Weed Risk Assessment for *Acalypha australis* L. (Euphorbiaceae) – Asian copperleaf

United States
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Health Inspection
Service

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Habit of *Acalypha australis* (source:
http://en.wikipedia.org/wiki/File:Acalypha_australis_2.JPG#metadata)

Agency Contact:

Plant Epidemiology and Risk Analysis Laboratory
Center for Plant Health Science and Technology

Plant Protection and Quarantine
Animal and Plant Health Inspection Service
United States Department of Agriculture
1730 Varsity Drive, Suite 300
Raleigh, NC 27606

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.

***Acalypha australis* L. – Asian copperleaf**

Species Information

Family: Euphorbiaceae

Initiation: On March 5, 2010, Al Tasker (USDA-APHIS-PPQ National Weeds Program Coordinator) informed the Plant Epidemiology and Risk Analysis Laboratory about a plant, *Acalypha australis*, that was resistant to herbicides in Australia (Tasker, 2010). We initiated this weed risk assessment because the distribution of this species appeared to be limited in the United States (NRCS, 2011).

Foreign distribution: *Acalypha australis* is native to the Russian Far East, China, Japan, and the Philippines. It has naturalized in Australia (NGRP, 2010) and other regions in Eurasia, including the Caucasus, Ukraine, Italy, Armenia, and Turkey (AgroAtlas, 2010; Alexeev et al., 2009; Berezutsky et al., 2002; DAISIE, 2010; Duman and Terzioğlu, 2009; Efimova et al., 1997; Moisiienko and Vasyl'ieva, 2003; Mulkidzhanyan, 1962).

U.S. distribution and status: This species was first reported in the United States (New York) in 1990 (Delendick, 1990). It is restricted to the western end of Long Island and to the mainland of New Jersey across the bay from the island (Delendick, 1990; NRCS, 2011). An old report exists of it being in Oregon, but we found no other evidence that it persists there (Delendick, 1990). Although the Global Biodiversity Information Facility database (GBIF, 2010) shows *A. australis* to be widely distributed and abundant across the eastern United States, this appears to be an error, since six other U.S. databases and virtual herbariums only show records from New York.

WRA area: Entire United States, including territories

1. *Acalypha australis* analysis

Establishment/Spread Potential *Acalypha australis* has naturalized in numerous Eurasian countries well beyond its native range. It may be spreading as a seed contaminant (AgroAtlas, 2010). We found no evidence that it has any adaptations for long-distance dispersal (e.g., bird, wind, water). It is not clear if this species is spreading after naturalizing in an area. As an annual plant (AgroAtlas, 2010; Duman and Terzioğlu, 2009) of disturbed environments that reproduces by seed (Zhang and Hirota, 2000; Zhirong, 1990) and contaminates grain (AgroAtlas, 2010), it may spread in certain agricultural systems and along agricultural pathways. One study reports resistance to the herbicide, glyphosate (Li et al., 2009), which could promote its spread in certain crops. We had a high amount of uncertainty with this risk element.
Risk score = 8 Uncertainty index = 0.27

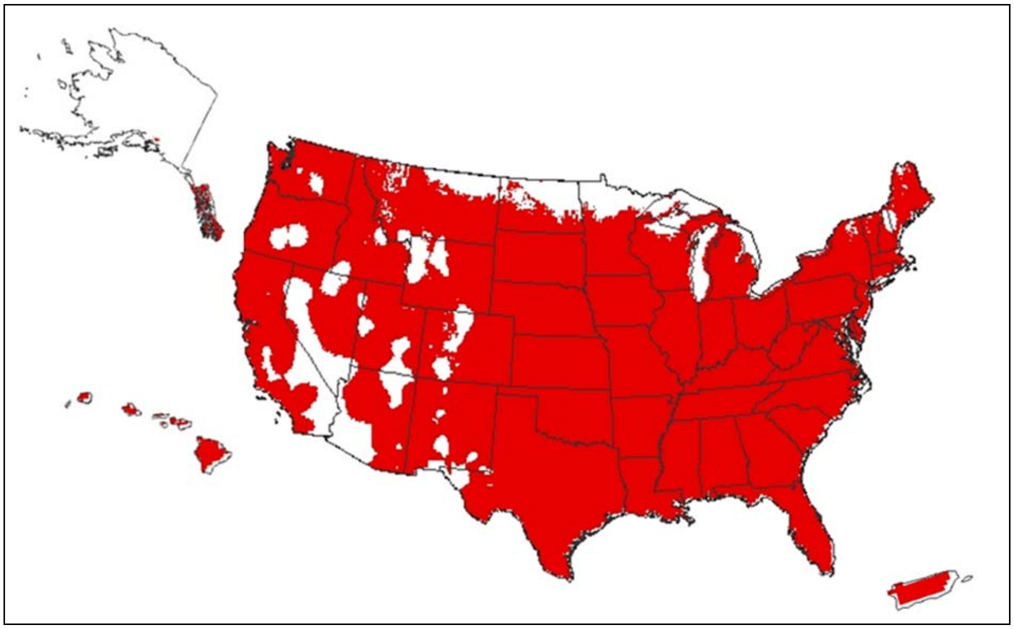
Impact Potential *Acalypha australis* is a weed of gardens, roadways, and waste places (AgroAtlas, 2010; Delendick, 1990; Ohwi, 1984), but seems to be even more harmful in row crops (AgroAtlas, 2010). It damages cotton, melons, pulses, root and tuberous crops, and vegetables (Zhirong, 1990), and may be a dominant weed in maize (Zuo et al., 2008). Korea is trying to identify a biological control agent to help manage it (Kwon, 2008). This element had an above average level of uncertainty.
Risk score = 2.1 Uncertainty index = 0.24

Geographic Potential Based on three climatic variables, we estimate that about 75 percent of the United States is suitable for the establishment of *A. australis* (Fig. 1). This distribution is based on the species' known distribution elsewhere in the world and includes point-referenced localities and areas of occurrence. The map represents the joint distribution of Plant Hardiness Zones 4-13, areas with 0-100+ inches of annual precipitation, and the following Köppen-Geiger climate classes: steppe, mediterranean, humid continental warm/cool summers, tropical rainforest, tropical savanna, humid subtropical, and marine west coast.

The area estimated in Fig. 1 likely represents a conservative estimate, as it uses only three climatic variables. Other environmental variables, such as soil and habitat type, may further limit the areas in which *A. australis* is likely to establish.

Entry Potential We did not assess the entry potential for *A. australis* because this species is already present in the United States (Delendick, 1990; NRCS, 2011).

Figure 1. Predicted distribution of *A. australis* 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) = 27.2%
P(Minor Invader) = 65.3%
P(Non-Invader) = 7.5%

Risk Result = Evaluate Further

Secondary Screening = Evaluate Further

Figure 2. *Acalypha australis* 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.

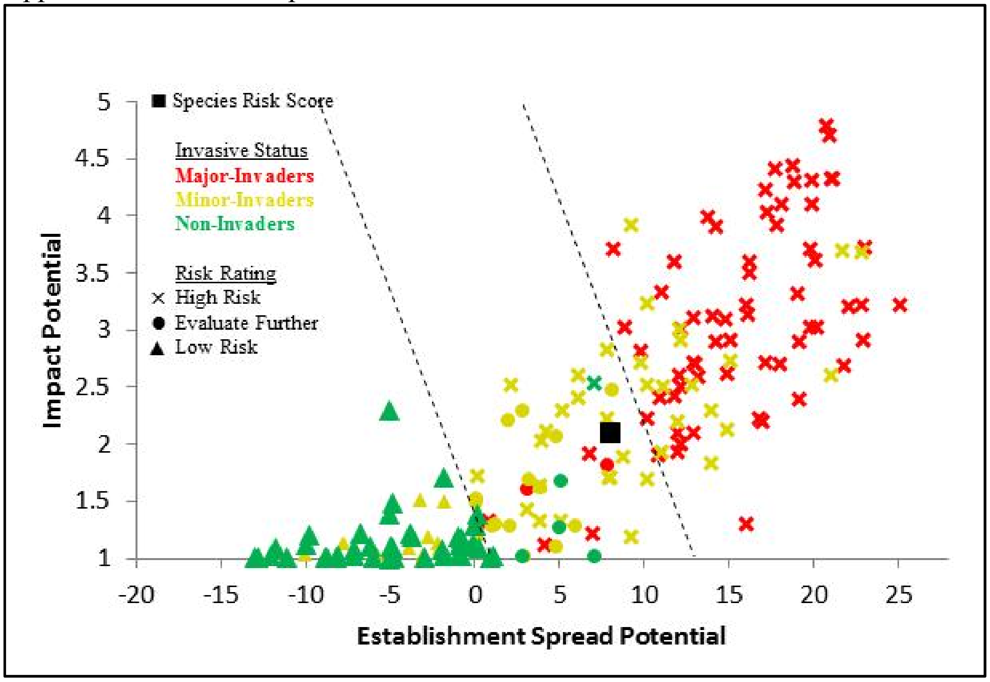
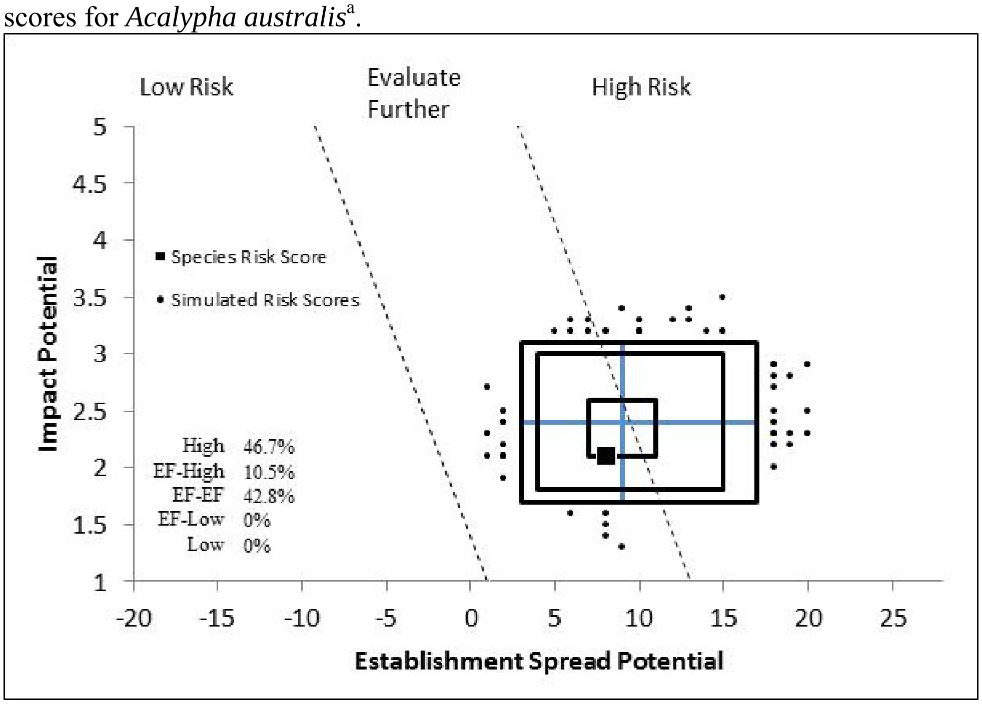


Figure 3. Monte Carlo simulation results (N=5,000) for uncertainty around the risk scores for *Acalypha australis*[a].



[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 *Acalypha australis* is Evaluate Further. This species did not show any strong invasive or weediness characters (Fig. 2). A moderate to large amount of uncertainty was associated with this assessment because we only found a limited amount of information on the species. Five questions could not be answered. Our uncertainty analysis indicated that 57.2 percent of the simulated risk scores resulted in conclusions of “High Risk,” while all others were “Evaluate Further” (Fig. 3).

Although *A. australis* is considered a medicinal plant in eastern Asia (E-PROSEA, 2010), we found no evidence that it is economically beneficial or is cultivated in the United States. Because this species is not likely to be cultivated or positively valued in the United States, we think that further evaluation is unnecessary, and that managers could make a determination based on the evidence in this weed risk assessment. This is a minor-invader with impacts primarily restricted to agricultural systems (Randall, 2010; Reed, 1977; Zhang and Hirota, 2000).

4. Literature Cited

7 U.S.C. § 1581-1610. 1939. The Federal Seed Act, Title 7 United States Code § 1581-1610.

7 U.S.C. § 7701-7786. 2000. Plant Protection Act, Title 7 United States Code § 7701-7786.

AgroAtlas. 2010. Interactive agricultural ecological atlas of Russia and neighboring countries: Economic plants and their diseases, pests and weeds (Online Database). University of St. Petersburg. http://www.agroatlas.ru/. (Archived at PERAL).

Alexeev, Y. E., A. P. Laktionov, V. N. Pilipenko, A. A. Isaev, and N. I. Marchenko. 2009. New and rare species in the flora of Astrakhan Province. Byulleten' Moskovskogo Obshchestva Ispytatelei Prirody Otdel Biologicheskii 114(Part 3):61-62.

Berezutsky, M. A., V. M. Vasykov, A. V. Panin, A. P. Sukhorukov, and L. P. Hudyakova. 2002. Floristic findings in Saratov and Pensa Regions. Botanicheskii Zhurnal (St. Petersburg) 87(3):149-153.

Bridges, D. C. (ed.). 1992. Crop Losses Due to Weeds in the United States - 1992. Weed Science Society of America, Champaign, IL. 403 pp.

Buchholtz, K. P., B. H. Grigsby, O. C. Lee, F. W. Slife, C. J. Willard, and N. J. Volk (eds.). 1960. Weeds of the North Central States. University of Illinois Agricultural Experiment Station, Urbana, IL. 262 pp.

Burrows, G. E., and Tyrl. 2001. Toxic Plants of North America. Iowa State University Press, Ames, IA. 1342 pp.

Cardenas, J., C. E. Reyes, J. D. Doll, and F. Pardo. 1972. Malezas Tropicales [Tropical Weeds] (Vol. 1). Instituto Colombiano Agropecuario, Bogota, Colombia. 341 pp.

Clark, G. H. 1923. Farm Weeds of Canada (2nd Ed.). Department of Agriculture, Ottawa, Canada. 192 pp.

DAISIE. 2010. Delivering Alien Invasive Species Inventories for Europe (Online Database). http://www.europe-aliens.org/index.jsp. (Archived at PERAL).

Delendick, T. J. 1990. *Acalypha australis* L. (Euphorbiaceae) new to New York

state. Bulletin of the Torrey Botanical Club 117(3):291-293.
Duman, H., and S. Terzioğlu. 2009. *Acalypha* (Euphorbiaceae): a new genus record for Turkey. Phytologia Balcanica 15(2):171-173.
E-PROSEA. 2010. Plant Resources of Southeast Asia, Online Database. PROSEA Foundation, Bogor, Indonesia. . http://www.proseanet.org/prosea/eprosea.php. (Archived at PERAL).
Efimova, V. A., A. L. Komzha, and K. P. Popov. 1997. New records of the adventive plants in the Central Caucasus. Botanicheskii Zhurnal (St. Petersburg) 82(3):149-153.
Enomoto, T. 2003. Weeds of Japan. Okayama University, The Research Institute for Bioresources, Laboratory of Wild Plant Science. Last accessed August 28, 2008, http://www.rib.okayama-u.ac.jp/wild/zassou_table.htm.
Fan, Z. J., Y. W. Al, C. F. Qian, and Z. M. Li. 2005. Herbicide activity of monosulfuron and its mode of action. Journal of Environmental Sciences-China 17(3):399-403.
Fournet, J., and J. L. Hammerton. 1991. Weeds of the Lesser Antilles [Mauvaises Herbes des Petites Antilles]. Institut de la Recherche Agronomique, Paris. 214 pp.
GBIF. 2010. GBIF, Online Database. Global Biodiversity Information Facility (GBIF). http://data.gbif.org/welcome.htm. (Archived at PERAL).
Gunn, C. R., and C. A. Ritchie. 1988. Identification of disseminules listed in the Federal Noxious Weed Act (Technical Bulletin Number 1719.). United States Department of Agriculture, Agricultural Research Service, Washington D.C. 313 pp.
Han, S. S., and B. H. Lim. 2000. Dormancy breaking of Virginia copperleaf (*Acalypha australis* L.) seed [Abstract]. Korean Journal of Weed Science.
Heap, I. 2010. The international survey of herbicide resistant weeds. Weed Science Society of America. www.weedscience.com. (Archived at PERAL).
Holm, L. G., J. V. Pancho, J. P. Herberger, and D. L. Plucknett. 1979. A Geographical Atlas of World Weeds. Krieger Publishing Company, Malabar, FL. 391 pp.
Kartesz, J. 2010. The Biota of North America Program. John Kartesz. http://www.bonap.org/genera-list.html. (Archived at PERAL).
Koop, A., L. Fowler, L. Newton, and B. Caton. 2012. Development and validation of a weed screening tool for the United States. Biological Invasions 14(2):273-294.
Kwon, O. 2008. Status of weed biological control utilizing insects in Korea. Entomological Research 38(Suppl. 1):S86-S91.
Kwon, O. D., Y. I. Kuk, and Y. Yeen Lee. 2004. Control methods of troublesome weeds in upland rice cultivation [Abstract]. Korean Journal of Weed Science 24(2):114-122.
Li, J., H. Lu, Z. Chen, H. Lu, and D. Qin. 2006. Effects of bromoxynil octanoate on control of broadleaved weeds in a maize field [Abstract]. Weed Science (China) (2):51-52.
Li, T., G. Shen, Z. Qian, X. Chai, and G. Wen. 2009. Study on control technique of glyphosate-resistant weeds [Abstract]. Acta Agriculturae Shanghai 25(3):54-58.
Mabberley, D. J. 1987. The plant-book: A portable dictionary of the higher plants. Cambridge University Press, New York. 706 pp.
Martin, P. G., and J. M. Dowd. 1990. A protein sequence study of the dicotyledons and its relevance to the evolution of the legumes and nitrogen fixation.

Australian Systematic Botany 3:91-100.
Moisiienko, I. I., and T. M. Vasyl'ieva. 2003. *Acalypha australis* L. (Euphorbiaceae) in Ukraine [Abstract]. Ukrayins'kyi Botanichnyi Zhurnal 60(5):537-540.
Morita, H. 1997. Handbook of Arable Weeds in Japan. Kumiai Chemical Industry, Tokoyo, Japan. 128 pp.
Mulkidzhanyan, Y. I. 1962. Data on the flora of the Armenian SSR [Abstract]. Izvest Akad Nauk Armyansk Ssr Biol Nauki 15(9):21-25.
NGRP. 2010. Germplasm Resources Information Network (GRIN). United States Department of Agriculture, Agricultural Research Service, National Genetic Resources Program (NGRP). http://www.ars-grin.gov/cgi-bin/npgs/html/index.pl?language=en. (Archived at PERAL).
NRCS. 2011. The PLANTS Database. United States Department of Agriculture, Natural Resources Conservation Service (NRCS), The National Plant Data Center. http://plants.usda.gov/cgi_bin/. (Archived at PERAL).
Ohwi, J. 1984. Flora of Japan (edited English version, reprint. Original 1954). National Science Museum, Tokyo, Japan. 1067 pp.
Pammel, L. H. 1911. Weeds of the Farm and Garden. Orange Judd Company, New York. 281 pp.
Raju, R. A. 1998. Prevalent Weed Flora in Peninsular India. Allied Publishers Limited, New Delhi, India. 271 pp.
Randall, J. M. 2007. The Introduced Flora of Australia and its Weed Status. CRC for Australian Weed Management, Department of Agriculture and Food, Western Australia, Australia. 528 pp.
Randall, R. P. 2010. A Global Compendium of Weeds. Department of Agriculture of Western Australia. http://www.hear.org/gcw/. (Archived at PERAL).
RBGDT. 2012. PlantNET - The Plant Information Network System of The Royal Botanic Gardens and Domain Trust [Online Database]. The Royal Botanic Gardens and Domain Trust (RBGDT). http://plantnet.rbgsyd.nsw.gov.au (Archived at PERAL).
Reed, C. F. 1977. Economically Important Foreign Weeds. Agricultural Research Service, U.S. Department of Agriculture., Washington, D.C. 746 pp.
Takabayashi, M., and K. Nakayama. 1977. Studies on growing stage and growing rate of the main upland weeds. Weed Research, Japan 22(2):69-74.
Takabayashi, M., and K. Nakayama. 1978. Longevity of buried weed seeds in soil. Weed Research, Japan 23(1):32-36.
Tasker, A. 2010. [Enviroweeds] *Acalypha australis*? Personal communication to A. L. Koop on March 5, 2010, from Al Tasker, Plant Protection and Quarantine, National Weeds Program Coordinator.
Woo, K., G. Yang, and J. Choi. 2004. Effect of 11 pre-emergence herbicides on vegetative establishment of zoysiagrass (*Zoysia japonica*) [Abstract]. Korean Journal of Horticultural Science & Technology 22(2):216-222.
Wright, J. 2009. Tropical plant reproduction biology. Smithsonian Tropical Reserach Institute (STRI). Last accessed February 24, 2009, http://striweb.si.edu/esp/tesp/plant_intro.htm.
Zhang, Z., and Hirota. 2000. Chinese Colored Weed Illustrated Book. 432 pp.
Zhirong, W. (ed.). 1990. Farmland Weeds in China: A Collection of Coloured Illustrative Plates. Agricultural Publishing House. 506 pp.
Zuo, S. P., Y. Q. Ma, and I. Shinobu. 2008. Ecological adaptation of weed biodiversity to the allelopathic rank of the stubble of different wheat genotypes in a maize field. Weed Biology and Management 8(3):161-171.

Appendix A. Weed risk assessment for *Acalypha australis* L. (Euphorbiaceae). The following information was obtained from the species' risk assessment, which was conducted using the 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)	e - high	2	This species is native to eastern Asia, from Russia and Japan south through China and into the Philippines (NGRP, 2010). A literature review shows that it is established/naturalized in several other locations, including the Caucasus, Ukraine, Italy, Armenia, Turkey (AgroAtlas, 2010; Alexeev et al., 2009; Berezutsky et al., 2002; DAISIE, 2010; Duman and Terzioğlu, 2009; Efimova et al., 1997; Moisiienko and Vasyl'ieva, 2003; Mulkidzhanyan, 1962). It is naturalized in eastern Australia (E-PROSEA, 2010; NGRP, 2010; Randall, 2007; RBGDT, 2012) and in the United States (NY and NJ) (Delendick, 1990). This species has clearly naturalized elsewhere, but it is not clear if it is spreading. This is difficult to evaluate with the limited descriptions of the species. The reference that described its naturalization in Turkey said that the following year, the population had disappeared. Answering "e" because I am not convinced it is spreading after naturalizing, but using high uncertainty. Both alternate answers for the Monte Carlo simulation were "f".
ES-2 (Is the species highly domesticated)	n - negl	0	No evidence of domestication. An internet search shows this species is considered a medicinal plant by some. Many sites sell extracts of it. Some cultivation of plants by backyard enthusiasts may be possible.
ES-3 (Weedy congeners)	y - negl	1	About 450 species in this genus of tropical and warm temperate species (Mabberley, 1987). *Acalypha alopecuroides*, *A. ciliata*, *A. fallax*, and *A. indica* are considered principle weeds (Holm et al., 1979). *Acalypha segetalis* is a serious weed in Mozambique (Holm et al., 1979). *Acalypha hamoltiniana* is invasive somewhere (Randall, 2007). *Acalypha ostryifolia* is considered a troublesome weed in peanuts in one state in the United States (Bridges, 1992). *Acalypha virginica* is considered a crop weed but of unknown significance (Buchholtz et al., 1960). In tropical America, *A. virginica* is not considered a troublesome weed, just common (Cardenas et al., 1972). *Acalypha arvensis* is a common weed of waste places and cultivated soils in the Lesser Antilles, but its importance is not described (Fournet and Hammerton, 1991).
ES-4 (Shade tolerant at some stage of its life cycle)	n - low	0	"It prefers weak shading (light forests) or places that are open.…Therefore, in anthropogenic habitats it is found in waste places and cultivated fields in lowlands. In nature the plant grows along river banks, on sandy or clay ground, in light forests and glades." (AgroAtlas, 2010).
ES-5 (Climbing or smothering growth form)	n - low	0	Species is an annual erect herb; not a vine, or with a tight basal rosette (AgroAtlas, 2010).

Question ID	Answer - Uncertainty	Score	Notes (and references)
ES-6 (Forms dense thickets)	n - high	0	No evidence. Plants can grow at densities ranging from 10 to 100 plants per square meter in maize (Zuo et al., 2008), but there is no evidence that this species is considered to form dense thickets.
ES-7 (Aquatic)	n - negl	0	Not an aquatic; a terrestrial herb (Ohwi, 1984).
ES-8 (Grass)	n - negl	0	Euphorbiaceae (NGRP, 2010).
ES-9 (Nitrogen-fixing woody plant)	n - negl	0	Species is in the Euphorbiaceae family (NGRP, 2010). This family is not known to fix nitrogen (Martin and Dowd, 1990). Furthermore, this species is herbaceous and not woody.
ES-10 (Does it produce viable seeds or spores)	y - negl	1	Reproduces from seeds in China (Zhang and Hirota, 2000; Zhirong, 1990).
ES-11 (Self-compatible or apomictic)	? - max	0	Unknown. Male and female flowers on the same plant (Ohwi, 1984), but it is unknown if it is self-compatible.
ES-12 (Requires special pollinators)	? - max		Unknown.
ES-13 (Minimum generation time)	b - negl	1	Annual herb to 50 cm high (Ohwi, 1984). Annual herb (AgroAtlas, 2010; Duman and Terzioğlu, 2009). The plant blossoms in July-August, fructifies in August-September (AgroAtlas, 2010).
ES-14 (Prolific reproduction)	n - mod	-1	Plants can grow at densities ranging from 10 to 100 plants per square meter in maize (Zuo et al., 2008). After field burial over the winter, seeds germinated at a rate greater than 80 percent (Han and Lim, 2000). In a pot experiment, *A. australis* produced 150-300 seeds (we are assuming this is per plant) (Takabayashi and Nakayama, 1977). Thus, if we take the high estimate of 100 plants per square meter, × 300 seeds per plant, × 80% germination, we get about 2400 seeds per square meter for this herbaceous plant. This upper estimate does not meet the requirement of 5000 for an herbaceous plant. Note: the congener, *A. indica* is also an annual and is of similar height; it produces 200 to 5000 seeds and appears in huge numbers after monsoons (Raju, 1998).
ES-15 (Propagules likely to be dispersed unintentionally by people)	? - max	0	Unknown. As a weed of cultivated areas, seeds may be unintentionally dispersed by people.
ES-16 (Propagules likely to disperse in trade as contaminants or hitchhikers)	y - low	2	Some fruits get into grain (especially in late crops) (AgroAtlas, 2010). Seeds of the congener *A. virginica* occasionally get mixed in crop seed (Buchholtz et al., 1960), including clover seed (Pammel, 1911).
ES-17 (Number of natural dispersal vectors)	0	-4	Fruit/seed description for ES-17a through ES-17e. Fruits are capsules about 3 mm across (Ohwi, 1984; Reed, 1977). Capsules armed with sharp spines (Reed, 1977). Seeds ovoid, about 1.5 mm long (Ohwi, 1984; Reed, 1977). "Seeds are 1.5-2 mm long, 1.2-1.5 mm wide, ovoid, smooth, with a fine narrow appendage, sulfur to light brown. Weight of 1000 seeds is 2 g" (AgroAtlas, 2010). Fruits ripen at various times. They mainly drop in field and litter ground (AgroAtlas, 2010). Seeds of *A. australis* are similar to the species *A. alopecuroides, A. ciliata*, and *A. fallax* (Gunn and Ritchie, 1988). *Acalypha macrostachya* and *A. diversifolia* are explosively dispersed (Wright, 2009).

Question ID	Answer - Uncertainty	Score	Notes (and references)
ES-17a (Wind dispersal)	n - low		No evidence. No obvious adaptations for wind dispersal (Reed, 1977).
ES-17b (Water dispersal)	n - mod		No evidence.
ES-17c (Bird dispersal)	n - low		No evidence. Fruit are capsules, not fleshy (Reed, 1977), unlikely to be bird-dispersed.
ES-17d (Animal external dispersal)	n - mod		No evidence. No obvious features for attachment to animals or rewards for species like ants.
ES-17e (Animal internal dispersal)	n - mod		No evidence.
ES-18 (Evidence that a persistent (>1yr) propagule bank (seed bank) is formed)	y - low	1	An experimental study that buried seeds for 4.5 years reported considerable seed longevity for most species (including *A. australis*) (Takabayashi and Nakayama, 1978); however, without translation of the full article, it is difficult to determine the germination rate.
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)	y - mod	1	Not listed in Heap (2010). Three studies report that it is controlled well by herbicides (Fan et al., 2005; Li et al., 2006; Woo et al., 2004). Another study says it is resistant to glyphosate (Li et al., 2009).
ES-21 (Number of cold hardiness zones suitable for its survival)	10	1	
ES-22 (Number of climate types suitable for its survival)	8	2	
ES-23 (Number of precipitation bands suitable for its survival)	11	1	
IMPACT POTENTIAL			
General Impacts			
Imp-G1 (Allelopathic)	n - mod	0	No evidence, despite its "importance" in maize and other crops in eastern Asia.
Imp-G2 (Parasitic)	n - negl	0	Plant in the Euphorbiaceae (NGRP, 2010). This family is not known to contain any parasitic species.
Impacts to Natural Systems			
Imp-N1 (Change ecosystem processes and parameters that affect other species)	n - mod	0	No evidence. This plant appears to be primarily a weed of cultivated land, waste places, and anthropogenic areas (AgroAtlas, 2010; Reed, 1977; Zhirong, 1990). Due to limited information on this species, using “mod” uncertainty for this subsection (natural area impacts).
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.
Imp-N5 (Is it likely to affect any globally outstanding ecoregions)	n - mod	0	No evidence.
Imp-N6 (Weed status in natural systems)	a - mod	0	Considered a weed of Japan, but domain is unknown (Enomoto, 2003); assuming it is an agricultural weed. The alternate answers for the Monte Carlo simulation were both “b”.
Impact to Anthropogenic Systems (cities, suburbs, roadways)			

Question ID	**Answer - Uncertainty**	**Score**	**Notes (and references)**
Imp-A1 (Impacts human property, processes, civilization, or safety)	n - low	0	No evidence. Not likely that a small herb would have this kind of impact.
Imp-A2 (Changes or limits recreational use of an area)	n - low	0	No evidence. Not likely that a small herb (up to 0.5 meters tall) would restrict human access to recreational areas.
Imp-A3 (Outcompetes, replaces, or otherwise affects desirable plants and vegetation)	n - high	0	Reported as a weed of gardens (AgroAtlas, 2010; E-PROSEA, 2010), but there is no evidence that it replaces or damages desirable plants in urban or suburban environments. In fact, some may cultivate this species for its medicinal properties. Answering “no” with “high” uncertainty
Imp-A4 (Weed status in anthropogenic systems)	b - low	0.1	Weed of rock piles, stone walls, and limestone soils (Reed, 1977). A weed of kitchen gardens in the Far East, and is found along country roads and on one- or two-year fallow lands (AgroAtlas, 2010). Locally common in gardens (E-PROSEA, 2010), but note that this reference doesn't identify it as a weed. In fact, it is described as a medicinal herb. In its native Japan, it grows in waste places and cultivated fields in lowlands (Ohwi, 1984). Plants in New York were growing in urban/suburban settings in abandoned gardens, along hedges, and cracks in walls (Delendick, 1990). Alternate answers for the Monte Carlo simulation were “a” and “c”.
Impact to Production Systems (agriculture, nurseries, forest plantations, orchards, etc.)			
Imp-P1 (Reduces crop/product yield)	y - high	0.4	"This weed is highly harmful to crops, despite its small size" (citation in AgroAtlas, 2010). Reported to be a very harmful weed in Japan, but specific impacts are not described (Reed, 1977). "Damages cotton, melons, pulses, root and tuberous crops, and vegetables" (Zhirong, 1990). It is a dominant weed in maize, growing at densities of 10 to 100 plants per square meter (Zuo et al., 2008). *Acalypha australis*, in conjunction with other weeds, has been reported to decrease maize yield from 10 to 20 percent, and even up to 50 percent (Zuo et al., 2008). In conjunction with two other weed species, it decreases maize yield (Li et al., 2006). Although none of these sources are very specific in describing the types of impact, because there were multiple sources, answering “yes”, but with “high” uncertainty.
Imp-P2 (Lowers commodity value)	? - max		Unknown. A study was conducted to evaluate herbicide effectiveness on it and two other principal weeds of maize (Li et al., 2006), suggesting that herbicides may be necessary to limit its impact. Use of herbicides would lower commodity value.
Imp-P3 (Is it likely to impact trade)	n - high	0	Some fruit contaminate grain (especially in late crops) (AgroAtlas, 2010), so there is a pathway. However, there is no evidence this genus is regulated. Using “high” uncertainty because it may represent an issue for seed quality.
Imp-P4 (Reduces the quality or availability of irrigation, or strongly competes with plants for water)	n - mod	0	No evidence.

Question ID	Answer - Uncertainty	Score	Notes (and references)
Imp-P5 (Toxic to animals, including livestock/range animals and poultry)	n - high	0	No evidence for *A. australis*. Given its prevalence as a cropland weed in eastern Asia, we would have expected this to have been mentioned in the literature, despite the little information available on this species. Only one species of *Acalypha* has been reported to be toxic: *A. virginica*, which produces an irritant action in the digestive tract (not sure if this is in reference to animals or people, or both) (Burrows and Tyrl, 2001). *Acalypha virginica* is avoided by livestock in Canada because of its acrid flavor (Clark, 1923). Note that these references are about North American plants, so *A. australis* would not be within their scope of study. Answering "no" but with "high" uncertainty due to poor information about this species.
Imp-P6 (Weed status in production systems)	c - negl	0.6	Weed at field edges, cultivated land, grassy fields (Reed, 1977). Frequent weed in plowed fields of all crops except rice in the Far East where it is native (AgroAtlas, 2010). Weed of upland rice in Korea (Kwon et al., 2004). An agricultural weed in several countries, including in its own native range (Randall, 2010). An arable weed in Japan (Morita, 1997; Reed, 1977). In China it is considered a principal weed of summer crops (Zhang and Hirota, 2000). In its native Japan, it grows in waste places and cultivated fields in lowlands (Ohwi, 1984). This weed is highly harmful to crops despite its small size (citation in AgroAtlas, 2010). Control measures are the same as for any annual weed. Good results in weed control are reached with a combination of agronomic and chemical measures. Seed cleaning of late harvest crops to remove weed seed is recommended (AgroAtlas, 2010). Biocontrol study initiated in Korea (Kwon, 2008). In a Web of Knowledge search (query December 13, 2010), several patents for herbicide formulations listed *A. australis*. One study reports impact of herbicides on the plant (Fan et al., 2005). Both alternate answers for the Monte Carlo simulation were "b".
GEOGRAPHIC POTENTIAL			Unless otherwise indicated, determinations were based on latitude/longitude data obtained from GBIF (2010).
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 - low	N/A	No evidence.
Geo-Z4 (Zone 4)	y - high	N/A	Present in Astrakhan - Russia edge (Alexeev et al., 2009).
Geo-Z5 (Zone 5)	y - low	N/A	China (edge).
Geo-Z6 (Zone 6)	y - negl	N/A	South Korea.
Geo-Z7 (Zone 7)	y - negl	N/A	Japan.
Geo-Z8 (Zone 8)	y - negl	N/A	Japan.
Geo-Z9 (Zone 9)	y - negl	N/A	New South Wales, Australia, Taiwan.
Geo-Z10 (Zone 10)	y - negl	N/A	Australia.
Geo-Z11 (Zone 11)	y - negl	N/A	Taiwan.
Geo-Z12 (Zone 12)	y - low	N/A	Present in the northern Philippines (NGRP, 2010).
Geo-Z13 (Zone 13)	y - mod	N/A	Present in the Philippines and Indochina (Reed, 1977).
Köppen-Geiger climate classes			

Question ID	Answer - Uncertainty	Score	Notes (and references)
Geo-C1 (Tropical rainforest)	y - low	N/A	Present in the northern Philippines (NGRP, 2010).
Geo-C2 (Tropical savanna)	y - mod	N/A	Present in Indochina (Reed, 1977).
Geo-C3 (Steppe)	y - low	N/A	Present in Saratov, Russia (Berezutsky et al., 2002).
Geo-C4 (Desert)	n - low	N/A	One point in the Sahara Desert (GBIF, 2010), but this is probably an error as it is not described as occurring in Africa (NGRP, 2010; Reed, 1977).
Geo-C5 (Mediterranean)	y - mod	N/A	Point on edge in Australia (GBIF, 2010). Present in Italy and Turkey (DAISIE, 2010).
Geo-C6 (Humid subtropical)	y - negl	N/A	Australia.
Geo-C7 (Marine west coast)	y - low	N/A	China and India.
Geo-C8 (Humid cont. warm sum.)	y - negl	N/A	South Korea.
Geo-C9 (Humid cont. cool sum.)	y - low	N/A	Yunnan China (edge). Present in the Ukraine (DAISIE, 2010)
Geo-C10 (Subarctic)	n - negl	N/A	No evidence. Well beyond known or suspected distribution.
Geo-C11 (Tundra)	n - negl	N/A	No evidence. Well beyond known or suspected distribution.
Geo-C12 (Icecap)	n - negl	N/A	No evidence. Well beyond known or suspected distribution.
10-inch precipitation bands			
Geo-R1 (0-10 inches; 0-25 cm)	y - high	N/A	Present in Astrakhan, Russia (Alexeev et al., 2009).
Geo-R2 (10-20 inches; 25-51 cm)	y - mod	N/A	Present in Ukraine (DAISIE, 2010).
Geo-R3 (20-30 inches; 51-76 cm)	y - low	N/A	Australia (edge) (GBIF, 2010). Present in Ukraine (DAISIE, 2010).
Geo-R4 (30-40 inches; 76-102 cm)	y - negl	N/A	Australia.
Geo-R5 (40-50 inches; 102-127 cm)	y - negl	N/A	Australia (edge) and South Korea.
Geo-R6 (50-60 inches; 127-152 cm)	y - negl	N/A	South Korea.
Geo-R7 (60-70 inches; 152-178 cm)	y - negl	N/A	Japan.
Geo-R8 (70-80 inches; 178-203 cm)	y - negl	N/A	Japan (one point) and Taiwan.
Geo-R9 (80-90 inches; 203-229 cm)	y - negl	N/A	Taiwan.
Geo-R10 (90-100 inches; 229-254 cm)	y - negl	N/A	Present in Indochina (Reed, 1977). Using "negl" uncertainty because this rainfall band is between two other bands that have negligible uncertainty.
Geo-R11 (100+ inches; 254+ cm))	y - negl	N/A	Present in the northern Philippines (NGRP, 2010).
ENTRY POTENTIAL			
Ent-1 (Plant already here)	y - negl	1	Present in the United States in New York and New Jersey (Kartesz, 2010). Found in New York for the first time in 1990 (Delendick, 1990)
Ent-2 (Plant proposed for entry, or entry is imminent)	-	N/A	
Ent-3 (Human value & cultivation/trade status)	-	N/A	Plant an important medicinal plant in South East Asia: the whole plant of *Acalypha australis* is used to cure dysentery, diarrhea, scrofula, dermatitis, nosebleed, hemoptysis, as well as to stop coughs and to cure swollen feet. The leaves are used for snake bites (E-PROSEA, 2010).
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 seeds))	-	N/A	
Ent-4c (Contaminant of seeds for planting)	-	N/A	

Question ID	Answer - Uncertainty	Score	Notes (and references)
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	