Inula britannica L.
(British elecampane)

Weed Risk Assessment
November, 2000
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USDA, APHIS,PPQ

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INTRODUCTION

This weed risk assessment (WRA) was prepared by the Animal and Plant Health Inspection Service (APHIS) of the U.S. Department of Agriculture (USDA) to examine the plant pest risk associated with the importation and interstate movement into and through the United States of *Inula britannica* L. (British elecampane). This is a qualitative weed risk assessment, that is, estimates of risk are expressed in qualitative terms such as high, medium and low as opposed to numerical terms such as probabilities or frequencies.

STAGE 1: INITIATING THE WEED RISK ANALYSIS PROCESS

Step 1. Document the Initiating Event(s) for the weed risk assessment

In November 1999, a nursery in west Michigan reported an unknown and difficult-to-control weed in hosta plants that had been imported from the Netherlands. APHIS Botany Identifier Rodney Young tentatively identified the plant as Asteraceae, *Inula* sp. After the plants flowered, Mr. Young consulted Dr. Harold Robinson, Asteraceae specialist at the U.S. National Herbarium, Smithsonian Institution, who confirmed the identification of *Inula britannica* L. The new pest advisory committee convened on September 28,2000 to discuss the new weed.

Step 2. Identify and Cite Previous Weed Risk Assessments.

This is the first weed risk assessment for this species.

Step 3. Establish Identity of Weed

TAXONOMY: (after Cronquist)

Division:	Spermatophyta (Seed plants)
Subdivision:	Angiospermae (Flowering plants)
Class:	Dicotyledonae (Dicots)
Subclass:	Asteridae
Order:	Asterales
Family:	Asteraceae (Compositae, the sunflower family)
Scientific name:	*Inula britannica* Linnaeus.
Synonyms:	*Inula japonica* Thunb. (Wiersema & Leon, 1999)
	Inula hispanica Pau (Flora Europaea database)
	Conyza britannica (L.) Moris ex Rupr..(w⌲Tropicos,2000)
	Inula serrata Gilib.(w⌲Tropicos,2000)
	Inula tymiensis Kudô (w⌲Tropicos,2000)
Common names:	British elecampane (Wiersema & Leon, 1999)

British yellowhead (BONAP, 2000)
Meadow fleabane (Gotfredsen, 2000)

Native distribution: According to various sources (Georgiadou *et a*l., 1980; Schischkin, 1999; Tutin *et a*l., 1976; Wiersema and Leon, 1999), the native distribution of this species is both Europe and temperate Asia.

***Current distribution**:* **Europe:** Albania, Austria, Belgium, Bulgaria, Czechoslovakia, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Luxembourg, Netherlands, Norway, Poland, Romania, Russia/USSR (Northern Region, Baltic Region, Central Region, Southwestern Region, Crimea, Southeastern Region), Spain, Sweden, Switzerland, Turkey (European part), Yugoslavia (Tutin et al., 1976; Blamey and Grey-Wilson, 1989)

Asia: China (North and Northeastern), Korea (Iwatsuki *et a*l., 1995); Iran (Georgiadou *et a*l., 1980); Armenia, Kurdistan, Dzhyungaria-Kashgaria, Mongolia, USSR (Eastern Siberia, Far East, Soviet Central Asia) (Schischkin, 1999). In Japan, this species occurs on the islands of Hokkaido, Honshu, Shikoku, and Kyushu (Iwatsuki et al., 1995.)

North America: In Canada, *I. britannica* was introduced into Ontario around 1928, along the Etobicoke River and into Quebec, 1979 or before, on Dupas Island in the St. Lawrence River, where it forms a colony in a pasture (Scoggan, 1979; Tessier & Lacoursiere, 1979; Darbyshire, 2000).

In New York, H. Moldenke (1950) noted a specimen collected in 1915 at Hewlett, Nassau County (close to New York City on Long Island). The species, collected in an area that is now densely populated, likely did not persist (Mitchell, 2000).

Inula britannica occurs in several nurseries in Michigan, and was detected in a Minnesota nursery in August, 2004. A Maryland Invasive Species Council report from October 4, 2002 indicates the species is growing in a parcel of farmland recently sold by a nursery, but it is not spreading from the site.

Description: The plant is an erect biennial, 6 to 30 inches in height (15 cm to 75 cm). The leaves are sparsely pubescent (covered with hairs, especially soft downy hairs) above and densely pubescent beneath. Rarely the leaves are almost sericeous (covered with fine, silky hairs). The margins of the leaf are entire (unbroken or even) or serrulate (finely toothed). Generally, the lower leaves are 1.5-6 inches by .4-1 in (4-15 cm by 1-2.5 cm). The shape of the lower leaves is elliptical or ovate-elliptical. The upper leaves are sessile (without a stalk) or amplexicaul (clasping the stem) (Tutin *et a*l., 1976). Most sources consider this plant a perennial (Blamey & Grey-Wilson, 1989; Iwatsuki *et a*l., 1995; Schischkin, 1999).

Sexual Reproduction: The yellow flowerheads are medium to large, .8 to 1 inch (20 to 50 mm). The rays are long and narrow. The flowerheads occur alone or in clusters of two or three. Flowering occurs in July and August (Blamey & Grey-Wilson, 1989). A detailed description of the flower and its parts is in *Flora Europaea* (Tutin *et a*l., 1976) and in *Flora of Japan* (Iwatsuki *et a*l., 1995).

Habitat: This plant occurs in wet habitats: river and stream margins, marshes, ditches, wet grassland, and wet woods. The wet habitats are at low altitudes (Blamey & Grey-Wilson, 1989). In Turkey, Davis (1975) mentions a habitat of moist ground besides streams and ditches. In Japan, the habitat is "wet ground along rivers in lowlands'' (Iwatsuki *et a*l., 1995).

STAGE 2: ASSESSING PEST RISK

Step 4. Geographic and Regulatory Information

Federal noxious weeds are prohibited entry into the United States.

Geographic: We do not know to what extent *Inula britannica* is distributed within the United States. Confirmed reports are limited to Michigan and Minnesota as of August, 2004.

First detection in the United States:
Location: Zeeland, MI (Walters Gardens)
Date: 12 Oct 99 (date on e-mail)
Habitat: In hosta fields (Number of acres not stated)
Collector: Barry Menser, USDA-APHIS-PPQ
Michigan Department of Agriculture
Identifier: Dr. Harold E. Robinson, (specialist in the taxonomy of the Asteraceae) National Museum of Natural History, Smithsonian Institution, Washington, DC
Identification date: 16 Aug 00 (17 Aug 00 e-mail from Rodney Young).

Subsequently, populations have been found at three additional nurseries in Holland and Hudsonville, MI. On August 17, 2004, the first survey find in Minnesota was confirmed. The State issued "treat and destroy" orders for the infestation, in Dakota County.

Regulatory: *I. britannica* has no regulatory status in the United States at this time. The Michigan Department of Agriculture has restricted individual fields at the nursery level. This weed is not on any prohibited or restricted list at the State level.

Step 5. Assess Economic Importance: Consequences of Introduction.

The weed risk assessment evaluates whether or not the weed is of potential economic importance by considering the consequences and likelihood of introduction. In qualitative risk assessments, we use five Risk Elements (RE) to estimate risk. RE's #1-4 focus on the consequences of introduction and RE #5 considers the likelihood of introduction.

RE #1: Habitat Suitability

A weed may behave in its area of introduction as it does in its native area if climatic conditions and habitat are similar. For this element, we base estimates on the availability of a suitable climate. To rate this RE, we use the USDA plant hardiness zones as described by the U.S. Department of Agriculture (USDA, 1990).

Assign rating as follows: Certainty level: very certain

Suitable climate and habitat would permit the weed to establish:

Rating	Numerical score	Explanation
High✓	3✓	In four or more hardiness zones. (In most or all of the United States) ✓

Medium	2	In two or three hardiness zones.(In approximately one third to two thirds of the United States)
Low	1	In a single hardiness zone. (approximately one third or less of the United States)
Negligible	0	no potential to survive and become established in the WRA area.

Ecological Factors: Temperature and Moisture. Typically, one or more ecological factors will limit the range (or potential range) of a plant species (Rubel, 1935; Scoggan, 1978). Often freezing temperatures are a limiting factor. However, this plant (or at least some ecotypes) is well able to withstand freezing temperatures, as indicated by its presence in Siberia and Sweden. Apparently, the factor that will limit the distribution of this species is its need for a moist habitat.

Ecological Factor: Climatic Conditions. This species appears to be well adapted to a number of climatic zones in Europe and the Orient. When the European, Asian, and North American maps of Walter (1975 and 1977) and his coworkers are examined, the comparison shows that this species is likely to survive in most, if not all, of the climatic zones in eastern North America. According to an analysis using Climate software, the area most likely for the species to establish roughly corresponds to Wisconsin in hardiness zone 4 (Randall, 2000).

Level of Certainty: Low. The prediction is based on climate preference and documented distribution in other parts of the world. The Climate matching software analysis suggests a more limited range.

RE #2: Dispersal/ Spread Potential

A newly introduced weed may disperse. We consider the following factors:

- reproductive patterns in the weed (e.g., reproductive output)
- dispersal capability of the weed
- facilitation of dispersal by natural factors (*e.g.*, wind, water, presence of vectors)
- facilitation of dispersal by human factors (*e.g.*, ornament, spice, food, medicine)

Assign rating as follows: Certainty level: moderate - more certain than not

Rating:	Numerical score	Explanation
High	3	Weed has potential for rapid natural spread throughout its potential range in the WRA area (*e.g.*, high reproductive potential ***AND*** highly mobile propagules)
Medium✓	2✓	Weed has potential for natural spread throughout a physiolographic region of the WRA within a year (*e.g.*, it has either high reproductive potential ***OR*** highly mobile propagules).✓
Low	1	Weed has potential for natural spread locally in the WRA area within a year (some reproductive potential and/or some mobility

Rating:	Numerical score	Explanation
		of propagules).
Negligible	0	Weed has no potential for natural spread in the WRA area

Alternate/ Check method for RE #2:

List characteristics that may influence a plant's ability to reproduce and disperse and assign a point for each: (Each check mark denotes that the characteristic applies, and represents one point.)

1. Prolific seed production. (Uncertain - Propagation is by seed or division, but we have no specific information about prolific seed production.)
2. Dormant, long-lived seeds (Uncertain - no data.)
3. Reproduction by rhizomes ✓, stolons, tubers, corms, turions, vegetative fragmentation, offsets and cleistogenes (The plant is strongly rhizomatous.)
4. Dispersal by wind (✓probably), water, machinery ✓, animals ✓, humans ✓(This plant is probably spread by water fowl (Blamey & Grey-Wilson, 1989) and by man because of its medicinal value. In Michigan, the nurserymen report spread by machinery. As humans move hosta rootstock, *Inula* rhizomes may hitchhike. The seeds have a long pappus (about 5 times the length of the seed) which look capable of wind dispersal.)
5. Rapid growth to reproductive maturity. (No data.)
6. High germination rate in a wide range of conditions. (No data.)
7. Allelopathy. (No data.)
8. Stress tolerance (ability to tolerate a wide range of conditions, includes herbicide resistance.) (No data.)

(Rate H(3) /M(2) /L(1) based on the number of characteristics: High = 6 or more, **medium = 4 or 5**, low = 1-3.) *Inula britannica* earns 5 points, which translates to a medium dispersal potential rating.

Level of certainty: medium.

RE #3: Economic Impact Rating

Introduced weeds can cause a variety of economic impacts. We divide these impacts into three primary categories (other types of impacts may occur):

1. Reduced crop yield (*e.g.*, by parasitism, competition, or by harboring other pests) or other negative affects to useful plants, plant products, or livestock. For non parasitic weeds, risk is correlated with the number of crops, plant products, other useful plants, or kinds of livestock affected.
2 Lower commodity value (e.g., by increasing costs of production, lowering the market price, or a combination); or if not an agricultural weed, by increasing costs of control.
3. Loss of markets (foreign or domestic) due to presence of a new Federal noxious weed.

Assign ratings as follows: Certainty level: reasonably certain

Rating	Numerical Score	Explanation
High	3	Weed causes all three of the above impacts, or causes any one impact over a wide range (over 5 types) of economic plants, plant products, or animals

Rating	Numerical Score	Explanation
Medium	2	Weed causes any two of the above impacts, or causes any one impact to 3 or 4 types of economic plants, plant products, or animals.
Low ✓	1 ✓	Weed causes any one of the above impacts to one or two types of economic plants, plant products, or animals. ✓
Nil	0	Weed causes none of the above impacts.

Recent negative impacts have been reported on hosta growing in the Netherlands and Michigan. In order to control the *Inula* with Roundup, some surrounding hosta plants must be sacrificed.

In *A Geographical Atlas of World Weeds,* Holm and his coauthors (1979) list this species as a common weed in the Soviet Union. The only other mention in this reference is that the species was present in the flora of China but confirming evidence was needed to prove that the plant behaves as a weed. Randall (2002) includes *I. britannica* in the Global Compendium of Weeds, citing a 1987 dictionary of weeds of Eastern Europe and the Chinese Colored Weed Illustrated Book (2000). Several publications discussing weeds in agriculture do not indicate any importance of the species as a weed in its native areas:

1. Bayer AG. 1983. *Important Weeds of the World*. Only elecampane, *Inula helenium*, is mentioned.
2. Malik, R. K. and Tsedev, D. 1996. *Major Weeds of Mongolia*. Food and Agriculture Organization of the United Nations, Rome. No mention.
3. Reed, C. and Hughes, R. 1977. *Economically Important Foreign Weeds: Potential Problems in the United States*. This reference lists only *Inula conyza*, *Inula indica*, and *Inula vestita*.
4. Holm, L. G. et al. 1977. *The World's Worst Weeds*. No mention.

Level of certainty: High

RE #4: Environmental Impact

Consider whether or not the weed, if introduced, could:
1. Cause impacts on ecosystem processes (alteration of hydrology, sedimentation rates, a fire regime, nutrient regimes).
2. Cause impacts on natural community composition (*e.g.*, reduces biodiversity, affects native populations).
3. Cause impacts on community structure (*e.g.*, changes the density of a layer, covers the canopy, eliminates or creates a layer).
4. Have impacts on human health such as allergies or changes in air or water quality.
5. Have sociological impacts on recreation patterns and aesthetic or property values.
6. Introduction of the weed would stimulate control programs including toxic chemical pesticides. ✓

Assign ratings as follows: Certainty level: very uncertain

Rating	Numerical Score	Explanation
High	3	Three or more of the above, (Potential to cause major damage to the environment with significant losses to plant ecosystems and subsequent physical environmental degradation.) Two of the above, (Potential to cause moderate impact on

Rating	Numerical Score	Explanation
Medium	2	the environment with obvious change in the ecological balance, affecting several attributes of the ecosystem, as well as moderate recreation or aesthetic impacts.)
Low ✓	1 ✓	One of the above, (Limited potential impact on environment.) ✓
Nil	0	None of the above, (No potential to degrade the environment or otherwise affect ecosystems.)

In the Netherlands and Michigan, infestations in hosta fields can be controlled by Roundup.

Level of Certainty: High

Economic Importance Summary: Consequences of Introduction. Cumulative Risk Element Score

Adding together the numerical estimates for the five risk elements, we produce an overall estimate of the Consequences of Introduction Risk Rating for the weed. The overall risk rating is used to assign a Consequences of Introduction Risk Score as follows:
Habitat suitability + Dispersal Potential + Economic Impact + Environmental Impact = Consequences of Introduction.

(RE1 + RE2 + RE3 + RE4) = TOTAL.
3 + 2 + 1 + 1 = 7

Risk: Consequences of Introduction

Cumulative risk element score	Risk Rating	Risk score
0-2	negligible	0
3-6	low	1
7-10 ✓	medium ✓	2 ✓
11-12	high	3

The consequences of introduction risk rating is an indicator of the potential of the weed to become established and spread, and its potential to cause economic and environmental impacts. For *Inula britannica*, the consequences of introduction risk rating is medium.

Step 6. Assess Likelihood of Introduction/Spread

RE #5: Entry Potential: Number of Potential Pathways and Likelihood of Survival in Each

The likelihood that an exotic weed will be introduced depends on the number of associated pathways and within each pathway, the weed's opportunity to survive and find a suitable habitat.

Assign ratings as follows:

Rating	Numerical Score	Explanation: Introduction is
High ✓	3✓	Very likely or certain ✓
Medium	2	Likely
Low	1	Low, but clearly possible
Negligible	0	Extremely unlikely

The pathway by which the weed most likely entered the United States is contaminated hosta nursery stock. Before export from the Netherlands, hosta root stocks are washed thoroughly with water jets, but intertwined root or rhizome fragments of *Inula* are difficult or impossible to detect. In the five years since the Netherlands began regulating (with zero tolerance) *Inula* in fields for export, this pathway is less likely. Hosta nursery stock from other origins could serve as a pathway. Because of its medicinal uses, *Inula britannica* also may be carried in passenger baggage. The likelihood of further introduction for *Inula britannica* is high (Score = 3). Likely pathways, including nursery stock shipments and intentional importation in passenger baggage or mail, are not subject to treatment prior to shipping. The propagules would be likely to survive and be introduced repeatedly into the environment. In the absence of regulation, *Inula britannica* will likely be introduced beyond its present range.

Level of Certainty: High

Step 7. Conclusion/Pest Risk Potential (PRP)

The pest risk potential is obtained from the combination of the scores for likelihood of introduction and consequences of introduction, and is assigned as follows: negligible (0), low (1-3), medium (4-6) and high (9):

Likelihood of Introduction (Rating and Score)	Consequences of Introduction (Rating and Score)	Overall Pest Risk Potential
Negligible (0)	Negligible (0)	Negligible
Negligible (0)	Low (1)	Negligible
Negligible (0)	Medium (2)	Negligible
Negligible (0)	High (3)	Negligible
Low (1)	Negligible (0)	Negligible
Low (1)	Low (1)	Low
Low (1)	Medium (2)	Low
Low (1)	High (3)	Low
Medium (2)	Negligible (0)	Negligible
Medium (2)	Low (1)	Low
Medium (2)	Medium (2)	Medium
Medium (2) ✓	High (3) ✓	Medium-high ✓
High (3)	Negligible (0)	Negligible
High (3)	Low (1)	Low
High (3)	Medium (2)	Medium

Likelihood of Introduction (Rating and Score)	Consequences of Introduction (Rating and Score)	Overall Pest Risk Potential
High (3)	High (3)	High

CONCLUSION: *Inula britannica* rates a medium consequences of introduction and a high likelihood of introduction for a medium-high pest risk potential.

DISCUSSION / RISK MANAGEMENT

Most of the articles from the literature search on *Inula britannica* referred to either the plant's presence in its ecosystems or to its chemical compounds. Several articles and web sites describe this species as an endangered species in Germany (www.biologie.uni- ulm.de/lehre/bestrueb/rotelist.htm), France (Klein & Vanderpoorten, 1998), and Switzerland (Kozlowski, 1998). Because this species is (1) rarely listed as a weed in Europe, (2) endangered in some European countries, (3) present in Canada for an extended period without serious damage (4) rarely mentioned in the scientific literature, and (5) usually associated with a moist habitat, this species may present little danger to crops in the United States.

Recent problems in hosta fields and the fact that the species was probably introduced without its natural enemies indicate the species may be capable of more damage than expected. Hosta is a widely-grown, popular garden plant, and the Netherlands exports millions of rootstocks every year to the United States. Statistics for the preclearance program reveal that in one month, 27 different exporters sold 5 million plants to importers in the U.S., for a total of 168 shipments. Rootstocks are pressure-washed to clear them of soil, seeds, and other contaminants (Bedat, 2000), but *Inula* roots and rhizomes intertwine with the hosta roots and are similar in appearance, making detection in great volumes of hosta rootstocks extremely difficult operationally.

About six years ago, the Dutch began noticing *Inula britannica* as an aggressive weed in fields cultivated for export. Five years ago, the Dutch placed the species on their noxious weed list (zero tolerance) for exports, which means Dutch officials inspect the fields every three months and reject a field for export if they find this species. The grower must then treat the field. A common configuration is a mother plant surrounded by 8-10 satellite plants, connected by rhizomes. Application of Roundup at low concentrations results in the slow death of the mother plant, followed by death of the satellite plants.

Michigan nurserymen first noticed *Inula* about 10 years ago, five years before the Dutch began treating *Inula* in the fields for export. It is most likely that the *Inula britannica* at the Michigan nurseries entered as a contaminant of hostas before The Netherlands initiated the control program (K. Bedat, 2000). The risk of introducing additional *Inula* plants with hosta rootstock has been minimized to the extent practical by the Dutch certification program.

Because many nurseries received hosta nursery stock from the Netherlands and because the hostas are distributed from Michigan nurseries to numerous places, it will be very difficult to find out where the *Inula* may have spread in the U.S. Members of the Asteraceae are difficult to identify and *Inula britannica* may be noticed, but unidentified in many nurseries across the country

Recommendations:

1. Enlist the cooperation of the American Nursery and Landscape Association (ANLA) to survey nurseries throughout the U.S. that import hostas from the Netherlands or receive hostas from Michigan to determine the extent of introduction.

2. If the distribution in the U.S. is found to be limited and the States involved are willing to cooperate in eradication or control, propose listing *Inula britannica* as a Federal noxious weed.

Methods of control:

Chemical Control: Roundup is effective.

Mechanical Control: Because it is a perennial with short rhizomes (Iwatsuki *et a*l., 1995), deep plowing or cultivation is likely to be effective against this species. Muenscher (1980) states that elecampane, *Inula helenium*, does *not* persist if the land is cultivated for a year; also, control of elecampane is obtainable by cutting crowns below the ground with a spade or a spud (a tool with a chisel-like blade).

Biological Control: Several pathogens and insects are probably damaging to this species. The following websites present information on potential biocontrol agents:

Http://www.funet.fi/pub/sci/bio/life/insecta/lepidoptera/ditrysia/tortricoidea/tortricidae/tortricinae/phalonidia/index.html
Phalonidia manniana Lepidoptera:Tortricidae Larvae on *Inula*
P. contractana Lepidoptera:Tortricidae Larvae on *I. viscosa* and *I. graveolens*

Http://www.funet.fi/pub/sci/bio/life/insecta/lepidoptera/ditrysia/sesioidae/choreutidae/tebenna/index.html
Tebenna micalis Lepidoptera:Choreutidae Larvae on *Inula*

Http://www.funet.fi/pub/sci/bio/life/insecta/lepidoptera/ditrysia/pterophoridae/pterophoinae/hellinsia/index.html
Hellinsia inulae Lepidoptera:Pterophoridae Larvae on *I. britannic*a, *I. salicin*a, *I. viscosa,* and *Ditrichia viscosa H. carphodactyla* Lepidoptera:Pterophoridae Larvae on *I. conyz*a, *I. bifron*s, *I. montana, I. hirta, Buphthallmum salicifoium,* and *Carina vulgaris.*

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