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Agriculture

Animal and Plant
Health Inspection
Service

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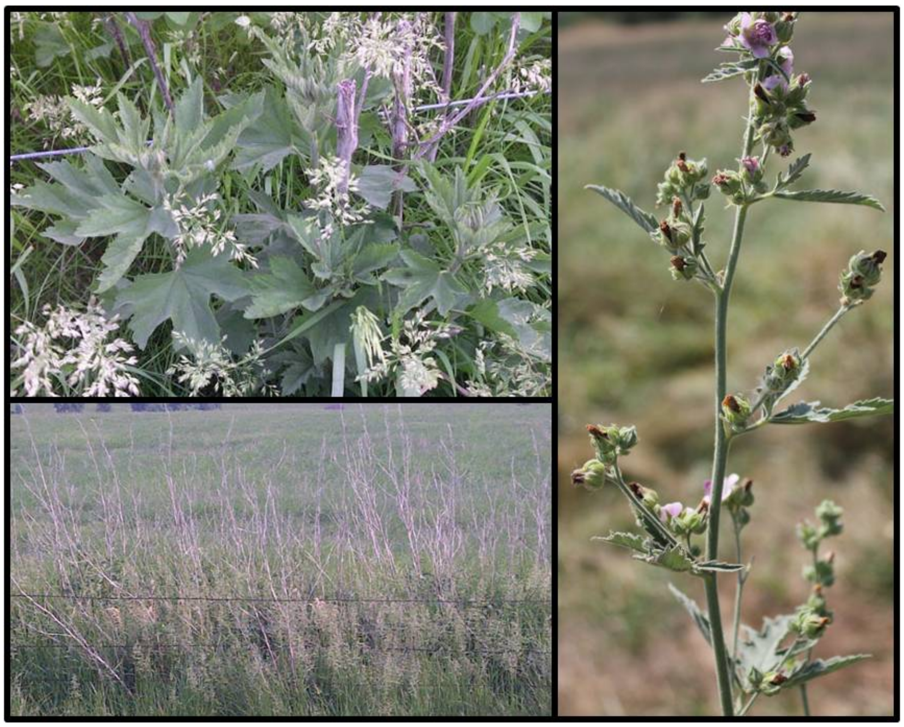
Version 2

Weed Risk Assessment for *Althaea armeniaca* Ten. (Malvaceae) – Marshmallow



Habit and inflorescence of *A. armeniaca* (source: Ron Moehring, South Dakota Department of Agriculture).

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Introduction Plant Protection and Quarantine (PPQ) regulates noxious weeds under the authority of the Plant Protection Act (7 U.S.C. § 7701-7786, 2000) and the Federal Seed Act (7 U.S.C. § 1581-1610, 1939). A noxious weed is defined as "any plant or plant product that can directly or indirectly injure or cause damage to crops (including nursery stock or plant products), livestock, poultry, or other interests of agriculture, irrigation, navigation, the natural resources of the United States, the public health, or the environment" (7 U.S.C. § 7701-7786, 2000). We use weed risk assessment (WRA)—specifically, the PPQ WRA model (Koop et al., 2012)—to evaluate the risk potential of plants, including those newly detected in the United States, those proposed for import, and those emerging as weeds elsewhere in the world.

Because the PPQ WRA model is geographically and climatically neutral, it can be used to evaluate the baseline invasive/weed potential of any plant species for the entire United States or for any area within it. As part of this analysis, we use a stochastic simulation to evaluate how much the uncertainty associated with the analysis affects the model outcomes. We also use GIS overlays to evaluate those areas of the United States that may be suitable for the establishment of the plant. For more information on the PPQ WRA process, please refer to the document, *Background information on the PPQ Weed Risk Assessment*, which is available upon request.

***Althaea armeniaca* Ten. – Marshmallow**

Species Information

Family: Malvaceae

Initiation: Mike Reed (Weed Superintendent for Douglas County Nebraska) alerted the Plant Epidemiology and Risk Analysis Laboratory (PERAL) to the detection of a species new to the United States. *Althaea armeniaca* was found growing along a roadside adjacent to cropland in Hutchinson County, South Dakota (CISEH, 2011; Reed, 2010).

Foreign distribution: *Althaea armeniaca* is native to the eastern Mediterranean and southwestern Asia in the area encompassing Afghanistan, northern Iran, Turkey, Armenia, Azerbaijan, Turkmenistan, and the Russian Federation (Bojňanský and Fargašová, 2007; NGRP, 2011). It is a casual alien in the Czech Republic (Pyšek et al., 2002).

U.S. distribution and status: This species was discovered by Bob Rennolet with the USDA Natural Resource Conservation Service (NRCS) in South Dakota at a fence line bordering some NRCS plantings on July 20, 2010. It was also found in smooth brome pastures and field borders over a two-mile area (Moehring, 2011). Populations consist of scattered dense patches of about 10 square feet in about a two-mile area. After discovery, all populations were treated with herbicides (CISEH, 2011; Moehring, 2011). The South Dakota Department of Agriculture is planning a two-week survey project to revisit the treated populations and map any additional ones in the area. South Dakota State University will conduct research on suitable control methods (Moehring, 2011). In June 2011, some of the plants previously treated were found to be regrowing (Moehring, 2011).

WRA area[1]: Entire United States, including territories

1. *Althaea armeniaca* analysis

Establishment/Spread Potential We found little information about the biology of *A. armeniaca* or its congeners, which resulted in high uncertainty indices in this assessment. Many questions about the invasiveness of the species or the lack thereof were unanswerable. The strongest predictor of invasive potential (*senso stricto*) in the PPQ WRA model is history elsewhere. *Althaea armeniaca* is only known to have been introduced to the Czech Republic, where it appears to have been extirpated (Pyšek et al., 2002). The most notable feature suggesting invasive potential is an ability to form dense patches (CISEH, 2011), but the impact of that on the risk score was tempered by a lack of any known long-distance dispersal vectors.
Risk score = 1 Uncertainty index = 0.36

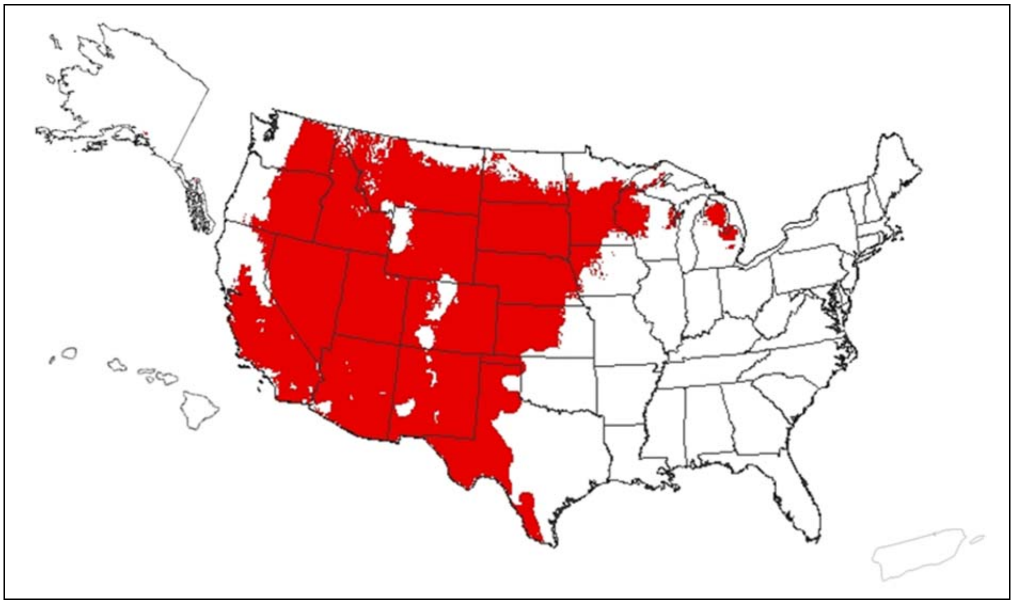
Impact Potential We found no evidence of impact for *A. armeniaca*, resulting in the lowest risk score possible for this element, but with, as mentioned above, high uncertainty. Based on the type of systems invaded by other *Althaea* species (Holm et al., 1979), if *A. armeniaca* were to become problematic (i.e., weedy), it would most likely impact pastures, rangelands, roadways, and other open, non-row crop habitats.
Risk score = 1 Uncertainty index = 0.31

Geographic Potential In its native range, *A. armeniaca* occurs in dry continental climates (NGRP, 2011). This roughly corresponds to the plains and intermountain west of the United States. We estimate that about 40 percent of the United States is suitable for its establishment (Fig. 1). Similar to the rest of this assessment, we had high uncertainty for this estimate. The Global Biodiversity Information Facility (GBIF, 2011) had very few herbarium records of *A. armeniaca*, none of which were geo-referenced data points. Our estimate of its potential U.S. distribution was based on its generalized native range and four small regions where it has been reported (NGRP, 2011). The map for *A. armeniaca* represents the joint distribution of USDA Plant Hardiness Zones 4-9, areas with 0-30 inches of annual precipitation, and the following Köppen-Geiger climate classes: steppe, desert, mediterranean, and humid continental warm/cool summers.

Entry Potential We did not assess the entry potential of *A. armeniaca* because it is already present in the United States in South Dakota (CISEH, 2011). One report suggests this species is cultivated (Bailey and Bailey, 1976), but we did not find any other evidence it is cultivated or available online.

[1] "WRA area" is the area in relation to which the weed risk assessment is conducted [definition modified from that for "PRA area" (IPPC, 2012)].

Figure 1. Predicted distribution of *Althaea armeniaca* in the United States. Map insets for Alaska, Hawaii, and Puerto Rico are not to scale.



2. Results and Conclusion

Model Probabilities: P(Major Invader) = 3.6%
P(Minor Invader) = 51.4%
P(Non-Invader) = 45.0%

Risk Result = Low Risk
Secondary Screening = Not Applicable

Figure 2. *Althaea armeniaca* risk score (black box) relative to the risk scores of species used to develop and validate the PPQ WRA model (other symbols). See Appendix A for the complete assessment.

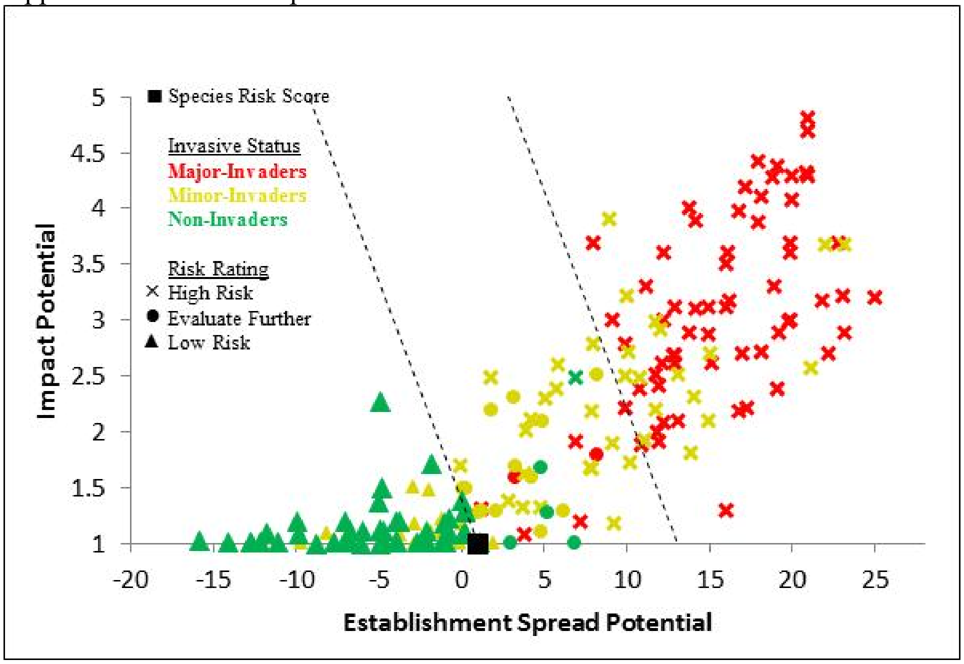
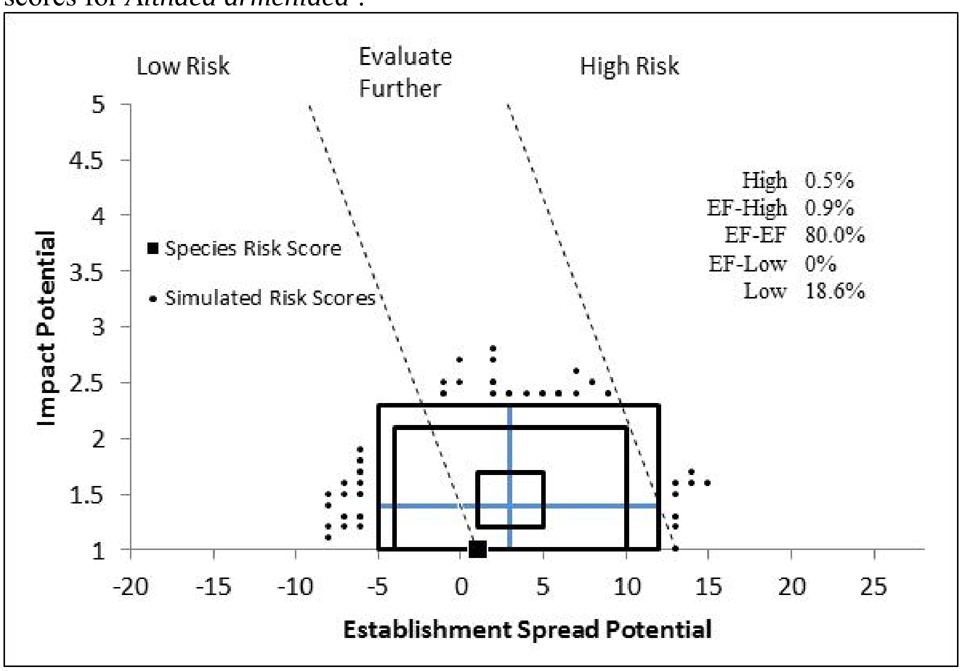


Figure 3. Monte Carlo simulation results (N=5,000) for uncertainty around the risk scores for *Althaea armeniaca*[a].



[a] The blue "+" symbol represents the medians of the simulated outcomes. The smallest box contains 50 percent of the outcomes, the second 95 percent, and the largest 99 percent.

3. Discussion

The result of the weed risk assessment for *A. armeniaca* is Low Risk. Its risk score is located just inside of the "Low Risk" decision region (Fig. 2). Adding just one point on any question would have given an "Evaluate Further" result. The relatively low risk scores for establishment/spread and impact partly reflect its status and biology, but also our limited understanding of the biology, ecology, and status of this species. Despite the high levels of uncertainty associated with this assessment, this species still seems unlikely to be or become a major invader (Fig. 3). At one point, it was a casual alien in the Czech Republic, but later became extirpated (Pyšek et al., 2002). Together, these data indicate *A. armeniaca* is a low risk for the United States.

While we revised this weed risk assessment in September, 2012, Ron Moehring (South Dakota State Weed Coordinator) informed us that fewer plants of *A. armeniaca* came back from the previous year (Moehring, 2012). He added that the state of South Dakota does not consider this species a threat to range, pasture, or crop sites in the state. Landowners will continue to treat the patches on their properties, and county weed supervisors and Natural Resources Conservation Staff will continue to monitor the sites (Moehring, 2012). Because this species is controlled in some production systems, we could have answered question Imp-P6 as "c" with "high" uncertainty. This would have resulted in a final risk potential of "Evaluate Further", which represents moderate risk. Because the level of control is very minor, however, and the state does not consider this species a threat, we decided to keep the answer as "a" with "high" uncertainty.

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Appendix A. Weed risk assessment for *Althaea armeniaca* Ten. (Malvaceae). The following information was obtained from the species' risk assessment, which was conducted using Microsoft Excel. The information shown in this appendix was modified to fit on the page. The original Excel file, the full questions, and the guidance to answer the questions are available upon request.

Question ID	Answer - Uncertainty	Score	Notes (and references)
ESTABLISHMENT/SPREAD POTENTIAL			
ES-1 (Status/invasiveness outside its native range)	d - low	0	Casual alien in the Czech Republic that possibly was extirpated (Pyšek et al., 2002). Not known to have been introduced anywhere else. Bother alternate answers for Monte Carlo simulation are "e".
ES-2 (Is the species highly domesticated)	n - low	0	Cultivated (Bailey and Bailey, 1976). Although there is no evidence that it has been bred for reduced weed potential, it was cultivated in study for medicinal and other commercial properties extracted from its rich mucilaginous material in the roots and leaves (Chladek and PatÁKovÁ, 1969). It has been crossed with *Althaea officinalis* (Chladek, 1971; Franz and Chládek, 1973), which is considered weedy (Holm et al., 1979).
ES-3 (Weedy congeners)	n - mod	0	No evidence. While numerous species of *Althaea* are considered weedy, none appear to be significant weeds (Holm et al., 1979; Randall, 2007).
ES-4 (Shade tolerant at some stage of its life cycle)	n - low	0	No evidence. Along with three other *Althaea* species, this species grows on river banks and field edges (Özkan and Uzunhisarcikli, 2008). Requires full sun (DavesGarden, 2011). Other *Althaea* species appear to be species of open, sunny habitats (Groves and Di Castri, 1991). *Althaea cannabina* and *A. officinalis*, which are closely related to *A. armeniaca*, cannot grow in the shade (PFAF, 2011).
ES-5 (Climbing or smothering growth form)	n - negl	0	Erect perennial herb (Hinsley, 2008; Özkan and Uzunhisarcikli, 2008).
ES-6 (Forms dense thickets)	y - high	2	Only one reference describes population density. From where it was found naturalized in the United States in 2010, it forms scattered dense patches (CISEH, 2011). However, because the total infested area in this reference was 10 square feet (CISEH, 2011), it is uncertain whether this species can form larger dense populations, which may be more consistent with the intent of the question. The guidance for this question does not refer to a minimum-sized area. Answering "yes" because it is reported to form dense patches, but using "high" uncertainty because this is only one report and the size of the patches appears to be small.
ES-7 (Aquatic)	n - negl	0	Terrestrial plant growing on river floodplains (Komissaranko and Kovalev, 1992).
ES-8 (Grass)	n - negl	0	Malvaceae (Özkan and Uzunhisarcikli, 2008).
ES-9 (Nitrogen-fixing woody plant)	n - negl	0	No evidence. Not in a plant family known to fix nitrogen (Martin and Dowd, 1990).
ES-10 (Does it produce viable seeds or spores)	y - low	1	Can be propagated from seed (DavesGarden, 2011); however, because there was very little other information on this species, it is possible this was a general statement about the entire genus. The fact that this species does not appear to reproduce vegetatively and that it appeared on a roadside by a farm field (CISEH, 2011) suggests it reproduces by seed. The closely related congeners *A. cannabina* and *A.*

Question ID	Answer - Uncertainty	Score	Notes (and references)
			officinalis (Escobar García et al., 2009) produce seed (PFAF, 2011).
ES-11 (Self-compatible or apomictic)	y - mod	1	Unknown for *A. armeniaca*. *Althaea armeniaca* is closely related to *A. cannabina* and *A. officinalis* (Escobar García et al., 2009). *Althaea cannabina* and *A. officinalis* can self-pollinate (PFAF, 2011). *Armeniaca broussontiifolia* can also self-pollinate (Rumi et al., 1976). Thus, based on these references, we are assuming *A. armeniaca* is likely to be self-compatible as well.
ES-12 (Requires special pollinators)	n - mod	0	Unknown for *A. armeniaca*. However, because *A. cannabina* is pollinated by bees (PFAF, 2011), and both *A. cannabina* and *A. officinalis* can self-pollinate (PFAF, 2011), it is likely that *A. armeniaca* does not require specialized pollinators.
ES-13 (Minimum generation time)	c - high	0	Plant is a perennial (Özkan and Uzunhisarcikli, 2008; Pyšek et al., 2002). It is highly unlikely the plant produces multiple generations in a year. Because it is described as a perennial, we are assuming it will require two or more years to reach reproductive age; however, it is possible for a perennial to begin reproducing in its first year. The alternate choices selected for the Monte Carlo simulation are “d” and “b”.
ES-14 (Prolific reproduction)	? - max	0	Unknown. No information for the species or genus.
ES-15 (Propagules likely to be dispersed unintentionally by people)	? - max	0	Unknown.
ES-16 (Propagules likely to disperse in trade as contaminants or hitchhikers)	? - max	0	Unknown.
ES-17 (Number of natural dispersal vectors)	0	-4	For questions ES-17a through ES-17e: Fruits are schizocarps that split into one-seeded mericarps when mature (Bojňanský and Fargašová, 2007; Özkan and Uzunhisarcikli, 2008).
ES-17a (Wind dispersal)	n - mod		No evidence. Seeds are small and disc-shaped; they do not have any obvious adaptation for wind dispersal (Bojňanský and Fargašová, 2007).
ES-17b (Water dispersal)	? - max		Unknown.
ES-17c (Bird dispersal)	n - mod		No evidence. Seeds do not appear to offer any type of reward (Bojňanský and Fargašová, 2007; Özkan and Uzunhisarcikli, 2008) typical of bird-dispersed species.
ES-17d (Animal external dispersal)	? - max		Unknown.
ES-17e (Animal internal dispersal)	n - mod		No evidence. Seeds or fruit do not appear to offer any type of reward (Bojňanský and Fargašová, 2007) to encourage consumption by animals.
ES-18 (Evidence that a persistent (>1yr) propagule bank (seed bank) is formed)	? - max	0	Unknown. Seeds from *A. officinalis* lasted 5 years, but it is unclear from the abstract if this was in the soil or under lab conditions (Ilieva and Petrova, 1981).
ES-19 (Tolerates/benefits from mutilation, cultivation or fire)	? - max	0	Unknown.
ES-20 (Is resistant to some herbicides or has the potential to become resistant)	n - high	0	No evidence. *Althaea* is not listed in Heap (2011). Using “high” uncertainty given how little information there is available for this species.
ES-21 (Number of cold hardiness	6	0	

Question ID	Answer - Uncertainty	Score	Notes (and references)
zones suitable for its survival)			
ES-22 (Number of climate types suitable for its survival)	5	2	
ES-23 (Number of precipitation bands suitable for its survival)	3	-1	
IMPACT POTENTIAL			
General Impacts			
Imp-G1 (Allelopathic)	n - mod	0	No evidence.
Imp-G2 (Parasitic)	n - negl	0	No evidence. Not a member of a family containing parasitic plants (Heide-Jorgensen, 2008; Nickrent, 2009).
Impacts to Natural Systems			
Imp-N1 (Change ecosystem processes and parameters that affect other species)	n - mod	0	No evidence.
Imp-N2 (Change community structure)	n - mod	0	No evidence.
Imp-N3 (Change community composition)	n - mod	0	No evidence
Imp-N4 (Is it likely to affect federal Threatened and Endangered species)	n - mod	0	No evidence that it is a weed or, if it were, that it would impact natural areas.
Imp-N5 (Is it likely to affect any globally outstanding ecoregions)	n - mod	0	No evidence that it is a weed or, if it were, that it would impact natural areas.
Imp-N6 (Weed status in natural systems)	a - low	0	No evidence that it is considered a weed. Alternate answers for the Monte Carlo simulation were both “b”.
Impact to Anthropogenic Systems (cities, suburbs, roadways)			
Imp-A1 (Impacts human property, processes, civilization, or safety)	n - mod	0	No evidence.
Imp-A2 (Changes or limits recreational use of an area)	n - mod	0	No evidence.
Imp-A3 (Outcompetes, replaces, or otherwise affects desirable plants and vegetation)	n - mod	0	No evidence.
Imp-A4 (Weed status in anthropogenic systems)	a - high	0	In anthropogenic areas, it was recorded as a casual alien that may have been extirpated (Pyšek et al., 2002). Because this source is about aliens and not necessarily about weeds, answering “a”, but with “high” uncertainty. Furthermore, its status as extirpated suggests it is not a weed. Alternate answers for the Monte Carlo simulation were both “b”.
Impact to Production Systems (agriculture, nurseries, forest plantations, orchards, etc.)			
Imp-P1 (Reduces crop/product yield)	n - high	0	No evidence. Using high uncertainty throughout the production systems subsection because other *Althaea* species have been identified as agricultural weeds (Holm et al., 1979), suggesting that if *A. armeniaca* were weedy, it would most likely be in agricultural systems. This species was found in South Dakota in smooth brome pastures and field borders (Moehring, 2011); but the establishment was too recent to make any conclusions about impact or potential impact.
Imp-P2 (Lowers commodity value)	n - high	0	No evidence.
Imp-P3 (Is it likely to impact trade)	n - high	0	No evidence.
Imp-P4 (Reduces the quality or	n - high	0	No evidence.

Question ID	Answer - Uncertainty	Score	Notes (and references)
availability of irrigation, or strongly competes with plants for water)			
Imp-P5 (Toxic to animals, including livestock/range animals and poultry)	n - mod	0	No evidence (Burrows and Tyrl, 2001; Cooper and Johnson, 1984).
Imp-P6 (Weed status in production systems)	c - high	0	No evidence this species is considered a weed. In the United States it was detected on the roadside of a crop field (CISEH, 2011) in smooth brome pastures and field borders (Moehring, 2011). Everything that was found in the summer of 2010 was treated with herbicides (Moehring, 2011). The South Dakota State Dept. of Agriculture plans to resurvey the following year to see if its status has changed (Reed, 2010). The congener *A. officinalis* is a weed of corn in New Zealand and controlled (Sumich, 1963). Alternate answers for the Monte Carlo simulation are “b” and “a”.
GEOGRAPHIC POTENTIAL			
Plant cold hardiness zones			
Geo-Z1 (Zone 1)	n - negl	N/A	No evidence.
Geo-Z2 (Zone 2)	n - negl	N/A	No evidence.
Geo-Z3 (Zone 3)	n - high	N/A	Suitable for zones 3-10 (DavesGarden, 2011); however, because this zone does not occur near its general native distribution, and because the extent of its cultivation in the United States appears to be very limited, marking this as “no” – “high”.
Geo-Z4 (Zone 4)	y - high	N/A	Suitable for zones 3-10 (DavesGarden, 2011). Answering “yes” because this zone is very close to its U.S. occurrence in Hutchinson County, South Dakota (CISEH, 2011).
Geo-Z5 (Zone 5)	y - negl	N/A	Localized occurrence: Armenia (Penksza, 1994), Turkey (Özkan and Uzunhisarcikli, 2008), South Dakota (Özkan and Uzunhisarcikli, 2008). Suitable for zones 3-10 (DavesGarden, 2011).
Geo-Z6 (Zone 6)	y - low	N/A	Answering “yes” by default because it occurs in the zones before and after this one. Suitable for zones 3-10 (DavesGarden, 2011).
Geo-Z7 (Zone 7)	y - low	N/A	Localized occurrence: Tashkent (Van et al., 2009). Suitable for zones 3-10 (DavesGarden, 2011).
Geo-Z8 (Zone 8)	y - mod	N/A	Generalized native distribution: Turkey and Turkmenistan (NGRP, 2011). Suitable for zones 3-10 (DavesGarden, 2011).
Geo-Z9 (Zone 9)	y - high	N/A	Suitable for zones 3-10, and growing near Austin, Texas which is in zone 9 (DavesGarden, 2011).
Geo-Z10 (Zone 10)	n - high	N/A	Suitable for zones 3-10 (DavesGarden, 2011); however, because this zone does not occur near its general native distribution, and because the extent of its cultivation in the United States appears to be very limited, marking this as “no” – “high”.
Geo-Z11 (Zone 11)	n - low	N/A	No evidence.
Geo-Z12 (Zone 12)	n - negl	N/A	No evidence.
Geo-Z13 (Zone 13)	n - negl	N/A	No evidence.
Köppen-Geiger climate classes			
Geo-C1 (Tropical rainforest)	n - negl	N/A	No evidence.

Question ID	Answer - Uncertainty	Score	Notes (and references)
Geo-C2 (Tropical savanna)	n - negl	N/A	No evidence.
Geo-C3 (Steppe)	y - low	N/A	Localized occurrence: Yerevan Basin-Armenia (Penksza, 1994).
Geo-C4 (Desert)	y - high	N/A	Generalized native distribution: Turkmenistan (NGRP, 2011).
Geo-C5 (Mediterranean)	y - high	N/A	Generalized native distribution: northern Iran, Turkey (NGRP, 2011).
Geo-C6 (Humid subtropical)	n - mod	N/A	No evidence.
Geo-C7 (Marine west coast)	n - low	N/A	No evidence.
Geo-C8 (Humid cont. warm sum.)	y - negl	N/A	Localized occurrence: Tashkent (Van et al., 2009); Hutchinson County, South Dakota (CISEH, 2011).
Geo-C9 (Humid cont. cool sum.)	y - low	N/A	Localized occurrence: Turkey (Özkan and Uzunhisarcikli, 2008).
Geo-C10 (Subarctic)	n - negl	N/A	No evidence.
Geo-C11 (Tundra)	n - negl	N/A	No evidence.
Geo-C12 (Icecap)	n - negl	N/A	No evidence.
10-inch precipitation bands			
Geo-R1 (0-10 inches; 0-25 cm)	y - high	N/A	Generalized native distribution: Turkmenistan (NGRP, 2011).
Geo-R2 (10-20 inches; 25-51 cm)	y - low	N/A	Localized occurrence: Tashkent (Van et al., 2009), and Yerevan Basin-Armenia (Penksza, 1994).
Geo-R3 (20-30 inches; 51-76 cm)	y - negl	N/A	Localized occurrence: Senkaya, Turkey (Özkan and Uzunhisarcikli, 2008); and Hutchinson County, South Dakota (CISEH, 2011).
Geo-R4 (30-40 inches; 76-102 cm)	n - high	N/A	No evidence.
Geo-R5 (40-50 inches; 102-127 cm)	n - mod	N/A	No evidence.
Geo-R6 (50-60 inches; 127-152 cm)	n - negl	N/A	No evidence.
Geo-R7 (60-70 inches; 152-178 cm)	n - negl	N/A	No evidence.
Geo-R8 (70-80 inches; 178-203 cm)	n - negl	N/A	No evidence.
Geo-R9 (80-90 inches; 203-229 cm)	n - negl	N/A	No evidence.
Geo-R10 (90-100 inches; 229-254 cm)	n - negl	N/A	No evidence.
Geo-R11 (100+ inches; 254+ cm))	n - negl	N/A	No evidence.
ENTRY POTENTIAL			
Ent-1 (Plant already here)	y - low	1	Plant cultivated in the United States (Bailey and Bailey, 1976). Escaped in South Dakota (CISEH, 2011).
Ent-2 (Plant proposed for entry, or entry is imminent)	-	N/A	
Ent-3 (Human value & cultivation/trade status)	-	N/A	The entire genus has been used medicinally (Özkan and Uzunhisarcikli, 2008).
Ent-4 (Entry as a contaminant)			
Ent-4a (Plant present in Canada, Mexico, Central America, the Caribbean or China)	-	N/A	
Ent-4b (Contaminant of plant propagative material (except	-	N/A	

Question ID	**Answer - Uncertainty**	**Score**	**Notes (and references)**
seeds))			
Ent-4c (Contaminant of seeds for planting)	-	N/A	
Ent-4d (Contaminant of ballast water)	-	N/A	
Ent-4e (Contaminant of aquarium plants or other aquarium products)	-	N/A	
Ent-4f (Contaminant of landscape products)	-	N/A	
Ent-4g (Contaminant of containers, packing materials, trade goods, equipment or conveyances)	-	N/A	
Ent-4h (Contaminants of fruit, vegetables, or other products for consumption or processing)	-	N/A	
Ent-4i (Contaminant of some other pathway)	-	N/A	
Ent-5 (Likely to enter through natural dispersal)	-	N/A	