EUROPEAN BLACK ALDER: CHARACTERISTICS AND POTENTIAL FOR IMPROVEMENT[1]

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ABSTRACT.--Black alder is potentially useful as an amenity tree under certain planting conditions. This paper presents information on pertinent biological features of the species, a discussion of the potential for genetic improvement, and a brief assessment of the need for additional information.

EUROPEAN BLACK ALDER (*Alnus glutinosa* (L.) Gaertn.) is one of about 30 species of alder found mainly in moist, sunny habitats in the Northern Hemisphere. Black alder is one of the few large, tree-sized members of the genus; most are shrubs or small trees, including all those native to the eastern United States. Unlike most non-legumes, alders are symbiotic with nitrogen-fixing bacteria, and this characteristic plays an important role in the ecology of the species.

In its native range in Europe, Asia, and North Africa, black alder is used as a source of stock for processed wood (pulp, chipboard, etc.) and specialty items such as wooden shoes and clog soles. The species is cultivated ornamentally to a moderate extent in Europe.

Black alder was apparently introduced to North America sometime during the colonial period (Rehder 1940), and it has since become naturalized from Newfoundland south to Delaware and west to Illinois and Michigan (Furlow 1979, Little 1979). Within this region, black alder is cultivated more often than any other species in its genus (Furlow 1979). Most plantings of black alder in the U. S. are for mine spoil reclamation, a use to which the species is particularly suitable because of its rapid growth, ability to fix nitrogen, and tolerance of poor soils and low pH. More recently there has been

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considerable interest in using the species as a nurse crop in interplantings with more valuable species (Dale 1963, Plass 1977) and as a short-rotation fiber crop (Franklin 1978, Phares et al. 1975).

All alders are rather unpretentious in appearance as ornamentals, and specimen plantings of any of the species are uncommon. Black alder is somewhat less handsome than Italian alder (Alnus cordata Desf.), which is also cultivated in the East, but black alder is hardier farther north than Italian alder. Black alder is also fast growing without the brittleness of some other fast-growing species, tolerant of infertile and poorly aerated soils, and reportedly resistant to de-icing salt (Ehrenberg 1979). Dirr (1977) suggests that black alder may be especially useful for difficult, wet sites such as are often found along highways.

The panel members of the second meeting of the Metropolitan Tree Improvement Alliance recommended black alder as one of 15 species that show promise for greater use in municipal street plantings. In my limited experience with the species as a lawn tree, it has drawn very favorable reaction. Although I doubt that the species could or should achieve wide popularity as an ornamental, it certainly deserves more frequent planting in certain situations.

CHARACTERISTICS

Black alder becomes a tree 65 feet or more in height with a conical or oblong crown and a weakly excurrent branching habit. The bark is dark brown and fissured into narrow, irregular ridges becoming scaly or platy with age. Growth is very rapid for the first ten years or so, and annual increments of at least 3 feet in height are easily achieved on favorable sites. Typical life spans under natural conditions range from 80 to 120 years.

The leaves are dark green, toothed, roughly circular in outline, and typically 1.5 to 3 inches long on older trees. They are easily distinguished from those of other alders in the region by a sticky (i.e., "glutinous") coating when young and by the usual presence of a prominent notch at the leaf apex. Black alder leaves remain green until late in the autumn. The "fall color" is an unattractive brown.

The flowers are clustered into inconspicuous, unisexual inflorescences with both sexes present on the same plant. The fruits are tiny, unwinged nutlets (easily mistaken for seeds) borne in interesting woody cones about one-half inch in length. The nutlets are only a minor attraction to some songbirds, such as the goldfinch.

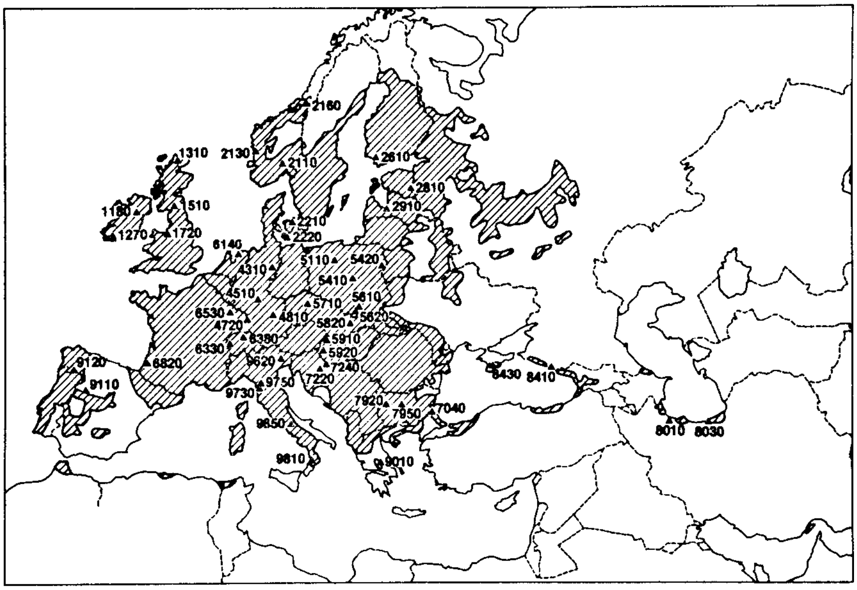

Figure 1.--Natural range of black alder in Europe and Asia, with locations of 48 provenances referred to in the text.

DISTRIBUTION AND OCCURRENCE

Black alder's unusually large natural distribution spans portions of three continents and nearly **30** degrees of latitude (Figure 1). Over most of its range the species inhabits climates that are, by our standards, moderate in both temperature and precipitation. However, in the extreme, black alder grows wild in regions with as little as 20 inches of annual precipitation and with January normal mean temperatures as low as 10°F (similar to the coldest portions of New England and the Upper Midwest). Its distribution in the Old World certainly suggests a greater potential naturalized range than exists in the U. S., but the genetic adaptability of the species is probably limited here by the provenance of the original introductions.

In both Europe and the U. S., natural regeneration is mostly limited to sunny areas on recent alluvia or soils with impeded drainage (Furlow 1979). Black alder prefers a high water table and seldom occurs away from standing or running water except when planted. However, a two-tiered system of shallow (nodule bearing) and deep roots enables it to grow under a range of moisture conditions and survive limited periods of drought (McVean 1956). In Europe the species apparently prefers rich, deep soil but will tolerate poor, compact clays. This is corroborated by experience in the u. s., and indeed the species survives better than most on some of the poorest of mine spoils. It will survive on soils with pH levels as low as 3.0 to 4.0, but our observations at Penn State indicate that optimum pH levels are in the range of 5.5 to 6.5. Growth declines under more alkaline conditions.

PROPAGATION

Sexual maturity is reached as early as three years of age and seed crops are usually fairly heavy. Seeds may be stored dry under refrigerated conditions for up to three years. Germination begins within 10 to 20 days after sowing and is essentially complete two weeks later. The species is suitable for nursery production in containers (Collins 1980), and its fibrous root system permits easy transplantability. White (1981) described controlled pollination procedures for black alder.

Vegetative propagation can be achieved through layering, air layering, rooting of softwood cuttings, and grafting under greenhouse conditions (Suszka 1980). Robison et al. (1979) reported poor success with grafting, but Robison and Hall (1981) routinely achieved better than 50 percent success in rooting softwood cuttings. Garton et al. (1981) described a micropropagation procedure which could be used to produce an estimated 10 million plants from one lateral bud in one year. Black alder does not normally produce root suckers, but the stumps sprout readily.

MAJOR INSECT AND DISEASE PROBLEMS

Stem cankering and dieback appears to be the most serious pathogenic problem of black alder. It is common in plantations in Kentucky and Pennsylvania, where symptoms show up rapidly in the spring after apparently normal growth the previous fall. Boyette and Brenneman (1976) reported dieback of unknown cause (but attributed to winter injury) on black alder in North Carolina; and Maynard and Hall (1981) observed dieback on black alder in Iowa in September of the first growing season after planting.

Oak and Dorset (1983) were able to attribute dieback in two Kentucky plantations to *Phomopsis alnea*. Plant pathologists Barry Towers, Pennsylvania Bureau of Forestry, and William Merrill, Penn State, have isolated both *Phomopsis* and *Cytoswhora* from cankered trees in Pennsylvania. *Phomowsis* and *Cytoswhora* are weak canker pathogens, so it is possible that dieback problems are aggravated by environmental stresses on the trees. Towers (personal communication) believes that dieback in Pennsylvania is generally worse in frost pockets. Dieback first appeared in Penn State's provenance test of black alder after an unusually dry and warm autumn. Dieback in a Kentucky plantation owned by Westvaco was more severe where soil depth to a hardpan was shallowest. However, the two plantations in which Oak and Dorset (1983) observed dieback were on a low, fairly moist site as well as on a much drier hillside.

I have observed rather severe outbreaks of European alder leaf miner (*Fenusa dohrnii*) and Japanese beetle on plantation trees in Pennsylvania. However, Dirr (1977) reported no trouble with foliage insects on black alder in central Illinois. The wooly alder aphid (*Prociphilus tessellatus*) can be periodically serious on the twigs of some trees, but many trees escape. The gypsy moth has not been a problem in our experimental plantations, despite a major infestation of the insect in 1981. According to Ehrenberg (1979), black alder is sensitive to sulfur dioxide injury. Funk (1965) provided a thorough list of insects and fungi that attack black alder.

POTENTIAL FOR GENETIC IMPROVEMENT

There are numerous black alder cultivars in the ornamental trade that differ primarily in their leaf shapes and branching habits. Among them are 'Aurea', 'Laciniata', 'Imperialis', 'Quercifolia', 'Sorbifolia', 'Incisa', 'Rubrinervia', and 'Pyramidalis', as listed by Rehder (1940). Wyman (1965) referred to at least 16 foliage forms selected by Europeans. A survey of the catalogs of several major nurseries indicates that most of these cultivars are not readily available in the United States.

The large natural range of the species suggests the possibility of considerable genetic variation in growth characteristics and climatic adaptability. Genetic improvement objectives in the United States have focused on the use of the species in mine spoil reclamation and fiber yield in pure and in mixed cultures with black alder as a "nurse" crop. Hall *et al.* (1979) reported research in progress to identify optimum combinations of genotypes in the alder/bacteria symbiosis in order to enhance the nitrogen-fixing capabilities of this biological system.

Provenance testing must play an important role in identifying populations of this exotic species that are climatically adapted to the United States. Maynard and Hall (1981) found large differences among 48 provenances (shown in Figure 1) in first-year growth, date of budburst, date of budset and winter injury at two locations in Iowa and Wisconsin. DeWald (1982) and DeWald *et al.* (1983) reported further information on the same 48 provenances grown for two years at three locations in Pennsylvania and New Brunswick, Canada. Their results showed provenance differences in growth rate, branch angle, apical dominance (a measure of "bushiness"), several leaf shape characteristics, phenology, cold tolerance, and Japanese beetle resistance. In general, central European provenances (geographically centered on West Germany) grew best on a moist, fertile site in Pennsylvania: southern European provenances grew relatively better on a droughty mine spoil in Pennsylvania; and Scandinavian and eastern European provenances grew relatively better at the colder New Brunswick location. In an Ohio plantation of 15 provenances, those from West Germany were generally superior in growth rate and survival to those from Belgium, Denmark, and Sweden after 16 growing seasons (Funk 1979).

Such information will point the way for new research by identifying the best regions from which to obtain breeding stock. Provenance hybridization may prove useful in combining the desirable characteristics of different natural populations, and further improvements will be possible through family and clonal selection. In addition, species hybridization offers the possibility of combining characteristics, such as drought tolerance from the more upland Italian alder with cold tolerance from the more northern black alder. Vigorous hybrids have been obtained with *A. cordata*, *A. incana*, and *A. rubra*. The species has also been hybridized with *A. inokumae*, *A. hirsuta*, *A. japonica*, *A. rugosa*, *A. subcordata*, *A. orientalis*, and *A. viridis*. These hybrids broaden the "gene pool" of black alder enormously, and some of them may indeed be useful in adapting black alder to the kinds of sites on which it is normally planted in this country.

NEED FOR ADDITIONAL INFORMATION

The growth capabilities and special ecological characteristics of black alder clearly suggest its wider use as an amenity tree in certain situations. It is also fairly evident that the species is less capable of vigorous, disease-free growth over a range of planting conditions than are some of our more popular ornamentals such as red maple and honeylocust. Unfortunately, it is not possible at this time to prescribe appropriate site conditions for black alder without some amount of uncertainty. Almost all of the published information on the performance of the species in the U. S. concerns its use in reclamation plantings, genetics experiments, and production plantations. We know it will survive better than most species on acid mine spoils, but we do not know how it will do, for example, on compacted or paved fill material in the presence of reflected heat and de-icing salts.

There is probably a good deal of unpublished, anecdotal information available from arborists and other practitioners that would increase our understanding of the usefulness of black alder. The METRIA Species Trials Project would be a useful vehicle for gathering and disseminating such information through questionnaires to members and the METRIA newsletter. To further demonstrate the utility of the species, there is also a need for small trials of black alder in urban areas and along highways. The trials should be established with trees from a few identified provenances or clones selected for their climatic tolerances. A legitimate function of the METRIA Species Trials Project would be to coordinate such plantings and obtain propagules of the desired provenances or clones.

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