TAMARIX AND RAPIDLY EVOLVING COLD HARDINESS

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ABSTRACT

To investigate the evolution of inherited latitudinal variation, we compared cold hardiness in the introduced saltcedar (*Tamarix ramosissima, T. chinensis,* and hybrids) and the native plains cottonwood (*Populus deltoides* subsp. *monilifera*), two dominant riparian trees in the western Great Plains. In a common garden in Fort Collins, CO (latitude 41ºN), we grew individuals of both species collected along a latitudinal gradient in the central U.S. from 29ºN to 48ºN. Eleven times between August 22, 2006, and May 22, 2007, we exposed twigs from 270 plants to a range of cold temperatures in a programmable freezer, allowed the twigs to stand in water at room temperature for 14 days, and determined survival by direct observation of stem color and formation of roots and leaves.

Both species are easily killed by freezing temperatures during the growing season and are hardier in the winter. Cottonwood, however, hardens off more rapidly and deeply. In midwinter, cottonwood was unharmed by cooling to -70 ºC, while saltcedar was killed at -33 to -47 ºC, which is within the temperature range of the northern Great Plains. Frost sensitivity, therefore, may explain the small size and relative scarcity of saltcedar in the north, and the recent spread of northern saltcedar may be related to increases in winter temperature.

There is inherited latitudinal variation in cold hardiness for both species. Twigs from northern plants survive colder temperatures earlier in the fall than twigs from southern plants. In addition, overwinter mortality of whole saltcedar plants in the common garden was inversely correlated with latitude of origin. Such clinal variation is common in native trees but was unexpected for saltcedar because of the limited time for evolution since its introduction around 1850. Analysis of nine microsatellite DNA loci shows a gradual north-south genetic gradient in saltcedar with no distinct breaks; southern plants are more closely related to *T. chinensis* and northern plants are more closely related to *T. ramosissima,* but most individuals appear to be hybrids. Such hybrids have not been reported in the native Asian range. Hybridization between these two *Tamarix* species may have introduced the genetic variability necessary for rapid evolution of the latitudinal gradient in cold hardiness.