

Key Words: Evaluate, Naturalized, Christmas Tree, Dense Stands, Wind-dispersed

Family: *Pinaceae*

Taxon: *Abies nordmanniana*

Synonym: *Abies equi-trojani* (Asch. & Sint. ex Boiss.) M
Abies nordmanniana f. *aurea* (Beissn.) Rehde
Abies nordmanniana subsp. *bornmuelleriana*
Abies pectinata var. *equi-trojani* Asch. & Sint
Pinus nordmanniana Steven
Abies bornmuelleriana Mattf.

Common Name: Nordmann Christmastree
 Nordmann fir
 Turkey fir
 Caucasian fir

Questionnaire :	current 20090513	Assessor:	Chuck Chimera	Designation:	EVALUATE
Status:	Assessor Approved	Data Entry Person:	Chuck Chimera	WRA Score 2	
101	Is the species highly domesticated?		y=-3, n=0		n
102	Has the species become naturalized where grown?		y=1, n=-1		
103	Does the species have weedy races?		y=1, n=-1		
201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"		(0-low; 1-intermediate; 2-high) (See Appendix 2)		Low
202	Quality of climate match data		(0-low; 1-intermediate; 2-high) (See Appendix 2)		High
203	Broad climate suitability (environmental versatility)		y=1, n=0		y
204	Native or naturalized in regions with tropical or subtropical climates		y=1, n=0		n
205	Does the species have a history of repeated introductions outside its natural range?		y=-2, ?=-1, n=0		y
301	Naturalized beyond native range		y = 1*multiplier (see Appendix 2), n= question 205		y
302	Garden/amenity/disturbance weed		n=0, y = 1*multiplier (see Appendix 2)		n
303	Agricultural/forestry/horticultural weed		n=0, y = 2*multiplier (see Appendix 2)		n
304	Environmental weed		n=0, y = 2*multiplier (see Appendix 2)		n
305	Congeneric weed		n=0, y = 1*multiplier (see Appendix 2)		y
401	Produces spines, thorns or burrs		y=1, n=0		n
402	Allelopathic		y=1, n=0		
403	Parasitic		y=1, n=0		n
404	Unpalatable to grazing animals		y=1, n=-1		
405	Toxic to animals		y=1, n=0		n
406	Host for recognized pests and pathogens		y=1, n=0		
407	Causes allergies or is otherwise toxic to humans		y=1, n=0		n
408	Creates a fire hazard in natural ecosystems		y=1, n=0		y

409	Is a shade tolerant plant at some stage of its life cycle	y=1, n=0	y
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y=1, n=0	y
411	Climbing or smothering growth habit	y=1, n=0	n
412	Forms dense thickets	y=1, n=0	y
501	Aquatic	y=5, n=0	n
502	Grass	y=1, n=0	n
503	Nitrogen fixing woody plant	y=1, n=0	n
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	y=1, n=0	n
601	Evidence of substantial reproductive failure in native habitat	y=1, n=0	n
602	Produces viable seed	y=1, n=-1	y
603	Hybridizes naturally	y=1, n=-1	y
604	Self-compatible or apomictic	y=1, n=-1	y
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation	y=1, n=-1	n
607	Minimum generative time (years)	1 year = 1, 2 or 3 years = 0, 4+ years = -1	>3
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y=1, n=-1	n
702	Propagules dispersed intentionally by people	y=1, n=-1	y
703	Propagules likely to disperse as a produce contaminant	y=1, n=-1	n
704	Propagules adapted to wind dispersal	y=1, n=-1	y
705	Propagules water dispersed	y=1, n=-1	n
706	Propagules bird dispersed	y=1, n=-1	n
707	Propagules dispersed by other animals (externally)	y=1, n=-1	
708	Propagules survive passage through the gut	y=1, n=-1	n
801	Prolific seed production (>1000/m2)	y=1, n=-1	
802	Evidence that a persistent propagule bank is formed (>1 yr)	y=1, n=-1	n
803	Well controlled by herbicides	y=-1, n=1	
804	Tolerates, or benefits from, mutilation, cultivation, or fire	y=1, n=-1	n
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	y=-1, n=1	

Designation: EVALUATE

WRA Score 2

Supporting Data:

101	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Is the species highly domesticated? No] "Many authors have studied the differences (in particular morphological ones) between fir species in south-eastern Europe, but even today the taxonomy and systematic significance of fir present in Asia Minor are not completely understood. Some authors distinguish three species: <i>Abies nordmanniana</i> , <i>Abies bornmuelleriana</i> and <i>Abies equi-trojani</i> , which extend progressively from north-east to south-west of the overall distribution area. If this is the case, its natural area of distribution would be restricted to the mountains of northern Turkey and western Caucasus. Others, for example, Arbez (1967), indicate that only one species occurs throughout the entire Caucasus and northern Turkey: <i>Abies nordmanniana</i> . The total area would thus extend from the slopes of Mount Ida (Kaz Daglari) to the western spurs of the Caucasus and Dogu Karadeniz mountains in north east Turkey. It is clear, therefore, that the problem of fir species taxonomy in Asia Minor and the southern parts of the Balkan Peninsula requires further research (Vidakovic, 1991)."
102	2012. WRA Specialist. Personal Communication.	NA
103	2012. WRA Specialist. Personal Communication.	NA
201	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Species suited to tropical or subtropical climate(s) 0-Low] "between 44°N and 39°N" [Although would be suitable to higher elevations of some tropical islands, such as Maui and Hawaii islands]
202	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Quality of climate match data 2-High]
203	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Broad climate suitability (environmental versatility)? Yes] " <i>A. nordmanniana</i> occurs at 600-2200 m altitude, preferring shady sites; it lives in pure stands or mixed with other species." [Elevation range >1000 m]
204	2004. Richardson, D.M./Rejmánek, M.. Conifers as invasive aliens: a global survey and predictive framework. Diversity and Distributions. 10: 321–331.	[Native or naturalized in regions with tropical or subtropical climates? No evidence] "Appendix List of naturalized or invasive (in bold) conifers (Pinopsida), based on hundreds of published and unpublished sources and the unpublished data and personal observation of the authors over more than a decade." ... " <i>A. nordmanniana</i> (Great Britain; New Zealand)" [Considered naturalized, but not invasive]
204	2009. Eckenwalder, J.E.. Conifers of the world: the complete reference. Timber Press, Portland, OR	[Native or naturalized in regions with tropical or subtropical climates? No evidence] "Mountains surrounding the Black Sea on the northeast, east, and south, from southernmost Russia through Georgia and Armenia to Turkey west to Ulu Dag [Mount Olympus] ... Caucasian fir is a handsome tree of the cool, humid Black Sea mountains, including the western Caucasus and Pontic Mountains, where the trees can reach an age of 500 years."
205	2000. Jonsell, B. (ed.). Flora Nordica. Volume 1. Lycopodiaceae to Polygonaceae. The Bergius Foundation, The Royal Swedish Academy of Sciences, Stockholm	[Does the species have a history of repeated introductions outside its natural range? Norway] "Distribution. Nowadays mainly planted for Christmas tree production. - D common in forestry, and as an ornamental. N fairly rare in forestry. S occasional as an ornamental, rare in forestry, rarely escaping. F very rarely cultivated for ornament in the south; not hardy. Fa occasional in plantations and as an ornamental."
205	2002. Simberloff, D./Relva, M.A./Nunez, M.. Gringos en el bosque: introduced tree invasion in a native <i>Nothofagus/Austrocedrus</i> forest. Biological Invasions. 4: 35–53.	[Does the species have a history of repeated introductions outside its natural range? northern Patagonia] "Appendix. Tree species introduced to Isla Victoria" [Includes <i>Abies nordmanniana</i>]
205	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Does the species have a history of repeated introductions outside its natural range? Yes] "It was introduced into Europe in 1838 (Normandy), principally as an ornamental tree. It has occasionally been used for reforestation in France and is becoming increasingly popular as a Christmas tree in many northern European countries."
205	2006. Krivanek, M./Pysek, P./Jarosik, V.. Planting History and Propagule Pressure as Predictors of Invasion by Woody Species in a Temperate Region. Conservation Biology. 20(5): 1487–1498.	Does the species have a history of repeated introductions outside its natural range? Czech Republic] "Table 1. Alien tree species planted in the Czech Republic for forestry purposes and included in the study." [Not recorded as naturalized]

301	2002. Heenan, P.B./de Lange, P.J./Cameron, E.K./Champion, P.D.. Checklist of dicotyledons, gymnosperms, and pteridophytes naturalised or casual in New Zealand: Additional records 1999–2000. <i>New Zealand Journal of Botany</i> . 40(2): 155-174.	[Naturalized beyond native range? Yes] "Significant Range Extensions of Fully Naturalised Taxa" ... "Abies nordmanniana (Steven) Spach Caucasian fir FIRST NORTH ISLAND RECORDS: AK 202960, R. O. Gardner 6243, 23 Aug 1991, Auckland, Auckland City, Western Park; AK 242747, E. K. Cameron 9975,6 Dec 1999, Waikato, Hamilton City, Waikato University campus. NOTES: Numerous seedlings in the vicinity of cultivated trees. In the South Island known from Canterbury (Webb et al. 1988, p. 47)."
301	2004. Richardson, D.M./Rejmánek, M.. Conifers as invasive aliens: a global survey and predictive framework. <i>Diversity and Distributions</i> . 10: 321–331.	[Naturalized beyond native range? Yes] "Appendix List of naturalized or invasive (in bold) conifers (Pinopsida), based on hundreds of published and unpublished sources and the unpublished data and personal observation of the authors over more than a decade." ... "A. nordmanniana (Great Britain; New Zealand)" [Considered naturalized, but not invasive]
301	2006. Domingues de Almeida, J./Freitas, H.. Exotic naturalized flora of continental Portugal – A reassessment. <i>Botanica Complutensis</i> . 30: 117-130.	[Naturalized beyond native range? Yes] "Table 2 Exotic vascular plant species (invasive, potentially invasive or more or less naturalized) in continental Portugal" [Abies nordmanniana - Year of first reported naturalization of exotic species = 1949]
301	2006. Howell, C.J./Sawyer, J.W.D.. New Zealand naturalised vascular plant checklist. New Zealand Plant Conservation Network, Wellington, NZ www.nzpcn.org.nz	[Naturalized beyond native range? Yes] "Fully naturalised"
301	2010. Marco, A./Lavergne, S./Dutoit, T./Bertaudiere-Montes, V.. From the backyard to the backcountry: how ecological and biological traits explain the escape of garden plants into Mediterranean old fields. <i>Biological Invasions</i> . 12: 761–779.	[Naturalized beyond native range? Not in the Lauris neighborhood, an urbanizing rural area of the French Mediterranean] "Table 5 List of the perennial alien plant species escaped (=1) and not escaped (=0) in abandoned agricultural lands of Lauris village" [Abies nordmanniana - Not escaped/ escaped = not escaped (=0)]
302	1995. Pheloung, P.C.. Determining the weed potential of new plant introductions to Australia. Report of the Development of a Weed Risk Assessment System Commissioned by the Australian Weeds Committee. Department of Agriculture, Perth, Australia	[Garden/amenity/disturbance weed? No evidence] "Table 9. Partitioning of species by WRA score and survey classification" [Prediction - Abies nordmanniana = Non-weeds]
302	2004. Richardson, D.M./Rejmánek, M.. Conifers as invasive aliens: a global survey and predictive framework. <i>Diversity and Distributions</i> . 10: 321–331.	[Garden/amenity/disturbance weed? No evidence]
303	2004. Richardson, D.M./Rejmánek, M.. Conifers as invasive aliens: a global survey and predictive framework. <i>Diversity and Distributions</i> . 10: 321–331.	[Agricultural/forestry/horticultural weed? No evidence]
303	2007. Randall, R.P.. Global Compendium of Weeds - Abies nordmanniana. http://www.hear.org/gcw/species/abies_nordmanniana/	[Agricultural/forestry/horticultural weed? No evidence]
304	2004. Richardson, D.M./Rejmánek, M.. Conifers as invasive aliens: a global survey and predictive framework. <i>Diversity and Distributions</i> . 10: 321–331.	[Environmental weed No evidence]
304	2007. Randall, R.P.. Global Compendium of Weeds - Abies nordmanniana. http://www.hear.org/gcw/species/abies_nordmanniana/	[Environmental weed No evidence]
305	2004. Richardson, D.M./Rejmánek, M.. Conifers as invasive aliens: a global survey and predictive framework. <i>Diversity and Distributions</i> . 10: 321–331.	[Congeneric weed? Yes] "The 15 non pine conifers (out of 507 species; 3%) known to be invasive (seven in the Pinaceae; six in Cupressaceae, one in Araucariaceae, one in Podocarpaceae) are: Abies grandis , Abies procera , " ... "Appendix List of naturalized or invasive (in bold) conifers (Pinopsida), based on hundreds of published and unpublished sources and the unpublished data and personal observation of the authors over more than a decade." ... "Abies alba (Great Britain; Ireland; New Zealand); A. cephalonica (Great Britain); A. concolor (USA (New England)); A. grandis (Great Britain, Ireland; Sweden); A. nordmanniana (Great Britain; New Zealand); A. procera (Great Britain); A. sibirica (Finland)"

305	2010. Poindexter, D.B.. <i>Abies firma</i> (Pinaceae) naturalize in North America. <i>Phytoneuron</i> . 41: 1-7.	[Congeneric weed> Potentially] "In North Carolina, <i>Abies firma</i> , an introduced fir from Japan, is reported as escaping and establishing for the first time in North America. Momi Fir is an infrequently introduced taxon that has been proposed as a highly suitable ornamental tree, particularly in the southeastern United States. This recent discovery of its ability to naturally produce viable progeny suggests that widespread horticultural use of this coniferous species needs further evaluation. A description and photographs are provided to aid in identification of this taxon."
401	2005. CAB International. <i>Forestry Compendium</i> . CAB International, Wallingford, UK	[Produces spines, thorns or burrs? No] "Trees reach a maximum height of 50 m (maximum stem diameter 1.5-2 m) with a monopodial, straight and columnar trunk. Bark is smooth and grey in young trees; rough, shallowly fissured and grey-brown in older trees. The crown is conical or pyramidal, with branches from the ground up, slender, lower branches drooping. Shoots are pubescent. Buds are ovoid (6 x 5 mm) without resin; bud scales are ovate, red-brown, with lacinate edges and persist for several years. Needles are spirally arranged, 2-3 cm long, with rounded apex, dark-green and glossy, with two stomata bands below and with two small resin canals."
402	2012. WRA Specialist. Personal Communication.	[Allelopathic? Unknown]
403	2005. CAB International. <i>Forestry Compendium</i> . CAB International, Wallingford, UK	[Parasitic? No] Pinaceae
404	2010. Plachter, H./Hampicke, U./Reay, L.. Large-scale Livestock Grazing. Springer-Verlag, Berlin / Heidelberg	[Unpalatable to grazing animals? Possibly Yes to cattle] "With respect to the woody vegetation species in the pastures which were examined the browsing preferences of the cattle were analyzed in both areas... Species which were avoided (E < -0.25) include <i>Abies nordmanniana</i> ... "
404	2011. Bitner, R.L.. Growing Conifers when Coping with Deer. <i>Hardy Plant Society/Mid-Atlantic Group</i> . 25(4): 3-5.	[Unpalatable to grazing animals? Possibly Unpalatable] "Conifers Seldom Browsed by Deer" [Includes <i>Abies nordmanniana</i>]
404	2012. Brand, M.H.. Uconn plant database of trees, shrubs and vines - <i>Abies nordmanniana</i> [Accessed 19 Aug 2012]. University of Connecticut, http://www.hort.uconn.edu/plants/a/abinor/abinor1.html	[Unpalatable to grazing animals? Not to deer] "often damaged by deer"
404	2012. Clean Air Gardening. How to make your yard deer proof [Accessed 19 Aug 2012]. http://www.cleanairgardening.com/deer-repellent-guide.html	[Unpalatable to grazing animals? Possibly Palatable] "Here are a list of plants that are like catnip to deer" [Includes Fir (<i>Abies nordmanniana</i> and other species)]
405	2008. Wagstaff, D.J.. International poisonous plants checklist: an evidence-based reference. CRC Press, Boca Raton, FL	[Toxic to animals? No] No evidence

406	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Host for recognized pests and pathogens] Pests recorded Insects: Adelges piceae (balsam woolly aphid) Dendroctonus micans (great spruce bark beetle) Dreyfusia nordmanniana (silver fir, adelges) Hylurgops palliatus (lesser spruce shoot beetle) Ips sexdentatus (six-toothed bark beetle) Megastigmus milleri (fir seed chalcid) Megastigmus pinsapinis (atlas cedar seed chalcid) Megastigmus pinus (fir seed chalcid) Megastigmus rafni (fir seed chalcid) Megastigmus specularis (fir seed chalcid) Megastigmus suspectus (fir seed chalcid) Pissodes piniphilus (pine-top weevil) Pityokteines curvidens (fir engraver beetle) Sirex juvencus (steel-blue woodwasp) Fungus diseases: Cytospora friesii [1] Fomes fomentarius (hoof fungus) Fomitopsis pinicola (brown crumbly rot) Heterobasidion abietinum Heterobasidion annosum sensu stricto Heterobasidion parviporum Bacterial diseases: Rhizobium radiobacter (crown gall) Rhizobium rhizogenes (gall)
406	2012. Missouri Botanical Garden. Abies nordmanniana [Accessed 19 Aug 2012]. http://www.missouribotanicalgarden.org/gardens-gardening/your-garden/plant-finder/plant-details/kc/d832/abies-nordmanniana.aspx	[Host for recognized pests and pathogens? Possibly No] "No serious insect or disease problems. Insect pests include balsam woolly adelgids, bark beetles, spruce budworms, aphids, bagworms and scale. Spider mites may occur in hot conditions. Disease problems include cankers, heart rot, root rot, needle rust and twig blight Trees are generally intolerant of urban pollution."
407	2008. Wagstaff, D.J.. International poisonous plants checklist: an evidence-based reference. CRC Press, Boca Raton, FL	[Causes allergies or is otherwise toxic to humans? No evidence]
407	2012. Plants for a Future Database. Abies nordmanniana [Accessed 19 Aug 2012]. http://www.pfaf.org/user/Plant.aspx?LatinName=Abies+nordmanniana	[Causes allergies or is otherwise toxic to humans? No evidence] "Known Hazards - None known"
408	2012. Fire Performance Plant Selector. Abies nordmanniana [Accessed 19 Aug 2012]. http://www.fire.sref.info/plants/abies-nordmanniana	[Creates a fire hazard in natural ecosystems? Probably Yes] "Firewise Rating - AT RISK Firewise (3)" ... "Ladder Potential without Pruning - Yes" ... "Leaf Characteristics - Resinous"
409	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Is a shade tolerant plant at some stage of its life cycle? Yes] "A. nordmanniana occurs at 600-2200 m altitude, preferring shady sites; it lives in pure stands or mixed with other species."
409	2012. Plants for a Future Database. Abies nordmanniana [Accessed 19 Aug 2012]. http://www.pfaf.org/user/Plant.aspx?LatinName=Abies+nordmanniana	[Is a shade tolerant plant at some stage of its life cycle? Yes] "Plants are very shade tolerant, especially when young, but growth is slower in dense shade[81]."
410	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Tolerates a wide range of soil conditions? Yes] "It is not particularly demanding with respect to soil, but gives best results on those with high clay content (Vidakovic, 1991). It requires abundant atmospheric moisture."
411	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Climbing or smothering growth habit? No] "Trees reach a maximum height of 50 m (maximum stem diameter 1.5-2 m) with a monopodial, straight and columnar trunk."
412	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Forms dense thickets? Yes] "A. nordmanniana occurs at 600-2200 m altitude, preferring shady sites; it lives in pure stands or mixed with other species."
412	2009. Eckenwalder, J.E.. Conifers of the world: the complete reference. Timber Press, Portland, OR	[Forms dense thickets? Yes] "Forming pure stands or mixed with Caucasian spruce (Picea orientalis) and other trees; (900-)1,300 - 1,900(-2,200) m. Zone 5"

501	2011. Gardner, M./Knees, S.. <i>Abies nordmanniana</i> . In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.1. Downloaded on 19 August 2012.. www.iucnredlist.org	[Aquatic? No] "Systems: Terrestrial"
502	2012. USDA ARS National Genetic Resources Program. Germplasm Resources Information Network - (GRIN). http://www.ars-grin.gov/cgi-bin/npgs/html/index.pl	[Grass? No] Pinaceae
503	2012. USDA ARS National Genetic Resources Program. Germplasm Resources Information Network - (GRIN). http://www.ars-grin.gov/cgi-bin/npgs/html/index.pl	[Nitrogen fixing woody plant? No] Pinaceae
504	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)? No] "Trees reach a maximum height of 50 m (maximum stem diameter 1.5-2 m) with a monopodial, straight and columnar trunk."
601	2011. Gardner, M./Knees, S.. <i>Abies nordmanniana</i> . In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.1. Downloaded on 19 August 2012.. www.iucnredlist.org	[Evidence of substantial reproductive failure in native habitat? No] "As this species forms extensive forests which are largely intact and has a widespread distribution throughout the Black Sea Region of northwestern Turkey, eastwards to the western Caucasus, it has been assessed as being of Least Concern. " ... "Even though the wood is highly prized, logging has not had a significant detrimental impact on the population. However, the habitat of <i>A. nordmanniana</i> ssp. <i>equi-trojani</i> is in decline due to a number of negative effects including acid rain, fire, local timber extraction and habitat degradation associated with large visitor numbers in Kazdagi National Park (Satil 2009)."
602	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Produces viable seed? Yes] "- Seed storage orthodox - Stand establishment using natural regeneration; direct sowing; planting stock"
602	2008. Hansen, O.K./Nielsen, U.B.. Crossing Success in <i>Abies nordmanniana</i> Following Artificial Pollination With a Pollen Mixture of <i>A. nordmanniana</i> and <i>A. alba</i> . <i>Silvae Genetica</i> . 57(2): 70-76.	[Produces viable seed? Yes] "The use of <i>A. nordmanniana</i> for Christmas tree production in Denmark has increased considerably in the last 10–15 years peaking around 2004 with 10–11 mill. trees sold per year (Kaj Østergaard pers. comm.). The industry is mainly based on imported material (DITLEVSEN and NIELSEN, 1997), but seeds for Christmas tree production have been harvested in Danish stands of <i>A. Nordmanniana</i> for years as well."
603	2008. Hansen, O.K./Nielsen, U.B.. Crossing Success in <i>Abies nordmanniana</i> Following Artificial Pollination With a Pollen Mixture of <i>A. nordmanniana</i> and <i>A. alba</i> . <i>Silvae Genetica</i> . 57(2): 70-76.	[Hybridizes naturally? Yes] "Controlled crossings were conducted with three <i>Abies nordmanniana</i> genotypes acting as mothers and a pollen mixture of three <i>Abies nordmanniana</i> genotypes and one <i>Abies alba</i> genotype acting as potential fathers. The aim was to investigate hybridization success under circumstances where pollen from both species are present, which is a potential risk in Danish clonal seed orchards of <i>Abies nordmanniana</i> . The number of seeds sired by each father was determined through SSRs and compared to the expected numbers based on the pollen mixture composition. All three mother genotypes of <i>Abies nordmanniana</i> had more progenies with the <i>Abies alba</i> as father (hybrids) than expected, based on proportions in the pollen mix. This indicates that no reproductive barriers between the two species exist, and that seed orchard managers should take precautions to avoid hybrids in seed crops. Furthermore, the experiments revealed quite different siring success of the three <i>Abies nordmanniana</i> genotypes, depending on which clone was the mother. <i>Abies nordmanniana</i> seed orchards should therefore not be established in the vicinity of <i>Abies alba</i> in the flowering age, and if a few clone set up is chosen, the mating interaction should be investigated beforehand through pollen mix experiments." ... "Danish Christmas tree growers have been aware of hybridization between the two species for a long time, based on phenotypic observations (JACOBSEN, 1988)." "In relation to management of seed sources of <i>A. nordmanniana</i> the present study makes it possible to draw the following conclusions: 1) The earlier reported crossing compatibility between <i>A. nordmanniana</i> and <i>A. alba</i> has been verified, and extended to conditions where pollens of both species are present. 2) Although only one specimen of <i>A. alba</i> has been tested, our results are in line with other studies which have reported high within section crossability in <i>Abies</i> species and 3) There seems to be large interaction among pollen donors and seed parents of <i>A. nordmanniana</i> , which may have importance in relation to the establishment of few-clone seed orchards."
604	2012. Plants for a Future Database. <i>Abies nordmanniana</i> [Accessed 19 Aug 2012]. http://www.pfaf.org/user/Plant.aspx?LatinName=Abies+nordmanniana	[Self-compatible or apomictic? Yes, but results in poor vigor] "Plants are strongly outbreeding, self-fertilized seed usually grows poorly[200]."

605	1990. Burns, R.M./Honkala, B.H.. Silvics of North America. Volume 1: Conifers. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC.	[Requires specialist pollinators? No. Wind pollinated] "Firs have unspecialized pollen mechanisms, long periods of pollen dormancy, a short time after germination when pollen tubes must develop and penetrate the long nucellar tip, and archegonia that abort quickly if unfertilized. These traits, plus a low number of archegonia, may cause the low percentage of viable seeds."
605	2012. Plants for a Future Database. <i>Abies nordmanniana</i> [Accessed 19 Aug 2012]. http://www.pfaf.org/user/Plant.aspx?LatinName=Abies+nordmanniana	[Requires specialist pollinators? No] "The flowers are monoecious (individual flowers are either male or female, but both sexes can be found on the same plant) and are pollinated by Wind."
606	1990. Burns, R.M./Honkala, B.H.. Silvics of North America. Volume 1: Conifers. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC.	[Reproduction by vegetative fragmentation No] <i>Abies</i> spp. Not documented to spread vegetatively
606	2012. Brand, M.H.. Uconn plant database of trees, shrubs and vines - <i>Abies nordmanniana</i> [Accessed 19 Aug 2012]. University of Connecticut, http://www.hort.uconn.edu/plants/a/abinor/abinor1.html	[Reproduction by vegetative fragmentation No evidence] "Propagation - by seed"
607	2008. Bonner, F.T./Karrfalt, R.P. (eds.). The Woody Plant Seed Manual. USDA FS Agriculture Handbook 727. Government Printing Office, Washington, D.C.	[Minimum generative time (years)? 30+] "Table 3— <i>Abies</i> , fir: phenology of flowering and fruiting, and major characteristics of mature trees" [A. <i>nordmanniana</i> - Minimum age for commercial seed bearing = 30–40]
607	2012. Shoot Gardening. <i>Abies nordmanniana</i> (Nordmann fir) [Accessed 19 Aug 2012]. http://www.shootgardening.co.uk/plant/abies-nordmanniana	[Minimum generative time (years)? 20+] "20-50 years to maturity"
701	2009. Eckenwalder, J.E.. Conifers of the world: the complete reference. Timber Press, Portland, OR	[Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)? No evidence] "Seed body (8-)10-12 mm long, the wing about as long to 1.5 times as long." [Relatively large seeds with no means of external attachment]
702	2000. Jonsell, B. (ed.). Flora Nordica. Volume 1. Lycopodiaceae to Polygonaceae. The Bergius Foundation, The Royal Swedish Academy of Sciences, Stockholm	[Propagules dispersed intentionally by people? Yes] "Distribution. Nowadays mainly planted for Christmas tree production. - D common in forestry, and as an ornamental. N fairly rare in forestry. S occasional as an ornamental, rare in forestry, rarely escaping. F very rarely cultivated for ornament in the south; not hardy. Fa occasional in plantations and as an ornamental."
702	2001. Bloom, A.. Gardening With Conifers. Frances Lincoln Ltd, London	[Propagules dispersed intentionally by people? Yes] "The Caucasian Fir or Nordmann Fir, although eventually large, has great ornamental value and is fast replacing the Norway Spruce (<i>Picea abies</i>) as a favourite Christmas tree, since it retains its attractive needs much longer after cutting."
703	2009. Eckenwalder, J.E.. Conifers of the world: the complete reference. Timber Press, Portland, OR	[Propagules likely to disperse as a produce contaminant? No evidence] "Seed body (8-)10-12 mm long, the wing about as long to 1.5 times as long." [Long time to reproductive maturity and relatively large seed size suggest seed contamination of commercial produce or other plant products is highly unlikely]
704	2009. Eckenwalder, J.E.. Conifers of the world: the complete reference. Timber Press, Portland, OR	[Propagules adapted to wind dispersal? Yes] "Seed body (8-)10-12 mm long, the wing about as long to 1.5 times as long."
705	2009. Eckenwalder, J.E.. Conifers of the world: the complete reference. Timber Press, Portland, OR	[Propagules water dispersed? Probably No] "Mountains surrounding the Black Sea on the northeast, east, and south, from southernmost Russia through Georgia and Armenia to Turkey west to Ulu Dag [Mount Olympus] ... Caucasian fir is a handsome tree of the cool, humid Black Sea mountains, including the western Caucasus and Pontic Mountains, where the trees can reach an age of 500 years." ... "Seed body (8-)10-12 mm long, the wing about as long to 1.5 times as long." [Not normally occurring in riparian areas, and seeds adapted for wind dispersal]
706	2009. Eckenwalder, J.E.. Conifers of the world: the complete reference. Timber Press, Portland, OR	[Propagules bird dispersed? No evidence] "Seed body (8-)10-12 mm long, the wing about as long to 1.5 times as long." [Adapted for wind dispersal]
707	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Propagules dispersed by other animals (externally)? Unknown, but Possibly] " <i>Abies grandis</i> ... The seeds are large winged and dispersed by wind and rodents, with most seeds being disseminated in the early autumn." [Related species have seed that are presumably moved by seed caching rodents. Introduced <i>Rattus</i> species may serve a similar role in the Hawaiian Islands for <i>A. nordmanniana</i>]

708	2000. Howard, J.L./Alekssoff, K.C.. <i>Abies grandis</i> . In: Fire Effects Information System, [Online]. USA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, http://www.fs.fed.us/database/feis/plants/tree/abigra/all.html	[Propagules survive passage through the gut? No. Related species consumed by animals] "Squirrels, other rodents, and some birds such as nuthatches and chickadees eat the seeds" [Animals act as seed predators]
708	2012. WRA Specialist. Personal Communication.	[Propagules survive passage through the gut? No] Consumption would likely result in seed predation, as seeds are not adapted for internal dispersal
801	2008. Bonner, F.T./Karrfalt, R.P. (eds.). The Woody Plant Seed Manual. USDA FS Agriculture Handbook 727. Government Printing Office, Washington, D.C.	[Prolific seed production (>1000/m ²)? Unknown] "Table 8— <i>Abies</i> , fir: cone measurements and yields of cleaned seeds" [<i>A. nordmanniana</i> - 11,550–19,000 seeds/kg in commercial production]
802	1999. Gosling, P.G./Parratt, M./Peace, A.. Identifying the optimum pretreatment duration and germination temperature for <i>Abies nordmanniana</i> [(Steven) Spach] seed, and assessing the effect of moisture content and storage temperature on seed longevity. Seed	[Evidence that a persistent propagule bank is formed (>1 yr)? No. Deteriorates rapidly at ambient temperatures, suggesting persistent seed bank will not form under natural conditions] " <i>Abies nordmanniana</i> has recently acquired significant popularity across Europe as a high quality Christmas tree. However, commercially available seed is relatively scarce and often poor quality. The cause(s) of low germination percentage in this species are currently unknown, but may be due to a combination of inherently low viability, unreliable seed test methods, unexpectedly rapid seed deterioration, ineffective dormancy breakage pretreatments or extreme sensitivity to germination conditions. One good quality seedlot (66% germination capacity) was prechilled for 0, 3, 6, 12, 24 and 48 weeks (w) and then germinated over a range of constant temperatures (10, 15, 20, 25, 30, 35, 40°C) and an alternating 20/30°C (the current ISTA germination regime).). A 6w prechill followed by 20°C for 28 days (d) was one of the best combinations of prechill period, germination temperature and incubation duration and is therefore recommended for adoption by the ISTA. 6-12w prechilling may be preferable for plant production purposes, especially when sowing early into cooler seedbeds (10-15°C). A second good quality seedlot (75% germination capacity) was stored at 10, 13 and 15 % moisture content (fresh weight basis), factorially combined with 5, 15 and 25°C for up to 104 weeks. Seed deterioration was very rapid in comparison to data published for most other conifers (especially pines and spruces). At 15 and 25°C seed was almost completely dead within 16w, and even at the lowest temperature (5°C) germination capacity had virtually halved within 32w. These results demonstrate the rapid death rate of dry stored seeds of <i>Abies nordmanniana</i> and why even the shortest temporary storage at ambient temperatures should be avoided."
802	2008. Royal Botanic Gardens Kew. Seed Information Database (SID). Version 7.1. http://data.kew.org/sid/	[Evidence that a persistent propagule bank is formed (>1 yr)? Only in storage] "Hermetic storage at -18°C with <9% mc recommended (Franklin, 1974); no loss in viability after 5 years hermetic storage at -15°C with 5.8% mc (Muller, 1980)"
803	2012. WRA Specialist. Personal Communication.	[Well controlled by herbicides? Unknown] No evidence of herbicide efficacy or chemical control of this species
804	2012. SelecTree. " <i>Abies nordmanniana</i> Tree Record." 1995-2012. Aug 19, 2012. http://selectree.calpoly.edu/treedetail.lasso?rid=10	[Tolerates, or benefits from, mutilation, cultivation, or fire? No] "Fire Resistance: Unfavorable"
805	2012. WRA Specialist. Personal Communication.	[Effective natural enemies present locally (e.g. introduced biocontrol agents)? Unknown]

Summary of Risk Traits

High Risk / Undesirable Traits

- Elevation range >1000 m
- Naturalized in Great Britain, New Zealand, and Portugal
- May increase fire risk (flammable)
- Shade tolerant
- Tolerates many soil conditions (and potentially able to exploit many different habitat types)
- Forms pure stands within native range
- Can hybridize with other *Abies* species
- Self-compatible (although seed set from selfing very low)
- Wind-dispersed seeds

Low Risk / Desirable Traits

- Widely cultivated for long time periods. Despite ability to spread, no negative impacts have been documented
- Non-toxic
- Long time to reproductive maturity (20+ years)
- Landscaping and ornamental value (Christmas trees)
- Timber tree