

**Taxon:** *Cosmos atrosanguineus* (Hook.) Voss

**Family:** Asteraceae

**Common Name(s):** black cosmos  
chocolate cosmos

**Synonym(s):** *Bidens atrosanguinea* (Hook.) Ortgies  
*Cosmos diversifolius* var.

**Assessor:** Chuck Chimera

**Status:** Assessor Approved

**End Date:** 18 Oct 2017

**WRA Score:** -5.0

**Designation:** L

**Rating:** Low Risk

**Keywords:** Perennial Wildflower, Ornamental, Tuberos, Self-Incompatible, Sterile

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	n
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	n
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		
403	Parasitic	y=1, n=0	n
404	Unpalatable to grazing animals	y=1, n=-1	y
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	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	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	y
601	Evidence of substantial reproductive failure in native habitat		
602	Produces viable seed	y=1, n=-1	n
603	Hybridizes naturally		
604	Self-compatible or apomictic	y=1, n=-1	n
605	Requires specialist pollinators		
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	2
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	n
706	Propagules bird dispersed	y=1, n=-1	n
707	Propagules dispersed by other animals (externally)		
708	Propagules survive passage through the gut	y=1, n=-1	n
801	Prolific seed production (>1000/m <sup>2</sup> )	y=1, n=-1	n
802	Evidence that a persistent propagule bank is formed (>1 yr)		
803	Well controlled by herbicides		
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
	Hind, N., & Fay, M. F. (2003). Plate 461. <i>Cosmos Atrosanguineus</i> Compositae. <i>Curtis's Botanical Magazine</i> , 20(1), 40-48	[No evidence of domestication] "In the Herbarium of the Royal Botanic Gardens, Kew, it is clear that this species has been in cultivation continuously since it was first discovered in the 1860s. However, other than the type material and one other collection, the species has apparently never been re-collected in the wild. It is presumed extinct in the wild, EW, following the 2000 Categories & Criteria (IUCN 2001), and is now only known from cultivation. Happily, according to one web site, the species is being re-introduced into the wild in San Luis Potosí, Mexico, from plants grown on from the micropropagated material at Kew."

102	Has the species become naturalized where grown?	
	Source(s)	Notes
	WRA Specialist. 2017. Personal Communication	NA

103	Does the species have weedy races?	
	Source(s)	Notes
	WRA Specialist. 2017. Personal Communication	NA

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, Germplasm Resources Information Network. 2017. National Plant Germplasm System [Online Database]. <a href="http://www.ars-grin.gov/npgs/index.html">http://www.ars-grin.gov/npgs/index.html</a> . [Accessed 18 Oct 2017]	"Native: Northern America Northern Mexico: Mexico - San Luis Potosi Southern Mexico: Mexico - Guanajuato, - Hidalgo, - Queretaro"

202	Quality of climate match data	High
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2017. National Plant Germplasm System [Online Database]. <a href="http://www.ars-grin.gov/npgs/index.html">http://www.ars-grin.gov/npgs/index.html</a> . [Accessed 18 Oct 2017]	

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

Qsn #	Question	Answer
	Dave's Garden. 2017. Chocolate Cosmos - <i>Cosmos atrosanguineus</i> . <a href="https://davesgarden.com/guides/pf/go/29/">https://davesgarden.com/guides/pf/go/29/</a> . [Accessed 18 Oct 2017]	"Hardiness: USDA Zone 8a: to -12.2 °C (10 °F) USDA Zone 8b: to -9.4 °C (15 °F) USDA Zone 9a: to -6.6 °C (20 °F) USDA Zone 9b: to -3.8 °C (25 °F) USDA Zone 10a: to -1.1 °C (30 °F) USDA Zone 10b: to 1.7 °C (35 °F)"
	Missouri Botanical Garden. 2017. <i>Cosmos atrosanguineus</i> . <a href="http://www.missouribotanicalgarden.org">http://www.missouribotanicalgarden.org</a> . [Accessed 18 Oct 2017]	"Zone: 7 to 9"

<b>204</b>	<b>Native or naturalized in regions with tropical or subtropical climates</b>	<b>y</b>
	<b>Source(s)</b>	<b>Notes</b>
	USDA, ARS, Germplasm Resources Information Network. 2017. National Plant Germplasm System [Online Database]. <a href="http://www.ars-grin.gov/npgs/index.html">http://www.ars-grin.gov/npgs/index.html</a> . [Accessed 18 Oct 2017]	"Native: Northern America Northern Mexico: Mexico - San Luis Potosi Southern Mexico: Mexico - Guanajuato, - Hidalgo, - Queretaro"

<b>205</b>	<b>Does the species have a history of repeated introductions outside its natural range?</b>	<b>y</b>
	<b>Source(s)</b>	<b>Notes</b>
	USDA, ARS, Germplasm Resources Information Network. 2017. National Plant Germplasm System [Online Database]. <a href="http://www.ars-grin.gov/npgs/index.html">http://www.ars-grin.gov/npgs/index.html</a> . [Accessed 18 Oct 2017]	"Cultivated: . also cult."
	Dave's Garden. 2017. Chocolate Cosmos - <i>Cosmos atrosanguineus</i> . <a href="https://davesgarden.com/guides/pf/go/29/">https://davesgarden.com/guides/pf/go/29/</a> . [Accessed 18 Oct 2017]	"Regional: This plant has been said to grow in the following regions: Albany, California Arroyo Grande, California Citrus Heights, California Hydesville, California Madera, California Napa, California Salinas, California San Francisco, California San Jose, California Naugatuck, Connecticut Wilton, Connecticut Washington, District Of Columbia Carrollton, Georgia Valdosta, Georgia Divernon, Illinois Cambridge, Massachusetts Manchester, New Hampshire Mount Laurel, New Jersey Corvallis, Oregon Portland, Oregon Walterville, Oregon Conway, South Carolina Austin, Texas Lubbock, Texas Sugar Land, Texas Tyler, Texas Vernal, Utah Chimacum, Washington Kalama, Washington Langley, Washington Seattle, Washington (2 reports) Spokane, Washington Tacoma, Washington"

Qsn #	Question	Answer
301	<b>Naturalized beyond native range</b>	n
	<b>Source(s)</b>	<b>Notes</b>
	Hind, N., & Fay, M. F. (2003). Plate 461. <i>Cosmos Atrosanguineus</i> Compositae. <i>Curtis's Botanical Magazine</i> , 20(1), 40-48	[No evidence] "other than the type material and one other collection, the species has apparently never been re-collected in the wild. It is presumed extinct in the wild, EW, following the 2000 Categories & Criteria (IUCN 2001), and is now only known from cultivation."
	Randall, R.P. (2017). <i>A Global Compendium of Weeds</i> . 3rd Edition. Perth, Western Australia. R.P. Randall	No evidence

302	<b>Garden/amenity/disturbance weed</b>	n
	<b>Source(s)</b>	<b>Notes</b>
	Randall, R.P. (2017). <i>A Global Compendium of Weeds</i> . 3rd Edition. Perth, Western Australia. R.P. Randall	No evidence

303	<b>Agricultural/forestry/horticultural weed</b>	n
	<b>Source(s)</b>	<b>Notes</b>
	Randall, R.P. (2017). <i>A Global Compendium of Weeds</i> . 3rd Edition. Perth, Western Australia. R.P. Randall	No evidence

304	<b>Environmental weed</b>	n
	<b>Source(s)</b>	<b>Notes</b>
	Randall, R.P. (2017). <i>A Global Compendium of Weeds</i> . 3rd Edition. Perth, Western Australia. R.P. Randall	No evidence

Qsn #	Question	Answer
305	<b>Congeneric weed</b>	<b>y</b>
	<b>Source(s)</b>	<b>Notes</b>
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Cosmos bipinnatus ... Weed of: Cereals, Potatoes, Vegetables" ... "Cosmos caudatus ... Weed of: Pastures"
	Nursery & Garden Industry Australia. 2012. Grow Me Instead - A Guide for Gardeners in Queensland Darling Downs. <a href="http://www.growmeinstead.com.au/">http://www.growmeinstead.com.au/</a> . [Accessed 18 Oct 2017]	"Cosmos bipinnatus" ... "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. Cosmos in the Garden. Utah State University Cooperative Extension. <a href="http://extension.usu.edu/">http://extension.usu.edu/</a> . [Accessed 18 Oct 2017]	"In many texts Cosmos 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. Cosmos ( <i>C. bipinnatus</i> ). <a href="http://www.gardening.cornell.edu/">http://www.gardening.cornell.edu/</a> . [Accessed 18 Oct 2017]	"May be weedy due to self seeding."
	Jansen, P.C.M. & Cardon, D. 2005. Plant Resources of Tropical Africa. Volume 3. Dyes and Tannins. PROTA, Wageningen, Netherlands	"Where <i>Cosmos sulphureus</i> has been found in the wild in Africa, it is a common roadside weed which does not spread into undisturbed localities. In southern Africa it flowers and fruits in Marc –May."

401	<b>Produces spines, thorns or burrs</b>	<b>n</b>
	<b>Source(s)</b>	<b>Notes</b>
	Hind, N., & Fay, M. F. (2003). Plate 461. <i>Cosmos Atrosanguineus</i> Compositae. Curtis's Botanical Magazine, 20(1), 40-48	[No evidence] "Tuberous rooted perennial; tuber relatively small to 3 cm long by 1.5 – 3 cm diameter, usually narrowing into a napiform taproot beneath. Stems relatively few, ascending to somewhat deflexed and probably decumbent, usually persistently retroscely hispid pubescent with uniseriate multicellular hairs in lower parts of stems and flowering branches but glabrous above on most. Young vegetative and flowering shoots often with simple petiolate leaves, petioles narrowly winged, c. 2 cm long, dark reddish-green above and beneath, lamina 4 cm long by c. 2 cm wide, elliptic, margins entire, apices acute. Later leaves conspicuously pinnate with 2 or 3 pairs of leaflets on a narrowly winged rachis and with a conspicuous simple, or sometimes lobed terminal lobe, lobe apex obtuse to rounded, to 5 cm long by 2 cm wide."

402	<b>Allelopathic</b>	
	<b>Source(s)</b>	<b>Notes</b>
	WRA Specialist. 2017. Personal Communication	Unknown. No evidence found

Qsn #	Question	Answer
403	Parasitic	n
	Source(s)	Notes
	Hind, N., & Fay, M. F. (2003). Plate 461. <i>Cosmos Atrosanguineus</i> Compositae. <i>Curtis's Botanical Magazine</i> , 20(1), 40-48	"Tuberous rooted perennial; tuber relatively small to 3 cm long by 1.5 to 3 cm diameter, usually narrowing into a napiform taproot beneath." [Asteraceae. No evidence]

404	Unpalatable to grazing animals	y
	Source(s)	Notes
	gardenguides.com. 2010. <i>Cosmos Flowers &amp; Deer</i> . <a href="http://www.gardenguides.com/">http://www.gardenguides.com/</a> . [Accessed 18 Oct 2017]	"A frequent invader of suburban gardens, deer wreak havoc on flowers and plants. <i>Cosmos</i> are annual, colorful flowers that deer usually avoid and can be used in landscapes to repel deer. When used as a border, <i>cosmos</i> prevent deer from entering landscapes where other, more attractive plants grow."
	Gardenia. 2017. <i>Cosmos atrosanguineus</i> (Chocolate <i>Cosmos</i> ). <a href="https://www.gardenia.net/plant/cosmos-atrosanguineus">https://www.gardenia.net/plant/cosmos-atrosanguineus</a> . [Accessed 18 Oct 2017]	"Deer and rabbit resistant"

405	Toxic to animals	n
	Source(s)	Notes
	Gardenersworld.com. 2017. <i>Cosmos atrosanguineus</i> . <a href="http://www.gardenersworld.com/plants/plant-finder/cosmos-atrosanguineus/">http://www.gardenersworld.com/plants/plant-finder/cosmos-atrosanguineus/</a> . [Accessed 18 Oct 2017]	"Effects: No toxic effects reported for this plant."
	Quattrocchi, U. 2012. <i>CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology</i> . CRC Press, Boca Raton, FL	No evidence

406	Host for recognized pests and pathogens	n
	Source(s)	Notes
	Missouri Botanical Garden. 2017. <i>Cosmos atrosanguineus</i> . <a href="http://www.missouribotanicalgarden.org">http://www.missouribotanicalgarden.org</a> . [Accessed 18 Oct 2017]	"No serious insect or disease problems. Rootstocks may rot in wet soils. Not winter hardy to St. Louis."
	Fine Gardening. 2017. <i>Chocolate cosmos - Cosmos atrosanguineus</i> . <a href="http://www.finegardening.com">http://www.finegardening.com</a> . [Accessed 18 Oct 2017]	"Problems: Stem canker, powdery mildew, <i>Rhizoctonia</i> stem rot, gray mold, and aphids sometimes cause problems."

407	Causes allergies or is otherwise toxic to humans	n
	Source(s)	Notes
	Quattrocchi, U. 2012. <i>CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology</i> . CRC Press, Boca Raton, FL	No evidence

408	Creates a fire hazard in natural ecosystems	n
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Qsn #	Question	Answer
	<b>Source(s)</b>	<b>Notes</b>
	Hind, N., & Fay, M. F. (2003). Plate 461. <i>Cosmos Atrosanguineus</i> Compositae. <i>Curtis's Botanical Magazine</i> , 20(1), 40-48	[No evidence. No information known about fire ecology in wild, but unlikely to contribute significantly to fire risk or fuel load in cultivation] "It is presumed extinct in the wild, EW, following the 2000 Categories & Criteria (IUCN 2001), and is now only known from cultivation."

409	Is a shade tolerant plant at some stage of its life cycle	n
	<b>Source(s)</b>	<b>Notes</b>
	Missouri Botanical Garden. 2017. <i>Cosmos atrosanguineus</i> . <a href="http://www.missouribotanicalgarden.org">http://www.missouribotanicalgarden.org</a> . [Accessed 18 Oct 2017]	"Grow in average, moderately fertile, medium moisture, well-drained soils in full sun."
	Dave's Garden. 2017. Chocolate Cosmos - <i>Cosmos atrosanguineus</i> . <a href="https://davesgarden.com/guides/pf/go/29/">https://davesgarden.com/guides/pf/go/29/</a> . [Accessed 18 Oct 2017]	"Sun Exposure: 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>
	Missouri Botanical Garden. 2017. <i>Cosmos atrosanguineus</i> . <a href="http://www.missouribotanicalgarden.org">http://www.missouribotanicalgarden.org</a> . [Accessed 18 Oct 2017]	"Grow in average, moderately fertile, medium moisture, well-drained soils in full sun. Tolerates dryish soils."
	Fine Gardening. 2017. Chocolate cosmos - <i>Cosmos atrosanguineus</i> . <a href="http://www.finegardening.com">http://www.finegardening.com</a> . [Accessed 18 Oct 2017]	"Grow in moist but well-drained, fertile soil in full sun."
	Dave's Garden. 2017. Chocolate Cosmos - <i>Cosmos atrosanguineus</i> . <a href="https://davesgarden.com/guides/pf/go/29/">https://davesgarden.com/guides/pf/go/29/</a> . [Accessed 18 Oct 2017]	"Soil pH requirements: 6.1 to 6.5 (mildly acidic) 6.6 to 7.5 (neutral) 7.6 to 7.8 (mildly alkaline)"
	Shoot Gardening. 2017. <i>Cosmos atrosanguineus</i> (Chocolate cosmos). <a href="https://www.shootgardening.co.uk/plant/cosmos-atrosanguineus">https://www.shootgardening.co.uk/plant/cosmos-atrosanguineus</a> . [Accessed 18 Oct 2017]	"Soil type - Chalky, Loamy, Sandy Soil drainage - Well-drained, Moist but well-drained Soil pH - Acid, Alkaline, Neutral"

411	Climbing or smothering growth habit	n
	<b>Source(s)</b>	<b>Notes</b>
	Hind, N., & Fay, M. F. (2003). Plate 461. <i>Cosmos Atrosanguineus</i> Compositae. <i>Curtis's Botanical Magazine</i> , 20(1), 40-48	"Tuberous rooted perennial; tuber relatively small to 3 cm long by 1.5 - 3 cm diameter, usually narrowing into a napiform taproot beneath. Stems relatively few, ascending to somewhat deflexed and probably decumbent"

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



Qsn #	Question	Answer
	Hind, N., & Fay, M. F. (2003). Plate 461. <i>Cosmos Atrosanguineus</i> Compositae. <i>Curtis's Botanical Magazine</i> , 20(1), 40-48	[No evidence] "the species has apparently never been re-collected in the wild. It is presumed extinct in the wild, EW, following the 2000 Categories & Criteria (IUCN 2001), and is now only known from cultivation."

501	Aquatic	n
	Source(s)	Notes
	Hind, N., & Fay, M. F. (2003). Plate 461. <i>Cosmos Atrosanguineus</i> Compositae. <i>Curtis's Botanical Magazine</i> , 20(1), 40-48	[Terrestrial] "HABITAT. Strangely Sherff (1932, 1955, 1964) mentioned nothing about the habitat that this species grows in and there is nothing on the label of the Parry & Palmer 481 1/2 collection in K. It would be reasonable to expect it to be found in the oak and pine forests, a habitat where many other species in the genus are found."

502	Grass	n
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2017. National Plant Germplasm System [Online Database]. <a href="http://www.ars-grin.gov/npgs/index.html">http://www.ars-grin.gov/npgs/index.html</a> . [Accessed 18 Oct 2017]	Family: Asteraceae (alt.Compositae)

503	Nitrogen fixing woody plant	n
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2017. National Plant Germplasm System [Online Database]. <a href="http://www.ars-grin.gov/npgs/index.html">http://www.ars-grin.gov/npgs/index.html</a> . [Accessed 18 Oct 2017]	Family: Asteraceae (alt.Compositae)

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	y
	Source(s)	Notes
	Hind, N., & Fay, M. F. (2003). Plate 461. <i>Cosmos Atrosanguineus</i> Compositae. <i>Curtis's Botanical Magazine</i> , 20(1), 40-48	[Functionally a geophyte] "Tuberous rooted perennial; tuber relatively small to 3 cm long by 1.5 - 3 cm diameter, usually narrowing into a napiform taproot beneath. Stems relatively few, ascending to somewhat deflexed and probably decumbent"

601	Evidence of substantial reproductive failure in native habitat	
	Source(s)	Notes
	Hind, N., & Fay, M. F. (2003). Plate 461. <i>Cosmos Atrosanguineus</i> Compositae. <i>Curtis's Botanical Magazine</i> , 20(1), 40-48	[Unknown. Currently not found in the wild] "other than the type material and one other collection, the species has apparently never been re-collected in the wild. It is presumed extinct in the wild, EW, following the 2000 Categories & Criteria (IUCN 2001), and is now only known from cultivation."

Qsn #	Question	Answer
602	<b>Produces viable seed</b>	n
	<b>Source(s)</b>	<b>Notes</b>
	Hind, N., & Fay, M. F. (2003). Plate 461. <i>Cosmos Atrosanguineus</i> Compositae. <i>Curtis's Botanical Magazine</i> , 20(1), 40-48	"Achenes immature and infertile/sterile in cultivated material, body 13-20 mm long, sparsely very short eglandular setuliferous and very sparsely glandular punctate; carpodium not evident"
	Dave's Garden. 2017. Chocolate Cosmos - <i>Cosmos atrosanguineus</i> . <a href="https://davesgarden.com/guides/pf/go/29/">https://davesgarden.com/guides/pf/go/29/</a> . [Accessed 18 Oct 2017]	"N/A: plant does not set seed, flowers are sterile, or plants will not come true from seed"
	Fine Gardening. 2017. Chocolate cosmos - <i>Cosmos atrosanguineus</i> . <a href="http://www.finegardening.com">http://www.finegardening.com</a> . [Accessed 18 Oct 2017]	"Propagation: Root basal cuttings with bottom heat in early spring."

603	<b>Hybridizes naturally</b>	
	<b>Source(s)</b>	<b>Notes</b>
	Oku, T., Takahashi, H., Yagi, F., Nakamura, I., & Mii, M. (2008). Hybridisation between chocolate cosmos and yellow cosmos confirmed by phylogenetic analysis using plastid subtype identity (PSID) sequences. <i>The Journal of Horticultural Science and Biotechnology</i> , 83(3), 323-327	[Artificial hybridization possible] "Chocolate cosmos has chocolate-coloured flowers with a scent of chocolate, and leaves like miniature dahlias. Chocolate cosmos is endangered in its native Mexico. It has been classified ambiguously as <i>Cosmos atrosanguineus</i> or <i>Bidens atrosanguinea</i> . We have resolved the phylogenetic relationship of chocolate cosmos among the genera <i>Cosmos</i> , <i>Bidens</i> and <i>Dahlia</i> by an analysis of plastid subtype identity (PSID) sequences. PSID sequences showed that chocolate cosmos has a closer relationship with <i>Cosmos</i> than with <i>Bidens</i> or <i>Dahlia</i> . Based on this finding, chocolate cosmos was open-pollinated with two <i>Cosmos</i> species, <i>C. bipinnatus</i> and <i>C. sulphureus</i> . We successfully produced a hybrid plant with <i>C. sulphureus</i> using embryo rescue. The hybrid plant showed an intermediate phenotype such as crimson-red flowers. Its hybrid nature was confirmed by DNA fingerprinting and flow cytometric analysis."

604	<b>Self-compatible or apomictic</b>	n
	<b>Source(s)</b>	<b>Notes</b>
	Lewendon, S. (2005). Self-incompatibility in <i>Cosmos atrosanguineus</i> : a rare Mexican endemic species of Asteraceae. PhD Dissertation. University of Greenwich, London, UK	" <i>Cosmos atrosanguineus</i> exhibits strong sporophytic self-incompatibility (SSI), does not set seed, and must be propagated vegetatively, a factor that has contributed to the proliferation of closely related or identical genotypes."

605	<b>Requires specialist pollinators</b>	
	<b>Source(s)</b>	<b>Notes</b>
	Lewendon, S. (2005). Self-incompatibility in <i>Cosmos atrosanguineus</i> : a rare Mexican endemic species of Asteraceae. PhD Dissertation. University of Greenwich, London, UK	[Pollinators irrelevant as plants do not produce viable seed] "The <i>Cosmos</i> stigma is dry, papillate and becomes receptive only after stigmas become reflexed. Prior to this period, the stigmas do not respond to pollination and selfed bud pollinations and crossed bud pollinations are incompatible."

606	<b>Reproduction by vegetative fragmentation</b>	n
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Qsn #	Question	Answer
	<b>Source(s)</b>	<b>Notes</b>
	Fine Gardening. 2017. Chocolate cosmos - <i>Cosmos atrosanguineus</i> . <a href="http://www.finegardening.com">http://www.finegardening.com</a> . [Accessed 18 Oct 2017]	"Propagation: Root basal cuttings with bottom heat in early spring." [No evidence of natural vegetative spread]
	Hind, N., & Fay, M. F. (2003). Plate 461. <i>Cosmos Atrosanguineus</i> Compositae. <i>Curtis's Botanical Magazine</i> , 20(1), 40-48	[No evidence] "Tuberous rooted perennial; tuber relatively small to 3 cm long by 1.5 - 3 cm diameter, usually narrowing into a napiform taproot beneath. Stems relatively few, ascending to somewhat deflexed and probably decumbent"

607	Minimum generative time (years)	2
	<b>Source(s)</b>	<b>Notes</b>
	Hind, N., & Fay, M. F. (2003). Plate 461. <i>Cosmos Atrosanguineus</i> Compositae. <i>Curtis's Botanical Magazine</i> , 20(1), 40-48	[Irrelevant. Probably 1-2 years, but achenes sterile] "Tuberous rooted perennial ... Achenes immature and infertile/sterile in cultivated material"

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	n
	<b>Source(s)</b>	<b>Notes</b>
	Lewendon, S. (2005). Self-incompatibility in <i>Cosmos atrosanguineus</i> : a rare Mexican endemic species of Asteraceae. PhD Dissertation. University of Greenwich, London, UK	[No seed set] "In conclusion, <i>Cosmos atrosanguineus</i> is a strongly self-incompatible species with a reduced genome. It does not set seed because the gene pool of cultivated individuals has narrowed to a level where S-allele numbers are too few to produce cross compatible genotypes."

702	Propagules dispersed intentionally by people	y
	<b>Source(s)</b>	<b>Notes</b>
	Fine Gardening. 2017. Chocolate cosmos - <i>Cosmos atrosanguineus</i> . <a href="http://www.finegardening.com">http://www.finegardening.com</a> . [Accessed 18 Oct 2017]	"A chocolate scented flower! Dark red-brown, sometimes almost black, velvety flowers on long, slender, reddish brown stems bloom from early summer to autumn. Chocolate cosmos is a tuberous-rooted, tender perennial native to Mexico that can be overwintered indoors where not hardy. Grow in a border or in containers where the flowers can be appreciated up close. They also make good cut flowers."
	Hind, N., & Fay, M. F. (2003). Plate 461. <i>Cosmos Atrosanguineus</i> Compositae. <i>Curtis's Botanical Magazine</i> , 20(1), 40-48	"With such spectacular colour and a scent of chocolate one is immediately tempted to have more and rather than buying more plants why not propagate yours instead? The stock of this <i>Cosmos</i> in the Royal Botanic Gardens, Kew has been here since the 1970s when it was accessioned onto our living collections database."

Qsn #	Question	Answer
703	Propagules likely to disperse as a produce contaminant	n
	<b>Source(s)</b>	<b>Notes</b>
	Lewendon, S. (2005). Self-incompatibility in <i>Cosmos atrosanguineus</i> : a rare Mexican endemic species of Asteraceae. PhD Dissertation. University of Greenwich, London, UK	[No seed set. No evidence] "In conclusion, <i>Cosmos atrosanguineus</i> is a strongly self-incompatible species with a reduced genome. It does not set seed because the gene pool of cultivated individuals has narrowed to a level where S-allele numbers are too few to produce cross compatible genotypes."

704	Propagules adapted to wind dispersal	n
	<b>Source(s)</b>	<b>Notes</b>
	Hind, N., & Fay, M. F. (2003). Plate 461. <i>Cosmos Atrosanguineus</i> Compositae. <i>Curtis's Botanical Magazine</i> , 20(1), 40-48	[Pappus may aid in wind dispersal over short distances, but achenes are sterile & plant can therefore not be dispersed] "Achenes immature and infertile/sterile in cultivated material, body 13-20 mm long, sparsely very short eglandular setuliferous and very sparsely glandular punctate; carpodium not evident; pappus of 2-3 (or apparently rarely 4) antorsely barbed setae c. 4-4.5 mm long, setae dark reddish-maroon."

705	Propagules water dispersed	n
	<b>Source(s)</b>	<b>Notes</b>
	Hind, N., & Fay, M. F. (2003). Plate 461. <i>Cosmos Atrosanguineus</i> Compositae. <i>Curtis's Botanical Magazine</i> , 20(1), 40-48	[Pappus may aid in wind dispersal over short distances, but achenes are sterile & plant can therefore not be dispersed] "Achenes immature and infertile/sterile in cultivated material, body 13-20 mm long, sparsely very short eglandular setuliferous and very sparsely glandular punctate; carpodium not evident; pappus of 2-3 (or apparently rarely 4) antorsely barbed setae c. 4-4.5 mm long, setae dark reddish-maroon."

706	Propagules bird dispersed	n
	<b>Source(s)</b>	<b>Notes</b>
	Hind, N., & Fay, M. F. (2003). Plate 461. <i>Cosmos Atrosanguineus</i> Compositae. <i>Curtis's Botanical Magazine</i> , 20(1), 40-48	[No evidence and achenes are sterile] "Achenes immature and infertile/sterile in cultivated material, body 13-20 mm long, sparsely very short eglandular setuliferous and very sparsely glandular punctate; carpodium not evident; pappus of 2-3 (or apparently rarely 4) antorsely barbed setae c. 4-4.5 mm long, setae dark reddish-maroon."

707	Propagules dispersed by other animals (externally)	n
	<b>Source(s)</b>	<b>Notes</b>
	Hind, N., & Fay, M. F. (2003). Plate 461. <i>Cosmos Atrosanguineus</i> Compositae. <i>Curtis's Botanical Magazine</i> , 20(1), 40-48	[Barbed pappus could aid in external attachment, but achenes are sterile] "Achenes immature and infertile=sterile in cultivated material" ... "pappus of 2-3 (or apparently rarely 4) antorsely barbed setae c. 4-4.5 mm long, setae dark reddish-maroon."

708	Propagules survive passage through the gut	n
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Qsn #	Question	Answer
	Source(s)	Notes
	WRA Specialist. 2017. Personal Communication	Sterile achenes unlikely to be consumed. Not internally dispersed

801	Prolific seed production (>1000/m <sup>2</sup> )	n
	Source(s)	Notes
	Lewendon, S. (2005). Self-incompatibility in <i>Cosmos atrosanguineus</i> : a rare Mexican endemic species of Asteraceae. PhD Dissertation. University of Greenwich, London, UK	" <i>Cosmos atrosanguineus</i> exhibits strong sporophytic self-incompatibility (SSI), does not set seed, and must be propagated vegetatively, a factor that has contributed to the proliferation of closely related or identical genotypes." ... "In conclusion, <i>Cosmos atrosanguineus</i> is a strongly self-incompatible species with a reduced genome. It does not set seed because the gene pool of cultivated individuals has narrowed to a level where S-allele numbers are too few to produce cross compatible genotypes. For this to have occurred, the genetic diversity of plants at the Royal Botanic Gardens Kew and in commercial cultivation must have been reduced to genets that share one, but more probably both S-alleles, thus preventing germination of pollen and formation of seed."

802	Evidence that a persistent propagule bank is formed (>1 yr)	
	Source(s)	Notes
	Lewendon, S. (2005). Self-incompatibility in <i>Cosmos atrosanguineus</i> : a rare Mexican endemic species of Asteraceae. PhD Dissertation. University of Greenwich, London, UK	[No seed set. Propagated by tuberous roots which may persist in the soil. Longevity of tubers in soil unknown] "In conclusion, <i>Cosmos atrosanguineus</i> is a strongly self-incompatible species with a reduced genome. It does not set seed because the gene pool of cultivated individuals has narrowed to a level where S-allele numbers are too few to produce cross compatible genotypes."

803	Well controlled by herbicides	
	Source(s)	Notes
	WRA Specialist. 2017. Personal Communication	Unknown. No information on herbicide efficacy or chemical control of this species

804	Tolerates, or benefits from, mutilation, cultivation, or fire	
	Source(s)	Notes
	Hind, N., & Fay, M. F. (2003). Plate 461. <i>Cosmos Atrosanguineus</i> Compositae. Curtis's Botanical Magazine, 20(1), 40-48	[Possible that plants regenerate from tuberous roots if cut back] "Tuberous rooted perennial; tuber relatively small to 3 cm long by 1.5 x 3 cm diameter, usually narrowing into a napiform taproot beneath."

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	Source(s)	Notes
	WRA Specialist. 2017. Personal Communication	Unknown

**Summary of Risk Traits:**

High Risk / Undesirable Traits

- Able to grow in tropical climates
- Other Cosmos species have become invasive
- Unpalatable to deer & rabbits
- Tolerates many soil types
- Tuberos roots (functional geophyte)

Low Risk Traits

- No reports of invasiveness or naturalization
- Unarmed (no spines, thorns, or burrs)
- Non-toxic
- Ornamental
- Sterile (only found in cultivation)
- Self-compatible
- Not reported to spread vegetatively
- Lack of fertile achenes limits ability of plant to escape and spread outside cultivation