FabaceaeCPea family

Acacia L.

acacia

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Growth habit, occurrence, and use. The acacias include about 1,200 species of deciduous or evergreen trees and shrubs widely distributed in the tropics and warmer temperate areas (Guinet and Vassal 1978). Nearly 300 species are found in Australia and about 70 in the United States. Some 75 species are of known economic value, and about 50 of these are cultivated. Certain species of acaciasC*A. karroo* Hayne, *A. baileyana* F. Muell, *A. pycnantha* Benth., and othersCrank among the most beautiful of all flowering trees, and many have been planted in the warmer regions of the United States (Menninger 1962, 1964; Neal 1965). Acacias produce many benefits: collectively they yield lumber, face veneer, furniture wood, fuelwood, and tannin; and such products as gum arabic, resins, medicine, fibers, perfumes, and dyes; some are useful for reclamation of sand dunes and mine spoils, and for shelterbelts, agroforestry hedgerows, and forage; and some serve as a host for the valuable lac insect (ACTI 1980; Prasad and Dhuria 1989; Turnbull 1986). They are valuable not only to the forest but also to pastures and agricultural crops for the nitrogen that is fixed in their root nodules (Hansen and others 1988).

Green wattle, introduced to Hawaii about 1890, has been declared noxious for state land leases (Haselwood and Motter 1966). A fast-growing tree of no local value, it spreads rapidly by seeds and root suckers, crowding out other plants. More than 90 years ago, Maiden (1908) commented on the pestiferous nature of several varieties of this species in Australia. Only acacia species that do not spread by suckering should be selected for planting. Also to be avoided under most circumstances are the thorny acaciasCsuch as sweet acacia and gum arabic treeCwhich are widely dispersed rangeland pests. These 2 species are know to exert allelopathic effects on plants growing near them (Hampton and Singh 1979; Singh and Lakshminarayana 1992). Reliable seed data are available on 8 species (table 1), all of which grow naturally or are widely planted in the United States or associated territories.

Flowering and fruiting. Acacia flowers are perfect or polygamous; most of them are yellow, some are white. They usually appear in the spring or summer. The fruit is a 2-valved or indehiscent legume (pod) that opens in the late summer. The 1 or more kidney-shaped seeds (figure 1) that develop per fruit are usually released by the splitting of the legume. The seeds contain no endosperm (figure 2). Acacias begin bearing seeds between 2 to 4 years of age

(Atchison 1948; Turnbull 1986). There are good seed crops nearly every year and seed production can be quite high. Individual trees in a mangium plantation were reported to produce 1 kg (2.2 lbs) of seeds (about 100,000 seeds) annually (ACTI 1983). Seeding habits of 8 acacias are listed in table 2.

Collection, cleaning, and storage. Ripe acacia legumes are usually brown. They can be picked from the trees, or fallen legumes and seeds can be collected from underneath the trees. Collections from the ground may include legumes more than a year old. Seeds can be extracted by hammermilling, trampling, or placing the legumes in a cloth bag and flailing it against the floor. Seeds are sometimes separated by feeding the legumes to cattle and collecting the seeds from the manure (NFTA 1992). Blowers and shakers will remove legume fragments and debris satisfactorily for most species. The weights of cleaned seeds for 8 species are listed in table 3 (Goor and Barney 1968; Letourneux 1957; Mangini and Tulstrup 1955; Salazar 1989; Turnbull 1986; Whitesell 1964, 1974). Seeds of blackwood collected and cleaned in Uruguay had a purity of 93% (Whitesell 1974).

Acacia seeds are among the most durable of forest seeds and need not be kept in sealed containers, although it is still advisable to do so. If kept in a cool, dry place, the seeds of most acacia species will germinate after many years of storage. For example, 63% of green wattle seeds germinated after 17 years in storage (Atchinson 1948). Seeds of blackwood, which were air-dried to a constant weight and then stored in sealed containers, retained viability unimpaired for at least 3 months; seeds stored in the open still retained 12% viability after 51 years (Whitesell 1974). Koa seeds lying on the ground are known to have retained their ability to germinate for as long as 25 years (Judd 1920).

Pre-germination treatments. The seeds of most species have hard coats that cause poor germination unless they are first scarified by briefly treating them with sulfuric acid or soaking in hot water (Gunn 1990; Kumar and Purkayastha 1972; Natarajan and Rai 1988; Rana and Nautiyal 1989). Hot water treatment is the most practical. The seeds are placed in hot or boiling water, the source of heat removed, and the seeds allowed to soak for 3 minutes to 24 hours (Clemens and others 1977). Blackwood seeds subjected to 90 to 100 ˚C water for 3 minutes and than stratified at 4 ˚C for 4 to 6 weeks germinated at a rate of over 98% and grew 25% faster than control seedlings in the first 3 months (De Zwaan 1978). Some species also appear to require 2 to 4 months of "after-ripening" in dry storage before good germination may be obtained (Whitesell 1974). Germination is epigeal.

Germination testing. Prescriptions for official testing for acacias call for clipping, nicking, or filing through the seedcoats and soaking in water for 3 hours, or soaking seeds in concentrated sulfuric acid for 1 hour, then rinsing thoroughly (ISTA 1993). Germination should then be tested on moist blotter paper at alternating 20/30 ˚C or constant 20 ˚C for 21 days. Germination tests of acacias can also be made in flats with sand or soil. Results of tests for 8 species of acacias are given in table 4.

Nursery and field practice. After proper pretreatment, the small-seeded acacias should be covered with 6 to 12 mm (1/4 to 2 in) of soil. Optimum sowing depth for sweet acacia seeds was found to be 2 cm (: in) (Scifres 1974). A 2:1 mixture of soil and sand proved to be a better germination medium for gum arabic tree than other mixtures of soil, sand, and manure (Bahuguna and Pyare 1990). The use of sawdust in germination mixtures was found to inhibit the

germination of mangium (Newman 1989b). Sowing is done in spring in the warm temperate zone of the United States mainland and year-round in tropical areas, except during dry periods. Earleaf acacia can be grown from cuttings treated with indole acetic acid (IAA) with a high degree of success (Huang 1989). Seedlings of mangium and earleaf acacia inoculated with *Bradyrhizobium* and *Rhizobium* bacterial strains nodulated, but only the *Bradyrhizobium* strains fixed nitrogen (Galiana and others 1990). Blackwood is preferably outplanted as small 1.25-cm (6/10-in) stumps lifted from a seedbed 1 year after planting (Parry 1956) or as transplanted seedling 20 to 25 cm (7.8 to 9.8 in) high (Streets 1962). The best survival for koa planted in Hawaii is obtained with potted seedlings. Mangium is usually planted as potted (plastic nursery bags, or polybags) seedlings but may be planted bareroot (Webb and others 1984). Container seedlings 20 cm (7.8 in) high were recommended for earleaf acacia (Wiersum and Ramlan 1982). Plantable seedlings of gum arabic tree were produced in India by planting pretreated seeds in May in polybags containing a nursery mixture in full sun and fertilizing them twice (Kumar and Gupta 1990). The use of straw mulch increased the emergence of direct-seeded sweet acacia in old fields (Vora and others 1988).

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Table 1C*Acacia,* acacia: nomenclature, occurrence, and height

Scientific name & synonym(s)	Common names	Occurrence		Height at maturity (m)
		Native	US	
***A. auriculiformis* A. Cunningham ex Benth.**	**earleaf acacia**	Australia	Florida & Puerto Rico	12B30
***A. decurrens* Willd.** *A. decurrens* var. *normalis* Benth.	**green wattle**, black wattle, Sidney black wattle	Australia	California & Hawaii	8B18
***A. farnesiana* (L.) Willd.** *Vachellia farnesiana* (L.) Wright & Arn.	**sweet acacia**, huisache, aroma	France & Italy	S US, Puerto Rico, & Virgin Islands	3B5
***A. koa* Gray**	**koa**	Hawaii	Hawaii	24B34
***A. mangium* Willd.** *Mangium montanum* Rumph.	**mangium**	Indonesia, New Guinea, & Australia	Hawaii & Puerto Rico	12B30
***A. mearnsii* de Wildeman** *A. decurrens* var. *mollis* Lindl.	**black wattle,** green wattle, black wattle	Australia	California & Hawaii	15
***A. melanoxylon* R. Br. ex Ait. f.**	**blackwood**, Australian black wood, Tasmanian blackwood, black acacia, Sally wattle	Australia	California & Hawaii	24B36
***A. nilotica* (L.) Willd. ex Delile** *A. arabica* (Lam.) Willd. *Mimosa nilotica* L.	**gum arabic tree,** Egyptian thorn, red heat	Asia & Africa	Puerto Rico & Virgin Islands	3B20

Sources: Anderson (1968), Barrett (1956), Fagg (1992), Muñoz (1959), Parrotta (1992), Turnbull (1987), Whitesell (1974).

Table 2C *Acacia*, acacia: phenology of flowering, fruit ripening, and seed dispersal

Species	Location	Flowering dates	Fruit ripening dates	Dispersal dates
A. auriculiformis	Florida	MarBApr	JunBJul	AugBDec
A. decurrens	California	FebBMar		
A. farnesiana	Puerto Rico	NovBFeb	MarBSep	MarBDec
A. koa	Hawaii	JanBJul	Jun-Jul	Feb; JunBNov
A. mangium	Puerto Rico	C	Mar-Apr	MayBAug
A. mearnsii	California	Jun & later	JunBOct	JunBOct
A. melanoxylon	California	FebBJun	JulBNov	JulBDec or later
	Hawaii	MayBJun		
A. nilotica	Puerto Rico	Almost continuously	All year	All year

Sources: Parrotta (1992), Turnbull (1986), Whitesell (1974).

Table 3C*Acacia*, acacia: pod and seed data

Species	Legume size (cm) Length	Width	No. of cleaned seeds/wt /kg	/lb
A. auriculiformis	5B10	1.3	30,000B158,000	14,000B72,000
A. decurrens	10	C	53,000B88,000	26,000B40,000
A. farnesiana	4B7	2.0	7,600B13,000	3,000B6,000
A. koa	3B6	1.5B2.5	5,300B16,300	2,000B7,000
A. mangium	3B12	1.3	80,000B110,000	36,000B50,000
A. mearnsii	5B8	C	33,000B74,000	15,000B34,000
A. melanoxylon	4B13	1.0	44,000B88,000	20,000B40,000
A. nilotica	5B15	0.8B1.6	5,000B16,000	2,000B7,000

Sources: ACTI (1983), Fagg (1992), Goor (1968), Letourneux (1957), Magini and Tulstrup (1955), NFTA (1987a,b), Salazar (1989), Turnbull (1986), Whitesell (1974).

Table 4C*Acacia,* accacia: pregermination treatments, germination test conditions, and results

Species	Seed source	Pretreatment	Germination test conditions			
			Medium	Temp. (°C)	Duration (days)	Germination (%)
A. auriculiformis	Puerto Rico	None	Soil	C	21	56
	Puerto Rico	Hot water	Soil	C	14	30
	Java	Warm water	Soil	C	85	C
A. decurrens	C	C	C	C	C	74
A. farnesiana	Puerto Rico	Abrasian	Paper	79	30	56
A. koa	Hawaii	Hot water	Soil	C	30	18
A. mangium	Australia	Hot water	C	C	10	80
A. mearnsii	C	C	Soil	60	14	72
A. melanoxylon	Tasmania	Hot water	Paper	77	60	70
	Tasmania	Hot water	Paper	77	30	74
	Victoria	Hot water	Paper	77	90	93
	Uruguay	None	C	C	30	4
	Uruguay	H_2SO_4	C	68	21	48
	Uruguay	Abrasion	C	68	28	26
	C	C	Soil	C	15	52
A. nilotica	C	Hot water	C	75	85	C
		Hot water	Soil	C	30	74

Sources: ACTI (1983), Francis and Rodríguez (1993), Newman (1989a), Parrotta (1992), Webb and others (1984), Whitesell (1974).


Acacia decurrens