United States Department of Agriculture

United States
Department of
Agriculture

Animal and Plant
Health Inspection
Service

February 8, 2016

Version 1

Weed Risk Assessment for *Mercurialis annua* L. (Euphorbiaceae) – Annual mercury

Left: *Mercurialis annua* ssp. *annua* plant (source: Malcolm Storey, www.discoverlife.org). Upper right: *M. annua* male flower buds and flowers (source: Luigi Rignanese, http://calphotos.berkeley.edu). Bottom right: *M. annua* fruit (source: Paul Busselen, https://gobotany.newenglandwild.org).

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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 the PPQ weed risk assessment (WRA) process (PPQ, 2015) 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.

The PPQ WRA process includes three analytical components that together describe the risk profile of a plant species (risk potential, uncertainty, and geographic potential; PPQ, 2015). At the core of the process is the predictive risk model that evaluates the baseline invasive/weed potential of a plant species using information related to its ability to establish, spread, and cause harm in natural, anthropogenic, and production systems (Koop et al., 2012). Because the predictive model is geographically and climatically neutral, it can be used to evaluate the risk of any plant species for the entire United States or for any area within it. We then use a stochastic simulation to evaluate how much the uncertainty associated with the risk analysis affects the outcomes from the predictive model. The simulation essentially evaluates what other risk scores might result if any answers in the predictive model might change. Finally, we use Geographic Information System (GIS) overlays to evaluate those areas of the United States that may be suitable for the establishment of the species. For a detailed description of the PPQ WRA process, please refer to the *PPQ Weed Risk Assessment Guidelines* (PPQ, 2015), which is available upon request.

We emphasize that our WRA process is designed to estimate the baseline—or unmitigated—risk associated with a plant species. We use evidence from anywhere in the world and in any type of system (production, anthropogenic, or natural) for the assessment, which makes our process a very broad evaluation. This is appropriate for the types of actions considered by our agency (e.g., Federal regulation). Furthermore, risk assessment and risk management are distinctly different phases of pest risk analysis (e.g., IPPC, 2016). Although we may use evidence about existing or proposed control programs in the assessment, the ease or difficulty of control has no bearing on the risk potential for a species. That information could be considered during the risk management (decision making) process, which is not addressed in this document.

***Mercurialis annua* L. – Annual mercury**

Species Information Family: Euphorbiaceae

Synonyms: *Discoplis serrata* Raf., *Mercurialis ambigua* L.f., *M. ciliata* C.Presl, *M. ladanum* Hartm., *M. monoica* (Moris) B.M.Durand, *M. pinnatifida* Sennen, *M. tarraconensis* Sennen, *Synema annuum* (L.) Dulac (The Plant List, 2013). *Mercurialis annua* is often referred to as a species complex (e.g., Korbecka et al., 2010; Obbard, 2004; Obbard et al., 2006a; Pannell et al., 2004) made up of "closely related lineages" that have a wide range of sexual systems (e.g., dioecious, monoecious, and androdioecious)[1] and ploidy levels (Obbard, 2004). Sexual systems include populations that are mainly or exclusively dioecious, monoecious, and androdioecious (Pannell, 1997a; Pannell et al., 2004). Ploidy levels include diploids (2n=16), tetraploids, hexaploids, and other polyploids (Pannell et al., 2004). Diploid populations are dioecious, and polyploid populations are either monoecious or androdioecious (Obbard, 2004). In the past, the *M. annua* complex was divided into three taxa: *M. annua sensu stricto* (*s.s.*) (comprising only dioecious diploid populations), *M. ambigua* L. (comprising monoecious and androdioecious tetraploid and hexaploid populations), and *M. monoica* (Moris) Durand (comprising higher ploidy populations that are invariably monoecious) (Obbard et al., 2006a, citing Durand, 1963). However, because of the difficulty of morphologically distinguishing the ploidy levels between taxa, other authors at that time and more currently have chosen to place these into one taxon, *M. annua sensu lato* (*s.l.*) (Obbard, 2004; Obbard et al., 2006a). On the other hand, some authors (e.g., Cal-IPC, 2015; Kelch, 2015b; SPB, 2015) and most Spanish floras (Kelch, 2015a) currently treat *M. annua* var. *ambigua* (L.f.) Duby as species *M. ambigua* L. f. Also, in California, the *M. ambigua* form is morphologically distinct from the *M. annua s.s.* form, and hybrids of the two are sterile (Kelch, 2015b).

For this weed risk assessment we assessed *M. annua* in the broad sense, that is, as *M. annua s.l.* instead of as *M. annua s.s.*, because most of the scientific literature, including taxonomic sources, typically either refers to *M. ambigua* as a synonym or a subspecies of *M. annua* (e.g., Acevedo-Rodríguez and Strong, 2012; Hanf, 1983; Korbecka et al., 2010; Obbard, 2004; Obbard et al., 2006a; Pannell et al., 2004; Randall, 2012; The Plant List, 2013) or only uses the name *M. annua* with no mention of *M. ambigua* (e.g., ITIS, 2015; NGRP, 2015). We also decided to evaluate *M. annua* at a broad level because most of the literature does not distinguish among the potential different forms, making it difficult to know what evidence pertains to *M. annua s.s.* versus other parts of the complex. For clarity, though, when the identity of the taxon is known, we note information specific to *M. ambigua* genotypes.

Common names: Annual mercury, French mercury, herb mercury (NGRP, 2015).

Botanical description: *Mercurialis annua* is an annual herb with erect stems (NRCS, 2015; Robson et al., 1991; UC, 2015) that grows mainly in open disturbed habitats (UC, 2015). It grows from10 to 60 cm high (Bencivenga et al., 1979; Britton and Millspaugh, 1920; Hanf, 1983). Male flowers are yellowish and occur in spike-like clusters, while female flowers are green and grow as solitary flowers or in clusters of two or three (Lonchamp, 2000). In California, the *M. annua s.s.* form is dioecious and has narrowly ovate to narrowly lanceolate leaves, while the *M. ambigua* form is monoecious and has wider ovate leaves (Kelch, 2015b). For a more detailed botanical description, see UC (2015), Britton and Millspaugh (1920), and Hanf (1983) for *M. annua*, and SPB (2015) for *M. ambigua*.

[1] Dioecious = having male and female flowers on different plants; monoecious = having unisexual male and female flowers on the same plant; and androdioecious = males occurring with monoecious plants.

Initiation: PPQ received a market access request for corn (*Zea mays*) kernels for human and animal consumption from the government of Ukraine (Government of Ukraine, 2013). A commodity risk assessment associated *Mercurialis annua* with corn kernels from the Ukraine. The PERAL Weed Team initiated a weed risk assessment for *M. annua* to help policy makers determine whether it represents a noxious weed threat.

Foreign distribution: This species is native to parts of Africa (the Canary Islands, Algeria, Egypt, Libya, the Madeira Islands, Morocco, Tunisia), temperate Asia (Cyprus, Georgia, Iran, Iraq, Israel, Jordan, Lebanon, Syria, Turkey), and central, eastern, and southern parts of Europe (Albania, Austria, Belgium, Bulgaria, France, Germany, Greece, Hungary, Italy, the Netherlands, Poland, Portugal, Romania, the Russian Federation, Spain, Switzerland, Ukraine, and the former Yugoslavia and Czechoslovakia) (BGBM, 2011; Greuter, 1979; NGRP, 2015; Salisbury, 1961; Shafiei et al., 2006).

It has naturalized in northern parts of Europe (Denmark, Finland, Ireland, Lithuania, Norway, Sweden) (Gudzinskas, 2009; Reynolds, 2002; Weidema, 2000), Canada (Kartesz, 2015; NRCS, 2015), Mexico (Vibrans et al., 2009), New Zealand (Esler and Astridge, 1987; Howell and Sawyer, 2006), Australia (Groves et al., 2005; Randall, 2007; Richardson et al., 2007; Ross and Walsh, 2003), and Japan (cited in Pannell et al., 2004).

It is reported in South Africa (GBIF, 2015; Pearson, 1918), the Caribbean (Acevedo-Rodríguez and Strong, 2012; NYBG, 2015), Argentina (GBIF, 2015), Chile (Ugarte et al., 2011), and Peru (Gutte et al., 1986), but it is unknown if it has naturalized in those areas.

Exclusively dioecious populations are widespread across central and western Europe; largely monoecious populations occur around the western Mediterranean in southern Europe and north Africa; and androdioecious populations are widespread in southern Spain, southern Portugal and northern Morocco (Pannell, 1997a). Based on this and other evidence (Durand and Durand, 1991; GBIF, 2015; Gillot, 1925; Sanchez-Campos et al., 2000; SPB, 2015), *M. ambigua* generally has a more limited and southern distribution in its native range than *M. annua s.s.*

U.S. distribution and status: *Mercurialis annua* is naturalized in a very limited number of counties in multiple states throughout the United States: one county each in Oregon, Alabama, Pennsylvania, Maryland, New Jersey, and New York; two counties each in South Carolina, Ohio, and Massachusetts; and a few counties in California (Kartesz, 2015; NRCS, 2015). It has also naturalized in Delaware, Illinois, and Maine, but no county information is given for those states (NRCS, 2015). In California, while *M. annua s.s.* has occurred in there for decades, *M. ambigua* has recently appeared suddenly in several locations (Kelch, 2015b) and is currently reported from five counties (Kelch, 2015a). Based on a literature search (e.g., Backyard Gardener, 2015; Bailey and Bailey, 1976; Dave's Garden, 2015; GardenWeb, 2015; Missouri Botanical Garden, 2015; UMN, 2015) we found no evidence of *M. annua* being cultivated in the United States. It is on the California Noxious Weed list under the name *M. ambigua* (CDFA, 2015), and is listed under both names on the California Invasive Plant Council Watchlist (an unofficial supplement to their Invasive Plant Inventory)

(Cal-IPC, 2015). *Mercurialis annua* is also a target species (with a priority of 2 on a scale of 1 to 3) of the "Invasive Plant Species Early Detection in the San Francisco Bay Area Network" (Wrubel, 2013). Finally, New Jersey included it in their 2002 "Prioritized Listing Of New Jersey's Nonindigenous Plant Species," with a 4 ranking, defined as "species that are presently not considered to be invasive in New Jersey" (Snyder, 2002).

WRA area[2]: Entire United States, including territories.

1. *Mercurialis annua* analysis

Establishment/Spread Potential Beyond its native range, *M. annua* has established in North America, New Zealand, Australia, and Japan (Howell and Sawyer, 2006; Kartesz, 2015; Pannell et al., 2004; Richardson et al., 2007; Vibrans et al., 2009). In its native range, it is described as continually spreading in Hungary (Magyar and Lehoczky, 2008; Szárnyas, 2002). The *M. ambigua* form is not very widespread in California but "is spreading evidently quickly" (Kelch, 2015b). *Mercurialis annua* has prolific seed production (Hofstetter, 1986; Jursik et al., 2004; Kohout and Hamouz, 2000), forms a persistent seed bank (Bencivenga et al., 1979; Gillot, 1925) and dense populations (Magyar and Lehoczky, 2008; Pannell, 1997b), and can be shade tolerant (Greuter, 1979; Magyar, 2003), and monoecious plants of *M. annua* are self-fertile (Eppley and Pannell, 2007; Pannell et al., 2004). The seeds are adapted to be dispersed by ants (Pacini, 1990), but evidence also indicates that they are sometimes spread via water (Pacini, 1990), by birds (Lainsbury et al., 1999; Padilla et al., 2012), unintentionally by people (Kelch, 2015a; Pannell et al., 2004), and possibly by animals that consume the seed (Padilla et al., 2012; Welchman et al., 1995). Lastly, some populations have developed herbicide resistance (Bencivenga et al., 1979; Kohout and Hamouz, 2000). We had a high amount of uncertainty for this risk element.

Risk score = 23 Uncertainty index = 0.22

Impact Potential *Mercurialis annua* is a weed of gardens (Groves et al., 2005; Kohout and Hamouz, 2000; Reynolds, 2002; Salisbury, 1961) and many crops, including maize, sugarbeet, sunflower, potato, wheat, root crops, and vegetables (Hanf, 1983; Kohout and Hamouz, 2000; Magyar, 1998, 1999; Qasem and Foy, 2001; Weber and Gut, 2005). In California, the *M. ambigua* form has recently become "an aggressive invader of nurseries," and pots in particular (Kelch, 2015b). Its residues are allelopathic (Qasem and Foy, 2001; Szárnyas, 2002), and it can cause yield losses in maize (Magyar and Lehoczky, 2008) and sugarbeets (Hofstetter, 1986). The plant is poisonous to livestock (Alzieu et al., 1993; Bensaid et al., 1995; Landau et al., 1973; Salisbury, 1961), and consumption by cattle can toxify their milk and create a bluish color (Bensaid et al., 1995). Because it is a regulated pest in at least one country (APHIS, 2015) and one U.S. state (CDFA, 2015), and the *M. ambigua* form in California appears to spread via nursery operations (Kelch, 2015a), it may impact the nursery trade. While *M. annua* occurs mainly in disturbed or artificial habitats (e.g., Calflora, 2015; Hanf, 1983; Robson et al.,

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

1991), some evidence also places it in natural systems (Cal-IPC, 2015; Keighery and Longman, 2004). For example, it may be displacing annual herbs in a nature reserve (VSG, 2015b). Other evidence indicates it is sometimes controlled in production systems (e.g., Jursik et al., 2008; Robson et al., 1991), but we found no such evidence of control in anthropogenic or natural systems. We had a high amount of uncertainty for this risk element.
Risk score = 3.2 Uncertainty index = 0.22

Geographic Potential Based on three climatic variables, we estimate that about 74 percent of the United States is suitable for the establishment of *M. annua* (Fig. 1). This predicted distribution is based on the species' known distribution elsewhere in the world and includes point-referenced localities and areas of occurrence. The map for *M. annua* represents the joint distribution of Plant Hardiness Zones 5-12, areas with 0-100 inches of annual precipitation, and the following Köppen-Geiger climate classes: steppe, desert, Mediterranean, humid subtropical, marine west coast, humid continental warm summers, humid continental cool summers, subarctic, and tundra. It was not clear if *M. annua* occurs in Plant Hardiness Zone 13 or in the tropical savanna climate class. We found two points in Haiti (GBIF, 2015) and a few old herbarium reports (from the early 1900s and 1976) for Nassau, Bahamas (NYBG, 2015), which correspond to these environments. However, we did not find clear evidence that *M. annua* is established in Haiti or the Bahamas, and despite being widespread in its native range and having a large amount of point data for that area, it does not occur in those environments there. Consequently, we concluded that Zone 13 and the tropical savanna were not suitable for *M. annua*.

The area of the United States shown to be climatically suitable (Fig. 1) is likely overestimated since our analysis considered only three climatic variables. Other environmental variables, such as soil and habitat type, may further limit the areas in which this species is likely to establish. Its habitats include mainly open, disturbed areas (UC, 2015), such as cropland, orchards, vineyards, gardens, roadsides, and wasteland (Hanf, 1983; Pacini, 1990; Robson et al., 1991; Stokes et al., 2004; VSG, 2015a). Its reported habitats also include a stream/drainage channel (Low, 2011) and a creek corridor (VSG, 2015a). In California, the *M. ambigua* form does especially well in mulched areas and in nursery pots (Kelch, 2015b).

Entry Potential We did not assess the entry potential of *Mercurialis annua* because it is already present in the United States (Kartesz, 2015; NRCS, 2015; Kelch, 2015a, 2015b).

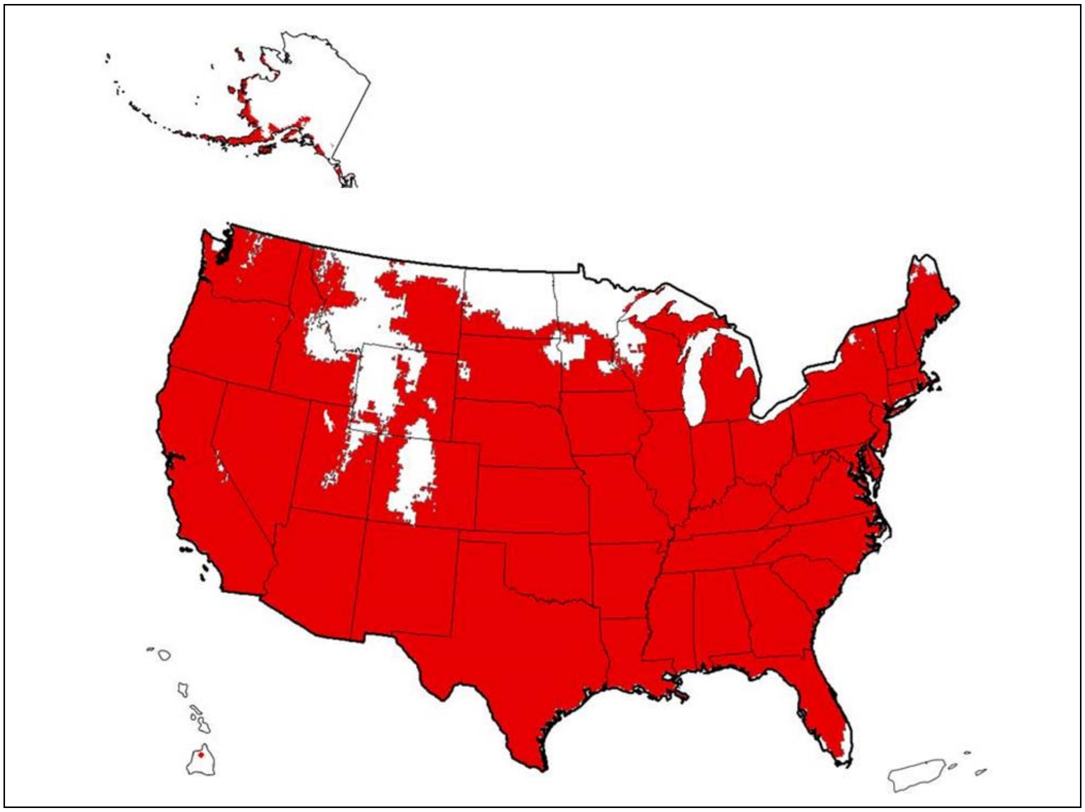

Figure 1. Predicted distribution of *Mercurialis annua* in the United States. Map insets for Alaska, Hawaii, and Puerto Rico are not to scale.

2. Results

Model Probabilities: P(Major Invader) = 96.1%
P(Minor Invader) = 3.8%
P(Non-Invader) = 0.1%

Risk Result = High Risk

Secondary Screening = Not Applicable

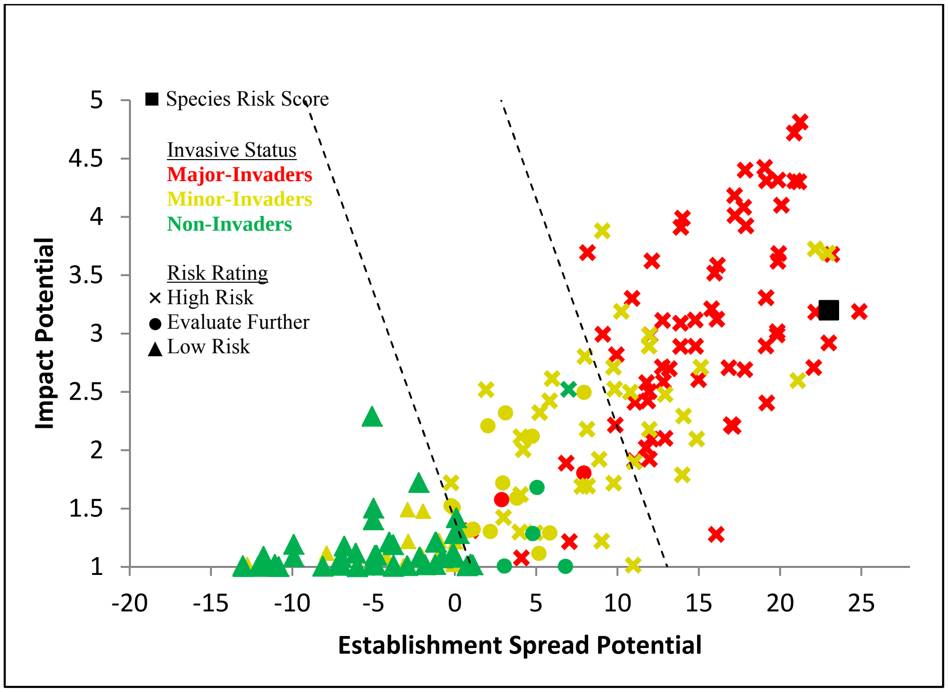

Figure 2. *Mercurialis annua* risk score (black box) relative to the risk scores of species used to develop and validate the PPQ WRA model (other symbols). See Appendix A for the complete assessment.

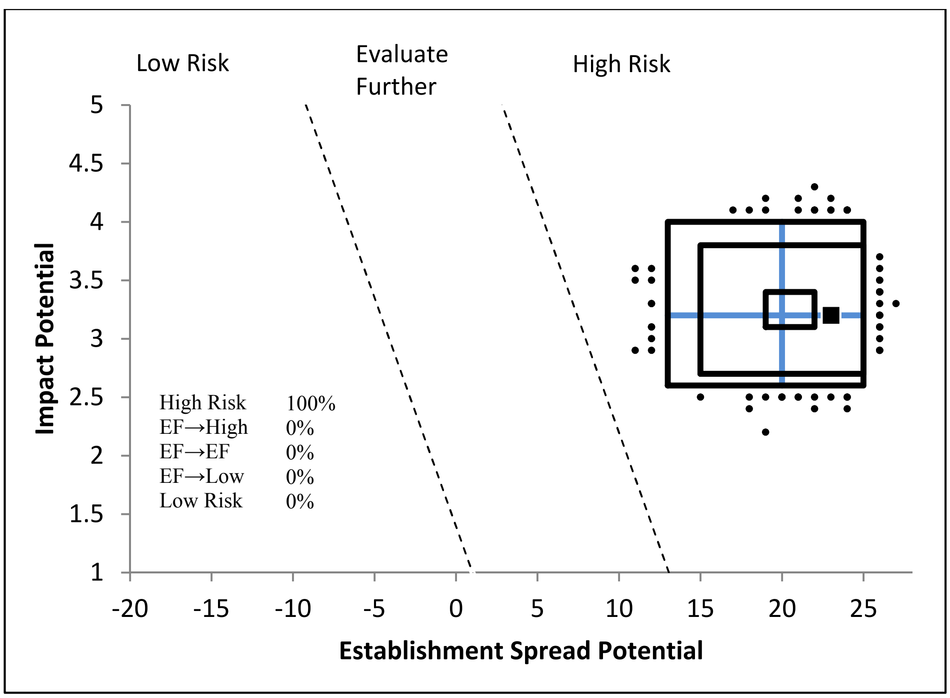

Figure 3. Model simulation results (N=5,000) for uncertainty around the risk score for *Mercurialis annua*. The blue "+" symbol represents the medians of the simulated outcomes. The smallest box contains 50 percent of the outcomes, the second 95 percent, and the largest 99 percent.

3. Discussion

The result of the weed risk assessment for *Mercurialis annua* is High Risk (Fig. 2). This species tolerates a wide range of environmental conditions. While it has naturalized in many areas of the world, we found no evidence of it being widespread in naturalized areas, and the only evidence we found of it spreading rapidly in its naturalized range is for the *M. ambigua* form in California (see above). *Mercurialis annua* is a garden weed (Groves et al., 2005; Kohout and Hamouz, 2000; Reynolds, 2002) and weedy in many crops (Bencivenga et al., 1979), in particular maize and sugarbeet (see above). Furthermore, *M. annua* can harm livestock health and the quality of animal products (Bensaid et al., 1995). While clear evidence exists of its impact in production systems, we only found limited evidence of damage in anthropogenic (i.e., gardens) and natural systems. Although our uncertainty was high, the uncertainty analysis (Fig. 3) indicated that the determination of high risk was robust, because all of the simulated risk scores resulted in conclusions of High Risk.

For this weed risk assessment, we assessed *M. annua* in the broad sense, that is, as *M. annua s.l.* (see the Synonyms section above for more details), but we noted when evidence was unambiguously for *M. ambigua*. The main evidence that appears to be unique to *M. ambigua* is as follows: a) having androdioecious tetraploid and hexaploid populations (Obbard et al., 2006a, citing Durand, 1963), b) recently spreading in California via landscaping and nursery operations (Kelch, 2015a, 2015b), and c) being regulated as a state noxious weed in California (CDFA, 2015). Furthermore, in contrast to *M. annua s.s.* but not necessarily all forms within the complex, it can be monoecious and self-fertile (Pannell, 1997a) and generally has a more limited and southern distribution in its native range (Durand and Durand, 1991; GBIF, 2015; Gillot, 1925; Pannell, 1997a; Sanchez-Campos et al., 2000; SPB, 2015). Also, because hexaploid *M. ambigua* populations are thought to have resulted from the hybridization between a tetraploid *M. annua* and the related diploid *M. huetii* (Obbard et al., 2006a), we searched the scientific literature for *M. huetii* but did not find any evidence of that taxon being weedy or problematic.

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Appendix A. Weed risk assessment for *Mercurialis annua* L. (Euphorbiaceae). Below is all of the evidence and associated references used to evaluate the risk potential of this taxon. We also include the answer, uncertainty rating, and score for each question. The Excel file, where this assessment was conducted, is available upon request.

Question ID	Answer - Uncertainty	Score	Notes (and references)
ESTABLISHMENT/SPREAD POTENTIAL			
ES-1 [What is the taxon's establishment and spread status outside its native range? (a) Introduced elsewhere =>75 years ago but not escaped; (b) Introduced <75 years ago but not escaped; (c) Never moved beyond its native range; (d) Escaped/Casual; (e) Naturalized; (f) Invasive; (?) Unknown]	f - high	2	This species is native to parts of northern Africa, temperate Asia, and central, eastern, and southern parts of Europe (NGRP, 2015). It has naturalized in northern parts of Europe (Gudzinskas, 2009; Reynolds, 2002; Weidema, 2000), the United States (Kartesz, 2015; NRCS, 2015), Canada (Kartesz, 2015; NRCS, 2015), Mexico (Vibrans et al., 2009), New Zealand (Esler and Astridge, 1987; Howell and Sawyer, 2006), Australia (Western Australia and Victoria) (Groves et al., 2005; Randall, 2007; Richardson et al., 2007; Ross and Walsh, 2003), and Japan (cited in Pannell et al., 2004). In Canada, its distribution includes four provinces, but it is also described as "rare and probably not persisting" (Darbyshire, 2003). It is naturalized in a very limited number of counties in multiple states throughout the United States (Kartesz, 2015; NRCS, 2015), and in Mexico only "very locally" in Mexico City (Vibrans et al., 2009). It is reported in South Africa (GBIF, 2015; Pearson, 1918), the Caribbean (Acevedo-Rodríguez and Strong, 2012; NYBG, 2015), and parts of South America (GBIF, 2015; Gutte et al., 1986; Ugarte et al., 2011), but it is unknown if it has naturalized in those areas. In Australia, it is described as "locally common in peppermint woodland at Hamelin Bay" in Western Australia (Hussey et al., 2007) and "not common" in Victoria (Richardson et al., 2007). Under both the name *M. annua* and *M. ambigua*, it is on the California Invasive Plant Council Watchlist, which is described as containing "plants that…have been reported spreading in California wildlands" but also as a list of "plants not yet rated as invasive but starting to raise concerns" (Cal-IPC, 2015). In California, while *M. annua s.s.* "may be spreading, but slowly," "*M. ambigua* has appeared suddenly in several localities recently" (e.g., nurseries, gardens, mulched areas) and "is spreading evidently quickly," but "neither [species] is very widespread" at this time (Kelch, 2015b). It is described as continually spreading in Hungary (Magyar, 1999; Magyar, 2003; Magyar and Lehoczky, 2008; Szárnyas, 2002), but this country is within its native range. Because we found only one source indicating this species is spreading rapidly in an area of its non-native range (Kelch, 2015b) and no evidence of it being widespread in naturalized areas, we used high uncertainty. The alternate choices for the Monte Carlo simulation were both "e."
ES-2 (Is the species highly domesticated)	n - low	0	We found no evidence that it has been bred for any particular traits resulting in reduced weed potential. Also, we found limited evidence of cultivation. Randall (2012) states it is "cultivated." It is a dye plant and an edible culinary plant (Kartesz, 2015) and historically has been used for medicinal purposes (Kohout and Hamouz, 2000).
ES-3 (Weedy congeners)	n - high	0	The genus *Mercurialis* has 7-11 species (Mabberley, 2008; Pannell et al., 2004). Randall (2012) lists two species as weeds (*M. ovata* and *M. perennis*). Although there are reports of control efforts against *M. perennis* (Burschel, 1958; Davison, 1972; Linden and Immel, 1960; Rozsnyay, 1959), and one source states it is an "aggressive native

Question ID	Answer - Uncertainty	Score	Notes (and references)
			species" in British woodlands (Marrs et al., 2013), we did not find evidence that this species is considered a significant weed. Besides *M. annua*, no species in the genus is listed in Randall (2007), Holm et al. (1979), Bridges (1992), or Weber (2003), and we found no evidence of other species being regulated by countries (APHIS, 2015; EPPO, 2015).
ES-4 (Shade tolerant at some stage of its life cycle)	y - mod	1	"On the basis of the calculated low value of NAR [Net Assimilation Rate] and the relatively high value of LAR [Leaf Area Ratio] it can be established that annual mercury belongs to shade plants" (Magyar, 2003). Referred to as a "shade plant" (Oppenheimer, 1951) and "shade-loving" (Greuter, 1979). Seed germination occurs more rapidly in the dark than in the light (Gillot, 1925). In one field study site, some patches were in deep shade, while others were in full sunlight (Pannell, 1997b). "*M[ercurialis] annua* has a high light requirement for its development and cannot develop under shading conditions" (Kohout and Hamouz, 2000), but no further information is provided by these authors. Because multiple sources indicate it can grow in the shade but one source states that it cannot develop under shade conditions, we answered yes but with moderate uncertainty.
ES-5 (Plant a vine or scrambling plant, or forms tightly appressed basal rosettes)	n - negl	0	*Mercurialis annua* is neither a vine nor an herb with a basal rosette. It is an erect herb (NRCS, 2015; Robson et al., 1991; UC, 2015).
ES-6 (Forms dense thickets, patches, or populations)	y - negl	2	It had a "high density" in corn production in Hungary (Magyar and Lehoczky, 2008) and occurred "at high densities" in sugarbeet and maize plots in Turkey (István et al., 1997). In central and western Europe, "large, dense populations often persist from one year to the next"; it can form "dense stands" (Pannell, 1997b).
ES-7 (Aquatic)	n - negl	0	Not an aquatic plant; it is a terrestrial plant (New England Wild Flower Society, 2015). Its habitats include mainly open disturbed habitats (UC, 2015), such as cropland, orchards, gardens, roadsides, and wasteland (Hanf, 1983; Robson et al., 1991; Stokes et al., 2004; VSG, 2015a).
ES-8 (Grass)	n - negl	0	*Mercurialis annua* is not a grass; rather it is an herb in the Euphorbiaceae family (NGRP, 2015).
ES-9 (Nitrogen-fixing woody plant)	n - negl	0	We found no evidence of *M. annua* fixing nitrogen. It is in the Euphorbiaceae family (NGRP, 2015), which is not one of the families known to contain nitrogen-fixing species (Martin and Dowd, 1990; Santi et al., 2013). Further, *M. annua* is not a woody plant.
ES-10 (Does it produce viable seeds or spores)	y - negl	1	It produces viable seed (Magyar and Lukacs, 2002; Szárnyas and Béres, 1999). "Its propagation takes place exclusively by seeds" (Magyar and Lukacs, 2002).
ES-11 (Self-compatible or apomictic)	y - negl	1	Monoecious plants of *M. annua* are "both self-fertile and capable of outcrossing as male parents" (Pannell, 1997a). Monoecious plants of *M. annua* are self-fertile (Eppley and Pannell, 2007; Obbard et al., 2006b; Pannell et al., 2004; Pujol et al., 2009). Also, "isolated female plants in a greenhouse have been recorded as setting fertile seed parthenogenetically" (Salisbury, 1961).
ES-12 (Requires specialist pollinators)	n - negl	0	We found no evidence of *M. annua* depending on pollinators. It is wind pollinated (Garciaortega et al., 1992; Lisci et al., 1994; Pannell, 1997b; Pannell et al., 2004). A pollination study "revealed the typical general characteristics of anemophilous [=wind pollinated] species rather than those of species pollinated by insects"; for instance, the

Question ID	Answer - Uncertainty	Score	Notes (and references)
			male inflorescence is "erect and terminal, designed to maximize exposure of the pollen to the wind" (Lisci et al., 1994). Also, there is evidence it can set seed parthenogenetically (see ES-11).
ES-13 [What is the taxon's minimum generation time? (a) less than a year with multiple generations per year; (b) 1 year, usually annuals; (c) 2 or 3 years; (d) more than 3 years; or (?) unknown]	b - high	1	*Mercurialis annua* is usually referred to as an annual (Hanf, 1983; Robson et al., 1991; Salisbury, 1961; UC, 2015). In warm conditions, male and female plants can complete their life span within 12 and 14 weeks from germination, respectively, and the flower buds form 12 to 21 days after the seedling begins to grow (Salisbury, 1961). *Mercurialis annua* plants produce flowers and fruit usually from the age of two weeks after germination (Pannell, 1997a). In Great Britain, after seeds are deposited from the fruit of the plant, germination usually takes place the following year, intermittently from May to early summer (Salisbury, 1961). In Italy, it flowers year-round (Lisci et al., 1994) and completes two generations a year, one beginning in the spring and a second in late summer (Bencivenga et al., 1979), but we do not know if these authors are referring to successive generations or two generations resulting from dormant seed germinating at different times of the year. One source refers to *M. annua* as a biennial (Weber and Gut, 2005). The alternate choices for the Monte Carlo simulation were "a" and "a."
ES-14 (Prolific reproduction)	y - negl	1	It has prolific seed production (Hofstetter, 1986; Kohout and Hamouz, 2000) and low seed mortality (Hofstetter, 1986), producing up to 20,000 seeds per m^2 in sugarbeet stands (Jursik et al., 2004). A single plant can produce from 1,805 (Bencivenga et al., 1979) to 16,900 seeds (references cited in Magyar and Lukacs, 2002). In crop production studies, its density ranged from 11 to 314 plants per m^2 (István et al., 1997; Magyar, 1998; Magyar and Lehoczky, 2008).
ES-15 (Propagules likely to be dispersed unintentionally by people)	y - low	1	Reported as a rare "ballast weed" from Charleston, SC, and Mobile, AL (1932 reference cited in Weakley, 2015). In New England, "[i]t may have been introduced in ships' ballast, as early collections were from ballast dump sites" (New England Wild Flower Society, 2015). Pannell et al. (2004) state that "seeds are...doubtless moved in soil by humans." It is common on roadsides, waste places (Robson et al., 1991), and landfills (Hanf, 1983; VSG, 2015a), indicating that people are likely moving it. It is listed as having been unintentionally introduced into Nordic countries (Weidema, 2000), but no information is given on exactly how. Based on this evidence and the fact that it is a common garden weed (see Imp-A4), it seems likely that its seeds could be dispersed unintentionally by humans. The *M. ambigua* form in California "produces numerous seeds that seem to be able to spread rather well via pathways that have to do with landscaping" (Kelch, 2015a).
ES-16 (Propagules likely to disperse in trade as contaminants or hitchhikers)	y - high	2	While we found no evidence of it being a seed contaminant, the *M. ambigua* form in California "produces numerous seeds that seem to be able to spread rather well via pathways that have to do with...nursery operations" (Kelch, 2015a).
ES-17 (Number of natural dispersal vectors)	4	4	Fruit and seed description used to answer questions ES-17a through ES-17e: The fruit is a two-seeded hispid (=covered with stiff hair) capsule (Lisci and Pacini, 1997; Lonchamp, 2000) that is 4-5 mm wide (Britton and Millspaugh, 1920). The seeds are 1.5-2.5 mm in length, ovoid, and grayish green or light brown (Britton and Millspaugh, 1920; Hanf, 1983; Pacini, 1990), each weighing 0.0013 to 0.0025 g (Pacini, 1990; Salisbury, 1961). The seeds contain a pale brown caruncle (a seed appendage containing lipid and protein

Question ID	Answer - Uncertainty	Score	Notes (and references)
			reserves) that continues with a three-cell layer enveloping the seed (Pacini, 1990).
ES-17a (Wind dispersal)	n - high		The fruit break open explosively, which scatters the seeds (Salisbury, 1961) up to 130 cm away from the plant, but mostly between 20 and 30 cm away (Pacini, 1990). "[M]ay be blown substantial distances by wind (our pers. observ.)" (Pannell et al., 2004), but because we found no other evidence of wind dispersal, we did not consider this sufficient evidence that wind contributes significantly to the dispersal of *M. annua* seeds. Plus, the seeds have no morphological features that facilitate their movement by wind.
ES-17b (Water dispersal)	y - high		"Seeds dispersed by small streams formed after heavy rain in autumn and early spring are very effective in...carrying the seeds far from the mother plant" (Pacini, 1990). Also, *M. annua* has been observed to germinate in channels formed by rivulets during storms (Pacini, 1990). In Victoria, Australia, "the plant is known to grow on a stream bank/drainage channel (Baber; Lorimer, pers. comms.)" (Low, 2011), which suggests it may be dispersed by water. However, we found no evidence on seed buoyancy, and this plant is mainly reported in areas away from water sources (see ES-7).
ES-17c (Bird dispersal)	y - mod		Seeds of *M. annua* are a food source for bullfinches (Lainsbury et al., 1999), and the seeds of the related species *M. perennis* are one of the most important food sources for the bullfinch, *Pyrrhula pyrrhula* (Newton, 1967). However, we found no evidence on seed viability when these seeds are consumed by bullfinches. On the other hand, in a field study in the Canary Islands, viable seeds of *M. annua* have been found in droppings of the kestrels (predatory birds), which consume the seeds when they consume frugivorous lizards (Padilla et al., 2012), but it is unclear from this source how frequently this type of dispersal may occur.
ES-17d (Animal external dispersal)	y - negl		Because they have a caruncle (a seed appendage containing lipid and protein reserves), the seeds of *M. annua* are adapted to be dispersed by ants (Pacini, 1990). In Italy, *Messor structor* ants collect seeds and transport them to their nests; the ants remove the caruncle, which allows the seed to germinate once the nests are disturbed by people (e.g., ploughing) or animals (e.g., large animals or underground animals) (Pacini, 1990). In another study, the maximum and mean distances of dispersal by ants were 14 and 3.4 m, respectively (Lisci and Pacini, 1997).
ES-17e (Animal internal dispersal)	y - high		Normally, livestock do not consume *M. annua* because of its disagreeable odor and acrid taste; however, the animals will eat it when they are hungry enough or when the plant is mixed with other feed (Bensaid et al., 1995). It has been regarded as unpalatable to grazing livestock; however, lambs reportedly graze on the plant (Welchman et al., 1995). We found no evidence, however, that the seeds can pass through the digestive tracts of livestock in a viable form. Viable seeds were found in kestrel droppings, presumably because the birds consumed Canary lizards (genus *Gallotia*) that had ingested *M. annua* seeds (Padilla et al., 2012). Canary lizards are known to be seed dispersers of other host plants, so we answered yes, but with high uncertainty.
ES-18 (Evidence that a persistent (>1yr) propagule bank (seed	y - negl	1	Seeds buried in the soil can remain viable for years (Bencivenga et al., 1979), with evidence for over ten years (references cited in Magyar and Lukacs, 2002) and even up to 20 (Gillot, 1925). In a

Question ID	Answer - Uncertainty	Score	Notes (and references)
bank) is formed)			long-term study, 30 percent of the seeds germinated after four years, and 16 percent germinated after seven years (Gillot, 1925). Traits facilitating its impact in crops include seed dormancy (Kohout and Hamouz, 2000).
ES-19 (Tolerates/benefits from mutilation, cultivation or fire)	n - low	-1	We found no evidence of *M. annua* having this ability. Also, it can be controlled by tillage (Robson et al., 1991), indicating that it does not tolerate mutilation.
ES-20 (Is resistant to some herbicides or has the potential to become resistant)	y - high	1	Although not listed as an herbicide-resistant weed by Heap et al. (2015), it has been reported in the past as "resistant" to some herbicides (e.g., alaclor, metamitron) (Bencivenga et al., 1979). Kohout and Hamouz (2000) say it is “relatively resistant” to most herbicides.
ES-21 (Number of cold hardiness zones suitable for its survival)	8	0	
ES-22 (Number of climate types suitable for its survival)	9	2	
ES-23 (Number of precipitation bands suitable for its survival)	10	1	
IMPACT POTENTIAL			
General Impacts			
Imp-G1 (Allelopathic)	y - mod	0.1	Residue of the weed has allelopathic inhibitory activity on wheat (reference cited in Qasem and Foy, 2001). In a study on allelopathic effects, it was found that "plant residues and different shoot extracts (water-acetone-ethanole) of…annual mercury have allelopathic effects on field crops by reducing their fresh weight and germination" (Szárnyas, 2002).
Imp-G2 (Parasitic)	n - negl	0	We found no evidence that this species is parasitic, and *M. annua* does not belong to a family known to contain parasitic plants (Heide-Jorgensen, 2008; NGRP, 2015; Nickrent, 2009).
Impacts to Natural Systems			
Imp-N1 (Changes ecosystem processes and parameters that affect other species)	n - mod	0	We found no evidence of this type of impact.
Imp-N2 (Changes habitat structure)	n - mod	0	We found no evidence of this type of impact.
Imp-N3 (Changes species diversity)	y - high	0.2	"Where it occurs near Melbourne, Victoria, it is associated with a creek corridor/drain in a nature reserve (Baber; Lorimer, pers. comms.) where it is displacing other more desirable annual herbs" (VSG, 2015b). As this was the only evidence we found for this type of impact, and because the authors did not cite a verifiable source, we used high uncertainty.
Imp-N4 (Is it likely to affect federal Threatened and Endangered species?)	y - high	0.1	While this plant occurs mainly in disturbed or artificial habitats (e.g., Calflora, 2015; Hanf, 1983; Robson et al., 1991; Stokes et al., 2004; UC, 2015; VSG, 2015a), there is some evidence of it occurring in natural systems, such as "reasonably intact bushland" in Western Australia (Keighery and Longman, 2004), a creek corridor in a nature reserve in Victoria, Australia (VSG, 2015a), and California "wildlands" (Cal-IPC, 2015). Also, limited evidence indicates that it

Question ID	Answer - Uncertainty	Score	Notes (and references)
			can affect species diversity (see Imp-N3).
Imp-N5 (Is it likely to affect any globally outstanding ecoregions?)	n - mod	0	Its predicted distribution in the United States includes globally outstanding ecoregions as defined by Ricketts et al. (1999, p. 34, Fig. 3.1). However, because we found no evidence that it can change ecosystem processes and parameters (Imp-N1) or habitat structure (Imp-N2), and no evidence that it forms extensive populations in natural areas, we believe it is unlikely to affect these ecoregions.
Imp-N6 [What is the taxon's weed status in natural systems? (a) Taxon not a weed; (b) taxon a weed but no evidence of control; (c) taxon a weed and evidence of control efforts]	b - mod	0.2	Reported as an environmental weed in Australia (Groves et al., 2005; Keighery and Longman, 2004; Randall, 2007; Randall, 2012). It is listed in the Lithuanian Invasive Species Database (Gudzinskas, 2009). We found no information on it being controlled in natural systems. The alternate choices for the Monte Carlo simulation are "a" and "c."
Impact to Anthropogenic Systems (cities, suburbs, roadways)			
Imp-A1 (Negatively impacts personal property, human safety, or public infrastructure)	n - low	0	We found no evidence of this type of impact.
Imp-A2 (Changes or limits recreational use of an area)	n - mod	0	We found no evidence of this type of impact.
Imp-A3 (Affects desirable and ornamental plants, and vegetation)	? - max		We found no direct evidence for this impact. In California, "the potential impacts [of *M. ambigua*] in private gardens is unknown" (Kelch, 2015b). However, because *M. annua* occurs in urban areas (Pysek et al., 2002; Reynolds, 2002; cited in Bond and Davies, 2007), has been listed multiple times as a garden weed (Bond and Davies, 2007; Groves et al., 2005; Kohout and Hamouz, 2000; Reynolds, 2002; Salisbury, 1961), can have important impacts on crop plants (see Imp-P1), has been found in mulched areas adjacent to buildings, and has aggressively invaded nurseries in California (Kelch, 2015b), *M. annua* seems likely to have some negative impacts on desirable plants and vegetation in home gardens.
Imp-A4 [What is the taxon's weed status in anthropogenic systems? (a) Taxon not a weed; (b) Taxon a weed but no evidence of control; (c) Taxon a weed and evidence of control efforts]	b - high	0.1	It is a garden weed (Bond and Davies, 2007; Groves et al., 2005; Kohout and Hamouz, 2000; Reynolds, 2002; Salisbury, 1961). In England, it "is sometimes troublesomely abundant, more especially in gardens" (Salisbury, 1961). We found no information on it being controlled in anthropogenic areas, but considering that it is a garden weed and is controlled in cropping situations (Imp-P6), it seems likely that it is sometimes controlled there as well. The alternate choices for the Monte Carlo simulation were both "c."
Impact to Production Systems (agriculture, nurseries, forest plantations, orchards, etc.)			
Imp-P1 (Reduces crop/product yield)	y - negl	0.4	In Hungary, high densities of *M. annua* at the emergence stage of the maize crop decreased maize ear weight 53 percent and grain yield by 60 percent in weedy plots compared to the chemically controlled plots (Magyar and Lehoczky, 2008). In Germany, five *M. annua* plants per m^2 reduced the yield of sugarbeets by 7.5-25 percent (Hofstetter, 1986). On a dairy farm in Tunisia, milk production dropped when cows were fed hay mixed with *M. annua* (Bensaid et al., 1995). "The effects of poisoning [of livestock] include...impaired productivity"

Question ID	Answer - Uncertainty	Score	Notes (and references)
			(Welchman et al., 1995).
Imp-P2 (Lowers commodity value)	y - mod	0.2	The toxic substances ingested by cattle pass into the milk, not changing the taste of the milk but giving it a bluish color, and can render it toxic (Bensaid et al., 1995). On a dairy farm in Tunisia, cows fed hay mixed with *M. annua* were sickened and had to undergo veterinary treatment (Bensaid et al., 1995). Multiple reports exist of control efforts for this weed in crops (see Imp-P6). Veterinary treatments and/or control efforts in crops may increase costs of production and therefore lower commodity value. Based on having only one source of direct evidence (i.e., Bensaid et al., 1995), we used moderate uncertainty.
Imp-P3 (Is it likely to impact trade?)	y - high	0.2	*Mercurialis annua* is listed as a regulated pest by Taiwan (APHIS, 2015), and is regulated as a state noxious weed in California under the name *M. ambigua* (CDFA, 2015). The *M. ambigua* form in California produces seeds that "seem to be able to spread rather well via pathways that have to do with...nursery operations" (Kelch, 2015a). Based on this evidence, we estimate it may be likely to impact the nursery trade.
Imp-P4 (Reduces the quality or availability of irrigation, or strongly competes with plants for water)	n - mod	0	We found no evidence of this type of impact.
Imp-P5 (Toxic to animals, including livestock/range animals and poultry)	y - negl	0.1	Due to the presence of a volatile basic oil, it can cause acute gastroenteritis in cattle (Salisbury, 1961). It is most toxic at the fruit stage, but is also toxic during other stages and even after the plant is dried (Bensaid et al., 1995). Numerous cases of livestock being poisoned have been recorded (e.g., Bensaid et al., 1995; Landau et al., 1973; Welchman et al., 1995). In Israel, out of 110 sheep fed contaminated forage, 11 animals were negatively affected and six died (Landau et al., 1973). In England, out of 400 lambs, 11 died after grazing on infested fields (Welchman et al., 1995). It is among the major toxins for cattle in France; all animals can be sensitive to the plant, but cattle are the most frequently affected (Alzieu et al., 1993).
Imp-P6 [What is the taxon's weed status in production systems? (a) Taxon not a weed; (b) Taxon a weed but no evidence of control; (c) Taxon a weed and evidence of control efforts]	c - negl	0.6	It is an agricultural weed (Calflora, 2015; Randall, 2012) of many crops (Bencivenga et al., 1979), including maize, sugarbeet, sunflower, potato, wheat, root crops, and vegetables (Hanf, 1983; Kohout and Hamouz, 2000; Magyar, 1998, 1999; Qasem and Foy, 2001; Weber and Gut, 2005). In Europe, it is one of the "major weeds" in maize (Sutton et al., 2002). In Galicia (Spain), it is among the moderately important weeds of maize (Fraga et al., 1994). In the Slovak Republic, it is among the top ten "most dangerous weed species" in sugarbeet (Týr and Vereš, 2012). In California, where "*M. ambigua* has appeared suddenly," "it is...an aggressive invader of nurseries, especially nursery pots where it can exclude other species of nursery container weed[s]" (Kelch, 2015b). Chemical control of *M. annua* in crops has been studied (Ambrosi and Carini, 1966; Jursik et al., 2008; Qasem and Foy, 2001; Sgattoni et al., 1990). In the Near East, it is controlled via tillage and herbicides (Robson et al., 1991). It can be completely controlled by soil solarization (Upadhyaya and Blackshaw, 2007). The alternate choices for the Monte Carlo simulation are both "b."
GEOGRAPHIC			Unless otherwise indicated, the following evidence represents

Question ID	Answer - Uncertainty	Score	Notes (and references)
POTENTIAL			geographically referenced points obtained from the Global Biodiversity Information Facility (GBIF, 2015).
Plant hardiness zones			
Geo-Z1 (Zone 1)	n - low	N/A	We found no evidence that it occurs in this hardiness zone.
Geo-Z2 (Zone 2)	n - low	N/A	We found no evidence that it occurs in this hardiness zone.
Geo-Z3 (Zone 3)	n - low	N/A	We found no evidence that it occurs in this hardiness zone.
Geo-Z4 (Zone 4)	n - high	N/A	Only one point in Finland. We considered this evidence insufficient to warrant a yes response.
Geo-Z5 (Zone 5)	y - low	N/A	A few points in Sweden and five points in Finland.
Geo-Z6 (Zone 6)	y - negl	N/A	France, Germany, and Italy.
Geo-Z7 (Zone 7)	y - negl	N/A	France, Spain, Switzerland, Germany, and Austria.
Geo-Z8 (Zone 8)	y - negl	N/A	Spain, Portugal, France, the United Kingdom, Germany, the Netherlands, Sweden, and one point in the United States (California).
Geo-Z9 (Zone 9)	y - negl	N/A	Morocco, Algeria, Spain, Portugal, France, Ireland, the United Kingdom, and one point in the United States (Alabama).
Geo-Z10 (Zone 10)	y - negl	N/A	Morocco, Algeria, Tunisia, Spain, Portugal, France, Ireland, the United Kingdom, Israel, and the United States (California).
Geo-Z11 (Zone 11)	y - negl	N/A	Morocco, Spain, Portugal, Greece, Israel, and one point in California.
Geo-Z12 (Zone 12)	y - low	N/A	Multiple points in Israel, two points in Morocco, three points in Australia, and one point in South Africa.
Geo-Z13 (Zone 13)	n - high	N/A	A few old herbarium reports (from early 1900s and then 1976) for the Bahamas (Nassau) (NYBG, 2015). Because we did not find clear evidence that *M. annua* is established in the Bahamas, and because it does not occur in this Plant Hardiness Zone in its native range, from which it is very widespread and for which there is a significant amount of point data, we answered no but with high uncertainty.
Köppen -Geiger climate classes			
Geo-C1 (Tropical rainforest)	n - mod	N/A	We found no evidence that it occurs in this climate class.
Geo-C2 (Tropical savanna)	n - high	N/A	Two points in Haiti. A few old herbarium reports (from early 1900s and then 1976) for the Bahamas (Nassau) (NYBG, 2015). Because we did not find clear evidence that *M. annua* is established in Haiti or the Bahamas, and because it does not occur in this climate class in its native range, from which it is very widespread and for which there is a significant amount of point data, we answered no but with high uncertainty.
Geo-C3 (Steppe)	y - low	N/A	Israel and Spain.
Geo-C4 (Desert)	y - low	N/A	Multiple points in the Canary Islands, and one or two points each for Algeria, Tunisia, Morocco, Mali, and Egypt.
Geo-C5 (Mediterranean)	y - negl	N/A	Israel, Morocco, Algeria, Portugal, Spain, France, Italy, Greece, and the United States (California)
Geo-C6 (Humid subtropical)	y - low	N/A	Italy, Croatia, and two points in the United States (Alabama and Maryland).
Geo-C7 (Marine west coast)	y - negl	N/A	Spain, France, the United Kingdom, Ireland, Germany, New Zealand, and two points in Australia.
Geo-C8 (Humid cont. warm sum.)	y - low	N/A	Two points in the United States. The climate qualifications for the humid subtropical region and the marine west coast region, where this species is known to occur, are identical to those of the humid continental warm summers region, with one difference: the coldest months of the humid subtropical region and the marine west coast region fall between -3 °C and 18 °C, while the coldest months of the humid continental warm summers region fall below -3 °C (Arnfield,

Question ID	Answer - Uncertainty	Score	Notes (and references)
			2015). Given that *M. annua* is known to occur in areas where the coldest temperatures fall between -28.9 °C to -23.3 °C (GBIF, 2015), we believe it is likely that this species can occur in humid continental warm summer regions.
Geo-C9 (Humid cont. cool sum.)	y - negl	N/A	Spain, France, Austria, Italy, Germany, Sweden, and Finland.
Geo-C10 (Subarctic)	y - negl	N/A	Norway, Sweden, Finland, France, and two points in Greece.
Geo-C11 (Tundra)	y - low	N/A	Multiple points in France.
Geo-C12 (Icecap)	n - low	N/A	We found no evidence that it occurs in this climate class.
10-inch precipitation bands			
Geo-R1 (0-10 inches; 0-25 cm)	y - negl	N/A	Algeria, Egypt, Morocco, Tunisia, the Canary Islands, and Israel.
Geo-R2 (10-20 inches; 25-51 cm)	y - negl	N/A	Greece, Morocco, Algeria, Spain, Portugal, Israel, and the United States (California).
Geo-R3 (20-30 inches; 51-76 cm)	y - negl	N/A	Greece, Israel, Australia, and the United States (California).
Geo-R4 (30-40 inches; 76-102 cm)	y - negl	N/A	Spain, Portugal, France, Germany, and Australia.
Geo-R5 (40-50 inches; 102-127 cm)	y - negl	N/A	Germany, Belgium, France, Ireland, the United Kingdom, and Norway.
Geo-R6 (50-60 inches; 127-152 cm)	y - negl	N/A	Ireland, the United Kingdom, France, Germany, Portugal, Spain, and one point in the United States (California).
Geo-R7 (60-70 inches; 152-178 cm)	y - negl	N/A	Spain, France, the United Kingdom, and one point in the United States (Alabama).
Geo-R8 (70-80 inches; 178-203 cm)	y - low	N/A	France and Germany.
Geo-R9 (80-90 inches; 203-229 cm)	y - mod	N/A	Germany and four points in France.
Geo-R10 (90-100 inches; 229-254 cm)	y - high	N/A	Two points in Slovenia, three points in France, and one point in Haiti.
Geo-R11 (100+ inches; 254+ cm)	n - low	N/A	We found no evidence that it occurs in this precipitation band.
ENTRY POTENTIAL			
Ent-1 (Plant already here)	y - negl	1	*Mercurialis annua* is naturalized in multiple states throughout the United States: one county each in Oregon, Alabama, Pennsylvania, Maryland, New Jersey, New York; two counties each in South Carolina, Ohio, and Massachusetts; and a few counties in California (Kartesz, 2015; NRCS, 2015). It is also naturalized in Delaware, Illinois and Maine, but no county information is given for those states (NRCS, 2015). Both *M. annua s.s.* and *M. ambigua* are present in California (Kelch, 2015a).
Ent-2 (Plant proposed for entry, or entry is imminent)	-	N/A	
Ent-3 (Human value & cultivation/trade status)	-	N/A	
Ent-4 (Entry as a contaminant)			
Ent-4a (Plant present in Canada, Mexico, Central America, the Caribbean or China)	-	N/A	

Question ID	Answer - Uncertainty	Score	Notes (and references)
Ent-4b (Contaminant of plant propagative material (except seeds))	-	N/A	
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	