

Table. Tree breeding programmes that have led to deployment of trees with improved resistance to targeted pests.

Tree Taxa	Targeted Pest	Organization	Approach ^{1,2}	Citation
Port orford cedar, <i>Chamaecyparis lawsoniana</i>	Root rot, <i>Phytophthora lateralis</i>	USDA Forest Service Dorena Tree Improvement Center, USDI Bureau of Land Management	Traditional	Sniezko <i>et al.</i> , 2000, 2006; Sniezko, 2004; Sniezko & Hansen, 2003
Western larch, <i>Larix occidentalis</i>	Meria needle cast, <i>Meria laricis</i> ; Hypodermella needle blight, <i>Hypodermella laricis</i>	USDA Forest Service, Moscow, ID	Traditional*	Rehfeldt, 1992
Whitebark pine, <i>Pinus albicaulis</i>	White pine blister rust, <i>Cronartium ribicola</i>	USDA Forest Service, Moscow, ID	Traditional*	Kinloch, 1982; Hoff & Hagle, 1990; Mahalovich Burr & Foushee, 2006
Lodgepole pine, <i>Pinus contorta</i> var <i>latifolia</i>	Western gall rust, <i>Endocronartium barknessii</i> Hirats.;	USDA Forest Service, Moscow, ID	Traditional*	Mahalovich, 1995
Slash pine, <i>Pinus elliotii</i>	Fusiform rust, <i>Cronartium quercuum</i>	Cooperative Forest Genetics Research Program, University of Florida, Gainesville, FL	Traditional*	Lopez-Upton <i>et al.</i> , 2000
Sugar pine, <i>Pinus lambertiana</i>	White pine blister rust, <i>Cronartium ribicola</i>	USDA Forest Service, Dorena, OR USDA Forest Service, Placerville, CA	Traditional Traditional	Sniezko & Kegley, 2005; Kegley & Sniezko, 2004
Western white pine, <i>Pinus monticola</i>	White pine blister rust, <i>Cronartium ribicola</i>	Canada	Traditional	Hunt, 2004; Hunt & Jensen, 2001
Western white pine, <i>Pinus monticola</i>	White pine blister rust, <i>Cronartium ribicola</i>	USDA Forest Service, Moscow, ID	Traditional*	Bingham <i>et al.</i> , 1969; Bingham, 1983; Goddard <i>et</i> <i>al.</i> , 1985; Hoff, 1986; Hoff & McDonald, 1971, 1993
Western white pine, <i>Pinus monticola</i>	White pine blister rust, <i>Cronartium ribicola</i>	USDA Forest Service, Dorena, OR	Traditional*	Kinloch <i>et al.</i> , 1999; Sniezko <i>et al.</i> , 2000, 2004
Western white pine, <i>Pinus monticola</i>	White pine blister rust, <i>Cronartium ribicola</i>	Inland Empire Tree Improvement Coop, University of Idaho, Moscow, ID	Traditional*	Fins <i>et al.</i> , 2002
Ponderosa pine, <i>Pinus ponderosa</i> var <i>ponderosa</i>	Western gall rust, <i>Endocronartium barknessii</i> Hirats.	USDA Forest Service, Moscow, ID	Traditional*	Mahalovich, 2003
Monterey pine, <i>Pinus radiata</i>	Needle blight, <i>Dothistroma pini</i>	New Zealand Forest Research Institute, Radiata Pine Breeding Company	Traditional*	Carson, 1990; Carson & Carson, 1991

¹ An * indicates that statistical estimates of gain are known

² Traditional refers to the use of standard plant breeding, testing and selection methods; GM refers to genetic modification or genetic engineering

Loblolly pine, <i>Pinus taeda</i>	Fusiform rust, <i>Cronartium quercuum</i>	USDA Forest Service, Asheville, NC & Saucier, MS Cooperative Forest Genetics Research Program, University of Florida, Gainesville, FL North Carolina State University Industry Tree Improvement Program, NCSU, Raleigh, NC Western Gulf Forest Tree Improvement Program, Texas Forest Service, College Station, TX	Traditional* Traditional* Traditional* Traditional*	Young, 2003; Kuhlman, 1997; Isik, Li & Frampton, 2003; Lambeth, 2000; Sierra-Lucero <i>et al.</i> , 2002
Poplar species and hybrids	Rust, leaf and shoot blight, insects, <i>Melampsora</i> , <i>Venturia</i> , <i>Septoria</i>	Greenwood Resources, Portland, OR Mead-Westvaco, Kentucky (Now discontinued) International Poplar Commission, FAO, Multiple Sites throughout Europe	Traditional* Traditional* Traditional*	Newcombe & van Oosten, 1997; Newcombe <i>et al.</i> , 1994; Newcombe & Bradshaw, 1996; Riemenschneider <i>et al.</i> , 2001
Poplar species and hybrids	Willow and poplar borer, <i>Cryptorhynchus lapathi</i>	Greenwood Resources, Portland, OR	Traditional*	Johnson & Johnson, 2003
Black poplar, <i>Populus nigra</i>	Asian longhorned beetle, <i>Anoplophora glabripennis</i>	Several Chinese organizations	Traditional and GMO	Yin & Lu, 2005; Hu <i>et al.</i> , 2001; Tian <i>et al.</i> , 1993; Wang <i>et al.</i> , 1996; Wang <i>et al.</i> , 2004
Poplar <i>P. alba</i> × <i>dauriana</i> ; <i>simonii</i> × <i>tomentosa</i>	Beetles	Agricultural University of Hebei	GMO	Zheng <i>et al.</i> , 2000; Tian <i>et al.</i> , 2000; Yang <i>et al.</i> , 2003; Liu <i>et al.</i> , 2004; Liu, 2004
Poplar, <i>P. trichocarpa</i> × <i>deltoides</i> ; <i>nigra</i> × <i>deltoides</i>	Leaf rust, <i>Melampsora larici-populina</i>	International Poplar Commission, FAO, Other EU members	Traditional*	van Slycken <i>et al.</i> , 2002; Dowkiw & Bastien, 2004; Dowkiw <i>et al.</i> , 2003; Jorge <i>et al.</i> , 2005
Poplar hybrids	<i>Melampsora medusae</i>	Argentina	Traditional	Cortizo <i>et al.</i> , 2006; Cortizo, 2005a; Cortizo, 2005b; Cortizo, 2003; Cortizo & Romero, 2000
Cherry, <i>Prunus avium</i>	Cherry leaf spot, <i>Blumeriella jaapii</i> (= <i>Phloeosporrella padi</i>)	Spain	Traditional	Díaz <i>et al.</i> , 2007; Santi <i>et al.</i> , 1998
Coastal Douglas-fir	Swiss needle cast, <i>Phaeocryptopus gaeumannii</i>	Northwest Tree Improvement Cooperative and the Swiss Needle Cast Cooperative, Oregon State University	Traditional	Temel <i>et al.</i> , 2005; Johnson, 2002; Temel <i>et al.</i> , 2004
Willow species	Diseases, insects	Cooperative University-Government-Industry Project, Syracuse, NY and elsewhere in the NE US Swedish Government Project	Traditional* Traditional*	Dawson <i>et al.</i> , 2005 Larsson, 2001a, 2001b