1.0 Organism description

Scientific name
Ludwigia hyssopifolia (G.Don) Exell, Onagraceae.

Common names
Seedbox, telurik, linear-leaf water primrose, primrose willow (Randall 2002).

Synonyms Cultivars, strains, or variants
Jussiaea linifolia Vahl (Randall 2002).

Previously recorded in New Zealand
No (Ministry of Agriculture and Forestry, Landcare Research).

2.0 Summary

- Pan-tropical distribution - *L. hyssopifolia* is restricted to warm, tropical or sub-tropical climates with associated high humidity and warm temperatures. One source lists it as present in northern Europe and northern USA but this could not be confirmed and may be an error.

- The genus contains a number of cultivated ornamentals, as well as serious economic and environmental weeds. *Ludwigia peploides* and *L. palustris* are naturalised and weedy in New Zealand, but are more tolerant of cooler climates elsewhere than *L. hyssopifolia*.

- *L. hyssopifolia* is an erect, annual herbaceous, marshy, or aquatic plant, sometimes growing on drier land, up to 2-3m tall. It is found in shallow, fresh water habitats, including ponds, swamps and ditches. It also grows in irrigated crops, fallow gardens, wastelands, roadsides, forest clearings, moist gardens, and pastures in humid areas.

- Rice appears to be the most commonly and seriously affected crop overseas. Other crops affected include maize, cotton, tobacco, vegetables, rubber, irrigated crops, sorghum, pineapple, taro and sugarcane.

- It is a common weed of aquatic systems in Thailand and India, but does not appear to have actual or potential environmental impacts in Australia.

- *L. hyssopifolia* is likely to be limited by climate to the northern North Island and frost free coastal areas elsewhere.

- It is possible that it may have low to moderate impacts as a weed of irrigated crops, and poor, or over-grazed, wet pasture. *L. hyssopifolia* also has some potential to be an environmental weed in New Zealand. However, it is probably at the limits of its climatic tolerance in New Zealand and this is likely to reduce its growth and competitiveness.

3.0 Basic biology and ecology

3.1 Overseas distribution

- Pan-tropical distribution - Africa, Central and South America, Caribbean, Asia, Australia and the Pacific. Place of origin uncertain. It is relatively local in Africa. In Asia it occurs from India and Sri Lanka to southern China and throughout South East Asia to Micronesia and northern Australia. Apparently recent populations in Fiji and Samoa (PIER). Holm et al. (1997) list it as present in northern Europe and northern USA – however, no references were found to validate these records and they appear anomalous.

- Africa (tropical, arid?); west tropical Africa – Senegal to Lake Chad, southern Sudan, Egypt and south to the Congo (Holm et al. 1997, Holm et al. 1979).

- Arabia (arid?); Iraq (Holm et al. 1979).

- Asia (tropical); India, Nepal and Sri Lanka to southern China. Throughout South East Asia to Papua New Guinea (PIER).

- New World (tropical/sub-tropical); Central America, South America and the Caribbean (Holm et al. 1997).

- Australia (tropical); Western Australia [Kimberley], Northern Territory [Darwin area], Queensland [Cape York south to about Townsville], and Christmas Island (AVH, Flora of Australia).

- Pacific (tropical); American Samoa, Western Samoa, Mariana Islands, Micronesia, Fiji, Cook Islands, French Polynesia, Guam, Japan [off-shore islands], Marshall Islands, Palau and the Solomon Islands (PIER, Swarbrick 1997).

3.2 Ecology/habitat

- The genus contains a number of cultivated ornamentals, as well as serious economic and environmental weeds (Mabberley 1997, PIER, ISSG).

- *L. hyssopifolia* is an erect, annual herbaceous, marshy, or aquatic plant, sometimes growing on drier land, up to 2-3m tall, occasionally persisting and becoming woody

at base. There are reports that it produces aerophores on shallow roots (Holm et al. 1997).

- It grows in ever-wet regions and in those with a pronounced dry season (Soerjani et al. 1987).

- In New Zealand, this weed was common in the shade houses which may indicate some shade tolerance. Shaded areas may also be important in keeping the soil surface moist, allowing the seed to germinate and establish (James pers. comm).

- It generally prefers wet places, although it sometimes grows on drier land. Because submergence inhibits seed germination (Pons 1982), it probably requires a dry period to establish initially. It is found in shallow, fresh water habitats, including ponds, swamps and ditches. It also grows along river edges, in fallow gardens, wastelands, roadsides, forest clearings, irrigated crops, moist gardens and pastures in humid areas (Holm et al. 1997). It is reported to grow mostly at lower altitudes (<700m), but possibly up to 3000m in Papuasia (PIER).

- The fruit is a capsule containing seeds of two types; those in upper part of the capsule are small (0.5mm) and numerous; in the lower capsule the seeds are larger (0.75mm), and each is embedded in a corky disc (Holm et al. 1997).

- High reproductive capacity. One plant can produce 75 000 seeds and seed continues to germinate for at least 3.5 years. Seeds require light to germinate. Optimum germination temperature is between 15-35° C. The lower temperature range for germination is 10-20° C, and the upper limit is 40° C (Holm et al. 1997). Submergence completely inhibits germination (Pons 1982).

- Not listed as toxic in Randall (2002). Unknown palatability to mammalian browsers but *L. peploides* is suspected of poisoning stock in Australia (Auld & Medd 1987).

4.0 Likelihood of establishment and spread

4.1 Environmental tolerances overseas and comparison with New Zealand

4.1.1 Environmental tolerances overseas

- *L. hyssopifolia* is restricted to warm, tropical or sub-tropical climates with associated high humidity and warm temperatures (but see section 3.1).

4.1.2 Comparison with New Zealand

- The warmer regions of Northland, Auckland and frost free coastal areas elsewhere provide the closest match with its sub-tropical environments elsewhere. However,

given that it is quite widespread in northern Australia but is not reported south of Townsville, this climate match is not very close.

- Two *Ludwigia* spp. are naturalised in New Zealand. *L. palustris* is an aquatic herb first recorded in 1933, and is now found throughout the North Island and locally in Marlborough and Westland (Webb et al. 1988, Sykes 1982). In Australia it is found in Queensland, New South Wales and Victoria (AVH). *L. peploides* is also an aquatic herb. It is a weedy invasive in New Zealand and is listed on the National Pest Plant Accord. It was first recorded in 1933 and is abundant in Auckland and Waikato, and sparse in Northland and Manawatu (Webb et al. 1988, Sykes 1982). In Australia, it is also considered weedy, and is widely distributed in Queensland, New South Wales, Victoria, and in central areas (AVH).

4.2 History of spread in other countries

- *L. hyssopifolia* is an introduced invasive in Fiji, Guam and Western Samoa (PIER).

- The two species naturalised in New Zealand, *L. palustris* and *L. peploides*, were first recorded in 1933 – for their current distribution see section 4.1.2 above.

- *L. hyssopifolia* was collected once on Christmas Island in 1904. This plant produced copious amounts of seed but may have since disappeared due to a lack of sufficiently wet habitats. It is thought to have been imported as a contaminant with rice (Flora of Australia).

- Naturalised in Australia but no information found regarding the date of introduction or history of spread. The date of the first collection listed in the ANHSIR database is 1948, from the Northern Territory (ANHSIR).

4.3 Natural dispersal mechanisms and human assisted means of spread

4.3.1 Natural dispersal mechanisms

- In terrestrial habitats, it is probably gravity or wind dispersed.

- The seed can adhere to the feet and feathers of birds (Mabberley 1997, Flora of Australia), and in Australia, *L. peruviana* is dispersed by birds, particularly ducks, which enjoy eating the seed (Parsons & Cuthbertson 1992).

- No information was found regarding animal dispersal (internal or external), or if the seed survives passage through the gut.

- In aquatic habitats, the capsule decays, releasing the seeds which can float for about two weeks, then sink (Holm et al. 1997). However, germination probably occurs

only from seed that becomes stranded in relatively dry environments at the water edge as germination is completely inhibited by submergence.

4.3.2 Human dispersal

- Human mediated dispersal is likely via aquatic recreational activities, as well as transport of seeds in contaminated machinery, produce, soil, and stock feed.

4.4 Distribution of potential habitat in New Zealand

- Habitat in New Zealand would probably be wetter areas including ditches, swamps and other freshwater habitats, river edges, irrigated crops, moist gardens, wet pasture, wasteland and roadsides, and disturbed areas of natural vegetation. It is likely to be limited by climate to the northern North Island and to frost free coastal environments elsewhere.

4.5 Constraints to spread and predicted rate of spread in New Zealand

4.5.1 Predicted rate of spread

- Potentially a moderate to fast rate of spread from local infestations by natural seed dispersal (wind/gravity, water, and possibly avian or animal transport - external or internal).

- Could form widespread populations quickly via human vectors (e.g. aquatic recreation, and in contaminated soil, produce, seed, machinery, and stock feed).

4.5.2 Constraints to spread

- Likely to be limited by climate to the northern North Island and frost free coastal areas elsewhere. Competitiveness, growth rate and reproductive capacity may also be affected if climatic conditions are marginal.

- Host of the fungus *Pseudocercospora jussiaeae* in Fiji (Dingley et al. 1981). Additional pests and diseases were not fully assessed.

- No information found on palatability to mammalian browsers but *L. peploides* is suspected of poisoning stock in Australia (Auld & Medd 1987).

5.0 Consequences

5.1 Overseas impacts

5.1.1 Economic impacts

- Rice appears to be the most commonly and seriously affected crop, also maize, cotton, tobacco, vegetables, rubber, irrigated crops, sorghum, pineapple, taro and sugarcane (Waterhouse 1993, Holm et al. 1997).

- A serious weed of rice in India, Myanmar, Malaysia and Sri Lanka and a principal weed of rice in Indonesia, Thailand, Malaysia and Trinidad. It is a common weed of maize in India, and rubber in Thailand. It is listed as present but not important as a weed in many other countries in South East Asia (Waterhouse 1993, Holm et al. 1997).

- In the Pacific, it is ranked as an intermediate weed (commonly occurring and significantly affecting yield and profitability) in dryland crops, wetland crops, and plantations in the Cook Islands, Fiji and Palau. It is also a minor weed of pasture and wastelands in Western Samoa, American Samoa, Solomon Islands, Guam and Micronesia (Swarbrick 1997). Not listed in Waterhouse (1997).

- In Australia, its impacts appear to be minor. It is not listed in Groves et al. (2003) who ranked agricultural weeds at state and national level.

- It is reported to be a minor weed of pasture in the Pacific (PIER, Swarbrick 1997).

5.1.2 Environmental impacts

- It is a common weed of aquatic systems in Thailand and India (Holm et al. 1997). Its impacts were not described by those authors but other species (e.g. *L. peruviana* in Australia and elsewhere) are known to clog aquatic systems and waterways, impede drainage, and dominate native vegetation (ISSG).

- *L. hyssopifolia* does not appear to have actual or potential environmental impacts in Australia. It is not listed in Groves et al. (2003) who ranked environmental weeds nationally and by state, nor is it mentioned as a potential environmental weed by Csurches & Edwards (1998).

5.1.3 Other impacts

- None known.

5.2 Potential impacts in New Zealand

5.2.1 Economic

- It is likely to have low to moderate impacts as a weed of irrigated crops, and possibly in poor, or over-grazed, wet pasture. However, it is probably at the limits of its climatic tolerance in New Zealand and this is likely to reduce its growth and competitiveness. Impacts are only likely in warm, mesic areas of the northern North Island and frost free coastal areas elsewhere.

- The direct consequence to agriculture would be potential losses in crop yield. Indirect costs are those associated with increased herbicide use or manual weed control. These costs would be ongoing if *L. hyssopifolia* was to establish in New Zealand.

5.2.2 Environmental

- *L. hyssopifolia* has some potential to be an environmental weed in New Zealand. Impacts are likely to be similar to *L. peploides*, which can clog waterways, impede drainage, dominate native vegetation, and cause fish death due to oxygen depletion (Biosecurity New Zealand). It may also be problematic in moist (but non-aquatic) habitats such as forest clearings and other disturbed natural vegetation in humid areas.

- However, it is probably at the limits of its climatic tolerance in New Zealand and this is likely to reduce its growth and competitiveness. Impacts are only likely in warm, mesic areas of the northern North Island and frost free coastal areas elsewhere.

- Use of herbicides may further disturb natural environments and kill non-target species. Additional consequences would be the costs associated with ongoing surveillance, control and eradication.

5.2.3 Other impacts

- None.

6.0 Control techniques

- In New Zealand, *L. peploides* is considered difficult to control due to lack of effective methods and its aquatic habitat (Biosecurity New Zealand). Manual control is possible, taking as much of the root system as possible, and by starting at the top of the catchment and working downstream. Cleaning boats, trailers and

fishing gear can help prevent human spread. Small infestations can be covered with weed-mat for at least 4 months. Chemical control may be effective using glyphosate at 100ml/10 litres water (ARC).

- Grass carp reduced the cover of aquatic macrophytes, including *L. peploides* in drainage ditches in Waikato (Wells et al. 2003).

7.0 Uncertainty summary

- Potential New Zealand distribution is uncertain but it seems likely to be limited by climate to the northern North Island and frost free coastal areas elsewhere.

- If it was confirmed to be present, and problematic, in northern Europe and northern USA (see section 3.1) then the potential economic and environmental effects in New Zealand could be more serious and more widely distributed.

- Other constraints to spread - additional pests and diseases were not fully assessed.

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