Dissertation for the Degree of Doctor of Philosophy in Systematic Botany, defended in public at the Botanical Institute, Göteborg University, Sweden, 7 December 2001.

Wallander, E. 2001. Evolution of wind-pollination in *Fraxinus* (Oleaceae) – an ecophylogenetic approach. PhD thesis, Göteborg University, Sweden. ISBN 91-88896-37-4.

ABSTRACT

Studies in *Fraxinus* (ash) and other genera of Oleaceae have revealed interesting trends and patterns in the evolutionary history of reproductive traits. They contribute empirical data for hypotheses under which conditions anemophily (wind-pollination) and dimorphic breeding systems, such as dioecy and the rare androdioecy, may evolve.

The study includes a molecular phylogeny of all 25 genera of the family Oleaceae, based on two noncoding chloroplast loci (the intron of *rps*16 and the *trn*L-F region), and of 40 of the 43 recognised species of the genus *Fraxinus*, based on the internal transcribed spacers of the nuclear ribosomal DNA (ITS-1 and ITS-2, and the intervening 5.8S gene).

The reproductive ecology of three species of *Fraxinus*, *F. excelsior*, *F. ornus*, and *F. longicuspis*, representing different combinations of pollination and breeding systems, were studied in the field in order to gain insight in their adaptations to wind and/or insect-pollination and compare different reproductive strategies.

Based on estimates of phylogenetic relationships in combination with reproductive data, I have shown that anemophily has three separate origins in *Fraxinus* and that it is preceded by ambophily (both wind- and insect-pollination). Dioecy is correlated with anemophily and has evolved after the origin of anemophily in three instances. In one case, dioecy has originated via androdioecy, which in turn has a hermaphroditic origin. This is the first study that shows the evolution of dioecy from hermaphrodites via the rare androdioecious pathway. In the other wind-pollinated taxa, dioecy has evolved twice, independently, from polygamous ancestors.

In the subtribe Oleinae, the sister group of *Fraxinus*, there are five genera with species that are adapted to wind-pollination. Here, anemophily is believed to have four separate origins. Many species have inconspicuous, whitish to yellowish-green flowers, which appear to attract unspecialised pollinators by offering pollen as a reward. This is believed to be an exaptation (a trait that facilitates or is a prerequisite) for ambophily, which in turn may have selected for anemophily. Many of the taxa of Oleinae are hermaphrodites, but dioecy and androdioecy are common breeding systems, especially among the anemophilous or ambophilous species.

The interpretations of the results are that ambophily and a breeding system with unisexual males, either androdioecy or polygamy, were some of the exaptations for the evolution of anemophily. Dioecy, on the other hand, has followed in evolutionary sequence and is interpreted as an adaptation that evolved in response to anemophily and is adaptive for increasing the efficiency and function of that system. In wind-pollinated flowers there are different structural and productivity demands for optimal male and female function that are hard to compromise between in one flower. Thus, the selection for sexual specialisation leads to dioecy through total or partial reduction of the opposite sex in the resulting unisexual flowers.

Key words: androdioecy, ambophily, anemophily, breeding system evolution, dioecy, floral evolution, *Fraxinus*, Oleaceae, pollination system evolution.

Eva Wallander, Botanical Institute, Göteborg University, Box 461, SE 405 30 Göteborg, SWEDEN.
eva.wallander@systbot.gu.se

Botanical Institute, Göteborg 2001.
ISBN 91-88896-37-4

Printed in Sweden by Kompendiet, Göteborg 2001.