

Sophora japonica: AN URBAN HARDY SPECIES
WITH POTENTIAL FOR GENETIC IMPROVEMENT

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ABSTRACT. --Sophora japonica, the Japanese pagodatree, is a valuable, late-flowering ornamental tree that has proven tolerant of urban conditions around the world. A native of China and Korea, it has not been studied extensively from a tree improvement standpoint. However, it is well known that the species possesses a tremendous range of genetic variability that is largely untapped. This combination of urban hardiness and a wide range of genetic variation suggests this tree deserves further study to develop desirable forms for streetside and park use.

Sophora japonica IS A VALUABLE URBAN TREE species, not only because of its outstanding ornamental features, but also because it has been proven urban hardy in major cities around the world. The scientific name for the genus, Sophora, is the common name most frequently associated with this tree, but others include Japanese pagodatree and scholar-tree.

The compound, glossy-green leaves of Sophora japonica are retained longer than those of most other species and maintain an attractive appearance throughout the growing season. The large, creamy-white, pea-like flower clusters are borne late in summer, a time when few other trees are in bloom, and are present an unusually long time, sometimes a month or more.

Sophora japonica is native to China and Korea, not Japan, as the name might lead one to expect. An-ci Sun¹ reports that it is very common in a loess plateau area north of Peking where

¹Ms. An-ci Sun, Botanical Institute of Peking, Peking, China.

it is exposed to a dry, cool and windy climate.

Although Sophora japonica is only beginning to gain popularity in this country, it has proven itself as an ornamental over thousands of years of use and in major cities around the world. More than 1000 years before the birth of Christ (Li 1963) the Chinese used this species as an amenity tree, and it has been planted around temples in Japan for centuries (Wyman 1965). The species was introduced in the United Kingdom about 1747, probably by D'Incarville (Gorer 1976). Since that time the species has been successfully grown in several Dutch cities in Rome, Peking, New York, Washington, Cleveland, Philadelphia, and Denver. In the greater New York City area, it has done well on many types of sites, including open areas, tree lawns, tree pits and containers.

In view of the cosmopolitan use this species has received, one might be surprised to see it included in a discussion of little-used tree species. Although the species has been tested and a demand for its use is developing, little has been done to develop cultivars of this species or to improve it genetically.

GENETIC VARIATION

There is no doubt that considerable genetic variability exists within Sophora japonica. William Flemmer¹ suggests that it is one of the more variable of all tree species and reports that one seedlot can produce trees ranging from a weeping-dwarf to a vigorous, broad-headed tree. Other authors have reported a great deal of variation within the species in cold hardiness and growth habit (Dirr 1983). Various references (Dirr 1983, Hillier 1974, Rehder 1940) indicate that there are at least seven varieties and cultivars of the species (Table 1).

This extensive genetic variation has gone largely untapped. Nursery catalogs indicate that although many firms supply Sophora japonica, only one cultivar is suitable for street tree use in this country; that is the 'Regent' cultivar developed by Princeton Nurseries. 'Regent' grows more rapidly and straighter than the species, it flowers at an earlier age, and it has a more uniform and compact growth habit than the species. To date, this cultivar has performed well under a variety of circumstances, but we must be careful not to overplant this one genotype.

Mr. Flemmer has suggested that future plant selection work on Sophora japonica concentrate on developing a more upright growth habit, greater winter hardiness and flowers with a purple color. As in any type of plant selection work, this will require

¹Mr. William Flemer III, Princeton Nurseries, Princeton, NJ.

Table 1, Cultivars and varieties of Sophora japonica.

<u>Cultivar/Variety</u>	<u>Characteristics</u>
'Columnaris'	Narrow pyramidal habit
'Fastigiata'	Upright growth habit
'Pendula'	Weeping form, seldom flowers, height of 12 to 15 ft.
<u>pubescens</u>	Pubescent leaves, flowers tinged with lilac; soft pubescent beneath
'Regent'	Selected by Princeton Nurseries for uniform habit, faster growth, straighter trunk, flowers at a younger age, resistant to leafhoppers, sold as grafted stock
<u>variegata</u>	Variegated leaves
'Violacea'	Flowers later than the species, wing and keel are stained with rose-violet color

reliable methods for propagation of plant material.

PROPAGATION

When Sophora japonica trees are grown from seed, they generally do not flower until nearly mature -- sometimes as late as 25-30 years (Main0 and Howard 1972). This makes sexual propagation a long-term project. However 'Regent' scholar-tree flowers at a much earlier age and presumably other selected genotypes could also be chosen, in part, for early flowering.

Sophora japonica flowers are borne late in the growing season; the second half of July and early August in the New York City area. They are perfect and insect pollinated. If controlled crosses are to be attempted, they will require development of an appropriate emasculation procedure as well as isolation of female flower parts. Seed set does not occur when Sophora japonica is grown in northern regions of this country. We occasionally get seed set in the New York City area but generally not north of there.

If seed is produced, it matures in the fall and seed pods may

remain on the trees into winter. Like those of other legumes, seeds of Sophora japonica require treatment to break their impervious seed coat. Various references recommend scarification, soaking in acid or hot water (Wait 1977, Weiner 1975). Dirr (1983) reports that reasonably good germination can be obtained without such treatment if seeds are planted shortly after they are collected. It is recommended that Sophora japonica seeds be planted in flats of sandy moist soil in a heated greenhouse during March.

Sophora japonica has been successfully vegetatively propagated by a variety of methods, including softwood cuttings, grafting and layering. The most common cultivar, 'Regent', is grafted, but Frank Santamour¹ has suggested it may be susceptible to latent graft incompatibility.

ENVIRONMENTAL TOLERANCES

Wyman (1977) classified this species as hardy in Arnold Arboretum hardiness zone number 4, but others suggest it is less hardy when young (Dirr 1983) or grown on acid or wet soil (Flemer, personal communication). Sophora japonica tolerates drought and heat once it is established (Isaeva 1973, Koller and Dirr 1979) but does best on well-drained soils and will not tolerate prolonged wet soil conditions. The species shows moderate to good salt tolerance (Townsend 1980) and ozone tolerance (Karnosky and Myers, 1982). William Collins² has rated soil compaction tolerance as moderate.

Sophora japonica has a fibrous root system and is reported to be relatively easy to plant. It can be moved either in fall or spring but some references recommend planting small material (Dirr 1983). As one might expect for a species from a dry area, the root system of Sophora is reported to be unusually deep (Maino and Howard 1972). William Flemer has recommended that their root system be dug deeper than is normally done for other species.

INSECTS, DISEASES, AND ENVIRONMENTAL STRESSES

Sophora japonica is relatively pest-free. However, there are two common problems: a canker caused by Fusarium lateritium and a twig blight caused by Nectria cinnabarina or Diplodia sophorae. These problems do not normally kill the trees but can severely disfigure them. Occasional scale infestations by Icerya purchasi and Coccus elongatus have been reported (Pirone 1972).

¹Dr. Frank Santamour, Jr., U.S. National Arboretum, Washington, DC.

²Mr. William Collins, formerly of Cole Nursery Company, Circleville, Ohio.

In the New York City area, we have noted some mortality of Sophora japonica planted in poorly drained tree pits. Potato leafhoppers occasionally kill young stems or cause witches'-broomstoform.

DRAWBACKS

One of the main drawbacks of Sophora japonica is stain caused by the prolific flowers. Complaints from irate owners of cars that have been stained by these flowers are not uncommon. The fruits are also somewhat messy. These two problems seem relatively minor, however, at least for the northeastern U.S. Another minor cultural problem is that Sophora japonica seedlings must be continually "headed-up" in the nursery to develop upright trees with branching habits suitable for street-side use.

ONGOING RESEARCH

There is very little active research relating to the arboricultural use or genetic improvement of Sophora japonica. Dr. Frank Santamour at the National Arboretum is doing some basic genetic work with the Sophora genus. He reports that Sophora japonica is a diploid with $2n=28$ chromosomes. He suggests that interspecific hybridization of Sophora japonica with other "Sophora" species may be hindered by differences in base numbers of chromosomes. We are unaware of any other additional research but it is not unlikely that additional selections of Sophora japonica are being tested in the nursery trade.

This would seem to be an auspicious time to select new Sophora cultivars and introduce them to the nursery trade. The combination of a developing demand for the species, its proven performance record and the limited choice of available cultivars should make the development of several new cultivars worthwhile. Additional provenance and progeny testing of this species should prove extremely worthwhile.

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