Flowering, Fertility, and Fruit Production in an Intersubgeneric *Alnus* Hybrid

Frank S. Santamour, Jr.¹

U.S. National Arboretum, Agricultural Research Service, U.S. Department of Agriculture, 3501 New York Avenue, Northeast, Washington, DC 20002

Additional index words. alder, breeding, inheritance

Interspecific hybrids between taxa that vary significantly in the season of flowering and/or flower bud formation may flower at times that preclude the development of viable seed or render the plants virtually fruitless. While the lack of fruit or seed production was not a desirable outcome of such hybridizations in *Ulmus* (Santamour, 1989) or *Ilex* (Santamour and Eisenbeiss, 1991), our program has endeavored to develop new types of alders (*Alnus*) for landscape planting. The hard, woody female catkins of alders may persist on the trees over winter, or even longer, and when abundant, they can appear messy. Furthermore, when the catkins finally fall, they may constitute a litter problem on lawns or sidewalks.

The ≈30 species of the genus *Alnus* can be classified into distinct subgenera on the bases of seasonal timing of catkin production and flowering (Furrow, 1979). Most of the temperate-zone, tree-type alders [e.g., *A. glutinosa* (L.) Gaertn.] belong to subg. *Alnus* and produce staminate and pistillate catkins during the latter part of the growing season, before anthesis. Species of subg. *Alnobetula* (Ehrhart) Paternmann are mostly shrubby (e.g., *A. pendula* Maxim.), and although they develop staminate catkins in the season before flowering, the pistillate catkins are formed on new shoots that emerge during the flowering season. I wanted to determine when hybrids between species belonging to these two subgenera would initiate staminate and pistillate catkins and if

such hybrids might exhibit physiological abnormalities that would render them fruitless.

In 1985, we pollinated *A. pendula* (NA 31689), from ≈35°N lat. in Japan, with pollen from trees of three European provenances of *A. glutinosa*. Catkin-bearing branches of *A. glutinosa* were collected from flowering trees in the test plots of K.C. Steiner (Pennsylvania State Univ.) and forced in the greenhouse. The origins of these trees were given by Maynard and Hall (1981) as Acc. 592 (Hungary, lat. 46°55'N), Acc. 511 (Poland, lat. 53°8'N), and Acc. 221 (Denmark, lat. 56°N). Although some apomictic seedlings of *A. pendula* were present in all seedling progenies, true hybrids were produced by all three *A. glutinosa* parents and were easily distinguished by the few leaf veins and lower leaf length : width ratio. Furlow (1979) stated that "although several species of (subg.) *Alnus* and (subg.) *Alnobetula* grow sympatrically, they do not produce hybrid offspring." Before this work, only one control-pollinated intersubgeneric hybrid combination had been reported in the literature. This was a cross between *A. sieboldiana* Matsum. and *A. hirsuta* var. *tinctoria* (Sarg.) Kudo made by Murai in Japan in 1963. Murai (1964) designated this hybrid as *A. ×moriokaensis* and noted that it was a "bad combination" with "small growth."

Fifty-one hybrid seedlings were established in field test plots in 1987 and 1988. The hybrids were decidedly shrubby, like *A. pendula*, with multiple trunks. Flowering began in 1990, and in 1991 and 1992, I made systematic observations on the parents and on plants of each of the three hybrid progenies. On 28 Aug. 1991, female catkins were just beginning to emerge on the hybrids and the male catkins were between 10 and 20 mm long. By 20 Nov. 1991, the terminal male catkins on the hybrids were ≈34 mm long and

two to three female catkin clusters had developed from lateral buds below the terminal. Male catkins of *A. glutinosa* were ≈48 mm long and from three to five lateral clusters of female catkins were noted. The male catkins of *A. pendula* averaged 34 mm long.

Anthesis of male catkins of *A. glutinosa* took place about 28 Feb. 1992, at which time the catkins were 67 to 80 mm long. Elongation of the male catkins on the hybrids was just beginning on 17 Mar. 1992, but elongation in *A. pendula* did not start until 30 Mar. 1992. With *A. glutinosa*, 96% of pollen was stainable with aceto-carmin and the grains averaged 25.1 μm in diameter and most had five germinal apertures. Only 1% of pollen of *A. pendula* was not stainable, with the 4- to 5-colpate grains averaging 22.5 μm in diameter. Male catkins of the hybrids, brought into the laboratory on 24 Mar. 1992, elongated to 55 to 95 mm, but the anthers did not dehisce and there was no staining of expressed pollen. This high rate of pollen abortion might have been caused by freezing weather for six consecutive days after catkin elongation had begun in the field. However, trials in 1993, in the absence of freezing temperatures, also indicated complete pollen abortion in the hybrids. Parthenocarpic fruit developed on the hybrids and persisted for more than 1 year. No viable seed was produced. The parent trees of both species were found to have $2n = 28$ chromosomes, which, based on $x = 7$, is a tetraploid number.

In summary, intersubgeneric hybrids between *A. glutinosa* and *A. pendula* produced both female and male catkins in the season before flowering (like *A. glutinosa*), and although the hybrids were virtually sterile, parthenocarpic and persistent fruit were produced.

Literature Cited

- Furrow, J.J. 1979. The systematics of the American species of *Alnus* (Betulaceae). *Rhodora* 81:1–121, 151–248.
- Maynard, C.A. and R.B. Hall. 1981. Early results of a range-wide provenance trial of *Alnus glutinosa* (L.) Gaertn. Proc. Northeastern For. Tree Improv. Conf. 27:184–201 (1980).
- Murai, S. 1964. Phytotaxonomical and geobotanical studies on gen. *Alnus* in Japan. III. Taxonomy of whole world species and distribution of each sect. Bul. Govt. For. Expt. Sta. (Tokyo) 171.
- Santamour, F.S., Jr. 1989. Flowering and fertility of hybrids between spring- and fall-flowering elms. *HortScience* 24:139–140.
- Santamour, F.S., Jr., and G.K. Eisenbeiss. 1991. Flowering and fertility in "English" × "American" holly hybrids. *Holly Soc. J.* 9(3):3–6.

Received for publication 23 Jan. 1995. Accepted for publication 18 July 1995. The cost of publishing this paper was defrayed in part by the payment of page charges. Under postal regulations, this paper therefore must be hereby marked *advertisement* solely to indicate this fact.

¹Research Geneticist.