1.0 Organism description

Scientific name
Eclipta prostrata (L.) L., Asteraceae.

Common names
Yerba de Tajo, false daisy, tattoo plant, white eclipta

Synonyms (USDA)
Eclipta alba (L.) Hassk.
Eclipta erecta (L.)
Eclipta punctata (L.)
Verbesina alba (L.)
Verbesina prostrata (L.)

Cultivars, strains, or variants

- *E. prostrata* var. *dixtii* (Singh et al. 2005). Ecotypic differentiation shown in the Philippines (Lee & Moody 1989).

Previously recorded in New Zealand

- Entry prohibited in Plants Biodiversity Index (Ministry of Agriculture and Forestry).

- Recorded in northern New Zealand by Hooker in 1855 but no specimen was found and its presence was rejected (Webb 1987).

2.0 Summary

- *E. prostrata* is a prostrate or erect, annual or perennial, herb up to 90cm tall.

- It is widely distributed, tending to remain in the tropics and sub-tropics, but is found also in temperate regions (particularly North America and Canada).

- In New Zealand it is most likely to establish in the northern North Island, but has the potential to grow as far south as Marlborough and Canterbury in the South Island.

- Propagation is by seed and it can spread from node-rooting stems in favourable habitats. It has a high reproductive capacity and can re-seed itself to form colonies at favourable sites.

- *E. prostrata* is adaptable to changing environmental conditions. Favoured habitats are poorly drained areas such as along streams, in ditches, marshes, wetlands and on dikes of rice paddies, but it is also common in lawns, pasture, waste areas, and crops. Also found in open areas of forest and estuaries.

- Overseas, it is reported to be a troublesome, rather than serious, weed in a variety of crops. Also noted to be a minor problem in wet pasture. No references found citing *E. prostrata* as an environmental weed overseas.

- In New Zealand, it may be moderately problematic as a weed of crops in the North Island, and possibly as far south as Marlborough and Canterbury - particularly under irrigation. It also has potential to be a nuisance in nurseries and glass houses, and a minor problem in pastoral agriculture.

- The risk *E. prostrata* poses to the environment is uncertain, but is likely to be low. Its growth habit is not a major concern, and it is not reported as an environmental weed overseas. Impacts, if any, would probably be in wetland and riparian habitats, and possibly estuaries.

- Its low growing, open branching, structure would allow it to persist in lawns and amenity areas.

3.0 Basic biology and ecology

3.1 Overseas distribution

- Worldwide; tending to remain in the tropics and sub-tropics, but found also in temperate regions (Holm et al. 1977). North America, Canada, Mexico, Central and South America, West Indies, Africa, Europe [Portugal], India, China, Japan, South East Asia, Pacific Islands and Australia (Holm et al. 1977, Flora of North America).

- North America/Canada; found in all the southern states, as well as central North America (Oklahoma, Kansas, Nebraska, South Dakota), and as far north as Michigan and Ontario. Possibly native to North America but considered weedy in Oklahoma, Kentucky and other parts of the north east (USDA). In other areas of the USA it is considered endangered/threatened (USDA).

- Pacific; Hawaii, Micronesia, Fiji, French Polynesia, Guam, Japan, Marshall Islands, New Caledonia, Niue and Palau (PIER).

- Australia; found in the far north [Darwin and Northern Territory] and from Cairns as far as southern New South Wales. Also recorded in Western Australia near Broome and Perth. Most records are within 200km of the coast, but it has also been collected 500km inland in southern Queensland, close to the New South Wales border (AVH).

3.2 Ecology/habitat

- Annual or perennial herbaceous plants, prostrate or erect, growing to a height of about 90cm (Holm et al. 1977). Can spread by node rooting from stems and re-seeds itself to form colonies at favourable sites. Growth rate described as moderate (USDA).

- The specimen grown in New Zealand was low growing and the seed heads tended to shatter, dropping all their seed at once. It required a relatively short period to reproductive maturity (James pers. comm.).

- Favoured habitats are poorly drained areas such as along streams, in ditches, marshes, wetlands and on dikes of rice paddies. It is also common in lawns, pasture, waste areas, and crops and can grow in open areas of forest and in estuaries (Holm et al. 1977).

- Adaptable to changing environmental conditions. It is most troublesome in warm, low-lying areas with high rainfall but it can also tolerate saline conditions, higher altitudes and drier sites (Holm et al. 1977). *E. prostrata* prefers full or partial sun and tolerates both fine and coarse-textured soils. It has low fertility requirements, high anaerobic tolerance, and low drought tolerance. (USDA).

- Propagation is by seed, which may be produced prolifically. Individual plants are known to produce 17000 seeds. Fruits are a brown achene, 1.5-3mm long. The pappus is not prominent or absent altogether, or sometimes a minute ring of teeth. Seed spread rate recorded as rapid (USDA) but no information given on dispersal mechanisms.

- Seed persistence is reportedly less than a year (USDA, Gupta 1992). However, in more temperate conditions the seed may dry out and persist for longer in the environment.

- Seeds require light and temperatures of 10-35° C to germinate, with better germination at higher temperatures (Altom & Murray 1996). Emergence did not occur at soil depths >2.0cm (Wu et al. 2003) and germination increased with soil moisture content (Gupta 1992).

- Not considered toxic to humans or mammalian browsers. Used medicinally and as a pot herb. Medium palatability to browsers (USDA).

4.0 Likelihood of establishment and spread

4.1 Environmental tolerances overseas and comparison with New Zealand

4.1.1 Environmental tolerances overseas

- Found mostly in New World and Old World tropical/sub-tropical areas with associated high humidity and warm temperatures but extending into continental areas with cooler winters.

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

- Australia (sub-tropical/temperate); the southern limit in Australia is currently about the latitude of Sydney (with one outlier recorded near the border of Victoria). This is in the 'warm summer/cool winter zone'; mean annual minimum temperature 13.6° C, mean annual rainfall 1000-1200mm, rain days (>1mm) 75-100 per year, 70-80% humidity and 0-10 frost days per year (Bureau of Meteorology).

- Australia (arid); *E. prostrata* is also recorded in south Queensland, close to the New South Wales border but approximately 500km inland (AVH). This is in the 'hot, dry with cold winter' climatic zone with mean annual rainfall of 400-600mm, 30-50 rain days (>1mm) per year, 12-15° C mean daily minimum temperature, 10-50 days of frost and 50-60% humidity (Bureau of Meteorology).

- North America (temperate); *E. prostrata* grows as far north as Michigan and Ontario – where the climate is described as 'humid continental'. These regions have hot summers and cold winters with frequent snow. Average January minimum temperatures are generally below 0° C, average July maximum temperatures range from 25-28.5° C and mean annual rainfall is approximately 800mm (World Climate).

4.1.2 Comparison with New Zealand

- New Zealand; *E. prostrata* is most likely to grow in the warmer regions of Northland, Auckland and coastal Bay of Plenty where average annual rainfall (1200-1500mm), rain days (>1mm) per year (111-137) and humidity (78-86%) are comparable, although mean daily minimum temperatures (10-11.8° C) are lower, and ground frosts more frequent (1-42 days per year) (NIWA). However, its distribution overseas, particularly in North America and Canada, indicates that it has the potential to establish and grow in cooler areas, particularly those with adequate rainfall or under irrigation. It may extend to Gisborne and Hawkes Bay, and possibly Marlborough and Canterbury.

4.2 History of spread in other countries

- Listed as introduced and invasive in Australia [Queensland], Micronesia, Fiji, French Polynesia, Guam, Hawaii, Marshall Islands, New Caledonia, Niue, Palau, Colombia, Mexico, Peru and Chagos Archipelago (PIER).

- In Australia, Auld & Medd (1987) gave its distribution as primarily north eastern New South Wales, Queensland and Northern Territory. However, current herbarium records show it extending to Sydney, with one outlying record near the border with Victoria, and one record near Perth (AVH).

- In a survey of weeds in lawns and turf in Guangzhou, China, *E. prostrata* infestations were noted to have become heavier from 1995-2003. Control measures (herbicides, manual weeding and integrated weed management) were recommended (Lin et al. 2004).

4.3 Natural dispersal mechanisms and human assisted means of spread

4.3.1 Natural dispersal mechanisms

- No specific references found on natural dispersal mechanisms.

- Seed spread rate described as rapid in North America (USDA).

- Wind or gravity dispersal is likely over short to medium rather than very long distances as the seeds are relatively large and the pappus is reduced or absent.

- Water dispersal is possible given its riparian habitats, although no information was found regarding this.

- Animal dispersal (internal/external) is possible.

4.3.2 Human dispersal mechanisms

- Human assisted dispersal is likely. Seeds could be transported with commodities, contaminated soil and machinery (although its low growing habit and tendency to drop all its seed at once may make the latter less likely).

4.4 Distribution of potential habitat in New Zealand

- Potential habitats in New Zealand are crops, poorly drained fresh-water habitats such as marshes, swamps, wetlands, streams, ditches and other riparian zones.

- Secondary habitats may include salt water estuaries, lawns, pasture, open areas of forest, and waste areas.

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

4.5.1 Predicted rate of spread

- Moderate to fast rate of spread by natural seed dispersal from local infestations. Could also form widespread populations quickly via human-assisted dispersal in contaminated produce and machinery.

- Slow to moderate rate of vegetative spread in favourable habitats via node-rooting stems (USDA).

4.5.2 Constraints to spread

- *E. prostrata* is a host for Tomato leaf-curl New Delhi virus in Pakistan (Haider et al. 2006), cucumber mosaic virus in India (Tewari & Tripathi 2003) and is attacked by the nematodes *Heterodera zeae* (corn cyst nematode) and *Meloidogyne incognita* (Holm et al. 1977, Parihar et al. 1991).

- The foliage is moderately palatable to mammalian browsers (USDA).

- The leaves contain nicotine which is an insecticide (USDA).

5.0 Consequences

5.1 Overseas impacts

5.1.1 Economic impacts

- Reported to be a troublesome, rather than serious, weed of 17 crops in 35 countries across the world. Common crops affected are sugarcane, flax, corn, rice, upland rice, taro, papayas, bananas, peanuts, soybeans, barley and vegetables (Holm et al. 1977, PIER). Waterhouse (1993) describes it as very widespread/very important in Malaysia and widespread/important in Thailand, Vietnam, Singapore and the Philippines.

- It is listed as a minor weed in dryland and wetland crops, gardens and wastelands in much of the Pacific (Swarbrick 1997).

- The direct impact on crops and nursery plants is reduced growth and yield through competition for light, water and nutrients. For example, *E. prostrata*, along with several other weeds, significantly affected yields of barley (Mamun et al. 1986).

- *E. prostrata* was noted to be a minor problem in wet pasture but no information found on economic consequences in this context (PIER, Holm et al. 1977). May compete with, or displace, forage grasses.

5.1.2 Environmental impacts

- No references found citing *E. prostrata* as an environmental weed.

5.1.3 Other impacts

- A weed of lawns and turf, presumably impacting on amenity values.

- A nuisance weed in nurseries and glasshouses (Judge et al. 2004).

5.2 Potential impacts in New Zealand

5.2.1 Economic

- Its possible late germination and fast maturity could make it a problem weed in more open crops of Northland, Auckland, Bay of Plenty, Poverty Bay, Hawkes Bay, and potentially Marlborough and Canterbury - particularly under irrigation. It also has potential to be a nuisance in nurseries and glass houses.

- The direct consequence to agriculture could be potential losses in yield. Indirect costs are those associated with increased herbicide use or manual weed control, although it appears likely to be readily controlled by existing practises.

- Could be a minor problem in pastoral agriculture as it is only partially palatable to browsers. However, it would probably be restricted to drought free areas and/or wetter habitats.

5.2.2 Environmental

- The risk *E. prostrata* poses to the environment in New Zealand is uncertain, but is likely to be low. Its growth habit is not a major concern, and it is not reported as an environmental weed overseas. Impacts, if any, would probably be in wetland and riparian habitats, and possibly estuaries.

- It may jeopardise the naturalness of these habitats and could displace native species or threaten local populations of rare or endangered plants.

- Control measures (herbicide use/manual weeding) could further disturb natural environments and kill non-target species.

5.2.3 Other impacts

- Its low growing, open branching, structure would allow it to persist in lawns and amenity areas.

6.0 Control techniques

- An acceptable range of control techniques exist. Herbicides known to be available in New Zealand are underlined.

- Escort is likely to be effective (James pers. comm.).

- Post-applications of diclosulam controlled *E. prostrata* less than 80% (Lancaster et al. 2007). Triclopyr, bensulfuron, ethoxysulfuron and 2,4-D (ester) applied 21 days after seeding increased rice yields by controlling *E. prostrata* and other broadleaved weeds in India (Singh et al. 2006).

- In nurseries, Gallery (isoxaben), Surflan (oryzalin) and Treflan were used to control common nursery weeds, including *E. prostrata* (Judge et al. 2004).

- Control of *E. prostrata* in water-ways may require specialised chemicals or manual control.

7.0 Uncertainty summary

- Potential New Zealand distribution is uncertain. Overseas, it is widely distributed through the tropics and sub-tropics, extending also to temperate regions. In New Zealand it seems likely to establish in the northern North Island, with a reasonable probability of growing as far south as Marlborough and Canterbury in the South Island.

- Lack of information on environmental impacts overseas and uncertainty as to the risk it poses to the environment and specific habitats in New Zealand.

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