DEVELOPMENT OF NOVEL ASH HYBRIDS TO INTROGRESS RESISTANCE TO EMERALD ASH BORER INTO NORTH AMERICAN ASH SPECIES

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ABSTRACT

Currently, there is no evidence that any of the native North American ash species have any resistance to the emerald ash borer (EAB). This means that the entire ash resource of the eastern United States and Canada is at risk of loss due to EAB. In contrast, outbreaks of EAB in Asian ash species are rare and appear to be isolated responses to stress (Bauer et al. 2005, Schaefer 2005, Gould et al. 2005). Our work is based on the hypothesis that there are resistance mechanisms and thus resistance genes that have evolved within Asian ash species that allow them to coexist with the EAB. This hypothesis is supported by a common garden study (Rebek et al., in press) that demonstrated that a cultivar of the Asian species *Fraxinus mandshurica* exhibits a higher level of resistance to EAB than several cultivars of North American green ash and white ash. It is our long-term goal to introgress, or introduce, these genes through the development of novel ash hybrids and, through subsequent rounds of backcrossing, retain all of the characteristics of the native North American species in addition to EAB-resistance.

Over the past three years, 31 different combinations of ash species have been used to perform controlled cross-pollinations. Nine different species were used as the maternal parent; eight different species were used as pollen donors. A total of 1,619 seeds were produced, but only four different species combinations germinated, producing a total of 44 seedlings. Genetic markers such as AFLPs and SSRs are being used to confirm the parentage of the resulting hybrid progeny, which will be supplemented through grafting and tested for EAB resistance. An estimation of relatedness of the species based on a phylogram generated by comparison of ITS sequences (Wallander 2001) indicates that the successful hybridizations occurred between species that were closely related.

In addition to genetic relatedness, there are many other potential barriers to successful interspecies hybridization, including differences in ploidy, phenology, and breeding systems. Ploidy levels in some Asian and North American species can vary depending on the region of origin. Ploidy levels of a few species remain unknown, including *F. quadrangulata* (blue ash) and *F. mandshurica* (Manchurian ash). Ash cytogenetics experiments are being initiated to determine the ploidy level of these species as well as to confirm that parent pairs used in hybridizations have compatible ploidy levels.

Equally significant barriers to a successful breeding program are the lack of species with known resistance to EAB and the need for well-defined, genetically diverse resistant trees for use as parents. To address these issues, efforts are being made in conjunction with various arboreta throughout the United States to obtain accessions of Asian ash species with diverse geographic origins. Information on genetic variation has been limited by the use of clonal horticultural cultivars in recent studies (Rebek et al., in press). In order to allow estimation of genetic variation in EAB resistance both within and between species, plantings are being established. These plantings include four North American ash species, three Asian ash species, and three European ash species. All material included in this planting is of seed origin, with one to three provenances represented per species.

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