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Assisted Migration of *Pinus brutia* in Türkiye: A Potential Tool for Sustaining Growth in the Face of Climate Change

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Abstract: Forest tree populations deal with climate change either by increasing frequency of alleles contributing to adaptation to new conditions through natural selection or by migrating to places where they can establish and survive. In order for either mechanism to work, changes in allele frequencies or rate of migration should be able to keep up with the rate of climatic changes. For most forest tree populations, however, rate of climate change is faster than their genetic adaptation or migration rates. One potential solution to this problem is human assisted migration of forest tree species and involves moving forest tree species or seed sources of a forest tree species into areas where they would be better adapted to future climatic conditions than the local species or seed source. *Pinus brutia* is the most important forest tree species in Türkiye, covering 5.1 million ha (23% of total forests), and accounting for 9.3 million m^3 (34%) of annual timber production. Over 50 million *P. brutia* seedlings are produced annually (~20% of total forest tree seedling production). Current seed transfer is based on the country's six current seed zones, developed in the absence of provenance test data, are based on relative humidity during the vegetation period, and are partitioned into two to six sub-zones within each main zone (22 in total) on the basis of the length of vegetation period. Most of the *P. brutia* range in Türkiye is located in places where the effects of climate change are prominent. In 1988, a comprehensive provenance testing program was initiated where 50 *P. brutia* populations from Türkiye and Northern Cyprus were tested on 26 sites in Türkiye and Northern Cyprus. Trees in these tests were measured for survival, growth and form at ages three, five, 10 and 20. We used population mean growth data from these provenance tests to develop transfer functions from which safe seed transfer distances were calculated. On average, DBH at age 20 (DBH20) had the strongest relationship with the transfer distances. For each site, growth relative to local population was calculated and plotted across all climatic transfer distances for all sites. Transfer distances for summer precipitation (PPT_sm), mean warmest month temperature (MWMT) and annual heat moisture index (AHM) were found to have significant relationship with DBH20. *P. brutia* seed sources can be transferred within 105 mm PPT_sm, 10 °C MWMT and 36 units AHM without sacrificing volume growth more than 5% compared to that of local seed source. Provenance test data can be used to determine suitable seed sources for a given plantation site for different future climatic condition scenarios. This approach can help sustaining growth in *P. brutia* plantations in the face of climate change.

Keywords: *Pinus brutia*, Seed transfer, Assisted migration, Climate change, Adaptation.