

<b>Taxon:</b> <i>Cosmos bipinnatus</i>	<b>Family:</b> Asteraceae
<b>Common Name(s):</b> garden cosmos Mexican aster	<b>Synonym(s):</b> <i>Bidens formosa</i> (Bonato) Sch. Bip. <i>Coreopsis formosa</i> Bonato

<b>Assessor:</b> No Assessor	<b>Status:</b> Assessor Approved	<b>End Date:</b> 24 Feb 2014
<b>WRA Score:</b> 9.0	<b>Designation:</b> H(HPWRA)	<b>Rating:</b> High Risk

**Keywords:** Naturalized, Garden Weed, Annual, Bee-Pollinated, Self-incompatible

Qsn #	Question	Answer Option	Answer
101	Is the species highly domesticated?	y=-3, n=0	n
102	Has the species become naturalized where grown?		
103	Does the species have weedy races?		
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	y
302	Garden/amenity/disturbance weed	n=0, y = 1*multiplier (see Appendix 2)	y
303	Agricultural/forestry/horticultural weed		
304	Environmental weed		
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		
403	Parasitic	y=1, n=0	n
404	Unpalatable to grazing animals	y=1, n=-1	n
405	Toxic to animals		
406	Host for recognized pests and pathogens	y=1, n=0	n
407	Causes allergies or is otherwise toxic to humans		
408	Creates a fire hazard in natural ecosystems	y=1, n=0	n
409	Is a shade tolerant plant at some stage of its life cycle	y=1, n=0	n

Qsn #	Question	Answer Option	Answer
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		
604	Self-compatible or apomictic	y=1, n=-1	n
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation	y=1, n=-1	y
607	Minimum generative time (years)	1 year = 1, 2 or 3 years = 0, 4+ years = -1	1
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)		
702	Propagules dispersed intentionally by people	y=1, n=-1	y
703	Propagules likely to disperse as a produce contaminant		
704	Propagules adapted to wind dispersal	y=1, n=-1	n
705	Propagules water dispersed	y=1, n=-1	n
706	Propagules bird dispersed		
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)		
802	Evidence that a persistent propagule bank is formed (>1 yr)		
803	Well controlled by herbicides	y=-1, n=1	y
804	Tolerates, or benefits from, mutilation, cultivation, or fire		
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)		

**Supporting Data:**

Qsn #	Question	Answer
101	Is the species highly domesticated?	n
	Source(s)	Notes
	Webb, C. J., Sykes, W. R., & Garnock-Jones, P. J. 1988. Flora of New Zealand Volume IV. Botany Division, DSIR, Christchurch, New Zealand	"Achenes of wild N.Z. material lack pappus awns (Fig. 22); most cvs of <i>C. bipinnatus</i> are also awnless, although awned and awnless forms occur in indigenous populations. " [Not highly domesticated, but certain cultivars may have reduced dispersibility due to absence of awns]

102	Has the species become naturalized where grown?	
	Source(s)	Notes
	WRA Specialist. 2014. Personal Communication	Not applicable

103	Does the species have weedy races?	
	Source(s)	Notes
	WRA Specialist. 2014. Personal Communication	Not applicable

201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"	High
	Source(s)	Notes
	USDA, ARS, National Genetic Resources Program. Germplasm Resources Information Network - (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. URL: <a href="http://www.ars-grin.gov/">http://www.ars-grin.gov/</a> . [Accessed 20 Feb 2014]	"Native: NORTHERN AMERICA (Check conservation status in U.S. & Canada in NatureServe Explorer database) Southwestern U.S.A.: United States - Arizona [s.] Northern Mexico: Mexico - Baja Sur, Chihuahua, Coahuila, Durango, Nuevo Leon, San Luis Potosi, Sinaloa, Sonora, Zacatecas [s.] Southern Mexico: Mexico - Aguascalientes, Chiapas, Federal District, Guanajuato, Guerrero, Hidalgo, Jalisco, Mexico, Michoacan, Morelos, Nayarit, Oaxaca, Puebla, Queretaro, Tlaxcala, Veracruz"

202	Quality of climate match data	High
	Source(s)	Notes
	USDA, ARS, National Genetic Resources Program. Germplasm Resources Information Network - (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. URL: <a href="http://www.ars-grin.gov/">http://www.ars-grin.gov/</a> . [Accessed 20 Feb 2014]	

203	Broad climate suitability (environmental versatility)	y
	Source(s)	Notes

Qsn #	Question	Answer
	Missouri Botanical Garden. 2014. <i>Cosmos bipinnatus</i> . <a href="http://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?kempercode=b733">http://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?kempercode=b733</a> . [Accessed 19 Feb 2014]	"Zone: 2 to 11" [Able to grow in >5 Zones]
	Tropicos.org. 2014. Tropicos [Online Database]. Missouri Botanical Garden. <a href="http://www.tropicos.org/">http://www.tropicos.org/</a> . [Accessed 20 Feb 2014]	Collected from 680 m in El Salvador (13°55'00"N 088°06'00"W) to 2700 m in Mexico (19°15'42"N 099°12'14"W) [Elevation range exceeds 1000 m from within native range, demonstrating environmental versatility]

204	Native or naturalized in regions with tropical or subtropical climates	y
	Source(s)	Notes
	Fosberg, F. R. & Sachet, M-H. 1980. Flora of Micronesia, 4: Caprifoliaceae-Compositae. Smithsonian Contributions to Botany 46: 1-71	"A pantropical and temperate cultivated garden ornamental not commonly seen in Micronesia."
	USDA, ARS, National Genetic Resources Program. Germplasm Resources Information Network - (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. URL: <a href="http://www.ars-grin.gov/">http://www.ars-grin.gov/</a> . [Accessed 20 Feb 2014]	"Native: NORTHERN AMERICA (Check conservation status in U.S. & Canada in NatureServe Explorer database) Southwestern U.S.A.: United States - Arizona [s.] Northern Mexico: Mexico - Baja Sur, Chihuahua, Coahuila, Durango, Nuevo Leon, San Luis Potosi, Sinaloa, Sonora, Zacatecas [s.] Southern Mexico: Mexico - Aguascalientes, Chiapas, Federal District, Guanajuato, Guerrero, Hidalgo, Jalisco, Mexico, Michoacan, Morelos, Nayarit, Oaxaca, Puebla, Queretaro, Tlaxcala, Veracruz"
	Snyder, L.C. 1991. Flowers for Northern Gardens. University of Minnesota Press, Minneapolis, MN	"Plants native to Mexico"

205	Does the species have a history of repeated introductions outside its natural range?	y
	Source(s)	Notes
	Staples, G.W. & Herbst, D.R. 2005. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	"...cosmos has become a staple of summer flower gardens on the mainland and winter annual beds here in Hawai'i."

Qsn #	Question	Answer
	<p>USDA, ARS, National Genetic Resources Program. Germplasm Resources Information Network - (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. URL: <a href="http://www.ars-grin.gov/">http://www.ars-grin.gov/</a>. [Accessed 20 Feb 2014]</p>	<p>"AFRICA                      Southern Africa: South Africa                      ASIA-TEMPERATE                      China: China                      Eastern Asia: Taiwan                      ASIA-TROPICAL                      Indian Subcontinent: Bhutan; India; Nepal                      AUSTRALASIA                      Australia: Australia - New South Wales, Queensland                      New Zealand: New Zealand                      EUROPE                      Northern Europe: United Kingdom                      Middle Europe: Belgium                      East Europe: Belarus; Estonia; Latvia; Lithuania; Moldova; Russian Federation - European part; Ukraine [incl. Krym]                      Southeastern Europe: Croatia; Montenegro; Romania; Slovenia                      Southwestern Europe: Spain                      NORTHERN AMERICA (Check conservation status in U.S. &amp; Canada in NatureServe Explorer database)                      Northeastern U.S.A.: United States - Connecticut, Maine, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, West Virginia                      North-Central U.S.A.: United States - Illinois, Kansas, Minnesota, Missouri, Oklahoma, Wisconsin                      Northwestern U.S.A.: United States - Colorado, Wyoming                      Southeastern U.S.A.: United States - Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, North Carolina, South Carolina, Tennessee, Virginia                      South-Central U.S.A.: United States - New Mexico, Texas                      Southwestern U.S.A.: United States - California, Utah                      SOUTHERN AMERICA                      Caribbean: Cuba; Hispaniola                      Mesoamerica: Costa Rica; Guatemala                      Brazil: Brazil - Sao Paulo                      Western South America: Bolivia; Colombia                      Southern South America: Argentina"</p>

301	Naturalized beyond native range	y
	Source(s)	Notes
	<p>Bowen, B., Johnson, K., Franklin, S., Call, G. &amp; Webber, M. (2002). Invasive Exotic Pest Plants in Tennessee. <i>Journal of the Tennessee Academy of Science</i> 77(2):45-48</p>	<p>"Exotic plants that naturalize and may become a problem in the future. At this time more information is needed, and there is no consensus about their status." [List includes <i>Cosmos bipinnatus</i>]</p>
	<p>Richardson, F. J., Richardson, R. G., &amp; Shepherd, R. C. H. 2011. <i>Weeds of the South-East: An Identification Guide for Australia</i>. Second Edition. RG and FJ Richardson, Victoria, Australia</p>	<p>"It has escaped gardens in warmer districts. [NSW, Qld]"</p>
	<p>Missouri Botanical Garden. 2014. <i>Cosmos bipinnatus</i>. <a href="http://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?kempercode=b733">http://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?kempercode=b733</a>. [Accessed ]</p>	<p>"Plants have escaped gardens and naturalized, particularly along roadsides, fields and waste areas, in many parts of the U. S."</p>

Qsn #	Question	Answer
	Miyawaki, S., & Washitani, I. (2004). Invasive alien plant species in riparian areas of Japan: the contribution of agricultural weeds, revegetation species and aquacultural species. <i>Global Environmental Research</i> 8(1): 89-101	"Table 5 Invasive alien plant species identified along 123 rivers (109 river systems) in Japan." [Includes <i>Cosmos bipinnatus</i> which is categorized as W: agricultural weed]
	Howell, C. J., & Sawyer, J. W. (2006). New Zealand naturalised vascular plant checklist. New Zealand Plant Conservation Network, Wellington, NZ	<i>Cosmos bipinnatus</i> - Fully naturalised
	Webb, C. J. (1987). Checklist of dicotyledons naturalised in New Zealand 18. Asteraceae (Compositae) subfamily Asteroideae. <i>New Zealand Journal of Botany</i> , 25(4), 489-501.	DISTRIBUTION: Coromandel, Wellington (Hutt River); Nelson City, Buller Gorge, lowland Marlborough, Canterbury, C Otago.

302	Garden/amenity/disturbance weed	y
	Source(s)	Notes
	Nursery and Garden Industry Australia. 2012. Grow Me Instead - A Guide for Gardeners in Queensland Darling Downs. <a href="http://www.growmeinstead.com.au/public/GMI-brochure-Qld-Darling-Downs.pdf">http://www.growmeinstead.com.au/public/GMI-brochure-Qld-Darling-Downs.pdf</a> . [Accessed ]	" <i>Cosmos bipinnatus</i> " ... "As this plant is 'free seeding' it only takes a single plant to establish a broad colony on roadsides and other natural areas. The plant can also regenerate from a small piece of stem, so effective disposal of garden waste is important." [This gardening guide discourages the planting of <i>Cosmos bipinnatus</i> as an invasive, and recommends the planting of some native alternatives in Australia]
	Hansen, S. & Drost, D. 2013. <i>Cosmos</i> in the Garden. Utah State University Cooperative Extension. <a href="http://extension.usu.edu/htm/publications/file=15108">http://extension.usu.edu/htm/publications/file=15108</a> . [Accessed ]	"In many texts <i>Cosmos</i> is referred to as a weed due to heavy seed production and self sowing. To avoid this problem, plant in an area where you want it to naturally reseed."
	Cornell University. 2006. <i>Cosmos</i> ( <i>C. bipinnatus</i> ). <a href="http://www.gardening.cornell.edu/homegardening/scene9a85.html">http://www.gardening.cornell.edu/homegardening/scene9a85.html</a> . [Accessed 20 Feb 2014]	"May be weedy due to self seeding."

303	Agricultural/forestry/horticultural weed	
	Source(s)	Notes
	Miyawaki, S., & Washitani, I. (2004). Invasive alien plant species in riparian areas of Japan: the contribution of agricultural weeds, revegetation species and aquacultural species. <i>Global Environmental Research</i> 8(1): 89-101	"Table 5 Invasive alien plant species identified along 123 rivers (109 river systems) in Japan." [Includes <i>Cosmos bipinnatus</i> which is categorized as W: agricultural weed. Impacts are not specified in this publication]
	Randall, R.P. 2012. <i>A Global Compendium of Weeds</i> . 2nd Edition. Department of Agriculture and Food, Western Australia	A few references in this book list <i>Cosmos bipinnatus</i> as an agricultural weed, but subsequent searches found no documented evidence of negative impacts
	WRA Specialist. 2014. Personal Communication	Possibly, but no evidence of negative impacts on crop yields have been found

304	Environmental weed	
	Source(s)	Notes
	Nursery and Garden Industry Australia. 2012. Grow Me Instead - A Guide for Gardeners in Queensland Darling Downs. <a href="http://www.growmeinstead.com.au/public/GMI-brochure-Qld-Darling-Downs.pdf">http://www.growmeinstead.com.au/public/GMI-brochure-Qld-Darling-Downs.pdf</a> . [Accessed ]	"It seeds freely and can quickly establish stands in natural areas." [May potentially impact native vegetation, but no details were provided in this publication]

Qsn #	Question	Answer
	Randall, R.P. 2012. A Global Compendium of Weeds. 2nd Edition. Department of Agriculture and Food, Western Australia	A few references in this book list <i>Cosmos bipinnatus</i> as an environmental weed, but subsequent searches found no documented evidence of negative impacts

305	Congeneric weed	y
	Source(s)	Notes
	Randall, R.P. 2012. A Global Compendium of Weeds. 2nd Edition. Department of Agriculture and Food, Western Australia	" <i>Cosmos sulphureus</i> " [Listed as a weed in numerous references]

401	Produces spines, thorns or burrs	n
	Source(s)	Notes
	Webb, C. J., Sykes, W. R., & Garnock-Jones, P. J. 1988. Flora of New Zealand Volume IV. Botany Division, DSIR, Christchurch, New Zealand	"Erect annual, (15)-30-110 cm tall. Stems moderately to densely clothed in short hairs, becoming glabrous below, striate, much-branched above to form infl. Lvs shortly petiolate or subsessile, ovate-triangular, (1)-2-pinnate, (2)-3-12 cm long; leaflets glabrous or sparsely clothed in short hairs and ciliolate, usually linear, rarely narrow-lanceolate, 5-30 mm long. Upper cauline lvs becoming smaller and apetiolate. Capitula (25)-45-90 mm diam., in loose cymes; peduncles glabrous or sparsely hairy. Outer involucre bracts foliaceous, glabrous, green with darker lines, ovate-oblong with extended acuminate apex; inner bracts membranous, pale green to brown with dark lined centre and pale margins, ovate-triangular, obtuse to acute. Receptacular scales membranous, acuminate. Ray florets (4)-7-9; ligules pale to deep mauve pink, pink or white. Disc florets numerous, yellow. Achenes (3)-4-angled, fusiform with attenuated beak, brown, glabrous except for short antrorse hairs toward apex, 5-12 mm long; pappus 0. "

402	Allelopathic	
	Source(s)	Notes
	WRA Specialist. 2014. Personal Communication	Unknown

403	Parasitic	n
	Source(s)	Notes
	Webb, C. J., Sykes, W. R., & Garnock-Jones, P. J. 1988. Flora of New Zealand Volume IV. Botany Division, DSIR, Christchurch, New Zealand	"Erect annual, (15)-30-110 cm tall." [Asteraceae]

404	Unpalatable to grazing animals	n
	Source(s)	Notes
	Masters, R., Mitchell, P. & Dobbs, S. 2010. Ornamental and garden plants: controlling deer damage F-6427. Oklahoma State University Cooperative Extension Unit. <a href="http://www.icwdm.org/publications/pdf/deer/osu_deerdamage.pdf">http://www.icwdm.org/publications/pdf/deer/osu_deerdamage.pdf</a> . [Accessed ]	"Herbaceous Plants—Annual Flowers Rarely Damaged" [List includes <i>Cosmos bipinnatus</i> . May be unpalatable to deer]

Qsn #	Question	Answer
	Gutierrez, D., Mendoza, S., Serrano, V., Bah, M., Pelz, R., Balderas, P., & Leon, F. 2008. Proximate composition, mineral content, and antioxidant properties of 14 Mexican weeds used as fodder. <i>Weed Biology and Management</i> , 8(4), 291-296	"Many wild weeds are used in Mexico as fodder. Due to their economic value, this investigation was undertaken to determine the chemical composition of 14 species. The mineral, crude protein, fiber, and total phenolic content, as well as the antioxidant activity, was determined." ... "To assess their nutritive and nutraceutical values, this investigation was undertaken to determine the chemical composition and antioxidant properties of the following fodder weeds: rough pigweed ( <i>Amaranthus hybridus</i> L.), field mustard ( <i>Brassica rapa</i> L.), Mexican aster ( <i>Cosmos bipinnatus</i> Cav.), Bermudagrass ( <i>Cynodon dactylon</i> Pers.), manayupa ( <i>Desmodium molliculum</i> DC.), morningglory ( <i>Ipomoea purpurea</i> Roth.), <i>M. parviflora</i> , toothed burclover ( <i>Medicago polymorpha</i> var. <i>vulgaris</i> Benth.), tenleaf ( <i>Oxalis decaphylla</i> H. B. & K), Santa Maria feverfew ( <i>Parthenium hysterophorus</i> L.), Irish eyes ( <i>Sanvitalia procumbens</i> Lam.), <i>simsia</i> ( <i>Simsia amplexicaulis</i> Pers.), Johnsongrass ( <i>Sorghum halepense</i> Pers.), and <i>Tithonia tubiformis</i> Cass." [ <i>Cosmos bipinnatus</i> classified as a palatable fodder weed]

405	Toxic to animals	
	Source(s)	Notes
	Dave's Garden. 2014. PlantFiles: Common Cosmos, Mexican Aster - <i>Cosmos bipinnatus</i> . <a href="http://davesgarden.com/guides/pf/go/28/">http://davesgarden.com/guides/pf/go/28/</a> . [Accessed 23 Feb 2014]	"Danger: Parts of plant are poisonous if ingested"
	Crescent Bloom. 2004. <i>Cosmos bipinnatus</i> . <a href="http://crescentbloom.com/plants/specimen/CO/Cosmos%20bipinnatus.htm">http://crescentbloom.com/plants/specimen/CO/Cosmos%20bipinnatus.htm</a> . [Accessed 23 Feb 2014]	"Internal poison - no; Dermatologic poison - no; Livestock poison - no"
	University of California. 2012. Safe and Poisonous Garden Plants - Toxic Plants (by common name). <a href="http://ucanr.edu/sites/poisonous_safe_plants/Toxic_Plants_by_common_Name_659/">http://ucanr.edu/sites/poisonous_safe_plants/Toxic_Plants_by_common_Name_659/</a> . [Accessed ]	"Safe Plants (by common name) A note on "safe" plants: The plants on this list are generally believed to be safe. However, if you suspect that a child (or adult) has eaten quantities of any of these plants (or any of their parts), or if you notice symptoms such as illness or dermatitis after handling these plants, call your Poison Control Center for additional information: (800) 222-1222." [ <i>Cosmos bipinnatus</i> listed among safe plants]
	WRA Specialist. 2014. Personal Communication	Toxicity uncertain. Some gardening websites list this plant as safe, others as toxic. Ingestion of the plant may be unlikely, but caution is advised.

406	Host for recognized pests and pathogens	n
	Source(s)	Notes
	Missouri Botanical Garden. 2014. <i>Cosmos bipinnatus</i> . <a href="http://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?kempercode=b733">http://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?kempercode=b733</a> . [Accessed 19 Feb 2014]	"No serious insect or disease problems."
	Gilman, E.F. & Howe, T. 1999. <i>Cosmos bipinnatus</i> . FPS-148. University of Florida IFAS Extension. <a href="http://edis.ifas.ufl.edu">http://edis.ifas.ufl.edu</a> . [Accessed ]	"Pest resistance: long-term health usually not affected by pests" ... "Cosmos species may be occasionally bothered by bacterial wilt, canker, powdery mildew, leaf spots, aphids, and Japanese beetles."

407	Causes allergies or is otherwise toxic to humans	



Qsn #	Question	Answer
	<b>Source(s)</b>	<b>Notes</b>
	Pollen Library. 2014. Garden Cosmos ( <i>Cosmos bipinnatus</i> ). <a href="http://www.pollenlibrary.com/Specie/Cosmos+bipinnatus/">http://www.pollenlibrary.com/Specie/Cosmos+bipinnatus/</a> . [Accessed 23 Feb 2014]	"Allergenicity: Garden Cosmos ( <i>Cosmos bipinnatus</i> ) is a mild allergen." [Possibly only to susceptible individuals]

408	Creates a fire hazard in natural ecosystems	n
	<b>Source(s)</b>	<b>Notes</b>
	Rhoads, A. F., & Block, T. A. (2007). <i>The plants of Pennsylvania: an illustrated manual</i> . University of Pennsylvania Press, Philadelphia, PA	"Glabrous annual to 2 m with leaves finely dissected into filiform segments:" ... "cultivated and occasionally escaped to fields and roadsides" [An annual with no history of increased fire risk]
	Van Wyk, B. 2000. <i>A Photographic Guide to Wild Flowers of South Africa</i> . Struik Publishers, Cape Town, South Africa	"Now well established throughout the cool and wet parts of the Highveld, where mass blooming of plants creates spectacular flower displays in autumn." [An annual of cooler, wetter areas, with no evidence of increased fire risk]

409	Is a shade tolerant plant at some stage of its life cycle	n
	<b>Source(s)</b>	<b>Notes</b>
	Gilman, E.F. & Howe, T. 1999. <i>Cosmos bipinnatus</i> . FPS-148. University of Florida IFAS Extension. <a href="http://edis.ifas.ufl.edu">http://edis.ifas.ufl.edu</a> . [Accessed ]	"Light requirement: plant grows in full sun"
	Floridata. 2014. <i>Cosmos bipinnatus</i> . <a href="http://www.floridata.com/ref/c/cosm_bip.cfm">http://www.floridata.com/ref/c/cosm_bip.cfm</a> . [Accessed 20 Feb 2014]	"Light: Bright sunlight"
	Missouri Botanical Garden. 2014. <i>Cosmos bipinnatus</i> . <a href="http://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?kempercode=b733">http://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?kempercode=b733</a> . [Accessed 19 Feb 2014]	"Sun: Full sun" ... "Warm weather annual that is easily grown in average, well-drained soils in full sun."

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y
	<b>Source(s)</b>	<b>Notes</b>
	Gilman, E.F. & Howe, T. 1999. <i>Cosmos bipinnatus</i> . FPS-148. University of Florida IFAS Extension. <a href="http://edis.ifas.ufl.edu">http://edis.ifas.ufl.edu</a> . [Accessed ]	"Soil tolerances: sand; acidic; slightly alkaline; loam; clay"

411	Climbing or smothering growth habit	n
	<b>Source(s)</b>	<b>Notes</b>
	Rhoads, A. F., & Block, T. A. (2007). <i>The plants of Pennsylvania: an illustrated manual</i> . University of Pennsylvania Press, Philadelphia, PA	"Glabrous annual to 2 m with leaves finely dissected into filiform segments:"

412	Forms dense thickets	y
	<b>Source(s)</b>	<b>Notes</b>

Qsn #	Question	Answer
	Van Wyk, B. 2000. A Photographic Guide to Wild Flowers of South Africa. Struik Publishers, Cape Town, South Africa	"Bushy annual herb, up to 2 m high; occurring mainly in grassland, usually in dense stands along roadsides, in cultivated lands and other disturbed places."
	Nursery and Garden Industry Australia. 2012. Grow Me Instead - A Guide for Gardeners in Queensland Darling Downs. <a href="http://www.growmeinstead.com.au/public/GMI-brochure-Qld-Darling-Downs.pdf">http://www.growmeinstead.com.au/public/GMI-brochure-Qld-Darling-Downs.pdf</a> . [Accessed 23 Feb 2014]	"It seeds freely and can quickly establish stands in natural areas." [Unknown if these stands can form monocultures or exclude other vegetation]

501	Aquatic	n
	Source(s)	Notes
	Webb, C. J., Sykes, W. R., & Garnock-Jones, P. J. 1988. Flora of New Zealand Volume IV. Botany Division, DSIR, Christchurch, New Zealand	"Waste places, riverbeds." [Terrestrial habitats]

502	Grass	n
	Source(s)	Notes
	Webb, C. J., Sykes, W. R., & Garnock-Jones, P. J. 1988. Flora of New Zealand Volume IV. Botany Division, DSIR, Christchurch, New Zealand	Asteraceae

503	Nitrogen fixing woody plant	n
	Source(s)	Notes
	Webb, C. J., Sykes, W. R., & Garnock-Jones, P. J. 1988. Flora of New Zealand Volume IV. Botany Division, DSIR, Christchurch, New Zealand	Asteraceae

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	Notes
	Webb, C. J., Sykes, W. R., & Garnock-Jones, P. J. 1988. Flora of New Zealand Volume IV. Botany Division, DSIR, Christchurch, New Zealand	"Erect annual, (15)-30-110 cm tall. Stems moderately to densely clothed in short hairs, becoming glabrous below, striate, much-branched above to form infl. Lvs shortly petiolate or sessile, ovate-triangular, (1)-2-pinnate, (2)-3-12 cm long; leaflets glabrous or sparsely clothed in short hairs and ciliolate, usually linear, rarely narrow-lanceolate, 5-30 mm long. Upper cauline lvs becoming smaller and apetalate."

601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	Notes
	WRA Specialist. 2014. Personal Communication	No evidence

602	Produces viable seed	y
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Qsn #	Question	Answer
	<b>Source(s)</b>	<b>Notes</b>
	Floridata. 2014. <i>Cosmos bipinnatus</i> . <a href="http://www.floridata.com/ref/c/cosm_bip.cfm">http://www.floridata.com/ref/c/cosm_bip.cfm</a> . [Accessed 20 Feb 2014]	"Propagation: <i>Cosmos</i> is very easy to grow from seed - sow right in the garden in warmer zones. In climates with shorter growing seasons, start indoors and transplant in garden when frost has past."
	Dave's Garden. 2014. PlantFiles: Common <i>Cosmos</i> , Mexican Aster - <i>Cosmos bipinnatus</i> . <a href="http://davesgarden.com/guides/pf/go/28/">http://davesgarden.com/guides/pf/go/28/</a> . [Accessed 19 Feb 2014]	"Self-sows freely; deadhead if you do not want volunteer seedlings next season"
	Gilman, E.F. & Howe, T. 1999. <i>Cosmos bipinnatus</i> . FPS-148. University of Florida IFAS Extension. <a href="http://edis.ifas.ufl.edu">http://edis.ifas.ufl.edu</a> . [Accessed ]	"The propagation of <i>Cosmos</i> is primarily accomplished by seed which can be directly sown in the garden. The seeds of these plants will germinate in approximately one week and bloom in 2 to 3 months."

603	Hybridizes naturally	
	<b>Source(s)</b>	<b>Notes</b>
	iVillage Garden Web. 2013. Will different <i>Cosmos</i> species cross pollinate? <a href="http://forums2.gardenweb.com/forums/load/annuals/msg122343571694.html?7">http://forums2.gardenweb.com/forums/load/annuals/msg122343571694.html?7</a> . [Accessed 24 Feb 2014]	"There are a lot of species of <i>Cosmos</i> . At least some of them can cross-pollinate to create F1 hybrids. For example, <i>Cosmos sulphureus</i> can cross with <i>Cosmos pacificus</i> . Both species have 12 chromosomes. Incidentally <i>Cosmos bipinnatus</i> also has 12 chromosomes, so there shouldn't be a chromosome count barrier to making a hybrid with either <i>sulphureus</i> or <i>pacificus</i> . But there can be other barriers. "

604	Self-compatible or apomictic	n
	<b>Source(s)</b>	<b>Notes</b>
	Howlett, B. J., Knox, R. B., Paxton, J. D., & Heslop-Harrison, J. (1975). Pollen-wall proteins: physicochemical characterization and role in self-incompatibility in <i>Cosmos bipinnatus</i> . <i>Proceedings of the Royal Society of London. Series B. Biological Sciences</i> , 188(1091), 167-182	" <i>Cosmos bipinnatus</i> has a well-developed self-incompatibility system (Crowe 1954) which shows the sporophytic pattern of inheritance where control appears to reside with the parental genotype (sporophyte) rather than with the individual haploid male gametophytes"
	Crowe, L. K. (1954). Incompatibility in <i>Cosmos bipinnatus</i> . <i>Heredity</i> , 8(1), 1-11	"The plants within a group are all cross incompatible"

605	Requires specialist pollinators	n
	<b>Source(s)</b>	<b>Notes</b>
	Wojcik, V. A., Frankie, G. W., Thorp, R. W., & Hernandez, J. L. (2008). Seasonality in bees and their floral resource plants at a constructed urban bee habitat in Berkeley, California. <i>Journal of the Kansas Entomological Society</i> , 81(1), 15-28.	"In mid 2003 a diverse floral resource was planted in a small urban residential plot at the University of California, Berkeley Oxford Tract with the goal of attracting local native California bee species to assess emerging patterns of diversity and seasonality." [bee pollinated]
	Suryanarayana, M. C., Rao, G. M., & Singh, T. S. M. S. 1992. Studies on pollen sources for <i>Apis cerana</i> Fabr and <i>Apis mellifera</i> L bees at Muzaffarpur, Bihar, India. <i>Apidologie</i> , 23(1): 33-46	"The major pollen sources for <i>A mellifera</i> were, in order of importance, <i>Zea mays</i> , <i>Parthenium hysterophorus</i> , <i>Brassica</i> spp, <i>Phoenix sylvestris</i> , <i>Borassus flabellifer</i> , <i>Fabaceae</i> , <i>Cucurbitaceae</i> , <i>Cajanus cajan</i> , <i>Pisum sativum</i> var <i>arvense</i> and <i>Cosmos bipinnatus</i> ." [Bee pollinated]

Qsn #	Question	Answer
606	<b>Reproduction by vegetative fragmentation</b>	<b>y</b>
	<b>Source(s)</b>	<b>Notes</b>
	Dave's Garden. 2014. PlantFiles: Common Cosmos, Mexican Aster - <i>Cosmos bipinnatus</i> . <a href="http://davesgarden.com/guides/pf/go/28/">http://davesgarden.com/guides/pf/go/28/</a> . [Accessed 19 Feb 2014]	"Propagation Methods:From seed; sow indoors before last frost From seed; direct sow after last frost" [No evidence]
	Floridata. 2014. <i>Cosmos bipinnatus</i> . <a href="http://www.floridata.com/ref/c/cosm_bip.cfm">http://www.floridata.com/ref/c/cosm_bip.cfm</a> . [Accessed 20 Feb 2014]	"Propagation: <i>Cosmos</i> is very easy to grow from seed - sow right in the garden in warmer zones. In climates with shorter growing seasons, start indoors and transplant in garden when frost has past."
	Nursery and Garden Industry Australia. 2012. Grow Me Instead - A Guide for Gardeners in Queensland Darling Downs. <a href="http://www.growmeinstead.com.au/public/GMI-brochure-Qld-Darling-Downs.pdf">http://www.growmeinstead.com.au/public/GMI-brochure-Qld-Darling-Downs.pdf</a> . [Accessed 23 Feb 2014]	"The plant can also regenerate from a small piece of stem, so effective disposal of garden waste is important." [Presumably Yes]

607	Minimum generative time (years)	1
	Source(s)	Notes
	Rhoads, A. F., & Block, T. A. (2007). The plants of Pennsylvania: an illustrated manual. University of Pennsylvania Press, Philadelphia, PA	"Glabrous annual to 2 m with leaves finely dissected into filiform segments;"

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	
	Source(s)	Notes
	Nursery and Garden Industry Australia. 2012. Grow Me Instead - A Guide for Gardeners in Queensland Darling Downs. <a href="http://www.growmeinstead.com.au/public/GMI-brochure-Qld-Darling-Downs.pdf">http://www.growmeinstead.com.au/public/GMI-brochure-Qld-Darling-Downs.pdf</a> . [Accessed 23 Feb 2014]	"As this plant is 'free seeding' it only takes a single plant to establish a broad colony on roadsides and other natural areas." [Distribution along roads suggests possible movement of seeds along heavily trafficked corridors, or adaptation to disturbed habitat]
	Kim, K. D. (2002). Plant invasion and management in turf-dominated waste landfills in South Korea. <i>Land Degradation &amp; Development</i> , 13(3): 257-267	" <i>Cosmos bipinnatus</i> is native to Mexico and was introduced to Korea between 1912 and 1926, cultivated as a garden plant and has now escaped into the wild (Park, 1995). It is distributed beside roads. It is therefore postulated that this species invades turf fields alongside roads." [Distribution along roads suggests possible movement of seeds along heavily trafficked corridors, or adaptation to disturbed habitat]

Qsn #	Question	Answer
702	<b>Propagules dispersed intentionally by people</b>	<b>y</b>
	<b>Source(s)</b>	<b>Notes</b>
	Rhoads, A. F., & Block, T. A. (2007). The plants of Pennsylvania: an illustrated manual. University of Pennsylvania Press, Philadelphia, PA	"...frequently a component of wildflower seed mixes"
	Plants For A Future. 2014. <i>Cosmos bipinnatus</i> . <a href="http://www.pfaf.org/user/Plant.aspx?LatinName=Cosmos+bipinnatus">http://www.pfaf.org/user/Plant.aspx?LatinName=Cosmos+bipinnatus</a> . [Accessed 19 Feb 2014]	"A very ornamental plant[200], the flowers are very attractive to bees[108]. There are many named forms selected for their ornamental value[200]."
	Floridata. 2014. <i>Cosmos bipinnatus</i> . <a href="http://www.floridata.com/ref/c/cosm_bip.cfm">http://www.floridata.com/ref/c/cosm_bip.cfm</a> . [Accessed 20 Feb 2014]	"Cosmos are popular components of wildflower and meadow gardens where seed is planted and left to its own devices to sprout, bloom, seed and sprout the following year. Cosmos is one of the best nectar plants for attracting butterflies to the garden."

703	<b>Propagules likely to disperse as a produce contaminant</b>	
	<b>Source(s)</b>	<b>Notes</b>
	Van Wyk, B. 2000. A Photographic Guide to Wild Flowers of South Africa. Struik Publishers, Cape Town, South Africa	"A native of the southern USA and Mexico. Introduced to South Africa with animal fodder in the late 1890s." [Unknown if this was an intentional or accidental introduction, and whether this continues to be a vector for dispersal]

704	<b>Propagules adapted to wind dispersal</b>	<b>n</b>
	<b>Source(s)</b>	<b>Notes</b>
	Vibrans, H. (1999). Epianthropochory in Mexican weed communities. <i>American Journal of Botany</i> , 86(4): 476-481.	"The diaspores of the 50 most important maize field weed species (agrestals) in a traditional maize-growing area of southcentral Mexico (region of Puebla and Tlaxcala) were analyzed for morphological adaptations to long distance dispersal. Adaptations to wind-dispersal were absent and to endozoochory were minimal." ... "TABLE 1. Most important maize field weeds in the region of Puebla-Tlaxcala with indication of the morphological adaptations to long-distance dispersal, arranged by the average height of the species under maize field conditions." [ <i>Cosmos bipinnatus</i> - Adhesive = diaspores have appendages with hooks, awns or lacerated scales]

705	<b>Propagules water dispersed</b>	<b>n</b>
	<b>Source(s)</b>	<b>Notes</b>
	Cortés-Flores, J., Andresen, E., Cornejo-Tenorio, G., & Ibarra Manríquez, G. 2013. Fruiting phenology of seed dispersal syndromes in a Mexican Neotropical temperate forest. <i>Forest Ecology and Management</i> , 289: 445-454	"Appendix A Growth form, fruiting phenology (indicating the presence of ripe fruit) and dispersal syndrome of 133 species in a temperate forest located within tropical latitudes at Cerro El Águila in the Mexican state of Michoacán." [ <i>Cosmos bipinnatus</i> - Dispersal syndrome = Epizoochory]
	WRA Specialist. 2014. Personal Communication	Water may move seeds that fall to the ground, but there are no specific adaptations to water dispersal, and the habitat of this species is generally along roadsides, fields or disturbed habitats, but not generally riparian areas

706	<b>Propagules bird dispersed</b>	
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Qsn #	Question	Answer
	Source(s)	Notes
	de Vlaming, V. L. (1967). Regurgitation by killdeer as a possible means of dispersal for seeds and aquatic organisms. <i>The Wilson Bulletin</i> 79(4): 449-450	"Killdeer remained viable after disgorgement. Seeds of <i>Ratibida columnifera</i> , <i>Samolus parviflorus</i> , <i>Cosmos bipinnatus</i> , and <i>Raphanus raphanistrum</i> each failed to pass successfully through the Killdeer intestinal tract, but were viable after regurgitation." [Possibly dispersed by birds and regurgitated]

707	Propagules dispersed by other animals (externally)	y
	Source(s)	Notes
	Fosberg, F. R. & Sachet, M-H. 1980. <i>Flora of Micronesia</i> , 4: Caprifoliaceae-Compositae. <i>Smithsonian Contributions to Botany</i> 46: 1-71	"...achenes blackish, 7-16 mm long, sulcate, with a long beak; pappus of 2-3 small retrorsely barbed awns or these lacking." [Barbed awns, when present, would aid in external dispersal]
	Vibrans, H. (1999). Epianthropochory in Mexican weed communities. <i>American Journal of Botany</i> , 86(4): 476-481.	"The diaspores of the 50 most important maize field weed species (agrestals) in a traditional maize-growing area of southcentral Mexico (region of Puebla and Tlaxcala) were analyzed for morphological adaptations to long distance dispersal. Adaptations to wind-dispersal were absent and to endozoochory were minimal." ... "TABLE 1. Most important maize field weeds in the region of Puebla-Tlaxcala with indication of the morphological adaptations to long-distance dispersal, arranged by the average height of the species under maize field conditions." [Cosmos bipinnatus - Adhesive = diaspores have appendages with hooks, awns or lacerated scales] [Would presumably allow for adherence to fur or feathers on animals]

708	Propagules survive passage through the gut	n
	Source(s)	Notes
	Vibrans, H. (1999). Epianthropochory in Mexican weed communities. <i>American Journal of Botany</i> , 86(4): 476-481.	[No evidence] "The diaspores of the 50 most important maize field weed species (agrestals) in a traditional maize-growing area of southcentral Mexico (region of Puebla and Tlaxcala) were analyzed for morphological adaptations to long distance dispersal. Adaptations to wind-dispersal were absent and to endozoochory were minimal." ... "TABLE 1. Most important maize field weeds in the region of Puebla-Tlaxcala with indication of the morphological adaptations to long-distance dispersal, arranged by the average height of the species under maize field conditions." [Cosmos bipinnatus - Adhesive = diaspores have appendages with hooks, awns or lacerated scales]

801	Prolific seed production (>1000/m2)	
	Source(s)	Notes
	Cornell University. 2006. <i>Cosmos</i> ( <i>C. bipinnatus</i> ). <a href="http://www.gardening.cornell.edu/homegardening/scene9a85.html">http://www.gardening.cornell.edu/homegardening/scene9a85.html</a> . [Accessed 20 Feb 2014]	"The plants self seed prolifically."

802	Evidence that a persistent propagule bank is formed (>1 yr)	

Qsn #	Question	Answer
	<b>Source(s)</b>	<b>Notes</b>
	Royal Botanic Gardens Kew. 2008. Seed Information Database (SID). Version 7.1. <a href="http://data.kew.org/sid/">http://data.kew.org/sid/</a> . [Accessed 23 Feb 2014]	"Storage Behaviour: Orthodox" [Unknown in field conditions]

803	Well controlled by herbicides	y
	<b>Source(s)</b>	<b>Notes</b>
	Dow AgroSciences. 2003. HERBICIDE ZEAZINE 500 SC. <a href="https://www.dowagro.com/webapps/lit/litorder.asp?filepath=/011-10121.pdf&amp;pdf=true">https://www.dowagro.com/webapps/lit/litorder.asp?filepath=/011-10121.pdf&amp;pdf=true</a> . [Accessed ]	"ZEAZINE SC controls a broad spectrum of grass and broadleaf weeds in crop rotation situations where sensitive follow up crops are important." ... Weed spp. controlled by ZEAZINE SC:" ... "Broadleaf weeds:" [List of broadleaf weeds controlled includes <i>Cosmos bipinnatus</i> ]

804	Tolerates, or benefits from, mutilation, cultivation, or fire	
	<b>Source(s)</b>	<b>Notes</b>
	Nursery and Garden Industry Australia. 2012. Grow Me Instead - A Guide for Gardeners in Queensland Darling Downs. <a href="http://www.growmeinstead.com.au/public/GMI-brochure-Qld-Darling-Downs.pdf">http://www.growmeinstead.com.au/public/GMI-brochure-Qld-Darling-Downs.pdf</a> . [Accessed 24 Feb 2014]	"The plant can also regenerate from a small piece of stem, so effective disposal of garden waste is important." [Possibly Yes]

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	<b>Source(s)</b>	<b>Notes</b>
	WRA Specialist. 2014. Personal Communication	Unknown

**Summary of Risk Traits:**

## High Risk / Undesirable Traits

- Thrives in tropical climates
- Elevation range exceeds 1000 m
- Widely naturalized
- A garden & disturbance weed
- Other *Cosmos* species have become invasive
- Conflicting reports on possible toxicity
- A mild allergen
- Tolerates many soil types
- Can form dense stands that may potentially exclude other vegetation
- Seeds freely
- The plant can regenerate from a small piece of stem
- Annual – able to reach maturity in one growing season
- Seeds dispersed intentionally by people and externally on animals & possibly machinery or clothing

## Low Risk or Desirable Traits

- Unarmed (no spines, thorns or burrs)
- Requires full sun
- Self-incompatible
- Used as an ornamental & to attract & benefit pollinators