias philodice</i> ) HENRY'S ELFIN ( <i>Incisalia henrici</i> ) EASTERN TAILED BLUE ( <i>Everes comyntas</i> ) WILD INDIGO DUSKYWING ( <i>Erynnis baptisiae</i> )
<i>Medicago</i> spp., <i>Melilotus</i> spp., <i>Trifolium</i> spp.	The following are on all three of these Fabaceae genera: CLOUDED SULPHUR ( <i>Colias philodice</i> ) ORANGE SULPHUR ( <i>Colias eurytheme</i> ) DOGFACE SULPHUR ( <i>Colias cesonia</i> )
<i>Amorpha</i> spp.	DOGFACE SULPHUR ( <i>Colias cesonia</i> ) MARINE BLUE ( <i>Leptotes marina</i> ) SILVER-SPOTTED SKIPPER ( <i>Epargyrus clara</i> ) NORTHERN CLOUDYWING ( <i>Thorybes pylades</i> )

PLANT	BUTTERFLY
FABACEAE ( <i>continued</i> )	<p>DOGFACE SULPHUR (<i>Colias cesonia</i>)                      REAKIRT'S BLUE (<i>Hemiargus isola</i>)                      MARINE BLUE (<i>Leptotes marina</i>)</p>
<i>Indigofera miniata</i>	<p>REAKIRT'S BLUE (<i>Hemiargus isola</i>)                      FUNERAL DUSKYWING (<i>Erynnis funeralis</i>)</p>
<i>Robinia pseudoacacia</i>	<p>FUNERAL DUSKYWING (<i>Erynnis funeralis</i>)</p>
<i>Sesbania</i> spp.	<p>FUNERAL DUSKYWING (<i>Erynnis funeralis</i>)</p>
<i>Wisteria</i> spp.	<p>SILVER-SPOTTED SKIPPER (<i>Epargyrus clarus</i>)                      CLOUDED SULPHUR (<i>Colias philodice</i>)                      ORANGE SULPHUR (<i>Colias eurytheme</i>)                      SOUTHERN CLOUDYWING (<i>Thorybes bathyllus</i>)                      NORTHERN CLOUDYWING (<i>Thorybes pylades</i>)                      WILD INDIGO DUSKYWING (<i>Erynnis baptisiae</i>)</p>
<i>Desmodium</i> spp., <i>Lespedeza</i> spp.	<p>The following are on both of these Fabaceae genera:                      EASTERN-TAILED BLUE (<i>Everes comyntas</i>)                      SILVER-SPOTTED SKIPPER (<i>Epargyrus clarus</i>)                      SOUTHERN CLOUDYWING (<i>Thorybes bathyllus</i>)                      NORTHERN CLOUDYWING (<i>Thorybes pylades</i>)</p>
<i>Vicia</i> spp.	<p>CLOUDED SULPHUR (<i>Colias philodice</i>)                      ORANGE SULPHUR (<i>Colias eurytheme</i>)                      NORTHERN CLOUDYWING (<i>Thorybes pylades</i>)                      FUNERAL DUSKYWING (<i>Erynnis funeralis</i>)</p>
<p><i>Clitoria mariana</i>,  <i>Centrosema virginianum</i>, <i>Galactea</i> spp.,  <i>Rhynchosia</i> spp.</p>	<p>The following are on all four of these Fabaceae taxa:                      ORANGE SULPHUR (<i>Colias curytheme</i>)                      MARINE BLUE (<i>Leptotes marina</i>)                      EASTERN TAILED BLUE (<i>Everes comyntas</i>)                      SILVER-SPOTTED SKIPPER (<i>Epargyrus clarus</i>)</p>
LINACEAE	<p><i>Linum</i> spp. VARIEGATED FRITILLARY (<i>Euptoieta claudia</i>)</p>
RUTACEAE	<p><i>Zanthoxylum</i> spp. GIANT SWALLOWTAIL (<i>Papilio cresphontes</i>)</p>
	<p><i>Ptelea trifoliata</i> GIANT SWALLOWTAIL (<i>Papilio cresphontes</i>)</p>
EUPHORBIACEAE	<p><i>Croton capitatus</i> GOATWEED LEAFWING (<i>Anaea andria</i>)</p>
	<p><i>Crotonopsis linearis</i> RED-BANDED HAIRSTREAK (<i>Calycopis cecrops</i>)</p>

PLANT	BUTTERFLY	
ANACARDIACEAE	<i>Rhus aromatica</i>	RED-BANDED HAIRSTREAK ( <i>Calycopis cecrops</i> )
	<i>Rhus copallinum</i>	RED-BANDED HAIRSTREAK ( <i>Calycopis cecrops</i> )
SAPINDACEAE	<i>Sapindus saponaria</i>	SOAPBERRY HAIRSTREAK ( <i>Phaeostrymon alcestis</i> )
	<i>Ungnadia speciosa</i>	SOAPBERRY HAIRSTREAK ( <i>Phaeostrymon alcestis</i> )
RHAMNACEAE	<i>Ceanothus americanus</i>	RED-BANDED HAIRSTREAK ( <i>Calycopis cecrops</i> ) MOTTLED DUSKYWING ( <i>Erynnis martialis</i> )
MALVACEAE	<i>Sphaeralcea</i> spp., <i>Malva</i> spp., <i>Callirhoe</i> spp., <i>Sida</i> spp., <i>Hibiscus</i> spp., <i>Malvaviscus</i> spp.	The following three are on all six Malvaceae of these genera: GRAY HAIRSTREAK ( <i>Strymon melinus</i> ) COMMON CHECKERED SKIPPER ( <i>Pyrgus communis</i> ) STREAKY SKIPPER ( <i>Celotes nesusus</i> )
VIOLACEAE	<i>Viola</i> spp.	VARIEGATED FRITILLARY ( <i>Euptoieta claudia</i> )
PASSIFLORACEAE	<i>Passiflora affinis</i> <i>Passiflora incarnata</i> <i>Passiflora lutea</i> <i>Passiflora tenuiflora</i>	GULF FRITILLARY ( <i>Agraulis vanillae</i> ) on all four <i>Passifloras</i> . VARIEGATED FRITILLARY ( <i>Euptoieta claudia</i> ) on <i>P. incarnata</i> and <i>P. lutea</i> and suspected on the other two.
APIACEAE	<i>Bifora</i> spp.	BLACK SWALLOWTAIL ( <i>Papilio polyxenes</i> )
	<i>Daucus</i> spp.	BLACK SWALLOWTAIL ( <i>Papilio polyxenes</i> )
	<i>Polytaenia nuttallii</i>	BLACK SWALLOWTAIL ( <i>Papilio polyxenes</i> )
EBENACEAE	<i>Diospyros texana</i>	HENRY'S ELFIN ( <i>Incisalia henrici</i> ) GRAY HAIRSTREAK ( <i>Strymon melinus</i> )
OLEACEAE	<i>Fraxinus</i> spp.	TIGER SWALLOWTAIL ( <i>Papilio glaucus</i> )
APOCYNACEAE	<i>Apocynum cannabinum</i>	MONARCH ( <i>Danaus plexippus</i> ) QUEEN ( <i>Danaus gilippus</i> )
ASCLEPIADACEAE	<i>Asclepias</i> spp.	MONARCH ( <i>Danaus plexippus</i> ) QUEEN ( <i>Danaus gilippus</i> )
	<i>Sarcostemma</i> spp.	QUEEN ( <i>Danaus gilippus</i> )
VERBENACEAE	<i>Lantana</i> spp.	GRAY HAIRSTREAK ( <i>Strymon melinus</i> )
	<i>Lippia (Phyla)</i> spp.	PHAON CRESCENT ( <i>Phyciodes phaon</i> )

PLANT		BUTTERFLY
SCROPHULARIACEAE	<i>Agalinus</i> spp., <i>Linaria texana</i> , <i>Castilleja</i> spp.	The species below is on all three of these Scrophulariaceae taxa: BUCKEYE ( <i>Junonia coenia</i> )
ACANTHACEAE	<i>Ruellia</i> spp.	BUCKEYE ( <i>Junonia coenia</i> ) TEXAS CRESCENT ( <i>Phyciodes texana</i> )
PLANTAGINACEAE	<i>Plantago</i> spp.	BUCKEYE ( <i>Junonia coenia</i> )
ASTERACEAE	<i>Aster</i> spp.	PEARL CRESCENT ( <i>Phyciodes tharos</i> )
	<i>Helianthus annuus</i>	BORDERED PATCHED ( <i>Chlosyne lacinia</i> ) GORGONE CHECKERSPOT ( <i>Chlosyne gorgone</i> ) SILVERY CHECKERSPOT ( <i>Chlosyne nycteis</i> )
	<i>Gnaphalium</i> spp.	PAINTED LADY ( <i>Vanessa cardui</i> )
	<i>Bidens</i> spp., <i>Thelesperma</i> spp., <i>Helenium</i> spp., <i>Palafoxia</i> spp., <i>Dysodiopsis tagetoides</i>	The following species is on all five of these Asteraceae taxa: DAINTY SULPHUR ( <i>Nathalis iole</i> )
	<i>Artemisia</i> spp.	AMERICAN PAINTED LADY ( <i>Vanessa virginiana</i> )
	<i>Centaurea</i> spp.	PAINTED LADY ( <i>Vanessa cardui</i> )
	<i>Cirsium</i> spp.	PAINTED LADY ( <i>Vanessa cardui</i> )

## II. LARVAL HOST PLANTS OF NORTH CENTRAL TEXAS MOTHS

Many moths, like *Automeris io*, are polyphagous, i.e. they may use a variety of leafy plants, often of a number of different families, completing their life-cycle on the plant where the eggs were laid. This list, then, is by no means definitive; it includes some of the largest, most spectacular, and/or most common moths of our region.

PLANT		MOTH
AGAVACEAE	<i>Yucca</i> spp.	YUCCA MOTHS ( <i>Prodoxidae</i> ), only <i>Pronuba yuccasella</i> has a symbiotic relationship with yucca.
SALICACEAE	<i>Populus</i> spp., <i>Salix</i> spp.	The following are on both <i>Populus</i> and <i>Salix</i> : POLYPHEMUS ( <i>Antheraea polyphemus</i> ) CECROPIA ( <i>Hylaphora cecropia</i> ) Io ( <i>Automeris io</i> ) BIG POPULAR SPHINX ( <i>Pachysphinx modesta</i> ) ONE-EYED SPHINX ( <i>Smerinthus cerisyi</i> ) TWIN-SPOTTED SPHINX ( <i>Smerinthus jamaicensis</i> ) UNDERWINGS: <i>Catocala junctura</i> , <i>Catocala amatrix</i>



PLANT		MOTH
MYRICACEAE	<i>Myrica cerifera</i>	<i>Catocala muliercula</i>
JUGLANDACEAE	<i>Carya illinoensis</i>	LUNA ( <i>Actias luna</i> ), UNDERWINGS ( <i>Catocala</i> species): <i>C. dejecta</i> , <i>C. consors</i> , <i>C. epione</i> , <i>C. agrippina</i> , <i>C. insolubilis</i> , <i>C. lacrymosa</i> , <i>C. maestosa</i> , <i>C. neogama</i> , <i>C. sappho</i> , <i>C. ulalume</i> , <i>C. vidua</i>
	<i>Juglans nigra</i>	WALNUT SPHINX ( <i>Lathoë juglandis</i> ) UNDERWINGS ( <i>Catocala</i> species): <i>C. piatrix</i> , <i>C. maestosa</i> , <i>C. neogama</i> , <i>C. vidua</i>
FAGACEAE	<i>Quercus</i> spp.	IMPERIAL ( <i>Eacles imperialis</i> ) SPINY OAKWORM ( <i>Anisota stigma</i> ) BUCKMOTH ( <i>Hemileuca maia</i> ) POLYPHEMUS ( <i>Antheraea polyphemus</i> ) WAVED SPHINX ( <i>Ceratomia undulosa</i> ) BLINDED SPHINX ( <i>Paonias excaetatus</i> ) UNDERWINGS ( <i>Catocala</i> species): <i>C. delilah</i> , <i>C. micronympha</i> , <i>C. amica</i> , <i>C. ilia</i> , <i>C. lineela</i>
ULMACEAE	<i>Celtis</i> spp., <i>Ulmus</i> spp.	The following are on both <i>Celtis</i> and <i>Ulmus</i> : IO ( <i>Automeris io</i> ) WAVED SPHINX ( <i>Ceratomia undulosa</i> ) BLINDED SPHINX ( <i>Paonias excaetatus</i> )
MORACEAE	<i>Maclura pomifera</i>	HAGEN'S SPHINX ( <i>Ceratomia hageni</i> )
NYCTAGINACEAE	<i>Liquidambar styraciflua</i>	LUNA MOTH ( <i>Actias luna</i> )
ROSACEAE	<i>Crataegus</i> spp.	WAVED SPHINX ( <i>Ceratomia undulosa</i> ) UNDERWINGS ( <i>Catocala</i> species): <i>C. alabamae</i> , <i>C. mira</i> , <i>C. texarkana</i> , <i>C. titania</i>
	<i>Prunus</i> spp.	GREAT ASH SPHINX ( <i>Sphinx chersis</i> ) ONE-EYED SPHINX ( <i>Smerinthus cerisyi</i> ) BLINDED SPHINX ( <i>Paonias excaetatus</i> ) SMALL-EYED SPHINX ( <i>Paonias myops</i> ) WALNUT SPHINX ( <i>Lathoë juglandis</i> ) WHITE-LINED SPHINX ( <i>Hyles lineata</i> ) APPLE SPHINX ( <i>Sphinx gordius</i> ) UNDERWING ( <i>Catocala ultronia</i> )
FABACEAE	<i>Cercis canadensis</i>	IO MOTH ( <i>Automeris io</i> )
	<i>Gleditsia</i> spp.	HONEY LOCUST MOTH ( <i>Sphingicampa bicolor</i> ) UNDERWINGS: ( <i>Catocala undulosa</i> , <i>Catocala minuta</i> )
ANACARDIACEAE	<i>Rhus</i> spp.	LUNA ( <i>Actias luna</i> )

PLANT	MOTH
AQUIFOLIACEAE <i>Ilex</i> spp.	PAWPAW SPHINX ( <i>Dolba hyloeus</i> )
ACERACEAE <i>Acer negundo</i>	IMPERIAL ( <i>Eackes imperialis</i> ) POLYPHEMUS ( <i>Antheraea polyphemus</i> )
VITACEAE <i>Ampelopsis</i> spp., <i>Cissus</i> spp., <i>Parthenocissus</i> spp., <i>Vitis</i> spp.	The following are on all four of these Vitaceae genera: HOG SPHINX ( <i>Darapsa myron</i> ) VINE SPHINX ( <i>Eumorpha vitis</i> ) ABBOTT'S SPHINX ( <i>Sphecedina abbottii</i> ) NESSUS SPHINX ( <i>Amphion floridensis</i> ) GAUDY SPHINX ( <i>Eumorpha labruscae</i> ) MOURNFUL SPHINX ( <i>Enyo lugubris</i> ) PANDORA SPHINX ( <i>Eumorpha pandorus</i> ) ACHEMON SPHINX ( <i>Eumorpha chemon</i> ) EIGHT-SPOTTED FORESTER ( <i>Alypia octomaculata</i> )
TILIACEAE <i>Tilia americana</i> var. <i>caroliniana</i>	WAVED SPHINX ( <i>Ceratomia undulosa</i> )
PASSIFLORACEAE <i>Passiflora</i> spp.	PLEBEIAN SPHINX ( <i>Paratraea plebeja</i> )
ONAGRACEAE <i>Calylophus</i> spp.  <i>Gaura</i> spp., <i>Ludwigia</i> spp.	PRIMROSE MOTH ( <i>Schinia florida</i> : Noctuidae)  The following are on both of these Onagraceae genera: PROUD SPHINX ( <i>Proserpina gaurae</i> ) WHITE-LINED SPHINX ( <i>Hyles lineata</i> ) BANDED SPHINX ( <i>Eumorpha fasciata</i> )
CORNACEAE <i>Cornus</i> spp.	CECROPIA ( <i>Hyalophora cecropia</i> )
ERICACEAE <i>Rhododendron</i> spp. (cultivated)	AZALEA SPHINX ( <i>Darapsa pholus</i> )
EBENACEAE <i>Diospyros texana</i>	LUNA MOTH ( <i>Actias luna</i> )
OLEACEAE <i>Fraxinus</i> spp., <i>Ligustrum</i> spp.	The following are on both of these Oleaceae genera: WAVED SPHINX ( <i>Ceratomia undulosa</i> ) ASH SPHINX ( <i>Manduca jasminearum</i> ) GREAT ASH SPHINX ( <i>Sphinx chersis</i> ) TWIN-SPOTTED SPHINX ( <i>Sphinx jamaicensis</i> )
APOCYNACEAE <i>Apocynum</i> spp.	SNOWBERRY CLEARWING ( <i>Hemaris diffinis</i> )
ASCLEPIADACEAE <i>Asclepias</i> spp.	MILKWEED TUSsock MOTH ( <i>Euchaetes egle</i> : Arctiidae)

PLANT		MOTH
SOLANACEAE	<i>Datura</i> spp.	PINK-SPOTTED HAWK MOTH ( <i>Agrilus cingulata</i> )
	<i>Solanum</i> spp.	CAROLINA SPHINX ( <i>Manduca sexta</i> ) FIVE-SPOTTED HAWK MOTH ( <i>Manduca quinquemaculata</i> )
SCROPHULARIACEAE	<i>Leucophyllum frutescens</i> (cultivated)	GREAT ASH SPHINX ( <i>Sphinx chersis</i> )
BIGNONIACEAE	<i>Catalpa speciosa</i>	The following are on all three of these Bignoniaceae species: CATALPA SPHINX ( <i>Cerestomia catalpe</i> ) RUSTIC SPHINX ( <i>Manduca rustica</i> )
	<i>Campsis radicans</i>	
	<i>Chilopsis linearis</i>	
RUBIACEAE	<i>Cephalanthus occidentalis</i>	TERSA SPHINX ( <i>Xylophanes tersa</i> ) HYDRANGEA SPHINX ( <i>Darapsa versicolor</i> )
CAPRIFOLIACEAE	<i>Lonicera</i> spp.,	The following are on all three of these Caprifoliaceae genera: HUMMINGBIRD CLEARWING ( <i>Hemaris thysbe</i> ) SNOWBERRY CLEARWING ( <i>Hemaris diffinis</i> )
	<i>Symphoricarpos</i> spp.,	
	<i>Viburnum</i> spp.	
ASTERACEAE	<i>Conyza</i> spp.	LYNX FLOWER MOTH ( <i>Schinia lynx</i> )
	<i>Ambrosia</i> spp.	RAGWEED FLOWER MOTH ( <i>Schinia rivulosa</i> )
	<i>Aster</i> spp.	ARCEGUA FLOWER MOTH ( <i>Schinia arcigera</i> )



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# A SUGGESTED LIST OF ORNAMENTAL NATIVE PLANTS: TREES, SHRUBS, VINES, GRASSES, WILDFLOWERS

FOR DALLAS, TEXAS BY BENNY SIMPSON 1928-1996

RANGE: 50 MILE RADIUS

NOTE: Many of the plants listed are not cultivated for sale through retail outlets.

Please do not remove them from the wild.

[Nomenclatural changes have been made to match the treatments elsewhere in this volume.]

TREES/	SCIENTIFIC NAME	COMMON NAME
	<i>Aesculus arguta</i>	TEXAS BUCKEYE
	<i>Carya texana</i>	BLACK HICKORY
	<i>Cercis canadensis</i> var. <i>canadensis</i>	EASTERN REDBUD
	<i>Cercis canadensis</i> var. <i>texensis</i>	TEXAS REDBUD
	<i>Cornus florida</i>	FLOWERING DOGWOOD
	<i>Crataegus reverchonii</i>	REVERCHON'S HAWTHORN
	<i>Diospyros virginiana</i>	COMMON PERSIMMON
	<i>Forestiera acuminata</i>	SWAMP-PRIVET
	<i>Fraxinus americana</i>	WHITE ASH
	<i>Fraxinus pennsylvanica</i>	GREEN ASH
	<i>Fraxinus texensis</i>	TEXAS ASH
	<i>Ilex decidua</i>	DECIDUOUS HOLLY
	<i>Juglans nigra</i>	BLACK WALNUT
	<i>Maclura pomifera</i>	BOIS D'ARC
	<i>Morus microphylla</i>	TEXAS MULBERRY
	<i>Morus rubra</i>	RED MULBERRY
	<i>Prosopis glandulosa</i>	HONEY MESQUITE, MESQUITE
	<i>Prunus mexicana</i>	MEXICAN PLUM
	<i>Prunus munsoniana</i>	MUNSON'S PLUM
	<i>Ptelea trifoliata</i>	WAFER-ASH
	<i>Quercus buckleyi</i>	TEXAS RED OAK
	<i>Quercus fusiformis</i>	ESCARPMENT LIVE OAK
	<i>Quercus macrocarpa</i>	BUR OAK
	<i>Quercus muhlenbergii</i>	CHINKAPIN OAK
	<i>Quercus nigra</i>	WATER OAK
	<i>Quercus shumardii</i>	SHUMARD'S RED OAK
	<i>Quercus sinuata</i> var. <i>breviloba</i>	BIGELOW OAK, SCALY-BARK OAK
	<i>Rhamnus caroliniana</i>	CAROLINA BUCKTHORN
	<i>Rhus copallinum</i>	SHINING SUMAC, WING-RIB SUMAC
	<i>Rhus lanceolata</i>	PRAIRIE FLAMELEAF SUMAC
	<i>Salix exigua</i>	SANDBAR WILLOW, COYOTE WILLOW
	<i>Sapindus drummondii</i>	WESTERN SOAPBERRY
	<i>Sophora affinis</i>	EVE'S-NECKLACE
	<i>Ulmus americana</i>	AMERICAN ELM
	<i>Ulmus crassifolia</i>	CEDAR ELM
	<i>Ulmus rubra</i>	SLIPPERY ELM
	<i>Zanthoxylum clava-hercules</i>	HERCULES'-CLUB, TICKLETONGUE
	<i>Zanthoxylum hirsutum</i>	TICKLETONGUE, PRICKLY-ASH

SHRUBS/	SCIENTIFIC NAME	COMMON NAME
	<i>Aloysia gratissima</i>	WHITEBRUSH, COMMON BEEBUSH
	<i>Amorpha fruticosa</i>	WILD INDIGO 'DARK LANCE'
	<i>Baccharis neglecta</i>	NEW DEAL WEED
	<i>Berberis trifoliolata</i>	AGARITO
	<i>Callicarpa americana</i>	AMERICAN BEAUTY-BERRY
	<i>Ceanothus americanus</i>	NEW JERSEY-TEA
	<i>Ceanothus herbaceus</i>	REDROOT
	<i>Cephalanthus occidentalis</i>	COMMON BUTTONBUSH
	<i>Cornus drummondii</i>	ROUGH-LEAF DOGWOOD
	<i>Dalea frutescens</i>	BLACK DALEA
	<i>Euonymus atropurpureus</i>	WAHOO
	<i>Forestiera pubescens</i>	SPRING-HERALD
	<i>Lonicera albiflora</i>	WHITE HONEYSUCKLE
	<i>Nolina lindheimeriana</i>	DEVIL'S-SHOESTRING
	<i>Prunus angustifolia</i>	CHICKASAW PLUM
	<i>Prunus gracilis</i>	OKLAHOMA PLUM
	<i>Prunus rivularis</i>	CREEK PLUM
	<i>Rhus aromatica</i>	FRAGRANT SUMAC
	<i>Rhus glabra</i>	SMOOTH SUMAC
	<i>Rosa foliolosa</i>	WHITE PRAIRIE ROSE
	<i>Rosa setigera</i>	CLIMBING PRAIRIE ROSE
	<i>Sabal minor</i>	DWARF PALMETTO
	<i>Sambucus nigra</i> var. <i>canadensis</i>	COMMON ELDERBERRY
	<i>Sideroxylon lanuginosum</i> subsp. <i>oblongifolium</i>	CHITTAMWOOD
	<i>Symphoricarpos orbiculatus</i>	CORAL-BERRY
	<i>Ungnadia speciosa</i>	MEXICAN-BUCKEYE
	<i>Viburnum rufidulum</i>	RUSTY BLACKHAW
	<i>Yucca arkansana</i>	ARKANSAS YUCCA
	<i>Yucca constricta</i>	BUCKLEY'S YUCCA
	<i>Yucca pallida</i>	PALE YUCCA

## VINES/

<i>Ampelopsis cordata</i>	HEART-LEAF AMPELOPSIS
<i>Campsis radicans</i>	TRUMPET-CREEPER
<i>Cissus incisa</i>	IVY-TREEBINE, COWITCH
<i>Clematis crispa</i>	CURLY CLEMATIS
<i>Clematis pitcheri</i>	LEATHER-FLOWER
<i>Cocculus carolinus</i>	SNAILSEED
<i>Ibervillea lindheimeri</i>	BALSAM GOURD, LINDHEIMER'S GLOBEBERRY
<i>Lonicera sempervirens</i>	CORAL HONEYSUCKLE
<i>Parthenocissus quinquefolia</i>	VIRGINIA-CREEPER
<i>Passiflora incarnata</i>	PASSION FLOWER
<i>Vitis</i> spp.	GRAPES

GRASSES/	SCIENTIFIC NAME	COMMON NAME
	<i>Andropogon gerardii</i>	BIG BLUESTEM
	<i>Andropogon glomeratus</i>	BUSHY BLUESTEM
	<i>Andropogon ternarius</i>	SPLIT-BEARD BLUESTEM
	<i>Andropogon virginicus</i>	BROOMSEDGE BLUESTEM
	<i>Bothriochloa laguroides</i>	SILVER BLUESTEM
	<i>Bouteloua curtipendula</i>	SIDE-OATS GRAMA
	<i>Bouteloua gracilis</i>	BLUE GRAMA
	<i>Bouteloua pectinata</i>	TALL GRAMA (HAIRY)
	<i>Chasmanthium latifolium</i>	BROADLEAF WOOD-OATS, INLAND SEA OATS
	<i>Elymus canadense</i>	CANADIAN WILD RYE
	<i>Elymus virginicus</i>	VIRGINIA WILD RYE
	<i>Eragrostis trichoides</i>	SAND LOVE GRASS
	<i>Eriochola sericea</i>	TEXAS CUP GRASS
	<i>Koeleria macrantha</i>	JUNE GRASS, PRAIRIE JUNE GRASS
	<i>Muhlenbergia reverchonii</i>	SEEP MUHLY
	<i>Panicum virgatum</i>	SWITCH GRASS
	<i>Pascopyrum smithii</i>	WESTERN WHEATGRASS
	<i>Paspalum floridanum</i>	FLORIDA PASPALUM
	<i>Poa arachnifera</i>	TEXAS BLUEGRASS
	<i>Schizachyrium scoparium</i>	LITTLE BLUESTEM
	<i>Sorghastrum nutans</i>	INDIAN GRASS
	<i>Spartina pectinata</i>	PRAIRIE CORD GRASS
	<i>Sphenopholis obtusata</i>	PRAIRIE WEDGESCALE
	<i>Tridens flavus</i>	PURPLETOP
	<i>Tridens strictus</i>	LONG-SPIKE TRIDENS
	<i>Tripsacum dactyloides</i>	EASTERN GAMA GRASS
<b>WILDFLOWERS/</b>		
	<i>Acacia angustissima</i>	FERN ACACIA
	<i>Allium drummondii</i>	DRUMMOND'S ONION
	<i>Allium stellatum</i>	PRAIRIE ONION
	<i>Alophia drummondii</i>	PURPLE PLEAT-LEAF
	<i>Amsonia ciliata</i>	NARROW-LEAF SLIMPOD, TEXAS SLIMPOD
	<i>Amsonia tabernaemontana</i>	BLUESTAR, WILLOW SLIMPOD
	<i>Androstaphyium caeruleum</i>	BLUE FUNNEL-LILY
	<i>Arnoglossum plantagineum</i>	PRAIRIE-PLANTAIN
	<i>Aster</i> spp.	PURPLE PRAIRIE ASTER
	<i>Baptisia australis</i>	WILD BLUE-INDIGO
	<i>Baptisia sphaerocarpa</i>	YELLOW BUSH PEA
	<i>Berlandiera texana</i>	GREENEYES
	<i>Callirhoe</i> spp.	WINECUPS
	<i>Calylophus</i> spp.	HALF-SHRUB SUNDROPS, SUNDROPS
	<i>Camassia scilloides</i>	WILD-HYACINTH
	<i>Castilleja purpurea</i> (3 var.)	PURPLE PAINTBRUSH
	<i>Dalea compacta</i> var. <i>pubescens</i>	SHOWY PRAIRIE-CLOVER

WILDFLOWERS/(CONTINUED)	SCIENTIFIC NAME	COMMON NAME
	<i>Dalea multiflora</i>	WHITE PRAIRIE-CLOVER
	<i>Datura wrightii</i>	ANGEL-TRUMPET
	<i>Delphinium carolinianum</i> var. <i>carolinianum</i>	WILD BLUE LARKSPUR
	<i>Delphinium carolinianum</i> var. <i>virescens</i>	PRAIRIE LARKSPUR
	<i>Dodecatheon meadia</i>	COMMON SHOOTING-STAR
	<i>Echinacea</i> spp.	CONEFLOWER, PURPLE CONEFLOWER
	<i>Engelmannia peristenia</i>	CUT-LEAF DAISY, ENGELMANN'S DAISY
	<i>Erigeron philadelphicus</i>	PHILADELPHIA FLEABANE DAISY
	<i>Erodium texanum</i>	TEXAS STORK'S-BILL
	<i>Eupatorium coelestinum</i>	MISTFLOWER
	<i>Gaura</i> spp.	GAURA, BUTTERFLY-WEED
	<i>Hedeoma reverchonii</i>	ROCK HEDEOMA
	<i>Helianthus grosse-serratus</i>	SAW-TOOTH SUNFLOWER
	<i>Helianthus hirsutus</i>	HAIRY SUNFLOWER
	<i>Helianthus maximiliani</i>	MAXIMILIAN SUNFLOWER
	<i>Helianthus mollis</i>	DOWNY SUNFLOWER
	<i>Helianthus pauciflorus</i>	STIFF SUNFLOWER
	<i>Helianthus salicifolius</i>	WILLOW-LEAF SUNFLOWER
	<i>Helianthus tuberosus</i>	CHOKE SUNFLOWER, JERUSALEM-ARTICHOKE
	<i>Hibiscus laevis</i>	HALBERD-LEAF HIBISCUS
	<i>Hypericum punctatum</i>	SPOTTED ST. JOHN'S-WORT
	<i>Lesquerella engelmannii</i>	ENGELMANN'S BLADDERPOD
	<i>Liatris elegans</i>	BLAZING STAR, PINK-SCALE GAYFEATHER
	<i>Liatris mucronata</i>	GAYFEATHER, NARROW-LEAF GAYFEATHER
	<i>Liatris squarrosa</i> var. <i>glabrata</i>	GAYFEATHER, SMOOTH GAYFEATHER
	<i>Lippa</i> spp. (PREVIOUSLY <i>Phyla</i> )	FROGFRUIT
	<i>Lithospermum caroliniense</i>	CAROLINA PUCCOON
	<i>Lithospermum incisum</i>	NARROW-LEAF PUCCOON
	<i>Lobelia cardinalis</i>	CARDINAL FLOWER
	<i>Manfreda virginica</i>	MANFREDA, RATTLE-SNAKE MASTER
	<i>Marshallia caespitosa</i>	BARBARA'S-BUTTONS
	<i>Melampodium leucanthum</i>	BLACK-FOOT DAISY
	<i>Mimosa nuttallii</i> (PREVIOUSLY <i>Schrankia</i> )	NUTTALL'S SENSITIVE-BRIAR
	<i>Monarda fistulosa</i>	WILD BERGAMOT
	<i>Nemastylis geminiflora</i>	PRAIRIE CELESTIAL
	<i>Oenothera macrocarpa</i>	MISSOURI EVENING-PRIMROSE
	<i>Oenothera speciosa</i>	SHOWY-PRIMROSE
	<i>Paronychia virginica</i>	WHITLOW-WORT
	<i>Penstemon cobaea</i>	COBAEA PENSTEMON, WILD FOXGLOVE
	<i>Penstemon digitalis</i>	SMOOTH BEARDTONGUE
	<i>Penstemon laxiflorus</i>	BEARDTONGUE
	<i>Phlox pilosa</i>	DOWNY PHLOX
	<i>Physostegia</i> spp.	OBEDIENT-PLANT
	<i>Phytolacca americana</i>	POKEWEED, POKE SALAT
	<i>Pontederia cordata</i>	PICKEREL WEED
	<i>Ratibida columnifera</i>	MEXICAN-HAT
	<i>Rivina humilis</i>	ROUGEPLANT, PIGEON-BERRY
	<i>Rudbeckia maxima</i>	GREAT CONEFLOWER
	<i>Salvia azurea</i>	BLUE SAGE

WILDFLOWERS/ (CONTINUED)	SCIENTIFIC NAME	COMMON NAME
	<i>Salvia engelmannii</i>	ENGELMANN'S SAGE
	<i>Salvia farinacea</i>	MEALY SAGE
	<i>Salvia texana</i>	TEXAS SAGE
	<i>Scutellaria resinosa</i>	RESIN-DOT SKULLCAP
	<i>Scutellaria wrightii</i>	WRIGHT'S SKULLCAP
	<i>Senna marilandica</i>	MARYLAND SENNA
	<i>Silphium albiflorum</i>	WHITE ROSINWEED
	<i>Silphium laciniatum</i>	COMPASSPLANT
	<i>Silphium</i> spp.	ROSINWEED
	<i>Solidago</i> spp.	GOLDENROD
	<i>Stenosiphon linifolius</i>	STENOSIPHON, FALSE GAURA
	<i>Tephrosia virginiana</i>	GOAT'S-RUE
	<i>Tetrameuris scaposa</i>	FOUR-NERVE DAISY
	<i>Teucrium canadense</i>	GERMANDER
	<i>Thelesperma</i> spp.	GREENTHREAD
	<i>Vernonia baldwinii</i>	IRONWEED, BALDWIN'S IRONWEED
	<i>Vernonia lindheimeri</i>	IRONWEED, WOOLLY IRONWEED

## ORNAMENTAL NATIVE PLANTS FOR DALLAS, TEXAS

RANGE: BEYOND 50 MILE RADIUS

### TREES/

<i>Acacia greggii</i> var. <i>wrightii</i>	WRIGHT'S ACACIA, CATCLAW
<i>Acer barbatum</i>	CADDO MAPLE
<i>Acer grandidentatum</i>	BIG-TOOTH MAPLE
<i>Acer leucoderme</i>	CHALK MAPLE
<i>Aesculus pavia</i> var. <i>flavescens</i>	PALE BUCKEYE, TEXAS YELLOW BUCKEYE
<i>Aesculus pavia</i> var. <i>pavia</i>	RED BUCKEYE
<i>Arbutus xalapensis</i>	TEXAS MADRONE
<i>Cercis canadensis</i> var. <i>mexicana</i>	MEXICAN REDBUD
<i>Cercocarpus montanus</i> var. <i>glabra</i>	SMOOTHLEAF MOUNTAIN MAHOGANY
<i>Chilopsis linearis</i>	DESERT-WILLOW
<i>Crataegus tracyi</i>	TRACY'S HAWTHORN
<i>Diospyros texana</i>	TEXAS PERSIMMON
<i>Fraxinus cuspidata</i>	FRAGRANT ASH
<i>Ilex vomitoria</i>	YAUPON, YAUPON HOLLY
<i>Juglans microcarpa</i>	LITTLE WALNUT, TEXAS WALNUT
<i>Leucaena retusa</i>	GOLDEN-BALL LEADTREE
<i>Liquidambar styraciflua</i>	SWEETGUM
<i>Magnolia grandiflora</i>	SOUTHERN MAGNOLIA
<i>Pinus cembroides</i>	PINYON, MEXICAN PINYON
<i>Quercus laceyi</i>	LACEY'S OAK
<i>Quercus mohriana</i>	MOHR'S OAK, MOHR'S SHIN OAK
<i>Quercus pungens</i> var. <i>pungens</i>	SANDPAPER OAK
<i>Quercus pungens</i> var. <i>vaseyana</i>	VASEY'S OAK, VASEY'S SHIN OAK
<i>Taxodium distichum</i>	BALD CYPRESS
<i>Vauquelinia corymbosa</i> var. <i>angustifolia</i>	CHISOS ROSEWOOD, SLIM-LEAF VAUQUELINIA

SHRUBS/	SCIENTIFIC NAME	COMMON NAME
	<i>Anisacanthus quadrifidus</i> var. <i>wrightii</i>	FLAME ACANTHUS, WRIGHT'S ACANTHUS
	<i>Atriplex canescens</i>	FOUR-WING SALTBUCH
	<i>Atriplex confertifolia</i>	SHADESCALE
	<i>Bouchea linifolia</i>	FLAX-LEAF BOUCHEA
	<i>Cotinus obovatus</i>	AMERICAN SMOKETREE
	<i>Croton alabamensis</i> var. <i>texensis</i>	TEXABAMA CROTON
	<i>Dalea bicolor</i> var. <i>argyrea</i>	SILVER DALEA
	<i>Dalea greggii</i>	GREGG'S DALEA
	<i>Fallugia paradoxa</i>	APACHE-PLUME
	<i>Fendlera</i> spp.	FENDLERBUSH
	<i>Forestiera reticulata</i>	NET-LEAF FORESTIERA
	<i>Garrya ovata</i> subsp. <i>lindheimeri</i>	LINDHEIMER'S SILKTASSEL
	<i>Hesperaloe parviflora</i> var. <i>parviflora</i>	RED-FLOWER-YUCCA
	<i>Lantana urticoides</i>	TEXAS LANTANA
	<i>Leucophyllum</i> spp.	SILVERLEAF
	<i>Menodora longiflora</i>	SHOWY MENODORA
	<i>Myrica cerifera</i> (INCLUDES DWARF FORMS)	SOUTHERN WAX-MYRTLE
	<i>Pavonia lasiopetala</i>	WRIGHT'S PAVONIA
	<i>Philadelphus</i> spp.	WILD MOCK ORANGE
	<i>Rhus microphylla</i>	LITTLE-LEAF SUMAC
	<i>Ribes aureum</i> var. <i>villosum</i>	BUFFALO CURRANT
	<i>Salix exigua</i>	SANDBAR WILLOW, COYOTE WILLOW
	<i>Salvia ballotaeflora</i>	SHRUBBY BLUE SAGE
	<i>Salvia greggii</i>	AUTUMN SAGE
	<i>Salvia regla</i>	MOUNTAIN SAGE
	<i>Styrax platanifolia</i>	SYCAMORE-LEAF SNOWBELL
	<i>Yucca rupicola</i>	TWIST-LEAF YUCCA

## LIST OF SOURCES FOR NATIVE PLANTS

### ☛ NATIVE PLANT SOCIETY OF TEXAS

State Office  
Coordinator: Dana Tucker  
P.O. Box 891  
Georgetown, TX 78627  
512/238-0695  
FAX 512/238-0703  
*E-MAIL:* dtucker@io.com

### ☛ NURSERIES

Anderson Landscape and Nursery  
2222 Pech  
Houston, TX 77055  
713/984-1342

Barton Springs Nursery  
3601 Bee Cave Rd.  
Austin, TX 78746  
512/328-6655

Bluestem Nursery  
4101 Curry Rd.  
Arlington, TX 76017  
817/478-6202  
Contact: John S. Snowden  
Native ornamental grasses, catalog

Brazos Rim Farm, Inc.  
433 Ridgewood  
Ft. Worth, TX 76107  
817/740-1184  
FAX 817/625-1327  
Contact: Pat Needham  
Wholesale

Buchanan's Native Plants  
611 E. 11th Street  
Houston, TX 77008  
713/861-5702  
Retail

Chaparral Estates Gardens  
Rte. 1, Box 425  
Killeen, TX 76542  
817/526-3973  
Contact: Ken and Rita Schoen

Discount Trees of Brenham  
2800 N. Park Street  
Brenham, TX 77833  
409/836-7225  
Retail

Dodd Family Tree Nursery  
515 West Main  
Fredericksburg, TX 78624  
830/997-9571  
Retail; native plants, organics, special order

Ecotone Gardens  
806 Pine/Hwy 69  
Kountze, TX 77625  
409/246-3070  
Contact: Becky Wilder, owner

Garden-Ville of Austin  
8648 Old Bee Caves Rd.  
Austin, TX 78735  
512/288-6113  
FAX 512/288-6114  
Retail

Gottlieb Gardens  
8263 Huber Rd.  
Seguin, TX 78155  
830/629-9876  
Wholesale

Gunsight Mountain Ranch and Nursery  
Williams Creek Rd., Box 86  
Tarpley, TX 78883  
210/562-3225  
FAX 562-3266  
Wholesale/retail

Hager Nursery  
A division of Hager Landscape & Tree, Inc.  
1324 Old Martindale Rd.  
San Marcos, TX 78666  
512/392-1089 or 800/443-TREE  
Contact Robert Hager  
Retail

Kings Creek Gardens  
813 Straus Rd.  
Cedar Hill, TX 75104  
972/291-7650  
FAX 972/293-0920  
Contact: Rosa Finsley, owner

Love Creek Nursery  
P.O. Box 1401  
Medina, TX 78055  
210/589-2265  
Contact: Ann Landry  
Wholesale/retail

Madrone Nursery  
2318 Hilliard  
San Marcos, TX 78666  
512/353-3944  
Wholesale/retail

Native American Seed  
610 Main Street  
Junction, TX 76849  
800/728-4043  
*INTERNET:* <http://www.seedsource.com>

Native Resources Inc.  
Rt.1, Box 7J, on FM 971  
Georgetown, TX 78626  
512/930-3935

Natives of Texas  
Spring Canyon Ranch  
6520 Medina Hwy.  
Kerrville, TX 78028  
210/896-2169 or 210/698-3736  
Contact: Betty Winningham

Native Texas Nursery  
1004 MoPac Circle #101  
Austin, TX 78746  
512/280-2824  
Contact: Henry Chalmers

North Haven Gardens  
7700 Northaven Road  
Dallas, TX 75230-3297  
214/363-5316  
Wholesale/retail

The Rustic Wheelbarrow  
416 W. Avenue D  
San Angelo, TX 76903  
915/659-2130

Southwest Landscape and Nursery Company  
2220 Sandy Lake Rd.  
Carrollton, TX 75006  
214/245-4557  
Wholesale/retail

Texzen Gardens  
4806 Burnet Rd.  
Austin, TX 78756  
512/454-6471

Weston Gardens in Bloom, Inc.  
8101 Anglin Dr.  
Ft Worth, TX 76140  
817/572-0549

Wichita Valley Landscape  
5314 SW Parkway  
Wichita Falls, TX 76310  
940/696-3082  
Contact: Paul or Nila  
10% discount to NPSOT members

Wildseed Farms, Inc.  
425 Wildflower Hills  
P.O. Box 3000  
Fredericksburg, TX 78624-3000  
800/848-0078  
FAX 830/990-8090  
*INTERNET:* [www.wildseedfarms.com](http://www.wildseedfarms.com)  
Wholesale/retail: seed and live plants



**☛ LANDSCAPE PROFESSIONALS**

Anderson Landscape & Nursery  
2222 Pech  
Houston, TX 77055  
713/984-1342

Rosa Finsley  
Landscape Architect  
Kings Creek Landscape  
214/653-1160  
972/293-0920

Don Gardner  
Consulting Arborist  
Native Plant Preservation Specialist  
13903 Murfin Rd.  
Austin, TX 78734  
512/263-2586

Landscape Details  
324 Cardinal  
New Braunfels, TX 78130  
830/629-9876  
Contact: David E. Will

Place Collaborative, Inc.  
8207 Callaghan Rd. #130  
San Antonio, TX 78205  
210/349-3434  
Contact: Larry A. Hicks, ASLA

Dave Shows Associates  
17320 Classen Rd.  
San Antonio, TX 78247  
210/497-3222

Wright Landscape for Texas  
2922 High Plains Dr.  
Katy, TX 77449  
281/578-7304  
Contact: LisaGay Wright  
Specializing in wildlife habitats

G. Owen Yost, ASLA  
Landscape Architect  
4516 Coyote Point  
Denton, TX 76208  
Phone/FAX: 940/383-9655

**☛ NATURE CENTERS AND ORGANIZATIONS**

Heard Natural Science Museum and Wildlife Sanctuary  
One Nature Place  
McKinney, TX 75069-8840  
972/562-5566

*E-MAIL:* heardmuseum@texoma.net  
*INTERNET:* <http://www.heardmuseum.org>

Lady Bird Johnson Wildflower Center  
4801 LaCross Avenue  
Austin, TX 78739  
512/292-4100 (info line)

*E-MAIL:* wildflower@wildflower.org  
*INTERNET:* <http://www.wildflower.org/>

Riverside Nature Center  
150 Lemos St.  
Kerrville, TX 78028  
830/257-4837 Non-profit organization;  
Information and education on the Hill Country

Seeds of Texas Seed Exchange  
P.O. Box 9882  
College Station, TX 77842  
409/693-4485

*E-MAIL:* jackrowe@compuserve.com  
*INTERNET:* <http://csf.Colorado.EDU/perma/stse/>  
Seeds of native, garden, and landscape plants

☛ These listings were provided by the Native Plant Society of Texas; such listings are published regularly in the *Native Plant Society of Texas News*.



## STATE BOTANICAL SYMBOLS

Information on state botanical symbols can be found in Texas Parks & Wildlife (1995), Tyrl et al. (1994), and Jones et al. (1997).

### TEXAS

*Lupinus* [Fabaceae], BLUEBONNET. All six *Lupinus* species which occur in the state are the **state flowers of Texas**. *Lupinus subcarnosus* was designated the state flower in 1901 and in 1971 the legislature extended state flower status to the other five *Lupinus* species native in Texas (Andrews 1986).

*Carya illinoensis* (Wangenh.) K. Koch [Juglandaceae], PECAN, NOGAL MORADO, NUEZ ENCARCELADA. **State tree of Texas** as designated by the state legislature in 1919 (Jones et al. 1997).

*Bouteloua curtipendula* (Michx.) Torr. [Poaceae], SIDE-OATS GRAMA. **State grass of Texas** as designated by the 62nd Texas Legislature in 1971 (Jones et al. 1997).

*Opuntia* [Cactaceae], PRICKLY-PEAR. All members of subgenus *Opuntia* (with flat stems) are considered the **state plant of Texas**, while those of subgenus *Cylindroopuntia* (with cylindrical stems) are not—as designated by the 74th state legislature (Jones et al. 1997).

*Citrus paradisi* (L.) Macfad. [*C. maxima* × *C. sinensis*] (cultivar “Ruby” (redblush)) [Rutaceae], TEXAS RED GRAPEFRUIT. **State fruit of Texas** as designated in 1993; while this hybrid cultivar was developed in TX, the parents are introduced (Jones et al. 1997).

*Capsicum annuum* L. var. *annuum* [Solanaceae], JALAPEÑO. **State pepper of Texas** as designated by the 74th state legislature (Jones et al. 1997).

*Capsicum annuum* L. var. *glabriusculum* (Dunal) Heiser & Pickersgill [Solanaceae], BIRD PEPPER, CHILITEPÍN, CHILIPÍQUÍN, CHILE PIQUÍN, BUSH REDPEPPER. **Native pepper of Texas** as designated by Texas House Concurrent Resolution 82 in 1997 (Andrews 1998).

### OKLAHOMA

*Gaillardia pulchella* Foug. [Asteraceae], FIRE-WHEELS, INDIAN-BLANKET, ROSE-RING GAILLARDIA. **State wild-flower of Oklahoma** (Tyrl et al. 1994).

*Cercis canadensis* L. [Fabaceae], REDBUD, JUDASTREE. **State tree of Oklahoma** (Tyrl et al. 1994).

*Sorghastrum nutans* (L.) Nash [Poaceae], INDIAN GRASS, YELLOW INDIAN GRASS, INDIAN REED. **State grass of Oklahoma** (S. Barber, pers. comm.).

*Phoradendron tomentosum* (DC.) Engelm. ex A. Gray [Viscaceae], MISTLETOE, CHRISTMAS MISTLETOE, INJERTO, HAIRY MISTLETOE. **Official floral emblem of Oklahoma** as designated by the Assembly of the Territory of Oklahoma on 11 February 1893 (Tyrl et al. 1994).

## SPECIAL RECOGNITION—BENNY J. SIMPSON

I N M E M O R I A M

BENNY J. SIMPSON

1928–1996

While a number of individuals have contributed to the native plant movement in Texas (e.g., Carroll Abbott, Rosa Finsley, Lynn Lowrey, Robert Vines, Barton Warnock, Sally Wasowski), only Benny Simpson (Fig. 43) worked his entire career in North Central Texas and devoted much of his professional life to the development of native species for use as landscape plants. From 1954 to his death in 1996, Benny worked at the Texas Research Foundation at Renner which in 1972 became the Texas A&M Research and Extension Center at Dallas.



**FIG. 43/BENNY SIMPSON** (1928–1996).  
USED WITH PERMISSION OF THE NATIVE PLANT SOCIETY OF TEXAS.

Simpson is possibly best known as the author of *A Field Guide to Texas Trees* (Simpson 1988) and he published many other scholarly works (for a list of his publications see Davis 1997). However, among botanists and native

plant enthusiasts he is correctly best remembered as the “Pioneer of the Native Plant Movement” in Texas (Nokes 1997). Simpson understood that the scarcity of water is one of the biggest challenges facing Texas’ future, and that native plants, well-adapted to the state’s climate, are an important resource (e.g., Simpson & Hipp 1984; Simpson 1993). Through his research, nine superior selections of native plants were released to the nursery industry including three forms of *Leucophyllum* (Scrophulariaceae), widely known as Texas purple-sage (Nokes 1997; Kiphart 1997). In addition to his other contributions, Simpson was one of the founding members and a former president of the Native Plant Society of Texas and was active in that organization until his death (Nokes 1997; Pickens 1997).

Plants from Simpson’s extensive research collection are now at the Dallas Horticultural Center at Fair Park, the Heard Natural Science Museum and Wildlife Sanctuary in McKinney, and the Benny Simpson Outdoor Learning Center at the Texas A&M Research and Extension Center at Dallas.



This glossary is modified from those of Shinnars (1958a) and Mahler (1988), with additional entries obtained or modified from a variety of sources including Lawrence (1951), Featherly (1954), Correll (1956), Gleason and Cronquist (1963), Radford et al. (1968), Correll and Johnston (1970), Gould (1975), Lewis and Elvin-Lewis (1977), Benson (1979), Schmutz and Hamilton (1979), Fuller and McClintock (1986), Jones and Luchsinger (1986), Schofield (1986), Gandhi and Thomas (1989), Blackwell (1990), Isely (1990), Harris and Harris (1994), Spjut (1994), and Hickey and King (1997).

## A

**A-** A prefix meaning without or not.

**ABAXIAL** Located on the side away from axis; e.g., lower leaf surface; contrasting with adaxial.

**ABERRANT** Different from normal or typical condition.

**ABORTIVE** Not developing or imperfectly developed; barren; defective.

**ABSCISSION** Act or process of cutting off or shedding; e.g., the shedding or abscising of leaves.

**ABSCISSION LAYER** Zone at base of petiole or other structure (e.g., pedicel) forming a layer of separation. This layer is important in the drop or shedding of leaves and fruits.

**ACAULESCENT** Stemless or apparently so; having leaves basal with stems not elongated.

**ACCESSORY FRUIT** A fruit or assemblage of fruits with fleshy parts derived from organs other than the pistil; e.g., strawberry with fleshy receptacle with achenes (individual fruits) embedded in its surface.

**ACCRESCENT** Enlarging after anthesis or with age, frequently in reference to the calyx.

**ACCUMBENT COTYLEDONS** Cotyledons lying face to face with the edges against the radicle.

**ACEROSE** (= Acicular) Needle-shaped or -like.

**ACHENE** Small, dry, indehiscent, one-seeded fruit with ovary wall free from seed.

**ACHLAMYDEOUS** Lacking a perianth.

**ACHLOROPHYLLUS** Lacking chlorophyll or apparently so; e.g., a number of non-green saprophytes or parasites.

**ACICULAR** (= Acerose) Needle-shaped or -like.

**ACORN** Fruit of a *Quercus* species (oak) composed of a nut and its cup or cupule made of fused bracts.

**ACRID** With sharp and harsh or bitterly pungent taste.

**ACROPETAL** Developing or maturing in succession from the base toward the apex.

**ACTINOMORPHIC** (= Regular) Radially symmetrical. The term usually refers to the arrangement of flower parts.

**ACUMINATE** Having a long, tapering point; longer tapering than acute.

**ACUTE** Forming a sharp angle of less than 90 degrees; less tapering than acuminate.

**AD-** A prefix meaning to or toward.

**ADAXIAL** Located on side towards axis; e.g., upper leaf surface; contrasting with abaxial.

**ADHERENT** Touching or sticking together, when two organs or parts (typically dissimilar) touch each other but are not grown or fused together.

**ADNATE** United or fused, when the fusion involves dissimilar structures; e.g., as in fusion of stamens and corolla.

**ADRESSED** (= Appressed) Lying flat against a surface.

**ADVENTITIOUS** Referring to structures or organs that develop in an unusual position; e.g., buds or roots that develop out of their usual place.

**ADVENTIVE** Not fully naturalized or established; of occasional occurrence.

**AERIAL** Above ground level.

**AESTIVAL** Appearing in or pertaining to the summer.

**AESTIVATION** Arrangement of young flower parts in the bud.

**AGAMOSPERMY** The production of seeds without fertilization.

**AGGREGATE** Crowded into a dense cluster or tuft.

**AGGREGATE FRUIT** A fruit formed by the clustering together of a number of separate pistils from a single flower; e.g., a blackberry is a cluster of drupelets.

**AGLYCONE** The nonsugar component of a glycoside. Glycosides are composed of a sugar plus another compound (the aglycone); many aglycones are toxic.

**ALATE** Winged.

**ALBIDUS** White.

**ALBUMEN** Nutritive material stored within the seed.

**ALKALOID** Any of a broad class (> 5000 known alkaloids) of bitter, usually basic (alkaline), organic compounds that contain nitrogen and typically have a ring in their structure. They are often physiologically active in animals; many are poisonous; many affect the nervous system; there are a number of general types based on chemical structure including indole, isoquinoline, piperidine, purine, pyrrolidine, quinoline, and tropane alkaloids; well-known examples of alkaloids include atropine, caffeine, cocaine, quinine, morphine, nicotine, theobromine, and strychnine.

**ALLELOPATHY, ALLELOPATHIC** Harmful or detrimental chemical effect by one species upon another; e.g., a plant producing phytotoxic compounds that inhibit the germination or growth of other plants.

**ALLERGEN** Substance capable of inducing an allergic response.

**ALLERGENIC** Causing an allergic response or an allergy to become manifest.

**ALLERGY** Hypersensitivity of the body cells to specific substances as antigens and allergens, resulting in various types of reactions (e.g., anaphylaxis, contact dermatitis, hay fever).

**ALLIACEOUS** Onion-like.

**ALLUVIAL** Of or pertaining to alluvium (= organic or inorganic materials, including soils, deposited by running water).

**ALTERNATE** Bearing one leaf or other structure at a node; having only one attached at a given point; contrasting with opposite or whorled.

**ALVEOLATE** Honeycombed.

**AMENT** (= Catkin) A flexible often pendulous spike or spike-like raceme of small, inconspicuous, unisexual, apetalous, usually wind-pollinated flowers, the whole falling as one piece; e.g., male inflorescence of oaks or pecan.

**AMENTIFEROUS** Bearing aments.

**AMETHYSTINE** Violet-colored.

**AMINO ACIDS** Compounds containing both an amino group and a carboxyl group. They are the subunits (monomers) that are linked together by peptide bonds to form the polymers known as proteins; some nonprotein amino acids are found free in plants and are sometimes toxic; e.g., in *Lathyrus* (Fabaceae).

**AMORPHOUS** Without regular or definite form; shapeless.

**AMPHITROPOUS OVULE** Ovule that is half inverted so that the point of attachment is near the middle.

**AMPLEXICAUL** (= Clasping) With base of leaf or other structure (e.g., stipule) wholly or partly surrounding the stem.

**AMPLIATE** Enlarged.

**ANASTOMOSING** Net-like; with veins connecting by cross-veins to form a network.

**ANATROPOUS OVULE** Ovule that is completely inverted, the micropylar end being essentially basal.

**ANDROECIUM** Collective term for the stamens or male structures of a flower.

**ANDROGYNOPHORE** A stalk bearing both androecium and gynoecium; e.g., in many Passifloraceae.

**ANDROGYNOUS** Bearing staminate flowers above (= distal) to the pistillate in the same spike; e.g., in some Cyperaceae.

**ANDROPHORE** A support or column bearing stamens.

**ANEMOPHILOUS, ANEMOPHILY** Wind-pollinated.

**ANGIOSPERM** (= Flowering plant) Literally, "vessel seed"; a plant having its seeds enclosed in an ovary (= the proximal part of the carpel or "vessel"); a member of Division Magnoliophyta.

**ANNUAL** Plant or root system living only one growing season (year); completing the growth cycle within one year.

**ANNULAR** Arranged in a ring or circle.

**ANNULATE** With the appearance of rings; e.g., cross-ribbed or ringed spines of some Cactaceae.

**ANNULUS** A group or ring of thick-walled cells, on the sporangia of some ferns, that are involved in spore dehiscence.

**ANTERIOR** Describing the position of an organ located toward the front in relation to the axis; e.g., in a flower the side away from the axis and toward the subtending bract.

**ANTHER** That part of a stamen producing the pollen.

**ANTHER-CELL** (= Theca) One of the pollen-sacs or locules of an anther.

**ANTHERIDIUM** Male sexual organ; structure forming male gametes, typically found in less derived plants (e.g., ferns) but so reduced evolutionarily as to not be present in flowering plants.

**ANTHESIS** (a) Time or process of flower expansion or opening; (b) also descriptive of period during which a flower is open and functional.

**ANTHOCARP** A structure that includes a fruit united with the perianth or the receptacle; e.g., Nyctaginaceae.

**ANTHOCYANIN** A red, purplish, or blue water-soluble pigment found in most flowers. The color of these pigments is affected by pH (e.g., in *Hydrangea*); chemically, anthocyanins are phenolic.

**ANTIPETALOUS** Referring to stamens that are of the same number as, and borne in front of (= on the same radius as) the petals or corolla lobes.

**ANTISEPALOUS** Referring to stamens that are of the same number as, and borne in front of (= on the same radius as) the sepals or calyx lobes.

**ANTORSE** Directed toward the summit, upward, or forward; e.g., pubescence directed up the stem, the free end of the hair above or distal to the attached end; contrasting with retrorse.

**ANTORSELY BARBED** With barbs (= points) pointing upward toward the summit or apex.

**APETALOUS** Having flowers without petals.

**APETALY** The condition of being without petals.

**APETURE** An opening.

**APEX** (pl. APICES) The tip or summit.

**APHYLLOPODIC** Lacking leaves at the base.

**APHYLLOUS** Leafless; e.g., Cuscutaceae.

**APICAL** At the tip or apex; relating to the apex.

**APICAL BUD** (= Terminal bud) Bud at the end (= apex) of a stem or branch.

**APICULATE** Having a small sharp point formed by blade tissue (of a leaf, sepal, or petal) rather than by projection of a rib or vein; with an abrupt tip or projection.

**APOCARPOUS** With the carpels separate or free from one another.

**APOGAMOUS** Forming a sporophyte without the union of gametes.

**APOMIXIS** A collective term for reproduction, including vegetative propagation, that does not involve sexual processes; any form of asexual reproduction.

**APOPETALOUS** (= Polypetalous) Referring to a corolla consisting of separate petals.

**APOPHYSIS** Swelling or enlargement of the surface of an organ.

**APOSEPALOUS** (= Polysepalous) Referring to a calyx consisting of separate sepals.

**APPENDAGE** Any attached structure that is supplementary or secondary.

**APPENDICULATE** With an appendage.

**APPRESSED** (= Adpressed) Lying flat against a surface.

**APPROXIMATE** Close together.

**AQUATIC** Living in water.

**ARACHNOID, ARACHNOSE** Cobwebby; cobweb-like, with entangled, slender, loose hairs; thinly pubescent with relatively long, usually appressed and interlaced hairs.

**ARBORESCENT** Tree-like or becoming tree-like.

**ARCHEGONIUM** Female sexual organ; structure forming female gametes, typically found in less derived plants (e.g., ferns) but so reduced evolutionarily as to not be present in flowering plants.

**ARCuate** Curved or bent like a bow, often used in reference to curving veins.

**ARENACEOUS** Sand-like or growing in sand.

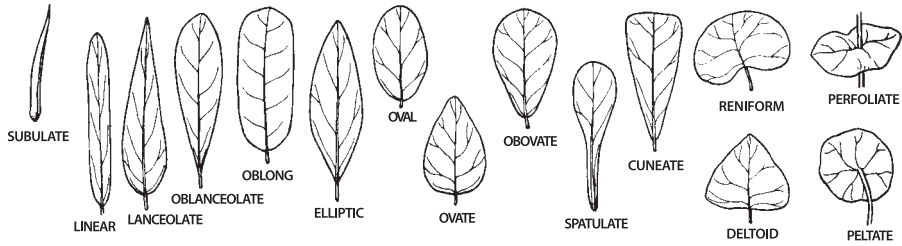
**AREOLATE** Divided into small angular spaces; marked with areolae.

**AREOLE, AREOLA** (pl. AREOLAE) (a) Small space marked out on a surface, usually referring to the space bounded by veinlets on the surface of a leaf; (b) the small spine-bearing areas on a cactus stem.

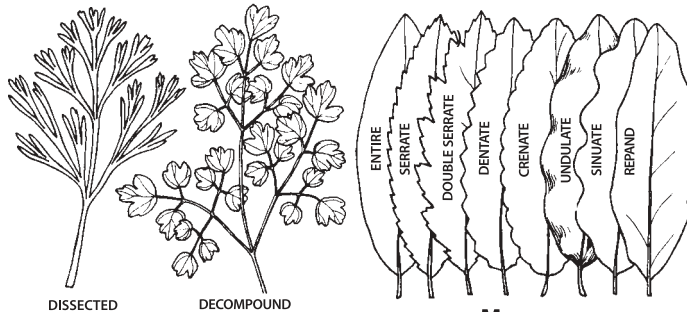
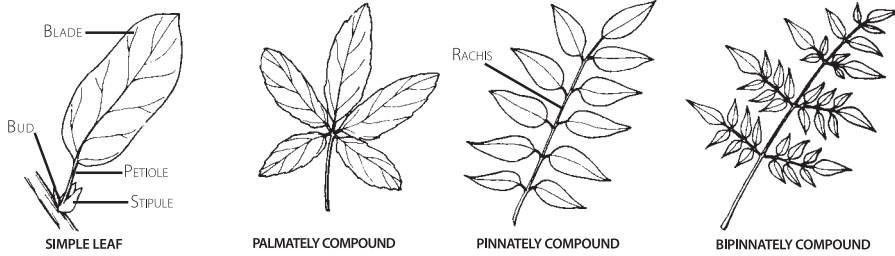
**ARGILLACEOUS** Clayey; growing in clay or clay-like material.

**ARIL** An appendage or covering on a seed, typically involved in dispersal by animals.

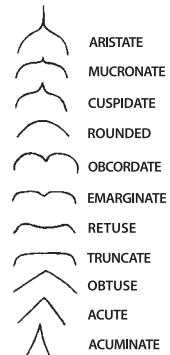
### LEAF CHARACTERS



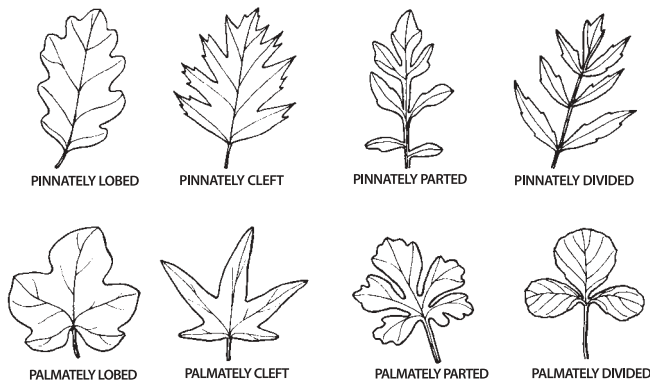
### LEAF SHAPES



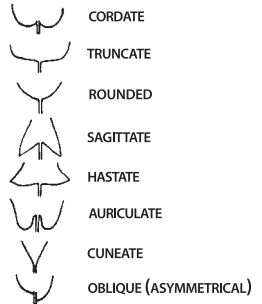
### APEX OF BLADE



### MARGINS



### BASE OF BLADE



**ARILLATE** With an aril.

**ARISTATE** Bearing a stiff awn or bristle.

**ARISTULATE** Diminutive of aristate.

**ARMED** Possessing sharp projections; e.g., prickles, spines, or thorns.

**AROMATIC** (a) Generally, having a fragrant odor; (b) chemically, containing or patterned after benzene rings, with or without fragrance.

**ARTICLE** The individual unit of a constricted or jointed fruit; e.g., in some Fabaceae such as *Desmodium*.

**ARTICULATE** Jointed; joined.

**ARTICULATION** A separation place; joint.

**ASCENDING, ASCENDENT** Rising at an oblique angle.

**ASEPALOUS** Without sepals.

**ASEXUAL** Without sex; reproducing without sex.

**ASPEROUS** Rough to the touch.

**ASSURGENT** Ascending, rising.

**ASTYLOUS** Without a style.

**ASYMMETRICAL** Without symmetry.

**ATOMIFEROUS** Bearing very fine glands.

**ATROCASTANEOUS** Very dark chestnut-colored.

**ATROPURPUREOUS** Dark purple; purple-black.

**ATTENUATE** Gradually tapering to a very slender tip, the taper more gradual than in acuminate.

**ATYPICAL** Not typical; deviating from the norm.

**AURICLE** Earlobe-like lobe or appendage; e.g., at the base of some leaves, sepals, etc.

**AURICULATE** With an auricle.

**AUTOTROPHIC** Descriptive of an organism capable of making its own food, usually through photosynthesis; free living, not parasitic or saprophytic; e.g., green plants.

**AUTUMNAL** Associated with or occurring in the fall of the year.

**AWL-SHAPED** (= Subulate) Tapering from the base to a slender or stiff point; narrow and sharp-pointed.

**AWN** Terminal slender bristle or hair-like extension or projection; e.g., in grasses, the prolongation of the midnerve of the glumes or lemmas.

**AWN COLUMN** In certain grasses, a prominent narrowed beak at the apex of the lemma. The awns arise from this structure.

**AXIAL** Relating to the axis.

**AXIL** Angle between two organs; e.g., upper angle formed by a leaf and a stem.

**AXILE** or **AXILLARY PLACENTATION** Placentation with the ovules attached to the central axis of the ovary.

**AXILLARY** In an axil; e.g., in the angle between a leaf and a stem.

**AXIS** (pl. AXES) (a) the central stem from which organs arise; (b) a portion of a plant from which a series of organs arises radially; e.g., the axis of an inflorescence.

## B

**BACCATE** Resembling or having the structure of a berry; berry-like.

**BALLISTIC** Referring to fruits that are forcibly or elastically dehiscent, whose seeds are thrown catapult-like; e.g., *Phyllanthus* (Euphorbiaceae).

**BANNER** (= Standard) Adaxial and typically largest petal of a

papilionaceous flower.

**BARBED** With short reflexed points like a multi-pronged fishhook.

**BARBELLATE** Diminutive of barbed; with short, fine, stiff hairs.

**BARK** Outer (= external to vascular cambium) protective tissues on the stems or roots of woody plants.

**BASAL** Located at the base of a plant or of an organ.

**BASAL ROSETTE** Cluster of leaves on or near the ground.

**BASAL STYLE** Style projecting from among the lobes of a deeply lobed ovary.

**BASIFIXED** Attached basally, typically referring to attachment of an anther to a filament; contrasting with either dorsifixed or versatile.

**BASILAMINAR** At base of blade of leaf or other structure.

**BASIPETAL** Developing or maturing in succession from the apex toward the base.

**BASISCOPIIC** Directed toward the base.

**BASONYM** The original epithet assigned to a species (or other taxon of lower rank) by its author.

**BEAK** A long, prominent, and relatively thickened point; a tapering projection; e.g., projection on a fruit resulting from a persistent style.

**BEAKED** Ending in a beak.

**BEARD** A group of long awns or bristle-like trichomes; a zone of pubescence; e.g., on some corollas.

**BEARDED** Bearing long or stiff hairs, typically in a line or tuft.

**BERRY** Indehiscent type of fruit with the entire pericarp fleshy and lacking a stone, usually with several to many seeds; e.g., tomato, grape.

**BETALAINS** Reddish, nitrogen-containing pigments (characteristic of most Caryophyllidae) that derive their name from the genus *Beta* (beets).

**Bi-, Bis-** Latin prefix signifying two, twice, or doubly.

**BICOLORED** Two-colored.

**BICONVEX** Convex on both sides.

**BIDENTATE** Two-toothed.

**BIENNIAL** Plant or root system living only two years (growing seasons), typically producing only leafy growth the first year, then flowering and dying the second.

**BIFID** Two-cleft, usually deeply so; with two lobes or segments.

**BIFURCATE** Two-forked; e.g., some Y-shaped trichomes, stigmas, or styles.

**BILABiate** Two-lipped, typically referring to corollas or calyces.

**BILATERAL** Arranged on two sides; two-sided.

**BILATERALLY SYMMETRICAL** With only one plane of symmetry; divisible into halves in one plane only.

**BILOCULAR** Having two cavities.

**BINOMIAL** The combination of a generic name and a specific epithet given to each species.

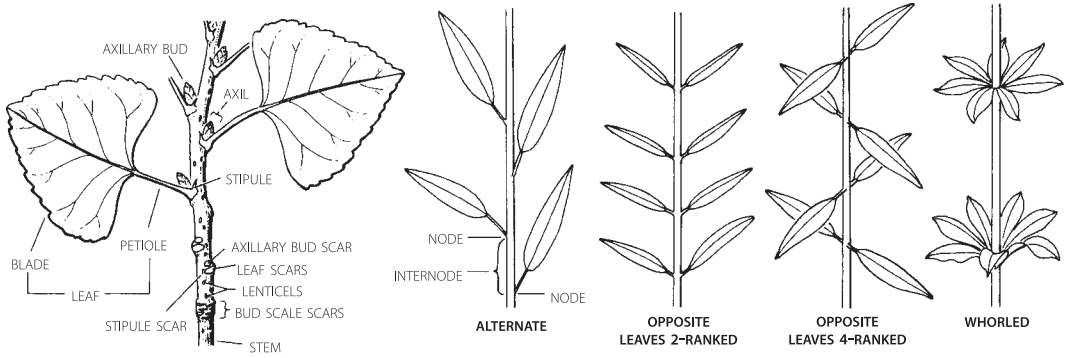
**BINOMIAL NOMENCLATURE** System of nomenclature where each species has a two-part name composed of a generic name and a specific epithet.

**BIPARTITE** Two-parted; divided into two parts nearly to the base.

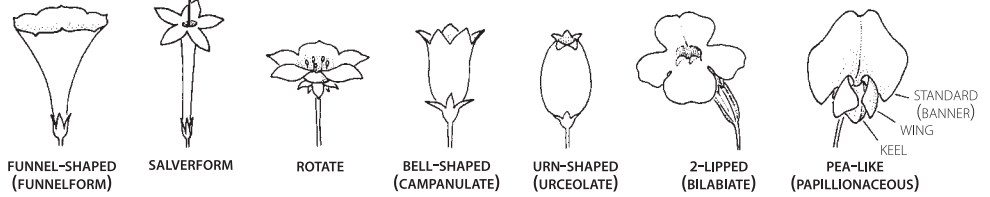
**BIPINNATE** (= Twice-pinnate or 2-pinnate) Descriptive of a leaf with leaflets pinnately arranged on lateral axes that are themselves pinnately arranged on the main axis; with the primary divisions (pinnae) themselves pinnate.



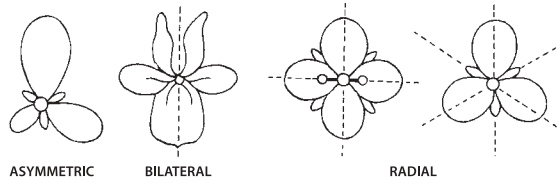
**LEAF AND TWIG STRUCTURE AND ARRANGEMENT**



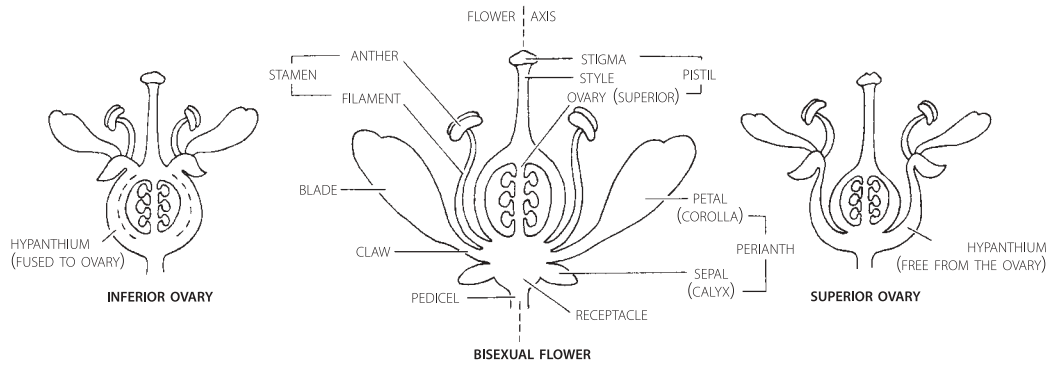
**FLOWER SHAPE**



**FLOWER SYMMETRY**



**FLOWER STRUCTURE**



**BISECTED** Completely divided into two parts.

**BISERIATE** In two whorls or cycles; e.g., a perianth with both calyx and corolla.

**BISEXUAL FLOWER** Type of flower with both stamens and pistil(s) functional within the same flower.

**BIVALVATE** Opening by two valves.

**BLADDER** (a) A thin-walled, inflated structure; (b) a hollow, membranaceous appendage that traps insects; e.g., *Utricularia* (Lentibulariaceae).

**BLADDERY** Thin-walled and inflated; like the bladder of an animal.

**BLADE** Flat, expanded portion, as the main part of a leaf or petal.

**BLOOM** (a) Flower or flowering; (b) coating of white wax or powder, as on plums or grapes.

**BOLE** The main trunk or stem of a tree.

**BOSS** A protrusion.

**BRACKISH** Somewhat salty.

**BRACT** A modified reduced leaf typically subtending a flower or cluster of flowers. Bracts can vary from very leaf-like to scale-like or thread-like; in some cases they can be colorful and attract pollinators.

**BRACTEAL** Having the form or position of a bract.

**BRACTEATE** Having bracts.

**BRACTEOLATE** Having bracteoles.

**BRACTEOLE, BRACTLET** A usually small bract borne on a secondary axis (e.g., on a pedicel).

**BRACTEOSE** Having numerous or conspicuous bracts.

**BRANCH** A shoot or secondary stem growing from the main stem.

**BRANCHLET** The ultimate division of a branch.

**BRISTLE** Stiff, strong but slender hair or trichome.

**BRISTLY** Bearing bristles.

**BROAD** (= Wide) Distance across a structure (equal to diameter if tubular); sometimes restricted to signify the width or diameter of three-dimensional structures.

**BRYOPHYTA** Group containing the mosses, liverworts, and hornworts. The Bryophyta is not treated in this flora.

**BUD** (a) Undeveloped or unopened flower; (b) undeveloped, much-condensed shoots, containing embryonic (meristematic or growing) tissue, usually covered by scales or bracts. Such buds are usually found at the tips of stems or in the axils of leaves.

**BULB** Underground structure composed of a short, disc-like stem and one or more buds surrounded by layers of thickened fleshy leaf bases or scales; e.g., an onion.

**BULBIL** Small bulbs produced in an inflorescence or in leaf axils; e.g., in *Allium* inflorescences.

**BULBLET** Small bulbs produced alongside a parent bulb; e.g., the numerous underground small bulbs produced by some garlics.

**BULBOUS, BULBOSE** Having bulbs or bulb-like structures.

**BULLATE** Describing a surface with rounded elevations resembling blisters or puckers.

**BUR, BURR** A structure with a rough or prickly envelope or covering; e.g., sandbur.

**BUSH** (= Shrub) A woody perennial usually branching from the base with several main stems.

## C

**CA.** Latin, circa; abbreviation meaning about, around, approximately.

**CADUCOUS** Falling off early, quickly, or prematurely; e.g., the sepals in some Papaveraceae.

**CAESPITOSE** (= Cespitose) Growing in clumps or tufts.

**CALCARATE** With a spur.

**CALCAREOUS** Containing an excess of available calcium, usually in the form of the compound calcium carbonate; containing limestone or chalk.

**CALICHE** A crust of calcium carbonate formed on stony soils in arid regions.

**CALLOSITY** (= Callus). A hard protuberance or thickened, raised area.

**CALLOUS** Having the texture of a callus.

**CALLUS** (= Callosity). A hard protuberance or thickened, raised area; e.g., thickened, hardened, basal portion of some lemmas in the Poaceae.

**CALYCINE** Resembling or pertaining to a calyx.

**CALYCLATE** Calyx-like; e.g., describing bracts that by their size or position are suggestive of a calyx.

**CALYPTRA** A lid, cap, cover, or hood; e.g., the lid of certain fruits and moss spore cases.

**CALYX** (pl. CALYCES, CALYXES) Collective term for the sepals; outer series of floral "leaves", often enclosing the other flower parts in bud. The calyx is typically green but can be corolla-like and showy.

**CALYX LOBE** One of the free projecting parts of a synsepalous calyx; also referred to as a calyx tooth.

**CALYX TUBE** The basal or tubular portion of a synsepalous calyx, as opposed to the free, distal, calyx lobes.

**CAMBium** The thin layer of delicate, rapidly dividing, meristematic cells that forms wood internally and bark externally; also known as vascular cambium.

**CAMPANULATE** Bell-shaped; rounded at base with a broad flaring rim.

**CAMPYLOTROPUS OVULE** Ovule curved in its development, so that the morphological apex lies near the base.

**CANALICULATE** Longitudinally channeled or grooved.

**CANCELLATE** Latticed.

**CANE** Stem, specifically (a) floricanes, the flowering stem of *Rubus* species (blackberries and dewberries); (b) primocane, first-year leafy stem of the same; (c) persistent woody stems of *Arundinaria gigantea*, giant cane.

**CANESCENT** With whitish or grayish-white appearance due to abundance of soft short hairs.

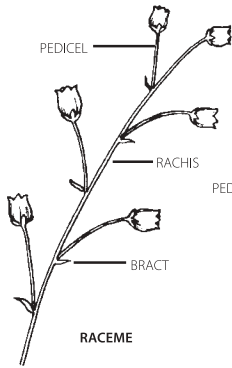
**CAP** A convex, lid-like, removable covering; e.g., the apical portion of a circumscissile capsule. The term calyptra is used for the cap of some fruits and moss spore cases.

**CAPILLARY** Hair-like; very slender.

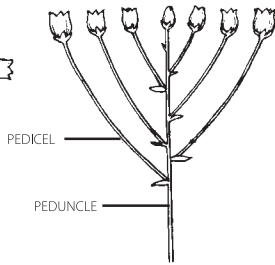
**CAPITATE** (a) In heads, head-like, or head-shaped; aggregated into a dense or compact cluster; (b) referring to capitate hairs, like a pin-head on a stalk.

**CAPITELLATE** Aggregated into a small, dense cluster; diminutive of capitate.

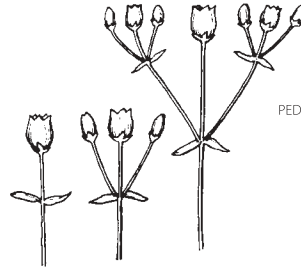
TYPES OF INFLORESCENCES



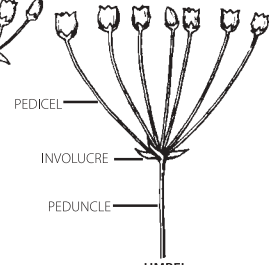
RACEME



CORYMB



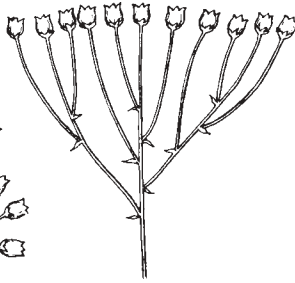
CYME



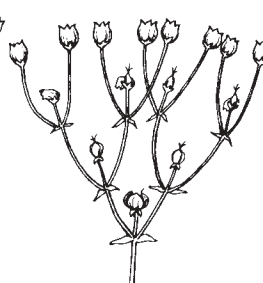
UMBEL



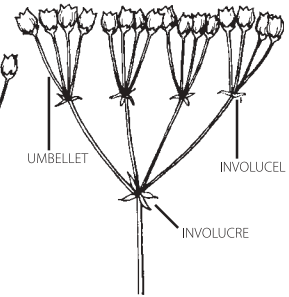
PANICLE



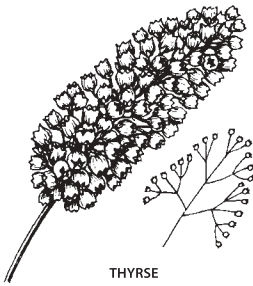
COMPOUND CORYMB



DICHOTOMOUS CYME



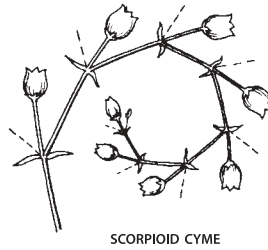
COMPOUND UMBEL



THYRSE



SPIKE



SCORPIOID CYME



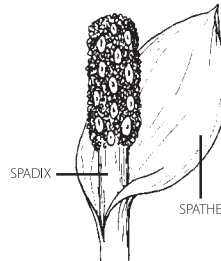
HEAD



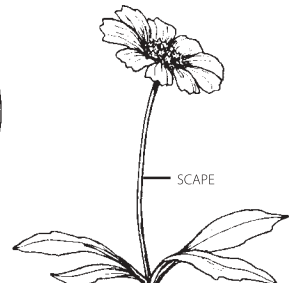
VERTICAL



AMENT (CATKIN)



SPADIX



HEAD (ANTHODIUM)

**CAPITULUM** (= Head) Dense cluster of sessile or nearly sessile flowers. This type of inflorescence is typical of the Asteraceae.

**CAPSULAR** Having the structure of a capsule.

**CAPSULE** A dry dehiscent fruit developed from more than one carpel.

**CARCINOGEN** A substance potentially inducing cancer or malignancy.

**CARDIAC GLYCOSIDE** A glycoside (two-component molecule) that upon breakdown yields a heart stimulant as the aglycone (= non-sugar component). The aglycones are steroidal in structure and are typically poisonous; e.g., digoxin and digitoxin from *Digitalis*, used as in treating heart trouble.

**CARINA** (= Keel) The two lower (= abaxial) fused petals of a papilionaceous flower (Fabaceae); (b) prominent longitudinal ridge, shaped like the keel of a boat.

**CARINATE** Keel-shaped; provided with a ridge or keel extending lengthwise along the middle. If more than one keel is present, the fact may be indicated by a numerical prefix.

**CARNIVOROUS** Referring to plants that digest animal (primarily insect) tissue to obtain nutrients such as nitrogen.

**CARNOSE** Fleshy; succulent.

**CARPEL** A modified leaf bearing ovules; a simple pistil or one unit of a compound pistil; female reproductive structure in flowering plants.

**CARPELLATE** Possessing carpels. The term is sometimes used with a numerical prefix to indicate the number of carpels.

**CARPOPHORE** The slender prolongation of the floral axis between the carpels that supports the pendulous fruit segments (= mericarps) in the Apiaceae.

**CARTILAGINOUS** Tough and hard but not bony; gristly; cartilage-like.

**CARUNCLE** Enlarged, somewhat spongy, seed appendage.

**CARYOPSIS** Achene-like, 1-seeded fruit with pericarp adnate to the seed coat; fruit typical of the Poaceae.

**CASTANEOUS** Chestnut-colored; dark brown.

**CATKIN** (= Ament) A flexible often pendulous spike or spike-like raceme of small, inconspicuous, unisexual, apetalous, usually wind-pollinated flowers, the whole falling as one piece; e.g., male inflorescence of oaks or pecan.

**CAUDATE** Having a tail or tail-like appendage.

**CAUDEX** (pl. CAUDICES) Woody stem base.

**CAULESCENT** With an evident leafy stem above ground.

**CAULIFLOROUS** Having flowers borne along the stems or trunks.

**CAULINE** Growing on or pertaining to the stem.

**CELL** (a) One of the living units of which a plant is composed; (b) (= locule) cavity or compartment containing the ovules in a carpel or the pollen in an anther.

**CENTRIFUGAL** Maturation of parts from the center toward the periphery.

**CENTRIPETAL** Maturation of parts from the periphery toward the center.

**CERACEOUS** Waxy.

**CERIFEROUS** Wax-bearing; waxy.

**CERNUOUS** Nodding or drooping.

**CESPITOSE** (= Caespitose) Growing in clumps or tufts.

**CHAFF** Thin, dry, or membranous scales or bracts, often used to refer to receptacular scales or bracts in many Asteraceae; see

pale or palea.

**CHAFFY** Thin, dry, or membranous.

**CHALAZA** The basal part of the ovule where it attaches to the funiculus.

**CHANNELED** Deeply grooved.

**CHARTACEOUS** Stiffly papery.

**CHASMOGAMOUS** Referring to flowers that open at anthesis; with pollination after opening of flowers; contrasting with cleistogamous.

**CHIROPTEROPHILY, CHIROPTEROPHILOUS** Bat-pollination.

**CHLOROPHYLL** The light-capturing pigment giving the green color to plants. Because chlorophyll absorbs less green than other wavelengths of light (and thus reflects and transmits relatively more green), leaves appear green to the human eye.

**CHORIPETALOUS** Composed of or characterized by separate petals.

**CHORISEPALOUS** Composed of or characterized by separate sepals.

**CHROMOSOMES** Thread-like "colored bodies" occurring in the nuclei of cells and containing the genetic material.

**CLILATE** With a marginal fringe of hairs similar to eye lashes.

**CLIOLATE** Diminutive of ciliate.

**CLILUM** (pl. CLILIA) Marginal hair or trichome.

**CINCINNUS** A curl; e.g., a helicoid (= curled or coiled) cyme, as in the Boraginaceae.

**CINEREOUS** Ash-colored; light-gray.

**CIRCINATE** Coiled, with the apex innermost, as the young fronds in some ferns.

**CIRCUMSCISSILE** Dehiscing by a regular transverse line around the fruit or anther, the top coming off like a lid.

**CIRRHOUS** Tendril-like; e.g., a leaf with a slender coiled apex.

**CLADOPHYLL, CLADODE** (= Phylloclade) A portion of a stem having the general form and function of a leaf; a flattened photosynthetic stem.

**CLAMBERING** Vine-like; growing over other plants often without the aid of tendrils or twining stems.

**CLASPING** (= Amplexicaul) With base of leaf or other structure (e.g., stipule) wholly or partly surrounding the stem.

**CLASS** The unit, category, or rank in classification made up of one or more orders; ending in -ae or -opsida; sometimes divided into subclasses which in turn are made of orders.

**CLATHRATE** Latticed; with a series of crossed members.

**CLAVATE** Club-shaped; becoming gradually enlarged apically.

**CLAVELLATE** Diminutive of clavate.

**CLAW** Stalk-like basal portion of some petals or sepals.

**CLAWED** Having a claw.

**CLEFT** (a) Cut 1/2 or more the distance from the margin to midrib or from the apex to base; (b) generally, any deep cut.

**CLEISTOGAM** A small flower that does not open and is necessarily self-pollinating.

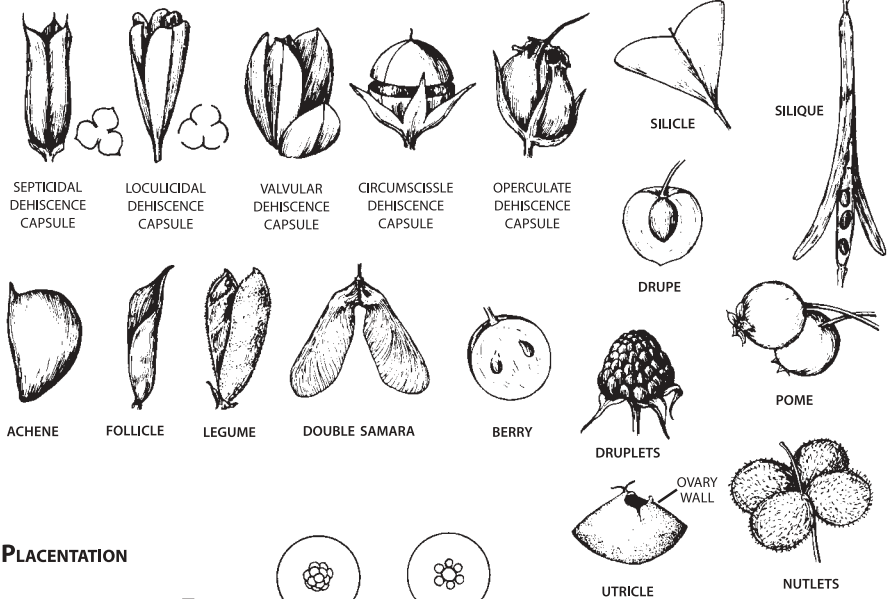
**CLEISTOGAMOUS, CLEISTOGAMIC** Referring to flowers not opening at anthesis and thus self-pollinating; with pollination prior to opening of flowers. Such flowers frequently have reduced or incompletely formed parts (e.g., petals).

**CLEISTOGAMY** The self-pollination of flowers that do not open.

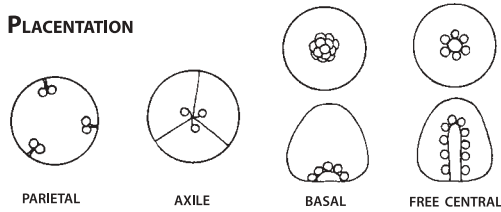
**CLONE** A group of individuals of the same genotype, usually propagated vegetatively.

## TYPES OF FRUITS AND ROOT AND STEM VARIATIONS

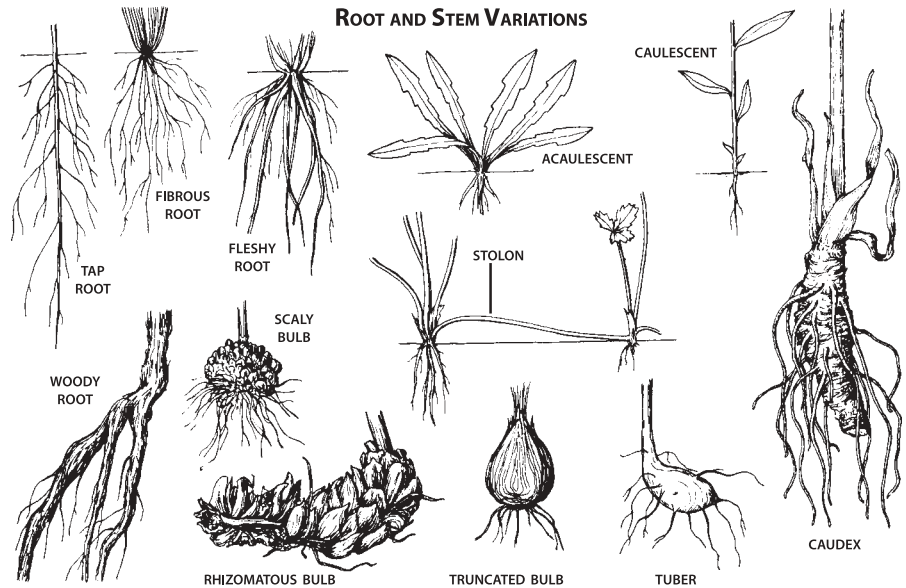
### TYPES OF FRUIT



### PLACENTATION



### ROOT AND STEM VARIATIONS



**CLUMP** A single plant with two to many, more or less crowded stems arising from a branched rootstock or short rhizome.

**CM** Centimeter; 10 mm; 1/100 of a meter; ca. 2/5 of an inch.

**COALESCENT** Referring to organs of one kind that have grown together.

**COARCTATE** Crowded together.

**COB** Rachis or central stalk of the pistillate inflorescence of corn.

**COCCUS** (pl. Cocco) (a) a berry; (b) one of the parts of a lobed or deeply divided fruit with 1-seeded sections.

**COCHLEATE** Coiled like a snail shell; spiral.

**COETANEOUS** At the same time or of the same age; e.g., flowers and leaves appearing at the same time.

**COHERENT** Descriptive of the close association of two similar structures without fusion.

**COLLAR** The outer side of a grass leaf at the junction of the blade and sheath.

**COLLATERAL** Located side by side; e.g., ovules located side by side; e.g., accessory buds located on either side of a lateral bud.

**COLUMELLA** The persistent central axis around which the carpels of some fruits are arranged.

**COLONIAL** Forming colonies usually by means of underground rhizomes, stolons, etc. The term is commonly used to describe groups of plants with asexual reproduction.

**COLONY** A stand, group, or population of plants of one species, spreading vegetatively, or from seeds, or both.

**-COLPATE** A suffix referring to pollen grains having grooves (= colp).

**-COLPORATE** A suffix referring to pollen grains having grooves and pores.

**COLUMN** (a) United style and filaments in Orchidaceae; (b) united filaments in Malvaceae and Asclepiadaceae; (c) basal differentiated portion of the awn(s) in certain grasses.

**COLUMNAR** Column-shaped.

**COMA** (a) A tuft of soft hairs or trichomes, as at the apices or bases of some seeds; (b) tuft of structures projecting from something (e.g., tuft of bracts projecting from heads of some *Eryngium* species).

**COMATE, COMOSE** Resembling or provided with a coma.

**COMMISURE** The surface where organs are joined; e.g., the face by which one carpel joins another.

**COMPLANATE** Flattened.

**COMPLETE** With all of the usual parts; e.g., a flower with all four flower parts: sepals, petals, stamens, and pistils.

**COMPLICATE** Folded together.

**COMPOSITE** (a) (= Compound) made up of several distinct parts; (b) common name for species of the Asteraceae.

**COMPOUND** (= Composite) Made up of several distinct parts.

**COMPOUND INFLORESCENCE** One having two or more degrees of branching; e.g., a compound umbel is one whose branches bear branchlets rather than ending directly in flowers.

**COMPOUND LEAF** A leaf that is cut completely to the base or midrib into segments (= leaflets) resembling miniature leaves; a leaf with two or more leaflets.

**COMPOUND OVARY** Ovary developed from two or more united carpels, as evidenced by the presence of two or more locules, valves, placentae, styles, or stigmas.

**COMPOUND PISTIL** Pistil composed of two or more united carpels.

**COMPRESSED** Flattened.

**CONCAVE** Hollow; with a depression on the surface.

**CONCOLOR, CONCOLOROUS** Of a uniform color.

**CONDUPLICATE** Folded together lengthwise.

**CONE** (= Strobilus) A usually globose or cylindrical structure involved in reproduction and composed of an axis with a spiral, usually dense aggregation of sporophylls, bracts, or scales (these bearing spores, pollen, or seeds).

**CONFLUENT** Blending of one part into another.

**CONGESTED** Crowded together.

**CONGLOMERATE** Densely clustered.

**CONICAL, CONIC** Cone-shaped.

**CONIFEROUS** Cone-bearing.

**CONJUGATE** Jointed in pairs.

**CONNATE** United or fused, when the fusion involves two or more similar structures; e.g., as in fusion of stamens into a tube.

**CONNATE-PERFOLIATE** Both connate and perfoliate; e.g., two leaves grown together and completely encircling a stem; e.g., in *Eupatorium perfoliatum*.

**CONNECTIVE** The tissue connecting the pollen-sacs of an anther. In certain plants the connective is prolonged at its base or apex.

**CONNIVENT** Converging or nearly or quite in contact, but not fused; e.g., connivent stamens in *Solanum*.

**CONSERVED** Term applied to a scientific name whose use, even though illegitimate according to nomenclatural rules, is allowed by the International Code of Botanical Nomenclature; e.g., many family names long in use, such as Cactaceae and Caryophyllaceae, have been conserved to prevent confusion.

**CONSPECIFIC** Of the same species.

**CONSTRICTED** Tightened or drawn together or narrowed.

**CONTACT DERMATITIS** Inflammation of the skin due to contact with poisons, irritants, or sensitizers. In some individuals it can be caused by even the slightest contact; caused by a variety of plants including poison-ivy (*Toxicodendron radicans*).

**CONTIGUOUS** Touching, but not fused.

**CONTINUOUS** Not interrupted; not articulated; not jointed.

**CONTORTED** Twisted or distorted.

**CONTRACTED** Narrowed or shortened; reduced in size.

**CONTRARY** In an opposite direction or at right angles to.

**CONVERGENT** Coming together or approaching.

**CONVEX** Rounded or bulged on the surface.

**CONVOLUTE** Rolled or twisted together when in an undeveloped stage.

**CORALLOID** Coral-like.

**CORDATE, CORDIFORM** (a) Heart-shaped; with a notch at the base and ovate in outline (the words apply specifically to flat surfaces and to solid shapes, respectively); (b) often referring only to the notched base of a structure; e.g., leaf base.

**CORIACEOUS** With texture like leather; tough; leathery.

**CORM** Bulb-like usually subterranean stem base, solid instead of with layers of modified leaves as in a true bulb.

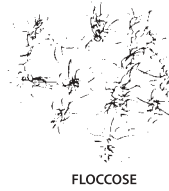
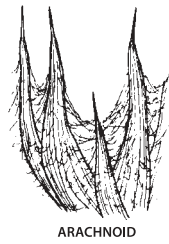
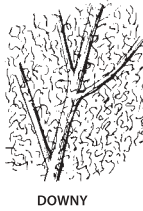
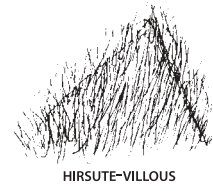
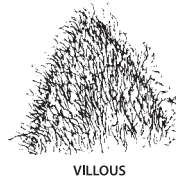
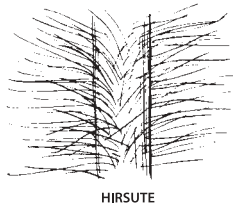
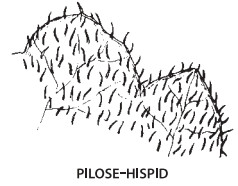
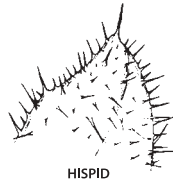
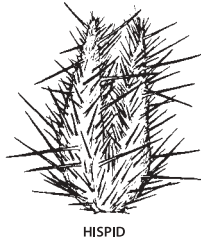
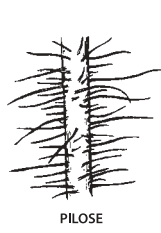
**CORMOUS** Having a corm.

**CORNEOUS** Horny in texture.

**CORNICULATE** Bearing a small horn or horns.

**CORNUTE** Horned or spurred.

### TYPES OF PUBESCENCE



**COROLLA** Collective term for the petals; the inner series of floral "leaves." Corollas are typically but not always colorful and showy.

**COROLLA LOBE** A free projecting part of a synsepalous corolla; also referred to as a corolla tooth.

**COROLLA TUBE** The basal or tubular portion of a synsepalous corolla, as opposed to the free, distal, corolla lobes.

**CORONA** (= Crown) Projection or outgrowth of a corolla, perianth, or anthers, in the form of a fringe, cup, or tube, sometimes greatly resembling an extra corolla or perianth.

**CORONIFORM SCALES** Membranous scales broader than long.

**CORPUSCULUM** In Asclepiadaceae, the gland-like clip connecting the two bands (= filament-like retinacula) attached to the pollinia; part of the translator.

**CORRUGATE** Having wrinkles or folds.

**CORTEX** (a) The tissue between the stele and epidermis of a stem; (b) bark or rind.

**CORYMB** A more or less flat-topped inflorescence (resulting from lower branches being longer than upper) that is indeterminate (i.e., with the outer flowers opening first); inflorescence superficially similar to an umbel but with the branches arising at different points rather than one.

**CORYMBIFORM** Shaped like a corymb.

**CORYMBOSE** In corymbs or corymb-like inflorescences (i.e., flat-topped).

**COSTA** (pl. *COSTAE*) A rib; the midvein of a leaf.

**COSTATE** Longitudinally ribbed.

**COSTULES** Midveins of the pinnules.

**COTYLEDON** Seed leaf; main leaf or leaves of the embryonic plant.

**COUMARIN GLYCOSIDE** A glycoside (two-component molecule) that upon breakdown yields coumarin as the aglycone (= non-sugar component). Coumarin can be converted to dicoumarin, a toxic compound which prevents blood-clotting; e.g., in *Melilotus*.

**CRATERIFORM** In the shape of a saucer; shallow and hemispherical.

**CREeping** Growing along the surface of the ground and emitting roots at intervals, usually from the nodes.

**CRENATE** Scalloped with rounded teeth; shallowly round-toothed or with teeth obtuse.

**CRENULATE** Diminutive of crenate; with small rounded teeth.

**CREST** An elevated ridge, process, or appendage on the surface of an organ or structure.

**CRESTED** Having a crest.

**CRISPATE, CRISPED** Irregularly curled or twisted.

**CROSS-SECTION** A slice cut across an object; e.g., a slice of bread.

**CROWN** (a) An irregular perennial or over-wintering stem or stem-root structure from which new growth arises; (b) (= Corona) projection or outgrowth of a corolla, perianth, or anthers, in the form of a fringe, cup, or tube, sometimes greatly resembling an extra corolla or perianth.

**CROZIER** A young coiled leaf of some ferns.

**CRUCIATE, CRUCIFORM** Cross-shaped.

**CRUCIFEROUS** (a) Cross-bearing; (b) specifically descriptive of cross-like arrangement of petals of members of the Brassicaceae (Cruciferae).

**CRUSTACEOUS, CRUSTOSE** With a brittle, hard texture.

**CRYPTOGAMS** An old term for plants that reproduce without flowers or seeds. Cryptogams typically reproduce by spores.

**CRYSTALLINE** Crystal-like.

**CUCULLATE** Hood-like.

**CULM** Stem of Poaceae and Cyperaceae.

**CULTIGEN** A plant known only in cultivation.

**CULTIVAR** A variety or race of a cultivated plant; abbreviated cv.

**CUNEATE, CUNEIFORM** Wedge-shaped; triangular with tapering, straight-sided, narrow base.

**CUP, CUPULE** The cup-like structure at the base of a fruit; e.g., acorn.

**CUPULIFORM, CUPULATE** Cup-shaped.

**CURVI-** A prefix to denote curved or bent.

**CUSP** A sharp, abrupt, and often rigid point.

**CUSPIDATE** Bearing a cusp or strong sharp point.

**CUT** A general term for any dissection of a leaf or petal deeper than a lobe.

**CUTICLE** The waxy, more or less waterproof coating secreted by the cells of the epidermis. The cuticle prevents water loss.

**CYANOGENIC GLYCOSIDE** A glycoside (two-component molecule) that upon breakdown yields hydrocyanic (prussic) acid (HCN) as the aglycone (= non-sugar component). Hydrocyanic acid is extremely dangerous, causing cyanide poisoning; e.g., amygdalin in cherry and peach leaves or apple seeds (Rosaceae).

**CYATHIFORM** Cup-shaped.

**CYATHIUM** (pl. *CYATHIA*) (a) Cup-shaped structure producing unisexual flowers; (b) specifically, the units of the inflorescence in *Euphorbia*. In this case the cup contains a single pistillate flower and a number of staminate flowers, each consisting of a single stamen; on the rim of the cup there are glands and these often have a petal-like appendage; the whole structure superficially resembles a single flower.

**-CYCLIC** A suffix referring to the circles of different parts in a flower, commonly used with a numerical prefix; e.g., a *Verbascum* flower with sepals, a corolla, stamens, and an ovary is four-cyclic; compare with -merous.

**CYLINDRICAL, CYLINDRIC** Elongate, circular in cross-section; having the form of a cylinder.

**CYMBIFORM** Boat-like or boat-shaped.

**CYME** A broad, flattish or convex, determinate inflorescence with the central flowers maturing first.

**CYMOSE** With the flowers in cymes; having an inflorescence type with the oldest flowers in the center.

**CYMULE** A small or few-flowered cyme.

**CYPSELA** Achene derived from an inferior ovary and adnate to the enclosing floral tube; e.g., in Asteraceae.

**CYSTOLITH** A stone-like mineral concretion, usually of calcium carbonate.

## CD

**DC.** De Candolle, name of a distinguished family of Swiss botanists; specifically Augustin Pyramus, who sponsored early botanical exploration in Texas by Berlandier, and named many Texas species; A. DC.: Alphonse, son of the preceding.

**DECIDUOUS** Falling away; not persistent over a long period of time.

**DECLINATE, DECLINED** Bent forward or downward.

**DECOMPOUND** More than once compound.



### TYPES OF HAIRS AND PROCESSES



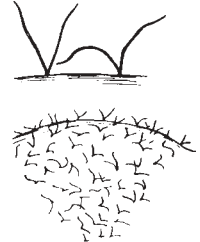
MALPIGHIAN OR BALANCED



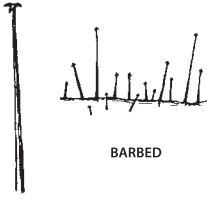
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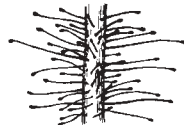
CILIATE



GEMINATE



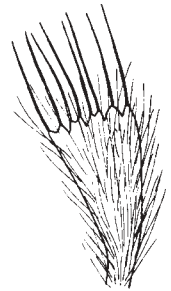
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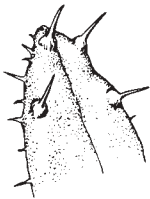
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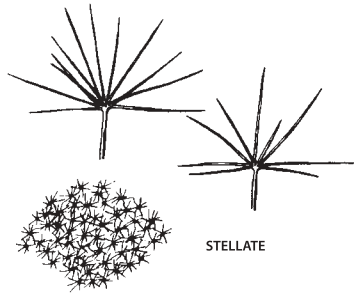
CILIATE



FLAGELLIFORM BRISTLES



PUSTULATE



STELLATE



SQUAMELLATE



PECTINATE



MONILIFORM



FIMBRIATE



HAMATE

**DECUMBENT** Lying flat or reclining with terminal shoots or stem tips ascending.

**DECURRENT** Extending down the stem and united with it, as in the continuation of leaf bases down the stem as wings.

**DECURVED** Curved downward.

**DECUSSATE** Arranged oppositely in pairs, each successive pair at right angles to the preceding one (resulting in the appearance of four rows), typically referring to arrangement of leaves.

**DEFLEXED** Bent downward.

**DEFOLIATE** To shed or remove leaves.

**DEHISCENT, DEHISCENT** To open at maturity to discharge the contents; e.g.; fruit releasing seeds or anther releasing pollen.

**DEHISCENCE** The process or act of opening.

**DELIQUESCENT** Softening, dissolving, melting away, or wasting away; e.g., ephemeral petals of *Tradescantia*.

**DELTATE, DELTOID** Shaped like an equilateral triangle, like the Greek letter delta ( $\Delta$ ).

**DENDRITIC** Tree-like, as in branching.

**DENTATE** With sharp teeth not directed forward.

**DENTICULATE** Minutely dentate.

**DEPAUPERATE** Smaller than the usual natural size; short of the usual development; stunted; impoverished.

**DEPRESSED** Low as if flattened.

**DERMATITIS** Inflammation of the skin due to exposure to poisons, irritants, or sensitizers. It can be caused by a number of plants including poison ivy.

**DESCENDING** With a gradual downward tendency.

**DETERMINATE** Descriptive of an inflorescence whose flowers begin to open first at the top or center, progressing downward or outward; with the number of flowers fixed or limited in number; contrasting with indeterminate.

**DI-, DIS-** Greek prefix meaning two or double.

**DIADELPHOUS** With filaments united so as to form two groups of stamens. The most common situation is nine in a group and a tenth separate; e.g., numerous Fabaceae.

**DIANDROUS** Having two stamens.

**DIAPHANOUS** Transparent.

**DIAPHRAGM** Dividing membrane or partition.

**DICHASIAL** With or in the form of a dichasium.

**DICHASIMUM** A cyme with lateral branches on both sides of the main axis.

**DICHOTOMOUS** Forking regularly into two equal or nearly equal branches.

**DICOTYLEDONS** (abbreviated Dicots) Flowering plants having two cotyledons, mostly net venation, and flower parts usually in 4s or 5s; one of the two classes of flowering plants which, depending on the system of classification, is known as Dicotyledonae or Magnoliopsida. The dicots are now considered to be a paraphyletic group.

**DIDYMOUS** Developed in or occurring in pairs; twin.

**DIDYNAMOUS** Having four stamens, two longer and two shorter.

**DIFFUSE** Loosely branching or spreading; of open growth; widely spread.

**DIGITATE** Fingered; with a number of structures attached at one point, like fingers on a hand.

**DILATED** Widened, flattened, broadened, or enlarged.

**DIMIDIATE** Halved, as if one half is missing.

**DIMORPHIC, DIMORPHISM** Occurring in two forms.

**DIOECIOUS** With staminate flowers on one plant (staminate plant) and pistillate flowers on a different plant (pistillate plant); literally, "two houses."

**DIPLOID** Possessing two sets of chromosomes in each nucleus; twice the haploid number typical for gametes.

**DIPLOSTEMONOUS** The stamens in two series, those of the outer series alternating with the petals.

**DIPTEROPHILY, DIPTEROPHILOUS** Pollination by dipterans (members of the insect order Diptera—flies, gnats, mosquitoes, and their relatives).

**DISARTICULATING** Separating; coming apart or falling apart.

**DISC, DISK** (a) A more or less fleshy or elevated development of the receptacle or of coalesced nectaries or staminodes about the pistil; (b) the central part of an Asteraceae head.

**DISC FLORET** (= Disk flower) In Asteraceae, small flower with tubular corolla, in disk (disc) portion of head; contrasting with ray (= ligulate) floret.

**DISCIFORM** (a) Shaped like a disc; (b) in Asteraceae, in reference to a head with disk florets in center and marginal florets with ligule reduced or lacking.

**DISCLIMAX** The condition where succession is indefinitely arrested or altered due to factors such as persistent disturbance (e.g., overgrazing).

**DISCOID** (a) Shaped like a disc; (b) in reference to disc (disk) florets of an Asteraceae head; (c) in reference to the head of some Asteraceae with disk florets in center and marginal florets with ligule reduced or lacking; (d) without ligulate flowers.

**DISCOID HEAD** In Asteraceae, a head with only disk (disc) florets.

**DISCOLOROUS** Having the two surfaces of a structure dissimilar in color.

**DISCRETE** Separate.

**DISJUNCT** (a) Outside the main range of a species; (b) being divided into separate groups; disconnected.

**DISK FLOWER** (= Disc floret) In Asteraceae, small flower with tubular corolla, in disk (disc) portion of head; contrasting with ray (= ligulate) florets.

**DISPARATE** Dissimilar; unequal.

**DISSECTED** Divided into numerous narrow or slender segments, the divisions usually deeper than lobes.

**DISTAL** Located at or toward the apex of a plant or organ; the terminal portion; the end opposite the attachment; contrasting with proximal.

**DISTANT** In reference to similar parts remote from one another; contrasting with approximate.

**DISTICHOUS** In two vertical rows or ranks, not spirally arranged; e.g., leaves occurring in two rows on opposite sides of a stem.

**DISTINCT** (= Free) Separate, not united or fused.

**DISTURBED** Referring to a habitat that has been altered or modified but not completely destroyed.

**DIURNAL** Occurring during the daytime.

**DIVARICATE** Very widely spreading.

**DIVERGENT** Spreading, but less broadly than divaricate.

**DIVIDED** (a) Cut 3/4—completely the distance from margin to midrib or from apex to base; (b) generally, cut deeply.

**DIVISION** The highest rank, category, or taxon in the plant kingdom; made up of classes; ending in -phyta; equivalent to the rank of phylum in the animal kingdom.

**DM** Decimeter; 10 cm.

**DOCTRINE OF SIGNATURES** Ancient belief that a plant structure that resembles a portion of the human body (a sign or signature) gives clues to its use. Some people believed that a creator had placed such signs to indicate the plant's value as a remedy for ailments of those body portions; e.g., *Hepatica*, named for its lobed, liver-shaped leaves, possibly useful for liver problems.

**DOLABRIFORM** (a) Referring to pubescence where the hairs are attached near the middle or towards (but not at) one end and are thus 2-forked; (b) having the form of an ax or hatchet.

**DORMANT** Not active.

**DORSAL** Referring to the back or outer surface of an organ; the side away from the axis; the lower or abaxial surface; contrasting with ventral.

**DORSIFIXED** Attached by the back or dorsal edge, often in reference to the attachment of an anther to a filament; contrasting with either basifixed or versatile.

**DORSIVENTRAL** Differentiated into upper and lower surfaces distinct in appearance or structure.

**DOUBLE FERTILIZATION** Process essentially unique to the angiosperms in which an egg unites with a sperm, forming a zygote, and a second sperm often unites with two nuclei resulting in a triploid endosperm. Double fertilization is also known in the small gymnosperm group the Gnetophyta.

**DOUBLE FLOWER** (a) One with more than the normal number of petals (anywhere from a few more to many times the usual number); (b) in Asteraceae, double can refer to a head with more than the normal number of ray (= ligulate) florets.

**DOUBLY SERRATE** With coarse serrations bearing minute teeth on their margins, the teeth angled toward the apex of the structure.

**DOWNY** Closely covered with short, weak, soft hairs.

**DROOPING** More or less erect at base but with upper part bending downward.

**DRUPACEOUS** Pertaining to, or of the nature of a drupe.

**DRUPE** One-seeded indehiscent fruit with a stony endocarp, the middle part fleshy or juicy, and an outer skin; e.g., plum or cherry.

**DRUPELET** A small drupe; one drupe from an aggregate fruit composed of many drupes; e.g., a blackberry is an aggregate fruit composed of drupelets.

**DUPLEX** Double, as in pubescence composed of two kinds of hairs.

## E

**E** East.

**E-, Ex-** Latin prefixes denoting without, that parts are missing.

**EBENEUS** Black, ebony-like.

**EBRACTEATE** Without bracts.

**ECHINATE** Prickly.

**ECILIATE** Without cilia.

**ECOLOGICAL INDICATOR** An organism that is sensitive to pollution or some other environmental problem and can therefore be

used as an indicator or gauge of the condition of an ecosystem.

**ECOTONE** Transition zone between two biological communities; e.g., much of the TX is an ecotone between the eastern deciduous forest and the central North American grassland.

**ECOTYPE** Those individuals adapted to only one of the kinds of environment occupied by a widespread species.

**EDAPHIC** Pertaining to soil conditions.

**EDENTATE** Without teeth.

**EGG** A female gamete or sex cell, in flowering plants contained in an ovule.

**EGLANDULAR** Without glands.

**ELAIOSOME** An oily appendage on the seeds of some plants. These structures have apparently evolved to attract ants that act as dispersal agents.

**ELIMBATE** Referring to a corolla without a limb.

**ELLIPSOID** A solid that is elliptical in outline.

**ELLIPTIC** Shaped like an ellipse, with widest part at the middle; in the form of a flattened circle usually more than twice as long as wide.

**ELONGATE** Lengthened; stretched out.

**EMARGINATE** With a notch in the usually rounded apex.

**EMBRYO** The new plant in a seed.

**EMERSED, EMERGENT** Raised above and out of the water.

**EMETIC** A substance that causes vomiting.

**ENATION** Outgrowth on the surface; epidermal outgrowth.

**ENDEMIC** Confined geographically to or native to a single area.

**ENDOCARP** Innermost layer of pericarp or fruit wall.

**ENDOGENOUS** Produced deep within another body.

**ENDOSPERM** The food reserve of many angiosperm seeds.

**ENSIFORM** Sword-shaped; e.g., leaves of an *Iris*.

**ENTIRE** With smooth margins; without teeth.

**ENTOMOPHILOUS, ENTOMOPHILY** Pollinated by insects.

**EPAPPOSE** Without pappus.

**EPHEMERAL** Lasting for a brief period; e.g., for only one day.

**EPI-** Greek prefix meaning upon or on.

**EPICALYX** A whorl or involucre of sepal-like bracts just below the true sepals; e.g., Malvaceae.

**EPICARP** (= Exocarp) The outermost layer of the pericarp or fruit wall.

**EPICOTYL** The portion of the embryo just above the cotyledon(s); the young stem.

**EPIDERMAL** Relating to the epidermis.

**EPIDERMIS** The cellular covering of plant tissue below the cuticle.

**EPIGEOUS** Growing upon or above the ground.

**EPIGYNOUS** Borne on the ovary; indicating a flower in which the hypanthium or the basal parts of the perianth are adnate to the ovary, the perianth and stamens thus appearing to rise from the summit of an inferior ovary.

**EPIGYNY** The state of being epigynous.

**EPIPETALOUS** Descriptive of stamens in which the filaments are adnate to the corolla for all or part of their length; borne upon or arising from the petals or corolla.

**EPIPHYTE** A plant growing on another plant for physical support only and not parasitic; e.g., many Bromeliaceae including *Tillandsia* species.

**EPIPHYTIC** Having the character of an epiphyte.

**EQUIDISTANT** Of equal distance.

**EQUITANT** Overlapping in two ranks; folded lengthwise and distichous; e.g., leaves folded around a stem in the manner of the legs of a rider around a horse.

**ERADIATE** Lacking ray (= ligulate) florets; e.g., discoid heads in Asteraceae.

**ERECT** (a) Growing essentially in a vertical position (e.g., whole plant); (b) a structure perpendicular to the object to which it is attached.

**ERGOT** An alkaloid producing fungus, *Claviceps purpurea* (and related species).

**ERGOTISM** A sometimes lethal poisoning due to a number of alkaloids (e.g., lysergic acid hydroxyethylamide—LSD-like, egrotamine—vasoconstrictive) produced by ergot fungi, *Claviceps purpurea* (Fr.) Tul., *C. paspali* Stev. & Hall, and related species, which sometimes infect the inflorescences of members of the grass family (e.g., *Secale*—rye). Symptoms resulting from eating ergot-contaminated grain can include hallucinations, psychosis, convulsions, and gangrene of the extremities (due to vasoconstriction); referred to in ages past as Saint Anthony's Fire. The reference to fire resulted from the assumption that the burning sensations and blackened (gangrenous) limbs were retribution for sins. Saint Anthony, supposedly with special powers to protect against fire, infection, and epilepsy, was often prayed to for help by those with the condition. Large scale epidemics of ergotism in Europe prior to 1800, from eating bread made with contaminated grain, resulted in 1,000s of deaths; isolated instances still occur where grain purity is not controlled; ergotism is blamed by some for the hysteria that resulted in the Salem witch trials in 17th century Massachusetts. See treatment of *Secale* (Poaceae) for references.

**EROSE** With ragged margin, as if nibbled or chewed.

**ESCAPE** A cultivated plant not purposely planted but found growing as though wild.

**ESCARPMENT** A steep slope.

**ESSENTIAL OILS** Fragrant (often pleasantly so) substances that are typically rather simple terpenoid compounds (monoterpenes, sesquiterpenes). They are responsible for the fragrance of many flowers and other plant tissues and are currently used in aromatherapy; e.g., in mint family and citrus family.

**ESTIPELLATE** Without stipels.

**ESTIPULATE** Without stipules.

**ETIOLATE** Lengthened and deprived of color by absence of light.

**EVANESCENT** Of short duration; quickly lost.

**EVEN-PINNATE** Descriptive of a compound leaf with terminal leaflet absent; with an even number of leaflets.

**EVERGREEN** Remaining green through the winter.

**EXALATE** Without wings.

**EXALBUMINOUS** In reference to seeds without endosperm.

**EXCENTRIC** Not having the axis placed centrally.

**EXCURRENT** Extending beyond the tip or margin.

**EXCURVED** Curved outward or away from a central part.

**EXFOLIATE** To peel off or come off in scales, flakes, plates, layers, or shreds; e.g., some types of bark.

**EXOCARP** (= Epicarp) The outermost layer of the pericarp or fruit wall.

**EXOTIC** Foreign; not native; from another geographic area.

**EXPLANATE** Spread out flat.

**EXPLOSIVELY DEHISCENT** Descriptive of a fruit that suddenly and forcibly dehisces its seeds, with the seeds being thrown away from the plant; e.g., *Impatiens*.

**EXsertED** Projecting out or beyond (e.g., stamens projecting beyond the corolla); contrasting with included.

**EXstIPULATE** Lacking stipules.

**EXtANT** Still existing; contrast with extinct.

**EXtINCT** No longer in existence; descriptive of a species for which living representatives no longer exist. Locally extinct refers to extinction in a given geographic region.

**EXtRAFLORAL** Outside the flower; e.g., extrafloral nectaries.

**EXtRORSE** Facing outward, away from the axis, typically used to refer to manner of anther dehiscence.

**EXUDATE** Material coming out slowly through small pores or openings.

**EYE** (a) The marked or contrastingly colored center of a flower; (b) a bud on a tuber; e.g., on potatoes.

## F

**f.** (a) After an author's name: abbreviation of *filius*, the son, or "jr."; (b) abbreviation of forma or form (see next page).

**FACET** One of a set of small plane surfaces.

**FACULTATIVE** Not necessary or essential; optional; contrasting with obligate.

**FALCATE** Sickle-shaped, with the tip curved to one side.

**FALL** Outer, spreading, often recurved, and commonly bearded perianth segment in *Iris*.

**FAMILY** The unit, category, or rank in classification made up of one or more genera; ending in -aceae; sometimes divided into subfamilies, which in turn are made up of genera.

**FARINACEOUS** Mealy in texture.

**FARINOSE** Covered with a whitish mealy powder or mealiness.

**FASCIATED** With an abnormal widening and flattening of the stem as if several stems had grown together.

**FASCICLE** A condensed or close bundle or cluster.

**FASCICULATE** Congested in bundles or clusters.

**FASTIGIATE** In reference to branches, close together and nearly parallel.

**FENESTRATE** Perforated with holes, openings (windows), or translucent areas.

**FERAL** Wild; not cultivated.

**FERRUGINEOUS** Rust-colored.

**FERTILE** Capable of normal reproductive functions, as a fertile stamen producing pollen, a fertile pistil producing ovules, or a fertile flower normally producing fruit (although it may lack stamens); e.g., used to describe Asteraceae flowers capable of maturing achenes, irrespective of ability to produce pollen.

**FERTILIZATION** Union of two gametes (e.g., egg and a sperm) to form a zygote.

**FETID** With a disagreeable odor.

**FIBRILLOSE** Having small fibers or appearing finely lined.

**FIBROUS** Resembling or having fibers.

**FIBROUS ROOT SYSTEM** One with several roots about equal in size and arising from about the same place; contrasting with taproot.

**-FID** A suffix meaning deeply cut.

**FILAMENT** (a) The thread-like stalk supporting an anther; (b) a thread or thread-like structure.

**FILAMENTOUS, FILAMENTOSE** Composed of filaments or threads; thread-like.

**FILIFEROUS** With coarse marginal threads.

**FILIFORM** Slender; having the form of a thread; filamentous.

**FIMBRIATE** Fringed; with narrow or filiform appendages or segments along the margin.

**FIMBRILLATE** With a minute fringe.

**FIRST GLUME** Lowermost of the two glumes in a grass spikelet.

**FISSURED** Cracked or fractured.

**FISTULOSE** Hollow; lacking pith.

**FLABELLATE, FLABELLIFORM** Fan-shaped; broadly wedge-shaped.

**FLACCID** Lax, weak, floppy, not rigid.

**FLAGELLIFORM** Whip-like.

**FLANGE** A rim-like structure.

**FLAVESCENT** Yellowish or becoming yellow.

**FLESHY** Succulent, juicy, or pulpy.

**FLEXUOUS** Zigzag; bending or curving alternately in opposite directions.

**FLOCCOSE** Covered with tufts of soft woolly hairs.

**FLOCCULENT** Minutely floccose.

**FLORA** (a) Collective term for the plants of an area; (b) a taxonomic work on the plants of an area.

**FLORAL BRACT** Reduced leaf subtending a flower in the inflorescence.

**FLORAL ENVELOPE** The calyx or corolla; the floral "leaves."

**FLORAL TUBE, FLORAL CUP** Tube or cup formed by union of sepals, petals, and stamen bases. The structure can be either adnate to or free from the ovary; in some cases it is synonymous with hypanthium.

**FLORET** (a) Small flower in a dense cluster; (b) in reference to individual flowers of Asteraceae and Poaceae; (c) in grasses referring to the lemma and palea together with the enclosed reproductive structures.

**FLORICANE** Flowering stem of the genus *Rubus* (dewberries and blackberries).

**FLORIFEROUS** Bearing or producing flowers.

**FLOWER** An axis bearing stamen(s), pistil(s), or both, and in addition, often floral envelopes (= calyx and corolla); the reproductive structure of an angiosperm.

**FLUTED** With alternating ridges and grooves.

**FOLIACEOUS** Leaf-like.

**FOLIAGE** Collective term for the leaves of a plant.

**FOLIATE** With leaves.

**FOLIOLATE** With leaflets.

**FOLIOSE** Leafy.

**FOLLICLE** Dry, one-carpellate fruit dehiscing along one suture only.

**FORB** An herbaceous, non-grass-like plant.

**FORKED** Dichotomous; divided into two equal or nearly equal branches.

**FORMA, FORM** (abbreviated f.) A taxon below the rank of variety

used to refer to minor variations without distinctive geographic occurrence; e.g., occasional albinos or seasonal growth forms. This category is generally ignored in this book.

**FORNICES** Internal appendages in the upper throat of a corolla; e.g., in some Boraginaceae.

**FOVEA** (pl. FOVEAE). A pit or depression.

**FOVEATE** Pitted.

**FOVEOLATE** Minutely pitted.

**FREE** (= Distinct) Separate from one another.

**FREE-CENTRAL PLACENTATION** Placentation with the seeds attached to a central column and surrounded by a single continuous locule.

**FROND** The leaf of a fern, often compound or decompound.

**FRUCTIFEROUS** Producing or bearing fruit.

**FRUGIVORE** Animal that feeds on fruits.

**FRUIT** A mature, ripened pistil or ovary. In the case of accessory "fruits" other tissues may be involved.

**FRUTICOSE** Shrubby or bushy in sense of being woody.

**FUGACIOUS** Falling or disappearing early, usually in reference to parts of a flower.

**FULVOUS** Tawny, brownish yellow.

**FUNCLE, FUNICULUS** The stalk attaching an ovule or seed to the ovary wall or placenta.

**FUNNELFORM** (= Infundibuliform) Funnel-shaped; gradually widening upwards.

**FURROWED** With longitudinal channels or grooves.

**FUSCOUS** Grayish-brown.

**FUSED** United by normal growth.

**FUSIFORM** Spindle-shaped; with broadest diameter at middle tapering to each end.

## G

**GALEA** The helmet-like or hood-like upper lip of a bilabiate corolla or calyx, especially one that is strongly concave.

**GALEATE** Hooded, hood-like, or helmet-like.

**GAMETE** A sex cell; an egg or sperm.

**GAMETOPHYTE** The gamete-producing, typically haploid generation alternating with the sporophyte (= spore-producing, typically diploid); the stage in the life-history of a plant that produces male or female cells (= gametes); the dominant generation in mosses and liverworts. In ferns and fern allies it is green and autotrophic, although small; in all flowering plants it is microscopic and develops within the tissues of the sporophyte.

**GAMO-** A prefix meaning united; e.g., gamopetalous or gamosepalous.

**GAMOPETALOUS** (= Sympetalous) With petals united, at least basally, forming a tube.

**GAMOSEPALOUS** (= Synsepalous) With sepals united, at least basally, forming a tube.

**GASTROENTERITIS** Inflammation of the stomach and intestines. It can be caused by a number of plant materials.

**GEMINATE** In pairs; twin.

**GEMMA** An asexual propagule sometimes appearing as, but not homologous with, a vegetative bud.

**GENICULATE** Bent abruptly, like a knee.

**GENUS** (pl. GENERA) The unit, category, or rank in classification between family and species; composed of one or more closely related species; sometimes divided into subgenera, which in turn are made up of species.

**GIBBOUS** Swollen basally on one side.

**GLABRATE, GLABRESCENT** Becoming hairless with age.

**GLABROUS** Without hairs.

**GLADIATE** Sword-shaped.

**GLAND** A secreting part or appendage, often protruding or wart-like.

**GLANDULAR** Having or bearing secreting organs, glands, or trichomes.

**GLANDULAR-PUBESCENT** With gland-tipped, pinhead-like hairs.

**GLANDULAR-PUNCTATE** With glands recessed in depressions.

**GLAUDESCENT** Becoming glaucous.

**GLAUCOUS** With waxy substances forming a whitish or gray-silvery covering or bloom.

**GLOBOSE** Nearly spherical or rounded.

**GLOCHID** (pl. GLOCHIDIA) An apically barbed bristle or hair; e.g., in many Cactaceae.

**GLOMERATE** In a dense cluster or glomerule.

**GLOMERULATE** Arranged in small dense clusters.

**GLOMERULE** A dense cluster of two or more structures.

**GLUCOSIDE** A glycoside with glucose as the sugar.

**GLUMACEOUS** With greenish bracts or petals similar in appearance to the glumes in grass spikelets.

**GLUME** One of a pair of bracts at the base of a grass spikelet.

**GLUTINOUS** Sticky, gluey, or resinous.

**GLYCOSIDE** Complex, two-component chemical compound that can break down or hydrolyze under certain conditions, yielding a sugar plus another compound (= aglycone) that can be physiologically active including poisonous. Types of glycosides include cardiac, coumarin, cyanogenic, mustard oil, steroidal, and saponic; the term glucoside refers to those in which the sugar molecule is glucose.

**GLYCOSINOLATE** (= Mustard oil glycoside) A complex molecule that upon breakdown yields a sugar, a sulfate fraction, and isothiocyanates (= mustard oils); e.g., in the Brassicaceae or mustard family.

**-GONOUS** A suffix meaning angled; e.g., trigonous means three-angled.

**GRADUATED** Referring to a sequence in shape or size; e.g., leaves becoming narrowed up a stem.

**GRAIN** The 1-seeded fruit typical of cereal crops; often used synonymously with caryopsis.

**GRANULAR, GRANULOSE, GRANULATE** Covered with minute, grain-like particles.

**GRIT CELL** (= Stone cell) A sclerotic or hardened cell, as in the flesh of pears.

**GYMNOSPERMS** Literally, "naked seed"; a polyphyletic assemblage of plants without flowers, the seeds "naked," (= not enclosed in a special structure), often on the surface of thick or thin, sometimes woody cone scales.

**GYNEANDROUS** The pistillate flowers above (= distal to) the staminate of the same spike; e.g., in some Cyperaceae.

**GYNOBASAL, GYNOBASIC** Referring to or having a gynobase.

**GYNOBASE** An enlargement of the receptacle at the base of the ovary.

**GYNODIOECIOUS** Basically dioecious, but with some flowers perfect and others pistillate.

**GYNOECIUM** The pistil or pistils of a flower considered collectively; collective term for the female parts of a flower.

**GYNOMONOECIOUS** Having female and bisexual flowers on the same plant.

**GYNOPHORE** Prolonged stipe (= stalk) of a pistil.

**GYNOSTEGIUM** (a) Sheath or covering of the gynoeceium; (b) in Asclepiadaceae, the columnar or disk structure made up of the connate stamens, style, and stigma.

**GYPSIFEROUS, GYPSEOUS** Containing gypsum (= calcium sulfate).

## H

**HABIT** Style or arrangement of growth; general appearance.

**HABITAT** Type of locality in which a plant grows; e.g., prairie.

**HAIR** An epidermal appendage that is usually slender, sometimes branched, not stiff enough to be called a spine, not flattened as a scale; often used synonymously with trichome.

**HALBERD-SHAPED** (= Hastate). Arrowhead-shaped but with the two basal lobes turned outward.

**HALLUCINOGEN** A material capable of causing the perception of imaginary sights, sounds, or objects through effects on the nervous systems. Various plant products, including certain alkaloids, are capable of such effects.

**HALOPHYTE** A plant tolerant of salty or alkaline soils.

**HAMATE** Hooked.

**HAPLOID** Having the reduced number of chromosomes typical of gametes; usually with a single set of chromosomes in each nucleus.

**HASTATE** (= Halberd-shaped). Arrowhead-shaped but with the two basal lobes turned outward.

**HAUSTORIUM** (pl. HAUSTORIA) Sucker-like attachment organ of parasitic plants by which they draw their food supply from the host-plant; e.g., in Cuscutaceae and some Scrophulariaceae.

**HAY FEVER** Respiratory allergy, frequently due to plant substances or microstructures such as pollen; e.g., *Ambrosia* (ragweed) pollen is a well-known cause of hay fever.

**HEAD** (= Capitulum) Dense cluster of sessile or nearly sessile flowers; the type of inflorescence typical of the Asteraceae.

**HEARTWOOD** The innermost and oldest wood, often with materials (e.g., toxins) giving it different characteristics from sapwood (e.g., more durability or resistance to rotting).

**-HEDRAL** A suffix signifying surface, usually preceded by a number and then indicating the number of sides, as a tetrahedral spore.

**HELICOID, HELICAL** Coiled or spiraled, usually in reference to inflorescences.

**HELIOPHYTE** A plant adapted to grow in or tolerate full sun.

**HEMI-** Greek prefix meaning half.

**HEMIPARASITIC** (= Semiparasitic) Descriptive of a plant that carries out photosynthesis but obtains some of its food, mineral nutrition, or water needs from another living organism (the host).

**HERB** A vascular plant lacking a persistent woody stem and typically dying back to the ground each season.

**HERBACEOUS** (a) Referring to the aerial shoot of a plant that does not become woody; typically dying back to the ground each year; (b) of a soft texture, as green leaves.

**HERBAGE** Collective term for the green or vegetative parts of a plant.

**HERBARIUM** (pl. HERBARIA) A collection of dried pressed plants prepared for permanent preservation (see Appendix eight for further details).

**HERBICIDAL** Having the ability to kill plants.

**HERMAPHRODITIC** With stamens and pistils in the same flower; bisexual.

**HESPERIDIUM** A specific type of fruit usually associated with the citrus family; a berry developed from a pistil with numerous carpels, pulpy within, and externally covered with a hard rind; e.g., orange.

**HETERO-** Greek prefix meaning other, various, or having more than one kind.

**HETEROCARPOUS** With more than one kind of fruit.

**HETEROCHLAMYDEOUS** With the perianth differentiated into a calyx and a corolla.

**HETEROGAMOUS** (a) With more than one kind of flower; (b) in Asteraceae, with each head composed of more than one kind of flower.

**HETEROGENEOUS** Not uniform in kind.

**HETEROPHYLLOUS** Having more than one form of leaf.

**HETEROSPOROUS** Having two spore types; e.g., *Selaginella*.

**HETEROSTYLOUS** Having styles of different lengths.

**HEXAGONAL** Six-angled.

**HEXAPLOID** Having six sets of chromosomes.

**HILUM** Scar or mark on a seed indicating where the seed was attached by a funiculus (= stalk) to the ovary wall or placenta. The hilum is the "eye" of a bean or other large seeds.

**HIP** The "fruit" of a rose; actually a fleshy hypanthium or floral cup with the true fruits (= achenes) inside.

**HIPPOCREPIFORM** Horseshoe-shaped.

**HIRSUTE** With straight moderately stiff hairs.

**HIRSUTULOUS** Diminutive of hirsute.

**HIRTELLOUS** Minutely hirsute.

**HISPID** Resembling hirsute but the hairs stiffer, ± bristly, feeling rough to the touch.

**HISPIDULOSE** Minutely hispid.

**HOARY** Covered with a fine, white, whitish, or grayish white pubescence.

**HOLOPHLETIC** A term used to describe a group consisting of a common ancestor and all of its descendants. The term monophyletic is sometimes used in the same sense.

**HOLOTYPE** The one specimen used or designated by the author of a species or other taxon as the nomenclatural type in the original publication. The holotype is the specimen to which the scientific name is permanently attached; it is not necessarily the most typical or representative element of a taxon.

**HOMO-** Greek prefix meaning all alike, very similar, same, or of one sort.

**HOMOCHLAMYDEOUS** With a perianth of tepals undifferentiated

into calyx and corolla.

**HOMOGAMOUS** (a) With only one kind of flower; (b) with anthers and stigmas maturing simultaneously.

**HOMOGENOUS** Of the same kind or nature; uniform; contrasting with heterogeneous.

**HOMOSPOROUS** With spores all of one type.

**HOOD** (a) A segment of the corona in Asclepiadaceae; (b) a hollow arched structure.

**HOODED** Descriptive of an organ with the lateral margins more or less inrolled and the apex more or less inflexed; helmet-like; shaped like a hood.

**HONEY-LEAF** Petal-like perianth part producing nectar; e.g., in some Ranunculaceae.

**HORN** An exerted tapering appendage resembling a cow's horn; e.g. appendage on the hood in some Asclepiadaceae.

**HORNY** Hard or dense in texture.

**HOST** Organism from which a parasite obtains nourishment.

**HUMIC** Consisting of or derived from humus (= organic portion of soil).

**HUMISTRATE** Laid flat on the soil.

**HUMUS** Decomposing organic matter in the soil.

**HUSK** The outer covering of some fruits, typically derived from the perianth or bracts.

**HYALINE** Thin, membranous, and transparent or translucent.

**HYBRID** (a) A cross between two unlike parents; (b) specifically, the offspring resulting from a cross between two species.

**HYDATHODE** An epidermal structure, usually marginal or terminal, that excretes water.

**HYDROPHILY, HYDROPHILOUS** Water-pollination; water-mediated pollination; using water as the mechanism of transferring pollen; e.g., in some Callitrichaceae; see Philbrick (1991).

**HYDROPHYTE** A plant typically growing partially or wholly immersed in water; contrasting with mesophyte and xerophyte.

**HYGROSCOPIC** Susceptible of expanding, shrinking, twisting, or untwisting on the application or removal of water or water vapor.

**HYMENOPTEROPHILY, HYMENOPTEROPHILOUS** Pollination by hymenopterans (= members of the insect order Hymenoptera—bees, wasps, and their relatives).

**HYPANTHIUM** (pl. HYPANTHIA) Cup-shaped or tubular structure formed by (a) fusion of the sepals, petals, and stamens; or (b) enlargement of the receptacle so that the perianth and androecium are attached above the gynoecium. A hypanthium may be adnate to ovary (resulting in epigyny) or free from ovary (perigyny); formerly referred to as calyx tube.

**HYPOCOTYL** Axis of an embryo below the cotyledons.

**HYPOGEOUS** Below the ground.

**HYPOGYNIUM** A structure below the ovary, as in *Scleria* (Cyperaceae).

**HYPOGYNOUS** Referring to a flower having floral organs attached below the ovary. Hypogynous flowers have superior ovaries.



**ILLEGITIMATE NAME** Name unacceptable as the accepted scientific name because it is not the earliest one given to the plant in question, or published without description, or violating some other specific requirement of the International Code of Botanical Nomenclature.

**IMBRICATE** Overlapping like shingles on a roof.

**IMMACULATE** Not spotted.

**IMMERSED** (= Submerged, Submersed) Growing under water.

**IMPARIPINNATE** Unequally or odd-pinnate, with a single terminal leaflet.

**IMPERFECT** In reference to a flower having either functional stamens or functional pistils, but not both; unisexual.

**INCANOUS** Gray or hoary.

**INCIPIENT** Beginning to be; coming into being.

**INCISED** Cut rather deeply and sharply; intermediate between toothed and lobed.

**INCLUDED** Not exerted; within; not projecting beyond the surrounding organ.

**INCOMPLETE** Referring to a flower lacking one or more of the flower parts: sepals, petals, stamens, or pistils.

**INCOMPLETE VEINS** In *Carex*, referring to veins that do not extend the entire length of the perigynium body.

**INCURVED** Curved inward.

**INDEHISCENT** Referring to a fruit that does not open at maturity; contrasting with dehiscent.

**INDETERMINATE** Inflorescence whose flowers begin to open first at bottom or outside, progressing upward or inward with the number of flowers not pre-determined at the beginning of flowering; growth of inflorescence not stopped by opening of the first flowers; contrasting with determinate.

**INDIGENOUS** Native to an area; not introduced.

**INDUMENT, INDUMENTUM** Surface coating such as hairs, roughening, bloom, or glands.

**INDUPLICATE** Folded or rolled inward.

**INDURATE** Hardened.

**INDUSIUM** (pl. INDUSIA) Epidermal outgrowth covering the sori or sporangia on fern fronds.

**INFERIOR** Descriptive of an ovary fused to the hypanthium or to the lower parts of the perianth and therefore appearing to be located below the rest of the flower; an ovary positioned below the point of attachment of the floral organs. This type of ovary is found in epigynous flowers.

**INFERTILE** (a) Incapable of normal reproductive functions; (b) specifically used to describe Asteraceae flowers incapable of maturing achenes, irrespective of presence of functional stamens.

**INFLATED** With an internal air space; bladderly.

**INFLEXED** Bent inward.

**INFLORESCENCE** (a) Term commonly used to refer to the flowering structure of a plant; (b) a flower cluster; (c) arrangement of flowers on the floral axis; (d) manner of bearing flowers.

**INFRA-** Latin prefix meaning below.

**INFRASPECIFIC** Within the species; referring to a unit of classification below the species; e.g., subspecies, variety, form.

**INFRUCTESCENCE** An inflorescence in the fruiting stage.

**INFUNDIBULIFORM** (= Funnelform) Funnel-shaped; gradually

widening upwards.

**INNOCUOUS** Harmless, unarmed, spineless.

**INNOVATION** A basal shoot of a perennial grass.

**INROLLED** Rolled inward.

**INSECTIVOROUS** Consuming insects; referring to plants that digest insect tissue to obtain nutrients such as nitrogen.

**INSERTED** Attached to another part or organ.

**INSERTION** The place or mode of attachment of an organ.

**INTEGUMENT** The covering of an organ; e.g., of the ovule.

**INTER-** Latin prefix meaning between.

**INTERCALARY** Medial in position.

**INTERCOSTAL** Located between the ribs or costae.

**INTERLACUNAR** Between air spaces.

**INTERNODE** Area of stem or other structure between two nodes.

**INTERRUPTED** Not continuous or regular.

**INTERSPECIFIC** Between different species.

**INTERSTITIAL** Referring to the space intervening between one thing and another.

**INTRA-** Prefix used to denote within.

**INTRODUCED** Brought from another geographic region; not native.

**INTROGRESSION, INTROGRESSIVE HYBRIDIZATION** Successive crosses, first between plants of two species, then between the offspring of this cross and plants of one parent species, followed by further interbreeding between mongrels of varying percentage of impurity with purebreds of the parent line. This eventually leads to whole populations of one parent species being contaminated with genes derived from the other.

**INTRORSE** Facing inward, toward the axis, typically used to refer to manner of anther dehiscence.

**INTRUDED** Projecting inward or forward.

**INVAGINATE** To enclose in a sheath.

**INVOLUCEL** Diminutive of involucre; a secondary involucre; e.g., the bracts subtending the secondary umbels in Apiaceae or the whorl of bracts subtending a flower in Malvaceae.

**INVOLUCellate** With an involucrel.

**INVOLUCRAL, INVOLUCRATE** Pertaining to or having an involucre.

**INVOLUCRE** The whorl of bracts subtending a flower cluster or flower; e.g., involucre of bracts (= phyllaries) subtending a head in Asteraceae or small involucre (= involucrel) subtending a flower in many Malvaceae (specifically called an epicalyx).

**INVOLUTE** With margins or edges rolled inward toward the upper side.

**IRREGULAR** (a) Structures not similar in size or shape; asymmetrical; (b) descriptive of a flower without any plane of symmetry; contrasting to regular and zygomorphic.

**-ISH** Suffix meaning "slightly," often used with color terms.

**ISODIAMETRIC** Of equal dimensions.

**ISOLATERAL** Equal-sided.

**ISOTHIOCYANATE** (= Mustard oil) Organic compound containing nitrogen and sulfur that has a pungent odor and taste and is irritating to the skin and mucous membranes. Isothiocyanates are toxic and can cause liver and kidney damage as well as other problems; e.g., in the Brassicaceae or mustard family.

**ISOTYPE** A specimen of the type collection other than the holotype; an extra or duplicate specimen made at the same time and place as the holotype.



## J

**JOINTED** With or apparently with nodes or points of articulation; e.g., jointed hairs of *Physalis* (Solanaceae).

**JUVENILE LEAVES** In plants with more than one leaf type (e.g., leaf dimorphism), the leaves on new growth, often quite different in appearance from adult leaves; e.g., found in *Juniperus*, *Hedera*.

## K

**KEEL** (a) (= Carina) The two lower (= abaxial) fused petals of a papilionaceous flower (Fabaceae); (b) prominent longitudinal ridge, shaped like the keel of a boat.

**KEELED** With a ridge or keel.

**KNEES** Erect woody projections; e.g., found in *Taxodium* (bald-cypress).

## L

**L.** Linnaeus, Swedish naturalist who established the binomial system of nomenclature; L. f., his son.

**LABELLUM** (= Lip) In Orchidaceae, the enlarged upper petal that appears to be the lowest petal because of twisting of the pedicel.

**LABIATE** Lipped; differentiated into an upper and a lower portion.

**LACERATE** Irregularly cleft as if torn.

**LACINIATE** Cut into long, narrow, ± equal divisions or segments.

**LACTIFEROUS, LACTESCENT** With milky sap.

**LACUNA** (pl. LACUNAE) A space, hole, cavity, or areole.

**LACUNOSE** Perforated, with holes, cavities, or depressions.

**LAEVIGATE** Smooth as if polished.

**LAMELLA** A flat, thin plate.

**LAMELLATE** Made up of flat, thin plates.

**LAMINA** The blade or expanded part of an organ.

**LAMINATE** In plates or layers.

**LANATE, LANOSE** Woolly; covered with dense, long, entangled hairs resembling wool.

**LANCEOLATE** Lance-shaped; several times longer than wide, tapering at both ends, widest about a third above the base.

**LANUGINOSE** With a cottony or woolly appearance, the hairs shorter than in lanate.

**LATENT** Dormant.

**LATERAL** Belonging to or borne on the sides.

**LATERAL BUD** Bud in a leaf axil; contrasting with terminal or apical bud.

**LATEX** A water insoluble mixture of organic compounds, predominantly hydrocarbons, produced in specialized cells called laticifers and often milky in color. The latex of some species has elastic properties (e.g., *Hevea brasiliensis*, rubber) while that of others contain compounds such as alkaloids (e.g., *Papaver somniferum*, opium poppy).

**LATICIFEROUS** Latex-bearing.

**LATISEPT** With broad partitions in the fruits; e.g., Brassicaceae.

**LATORSE** Dehiscing laterally and longitudinally; e.g., some anthers.

**LAX** (a) Spread apart, loose, distant; (b) not rigid.

**LEAF** The primary photosynthetic organ of most plants, usually composed of an expanded blade and a stalk-like petiole.

**LEAFLET** A single, expanded segment or division of a compound leaf.

**LEAF SCAR** The mark or scar left on the stem by the fall of a leaf.

**LEAF TRACE** A vascular bundle, one or more in number, extending from the stem into the leaf.

**LECTOTYPE** A specimen or other material selected by a later worker from the original material studied by the author of the species (or other taxon) to serve as the nomenclatural type when a holotype was not originally designated or was lost or destroyed.

**LEGUME** (a) Fruit type with a single carpel typically dehiscent along both sutures (= margins); (b) a member of the Fabaceae; (c) any fruit type within the Fabaceae.

**LEMMA** The outer (= lowermost) of the two bracts enclosing the reproductive structures in the grass floret.

**LENTICEL** A small corky pore or spot on the bark of young twigs found in many trees and shrubs and allowing gas exchange.

**LENTICULAR** Two-sided; lens-shaped.

**LEPIDOTE** Covered with small scales; scurfy.

**LEPIDOPTEROPHILY, LEPIDOPTEROPHILOUS** Pollination by lepidopterans (= members of the insect order Lepidoptera—butterflies and moths).

**LECTINS** Certain plant proteins that cause linking or agglutination between cells. They can be toxic or mitogenic (= capable of stimulating mitosis); they apparently function in the binding of symbiotic nitrogen-fixing bacteria to roots and in protecting against pathogenic bacteria; often found in members of the Fabaceae.

**LIANA, LIANE** A woody climber (e.g., grape vine). Lianas are common in the tropics.

**LIGNEOUS** Woody.

**LIGNESCENT** Somewhat woody or becoming woody.

**LIGULATE** Tongue-shaped; strap-shaped.

**LIGULATE FLORET** (= Ray floret) Flower, with corolla expanded into a ligule, typical of many Asteraceae.

**LIGULATE HEAD** Head having only bisexual flowers with strap-shaped corollas.

**LIGULE** (a) A strap-shaped limb or body; (b) strap-shaped part of ray (= ligulate) corolla in Asteraceae; (c) membranous or hairy appendage on adaxial surface of the leaf at junction of blade and sheath in Poaceae.

**LIGULIFORM** Strap-shaped.

**LIMB** (a) In a corolla of united petals, the main expanded portion, as distinguished from a basal tube; (b) expanded part of an organ.

**LIMBATE** With limb present.

**LINEAR** Resembling a line, long and narrow, with margins parallel to one another.

**LINGULATE** Tongue-shaped.

**LIP** (a) Either of the principal lobes of a bilabiate or strongly zygomorphic corolla or calyx (e.g., Lamiaceae); (b) (= Labellum) the enlarged upper petal in Orchidaceae that appears to be the lowest petal because of twisting of the pedicel.

**LITHOPHYTE** Plant that grows on rocks but derives its nourishment from the atmosphere and from accumulated humus.

**LITTORAL** Of a shore, particularly of the seashore.

**LOAM** Soil consisting of a mixture of sand, clay, silt, and organic matter.

**LOBATE** Having lobes.

**LOBE** A usually rounded segment or division of a leaf, petal, or other organ.

**LOBED** Having deep or coarse indentations of the margin, larger than mere teeth (However, there is no sharp distinction between large teeth and small lobes.)

**LOBULATE** Having small lobes.

**LOCULAR** Having one or more locules.

**LOCULE, LOCULUS** The cavity, compartment, or cell containing the ovules in a carpel or the pollen in an anther.

**LOCULICIDAL** Descriptive of a capsule dehiscing along the middle of the back of each locule or chamber (= along the midrib of each carpel).

**LODICULE** One of the two or three minute scales at the base of the ovary in most grasses, thought to be a rudiment of a perianth part. They swell and thus open the lemma and palea, allowing the reproductive parts to be exposed.

**LOMENT, LOMENTUM** An indehiscent fruit separating into one-seeded segments at maturity.

**LONGITUDINAL** Lengthwise; along the long axis.

**LUMPER** A taxonomist who in general has the tendency to lump segregates into larger groups; contrasting with splitter.

**LUNATE** Crescent-shaped; half-moon-shaped.

**LURID** Dirty, dingy.

**LUSTROUS** Shining.

**LUTESCENT** Becoming yellow.

**LYRATE** Lyre-shaped; pinnately lobed with the terminal lobe the largest.

## M

**m** Meter; 10 decimeters; 39.37 inches.

**MACRO-** Greek prefix denoting large or long.

**MACROSPORE** (= Megaspore) A large spore giving rise to the female gametophyte; the larger of two kinds of spores produced by heterosporous plants; a female spore.

**MACULATE** With a spot or spots.

**MALODOROUS** Foul-smelling.

**MALPIGHIAN** Describing hairs lying parallel to a surface and attached by their middle; with two branches and almost no stalk; appearing to be an unbranched hair attached at the middle.

**MAMMIFORM** Breast-shaped; conical with rounded apex.

**MAMMILLATE** Having nipple-like structures.

**MARbled** With irregular streaks or blotches of color.

**MARCESCENT** Withering, but the remains persistent; e.g., the corollas of most *Trifolium*.

**MARGIN** Edge; the outer portion of a blade or other structure.

**MARGINAL** Attached to the edge or pertaining to the edge.

**MARGINATE** Distinctly margined; with a distinctly different margin.

**MARSH** Wet or periodically wet, treeless area.

**MEDIAL, MEDIAN** Central, middle.

**MEDULLARY** Pertaining to the pith.

**MEGA-** Greek prefix meaning very large.

**MEGAPHYLL** Leaf with branched veins.

**MEGASPORANGIUM** Sporangium in which megaspores are formed.

**MEGASPORE** (= Macrospore) A large spore giving rise to the female gametophyte; the larger of two kinds of spores produced by heterosporous plants; a female spore.

**MEGASPOROPHYLL** A sporophyll (= spore-bearing leaf) bearing one or more megaspores.

**MEMBRANACEOUS, MEMBRANOUS** Having the nature of a membrane, thin, somewhat flexible, translucent.

**MENTUM** A projection near the base of some flowers in the Orchidaceae.

**MEPHITIC** Having an offensive odor.

**MERICARP** The individual, separated carpels of a schizocarpic fruit; e.g., one of the fruit segments in the Apiaceae or one of the "nutlets" in the Boraginaceae.

**MERISTEM** Embryonic or undifferentiated tissue, capable of developing into various organs.

**MERISTEMATIC** Pertaining to or with the nature of a meristem.

**-MEROUS** Greek suffix used to refer to the number of parts (or multiples of such) in each circle of the floral organs, usually with a numerical prefix (e.g., a 3-merous perianth would mean there are three petals and three sepals or some multiple of three). The term often refers to the perianth only.

**MESA** A flat-topped hill with abrupt or steeply sloping side or sides.

**MESOCARP** The middle layer of the pericarp or fruit wall.

**MESOPHYTE** Plant that grows under medium moisture conditions; contrasting with hydrophyte and xerophyte.

**MICRO-** Greek prefix meaning small.

**MICROPHYLL** A relatively small leaf with a single unbranched vein, typical of the Lycopodiophyta and Equisetophyta.

**MICROPHYLOUS** Having small leaves.

**MICROPYLE** A minute opening through the integuments into the ovule through which the pollen-tube usually enters and often distinguished in the mature seed as a slight depression.

**MICROSPORANGIUM** Sporangium in which microspores are produced. In angiosperms, the microsporangium is equal to the pollen sac and there are typically four microsporangia per anther.

**MICROSPORE** A small spore giving rise to the male gametophyte; the smaller of two kinds of spores produced by heterosporous plants; a male spore.

**MICROSPOROPHYLL** The sporophyll (= spore-bearing leaf) upon which microspores are produced.

**MICROTUBERCULATE** Minutely tuberculate.

**MIDRIB** The central or main rib or vein of a leaf or other similar structure.

**MITRIFORM** Shaped like a miter or bishop's hat.

**MIXED INFLORESCENCE** One in which the parts are not consistent in being all determinate or all indeterminate.

**mm** Millimeter; 1000 microns or 1/1000 of a meter.

**MONADELPHOUS** With all filaments united into a single tube surrounding the pistil.

**MONANDROUS** Having a single stamen.

**MONILIFORM** Like a string of beads.

**MONO-** Greek prefix meaning one or of one.

**MONOCARPIC** (a) Descriptive of a plant that flowers only once before dying; (b) having a single carpel.

**MONOCEPHALOUS, MONOCEPHALIC** Bearing only a single head.

**MONOCHASIAM** A cyme with lateral branching on only one side of the main axis.

**MONOCHLAMYDEOUS** Having only one set of floral envelopes; having perianth of a single series.

**MONOCOLPATE** With a single furrow; e.g., on a pollen grain.

**MONOCOTYLEDONS** (abbreviated **MONOCOTS**) Flowering plants having one cotyledon (= seed leaf), mostly parallel venation, and flower parts usually in threes; one of the two classes of flowering plants which, depending on the system of classification, is known as *Monocotyledonae* or *Liliopsida*.

**MONOECIOUS** Plants with staminate flowers and pistillate flowers on the same plant, but lacking perfect flowers.

**MONOMORPHIC** One form; contrasting with polymorphic.

**MONOPHYLETIC** A term previously used to describe a group of organisms with a common ancestor; more recently it has been used to describe a group consisting of a common ancestor and all of its descendants. Some authorities believe that a different term, *holophyletic*, should be used for a group consisting of a common ancestor and all of its descendants.

**MONOPODIAL** With an evident single and continuous axis.

**MONOTYPIC** Having a single type or representative; e.g., a genus with only one species.

**MONTANE** Pertaining to or living in mountains.

**MOSTLY** A quantitative term meaning "most of them."

**MUCILAGINOUS** Slimy; with mucilage.

**MUCRO** A short and small abrupt tip, as with the midrib extending as a short point.

**MUCRONATE** With a mucro.

**MUCRONULATE** Diminutive of mucronate.

**MULTI-** Latin prefix for many.

**MULTICIPITAL** Literally, "many-headed"; descriptive of a crown of roots or a caudex from which several stems arise.

**MULTIFID** Divided into many narrow segments or lobes.

**MULTIFLOROUS** Many-flowered.

**MULTIPLE FRUIT** (= *Syncarp*) A single "fruit" formed by the coalescence of several fruits from separate flowers; e.g., *Morus* (mulberry), *Maclura* (bois d'arc), *Ananas* (pineapple).

**MURICATE** With numerous minute short points; roughened.

**MURICULATE** Diminutive of muricate.

**MUSTARD OIL** (= *Isothiocyanate*) Organic compound containing nitrogen and sulfur that has a pungent odor and taste and is irritating to the skin and mucous membranes. Mustard oils are toxic and can cause liver and kidney damage as well as other problems; e.g., in the *Brassicaceae* or mustard family.

**MUSTARD OIL GLYCOSIDE** (= *Glycosinolate*) A complex molecule that upon breakdown yields a sugar, a sulfate fraction, and an irritating mustard oil or isothiocyanate; e.g., in the mustard family.

**MUTICIOUS** Blunt, lacking a point.

**MYCORRHIZA** (pl. *MYCORRHIZAE*) A mutually beneficial, symbiotic association of a fungus and the root of a plant. Mycorrhizal relationships are characteristic of most vascular plants.

**MYCORRHIZAL** Pertaining to mycorrhiza.

## N

**N** North.

**NAKED** Lacking various coverings, organs, or appendages, almost always referring to organs or appendages present in other similar plants; e.g., a naked flower lacks perianth.

**NAPIFORM.** Turnip-shaped; e.g., roots.

**NASCENT** In the act of being formed.

**NATANT** Floating underwater; immersed.

**NATURALIZED** Referring to an introduced foreign plant that has become part of the spontaneous, self-perpetuating flora of a region.

**NAVICULATE, NAVICULAR** Boat-shaped.

**NECTAR** A sugar-rich solution secreted by plants, typically produced in nectaries. Nectar production has apparently evolved to attract insects or other animals for pollination or other purposes.

**NECTAR-GUIDE** A line or other marking leading insects to the nectary; e.g., contrastingly colored lines on many corollas.

**NECTARIFEROUS** Having or producing nectar.

**NECTARY** A specialized nectar-secreting structure or area; there can be floral nectaries (in the flowers) or extra-floral nectaries (not associated with the flowers).

**NEEDLE** Linear, often stiff leaf as in *Pinus* (*Pinaceae*).

**NEOTYPE** A specimen selected by a later worker to serve as the nomenclatural type of a taxon when all material studied by the original author has been lost or destroyed.

**NERVE** A simple vein or slender rib of a leaf, bract, or other structure.

**NERVED** Having nerves.

**NET-VEINED** With veinlets branching irregularly and not uniformly angular, forming a net-like pattern.

**NEUTER** Sexless, as a flower that has neither functional stamens nor pistils.

**NEUTRAL FLOWER** A sterile flower; flower with a perianth but without functional sexual organs.

**NIGRESCENT** Turning black.

**NITID** Smooth and clear, lustrous, glittering.

**NITRATES** Nitrogen containing compounds that can be accumulated in plant tissues and cause toxicity in animals if ingested. During digestion, nitrates are converted to nitrites that are toxic due to their ability to render hemoglobin incapable of transporting oxygen.

**NOCTURNAL** Occurring at night or lasting for only one night.

**NODAL** Located at or pertaining to a node.

**NODE** Area of stem or axis at which branches, leaves, bracts, or flower stalks are attached; joint of a stem.

**NODDING** Hanging down.

**NODOSE** Nodular, knotty, with semispheroid protuberances.

**NODULOSE** Diminutive of nodose; having small, knobby nodes or knots.

**NUT** Hard-shelled and indehiscent fruit with a single seed.

**NUTANT** Nodding.

**NUTLET** (a) Diminutive of nut; (b) used to refer to any small, dry, nut-like fruit or seed, thicker-walled than an achene; (c) seed-like sections into which the mature ovary breaks in *Boraginaceae*, *Labiatae*, and most *Verbenaceae*, each section consisting of one seed with extra coat formed from ovary wall or partitions, making it technically a fruit.



**OB-** Latin prefix indicating the reverse or upside-down, as obcordate, meaning cordate or ovate with wider end at top or away from point of attachment.

**OBCONIC, OBCONICAL** Inversely cone-shaped, with attachment at the small end.

**OBDELTOID** Inversely deltoid; triangle-shaped with base pointed.

**OBDIPLSTEMONOUS** Describing a flower with two circles of stamens, in which those of the outer circle are borne in front of (= on the same radius as) the petals.

**OBLANCEOLATE** Lanceolate with broadest part above the middle and tapering toward the base.

**OBLATE** Nearly spherical but flattened at the poles.

**OBLIGATE** Necessary or essential; contrasting with facultative.

**OBLIQUE** Slanting; unequal-sided.

**OBLONG** Longer than wide with sides nearly parallel.

**OBVATE** Egg-shaped with attachment at narrow end; inversely ovate.

**OBOVOID** Inversely ovoid; a solid that is obovate in outline.

**OBPYRIFORM** Pear-shaped with attachment at narrow end.

**OBSOLESCENT** Nearly or becoming obsolete; rudimentary; referring to structures that are not or are only slightly evident.

**OBSOLETE** Not apparent or evident; rudimentary; vestigial; extinct.

**OBTUSE** Forming a blunt or rounded angle of more than 90 degrees; not pointed.

**OCRACEOUS** Ochre-colored, yellow with a tinge of red.

**OCROLEUCOUS** Yellowish-white, buff.

**OCREA** (pl. *OCREAE*) Tube formed by fused, sheathing stipules; e.g., in Polygonaceae.

**OCREATE** With an ocrea.

**OCREOLA** (pl. *OCREOLAE*) Secondary sheath; sheath surrounding a fascicle of flowers; e.g., in the Polygonaceae.

**ODD-PINNATE** Compound leaf with terminal leaflet present; with an odd number of leaflets.

**OFFSET** A short lateral shoot, arising near the base of a plant, primarily propagative in function and thus can give rise to a new plant.

**OLIGO-** Greek prefix signifying few.

**OLIVACEOUS** Olive-green.

**ONTOGENY** The developmental cycle of an individual organism.

**OPAQUE** Impervious to light.

**OPERCULATE** Having an operculum.

**OPERCULUM** Literally, "a small lid"; term applied to the terminal portion (= lid or cap) of a circumscissile fruit or other organ.

**OPPOSITE** Arranged two at each node, on opposite sides of the axis.

**ORBICULAR, ORBICULATE** With round, approximately circular outline.

**ORDER** The unit, category, or rank in classification made up of one or more families; ending in -ales; sometimes divided into suborders or superfamilies, which in turn are made up of families.

**ORIFICE** An opening.

**ORNITHOPHILY, ORNITHOPHILOUS** Pollination by birds.

**ORTHO-** Greek prefix signifying straight.

**ORTHOTROPOUS OVULE** An erect ovule, with the micropylar end at the summit.

**OVAL** Broadly elliptic.

**OVARY** Basal, ovule-containing portion of the pistil in angiosperms, developing into the fruit.

**OVATE** Egg-shaped with widest part at the base.

**OVOID** Solid oval or solid ovate.

**OVULATE** Bearing ovules.

**OVULE** An immature or unfertilized seed; the megasporangium of a seed plant; the egg-containing unit of the ovary.

**OXALATES** Salts of oxalic acid, a carboxylic acid that can occur in plant tissue either as the free acid (e.g., rhubarb leaves) or as salts in the form of calcium oxalate, potassium oxalate, or sodium oxalate. Ingestion of the soluble oxalates by animals results in the formation of calcium oxalate crystals, which when deposited in the kidneys and other organs can cause serious mechanical damage; calcium deficiencies can also result; calcium oxalate also occurs in some plant tissues in the form of raphides or needle-like crystals; e.g., in Araceae.



**PALATE** The raised portion within the throat of a bilaterally symmetrical corolla.

**PALE** (= *Palea*) A chaffy scale or bract on the receptacle of many Asteraceae, often subtending the fruit; see chaff.

**PALEA** (a) In Poaceae, the inner (= uppermost) bract of a floret, often partly enclosed by the lemma; (b) (= pale) the receptacular scale or bract in Asteraceae; see chaff.

**PALEACEOUS** Chaffy; with small membranaceous scales.

**PALLID** Pale in color.

**PALMATE** Attached or radiating from one point, as leaflets in a palmately compound leaf, veins in some leaf blades, or fingers of a hand.

**PALMATELY COMPOUND** With the leaflets attached at one point at the apex of the petiole, like the fingers all attached to the palm of a hand.

**PALMATELY TRIFOLIOLATE** Having three leaflets with the terminal leaflet unstalked, sessile.

**PALMATIFID** Cut so as to appear nearly palmately compound.

**PALUDAL** Growing in marshes.

**PANDURATE, PANDURIFORM** Fiddle-shaped; obovate with a contraction on each side.

**PANICLE** A branched usually elongate (not flat-topped) inflorescence with flowers on the branches of the primary axis; a compound racemose inflorescence. Panicles are indeterminate.

**PANICULATE** Resembling a panicle.

**PANICULIFORM** Having the form and appearance but not necessarily the structure of a panicle.

**PANNOSE** Having the texture or appearance of woolen cloth or felt.

**PAPILIONACEOUS, PAPILIONOID** Descriptive of a flower having a bilaterally symmetrical corolla composed of a banner (= standard), two lateral wing petals, and a keel of two fused petals; descriptive of flowers characteristic of many Fabaceae in the subfamily Papilionoideae.

**PAPILLA** (pl. *PAPILLAE*) Small pimple-like or nipple-like projection.

**PAPILLATE, PAPILLIFORM, PAPILLOSE** Shaped like or bearing papillae.

**PAPPUS** The crown of bristles, awns, scales, etc. at the apex of the achene of most Asteraceae, thought to be the modified calyx.

**PAPYRACEOUS** Papery.

**PARALLEL-VEINED** With main veins parallel to each other. Such leaves are typical of many monocots.

**PARAPHYLETIC** A term used to describe a taxonomic group consisting of an ancestral species and some but not all of its descendants. Paraphyletic groups can give an inaccurate view of phylogeny but are often useful in classification; see Appendix 6 for discussion.

**PARASITE** A plant that derives its food, mineral nutrition, and/or water wholly or chiefly from another plant (the host) to which it is attached; contrasting with epiphyte, saprophyte, or autophyte.

**PARASITIC** Deriving food, mineral nutrition, water, or any combination from another living organism (the host).

**PARIETAL** Located on the inner side of the exterior wall of the ovary.

**PARIETAL PLACENTATION** Placentation with ovules attached to the ovary wall instead of the axis.

**PARIPINNATE** Referring to a pinnately compound leaf with an even number of leaflets or pinnae.

**PARTED** (a) Cut nearly but not quite the distance from the margin to midrib or from the apex to base; (b) more generally, any deep cut; (c) as a suffix can be combined with a numerical prefix to indicate the number of segments.

**PARTHENOGENETIC** Developing without fertilization.

**-PARTITE** A suffix synonymous with -parted.

**PATELLIFORM** Disk-shaped; circular with narrow rim.

**PATENT** Spreading.

**PAUCI-** Latin prefix denoting few.

**PECTINATE** With narrow closely set segments or units similar to the teeth of a comb.

**PEDATE** Palmately divided with the lateral segments again divided.

**PEDICEL** (a) Stalk supporting a single flower of an inflorescence; (b) in grasses the stalk supporting a single spikelet.

**PEDICELLATE, PEDICELLED, PEDICELLED** Borne on a pedicel; contrasting with sessile.

**PEDUNCLE** Stem or stalk of an inflorescence, flower cluster, or of the only flower in an inflorescence.

**PEDUNCULAR** Pertaining to or on a peduncle.

**PEDUNCULATE** With a peduncle.

**PELLICLE** A thin skin or filmy covering.

**PELLUCID** Clear, almost transparent.

**PELTATE** Shield-shaped, with stalk attached on the undersurface away from the margin or base (sometimes attached at the middle like the axis of an umbrella).

**PENDENT, PENDULOUS** Hanging down or suspended.

**PENICILLATE** Like a brush, usually referring to a tuft of hairs.

**PENTAGONAL** Shaped like a pentagon; five-sided or -angled.

**PENTAMEROUS** Having the parts in fives.

**PEPO** A specific type of fruit usually associated with the Cucurbitaceae; a many-seeded fruit with a hard rind; e.g., gourd.

**PERENNATING** Surviving from growing season to growing season.

**PERENNIAL** Root system or plant living at least three growing seasons (years); lasting from year to year.

**PERFECT FLOWER** One with both functional stamens and pistils; a bisexual flower.

**PERFOLIATE** Referring to a sessile leaf or bract whose base completely surrounds the stem, the latter seemingly passing through the leaf or with two leaves basally united around the stem.

**PERFORATE** Having translucent dots that look like small holes, or pierced through.

**PERI-** Greek prefix denoting around, enclosing.

**PERIANTH** Collective term for the corolla and calyx, often used when corolla and calyx are not well differentiated.

**PERICARP** Fruit wall; structure enclosing the seeds in angiosperms. The pericarp can be subdivided into endocarp, mesocarp, and exocarp.

**PERIGYNIUM** Urn-shaped, sac-like or pouch-like structure surrounding the pistil in *Carex* (Cyperaceae).

**PERIGYNOUS** Having floral organs united forming a tube (= floral tube) surrounding but not adnate to the pistil, the floral organs thus borne around (versus above or below) the ovary.

**PERIPHERAL** On or near the margin.

**PERISPERM** The nutritional material of a seed surrounding the embryo and formed outside the embryo sac.

**PERISPORIUM, PERISPORE** A thin envelope enclosing a spore.

**PERNICIOUS** Highly hurtful or harmful.

**PERSISTENT** Remaining attached; not falling off; contrasting with deciduous.

**PERSONATE** Referring to a strongly two-lipped corolla with the throat closed by a palate.

**PETAL** One of the next-to-outermost whorl of parts in a complete flower; a segment of the corolla; the inner series of floral "leaves." The petals are collectively referred to as the corolla.

**PETAL-LIKE** (= Petaloid) Having the character or appearance of a petal, usually showy.

**PETALOID** (= Petal-like) Having the character or appearance of a petal, usually showy.

**PETALIFEROUS** Bearing petals.

**PETIOLAR** Pertaining to or located on the petiole.

**PETIOLATE** With a petiole.

**PETIOLE** Stalk of a leaf supporting the blade.

**PETIOLULATE** Having a petiolule.

**PETIOLULE** Stalk supporting a leaflet.

**PHANEROGAM** A seed plant or spermatophyte; contrasting with cryptogam.

**PHENOLIC, PHENOL** An aromatic alcohol; more technically, a substance with an alcohol (= hydroxyl) group attached to an aromatic (= benzene or phenyl) ring structure. Plant phenolics are sometimes toxic; a number of plant resins or resinoids are phenolic in nature; e.g., urushiol from poison ivy, tetrahydrocannabinol (THC) from marijuana; other phenolic compounds include vitamin E and anthocyanins.

**PHENOLOGY** Study of the times at which various events occur in the life of a plant or a flower.

**PHLOEM** The food-conducting tissue in a plant.

**PHOTODERMATITIS** Skin inflammation resulting from increased sensitivity to sunlight, often caused by exposure to certain plants or plant-derived materials.

**PHOTOSYNTHESIS** The process by which plants convert carbon dioxide and water into carbohydrates in the presence of light.

**PHYLLARY** (= Involucral bract) One of the bracts subtending a head in the Asteraceae.

**PHYLLOCLADE** (= Cladophyll, Cladode) A portion of stem having the general form and function of a leaf.

**PHYLLODE, PHYLLODIUM** An expanded bladeless petiole; a leaf reduced to a flattened petiole. These structures typically serve the photosynthetic function of a blade.

**PHYLLODIAL** Having the character of a phyllode.

**PHYLLOTAXY** Arrangement of the leaves on their axis.

**PHYLOGENY** The evolutionary history of a group.

**PHYTOPHOTODERMATITIS** Plant-induced skin inflammation resulting from increased sensitivity to sunlight.

**PHYTOTOXIC** Term used to describe materials that are toxic to plants.

**PHYTOTOXIN** (a) General term for a plant-derived toxin; (b) more typically used to refer to toxic plant proteins or toxalbumins; e.g., ricin from *Ricinus*.

**PILOSE** With long, soft,  $\pm$  straight hairs; softer than hirsute, not flexuous or curved as in villous.

**PILOSULOUS** Diminutive of pilose.

**PINNA** (pl. PINNAE) A primary division of a compound leaf. A pinna can be simple (and thus equivalent to a leaflet) or compound and divided into leaflets. The term is frequently used in describing fern leaves—here the term is used for any primary division of a leaf (e.g., a leaflet or a leaf division divided into leaflets). In flowering plants the term is generally used to describe a primary division of a decompound leaf (a pinna is thus divided into leaflets).

**PINNATE, PINNATELY COMPOUND** Descriptive of a compound leaf with leaflets distributed along both sides of an elongate axis; feather-like. Bipinnate or 2-pinnate leaves have the leaflets distributed along a secondary axis; tripinnate or 3-pinnate leaves have the leaflets along a tertiary axis, etc.

**PINNATELY TRIFOLIATE** Referring to trifoliolate leaves in which the terminal leaflet is extended beyond the other two by having a distinct petiolule.

**PINNATIFID** Pinnately divided into stalkless segments, but the segments not distinct leaflets (i.e., not divided all the way to the midrib).

**PINNATISECT** Pinnately divided to the midrib.

**PINNIPALMATE** Descriptive of a leaf exhibiting a combination of pinnate and palmate arrangements of the leaflets.

**PINNULE** A secondary pinna; division of a pinna or a leaflet.

**PISIFORM** Pea-shaped.

**PISTIL** The female reproductive organ of a flower consisting of the ovary, stigma, and style. Pistils can be either simple (of one carpel) or compound (with > one carpel); the pistils are collectively referred to as the gynoecium.

**PISTILLATE** With only the female reproductive structures being functional or with female reproductive structures only.

**PISTILLODE, PISTILLODIUM** A rudimentary or vestigial pistil.

**PITH** The soft spongy center of a stem.

**PITTED** Having little depressions or cavities.

**PLACENTA** (pl. PLACENTAE) Place of attachment of the ovule(s) within an ovary.

**PLACENTATION** Arrangement of placentae and thus ovules in an ovary.

**PLAIT** A lengthwise fold or pleat.

**PLAITED** (= Plicate) Folded like a fan.

**PLANE** With a flat even surface.

**PLANO-** A suffix denoting flat.

**PLEATED** Folded.

**PLICATE** (= Plaited) Folded like a fan.

**-PLOID** A suffix used in genetics, prefixed by a term indicating number, to denote the number of sets of chromosomes in the nucleus.

**PLUMOSE** Feathery; descriptive of a long hair with long, slender, lateral hairs.

**POD** A legume, or more generally, a dry dehiscent fruit; sometimes loosely synonymous with capsule.

**POLLEN, POLLEN GRAIN** The microscopic spheroidal structures that produce the male cells and borne within the anther of a flowering plant or on the microsporophyll of a gymnosperm; technically microgametophytes develop from microspores.

**POLLEN SAC** A microsporangium containing pollen. In angiosperms there are typically four pollen sacs per anther.

**POLLEN TUBE** The slender tube that develops from a pollen grain, penetrates the tissue of the ovary, and enters the ovule.

**POLLINATE** To transfer pollen from a stamen to a stigma.

**POLLINATION** The act or process of pollinating.

**POLLINIUM** (pl. POLLINIA) A mass of coherent pollen, as developed in Asclepiadaceae and Orchidaceae.

**POLY-** Greek prefix meaning many.

**POLYADELPHOUS** With several groups of stamens.

**POLYGAMO-DIOECIOUS** Descriptive of dioecious plants having some perfect flowers; bearing on one plant flowers partly perfect and partly pistillate, on another plant flowers partly perfect and partly staminate.

**POLYGAMO-MONOECIOUS** Descriptive of monoecious plants having some perfect flowers; bearing partly perfect, partly unisexual flowers.

**POLYGAMOUS** Bearing unisexual and bisexual flowers on the same plant.

**POLYMORPHIC** Of various forms; with three or more forms.

**POLYPETALOUS** (= Apopetalous) With corolla of separate petals; contrasting with gamopetalous.

**POLYPHYLETIC** A taxonomic group having species derived from more than one common ancestor, the species having been placed in the same group because of similarities due to convergent or parallel evolution. Polyphyletic taxa give an inaccurate view of phylogeny.

**POLYPLOID** A plant with three or more basic sets of chromosomes.

**POLYSEPALOUS** (= Aposepalous) Composed of or possessing separate sepals.

**POLYSTICHOUS** Arranged in several longitudinal rows.

**POME** A fleshy indehiscent fruit developing from a compound inferior ovary embedded in receptacular or floral cup tissue; e.g., apples or pears.

**PORE** A small aperture or opening; e.g., opening at end of anther in *Solanum* species.

**PORICIDAL** Opening by pores.

**PORULUS** Somewhat porous (= pierced with small round holes).

**POSTERIOR** Describing the position of an organ located on the side adjacent to the axis. In flowers, the upper lip is posterior, the lower anterior.

**PRAEMORSE** Short and truncate at the base, as if eaten or chewed off; descriptive of the rhizomes in some species of *Viola* and *Hieracium*.

**PRECOCIOUS** Developing or appearing very early; denoting flowers that appear in advance of the leaves.

**PREHENSILE** Clasping or grasping; e.g., tendrils.

**PRICKLE** A slender, sharp, epidermal outgrowth without vasculature; e.g., the armature of roses.

**PRIMOCANE** The first year's shoot of woody biennials, typically non-flowering; e.g., *Rubus*.

**PRISMATIC** Angular with flat sides; shaped like a prism.

**PROCUMBENT** Trailing or prostrate, not rooting.

**PROLIFEROUS** Bearing or developing offshoots or redundant parts; producing numerous new individuals, or parts, of the same kind; bearing offsets, bulbils, or other vegetative progeny.

**PROPHYLL, PROPHYLLUM** (a) In the Poaceae, the first leaf of a lateral shoot or vegetative culm branch, consisting of a sheath without a blade; (b) bracteole subtending an individual flower; e.g., in some species of *Juncus*.

**PROPHYLLATE** Furnished with prophylls.

**PROSTRATE** Lying flat.

**PROTANDROUS, PROTERANDROUS** Having the anthers mature before the pistils in the same flower.

**PROTHALLUS, PROTHALLIUM** Gametophyte stage or generation in ferns and fern-allies, bearing the sexual organs.

**PROTOGYNOUS** Having the stigma receptive to pollen before pollen is shed from the anthers of the same flower.

**PROTUBERANCE** A protrusion, swelling, bump, or bulge.

**PROXIMAL** Located nearest to the base or attachment point of a structure; contrasting with distal.

**PRUINOSE** Having a bloom on the surface; with a waxy or powdery secretion; with a surface coating more pronounced than glaucous.

**PSEUDO-** Greek prefix meaning false, not genuine.

**PSEUDOANTAGONISM** Pollination system (e.g., in some Orchidaceae) in which a flower mimics a male insect, thereby attracting a male insect that "fights" with the flower in an effort to protect his territory. In the process of repeating this activity, pollen can be transferred from one plant to another.

**PSEUDOBULB** The thickened or bulb-like, above ground stems of certain orchids.

**PSEUDOCARP** A structure made up of the mature ovary combined with some other organ; e.g., the hip of a rose.

**PSEUDOCOPULATION** Pollination system (e.g., in some Orchidaceae) in which a flower mimics a female insect (e.g., wasp or fly), thereby attracting male insects who copulate with the flowers and in the process of repeating this activity transfer pollen from one plant to another.

**PSYCHOACTIVE** Mind altering. A number of psychoactive materials are produced by plants.

**PTERIDOLOGY** The study of ferns and similar plants.

**PTERIDOPHYTE** A fern or similar plant; any member of the Lycopod-

iophyta, Psilophyta, Polypodiophyta (formerly Pteridophyta), or Equisetophyta (formerly Sphenophyta).

**PUBERULENT** Minutely pubescent.

**PUBESCENCE** The covering or indumentum of hairs on a plant without reference to specific type (e.g., pilose, hirsute).

**PUBESCENT** (a) General term for covering or indumentum of hairs; (b) sometimes used in a more restricted sense to refer to fine short hairs; downy.

**PULP** The juicy or fleshy tissue of a fruit.

**PULVINATE** With a pulvinus; cushion-shaped.

**PULVINUS** The swollen base of a petiole, as in many Fabaceae. The structure is often involved in leaf movements.

**PUNCTAE** Dots, depressions, or pits, commonly glandular in nature.

**PUNCTATE** With translucent or colored dots, depressions, or pits.

**PUNCTICULATE** Minutely punctate.

**PUNGENT** (a) Ending in a rigid sharp point or prickle; (b) acrid to the taste or smell.

**PURPURASCENT** Becoming or turning purple.

**PUSTULATE** With pustules, blisters, or blister-like swellings.

**PUTAMEN** The bony endocarp or "pit" of some fruits.

**PYRENE** The "nutlet," "pit," or stone in a drupe or drupelet; a seed together with the bony endocarp.

**PYRIFORM** Pear-shaped.

**PYXIS** (pl. PYXIDES) A capsule with circumscissile dehiscence, the top coming off as a lid; e.g., in *Plantago*.

## Q

**QUADR-** Latin prefix meaning four.

**QUADRANGULAR** Four-cornered; square.

**QUADRATE** Nearly square.

**QUASI-** Prefix meaning "as if."

## R

**RACEME** An unbranched (= simple) inflorescence with pedicelled flowers from an elongate main axis. Racemes are indeterminate.

**RACEMIFORM** Having the form, but not necessarily the technical character of a raceme.

**RACEMOSE** In racemes or resembling a raceme.

**RACHILLA** (a) A small rachis; (b) specifically the axis of a spikelet in the Poaceae.

**RACHIS** (a) Leaflet-bearing central axis of a pinnately compound leaf; (b) axis of an inflorescence.

**RADIALLY SYMMETRICAL** Descriptive of a structure that can be cut into halves from any marginal point through the center. When used in reference to flowers, the term is synonymous with actinomorphic or regular.

**RADIATE** (a) Spreading from a common center; (b) in Asteraceae, describing a head with disk florets in center and a whorl of ray (= ligulate) florets around the periphery.

**RADIATE HEAD** In Asteraceae, a head with both peripheral ray (= ligulate) florets and central disk florets.

**RADICAL LEAVES** Leaves arising from a root crown; basal leaves.

**RADICLE** Embryonic root of a germinating seed.

**RAMEAL** Pertaining to or located on a branch.

**RAMIFICATION** The arrangement of branching parts.

**-RANKED** Suffix, when combined with a numerical prefix, indicating the number of longitudinal rows in which leaves or other structures are arranged along an axis or rachis.

**RAPHIDE** Needle-shaped crystal in a plant cell, typically of calcium oxalate.

**RAPHIDULOUS** Resembling or having raphides.

**RAY** (a) Flat or strap-shaped type of corolla found in many Asteraceae; (b) primary branch of a compound umbel.

**RAY FLORET** (= Ligulate floret) Flower, with corolla expanded into a ligule, typical of many Asteraceae.

**RECEPTACLE** (a) (= Torus) Tip of a stem or pedicel, usually more or less enlarged, on which flower parts are attached; (b) in Asteraceae, the structure on which the florets of a head are attached.

**RECEPTACULAR** Referring to the receptacle.

**RECLINED, RECLINATE** Bent or turned downward.

**RECUMBENT** Leaning or reclining.

**RECURVED** Curved downward or backward.

**REDUCED** Small but probably derived from larger forerunners.

**REFLEXED** Abruptly bent downward.

**REGULAR** (= Actinomorphic or Radially symmetrical) Referring to a structure that can be cut into halves from any marginal point through the center; with the parts in each series alike or uniform. The term usually refers to flowers.

**RELIC** (a) A long-surviving species whose relatives have become extinct; (b) a plant persisting in a relatively small portion or portions of its former range.

**REMOTE** Widely or distantly spaced.

**RENIFORM** Kidney-shaped.

**REPAND** With a shallowly sinuate, undulating, or slightly wavy margin; less strongly wavy than sinuate.

**REPENT** Creeping and rooting at the nodes.

**REPLICATE** Folded backward.

**REPLUM** The partition between the halves of a fruit; e.g., Brassicaceae.

**RESIN, RESINOID** A miscellaneous or catchall term for a variety of amorphous, sometimes semisolid, perhaps gummy substances from plants. A number are toxic, sometimes extremely so; some are terpene derivatives while others are phenolic compounds; examples of phenolic resins are tetrahydrocannabinol (THC) from marijuana, urushiol from poison ivy, and hypericin from *Hypericum perforatum*.

**RESINOUS, RESINIFEROUS** Producing or bearing resin.

**RESUPINATE** Upside down; inverted; turned 180 degrees; e.g., some members of the Fabaceae and Orchidaceae have resupinate flowers.

**RETICULATE** Net-veined or with a net-like pattern.

**RETINACULUM** (pl. RETINACULA) (a) In Asclepiadaceae, the filament-like band connecting a pollinium to the gland-like corpusculum; (b) in Acanthaceae, the curved, hook-like, modified funiculus which retains the seed until maturity.

**RETROSE** Bent or turned backward or downward; e.g., hairs pointing down a stem, the free end of the hair below or proximal to the attached end; contrasting with antrorse.

**RETROSELY BARBED** With barbs (= points) pointing downward toward base.

**RETUSE** Shallowly notched at a rounded apex.

**REVOLUTE** With margins rolled down and inward; e.g., revolute leaves.

**RHIZOID** A filamentous root-like structure (without the anatomy of a root) on the gametophyte of ferns or other non-seed-producing plants.

**RHIZOMATOUS** Possessing a rhizome.

**RHIZOME** Underground stem with nodes and scale leaves.

**RHIZOPHORE** In certain Pteridophytes, a specialized leafless stem emitting roots.

**RHOMBIC** Somewhat diamond-shaped; shaped like two adjacent equilateral triangles.

**RHOMBOID, RHOMBOIDAL** A three-dimensional rhombic figure.

**RIB** (a) One of the principal longitudinal veins of a leaf or other organ; (b) ridge on a fruit.

**RIBBED** With prominent ribs or veins.

**RINGENT** Gaping; open.

**ROOT** The portion of the main axis (or one of its subdivisions) of a plant usually found below ground and lacking nodes, internodes, or leaves.

**ROOTLET** (a) A little root; (b) term often applied to the holdfast roots of certain climbing plants.

**ROOTSTOCK** According to Shinnors (1958), a "weasel-word" indicating an elongate crown, rhizome, or rhizome-like structure; an old inaccurate term for rhizome.

**ROSEATE** Rosy or pinkish.

**ROSETTE** A cluster or whorl of leaves or other organs closely arranged in a radial pattern.

**ROSTELLATE** Diminutive of rostrate.

**ROSTELLUM** (a) A small beak; (b) in Orchidaceae, an extension from the upper edge of the stigma.

**ROSTRATE** Beaked.

**ROSTRUM** A beak or any beak-like extension.

**ROSULATE** In rosettes.

**ROSY** The rich pink characteristic of the petals of some roses.

**ROTATE** Wheel-shaped or saucer-shaped as in a sympetalous corolla with an obsolete or very short tube and a flat circular limb.

**ROTUND** Essentially circular in outline.

**RUDERAL** Weedy or growing in waste places.

**RUDIMENT** A structure very imperfectly developed, non-functional, or represented only by a vestige; e.g., rudimentary non-functional florets in some grass spikelets.

**RUDIMENTARY** Having the character of a rudiment.

**RUFESCENT** Becoming reddish brown.

**RUFIOUS** Reddish brown.

**RUGOSE** Wrinkled.

**RUGULOSE** Diminutive of rugose.

**RUMINATE** Appearing as though chewed or wadded; roughly wrinkled.

**RUNCINATE** With margins that are coarsely serrate to sharply incised with the segments pointing toward the base, as in *Taraxacum*.

**RUNNER** An elongate, slender, prostrate stem taking root at the nodes or tip.

**RUPTURING** Bursting open along irregular lines.

**RUSSET** Reddish brown.



s South.

**SAC** A pouch or bag.

**SACCATE** Sac-like; pouch-like.

**SAGITTATE** With the form of an arrowhead; triangular with the basal lobes pointing downward or inward toward the petiole.

**SALIENT** Projecting forward.

**SALINE** Of or pertaining to salt.

**SALVERFORM** Descriptive of a corolla having a narrow, nearly straight basal tube, abruptly expanded at top into a flattened or saucer-shaped limb.

**SAMARA** A dry, indehiscent, winged fruit; a fruit that is achene-like but with a flat wing; e.g., in maple, *Acer* (Aceraceae).

**SAP** The juice of a plant.

**SAPONACEOUS** Soapy, slippery to the touch.

**SAPONIC** or **SAPONIN GLYCOSIDE** A glycoside (two-component molecule) that upon breakdown yields a saponin.

**SAPONIN** A soap-like molecule that lowers the surface tension of aqueous solutions. Saponins usually have a bitter acrid taste and are commonly irritating to mucous membranes; chemically saponins are either triterpenes or steroids; they can alter the permeability of cell membranes and may react with proteins and are thus potentially toxic; they are highly toxic to cold-blooded animals and have long been used to stun fish.

**SAPROPHYTE** A non-photosynthetic plant without chlorophyll, deriving its food from dead organic material in the soil by mycorrhizal relationships or otherwise; e.g., *Monotropa* (Ericaceae).

**SAPROPHYTIC** Subsisting on dead organic matter.

**SAXICOLOUS** Growing on rocks.

**SCABERULOUS** Minutely scabrous.

**SCABRIDULOUS** Slightly rough.

**SCABROUS** Rough to the touch due to short stiff hairs or the structure of the epidermis.

**SCALARIFORM** Ladder-like.

**SCALE** Any small, thin, usually dry, appressed leaf or bract, often only vestigial.

**SCALLOPED** Crenate.

**SCANDENT** Climbing without aid of tendrils.

**SCAPE** A naked (leafless but scales or bracts may be present) flowering stem or stalk arising from the ground.

**SCAPIFORM** Resembling a scape.

**SCAPOSE** Bearing or resembling a scape.

**SCARIOUS** Membranous, dry, papery, translucent or transparent, not green.

**SCATTERED** Distributed in an irregular manner; not clustered together.

**SCHIZO-** Greek suffix meaning split or divided.

**SCHIZOCARP** A fruit that splits between carpels into one-seeded portions (= mericarps); e.g., in the Apiaceae or Boraginaceae.

**SCIOPHYTE** A plant adapted to grow in or tolerate shade.

**SCIMITAR-SHAPED** With the shape of a curved sword or scimitar.

**SCLERENCHYMA** An internal tissue composed of hard, thick-walled cells.

**SCLERENCHYMATOUS** Having sclerenchyma.

**SCLEROTIC** Hardened; stony in texture.

**SCORPIOID** Uncurling, like a scorpion's tail.

**SCROBICULATE** Marked by minute or shallow depressions.

**SCROTIFORM** Pouch-like.

**SCRUB** Vegetation of stunted or densely crowded bushes.

**SCURFY** With whitish, scaly, blister-like structures or scales on the surface.

**SCUTELLUM** A shield-like protrusion on the calyx; e.g., in some Lamiaceae.

**SECONDARY COMPOUNDS** Naturally occurring plant materials not essential to the primary (= life-sustaining) metabolism of the plant; examples of categories include alkaloids and glycosides. Many are significant because of their physiological activity when given to animals; they are probably important to plants in defense against herbivores or microbes.

**SECOND GLUME** The uppermost of the two glumes of a spikelet.

**SECUND** Directed to one side; arranged on one side only; unilateral; one-sided.

**SEED** A fertilized ripened ovule, covered by a seed coat (developed from the integument(s)) and containing the embryo and in flowering plants the endosperm. The seed also contains the remnants of the nucellus (= sporangium) and megagametophyte.

**SEED COAT** (= Testa) Outer covering of a seed, developed from the integument(s).

**SEEP** A moist spot where underground water comes to or near the surface.

**SEGMENT** One of the parts of a leaf, petal, or calyx that is divided but not truly compound.

**SEGREGATE** Term used as a noun or adjective to refer to or describe a taxon that is sometimes recognized separately from a more inclusive group; e.g., depending on authority, the segregate, *Tovara* (or the segregate genus, *Tovara*), is either included in, or recognized separately from, the more inclusive genus *Polygonum*.

**SELENIFEROUS** Containing selenium.

**SELENIUM** An element that is concentrated in the tissues of some plants (e.g., poison-vetches in genus *Astragalus*) and can cause a toxic, sometimes fatal response in livestock.

**SELF-FERTILE** Capable of self-fertilization (= union of gametes from same plant).

**SELF-INCOMPATIBLE** Incapable of self-fertilization.

**SEMI-** Latin prefix meaning half.

**SEMIPARASITIC** (= Hemiparasitic) Descriptive of a plant that carries out photosynthesis but obtains some of its food, mineral nutrition, or water needs from another living organism (the host).

**SENESCENT** Aging or aged.

**SENSU LATO** "In a broad sense"; used to refer to the broad treatment of taxa; e.g., a genus sensu lato is one that has not been split into a number of segregates.

**SENSU STRICTO** "In a narrow sense"; used to refer to a restricted or narrow treatment of a taxonomic group; e.g., a genus sensu stricto is viewed in a more restricted sense than previously as the result of segregating or splitting out various taxa.

**SEPAL** A single unit of the calyx; one of the outermost whorl of parts in a complete flower. Sepals typically cover the other flower parts during the bud stage; they are collectively referred to as the calyx.

**SEPALOID** Sepal-like, usually green and thicker in texture than a petal.

**SEPARATE** Not joined; of individual units.

**SEPTATE** With partitions or divisions.

**SEPTICIDAL** Descriptive of a capsule that dehisces along or through the septa or partitions separating its locules or seed chambers; contrasting with loculicidal.

**SEPTIFRAGAL** Breaking away at the partitions, as the valves of a capsule.

**SEPTUM** A partition or cross wall within an organ; e.g., the septa of an ovary or of the leaf of a rush (*Juncus*).

**SERiate, SERIAL** With series or distinct rows.

**SERICEOUS** Silky; with appressed, fine, and straight hairs.

**SEROTINOUS** Literally, "late"; in *Salix* indicating those species in which the catkins develop later than the leaves; produced or occurring late in the season.

**SERRATE** With pointed teeth sloping forward; saw-toothed.

**SERRULATE** Finely serrate.

**SESSILE** Without a pedicel, petiole, or stalk; inserted directly.

**SETA** (pl. SETAE) A bristle.

**SETACEOUS** Bristle-like.

**SETIFEROUS** Bearing bristles.

**SETIFORM** Resembling a bristle.

**SETOSE** Bearing bristles.

**SETULOSE** Diminutive of setose.

**SHEATH** (a)  $\pm$  tubular structure surrounding an organ; portion that clasps or encloses; (b) specifically, the basal tubular portion of the leaf in grasses and grass-like plants between the node and the blade.

**SHOOT** (a) A young stem or branch; (b) the ascending axis of a plant.

**SHOULDER** That part of an organ that rather abruptly curves inward.

**SHRUB** A woody perennial usually branching from the base with several main stems.

**SIGMOID** S-shaped; doubly curved.

**SILICA** Silicon dioxide; a white or colorless, very hard, crystalline mineral substance.

**SILICEOUS** Containing or composed of silica (the principal component of glass and sand); e.g., descriptive of certain hairs, with high silica content, that easily break off in the flesh.

**SILICLE, SILICULA** A short silique; short and broad capsular fruit of the mustard family. A silicle is not much longer than broad; sometimes defined as  $< 3$  times as long as broad.

**SILIQUE, SILIQUA** Dry, dehiscent, variously shaped, many-seeded, 2-valved capsule with valves splitting from the bottom and leaving a false partition known as a replum; the fruit type typical of the mustard family. The term is sometimes restricted to long and narrowly cylindrical fruits 3 times as long as broad or longer; shorter fruits with the same structure are then referred to as silicles.

**SILKY** Sericeous; with appressed, fine, and straight hairs.

**SILVERY** With a whitish, metallic, more or less shining luster.

**SIMPLE** (a) Single, of one piece, not compound, as a pistil of one carpel. (b) descriptive of an unbranched stem, inflorescence, or other structure; (c) descriptive of a leaf that is not compound.

**SIMPLE LEAF** Single-bladed leaf, not divided into individual leaflets.

**SIMPLE PISTIL** Pistil composed of only one carpel (and with a single style branch).

**SINUATE, SINUOUS** Having the margin wavy with regular strong indentations.

**SINUS** The space or recess between two lobes, segments, or divisions of a leaf or other expanded organ.

**SLOUGH** A wet place or deep mud or mire; a sluggish channel.

**SMOOTH** Not rough to the touch; without vestiture or other special covering.

**SOBOL** A basal shoot.

**SOBOLIFEROUS** Producing basal shoots, clump-forming.

**SOLITARY** Borne singly.

**SORDID** Dirty white.

**SORUS** (pl. SORI) A cluster or heap of sporangia. The term is used mainly to refer to the sporangial clusters of ferns.

**SPADIX** (pl. SPADICES) Fleishy spike with inconspicuous flowers, usually surrounded or partially enclosed by a spathe; e.g., characteristic of Araceae.

**SPATHACEOUS, SPATHIFORM** Resembling a spathe.

**SPATHE** Enlarged leafy bract surrounding or partially enclosing an inflorescence.

**SPATULATE** Spatula-shaped; rounded above and gradually narrowed to base.

**SPECIES** Unit of classification below the rank of genus; a group of individuals that are actually or potentially capable of interbreeding in natural populations and are reproductively isolated from other such groups. Generally there are morphological characteristics that distinguish and can thus be used to separate such groups; the definition is complicated by instances of asexual reproduction.

**SPECIFIC EPITHET** The second half of the scientific name of a species, the scientific name being composed of the genus name and the specific epithet.

**SPERMATOPHYTE** A plant that produces seeds; all gymnosperms and angiosperms.

**SPHERICAL** Globular; orbicular.

**SPICATE** In spikes or resembling a spike.

**SPICIFORM** Having the form of a spike but not necessarily the technical structure.

**SPIKE** Indeterminate inflorescence with sessile flowers on a  $\pm$  elongate floral axis.

**SPIKELET** The basic unit of the grass inflorescence, usually consisting of a short axis (= rachilla) bearing two empty bracts (= glumes) at the basal nodes and one or more florets above. Each floret usually consists of two bracts (the lemma = lower bract and the palea = upper bract) and a flower. The flower usually includes two lodicules (= vestigial perianth segments that become turgid and open the bracts at flowering time), three stamens, and a pistil. The term spikelet is also used to refer to the basic unit of the inflorescence in the Cyperaceae.

**SPINE** A sharp-pointed structure, usually vascularized and thus  $\pm$  stout or woody, generally modified from part or all of a leaf or stipule. A spine is sometimes distinguished from a thorn, which is a modified branch.

**SPINESCENT** Becoming spine-like; ending in a spine; having spines.

**SPINIFEROUS, SPINOSE** Having spines.

**SPINULOSE** With small spines over the surface, margin, or edge.

**SPIRAL** Describing the arrangement of like organs, such as leaves, at regular angular intervals along an axis.

**SPIRAL THICKENING** Thickening of the walls of a xylem cell laid down in the form of a spiral.

**SPLITTER** A taxonomist who in general has the tendency to split or divide larger taxa into a number of segregates; contrasting with lumpers.

**SPONGIOSE** Soft, spongy.

**SPORADIC** Of irregular occurrence.

**SPORANGIOPHORE** An appendage holding a sporangium.

**SPORANGIUM** (pl. SPORANGIA) A spore case or spore sac.

**SPORE** An asexual, usually one-celled reproductive body; a cell resulting from meiotic cell division in a sporangium representing the first cell of the gametophyte generation.

**SPOROCARP** A specialized structure containing sporangia.

**SPOROPHYLL** Spore-bearing leaf.

**SPOROPHYTE** The spore-producing, typically diploid generation that alternates with the gametophyte (= gamete-producing, typically haploid); the dominant generation in most plants except mosses and liverworts.

**SPREADING** Diverging to the side, almost to the horizontal.

**SPREADING HAIRS** Hairs that are  $\pm$  erect, not at all appressed.

**SPUR** (a) Basal, sac-like, hollow projection, short or long and narrow, from a corolla or calyx, and often containing nectar; (b) a short lateral branch with little internode development resulting in closely clustered leaves or flowers.

**SQUAMA** (pl. SQUAMAE) A scale, usually reduced from and homologous to a leaf.

**SQUAMELLA** (pl. SQUAMELLAE) A tiny or secondary scale.

**SQUAMOSE, SQUAMATE** Covered with scales; scaly.

**SQUAMULOSE** With small scales.

**SQUARROSE** Spreading rigidly at right angles or more; e.g., with leaves or bracts spreading and bending backward abruptly in the upper part.

**STALK** The supporting structure of an organ; e.g., petiole, pedicel, peduncle.

**STAMEN** The male reproductive organ of a flower consisting of a filament (= stalk) and anther (= pollen-bearing structure). The stamens of a flower are collectively referred to as the androecium.

**STAMINAL** Pertaining to a stamen.

**STAMINATE** Referring to a flower with only the stamens being functional or with stamens only.

**STAMINODE, STAMINODIUM** (pl. STAMINODIA) An abortive, sterile, or nonfunctional stamen with reduced anther or usually none. A staminode can be enlarged or widened, sometimes so much so as to be petal-like.

**STANDARD** (a) (= Banner) The usually large, upper (= adaxial) petal of a papilionaceous flower (Fabaceae); (b) the inner erect tepals or perianth segments in *Iris* (Iridaceae).

**STELE** The central vascular cylinder of a plant.

**STELLATE** Star-shaped or star-like; when used in reference to hairs it means those branched hairs with a central stalk and branch hairs arising at the top of the stalk (like points of light coming out of a star).

**STEM** A major division of the plant-body in contrast to root

and leaf, distinguished from both by certain anatomical features and commonly also by general aspect; the main axis or axes of a plant; the portion of the plant axis bearing nodes, leaves, and buds and usually found above ground.

**STERILE** Unproductive; nonfruiting; without functional sex organs; without spores.

**STERIGMA** (pl. STERIGMATA) A very short persistent stipe or stalk.

**STERNOTRIBAL** Descriptive of flowers in which anthers are positioned to dust pollen on underside of thorax of insects.

**STEROID** Any of a large group of lipid soluble organic compounds based on a complex framework of four interconnected rings of carbon atoms. A number of plant glycosides have steroids as the aglycone; these aglycones are often toxic.

**STEROID GLYCOSIDE** A glycoside (two-component molecule) that upon breakdown yields a steroid as the aglycone (= non-sugar component). Cardiac glycosides and some saponic glycosides have steroidal aglycones; these are often poisonous.

**STIGMA** Portion of pistil (usually terminal and small) modified (roughened, sticky, or branched) to catch or receive pollen; the receptive surface of the pistil.

**STIGMATIC** Like or pertaining to a stigma.

**STIPE** (a) In general, a stalk; (b) specifically, the leaf stalk of a fern; (c) specifically, the narrow, stalk-like, basal portion of an ovary or fruit; e.g., in *Cleome*.

**STIPEL** Appendage at the base of a leaflet, analogous to a stipule at base of a leaf.

**STIPELLATE** With stipels.

**STIPITATE** With a stalk or stipe.

**STIPULAR** Pertaining to or located on a stipule.

**STIPULATE** With stipules.

**STIPULE** Paired appendages subtending the petiole of a leaf. Stipules can be conspicuous and persistent, small and rapidly lost, or totally lacking; the evolutionary origin and original function of stipules is unclear. They have become variously modified to serve as spines, additional photosynthetic area, etc.

**STOLON** A creeping horizontal stem that loops or runs along the surface of the ground and roots at the nodes.

**STOLONIFEROUS** Producing stolons.

**STOMA, STOMATE** (pl. STOMATA) A minute opening (= "breathing" pore) between the epidermal cells of a leaf or stem through which gases and water-vapor enter and leave the plant.

**STOMATIFEROUS** Bearing stomata.

**STONE** Bony endocarp of a drupe.

**STONE CELLS** (= Grit cells) Individual cells that have become hardened or sclerotic; e.g., in flesh of a pear.

**STRAMINEOUS** Straw-colored.

**STRIATE** With fine longitudinal lines, channels, or ridges.

**STRICT** Very straight, unbranched, upright.

**STRIGILLOSE, STRIGULOSE** Diminutive of strigose.

**STRIGOSE** With sharply bent (at base) but otherwise straight, appressed hairs.

**STROBILUS** (pl. STROBILI) (= Cone) A usually cone-like, globose or cylindrical structure involved in reproduction and composed of an axis with a spiral, usually dense aggregation of sporophylls, bracts, or scales (these bearing spores, pollen, or seeds).

**STROPHILOLATE** Having a strophiole.

**STROPHIOLE** On certain seeds, an appendage to the hilum.

**STRUMOSE** Descriptive of the surface of an organ bearing cushion-like swellings.

**STYLE** Portion of pistil between ovary and stigma, often elongated and narrow, frequently branched with the number of branches often indicative of the number of carpels making up the pistil.

**STYLOPODIUM** Enlarged base of style as in many Apiaceae.

**SUB-** Latin prefix meaning almost, somewhat, of inferior rank, beneath.

**SUBAPICAL** Almost at the apex.

**SUBBASAL** Almost at the base.

**SUBCLASS** The unit, category, or rank in classification between class and order, composed of one or more orders; e.g., the Liliidae is a subclass of class Monocotyledonae.

**SUBCORIACEOUS** Somewhat leathery in texture.

**SUBEROSE** Corky in texture.

**SUBFAMILY** The unit, category, or rank in classification between family and genus, composed of one or more genera.

**SUBGENUS** A unit, category, or rank in classification between genus and species, composed of one or more species.

**SUBORDER** The unit, category, or rank in classification between order and family, composed of one or more families.

**SUBMERGED, SUBMERSED** (= Immersed) Growing under water.

**SUBSESSILE** Almost sessile.

**SUBSPECIES** A unit, category, or rank in classification below the level of species and between species and variety; a geographically distinct variant. The categories of subspecies and variety are not used consistently by taxonomists.

**SUBTEND** To be present just below; e.g., an involucre of bracts immediately subtends the flowers of some Malvaceae.

**SUBTERRANEAN** Below ground.

**SUBULATE** (= Awl-shaped) Tapering from the base to a slender or stiff point; narrow and sharp-pointed.

**SUCCULENT** Fleshy, thickened.

**SUCKER** A shoot of subterranean origin. Many tree species have sucker shoots with leaves atypical for the species (e.g., oaks).

**SUFFRUTESCENT, SUFFRUTICOSE** Woody only at base with the upper parts herbaceous and annual; obscurely shrubby or fruticose.

**SULCATE** Grooved or furrowed longitudinally.

**SULCUS** A furrow or groove.

**SUPERIOR OVARY** One that is separate from the other flower parts. The other flower parts may over-top it but are attached at or under its base; a superior ovary is found in either a hypogynous or a perigynous flower.

**SUPINE** Laying flat with face upward.

**SUPRA-, SUPER-** Latin prefix meaning above.

**SUPRAMEIAL** Above the middle; when used to refer to the location of fern sori, it means somewhat beyond the middle of the distance between the leaf segment midvein and margin, but not so much so as to be called submarginal.

**SUPPRESSED** Failing to develop.

**SURCULOSE** Producing suckers or shoots arising from underground parts.

**SURCURRENT** Extending upward; said of a pinnule whose base extends upward and forms a wing along the rachis; opposite

of decurrent.

**SUSPENDED** Hanging downward.

**SUTURE** A line of dehiscence or a longitudinal seam.

**SWALE** A moist meadowy area lower than the surrounding areas.

**SWAMP** Wet or periodically wet area with some trees.

**SYM-**, Greek prefix meaning with or together.

**SYMMETRICAL** Possessing one or more planes of symmetry; regular in number and size of parts.

**SYMPATRIC** Growing together with or having the same range as.

**SYMPETALOUS** (= Gamopetalous) With petals united, at least basally, forming a tube.

**SYMPODIAL** With the main axis or stem ceasing to elongate but growth being continued by the lateral branches.

**SYMPODIUM** An apparent main axis formed of successive secondary axes, each of which represents one fork of a dichotomy, the other being much weaker or entirely suppressed.

**SYN-** Greek prefix meaning united.

**SYNCARP** (= Multiple fruit) Used to refer to a structure composed of several more or less coalescent fruits from separate flowers; e.g., *Morus* (mulberry), *Maclura* (bois d'arc), *Ananas* (pineapple).

**SYNCARPOUS** (a) Having carpels united; (b) of or pertaining to a syncarp.

**SYNCONIUM** The multiple, hollow "fruit" of a fig (*Ficus*), which is actually an enlarged fleshy branch or receptacle enclosing the inflorescence (with flowers borne inside). Much of the tissue of a fig is morphologically derived from the stem.

**SYNGENESIOUS** With anthers united into a tube surrounding the style. This condition is typical of Asteraceae.

**SYNSEPALOUS** (= Gamosepalous) With sepals united, at least basally, forming a tube.

**SYNONYM** A currently unaccepted scientific name for a taxon.

**SYNONYMY** Referring to the series of names no longer used for a taxon.

**SYSTEMATICS** Scientific study of the kinds and diversity of living organisms and of the relationships between them. The term is often used synonymously with taxonomy.

## T

**TANNIN** A type of phenol (= aromatic alcohol) that can act as a digestion inhibitor by binding up proteins and thus stopping enzymatic action. They are widespread in plants apparently as a chemical defense against herbivores; used by humans to tan leather; when ingested in quantity they can be toxic to animals.

**TAPROOT, TAPROOTED** The primary descending root, giving off small laterals but not dividing; the one dominant root markedly larger than the others.

**TAWNY** Dull brownish-yellow; fulvous.

**TAXON** (pl. TAXA) (a) General term referring to any unit of classification such as variety, subspecies, species, genus, family, etc.; (b) term used to refer to a specific variety, subspecies, etc.

**TAXONOMY** The branch of science that deals with classification, identification, and nomenclature.

**TEETH** (plural of tooth) Marginal projections, protuberances,

serrations, or dentations, usually sharply pointed.

**TENDRIL** A slender twining or coiling appendage or axis that enables plants to climb; often a modified leaf or stem.

**TEPAL** Part of a perianth, usually of a perianth consisting of only one whorl, or of one not differentiated into sepals and petals; a part of the outermost whorl or whorls of flower parts.

**TERATOLOGICAL** Distinctly abnormal; malformed.

**TERETE** Rounded or circular in cross-section, cylindrical.

**TERMINAL** At the tip or apex; distal.

**TERMINAL BUD** (= Apical bud) Bud at the end (= apex) of a stem or branch.

**TERNATE, TERNARY** In threes.

**TERPENES, TERPENOIDS** Common organic compounds in plants that are products of acetate metabolism. Numerous kinds are known resulting from variations in the use of 5-carbon isoprene units in their structures; they are often combined with other substances to form complex molecules; essential oils, saponins, some resins, latex, carotenoid pigments, and steroids are examples of compounds that are terpene derivatives.

**TERRESTRIAL** Growing in the ground; supported by soil; contrasting with aquatic.

**TESTA** (= Seed coat) The outer covering of a seed; hardened mature integument(s).

**TETRA-** Greek prefix referring to four.

**TETRAD** A group of four similar objects; e.g., in Ericaceae, the four pollen grains remaining together.

**TETRADYNAMOUS** With four long stamens and two short stamens.

**TETRAGONAL, TETRAGONOUS** Four-angled.

**TETRAHEDAL** Four-sided, as a three-sided pyramid and its base.

**TETRAMEROUS** (= 4-merous) Having flower parts in fours or multiples of four.

**TETRAPLOID** With four sets of chromosomes; twice the normal diploid level.

**THALLOID** Consisting of a thallus; thallus-like.

**THALLOPHYTES** Algae and fungi.

**THALLUS** (a) A plant body not differentiated into true leaves, stems, or roots; (b) a flat, leaf-like organ.

**THECA** (= Anther cell) One of the pollen sacs or locules of an anther.

**THORN** A sharp-pointed, stiff, woody structure derived from a modified branch.

**THROAT** The area of juncture of limb and tube in a sympetalous corolla.

**THYRSE** A panicle-like inflorescence consisting of cymes, usually elongate and slender with main axis indeterminate and the lateral axes determinate.

**THYRSOID** With the appearance of a thyrse.

**TOMENLOSE** Covered with short, soft, curly, densely matted or entangled hairs.

**TOMENTULOSE** Diminutive of tomentose.

**TOMENTUM** Densely matted wool.

**TOOTH** (pl. TEETH). Any marginal projection, protuberance, serration, or dentation, usually sharp pointed.

**TOOTHED** With minor projections and indentations alternating along the margin.

**TOPOTYPE** A specimen from the original or type locality of that species or other taxon.

**TOROSE** Alternately contracted and expanded.

**TORTUOUS** Twisted or bent in different directions.

**TORULOSE** Cylindrical with slight constrictions at intervals; necklace-like.

**TORUS** (= Receptacle) Tip of a stem or pedicel, usually more or less enlarged, on which flower parts are attached.

**TOXALBUMIN** Toxic plant proteins; e.g., ricin from *Ricinus*. The term phytotoxin is also often used in this context.

**TRABECULA** A transverse partition or cross-bar.

**TRABECULAR, TRABECULATE** Like or with a partition or cross-bar.

**TRAILING** Prostrate, but not rooting.

**TRANSLATOR** In Asclepiadaceae, the wishbone-shaped combination of the clip (= gland-like corpusculum) and bands (= filament-like retinacula) connecting a pair of pollinia from adjacent anthers.

**TRANSLUCENT** Allowing the passage of light rays, but not transparent.

**TRANSVERSE** Lying or being across or in a cross direction.

**TRAPEZOID** A body with four unequal sides.

**TREE** A woody perennial with usually a solitary trunk or main stem.

**TRI-** Latin prefix indicating three, or three times.

**TRIAD** In threes.

**TRIBE** The unit, category, or rank in classification between subfamily and genus, composed of one or more genera.

**TRICHOME** Any hair, hair-like projection, or bristle from the epidermal surface.

**TRICHOTOMOUS** Forking into three equal parts.

**TRICOLPATE** Three-grooved; e.g., a three-grooved pollen grain.

**TRIFID** Three-cleft.

**TRIFOLIATE** Having three leaves. The term is often used synonymously with trifoliate.

**TRIFOLIOLATE** Having three leaflets.

**TRIFURCATE** With three prongs; three-forked.

**TRIGONOUS, TRIGONAL** Three-angled.

**TRILOBED, TRILOBATE** Three-lobed.

**TRIMEROUS** Having the parts in threes.

**TRIMORPHIC** Of three forms.

**TRINERVED** With three primary nerves; triple-nerved; usually with a midrib and two main lateral nerves arising from the base of the midrib.

**TRIPARTITE** Three-parted.

**TRIQUETROUS** Three-angled in cross-section.

**TRISTICHOUS** In three vertical rows.

**TRULLATE** Trowel-shaped, widest below the middle.

**TRUMPET-SHAPED** Describing a gamopetalous corolla or gamosepalous calyx in which the tube gradually widens upward.

**TRUNCATE** Ending abruptly as if cut off squarely at the end; appearing "chopped off."

**TUBE** The narrow, cylindrical, basal portion of a sympetalous corolla or synsepalous calyx.

**TUBER** Modified underground stem; stem enlarged and subterranean with nodes, buds, and scale leaves, often serving to store food; e.g. in *Solanum* (potato).

**TUBERCLE** (a) A small, tuber-like structure; (b) small rounded protuberance or projection from a surface; (c) the persistent style base in some Cyperaceae.

**TUBERCULATE** Covered with tubercles or warty or nipple-like protuberances.

**TUBERIFEROUS** Bearing tubers.

**TUBEROUS** Bearing tubers or resembling a tuber in appearance.

**TUBULAR** With the shape of a hollow cylinder.

**TUFT; TUFTED** A cluster or fascicle of trichomes, leaves, or other elongate structures.

**TUMID** Swollen; inflated.

**TUNIC** A loose, membranous, outer skin or coat.

**TUNICATE** Describing a bulb in which the leaves are arranged in concentric circles; with coats or tunics.

**TURBINATE** Top-shaped; inversely conical.

**TURGID** Swollen, but solid or full; contrasting with inflated.

**TURION** A scaly swollen structure or offshoot, often serving to overwinter; e.g., in some *Myriophyllum* species the turions store carbohydrates and serve as propagules.

**TWICE-PINNATELY COMPOUND** (= Bipinnate) Descriptive of a leaf with leaflets pinnately arranged on lateral axes that are themselves pinnately arranged on the main axis; with the primary divisions (= pinnae) themselves pinnate.

**TWIG** A young woody stem; the growth of the current season.

**TWO-LIPPED** (= Bilabiate) Descriptive of a corolla (or calyx) of united petals (or sepals) cut on the two sides forming an upper and a lower portion.

**TYPE** A plant specimen to which the name of a taxon is permanently attached. When a new taxon (e.g., species, variety) is named, the name has to be associated with a particular "type" specimen.

## U

**UBIQUITOUS** Occurring everywhere.

**UMBEL** Usually flat-topped or convex inflorescence with flower pedicels all attached at the same point, like the rays of an umbrella; inflorescence type typical of Apiaceae (Umbelliferae).

**UMBELLATE** Umbel-like, or in an umbel.

**UMBELLET** A secondary or ultimate umbel; one of the smaller umbellate flower clusters in a compound umbel.

**UMBELLIFORM** Resembling an umbel in appearance.

**UMBO** A rounded elevation or protuberance at the end of or on the side of a solid organ.

**UMBONATE** With an umbo or projection.

**UNCINATE** With apex hooked; e.g., hairs with a hook at tip.

**UNCINULATE** Minutely uncinat.

**UNDULATE** Gently wavy, less pronounced than sinuate.

**UNGUICULATE** Narrowed at the base into a claw.

**UNI-** Latin prefix meaning one.

**UNIFOLIATE** With only one leaf.

**UNIFOLIOLATE** Referring to a compound leaf reduced to a single leaflet; e.g., in some members of the Fabaceae.

**UNILATERAL** One-sided; developed or hanging on one side.

**UNILOCULAR** Having only one locule or cell.

**UNISERIATE** Arranged in a single horizontal row.

**UNISEXUAL** Having only stamens or only pistils; of only one sex; having flowers either staminate or pistillate.

**UNITED** Fused into one unit.

**URCEOLATE** Urn-shaped or pitcher-like, ovoid or subcylindrical in shape with narrowed top or opening; e.g., corollas in some Ericaceae.

**UTRICLE** (a) A small, bladder-like, one-seeded, usually indehiscent fruit; (b) a small bladder.

## V

**VALVATE** Meeting along the margins only and not overlapping; contrasting with imbricate.

**VALVE** A separable part of a capsule; the units or pieces into which a capsule splits or divides in dehiscing.

**VARIEGATED** Irregularly colored in patches; blotched.

**VARIETY** A unit, category, or rank in classification below the level of species, sometimes treated as a subdivision of subspecies; group of plants with minor characters or differences separating them from other similar plants. The terms variety and subspecies are used inconsistently by taxonomists.

**VASCULAR** Pertaining to the conducting tissues (xylem and phloem).

**VASCULAR BUNDLE** Thread-like fiber of xylem and phloem in a stem or other organ.

**VASCULAR CAMBIUM** The thin layer of delicate rapidly dividing cells that form wood internally and bark externally; also known as cambium.

**VEGETATIVE ORGAN** Root, stem, leaf, or other non-reproductive organ of a plant.

**VEIN** Strand or bundle of vascular tissue.

**VEINLET** A little or ultimate vein.

**VELAMEN** A thin sheath or covering; e.g., on orchid roots.

**VELAMENTOUS** With a thin sheath or covering.

**VELUM** Thin flap of tissue.

**VELUTINOUS** Velvety with numerous erect hairs.

**VENATION** The pattern or arrangement of veins.

**VENTRAL** Situated on or pertaining to the adaxial side (= side toward axis) of an organ; typically the upper or inner surface; contrasting with dorsal.

**VENTRICOSE** (= Gibbous) Swollen or inflated on one side.

**VERMIFORM** Worm-like.

**VERMILLION** Scarlet; brilliant red.

**VERNAL** Appearing in spring.

**VERNATION** The arrangement of leaves, sepals, or petals in the unopened bud.

**VERRUPOSE** Covered with wart-like protuberances.

**VERRULOSE** Diminutive of verrucose.

**VERSATILE** Attached near the middle and often capable of swinging about the attachment point, typically referring to attachment of an anther to a filament; contrasting with either basifixed or dorsifixed.

**VERTICIL** (= Whorl) A whorl of three or more members or parts attached at the same node of the supporting axis.

**VERTICILLASTER** A false whorl composed of pairs of opposite cymes; e.g., in some Lamiaceae.

**VERTICILLATE** (= Whorled) With three or more leaves or flowers attached at the same node; in a circle or ring.

**VESPERTINE** Opening in the evening; e.g., night-blooming *Cereus* (Cactaceae).

**VESICLE** A small cavity or bladder.

**VESSEL** Water conducting structure of the xylem, formed from the walls of a series of dead xylem cells stacked end to end.

**VESTIGIAL** Reduced to a trace, rudiment, or vestige; degenerate; referring to a once more fully developed structure.

**VESTURE, VESTITURE** Any covering on a surface making it other than glabrous; e.g., hairs, scales.

**VEXILLUM** The standard or banner in papilionaceous flowers.

**VILLOSULOUS** Diminutive of villous.

**VILLOUS, VILLOSE** With long, soft, spreading, or ascending, unattached hairs; shaggy.

**VINE** A plant that climbs by tendrils or other means, or that trails or creeps along the ground.

**VIRGATE** Wand-shaped; slender, straight, and erect.

**VISCID, VISCOUS** Sticky; with sticky surfaces formed by secretions; glutinous.

**VISCIDULOUS** Slightly viscid.

**VIVIPAROUS** Germinating or sprouting from seed or bud while attached to the parent plant.

**VOLUBLE** Twining.

## W

**w** West.

**WAIF** A species that is only fleetingly established and probably not permanently naturalized.

**WEED** (a) A plant growing where it is not wanted; (b) a plant with the genetic endowment to inhabit and thrive in places of continual disturbance, most especially in areas that are repeatedly affected by the activities of humankind.

**WHORL, WHORLED** (= Verticillate) With three or more leaves or flowers attached at the same node; in a circle or ring.

**WIDE** (= Broad) Distance across a structure (equal to diameter if tubular).

**WING** (a) A thin, membranous or flat extension or projection; (b) the two lateral separate petals in some Fabaceae and Polygalaceae.

**WINTER ANNUAL** An annual plant (the total life cycle taking one year or less) vegetatively persistent through the winter, and flowering and fruiting in the late winter or early spring.

**WOOLLY** (= Lanate) With long, soft, and more or less matted or entangled hairs; wool-like.

**WORT** An old word of Anglo-Saxon origin meaning the equivalent of herbaceous plant.

## X

**XERIC** Characterized by or pertaining to conditions of scanty moisture supply; dry.

**XERO-** Greek prefix signifying dry.

**XEROPHYTE** A plant that can subsist with a small amount of moisture, such as a desert plant; contrasting with hydrophyte and mesophyte.

**XEROPHYTIC** Dry-adapted; drought resistant; contrasting with mesophytic and hydrophytic.

**XYLEM** Water conducting tissue.

## Z

**ZYGOMORPHIC** Referring to a flower or other structure with only one plane of symmetry; divisible into halves in one plane only; bilaterally symmetrical; e.g., with the left half a mirror image of the right; contrasting with both actinomorphic and irregular.

**ZYGOTE** Cell produced from fertilization or the union of two gametes; a fertilized egg.

