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D. TAXUS

TAXUS L., Sp. Pl. 1040. 1753. Type species: T. baccata L., Sp. Pl., 1040. 1753.
[ILLUSTRATION FOR FIGURE 5 OMITTED]

Dioecious (except for T. canadensis Marsh.) trees or shrubs 3-9 m, rarely to 25 m tall; bark scaly, red-brown, purple-brown or chestnut-brown; branches irregularly arranged, erect or spreading; branchlets slender, yellow-green or olive green to red-orange or orange-brown, the second-year shoots often remaining green, at least in part; winter buds ovoid, conical or ohovoid, 1.5-3 mm long, the apex acute or obtuse, often 2-4-angled at the apex, the scales imbricate, usually persistent [mostly deciduous in T. chinensis (Pilg.) Rehder)], thickened and slightly to strongly keeled especially toward the apex. Leaves persistent (3-)4 years, usually pectinate and 2-ranked, leathery, linear, abruptly narrowed at the petiole, 2-4.5 cm x 1-3 mm, acuminate to cuspidate or almost mucronate-apiculate, dark green to yellow-green on upper surface, petiole distinct, 1-2 mm long, widening into a broad decurrent base; dark green to yellow-green on upper surface, midrib usually prominently raised on the upper surface, sometimes also raised on the lower surface, with or without cuticular papillae, the stomatal bands each about twice the width of the margin, 0.2-1 mm wide, pale green or yellow-green, resin ducts lacking.

Pollen strobili simple, solitary, subsessile, the peduncles to 1 mm long, axillary on first-year branchlets, globose before expansion then short oblong-cylindrical, 2.5 mm diam. when closed, 4 x 2 mm at pollen release, green, yellow-green, or yellow; sterile scales all basal, ca. 10; microsporophylls 6-14, perisporangiate, radially symmetrical, peltate, each bearing 4-9 microsporangia.

Ovules solitary or occasionally paired in the axils of bracts on short branchlets or stalks which themselves are axillary on the first-, second- or occasionally third-year branchlet, sessile, subtending scales about 12-20, decussate, ovate to flabellate, concave, membranous, often rugose, nearly enclosed at maturity by the aril; arils open at the apex, 5-10 x 5-7 mm, green when young, sometimes remaining so, becoming orange or usually bright scarlet red at maturity; seeds hard, ovoid, 5-7 x 4-5 mm, becoming 2-4-angled at the apex, the hilum slightly depressed, ovate, triangular or square. Chromosome number, n = 12.

Taxus is a genus of 12 species (including two artificial hybrid species) distributed mainly in the Northern Hemisphere [ILLUSTRATION FOR FIGURE 6 OMITTED]. It is a taxonomically troublesome genus because of the variability and overlapping nature of the limited number of morphological features that are used to distinguish species. The genus might also be considered monospecific with clear-cut geographical subspecies as Pilger (1926) and others have treated it. It is convenient here, as in most treatments, to recognize the taxa at the specific level, although identification based on morphological characters is uncertain.

The species of Taxus occupy distinct geographical regions of the world, with four species in North America, one in Europe, and the remainder native to Southeast Asia (Fig. 6). The species ranges do not overlap except in Southeast Asia where, depending on taxonomic interpretation, there are at least four species present. The most widespread of the Asian species, T. chinensis (Pilg.) Rehder, is endemic to China, occurring mainly in the central and southern provinces. Cheng et al. (1978) have accepted two varieties, T. chinensis var. chinensis, which has papillae on the midrib of the abaxial surface of the leaf, and T. chinensis var. mairei (Lemee & A. Leveille) W. C. Cheng & L. K. Fu, which lacks papillae. These are the same taxa that Hu (1964)

earlier recognized as species. Taxus chinensis var. mairei has been collected in every province that the typical variety has, but is also found farther south and east in the provinces of Jiangxi (Kiangsi), Zhejiang (Chekiang), Guangdong (Kwantung), Fujian (Fukien), and Taiwan. Taxus wallichiana Zucc., principally of the eastern Himalayas and southern Tibet, in the wider sense, extends to western China (Yunnan province), the Philippines, and Celebes. Cheng and Fu (Cheng et al., 1975) have described T. yunnancrisis from the Yunnan Province, and Li (1963, 1975) proposed T. celebica (Warb.) Li from the Celebes. However, Laubenfels (1978) merged T. celebica into T. sumatrana (Miq.) Laubenf., which he described from the high elevations of the Philippines, Celebes, and Sumatra. This Southeast Asian complex needs further collecting and systematic study.

Bud scales and leaf apices, features traditionally used to separate taxa, are variable and the differences slight, as is seen in Figure 7. Presence or absence of papillae on the lower surface of the leaves and variability in the persistence of the bud scales are two other features that have been used with limited success in the analyses of taxa in Southeast Asia (Cheng et al., 1978; Ferguson, 1978; Hu, 1964). Differences in stomatal band width and stomate density among several species have been reported (Nicolosi & Lineberger, 1982). Pollen morphology and leaf chemistry have not produced reliable characters (Baxter et al., 1958; Graf et al., 1958; Jones & Lynn, 1933; Nicolosi & Lineberger, 1982; Xi, 1986a).

Taxus differs from Torreya in its obviously alternate leaves and open red aril; from Pseudotaxus by its red aril, lack of sterile scales among the microsporophylls, and fewer scales subtending the ovule; from Austrotaxus by its simple pollen strobili and smaller leaves; and from Amentotaxus by its alternate leaves and simple, axillary pollen strobili. It is distinguished from Cephalotaxus by its shorter, alternate leaves and open, red aril.

The microsporangia of Taxus, as with Pseudotaxus, are distinctive among conifers in that they are radial (as opposed to being positioned only abaxially on the sporangiophore), which has led Wilde (1975) to suggest that the pollen strobilus is a reduced lateral one. The leaves of Taxus are distinctive because of the expanded, papillose subsidiary cells of stomata being amphicyclic as in Austrotaxus and resin canals lacking as in Pseudotaxus and Austrotaxus (Florin, 1948c). Cyanogenic glycosides probably contribute greatly to the toxicity of Taxus plant parts. Other biflavonoid compounds of the amentoflavone series, including sciadopitysin, have unknown effects (Khan et al., 1976; Ma et al., 1985; Morelli, 1976).

The compound in Taxus with the greatest current significance for man is a cancer cell-inhibiting, oxygen-rich diterpene called taxol. First isolated in the late 1960s (Wani et al., 1971) from the bark of T. brevifolia Nutt., it was available in short supply because six trees, each 100 years old, were required for the treatment of a single patient - a quantity that posed an immediate threat to the prosperity of this northwestern North American endemic. However, with the discovery oftaxol precursors in related species, especially T. baccata, and in 1994 the development of the capability to completely synthesize taxol (Nicolaou et al., 1994c; Holten et al., 1994), the future of T. brevifolia became more secure. Further work by chemists continues to yield many derivative compounds, called taxoids, that are now commonly used in chemotherapy treatments for many types of cancer (Nicolaou et al., 1996).

The identification of Taxus species is nearly impossible in cultivation, where the most reliable information, native geographical distribution, is unavailable. Yew is a popular and useful ornamental plant that is easily propagated, resulting in an abundance of named cultivars, most of which cannot be identified without comparing the plants side by side.

The yew is planted for a variety of horticultural purposes and is particularly popular as a planting

next to buildings and as hedges живая изгородь. This is true despite the fact that foliage and seeds are poisonous to some animals and humans and that the dark green foliage can cast a somber atmosphere to a planting site if these shrubs are planted in great abundance (Brown & Hull, 1951; Graf et al., 1958). The pulp of the juicy aril is sweet and edible and can be used in jams, as long as the toxic seed is removed. Several authors have discussed cultivar growth habit, identification, and nomenclature, and have attempted comprehensive compilations of cultivars (Bailey, 1933; Chadwick, 1951; Chadwick & Keen, 1976; Cope, 1986; Cope & Vance, 1991; Dallimore, 1908; Den Ouden & Boom, 1965; Hatfield, 1921; Krussmann, 1979, 1983, 1985; Rehder, 1940; Wyman 1964). An excellent yew collection, now nearly 50 years old, of various cultivars from seven species of Taxus is maintained at Secrest Arboretum, Wooster, Ohio. The Taxus cultivars most commonly cultivated in the United States and Canada include T. baccata 'Fastiglata' and 'Repandens'; T. cuspidata 'Capitata', 'Green Wave', 'Nana', and 'Thayerae'; and T. x media 'Brownii', 'Densiformis', 'Hatfieldii', 'Henryi', 'Hicksii', 'Hill', 'Nigra', 'Runyan', Sebian, and 'Wardii' (Cope & Vance, 1991). These and other, less common cultivars are listed in the Appendix according to growth rate, habit, and color.

1. Species Not in Cultivation

TAXUS GLOBOSA Schldl., Linnaea 12: 496. 1838.

T. baccata L. subsp. globosa (Schldl.) Pilg. in Engl., Pflanzenr. 4:114. 1903.

T. mexicana Senills, Pinaceae: 174. 1866.

T. SUMATRANA (Miq.) Laubenf., Kalikasan 7:117-152. 1978.

Cephalotaxus sumatrana Miq., Flor. Ned. Ind. 2: 1076. 1859. Taxus celebica (Warb.) H. L. Li, Woody Fl. Taiwan: 34. 1963. Cephalotaxus celebica Warb., Monsunia 1: 194. 1900.

T. WALLICHIANA Zucc., Abh. Math-Phys. Cl. Konigl. Bayr. Akad. Wiss. Munch. 3: 803. 1843.

T. baccata L. subsp. wallichiana (Zucc.) Pilg. in Engl., Pflanzenr. 18: 112. 1903.

T. YUNNANENSIS W. C. Cheng & L. K. Fu in W. C. Cheng et al., Acta Phytotax. Sin. 13: 86-87. 1975.

2. Representative Specimens

Taxus globosa. EL SALVADOR: Chalatenango, J. M. Tucker 1073 (BH, A). HONDURAS: Yoja, Santa Barbara Mrs., 21 Mar 1949, A. J. Chable s.n. (A). GUATEMALA: El Progress, J. K. Steyermark 43487 (A). MEXICO: Oaxaca, Tetillan, 11 Dec 1907, C. Conzattis. n. (A); Tamaulipas, Gomez Farias, A. J. Sharp et al. 50178 (A); Nuevo Leon, El Cerado, Puertos, C. J. Mueller & K. Mueller 1337 (A); Hildalgo, Aqua Blanca, Dec 1945, M. Martinez s. n. (A); Hildalgo, Barranca, C. G. Pringle 10808.

T. sumatrana. PHILIPPINES: Luzon, Mt. Banaho, D. J. de Laubenfels P668 (A); Luzon, Mt. Panai, January 1948, M.D. Sulits. n. (A); Bengiut, M. S. Clemens 17112 (A); TAIWAN: Tai Shu Shan, D. J. de Laubenfels P670 (A), P671 (GH).

T. wallichiana. CHINA: Sichuan, Mt. Omei, W K. Hu 8176 (A), T. C. Lee 3237 (A), W. P. Tang 18420 (A). BURMA: F. K. Ward 9375 (A). NEPAL: Khola, 5 Aug 1983, H. Ohba et al. s.n. (A).

INDIA: Dharmsala, Dhamkat, R. R. Stewurt 1938 (BH).

T. yunnanensis. CHINA: Yunnan, Xieniupindi, Anonymous 0227 (A); Shangchung, Anonymous 0419 (A); Champu-tung, C. W. Wang 67414 (A); Yanghi-xian, B. Bartholomew et al. 388 (A).

TAXUS BACCATA L., Sp. Pl. 1040. 1753. Common names: English yew, common yew.

Tree 12-20 m tall or densely branched shrub; bark scaly, flaky, red-brown to purple-brown; branchlets all green or all brown or mixed, first-year shoots always green; buds ovoid, almost globose, the scales persistent, only slightly keeled, obtuse. Leaves directed slightly forward along the shoot, 2-3(-4.5) cm x 3 mm, upper surface dark green, the lower surface yellow-green; petiole short, yellow-green, apex acuminate to acuminate-cuspidate, midrib prominent on upper surface. Arils 1 or 2 on a shoot, 1 cm x 6 mm, bright red; seeds ellipsoid, 6-7 x 5 mm, green-brown to brown, usually 2-angled or flattened at the apex.

A native of northern and middle Europe and the Mediterranean area (Asia minor, Caucasia, North Africa), English yew is cultivated extensively in Europe, North America, and, to some extent, Asia, North Africa, and Australia. The English yew has a long history of cultivation, having been grown by the Druids and nearly always present around ancient cemeteries and churches. Historically the wood of English yew has been used for furniture and bows. Horticulturally, it continues to be used for a variety of purposes, but most often as hedges and plantings next to buildings. Zone 5.

Representative specimens: HUNGARY: S. Javorka 935 (BH). UNITED STATES (CULTIVATED): Virginia, Williamsburg, d. T. Baldwin 12194 (BH); New York, Chatauqua Co., Brocton, J. F. Cornman 15 (BH); Massachusetts, Jamaica Plain, S. Elsik et al. 872 (BH), 6119 (BH).

TAXUS BREVIFOLIA Nutt., N. Amer. Sylva 3:86.1849. Common names: Pacific yew, western yew.

T. baccata L. var. brevifolia Koehne, Deut. Dendrol.: 6. 1893. T. baccata L. subsp. brevifolia Pilg. in Engl., Pflanzenr. 4: 113. 1903. T. bourcier Carriere, Rev. Hort. 4: 228. 1854. T. lindleyana Lawson ex Carriere, Traite Gen. Conif.: 523. 1855. T. lindleyana A. Murr., Edinburgh New Philos. J., ser. 2, 1: 294. 1855.

Tree 5-25 m tall with slightly pendulous branches; bark scaly, dark red-brown; branchlets yellow-green to light brown, first-year shoots green; buds ovoid, the scales persistent but loose, sometimes yellow-brown. Leaves loosely spaced on the shoot, distinctly 2-ranked, 1.2-1.8 cm x 1-2 mm; light green on upper and lower surfaces, petiole yellow-green, sometimes longer than in other species, apex cuspidate, midrib raised on upper surface. Arils ovoid, 1 cm x 6-7 mm, scarlet; seeds ovoid, 5-6 mm long, 2-4 angled.

A native of western North America, British Columbia to California and Montana, Pacific yew was introduced into cultivation in Britain in 1854. It is planted there and in North America mostly in botanical gardens as specimen plantings. Zone 5.

Representative specimens: UNITED STATES: California, Trinity Co., L. S. Rose 55089 (BH); Idaho, Latah Co., W. C. Muenscher 13 (BH). UNITED STATES (CULTIVATED): New York, Tompkins Co., 23 Aug 1983, J. Appling s.n. (BH); Ohio, Hunting Valley, 12 Dec 1942, E. D. MacDonald s. n. (BH).

TAXUS CANADENSIS Marshall, Arbust. Amer. 151. 1785. Common names: Canada yew, American yew, ground-hemlock.

T. baccata L. subsp. canadensis Pilg. in Engl., Pflanzenr. 4: 113. 1903. T. minor Britton, Mem. Torrey Bot. Club 5: 19. 1893. T. baccata L. vat. minor Michaux, Fl. Bor.-Amer. 2: 245. 1803. T. baccata L. vat. procumbens Loudon, Arbor. et Frutic. Brit. 4: 2067. 1838.

Monoecious or dioecious shrub to 2 m tall, with many ascending branches, the main stems often prostrate and rooting; bark scaly, brown; branchlets red-brown, the tips drooping slightly, first-year shoots green; buds ovoid or conical, green, small, the scales persistent, greater in number than the other species, keeled, acute or obtuse. Leaves crowded in a flat plane forming a deep V along the shoot, shorter near tips of the branchlets, 1-2 cm x 1-2 mm, light or dull green on upper surface, yellow-green on lower surface, sometimes becoming slightly red or purple in the winter sun, petiole 0.5-1 mm long; apex more cuspidate than acuminate, midrib inconspicuously raised on upper surface. Arils globose or subglobose, 6-8 x 6 mm, orange to scarlet; seeds ovoid, 5 x 4 mm, mostly 2-angled at the apex.

A native of eastern United States and Canada, south to Virginia, west to Manitoba and Iowa, this yew is cultivated occasionally in North America as a low cover or specimen planting. Outside North America it is typically found only in botanical gardens. Taxus canadensis is reported to be monoecious in most floras and manuals, but this has not been substantiated by examination of herbarium specimens. This species was introduced into cultivation in Britain in 1800. Zone 3.

Representative specimens: UNITED STATES: New York, Cortland Co., A. J.. Eames 5447 (BH); Maine, Piscataquis Co., M. L. Fernald 297 (BH). UNITED STATES (CULTIVATED): New York, Monroe Co., 19 Aug 1917, L. H. Bailey s.n. (BH); Wellesley, Mass., 8 Aug 1932, L. H. Bailey s. n. (BH).

TAXUS CHINENSIS (Pilg.) Rehder, J. Arnold Arbor. 1: 51. 1919. Common name: Chinese yew.

T. baccata L. subsp. cuspidata (Siebold & Zucc.) Pilg. vat. chinensis Pilg. in Engl., Pflanzenr. 18: 112-113. 1903.

T. cuspidata Siebold & Zucc. var. chinensis Rehder & E. Wilson, Sarg., Pl. Wilson. 2: 8. 1914.

T. chinensis (Pilg.) Rehder var. mairei (Lemee & A. Leveille) W. C. Cheng & L. K. Fu in W. C. Cheng, L. K. Fu & C. D. Chu in W. C. Cheng & L. K. Fu, eds., Fl. Rep. Pop. Sinicae, Gymnosperms, Tom. 7: 443-445. 1978.

T. mairei (Lemee & A. Leveille.) S. Y. Hu ex Liu, Ill. Nat. Lign. Pl. Taiwan 1: 16. 1960.

T. speciosa Florin, Acta Horti Berg. 14: 382-383. 1948.

Tsuga mairei Lemee & A. Leveille, Monde Pl. II, 16: 20. 1914.

Tree to 15 m tall, in cultivation a wide shrub; bark red-brown to red-orange or sometimes gray; branchlets yellow-green to light brown, first-year shoots green; buds smaller than in T. baccata, the scales mostly deciduous or only partly persistent, thickened toward the base, rounded or only slightly keeled. Leaves sparse on the shoots, some curving backward, 1.2-3 cm x 2-3 mm, upper surface dark green, the lower surface gray-green to yellow-green, petiole short, yellow to yellow-green, apex abruptly acute, acute or acuminate, midrib inconspicuously raised on upper surface.

Arils globose or subglobose, 4-7 mm diam., red or sometimes remaining green; seeds ovoid, 4-6 x 4 mm, 2-4-angled at the apex.

An endemic of China and Taiwan, Chinese yew is rarely cultivated in North America as a specimen planting or near buildings but is cultivated more frequently in Europe and presumably also in its native land. It was introduced into cultivation in Britain in 1908. Zone 6.

Representative specimens: CHINA: Jiangxi, R. C. Ching 5976 (A); Fujian, H. H. Chung 3581 (A); Zhejiang, R. C. Ching 2489 (A), S. Chen 1063 (A); Sichnan, W. K. Hu 8542 (BH), W. P. Fung 3796 (A). UNITED STATES (CULTIVATED): New York, Long Island, 18 Apr 1932, L. H. Bailey s.n. (BH); Massachusetts, Jamaica Plain, Arnold Arboretum, 25 Nov 1921, C. M. Merrill s.n. (BH).

TAXUS CUSPIDATA Siebold & Zucc., Fl. Japonic. Fam. Naturales 2: 108. 1846. Common name: Japanese yew.

T. baccata L. var. cuspidata Carriere, Traite Gen. Conif., ed. 2. 733. 1867.

T. baccata L. subsp. cuspidata Pilg. in Engl., Pflanzenr. 4: 112. 1903.

T. sieboldii hort.

T. cuspidata vat. capitata hort.

Tree to 20 m tall, but mostly a shrub in cultivation; bark scaly, red-brown to dark brown; branchlets brown, first-year shoots yellow-green; buds oblong to ovoid, the scales persistent, keeled, tending to be acute. Leaves vertically arranged along the shoot forming an irregular V-shaped trough; 1.5-2.5 cm x 1.5-2.5 mm, upper surface dark or dull green, the lower surface yellow-green, petiole short, yellow to yellow-green, apex cuspidate, midrib prominent on upper surface, narrow or invisible on lower surface. Arils globose, 1 cm diam., red; seeds ovoid, 6 x 5 mm, mostly 3-4-angled at the apex.

A native of Japan, Korea, and northeastern China, Japanese yew is cultivated commonly and successfully in North America, Europe, and Asia. It was first planted in England in 1862. This popular species is utilized for many horticultural purposes including hedges, specimen plantings, and near buildings. Zone 4.

Representative specimens: JAPAN: Yamoto, 20 Jul 1953, H. Tanaha s.n. (BH); Ohmachi, 27 Aug 1951, K. Uno s.n. (BH). UNITED STATES (CULTIVATED): New York, Tompkins Co., E. A. Cope 528 (BH); Illinois, DeKalb Co., 28 May 1962, J. Tate s.n. (BH).

T. FLORIDANA Nutt., N. Amer. Sylva 3: 92. 1849. Common name: Florida yew.

Tree to 8 m tall or shrub, with crowded, short, spreading branches; bark scaly, purplebrown; branchlets red-brown, first-year and sometimes second-year shoots green; buds ovoid, the scales persistent, rounded or only slightly keeled, obtuse. Leaves forming a V-shaped trough on the shoot, 1.2-2.5 cm x 2-2.5 mm, upper surface dark green, the lower surface light green, petiole green, short, apex cuspidate, midrib obscure. Arils 1 cm x 6 mm, light red; seeds ovoid, 5-7 x 5 mm, usually 2-angled at the apex.

Florida yew is an endangered plant, endemic to the bluffs along the Apalachicola River in Gadsden and Liberty counties in northwestern Florida. It is cultivated only very rarely as

specimen plantings in or near its native region. Zone 7.

Representative specimens: UNITED STATES: Florida, Liberty Co., W. J. Dress & W. Read 7710 (BH), R. F. Thorne & W. C. Muenscher 2623 (BH); Florida, Gadded Co., 26 Apr 1936, L. H. MacDaniels s.n. (BH). UNITED STATES (CULTIVATED): Florida, Leon Co., E. A. Cope 927 (BH).

TAXUS x HUNNEWELLIANA Rehder (T. cuspidata Siebold & Zucc. x T. canadensis Marshall), J. Arnold Arbor., 6: 201. 1925. Common name: Hunnewell yew.

Shrubs with dense ascending branches or with vigorous growth and spreading branches; bark red-brown; branchlets brown, first-year shoots green', buds ovoid, the scales persistent, and less keeled than T. cuspidata, acute. Leaves 1-2.5 cm x 1.5-2.5 mm, the base more swollen and generally larger in all dimensions than T. canadensis, upper surface dark green, lower surface yellow-green, petiole short, apex sometimes less cuspirate than in T. cuspidata. Arils globose, 8-10 mm diam., red, ripening later than T. canadensis; seeds ovoid, 5-6 x 4-5 mm, 2-4-angled.

A chance hybrid originating about 1900 in Hunnewell Gardens, Massachusetts, this yew is cultivated mostly in botanical gardens, occasionally offered by nurseries specializing in conifers. Used in specimen plantings. Zone 5.

Representative specimens: UNITED STATES (CULTIVATED): New York, Tompkins Co., Cornell Plantations, E. A. Cope 542 (BH); Massachusetts, Jamaica Plain, Arnold Arboretum, G. P. DeWolf & P. Bruns 2186 (BH), S. Elsik et al. 6122 (BH).

TAXUS xMEDIA Rehder (T. baccata L. x T. cuspidata Siebold & Zucc.), J. Arnold Arbor. 4: 107. 1923. Common names: hybrid yew, Anglo-Japanese yew.

Tree or shrub, often densely branched; bark red-brown to red-orange; branchlets olive-green, often red-brown above, not changing to brown (at least on the more vigorous growth); buds ovoid, the scales persistent, not as strongly keeled as T. cuspidata, obtuse. Leaves spreading distinctly in 2 ranks, 1.5-3 cm x2-3 mm, upper surface green, the lower surface yellow-green, petiole short, yellow to yellow-green, apex cuspidate or cuspidate-acuminate, midrib more raised than in T. baccata. Arils globose, 1 cm long, red; seeds ovoid, 6 x 5 mm, 2-4-angled at the apex.

Taxus x media is a hybrid of the two most commonly cultivated species, T. baccata and T. cuspidata. This hybrid originated in 1900 in the Hunnewell Gardens in Massachusetts and is now planted more than any other yew species in North America. It is also cultivated in Europe. The plants are used extensively in horticultural plantings including hedges, specimen plantings, and plantings next to buildings. Zone 4.

Representative specimens: UNITED STATES (CULTIVATED): New York, Tompkins Co., E. A. Cope 530 (BH), Nov 1979, J. W. Appling 29 (BH); Massachusetts, Jamaica Plain, Arnold Arboretum, R. Warren et al. 551 (BH); Illinois, Cook Co., M. Nee 30082 (BH).

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VI.

Key to the genera of Taxaceae

1. Pollen strobili in racemes; leaves 5-9 mm wide.

2. Leaves opposite; pollen strobili terminal or subterminal; tracheids with spiral thickenings — Amentotaxus

2. Leaves spirally arranged; pollen strobili axillary; tracheids lacking spiral thickenings — Austrotaxus

1. Pollen strobili solitary; leaves [less than]5 mm wide.

3. Arils closed at the apex, concealing the seed; branchlets opposite; leaves lacking elevated midrib on adaxial surface — Torreya

3. Arils open at the apex, revealing the seed; branchlets alternate; leaves with prominent midrib on adaxial (upper) surface.

4. Arils white; pollen strobili with sterile scales; leaves with papillae only at the margins — Pseudotaxus

4. Arils red; pollen strobili lacking sterile scales; leaves with papillae, if present, along the midrib of the abaxial surface — Taxus

3. Cultivated Species

Key to the cultivated species of Taxus

1. Bud scales deciduous; arils 4-7 mm long; rare in cultivation — T. chinensis

1. Bud scales persistent; arils normally [less than]7 mm long.

2. Leaves mostly acuminate; bud scales obtuse, not sharply keeled — T. baccata

2. Leaves cuspidate; bud scales acute, sharply keeled.

3. Plants monoecious; arils globose or subglobose, 6-8 mm diam — T. canadensis

3. Plants dioecious; arils ovoid or ellipsoid, usually 13 mm diam.

4. Plants endemic to small region in Florida, rare in cultivation; leaves often widely spaced on the branchlets — T. floridana

4. Plants native to northwestern North America or Asia or common in cultivation; leaves mostly close together on the branchlets.

5. Leaves 2-ranked, flat and forming a V-trough on

upper side of branchlet; native to northwestern North America, infrequently cultivated — T. brevifolia

5. Leaves scattered along branchlet and lacking V-trough on upper side of branchlet; native to Asia and commonly cultivated — T. cuspidata and its hybrids, T. x hunnewelliana and T. x media

1. Leaves 3-9 cm long.

2. Leaves falcate, to 9 cm long, the spiny tip [less than]0.5 mm; megagametophyte ruminate — T. jackii

2. Leaves straight, [less than]6.5 cm long, the spiny tip to 2 mm long; megagametophyte smooth or only slightly ruminate — T. californica

1. Leaves mostly [less than]3 cm long.

3. Megagametophyte deeply ruminate; leaves with 2 longitudinal grooves on upper surface, spines at leaf tips usually [less than]1 mm long — T. fargesii

3. Megagametophyte smooth or only slightly ruminate; leaves lacking longitudinal grooves (if present, extending only 1/3 of the distance toward tip) on upper surface, spines at leaf tips usually at least 1.5 mm long.

4. Stomatal bands scarcely impressed on lower leaf surface; extremely rare; hardy only to Zone 8 — T. taxifolia

4. Stomatal bands impressed on lower leaf surface; less rare; hardy at least to Zone 6.

5. Branchlets dark red-brown or brown by the third year; spines at leaf tips usually 2 mm long — T. nucifera

5. Branchlets light-colored or only gray by the third year; spines at leaf tips usually 1.5 mm long — T. grandis