

1.0 Organism description

Scientific name

Lindernia crustacea (L.) F.Muell., Scrophulariaceae.

Common names

Malaysian false pimpernel (USDA).

Synonyms (Randall 2002)

Capraria crustacea L.

Gratiola lucida Vahl

Mimulus javanicus Bl.

Pyxidaria crustacea (L.) Kuntze

Torenia crustacea (L.) Cham. & Schltl.

Torenia minuta Bl.

Vandellia bodinieri H.Lev.

Vandellia crustacea (L.) Benth.

Vandellia minuta Miq.

Cultivars, strains, or variants

None found.

Previously recorded in New Zealand

No (Ministry of Agriculture and Forestry, Landcare Research).

2.0 Summary

- Annual (sometimes perennial), mat forming herb up to 30 cm high. Stems decumbent, branching, usually rooting at lower nodes.
- Restricted to tropical or sub-tropical climates from India eastward to Australasia and Polynesia, also in tropical Africa and America.
- Preferred habitat is moist to wet disturbed areas; particularly rice fields, irrigated crops, riparian zones, grassland, lawns, roadsides and plantations.
- It grows both in the open and in the shade, and can form dense turf on bare ground if not disturbed.
- *L. crustacea* appears to be a weed of generally minor economic importance in the tropics and sub-tropics. It is listed as a weed of rice, tobacco and vegetables. No environmental impacts are known from overseas.

- In New Zealand, *L. crustacea* is likely to be restricted to coastal and lowland localities in the northern North Island, but may grow in warm micro-climates through the lower North Island to the top of the South Island.
- It is likely to have minimal economic impact as a minor weed of irrigated crops, nurseries and home gardens. Environmental impacts are unlikely. While its shade tolerance and mat-forming growth habit could be cause for concern, it is not particularly invasive, no environmental impacts are known from overseas, and it seems unlikely to establish in undisturbed areas.

3.0 Basic biology and ecology

3.1 Overseas distribution

- Pantropical; origin obscure. Tropical and sub-tropical Asia, from India eastward into Australasia and Polynesia, also in tropical Africa and America. Its presence in parts of the Pacific may be due to aboriginal introductions (PIER).
- Asia (tropical/sub-tropical); India, Sri Lanka, Nepal, Taiwan, China [Anhui, Fujian, Guangdong, Guangxi, Guizhou, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Sichuan, Xizang, Yunnan, Zhejiang], Philippines, Cambodia, Korea, Japan, Malaysia, Indonesia, Singapore, Thailand, Vietnam, Laos, Myanmar, and Papua New Guinea (PIER, eFlora).
- North America (tropical/sub-tropical); introduced to Florida, Georgia, South Carolina, North Carolina, Alabama, Mississippi, Arkansas and Louisiana (USDA).
- Central America and Caribbean (tropical); Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Jamaica, Puerto Rico, Leeward Islands and Trinidad (W³TROPICOS).
- South America (tropical/sub-tropical); Bolivia, Brazil, Colombia, Ecuador, French Guiana, Guyana, Peru, Suriname and Venezuela (W³TROPICOS).
- Africa (tropical); Central African Republic and Tanzania (PIER, W³TROPICOS).
- Australia (tropical/sub-tropical); introduced and naturalised. Common in north eastern Queensland from Cape York Peninsula to Brisbane. Local in West Australia (Wyndham and Broome) and Northern Territory (AVH, Hnatiuk 1990, Hussey et al. 2007).
- Pacific (tropical); Mariana Islands, Micronesia, Fiji, French Polynesia, Hawaii, Palau, Marshall Islands, Solomon Islands and Tonga (PIER).

3.2 Ecology/habitat

- Annual (sometimes perennial), mat forming herb. Stems decumbent, branching, usually rooting at lower nodes, up to 30cm high (PIER).
- Its preferred habitats are moist to wet disturbed areas; particularly rice fields, irrigated crops, along banks of rivers and creeks, swamp edges, damp grassland, lawns, forest clearings, roadsides and plantations (eFlora, PIER, ANHSIR).
- It grows in open places and in heavy shade (ANHSIR, FloraBase) and can form dense turf on bare ground if not disturbed (PIER). In crops, emergence and growth is probably best in irrigated situations (Yamamoto et al. 1981).
- Grows at altitudes of 0-1300m in China, 250-1800m in Nepal (eFlora), 150-1220m in Hawaii (PIER), 0-300m in Fiji, and from 0-2500m in Papua New Guinea (PIER).
- Propagation is by seed and vegetatively from lower nodes on the stems. The fruit is a non-fleshy, dehiscent capsule, containing small yellow-brown seeds, elliptic, tuberculate, approximately 0.5mm long (PIER).
- In China it flowers and fruits all year round (eFlora). In Australia, flowering generally occurs from March to April, or for most of the year in south-east Queensland (FloraBase).
- Very little information found relating to general ecological characteristics, and no specific references found on seed ecology or seed bank formation. However, in a seed bank study conducted in agricultural fields, *L. crustacea* seed was present at the highest density (1776 seeds/m²) and frequency (37.2%) of all the species detected. Its seed germinated over a three month period when incubated in 1cm of soil, at 74-92 % humidity and soil surface temperatures of 25-29.4° C (Kellman 1974).
- No information found on palatability to mammalian browsers. It has herbal or medicinal uses in Asia, and is not recorded as toxic (Randall 2002).

4.0 Likelihood of establishment and spread

4.1 Environmental tolerances overseas and comparison with New Zealand

4.1.1 Environmental tolerances overseas

- Restricted to tropical or sub-tropical climates with associated high humidity and warm temperatures.

- Australia (tropical/sub-tropical); the climate of northern Australia is characterised by hot humid summers and hot to mild winters. In this broad region, mean daily minimum temperature ranges from 12-24° C, average annual rainfall is 800-3200mm, rain days (>1mm) number 50-150 days per year, frost days range from 0-10 days per year and humidity is 60-90% (Bureau of Meteorology).

4.1.2 Comparison with New Zealand

- The closest match to its sub-tropical environment overseas are the warmer regions of Northland, Auckland and coastal Bay of Plenty where average annual rainfall (1200-1500mm), rain days (>1mm) per year (111-137 days), and humidity (78-86%) are comparable, although mean daily minimum temperatures (10-11.8° C) are lower, and ground frosts are more frequent (1- 42 days per year) (NIWA).
- In New Zealand, *L. crustacea* is likely to be restricted to coastal and lowland localities in the northern North Island, but may grow in warm micro-climates through the lower North Island to the top of the South Island.

4.2 History of spread in other countries

- Listed as introduced and invasive in Hawaii, Mariana Islands and French Polynesia (PIER).

4.3 Natural dispersal mechanisms and human assisted means of spread

4.3.1 Natural dispersal mechanisms

- No references specifically relating to the dispersal of this species were found.
- The seed appears to have no specialised means of dispersal. Short to moderate distance dispersal is probably wind/gravity assisted.
- Seeds may be carried on the exterior of animals (e.g. on pelts, or in mud on hooves etc).
- Internal transport by animals and birds is possible, although no information was found as to seed survival after passage through the gut.
- Water dispersal is possible, based on diaspore morphology (ePIC).

4.3.2 Human dispersal

- Human mediated dispersal is likely via transport of seeds in contaminated machinery, produce and soil.

4.4 Distribution of potential habitat in New Zealand

- Probably limited by climate to the northern North Island, with the possibility of growing in warmer areas further south, as far as the top of the South Island.
- Habitat in New Zealand is likely to be moist to wet disturbed areas; particularly irrigated crops, along banks of rivers and creeks, swamp edges, damp grassland, lawns, forest clearings and roadsides.

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

4.5.1 Predicted rate of spread

- No specific information found regarding reproductive capacity, seed ecology or seed bank formation.
- Moderate rate of spread by natural seed dispersal (wind/gravity, possibly water and animal external/internal) from local infestations.
- Could form widespread populations quickly via human vectors; seed in contaminated soil, produce and machinery.

4.5.2 Constraints to spread

- Climate is likely to limit its establishment and spread to warmer areas of the northern North Island.
- Host of the Bihar hairy caterpillar (*Diacrisia obliqua* Wlk.) (Satpathi 1999).

5.0 Consequences

5.1 Overseas impacts

5.1.1 Economic impacts

- *L. crustacea* appears to be a weed of generally minor importance in the tropics and sub-tropics. It is listed as a weed of rice, tobacco and vegetables (Waterhouse 1993).
- It is described as a serious weed in Trinidad; widespread and important in Malaysia and Singapore; and common but not seriously threatening to crops in China, Vietnam, Indonesia and Japan (Holm et al. 1979, Waterhouse 1993).

- No references were found citing economic impacts in Australia. It is not listed in Wilson et al. (1995), Auld & Medd (1987), or Parsons & Cuthbertson (1992).
- In the Pacific it is a minor weed, mostly in wetland crops such as rice and taro, where it has limited adverse effects. Waterhouse (1997) does not list it as a weed at all in the South Western Pacific. Swarbrick (1997) recorded it as a minor weed in Fiji, and as present but not weedy in the Solomon Islands, Tonga, Palau, Micronesia and Marshall Islands.

5.1.2 Environmental impacts

- In Australia, Groves et al. (2003) rank *L. crustacea* as a minor problem that does not warrant control at any location.
- Not listed as an environmental weed (Randall 2002).

5.1.3 Other impacts

- It is a localised lawn weed in Wyndham and Broome, Australia (Hussey et al. 2007).

5.2 Potential impacts in New Zealand

5.2.1 Economic

- It is only likely to be a minor weed of irrigated crops and nurseries, with negligible economic impacts. Unlikely to pose a problem in pastoral agriculture.

5.2.2 Environmental

- Environment impacts are unlikely. While its shade tolerance and mat-forming growth habit could be cause for concern, it is not particularly invasive, no environmental impacts are known from overseas, and it seems unlikely to establish in undisturbed areas.
- Any impact is likely to be restricted to disturbed, moist or wet areas such as wetlands, marshes, or swampy forest clearings in the northern North Island. It may jeopardise the naturalness of these environments, displace native species, prevent regeneration, or threaten local populations of rare or endangered plants.

5.2.3 Other impacts

- May be a nuisance weed in home gardens and lawns in warm, damp areas.
- Establishment in lawns and turf could affect amenity values.

6.0 Control techniques

- Limited information found on control techniques but there is nothing to indicate that it is problematic. Herbicides known to be available in New Zealand are underlined.
- Post emergence application of ioxynil + 2,4-D controlled a range of broadleaved weeds, including *L. crustacea*, in sugar cane (Cooke et al. 1969).
- Manual weeding; although its creeping habit and rooting at nodes may make this difficult.

7.0 Uncertainty summary

- Potential New Zealand distribution is uncertain but it seems likely to be limited by climate to the northern North Island.
- Unlikely to have any significant environmental impact but its shade tolerance and mat-forming growth habit gives cause for some uncertainty.

8.0 References

ANHSIR. Australian National Herbarium Specimen Information Register.
<http://www.cpbr.gov.au/cgi-bin/ahsir?040=lindernia+crustacea> (19 May 2008).

Auld, B.A. & Medd, R.W. 1987. Weeds; an illustrated botanical guide to the weeds of Australia. Inkata Press, Melbourne.

AVH. Australian Virtual Herbarium.
<http://www.anbg.gov.au/cgi-bin/avh.cgi> (12 May 2008).

Bureau of Meteorology. Australian Government Bureau of Meteorology
http://www.bom.gov.au/climate/averages/index.shtml?map_type=cdio&code=3 (14 April 2008).

Cooke, K., Parker, C.G. & Williams, D.J. 1969. Post emergence weed control experiments in sugar cane with formulations of asulam and ioxynil/2,4-D. *Proceedings of the West Indies Sugar Cane Conference* pp. 112-117.

ePIC. Royal Botanic Gardens, Kew. Online data for *Lindernia crustacea*.
<http://epic.kew.org/searchepic/summaryquery.do?searchAll=true&scientificName=Lindernia+crustacea> (5 May 2008).

eFlora. Online information for *Lindernia crustacea* in Flora of China. Volume 18: 32.
http://www.efloras.org/florataxon.aspx?flora_id=2&taxon_id=200020720 (5 May 2008).

FloraBase. Descriptions by the Western Australian Herbarium, Department of Environment and Conservation. <http://florabase.calm.wa.gov.au/> (5 May 2008).

Groves, R.H., Hosking, J.R., Batianoff, G.N., Cooke, D.A., Cowie, I.D., Johnson, R.W., Keighery, G.J., Lepschi, B.J. Mitchell, A.A., Moerkerk, M., Randall, R.P., Rozefelds, A.C., Walsh, N.G. & Waterhouse, B.M. 2003. Weed Categories for Natural and Agricultural Ecosystems Management. Department of Agriculture, Fisheries and Forestry, Australian Government.

Holm, L. G., J. V. Pancho, J. P. Herberger, and D. L. Plucknett. 1979. A Geographic Atlas of World Weeds. John Wiley & Sons, New York.

Hnatiuk, R.J. 1990. Census of Australian Vascular Plants. Australian Flora and Fauna Series Number 11. Australian Government Publishing Service, Canberra.

Hussey, B.M.J., Keighery, G.J., Dodd, J., Lloyd, S.G. & Cousens, R.D. 2007. Western Weeds. A guide to the weeds of Western Australia. Second edition. The Weeds Society of Western Australia, Western Australia.

Kellman, M. C. 1974. The viable weed seed content of some tropical agricultural soils. *The Journal of Applied Ecology* 11(2): 669-677.

Landcare Research. Flora of New Zealand online search page. Taxon search.
<http://floraseries.landcareresearch.co.nz/pages/Search.aspx> (2 May 2008).

Ministry of Agriculture and Forestry, New Zealand.
Plants Biosecurity Index (version 1.6.0)
<http://www1.maf.govt.nz/cgi-bin/bioindex/bioindex.pl> (2 May 2008).

NIWA. National Institute of Water and Atmospheric Research. Crown Research Institute, New Zealand. <http://www.niwa.cri.nz/edu/resources/climate> (17 April 2008).

Parsons, W.T. & Cuthbertson, E.G. 1992. Noxious Weeds of Australia. Inkata Press, Melbourne.

PIER. Pacific Island Ecosystems at Risk.

http://www.hear.org/pier/species/lindernia_crustacea.htm

Randall, R.P. 2002. A Global Compendium of Weeds. Shannon Books, Australia.

Satpathi, C.R. 1999. Weeds as hosts of Bihar hairy caterpillar (*Diacrisia obliqua* Wlk.). *Insect Environment* 5(3): 122.

Swarbrick, J.T. 1997. Weeds of the Pacific Islands. Technical Paper No. 209. South Pacific Commission, New Caledonia.

USDA. United States Department of Agriculture. ARS, National Genetic Resources Program. Germplasm Resources Information Network - (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland.
http://www.ars-grin.gov/cgi-bin/npgs/html/tax_search.pl?Lindernia%20crustacea (18 May 2008).

W³TROPICOS. Nomenclature and Specimen Database of the Missouri Botanical Garden.
http://mobot.mobot.org/cgi-bin/search_pick?name=Lindernia+crustacea 1(8 May 2008).

Waterhouse, D.F. 1993. The Major Arthropod Pests and Weeds of Agriculture in Southeast Asia. Australian Centre for International Agricultural Research, Canberra.

Waterhouse, D.F. 1997. The Major Invertebrate Pests and Weeds of Agriculture and Plantation Forestry in the Southern and Western Pacific. Australian Centre for International Agricultural Research, Canberra.

Wilson, B.J., Hawton, D. & Duff, A.A. 1995. Crop Weeds of Northern Australia. Department of Primary Industries, Brisbane, Queensland.

Yamamoto, H., Iwata, I. & Ohba, T. 1981. Studies on ecological changes and control of weeds in upland irrigation culture. V. Changes in weed vegetation and competition between upland-rice and weeds in upland irrigation culture. *Weed Research* 26(4): 286-290.