Importation of Water Dropwort, *Oenanthe javanica*, from Korea into the United States

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A Pathway-initiated Risk Assessment

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Executive Summary

This document presents results of an assessment of the risks associated with the importation, from Korea into the United States, of fresh water dropwort, *Oenanthe javanica* (Blume) DC. (leaves and stems). A search of both print and electronic sources of information identified two pests of *O. javanica* of quarantine significance that exist in Korea and could be introduced into the United States in shipments of that commodity. A *Consequences of Introduction* value was estimated by assessing five elements that reflect the biology and ecology of the pests: climate/host interaction, host range, dispersal potential, economic impact, and environmental impact. A *Likelihood of Introduction* value was estimated by considering both the quantity of the commodity imported annually and the potential for pest introduction and establishment. The two values were summed to estimate an overall *Pest Risk Potential*, which is an estimation of risk in the absence of mitigation.

Quarantine-significant pests likely to follow the pathway (i.e., accompany shipments of water dropwort) include a phytoplasma and a fungus:

Phytoplasma:

Water dropwort witches' broom

Fungus:

Puccinia oenanthes-stoloniferae S. Ito ex Tranzschel (Urediniomycetes: Uredinales)

The identified quarantine pests likely to follow the pathway pose phytosanitary risks to agriculture in the United States. Both were given a Pest Risk Potential value of Medium. Port-of-entry inspection, as a sole mitigative measure, is considered insufficient to safeguard U.S. agriculture from these pests, and additional phytosanitary measures are considered necessary to reduce risk.

Other pests, some of quarantine significance, were considered not likely to follow the pathway, assuming that the commodity will be subject to minimal processing, such as washing.

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A. Introduction

This risk assessment has been prepared by the United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Plant Protection and Quarantine (PPQ), Center for Plant Health Science and Technology (CPHST), Plant Epidemiology and Risk Analysis Laboratory (PERAL) to examine plant pest risks associated with importation into the United States of fresh water dropwort (also known as water celery, water parsley, Japanese parsley, Indian pennywort), *Oenanthe javanica* (Blume) DC. (leaves and stems), from the Republic of Korea. Estimates of risk are expressed in terms of high, medium, or low. The risk assessment is "pathway-initiated" in that it is based on the potential pest risks associated with the commodity as it enters the United States.

The International Plant Protection Convention (IPPC) of the United Nations Food and Agriculture Organization (FAO) provides guidance for conducting pest risk analyses. The methods used to initiate, conduct, and report this pest risk assessment are consistent with guidelines provided by the IPPC. Biological and phytosanitary terms (e.g., *introduction*, *quarantine pest*) conform with those outlined in International Standards for Phytosanitary Measures: Glossary of Phytosanitary Terms (FAO, 2002).

Pest risk assessment is one component of an overall pest risk analysis. The IPPC (FAO, 1996) describes three stages in pest risk analysis. This document satisfies the requirements of Stages 1 (initiation) and 2 (risk assessment). Details of the methodology and rating criteria can be found in the template document, Guidelines for Pathway-Initiated Pest Risk Assessments, Version 5.02 (USDA, 2000).

The IPPC (FAO, 1996) defines *pest risk assessment* as "Determination of whether a pest is a quarantine pest and evaluation of its introduction potential." *Quarantine pest* is defined as "A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled" (FAO, 1996). Thus, pest risk assessments should consider both the consequences and likelihood of introduction of quarantine pests. Both issues are addressed in this document.

Oenanthe javanica is native to temperate and tropical regions of Asia (e.g., China, Japan, Taiwan, Russian Far East, India, Pakistan, Bhutan, Nepal, Burma, Thailand, Vietnam, Malaysia, Indonesia), New Guinea, and Australia (USDA, 2003; Pistrick, 2002; Watson, 2003). It is used as an ornamental plant, in folk medicine, as a food additive, and consumed as a vegetable (USDA, 2003). Leaves and stems may be eaten raw, in salads or as a garnish similar to parsley, or cooked (Stephens, 1994).

B. Risk Assessment

1. Initiating Event: Proposed Action

This risk assessment is developed in response to a request, in 1999, by the Korea Ministry of Agriculture and Forestry for USDA authorization to permit imports of fresh water dropwort into the United States. Entry of this commodity into the United States presents the risk of introduction

of exotic plant pests. Title 7, Part 319, Section 56 of the United States Code of Federal Regulations (7 CFR §319.56) provides regulatory authority for the importation of fruits and vegetables from foreign countries into the United States.

2. Assessment of Weed Potential of Water Dropwort (*Oenanthe javanica*)

This step examines the potential of the commodity to become a weed after it enters the United States (Table 1). If the assessment indicates significant weed potential, then a "pest-initiated" risk assessment is conducted.

Table 1. Assessment of the weed potential of water dropwort.

Commodity: Water dropwort (*Oenanthe javanica*) (Apiaceae).

Phase 1: *Oenanthe javanica* is said to have been cultivated, since 1975, as a culinary herb by Asian immigrants in the southern United States (Pistrick, 2002). It is reported to be naturalized from California to British Columbia (Hargis, 1998) and is found in Missouri (MDC, 2002). It has been introduced into Florida on a trial basis (Stephens, 1994) and is offered for sale via the internet by various garden supply houses throughout the country (e.g., Pondarama.com in Pennsylvania, Pondmart.com in Maryland).

Phase 2: Is the species listed in:

Yes	*Geographical Atlas of World Weeds* (Holm *et al*., 1979)
No	*World's Worst Weeds* (Holm *et al*., 1977) or *World Weeds: Natural Histories and Distribution* (Holm *et al*., 1997)
Yes	1982 Report of the Technical Committee to Evaluate Noxious Weeds: Exotic Weeds for Federal Noxious Weed Act (Gunn and Ritchie, 1982)
Yes	*Economically Important Foreign Weeds* (Reed, 1977)
No	Weed Science Society of America Composite List of Weeds (WSSA, 2003)
Yes	Is there any literature reference indicating weediness, *e*.g., AGRICOLA, CAB Abstracts, Biological Abstracts, AGRIS; search on "species name" combined with "weed."

Phase 3: *Oenanthe javanica* is listed by Randall (2003) as a weed. The species is considered a weed in China (Zou *et al*., 2001), Japan (Asano, 2001), and Korea (Lee *et al*., 2001). It is designated by Holm *et al*. (1979) as a "principal" weed in Japan and a "common" weed in Taiwan. However, the plant is naturalized in parts of the United States and is available to the public for cultivation. Further, it will be imported strictly for consumption, without roots, in which state it would be difficult to establish itself. A pest-initiated risk assessment for the species is not considered necessary.

3. Previous Risk Assessments, Current Status, and Pest Interceptions

There are no previous risk assessments for *Oenanthe javanica* from Korea. Currently, water dropwort imports are not authorized by 7 CFR §319.56. There is but a single pest interception on the plant (the noctuid moth *Chrysodeixis eriosoma* Doubleday from Hawaii in 1995), in baggage, the material for consumption (PIN 309).

4. Pest Categorization–Identification of Quarantine Pests and Quarantine Pests Likely to Follow the Pathway

Pests associated with *O. javanica*, which also occur in Korea, are listed in Table 2. This list includes information on the presence or absence of these pests in the United States, the affected plant part or parts, the quarantine status of the pest with respect to the United States, an indication of the pest-host association, and pertinent references for pest distribution and biology.

Table 2. Pests in Korea associated with water dropwort (*Oenanthe javanica*).

Pest	Geographic Distribution[1]	Plant Part Affected[2]	Quarantine Pest	Likely to Follow Pathway	References
ARTHROPODS					
ACARI					
Tetranychidae					
Tetranychus kanzawai Kishida	KR, US	L, S	No	Yes	Bolland *et al*., 1998; CABI, 2002
HETEROPTERA					
Acanthosomatidae					
Elasmostethus humeralis Jakovlev	KR	I, L	Yes	No[3]	Ahn, 1999; An, 2000; Krivolutskaya, 2001
HOMOPTERA					
Aphididae					
Aphis spiraecola Patch	KR, US	I, L, S	No	No[4]	CABI, 2002; Hong & Boo, 1998
Cavariella oenanthi (Shinji)	KR	L	Yes	No[4]	Ahn, 1999; An, 2000
Delphacidae					
Paradelphacodes paludosus (Flor)	KR	S	Yes	No[5]	Ahn, 1999; An, 2000
LEPIDOPTERA					
Epermeniidae					
Epermenia strictella (Wocke)	KR	L	Yes	No[5]	Ahn, 1999; An, 2000
Noctuidae					
Amphipyra livida (Denis & Schiffermüller)	KR	F, L	Yes	No[5]	Ahn, 1999; An, 2000; Yoon & Lee, 1974
Chrysodeixis eriosoma Doubleday	KR, US (HI)	F, L	Yes	No[6]	CABI, 2002; PPQ interception
Ochropleura praecox (L.)	KR	L	Yes	No[5]	Ahn, 1999; An, 2000
Zonoplusia ochreata (Walker)	KR	L	Yes	No[5]	Ahn, 1999; An, 2000
PHYTOPLASMA					
Water dropwort witches' broom	KR	Entire plant[7]	Yes	Yes	Jung *et al*., 2002

Pest	Geographic Distribution[1]	Plant Part Affected[2]	Quarantine Pest	Likely to Follow Pathway	References
FUNGI					
Corticium sasakii (Shirai) Matsumoto (Basidiomycetes: Polyporales)	KR, US	L	No	Yes	Ahuja & Payak, 1983; Farr *et al*., 2005; Yu, 1981
Erysiphe heraclei DC. (Ascomycetes: Erysiphales)	KR, US	I, L, S	No	Yes	Davis & Raid, 2002; Farr *et al*., 2005
Puccinia oenanthes-stoloniferae S. Ito ex Tranzschel (= *P. oenanthes* Miyake) (Urediniomycetes: Uredinales)	KR	L, S	Yes	Yes	Ahn, 1999; Anon., 1986; Farr *et al*., 2005
Pythium ultimum Trow (Oomycetes: Saprolegniales)	KR, US	R, Sd	No	No	Ahn, 1999; Farr *et al*., 2005; Schwartz & Mohan, 1995
Sclerotinia sclerotiorum (Lib.) de Bary (Ascomycetes: Helotiales)	KR, US	I, L, R, S, Sd	No	Yes	CABI, 2002; Farr *et al*., 2005
Septoria sp. (Coelomycetes)	KR	L	Yes	Yes	Ahn, 1999
Septoria oenanthes Ellis & Everh. (Coelomycetes)	KR, US (WA)	L, S	No	Yes	Farr *et al*., 2005; Shin, 1998
MOLLUSC					
Pomacea canaliculata (Lamarck) (Ampullariidae)	KR, US (HI)	L, S	Yes	No[8]	Bishop Museum, 1999; CABI, 2002; Mochida, 1991

[1]Distribution (specific states are listed only if distribution is limited): HI = Hawaii; KR = Korea; US = United States (widespread); WA = Washington

[2]Plant Parts: F = Fruit; I = Inflorescence; L = Leaf; R = Root; S = Stem; Sd = Seed

[3]Species is an external feeder (An, 2000) that deposits its eggs, in masses of 5-40, on the lower surface of host leaves (Kudo, 2001). It is unlikely to remain with the commodity through harvest and processing.

[4]Pest is an active, external feeder (Blackman & Eastop, 2000), and is unlikely to remain with the commodity through harvest and processing.

[5]Species is an external feeder (An, 2000), and is unlikely to remain with the commodity through harvest and processing.

[6]Species is an external feeder (CABI, 2002), and is unlikely to remain with the commodity through harvest and processing.

[7]Phytoplasmas generally cause systemic infections (Agrios, 1997).

[8]Juveniles do not begin to consume plant material until they have reached a shell size of about 1.5 cm (CABI, 2002), at which size they would be readily detectable on the plant. This snail thus is unlikely to remain with the commodity through harvest and processing.

Quarantine pests that reasonably can be expected to follow the pathway (i.e., be included in shipments of water dropwort plants) are subjected to steps 5-7 (USDA, 2000) in the following

sections of this risk assessment. These pests are listed in Table 3. Other organisms on the pest list (Table 2), but not chosen for further scrutiny, were excluded for a variety of reasons: they are well established and widespread in the United States; they are associated mainly with plant parts other than the commodity; they may be associated with the commodity, but it was not considered reasonable to expect these pests to remain with the commodity during processing; or they have been intercepted on rare occasions, as biological contaminants, by APHIS-PPQ Officers during inspections of the commodity and would not be expected to be found frequently with commercial shipments. However, risk is a dynamic concept since pest distributions are fluid and pest mitigations evolve. As information on new hazards or new mitigations is identified, the findings of this assessment may be updated.

Pests listed at the level of genus or higher were not considered for further analysis for lack of evidence that these organisms posed risks.

Table 3. Quarantine pests selected for further analysis.

PHYTOPLASMA
Water dropwort witches' broom
FUNGUS
Puccinia oenanthes-stoloniferae S. Ito ex Tranzschel (Urediniomycetes: Uredinales)

5. Consequences of Introduction—Economic/Environmental Importance

Potential consequences of introduction are rated using five risk elements: Climate-Host Interaction, Host Range, Dispersal Potential, Economic Impact, and Environmental Impact. These elements reflect the biology, host ranges, and climatic/geographic distributions of the pests. For each risk element, pests are assigned a rating of Low (1 point), Medium (2 points), or High (3 points) (USDA, 2000). A Cumulative Risk Rating is then calculated by summing all risk element values.

Consequences of Introduction: Water dropwort witches' broom	**Risk Value**
Risk Element #1: Climate-Host Interaction This pathogen thus far has been reported only from Korea (Jung *et al*., 2002). Winter in the Republic of Korea can be bitterly cold; temperatures are reported to be somewhat lower than those at corresponding latitudes in other continents (Korea Information Service, 2003). Mean temperature in January, the coldest month, ranges from –5° to 5°F. It is estimated that the phytoplasma would be able to become established in regions of the United States corresponding to Plant Hardiness Zones 6-11.	High (3)
Risk Element #2: Host Range The pathogen is known only to attack *O. javanica* (Jung *et al*., 2002).	Low (1)
Risk Element #3: Dispersal Potential No information is available on the virulence or capacity for spread of this species. Because of the uncertainty surrounding the dispersal potential of the species, this risk element is rated high.	High (3)

Risk Element #4: Economic Impact This phytoplasma is said to cause a serious disease of *O. javanica*, which has spread wherever the plant is grown in Korea (Jung *et al*., 2002). No other information is available. Water dropwort is of some, if limited, economic value in the United States, as an ornamental and landscaping plant. Because of the uncertainty surrounding the economic impact of the pathogen, this element is rated high.	High (3)
Risk Element #5: Environmental Impact Because of its highly restricted host range, this pathogen is unlikely to pose a threat to vulnerable native plants in the United States. No species of *Oenanthe* is listed as Threatened or Endangered in Title 50, Part 17, Section 12 of the U.S. Code of Federal Regulations (50 CFR §17.12). The exotic *Oenanthe javanica* apparently is not of great economic importance in the United States. (The plant is available commercially from a few garden supply firms.) Introduction of the phytoplasma is unlikely to result in the initiation of programs for its control.	Low (1)

Consequences of Introduction: *Puccinia oenanthes-stoloniferae* S. Ito ex Tranzschel (Urediniomycetes: Uredinales)	**Risk Value**
Risk Element #1: Climate-Host Interaction *Puccinia oenanthes-stoloniferae* is known to occur in China, Japan, Korea, the Russian Far East, and Taiwan (Anon., 1986; Farr *et al*., 2005). It is estimated that it could become established in the United States in areas corresponding to Plant Hardiness Zones 6-11.	High (3)
Risk Element #2: Host Range The pathogen is known to attack *O. javanica* (Anon., 1986). Although no other information on hosts is available, the specific epithet suggests that it is specific to the genus *Oenanthe*.	Low (1)
Risk Element #3: Dispersal Potential No information is available on the virulence or capacity for spread of *P. oenanthes-stoloniferae*. Because of the uncertainty surrounding the dispersal potential of the species, this risk element is rated high.	High (3)
Risk Element #4: Economic Impact No information is available on the pest status of this species. Because of the uncertainty surrounding the economic impact of the pathogen, the rating for this element defaults to high.	High (3)
Risk Element #5: Environmental Impact *Puccinia oenanthes-stoloniferae* is unlikely to pose a threat to native plants in the United States. No species of *Oenanthe* is listed as Threatened or Endangered in 50 CFR §17.12. As *O. javanica* apparently is of little economic importance in the United States, introduction of the fungus is unlikely to result in the initiation of programs for its control.	Low (1)

The values determined for the Consequences of Introduction for each pest are summarized in Table 4. Because of a lack of information, and thus a high degree of uncertainty, concerning several of the risk elements, they have been given risk ratings higher than the available evidence, *prima facie*, might otherwise indicate.

Table 4. Risk rating for Consequences of Introduction (water dropwort, *Oenanthe javanica*, from Korea).

Pest	Risk Element 1 Climate/ Host Interaction	Risk Element 2 Host Range	Risk Element 3 Dispersal Potential	Risk Element 4 Economic Impact	Risk Element 5 Environmental Impact	Cumulative Risk Rating
Water dropwort witches' broom	High (3)	Low (1)	High (3)	High (3)	Low (1)	Medium (11)
Puccinia oenanthes-stoloniferae S. Ito ex Tranzschel	High (3)	Low (1)	High (3)	High (3)	Low (1)	Medium (11)

6. Likelihood of Introduction—Quantity Imported and Pest Opportunity

Likelihood of introduction is a function of both the quantity of the commodity imported annually and pest opportunity, which consists of five criteria that consider the potential for pest survival along the pathway (USDA, 2000) (Table 5).

Quantity imported annually

The rating for the quantity imported annually usually is based on the amount reported by the exporter, and is converted into standard units of 40-foot-long shipping containers. As the projected volume of water dropwort to be shipped annually from Korea to the United States presently is unknown, the risk rating for this element defaults to high.

Survive post-harvest treatment

Both of the pathogens, as internal pests, would be expected to have a high probability of surviving minimal post-harvest treatments, such as washing and culling, if infection is in the early stages, before symptoms of disease appear.

Survive shipment

Conditions under which water dropwort may be shipped (e.g., low temperatures) are not expected to exceed in severity those prevailing during an average winter in Korea. It therefore is highly likely that the pathogens will survive shipment. For example, as mycelium may survive a range of temperatures from approximately –5° to 45°C (Agrios, 1997), the fungus is highly likely to survive shipment. There is no evidence that conditions likely to prevail during shipment adversely affect phytoplasmas.

Not detected at port-of-entry

Again, if infection of water dropwort is in early stages, before symptoms become obvious, the pathogens would have a high probability of evading detection at a port-of-entry.

Moved to suitable habitat

The market for water dropwort in the United States is likely to consist largely of consumers of East and Southeast Asian extraction. Of the 18 states that have substantial "Asian" populations (over 100,000; USBC, 2003), nine (i.e., California, Florida, Georgia, Hawaii, Maryland, New Jersey, North Carolina, Texas, and Virginia) are situated wholly within Plant Hardiness Zones 6-11. More than 61% of the "Asian" population of the country resides in these states. The pathogens likely would find conditions suitable for survival and reproduction in approximately 18% of the United States.

Contact with host material

The pathogens apparently are restricted to water dropwort or other species of *Oenanthe*, which are naturalized in at least five states (Alaska, California, Ohio, Oregon, and Washington; USDA, 2003). Because of the limited distribution of potential hosts in the United States and their restriction to wetland habitats, the pathogens are considered to have a low probability of coming into contact with suitable host material.

Table 5. Risk rating for Likelihood of Introduction (water dropwort, *Oenanthe javanica*, from Korea).

Pest	Quantity Imported Annually	Survive Postharvest Treatment	Survive Shipment	Not Detected at Port of Entry	Moved to Suitable Habitat	Contact with Host Material	Cumulative Risk Rating
Water dropwort witches' broom	High (3)	High (3)	High (3)	High (3)	Medium (2)	Low (1)	High (15)
Puccinia oenanthes-stoloniferae S. Ito ex Tranzschel	High (3)	High (3)	High (3)	High (3)	Medium (2)	Low (1)	High (15)

7. Conclusion—Pest Risk Potential and Pests Requiring Phytosanitary Measures

The summation of the values for the Consequences of Introduction and the Likelihood of Introduction yields Pest Risk Potential values (USDA, 2000) (Table 6). This is an estimate of the risks associated with this importation.

Table 6. Pest Risk Potential.

Pest	Consequences of Introduction	Likelihood of Introduction	Pest Risk Potential
Water dropwort witches' broom	Medium (11)	High (15)	Medium (26)
Puccinia oenanthes-stoloniferae S. Ito ex Tranzschel	Medium (11)	High (15)	Medium (26)

Pests with a Pest Risk Potential value of Low do not require mitigation measures, whereas a value within the Medium range indicates that specific phytosanitary measures may be necessary. The PPQ Guidelines state that a High Pest Risk Potential means that specific phytosanitary measures are strongly recommended, and that port-of-entry inspection is not considered sufficient to provide phytosanitary security. The choice of appropriate phytosanitary measures to mitigate risks is undertaken as part of Risk Management, and is not addressed in this document.

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