

Key Words: Low Risk, Ornamental Tree, Edible Seeds, Large-seeded, Animal-dispersed

**Family:** *Araucariaceae*

**Taxon:** *Araucaria bidwillii*

**Synonym:** NA

**Common Name:** Bunya-bunya  
Bunya-pine  
Queensland pine

Questionnaire :	current 20090513	Assessor:	Chuck Chimera	Designation: L
Status:	Assessor Approved	Data Entry Person:	Chuck Chimera	WRA Score 1
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)	High
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	y
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	
302	Garden/amenity/disturbance weed		n=0, y = 1*multiplier (see Appendix 2)	
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	n
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	
409	Is a shade tolerant plant at some stage of its life cycle		y=1, n=0	
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	n
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	
604	Self-compatible or apomictic	y=1, n=-1	
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	n
705	Propagules water dispersed	y=1, n=-1	y
706	Propagules bird dispersed	y=1, n=-1	n
707	Propagules dispersed by other animals (externally)	y=1, n=-1	y
708	Propagules survive passage through the gut	y=1, n=-1	n
801	Prolific seed production (>1000/m2)	y=1, n=-1	n
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	y
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	y=-1, n=1	

Designation: L

WRA Score **1**

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**Supporting Data:**

101	2006. Boland, D.J./Brooker, M.I.H./Chippendale, G.M./William McDonald, M.. Forest trees of Australia. CSIRO Publishing, Collingwood, Australia	[Is the species highly domesticated? No] No evidence
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) 2-High] "A. bidwillii is known as bunya pine, from its indigenous distribution in coastal southeastern Queensland, Australia, between Gympie and the Bunya Mountains (Streets, 1962). It has been planted in Papua New Guinea, and on a small scale, or as an exotic in test plantings, in India, Malaysia (Streets, 1962), and Argentina (Golfari, 1961, 1962). In its native range it occurs in subtropical zones with warm humid summers; at altitudes up to about 1200 m (where there may be about 30 frosts per year)."
202	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Quality of climate match data 2-High]
203	1996. Rowell, R.J.. Ornamental Conifers for Australian Gardens. UNSW Press, Sydney	[Broad climate suitability (environmental versatility)? Yes] "As an ornamental tree, Bunya Pine has adapted to a wide range of climates and soils, commonly featuring as a specimen tree in parks and golf courses, but due care should be taken to avoid injury from the falling cones."
203	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Broad climate suitability (environmental versatility)? Yes] "In its native range it occurs in subtropical zones with warm humid summers; at altitudes up to about 1200 m (where there may be about 30 frosts per year)." [Elevation range exceeds 1000 m, demonstrating environmental versatility] "Climatic amplitude (estimates)  - Altitude range: 0 - 2000 m - Mean annual rainfall: 1000 - 4500 mm - Rainfall regime: summer - Dry season duration: 2 - 4 months - Mean annual temperature: 18 - 26°C - Mean maximum temperature of hottest month: 24 - 32°C - Mean minimum temperature of coldest month: 5 - 10°C - Absolute minimum temperature: > -4°C"
203	2006. Boland, D.J./Brooker, M.I.H./Chippendale, G.M./William McDonald, M.. Forest trees of Australia. CSIRO Publishing, Collingwood, Australia	[Broad climate suitability (environmental versatility)? Yes] "This species grows on the ranges within about 160 km of the coast, occupying various topographic positions, from the moist valley floors at low altitudes to ridgetops and upper slopes at higher localities." ... "It appears to be fairly frost resistant and has been grown in gardens in Hobart and Canberra."
203	2009. Orwa, C./Mutua, A./Kindt, R./Jamnadass, R./Simons, A.. Agroforestry Database: a tree reference and selection guide version 4.0. World Agroforestry Centre, ( <a href="http://www.worldagroforestry.org/af/treedb/">http://www.worldagroforestry.org/af/treedb/</a> )	[Broad climate suitability (environmental versatility)? Yes] "Altitude: 0-2500 m, Mean annual temperature: 20-27 deg. C, Mean annual rainfall: 900-2 000 mm"
204	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Native or naturalized in regions with tropical or subtropical climates? Yes] "In its native range it occurs in subtropical zones with warm humid summers; at altitudes up to about 1200 m (where there may be about 30 frosts per year). In Australia, A. bidwillii grows in mountain forests near the coast, preferring moist valley-bottoms at lower altitudes, but is also found on slopes at higher altitudes, particularly if the soils are rich and of volcanic origin."
205	1994. Kokwaro, J.O.. Flowering Plant Families of East Africa: An Introduction to Plant Taxonomy. East African Educational Publishers, Nairobi	[Does the species have a history of repeated introductions outside its natural range? Yes] "There are several species of both Araucaria and Agathis grown in East Africa as ornamentals." ... "1. Araucaria bidwillii (Bunya pine)"
205	2005. Staples, G.W./Herbst, D.R.. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	[Does the species have a history of repeated introductions outside its natural range? Yes] "...it is widely cultivated in tropical and warmer subtropical regions of the world." ... "Araucaria bidwillii was introduced to the Hawaiian Islands in 1851 as part of a shipment of plants from the Botanic Gardens at Sydney, Australia, to the 'King of the Sandwich Islands.' The seedlings were disseminated throughout the Islands; one of them, now a sizable tree, still grows in Foster Botanical Garden, Honolulu. Other exceptional specimens are located on the ground of Kaneohe ranch in windward Oahu and at Ulupalakua Ranch, Maui."

205	2012. Nickrent, D.L./Barcelona, J./Pelser, P./Molina, J.E./Callado, J.R.. Co's Digital Flora of the Philippines. <a href="http://www.philippineplants.org/">http://www.philippineplants.org/</a>	[Does the species have a history of repeated introductions outside its natural range? Yes] "Non-naturalized cultivated species:" ... "Araucaria bidwillii"
301	2006. Howell, C.J./Sawyer, J.W.D.. New Zealand naturalised vascular plant checklist. New Zealand Plant Conservation Network, Wellington, NZ <a href="http://www.nzpcn.org.nz">www.nzpcn.org.nz</a>	[Naturalized beyond native range? Not fully naturalized] "Araucaria bidwillii" ... Naturalised plant status = Casual "Casual is the name given to taxa that are: passively regenerating only in the immediate vicinity of the cultivated parent plant, or more widespread but only known as isolated or few individuals; garden escapes persisting only 2–3 years; or garden discards persisting vegetatively but not spreading sexually or asexually"(Webb et al. 1988)."
301	2012. Nickrent, D.L./Barcelona, J./Pelser, P./Molina, J.E./Callado, J.R.. Co's Digital Flora of the Philippines. <a href="http://www.philippineplants.org/">http://www.philippineplants.org/</a>	[Naturalized beyond native range? No evidence from Philippines] "Non-naturalized cultivated species:" ... "Araucaria bidwillii"
302	2007. Randall, R.P.. Global Compendium of Weeds - Araucaria bidwillii. <a href="http://www.hear.org/gcw/species/araucaria_bidwillii/">http://www.hear.org/gcw/species/araucaria_bidwillii/</a>	[Garden/amenity/disturbance weed] Listed as a weed of unspecified impacts in New Zealand [Subsequent searches could find no evidence of adverse impacts from New Zealand]
303	2004. Richardson, D.M./Rejmánek, M.. Conifers as invasive aliens: a global survey and predictive framework. Diversity and Distributions. 10: 321–331.	[Agricultural/forestry/horticultural weed? No evidence]
304	2004. Richardson, D.M./Rejmánek, M.. Conifers as invasive aliens: a global survey and predictive framework. Diversity and Distributions. 10: 321–331.	[Environmental weed? No evidence] "Table 2 Predicted invasiveness (Z scores; modified from Rejmánek & Richardson, 1996; see Rejmánek et al., 2004a) of selected non Pinus conifers and numbers of countries (or regions/states within large countries) where the taxon is known to be naturalized (regenerating naturally) or invasive (Appendix 1; see text for criteria for labelling taxa as 'naturalized/'invasive')" ... "Araucaria bidwillii ... Naturalized records = 0; Invasive records = 0"
305	2004. Richardson, D.M./Rejmánek, M.. Conifers as invasive aliens: a global survey and predictive framework. Diversity and Distributions. 10: 321–331.	[Congeneric weed? Yes] "Araucaria araucana (Argentina; Great Britain*); A. columnaris (Hawaii); A. heterophylla (New Zealand)" [A. araucana = invasive in Great Britain; the other two species are naturalized]
305	2007. Randall, R.P.. Global Compendium of Weeds - Index. <a href="http://www.hear.org/gcw/">http://www.hear.org/gcw/</a>	[Congeneric weed? Yes] Multiple Araucaria species are listed as naturalized and/or invasive weeds.
401	1993. Gilman, E.F./Watson, D.G.. Araucaria bidwillii - False Monkey-Puzzletree. Fact Sheet ST-82. University of Florida IFAS Extension, Gainesville, FL <a href="http://hort.ufl.edu/database/documents/pdf/tree_fact_sheets/arabida.pdf">hort.ufl.edu/database/documents/pdf/tree_fact_sheets/arabida.pdf</a>	[Produces spines, thorns or burrs? No] "Trunk/bark/branches: droop as the tree grows, and will require pruning for vehicular or pedestrian clearance beneath the canopy; not particularly showy; should be grown with a single leader; no thorns"
401	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Produces spines, thorns or burrs? No] "A dioecious tree to 50 m tall; the crown of young trees is symmetrical and pyramidal in shape. Bark thick, peeling off in thin layers."
402	2012. Braine, J.W./Curcio, G.R./Wachowicz, C.M./Hansel, F.A.. Allelopathic effects of Araucaria angustifolia needle extracts in the growth of Lactuca sativa seeds. Journal of Forest Research. Online First: DOI 10.1007/s10310-011-0314-1.	[Allelopathic? Unknown. Other Araucaria species have allelopathic properties] "Araucaria forest, named due to the high abundance of Araucaria angustifolia, occurs mainly in the southern Brazilian highlands, and the abundance of A. angustifolia in the forest is a current forest issue. The present study aimed at evaluating a potential allelopathic effect of A. angustifolia needle extracts that could mediate plant successional dynamics in the Araucaria forests. Senescent araucaria needles from A. angustifolia were evaluated for their allelopathic potential on Lactuca sativa through an in vitro study. The effect was evaluated by determining the germination of seeds, length of seedling and germination rate. The allelopathic potential of the A. angustifolia was confirmed for the highest doses tested (187.5 and 250 mg of the extracts). The potential allelochemical compounds identified were ent-kaurene and phyllocladene. In conclusion, A. angustifolia showed a potential allelopathic effect that may play an important role in successional dynamics of Araucaria forests."
403	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Parasitic? No] "A dioecious tree to 50 m tall; the crown of young trees is symmetrical and pyramidal in shape. Bark thick, peeling off in thin layers."
404	2012. WRA Specialist. Personal Communication.	[Unpalatable to grazing animals? Unknown]
405	2008. Wagstaff, D.J.. International poisonous plants checklist: an evidence-based reference. CRC Press, Boca Raton, FL	[Toxic to animals? No evidence]

406	1993. Gilman, E.F./Watson, D.G.. Araucaria bidwillii - False Monkey-Puzzletree. Fact Sheet ST-82. University of Florida IFAS Extension, Gainesville, FL hort.ufl.edu/database/documents/pdf/tree_fact_sheets/arabida.pdf	[Host for recognized pests and pathogens? No] "Pest resistance: long-term health usually not affected by pests" ... "Pests Scale and sooty mold are minor problems. Diseases No diseases are of major concern. Leaf spots are a minor problem."
407	2001. Hegarty, M.P./Hegarty, E.E./Wills, R.B.H.. Food Safety of Australian Plant Bushfoods. RIRDC Publication No 01/28. Rural Industries Research and Development Corporation, Kingston, Australia	[Causes allergies or is otherwise toxic to humans? No evidence] "Traditional uses. Large quantities of the nuts were consumed in South-East Queensland during the feasting season. In years when there were heavy crops, Aboriginal groups would travel far beyond their normal range to participate in the feasts. Bunya nuts are one of the few native Australian plant foods which have been popular in both traditional and European diets, e.g. Iselin & Shipway (c.1998). Aboriginal people placed surplus nuts in waterholes or soaks in times of plenty, or buried them, for later consumption. During germination, an "after-nut", a form of crisp, coconut-flavoured tuber of approximately the same size as the original nut, forms on the main root-stem and was also eaten (Noel 1991)." ... "Toxicological. No reliable records of adverse effects attributed to eating bunya nuts have been located. Cleland (1943) notes a comment from a Gympie doctor, who attributed a case of asthma to a patient having eaten the nuts, but gives no further information. There seem to have been no other similar reports. No reports have been found of adverse effects from the traditional consumption of nuts of the very similar, closely related South American species for various edible products."
407	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Causes allergies or is otherwise toxic to humans? No evidence] "The large seeds are edible (Noel, 1992). It also exudes a gum resin."
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]
408	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Creates a fire hazard in natural ecosystems? No evidence] Although litter may increase risk of fire, there is no evidence that these trees do increase fire risks in native or introduced areas.
409	1993. Gilman, E.F./Watson, D.G.. Araucaria bidwillii - False Monkey-Puzzletree. Fact Sheet ST-82. University of Florida IFAS Extension, Gainesville, FL hort.ufl.edu/database/documents/pdf/tree_fact_sheets/arabida.pdf	[Is a shade tolerant plant at some stage of its life cycle] "Light requirement: tree grows in full sun"
409	2012. Plants for a Future Database. Araucaria bidwillii. http://www.pfaf.org/user/Plant.aspx?LatinName=Araucaria+bidwillii	[Is a shade tolerant plant at some stage of its life cycle? Possibly] "It can grow in semi-shade (light woodland) or no shade."
410	1993. Gilman, E.F./Watson, D.G.. Araucaria bidwillii - False Monkey-Puzzletree. Fact Sheet ST-82. University of Florida IFAS Extension, Gainesville, FL hort.ufl.edu/database/documents/pdf/tree_fact_sheets/arabida.pdf	[Tolerates a wide range of soil conditions? Yes] "Growing best in full sun locations, this tree thrives on a variety of soils and is moderately salt tolerant."
410	1996. Rowell, R.J.. Ornamental Conifers for Australian Gardens. UNSW Press, Sydney	[Tolerates a wide range of soil conditions? Yes] "As an ornamental tree, Bunya Pine has adapted to a wide range of climates and soils,..."
410	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Tolerates a wide range of soil conditions? Possibly] "Soil descriptors - Soil texture: medium; heavy - Soil drainage: free - Soil reaction: acid; neutral"
411	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Climbing or smothering growth habit? No] "A dioecious tree to 50 m tall; the crown of young trees is symmetrical and pyramidal in shape. Bark thick, peeling off in thin layers."
412	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Forms dense thickets? Yes] "In Queensland, it is never found in pure stands, but occurs scattered as the predominant species in rain forests, associated with hoop pine (A. cunninghamii), although usually on lower and moister sites than hoop pine."
501	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Aquatic? No] "A dioecious tree to 50 m tall; the crown of young trees is symmetrical and pyramidal in shape. Bark thick, peeling off in thin layers."
502	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Grass? No] Araucariaceae
503	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Nitrogen fixing woody plant? No] Araucariaceae

504	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)? No] "A dioecious tree to 50 m tall; the crown of young trees is symmetrical and pyramidal in shape. Bark thick, peeling off in thin layers."
601	2004. Pye, M.G./Gadek, P.A.. Genetic diversity, differentiation and conservation in <i>Araucaria bidwillii</i> (Araucariaceae), Australia's Bunya pine. Conservation Genetics. 5(5): 619-629.	[Evidence of substantial reproductive failure in native habitat? No, but suffering from range reduction] "Australia's Bunya pine ( <i>Araucaria bidwillii</i> Hook., Araucariaceae) represents one such species that has undergone extensive range reductions and fragmentation, now occurring in only 2 widely disjunct regions in North and South Queensland, Australia. Extant populations occur from as far north as Mt Lewis in North Queensland (16 30¢ S) and as far south as the wider Brisbane area (26°15' S–27°00' S), with a substantial break in distribution of approximately 1000 kms (Figure 1). The northern populations are small and are suggested to be relictual while the southern populations are generally more extensive."
602	2006. Boland, D.J./Brooker, M.I.H./Chippendale, G.M./William McDonald, M.. Forest trees of Australia. CSIRO Publishing, Collingwood, Australia	[Produces viable seed? Yes] "Mature cones are ovoid, very large, up to 20 x 30 cm, with woody scales up to 15 cm broad and bearing a single seed about 5 cm long, loosely united with the scale. The seed is egg-shaped with one end pointed. Germination is hypogeal."
602	2009. Orwa, C./Mutua, A./Kindt, R./Jamnadass, R./Simons, A.. Agroforestry Database:a tree reference and selection guide version 4.0. World Agroforestry Centre, ( <a href="http://www.worldagroforestry.org/af/treedb/">http://www.worldagroforestry.org/af/treedb/</a> )	[Produces viable seed? Yes] "Seed quality varies annually; if sufficient pollen is available, seed quality is usually good."
603	2012. WRA Specialist. Personal Communication.	[Hybridizes naturally? Unknown]
604	1996. Rowell, R.J.. Ornamental Conifers for Australian Gardens. UNSW Press, Sydney	[Self-compatible or apomictic? Possibly] "The tree is usually dioecious but occasional trees bear flowers of both sexes."
604	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Self-compatible or apomictic? No, if dioecious] "A dioecious tree to 50 m tall; the crown of young trees is symmetrical and pyramidal in shape. Bark thick, peeling off in thin layers."
604	2006. Boland, D.J./Brooker, M.I.H./Chippendale, G.M./William McDonald, M.. Forest trees of Australia. CSIRO Publishing, Collingwood, Australia	[Self-compatible or apomictic? Possibly] "Male and female strobili are usually borne on the same tree. Males - up to 20 cm long, produced at the ends of short lateral branches and made up of numerous spirally arranged scales, each with a diamond-shaped expanded summit covering about 12 pollen cells. Females - borne on short lateral branches and ovoid, made up of numerous bracts with sharp projections on the outer end; each bract has an ovuliferous scale attached to the upper surface."
604	2009. Orwa, C./Mutua, A./Kindt, R./Jamnadass, R./Simons, A.. Agroforestry Database:a tree reference and selection guide version 4.0. World Agroforestry Centre, ( <a href="http://www.worldagroforestry.org/af/treedb/">http://www.worldagroforestry.org/af/treedb/</a> )	[Self-compatible or apomictic? Possibly] "Male and female flowers are typically found on different parts of the same tree. Male flowers usually appear at the base of the crown in young trees and female flowers at the top. As the tree grows older, the male and female flowers move closer to each other. Bisexual flowers are also found."
605	2004. Pye, M.G./Gadek, P.A.. Genetic diversity, differentiation and conservation in <i>Araucaria bidwillii</i> (Araucariaceae), Australia's Bunya pine. Conservation Genetics. 5(5): 619-629.	[Requires specialist pollinators? No] "This conifer is wind pollinated and extremely long-lived – factors which generally contribute to a low degree of population differentiation (Nybom and Bartish 2000)."
606	1993. Gilman, E.F./Watson, D.G.. <i>Araucaria bidwillii</i> - False Monkey-Puzzletree. Fact Sheet ST-82. University of Florida IFAS Extension, Gainesville, FL <a href="http://hort.ufl.edu/database/documents/pdf/tree_fact_sheets/arabida.pdf">hort.ufl.edu/database/documents/pdf/tree_fact_sheets/arabida.pdf</a>	[Reproduction by vegetative fragmentation? No] "Propagation is by seeds or cuttings of erect shoot tips only."
607	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Minimum generative time (years)? 4+] "The cones are very large, about 30 cm long by 23 cm across, and seeds are also large (5-6.5 cm x 2.5 cm), maturing in the third year." ... "It has been planted locally in afforestation areas in Australia, but much less so than <i>A. cunninghamii</i> , as it is more slow-growing, is more heavily branched (compression wood can be a problem), and is more difficult to establish."
607	2009. Orwa, C./Mutua, A./Kindt, R./Jamnadass, R./Simons, A.. Agroforestry Database:a tree reference and selection guide version 4.0. World Agroforestry Centre, ( <a href="http://www.worldagroforestry.org/af/treedb/">http://www.worldagroforestry.org/af/treedb/</a> )	[Minimum generative time (years)? 15+] "Araucarias generally begin to flower and fruit between the ages of 15 and 20 years."

701	2006. Boland, D.J./Brooker, M.I.H./Chippendale, G.M./William McDonald, M.. Forest trees of Australia. CSIRO Publishing, Collingwood, Australia	[Propagules likely to be dispersed unintentionally? No] "Mature cones are ovoid, very large, up to 20 x 30 cm, with woody scales up to 15 cm broad and bearing a single seed about 5 cm long, loosely united with the scale." [Unlikely such large seeds, which lack means of external attachment, would be inadvertently dispersed]
702	2005. Staples, G.W./Herbst, D.R.. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	[Propagules dispersed intentionally by people? Yes] "...it is widely cultivated in tropical and warmer subtropical regions of the world."
702	2009. Orwa, C./Mutua, A./Kindt, R./Jamnadass, R./Simons, A.. Agroforestry Database:a tree reference and selection guide version 4.0. World Agroforestry Centre, ( <a href="http://www.worldagroforestry.org/af/treedb/">http://www.worldagroforestry.org/af/treedb/</a> )	[Propagules dispersed intentionally by people? Yes] "Shade and shelter: A. bidwillii can be planted as a windbreak. Ornamental: Is planted in parks and roadsides as an ornamental."
703	2006. Boland, D.J./Brooker, M.I.H./Chippendale, G.M./William McDonald, M.. Forest trees of Australia. CSIRO Publishing, Collingwood, Australia	[Propagules likely to disperse as a produce contaminant? No] "Mature cones are ovoid, very large, up to 20 x 30 cm, with woody scales up to 15 cm broad and bearing a single seed about 5 cm long, loosely united with the scale." [Unlikely such large seeds, which lack means of external attachment, would be inadvertently dispersed as a produce contaminant]
704	2006. Boland, D.J./Brooker, M.I.H./Chippendale, G.M./William McDonald, M.. Forest trees of Australia. CSIRO Publishing, Collingwood, Australia	[Propagules adapted to wind dispersal? No] "Mature cones are ovoid, very large, up to 20 x 30 cm, with woody scales up to 15 cm broad and bearing a single seed about 5 cm long, loosely united with the scale." [No adaptations for wind dispersal]
705	2011. Earle, C.J.. The Gymnosperm Database - Araucaria bidwillii. <a href="http://www.conifers.org/ar/Araucaria_bidwillii.php">http://www.conifers.org/ar/Araucaria_bidwillii.php</a>	[Propagules water dispersed? Yes. Capable of water dispersal] "At maturity ... the intact female cone with scales still green on the surface falls from the tree. As the cone is very heavy, and as the seeds usually remain in the cone until after it falls from the tree, seed dispersal is limited to the area covered by the cone rolling on slopes, or being transported by water flowing in creeks or gullies" (Huth 2002)."
706	2009. Orwa, C./Mutua, A./Kindt, R./Jamnadass, R./Simons, A.. Agroforestry Database:a tree reference and selection guide version 4.0. World Agroforestry Centre, ( <a href="http://www.worldagroforestry.org/af/treedb/">http://www.worldagroforestry.org/af/treedb/</a> )	[Propagules bird dispersed? No] "Seeds joined to the cone scales, brown, pear-shaped or kite shaped, up to 6.5 x 3 cm." ... "The seeds generally fall within the periphery of the crown."
707	2004. Kanowski, J./Catterall, C.P./Dennis, A.J./Westcott, D.A. (eds).. Animal-Plant Interactions in Rainforest Conservation and Restoration. Cooperative Research Centre for Tropical Rainforest Ecology & Management. Rainforest CRC, Cairns	[Propagules dispersed by other animals (externally)? Yes] "Most studies have shown that the majority of dispersal is conducted by birds, and that small-fruited disturbance-adapted plants (<10 mm diameter) are more commonly dispersed than large-fruited species (>30 mm diameter). Nevertheless, in forest adjacent to restoration plots, large fruited species such as E. insignis, grey milkwood Cerbera inflata, S. cormiflorum and bunya pine Araucaria bidwillii have established at distances of 50 – 300 m from the nearest parent tree, clearly due to vertebrate dispersal (Tucker and Simmons, unpublished data). In three of four cases, the seedlings have been located directly at the base of stems, indicating that caching by rodents was a likely cause. Whilst their role as seed predators is well established, it is likely that rodents are also responsible for sporadic, though important, dispersal events."
707	2005. Smith, I.R. et al.. The role of native rodents in seed dispersal & seed predation of the Bunya Pine (Araucaria bidwillii). In: 22nd Ann. Conf. of the Australian & New Zealand Soc. for Comparative Physiology & Biochemistry, 9-11 Dec 2005, Dunedin, NZ	[Propagules dispersed by other animals (externally)? Yes] "The bunya pine (A. bidwillii) has a very limited distribution within Australia. Part of the reason for this is likely to be its poor seed dispersal. Macropods, possums and rodents are known predators of both the seeds and tubers. However, there are no reported dispersal agents for A. bidwillii seeds. The aim of this research is to determine the extent to which A. bidwillii seeds are destroyed or dispersed by native rodents. Predation and dispersal of A. bidwillii seeds are being examined in southern Queensland in a small stand of A. bidwillii at Mt Mee, and in a larger stand at the Bunya Mountains and in northern New South Wales in a similar habitat devoid of A. bidwillii near Queen Mary Falls. At each site, groups of 100 seeds are placed on the soil; 25 seeds are covered by wire mesh to exclude predators and 75 are left uncovered. Each seed is marked by a pink tag to assist in locating it and tracking its movement. Activity of rodents is monitored using CCD cameras connected to video-recorders. Hair tubes are also utilized for identification of rodents. Preliminary results indicate that a small but significant amount of seeds are eaten. However, enough seeds escape predation to produce seedlings. Germination is rapid under field conditions. Seeds were dispersed more than 16 m from their original locations, permitting some to germinate in open sites away from the bunya pine canopy, where they are more likely to survive."

707	2007. Butler, D.W./Green, R.J./Lamb, D./McDonald, W.J.F./Forster, P.I.. Biogeography of seed-dispersal syndromes, life-forms and seed sizes among woody rain-forest plants in Australia's subtropics. <i>Journal of Biogeography</i> . 34: 1736-1750.	[Propagules dispersed by other animals (externally)? Yes. :Large, unadorned seed presumed to be "externally" dispersed via scatter-hoarding] "The low average seed diameter of unadorned diaspores concealed a significant group of very large-seeded species (> 10 mm diameter) with unadorned diaspores (e.g. <i>Araucaria bidwillii</i> , <i>Castanospermum australe</i> and <i>Macadamia</i> spp.). Species with unadorned or fleshy diaspores tended to have very similar average seed diameters within sites, particularly towards the wetter end of the spectrum. In other words, species with unadorned diaspores in wetter forests were relatively unusual but tended to have large seed. Such species are likely to be scatter-hoarded by rodents (Gautier-Hion et al., 1985)."
708	2011. Earle, C.J.. The Gymnosperm Database - <i>Araucaria bidwillii</i> . <a href="http://www.conifers.org/ar/Araucaria_bidwillii.php">http://www.conifers.org/ar/Araucaria_bidwillii.php</a>	[Propagules survive passage through the gut? No. Seeds consumed as food or dispersed intact for later consumption] "The absence of effective dispersal is one likely explanation for the very restricted range of this species. The peculiar dispersal mechanism would seem to imply that, as with <i>Pinus albicaulis</i> of North America, there should be some sort of animal vector (perhaps now extinct) to transport the bunya nuts. Smith et al. (2007) investigated this problem by tagging seeds and placing them on the ground with naturally fallen seeds, during a mast year. Some seeds were eaten by animals, but some were carried up to 8 m from the tree, sometimes in an uphill direction. Later, seeds were placed and monitored with a video camera, which recorded seed collection and dispersal by the short-eared possum <i>Trichosurus caninus</i> . This is the first evidence of an animal vector, other than humans, that can disperse <i>A. bidwillii</i> seed. It is worth considering, though, that the large, nutritious bunya seed is well adapted to survival within the forest environment. It germinates best in moist conditions, and the generous food supply in the seed facilitates hypogeal germination, which may confer a competitive advantage to a seedling forced to compete with other seedlings trying to colonize a forest edge or gap environment. Thus the large bunya seed may function not to lure animal dispersers, but to produce a competitive seedling."
801	1993. Gilman, E.F./Watson, D.G.. <i>Araucaria bidwillii</i> - False Monkey-Puzzletree. Fact Sheet ST-82. University of Florida IFAS Extension, Gainesville, FL <a href="http://hort.ufl.edu/database/documents/pdf/tree_fact_sheets/arabida.pdf">hort.ufl.edu/database/documents/pdf/tree_fact_sheets/arabida.pdf</a>	[Prolific seed production (>1000/m <sup>2</sup> )? No] "The large, spiny, 10 to 15-pound cones are rare in cultivation."
802	2008. Royal Botanic Gardens Kew. Seed Information Database (SID). Version 7.1. <a href="http://data.kew.org/sid/">http://data.kew.org/sid/</a>	[Evidence that a persistent propagule bank is formed (>1 yr)? No] "Storage Behaviour: Recalcitrant Storage Conditions: Seeds intolerant of desiccation (Tompsett, 1984a). LSMC= 35% (Tompsett, 1994). Seeds tolerate desiccation to 25% mc, but none survives further desiccation to 15% (Doley, 1990)"
802	2009. Orwa, C./Mutua, A./Kindt, R./Jamnadass, R./Simons, A.. Agroforestry Database:a tree reference and selection guide version 4.0. World Agroforestry Centre, ( <a href="http://www.worldagroforestry.org/af/treedb/">http://www.worldagroforestry.org/af/treedb/</a> )	[Evidence that a persistent propagule bank is formed (>1 yr)? No] "Araucaria seeds have short viability under atmospheric conditions and should be sown within a month of collection. To be stored for any amount of time, seeds must be partially dried; the acceptable safe drying level is 25-40% mc. At this mc, seeds can be stored for some time at 5 deg. C. They should be sown as soon as they are removed from cold storage as they rapidly lose viability."
803	2012. WRA Specialist. Personal Communication.	[Well controlled by herbicides? Unknown] No information on herbicide efficacy or chemical control of this species
804	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Tolerates, or benefits from, mutilation, cultivation, or fire? Yes. Can be grown from stumps] " - Stand establishment using stump plants; natural regeneration; planting stock"
804	2009. Orwa, C./Mutua, A./Kindt, R./Jamnadass, R./Simons, A.. Agroforestry Database:a tree reference and selection guide version 4.0. World Agroforestry Centre, ( <a href="http://www.worldagroforestry.org/af/treedb/">http://www.worldagroforestry.org/af/treedb/</a> )	[Tolerates, or benefits from, mutilation, cultivation, or fire? Yes] "Trees may coppice slightly from cut branches and stems, and they should be planted under full sunlight."
805	2012. WRA Specialist. Personal Communication.	[Effective natural enemies present locally (e.g. introduced biocontrol agents)? Unknown] Probably No

## **Summary of Risk Traits**

### **High Risk / Undesirable Traits**

- Casual in New Zealand (but not clearly naturalized)
- Broad elevation range and climatic tolerance
- Tolerates many soil conditions
- Can coppice or sprout from stumps

### **Low Risk / Desirable Traits**

- No history of or reputation for invasiveness
- Edible seeds
- Non-toxic
- Landscaping and ornamental value
- Large seeds unlikely to be inadvertently dispersed
- Takes 15-20 years to reach maturity
- Seeds will not persist in the soil