Abies balsamea (L.) Mill.

Abietaceae
Balsam Fir, Balm of Gilead Tree, Canada Balsam

Uses

The balsam or pitch, in extreme emergency, forms a highly concentrated, though disagreeable, food (Fernald, Kinsey, and Rollins, 1958). Bark of conifers, mostly, was so important in the diet of some tribes that at least one tribe, the Adirondacks, owe their name to the Mohawk term for "tree eaters." Erika Gaertner devotes a four-page article to the making of breadstuff from the bark of balsam fir. In contrast to pine bark, the fir bark is a delight to chew in winter or early spring, slightly mucilaginous and sweetish, better raw than cooked (Gaertner, 1970). Inner bark that does not show any discoloration can be used for breadstuff and it takes about an hour to peel enough for one loaf. Leaves average 0.65% essential oil, ranging to 1.4% or higher. Trunks also yield oil of "Canada balsam" or turpentine, used as a permanent mounting medium in microscopy and as a cement for glassware. Canada turpentine yields 15–25% volatile oil, the resin being used for caulking and incense (Erichsen-Brown, 1979). Often used for Christmas trees. *Abies* species are commercially valuable for timber even though their wood is relatively soft, weak, and perishable. Balsam fir is used in the US for timber and plywood, and is the mainstay of the pulp wood industry in the northeast.

Folk Medicine

According to Hartwell (1967–1971), the buds, resin, and/or sap are used in folk remedies for cancers, corns, and warts. Reported to be anodyne, antiseptic, diaphoretic, diuretic, masticatory, and vulnerary, balsam fir is a folk remedy for bronchitis, burns, cancer, catarrh, cold, consumption, cough, dysentery, earache, gleet, gonorrhea, heart ailments, leucorrhea, paralysis, rheumatism, scurvy, sores, ulcers, urogenital ailments, warts, and wounds (Duke and Wain, 1981; Erichsen-Brown, 1979). Chippewa used the gum as an analgetic, the root decoction as an antirheumatic. Kwakiutl used the gum as a laxative and held the root in the mouth to cure sores there. Menominee used the gum for colds, cuts, lungs, and sores, the inner bark for chest pains, colds, and skin. Montagnai applied the gum for chest or heart pain. Ojibwa use the gum for colds, sores, sore eyes, and venereal diseases; the leaves as stimulant; Penobscot used the gum for cuts and sores; Pillagers used the needles in sweat baths and fumitories. Potawatomi used the gum for colds and sores, the bark infusion for consumption and other ailments. Caughnawaga used the gum as a cataplasm for cancer (Duke, 1983c).

Chemistry

Reducing sugars are said to account for 47% of the DM of balsam fir bark. The leaf oil contains 17.6% bornyl acetate and probably 1-α-pinene, Canada balsam contains ca 20% 1-β-phellandrene and smaller quantities of α- and β-pinene bornyl acetate, and the alcohols androl and bupleurol (Guenther, 1948-1952). Oils are also reported to contain juvabione and dehydrojuvabione (List and Horhammer, 1969–1979). The term Canada Balsam is a misnomer because balsams are supposed to contain benzoic and cinnamic acids, both absent from the Canada oleoresin. "Turpentine" is also a misnomer, implying that the oleoresin is entirely steam volatile. Actually it contains 70–80% resin, only 16-20% voaltile oil (Anderson, 1955). One analysis of the essential oils reports 14.6% bornyl acetate, 36.1% β-pinene, 11.1% 3-carene, 11.1% limonene, 6.8% camphene, and 8.4% α-pinene (Erichsen-Brown, 1979).

Toxicity

Canada balsam is reported to produce dermatitis when applied as perfume. The foliage has also induced contact dermatitis.

Description

Tree to 20 m tall; trunk 3–5 dm in diameter. Bark brown, broken into scaly plates with resin-filled pockets. Twigs pale green and pubescent when young, becoming gray, reddish, or purplish. Leaves dark green, linear, sessile, spiral in origin, but twisted at base to form two ranks; leaves persisting many years; leaf-scars circular. Lower leaves to 3 cm long, those on coniferous branches much shorter. Winter buds globose, 3–6 mm in diameter, with orange-green scales, resinous. Mature cones nearly cylindrical, 3–8.5 cm long by 2–3 cm thick, dark purple when growing. Bracts ovate, the distinct awn protruding beyond the scale below it. Seeds ovoid

or oblong, acute at base, with thin wing and resinous vesicles, maturing in one summer. Germination phanerocotylar (Brown and Brown, 1972).

Germplasm

Reported from the North American Center of Diversity, balsam fir, or cvs thereof, is reported to tolerate frost and slope. ($2n = 24$)

Distribution

Labrador and Newfoundland south to New York and Pennsylvania, west to central-Wisconsin and Minnesota, north and west to Alberta; generally south of 55°N latitude, except in Alberta and Saskatchewan (Ag. Handbook 450, 1974).

Ecology

Estimated to range from Cool Temperate Moist to Wet through Boreal Moist to Wet Forest Life Zones, balsam fir is estimated to tolerate annual precipitation of 6 to 15 dm, annual temperature of 5 to 12°C, and pH of 4.5 to 7.5. Female strobili may be wholly or partially aborted up to 6 to 8 weeks after bud burst by late spring frosts. Pollen dispersal can be reduced by adverse weather (Ag. Handbook No. 450)

Cultivation

Flowering in May, fruiting August-September; seeds are dispersed in late September. Extensive data on seed vitality etc. are reported in Agriculture Handbook No. 450. Seeds should be moist stratified 14–28 days at 1–5°C. Seed may be sown in autumn without stratification, with target seedling densities in the nursery ca 450–500/m^2, often mulched with sawdust. Of slow initial growth, the stock is usually out planted as 2- to 3-year-old seedlings or 3- to 4-year-old transplants (Ag. Handbook 450, 1974).

Harvesting

"Turpentine" is usually collected July-August by breaking the turpentine blisters into small metal cans with sharp-pointed lids. Trees are then allowed to recuperate 1–2 years. For the leaf oil, it would appear that branches should be snipped off younger trees in early spring (January-March).

Yields and Economics

Fifteen year old trees yield 70% more leaf oil than 110-year-old trees; oil yields are highest in January–March and September, lowest from April to August. Around 1800, one author reported averaging nearly a ton of balsam at "6 pence a lb." (Erichsen-Brown, 1979).

Energy

According to the phytomass files (Duke, 1981b), annual productivity ranges from 9 to 13 MT/ha, standing biomass from 77–200 MT/ha. Gaertner cites references dealing with the potential use of bark for fuel, as charcoal or briquets.

Biotic Factors

The following are listed as affecting *Abies balsamea*: Acanthostigma parasiticum, *Adelopus nudus, Aleurodiscus abietis, A. amorphus, Armillaria mellea, Ascocalyx abietis, Bifusella faulii, B. linearis, Cenangium ferruginosum, Cephalosporium* sp., *Coniophora puteana, Corticium galactinum, Coryne sarcoides, Cryptosporium macrospermum, Cyptospora pinastri, Dasyscypha agassizii, D. arida, D. calyciformis, D. calycina, D. resinaria, Dermea balsamea, Dimerosporium balsamicola, Echinodontium tinctorium, Flammula alnicola, Fomes pini, F. pinicola, F. robustus, F. roseus, F. subroseus, Fusicoccum abietinum, Gloeosporium balsameae, Herpotrichia nigra, Hyalopsora aspidiotus, Hydnum balsameum, Hymenochaete tabacina, H. mirabilis, H. nervata, H. punctata, Lenzites saepiaria, Leucostoma kunzei, Limacina alaskensis, Lophodermium autumnale, L. lacerum, L. piceae, Melampsora abieti-capraearum, M. epitea, Melampsorella caryophyllacearum, M. cerastii, Merulius himantoides, Micropera abietis, Milesina fructuosa, M. laeviuscula, M. marginalis, M. polypodophila, M. pycnograndis, M. vogesiaca, Nectria cucurbitula, Nothophacidium abietinellum, Odontia bicolor, Ophionectria scolecospora, Peniophora gigantea, Peridermium balsameum, Phacidium abietinellum, P. abietis, P. balsameae, P. infestans, Phaeocryptopus nudus, Phaeophacidium abietinum, Polyporus abietinus, P. anceps, P. balsameus, P. circinatus, P. fragilis, P.*

guttulatus, P. hirtus, P. mollis, P. resinosus, P. schweinitzii, P. tomentosus, Poria sericeo-mollis, P. subacida, P. vaporaria, Potebniamyces balsamicola, Pucciniastrum epilobii, P. goeppertianum, P. pustulatum, Rehmiellopsis abietis, R. balsamea, Rhizosphaera pini, Rhizothyrium abietis, Sarcotrochila balsamea, Scoleconectria cucurbitula, Sphaeropsis abietis, Stereum chailletii, S. pini, S. sanguinolentum, Thyronectria balsamea, Trametes heteromorpha, Trichoscyphella resinaria, Tympanis pinastri, Uredinopsis ceratophora, U. longimucronata, U. mirabilis, U. osmundae, U. phegopteris, U. struthiopteridis, Valsa abietis, V. pini (Ag. Handbook 165, 1960; Browne, 1968). Also listed in Browne (1968) are the following: Angiospermae: *Viscum album*; Acarina: *Trisetacus grosmanni*; Coleoptera: *Dryocoetes confusus, Hylobius pales, H. pinicola, H. warreni, Melanophila drummondi, Monochamus scutellatus, Pityokteines sparsus, Pityophthorus cariniceps, P. granulatus, P. puberulus, Polygraphus rufipennis*; Diptera: *Dasyneura balsamicola*; Hemiptera: *Adelges piceae, Aphrophora parallela, Cinara curvipes, Mindarus abietinus, Prociphilus bumeliae*; Hymenoptera: *Camponotus* spp., *Gilpinia hercyniae, Megastigmus specularis, Neodiprion abietis, Pleroneura borealis, Urocerus albicornis, Xeris spectrum*; Lepidoptera: *Acleris variana, Choristoneura fumiferana, Cladaria limitaria, Dasychira plagiata, Dioryctria abietivorella, Hemerocampa leucostigma, Lambdina fiscellaria, Lymantria dispar, Melanolophia imitata, Orgyia antiqua, Protoboarmia porcelaria, Semiothisa granitata, Zeiraphera canadensis*; Aves: *Loxia curvirostra, L. leucoptera*; and Mammalia: *Alces alces, Erethizon dorsatum, Euarctos americanus, Odocoileus virginianus, Peromyscus* sp., *Tamiasciurus hudsonicus*. Seed production may be reduced by squirrels and birds. *Abies* cones are preferred source of food for squirrels in some localities. Large quantities of cones are cut and cached; such cutting may also reduce future cone crops. Cone and seed insects may significantly reduce seed yields and occasionally totally destroy seed crops. Seed chalcids (*Megastigmus* spp.) are most common and may be abundant enough to have a major impact. For example, *Megastigmus pinus* typically infest 8–10% of *A. concolor* seed and have destroyed as much as 60% of a crop. Cone moths (e.g., *Barbara colfaxiana siskiyouana* and *Dioryctria abietivorlla*) and cone maggots (*Earomyia* spp.) cause the most conspicuous damage; all seeds are lost in heavily infested cones. Cone and scale midges cause no significant loss, but seed or gall midges may reduce seed yields by fusing seeds to cone scales (Ag. Handbook 450, 1974). Nematodes reported include *Criconemella* (*Criconemoides*) *lobata, Paratylenchus* sp., *Rotylenchus* sp., *Tylenchorhynchus maximus* and *Xiphinema americana* (Golden, p.c. 1984).

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