

Genotype x Environment Interaction and Growth Stability of Several Elm Clones Resistant to Dutch Elm Disease

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Abstract

The elm breeding program carried out in Italy at the Institute of Plant Protection - Consiglio Nazionale delle Ricerche (CNR) during the last 40 years aimed to develop Dutch elm disease (DED)-resistant elm selections specific to the Mediterranean environment. The need for genotypes adapted to Mediterranean conditions was evident from the poor performance of the Dutch elm clones in the hot and dry areas of central Italy, and the opportunity to breed better adapted hybrids was offered by the favorable adaptation in Italy of the Siberian elm (*Ulmus pumila* L.), a species that does not thrive in central Europe and the Netherlands. For this reason, a base of valuable individuals of native elms was bred with several accessions of Asian elm species that proved to easily acclimate to different conditions in the Mediterranean region. As a result, four resistant hybrid elms have been patented and released to the market, and many experimentally tested DED-resistant elm hybrids of different parentage are under evaluation to be released in the near future.

Conventionally, hybrid elm clones obtained within DED resistance breeding programs were selected to meet requirements for use as ornamentals. However, it has been long and commonly observed that these clones may show hybrid vigour and enhanced growth. Nowadays, DED-resistant hybrid elm clones, which have been released to the market or are under evaluation for an upcoming release, are numerous enough to be considered for timber production or short rotation coppice (SRC). But experimental testing of the growth performances of these clones in different environments is still lacking. Here, growth and stability of performance of several DED-resistant hybrid elm clones planted at three experimental sites with contrasting environmental conditions in Italy were studied. Height and diameter were measured yearly from 2001 to 2009, and the mean yearly increments after plant establishment were calculated. The study revealed a general good growth performance of the majority of the clones with mean height increments above 1 m per year, and an excellent growth performance of some genotypes. Analysis of variance showed significant effects of clone, site, and clone x site interaction, for both height and diameter increments. Stability analysis of diameter and height increments was performed using two parametric (Coefficient of variation, CV percent and Wricke's Ecovalence, W^2) and two non-parametric (Hühn's $S_i(1)$ and $S_i(2)$) indexes. According to all indexes, two clones showed superior and stable growth. These clones may be suitable for planting in a range of environments. In addition, several other clones had high growth in general or at a particular site. The results support our belief that these elm clones could be successfully used for timber and biomass production, and provide new knowledge for an informed choice of the most suitable genotypes.

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