

1.0 Organism description

Scientific name

Kyllinga nemoralis (J.R.Forst. & G.Forst) Dandy ex Hutch. & Dalziel, Cyperaceae.

Common names

Whitehead spikesedge, white kyllinga, white water sedge, white-flowered kyllinga, poverty grass (PIER).

Synonyms (PIER)

Cyperus kyllingia Endl.

Kyllinga monocephala Rottb.

Kyllinga cephalotes (Jacq.)

Cultivars, strains, or variants

None found.

Previously recorded in New Zealand

Yes - Kermadec Island only (Sykes & West 1996). Entry prohibited on MAF Plant Biosecurity Index (Ministry of Agriculture and Forestry).

2.0 Summary

- A perennial, mat forming, sedge, growing up to 50cm high, propagated by seed and a creeping rhizome.
- Pantropical distribution, restricted to tropical and sub-tropical regions. In New Zealand, it is only likely to establish in the northern North Island, if at all, with a small probability of growing in warm micro-climates further south.
- The family Cyperaceae contains a number of genera/species that are major weeds both overseas and in New Zealand, and are often difficult to control. A related plant, *Kyllinga polyphylla*, is a major weed of improved pastures in the Pacific.
- It prefers moist, fertile soil and full sun, and grows in crops, gardens, lawns, pasture, plantations and roadsides. It is listed as a facultative wetland plant and probably has limited tolerance for dry conditions.
- Economic impacts of *K. nemoralis* overseas are low to moderate, and are restricted to tropical regions. Wetland crops such as rice and taro are most affected – also dryland crops, nurseries, pastures and lawns. No environmental impacts overseas are known.

- In New Zealand, potential economic impacts are likely to be negligible. Its behaviour under cultivation in New Zealand suggests it is unlikely to be competitive in pasture, crops or the environment. Impacts, if any, would probably be limited to the northern North Island.

3.0 Basic biology and ecology

3.1 Overseas distribution

- Pantropical; common in South East Asia and Malesia, less so in Africa, Madagascar and Australia, and scarce in the New World (Flora of Australia). Probable origin is the Old World tropics (PIER).
- Africa (tropical/sub-tropical); Benin, Ghana, Guinea, Ivory Coast, Liberia, Nigeria, Togo, Cameroon, Congo, Gabon, Socotra, Kenya, Tanzania, Uganda, Mozambique, Natal and South Africa (Royal Botanic Gardens).
- Asia (tropical/sub-tropical); Philippines, Indonesia, Malaysia, Brunei, Singapore, Japan [Kazan-retto, Ryukyu], Taiwan, Thailand, Borneo, Sulawesi, China [south central and south east], Vietnam, India [east/west Himalaya and Assam], Nepal, Sri Lanka, Pakistan and Cambodia (PIER, Holm et al. 1979, Royal Botanic Gardens).
- Indian Ocean (tropical); Comoros, Madagascar, Reunion, Seychelles, Mauritius, Chagos, Andaman Islands (Royal Botanic Gardens, PIER, Holm et al. 1979).
- Central and South America (tropical); relatively scarce in tropical America. Costa Rica, Suriname and Brazil (Royal Botanic Gardens, Holm et al. 1979).
- Caribbean (tropical); Jamaica, Puerto Rico, Leeward Islands, Windward Islands, Trinidad and Tobago (Royal Botanic Gardens, Holm et al. 1979).
- Pacific (tropical); Hawaii, Fiji, New Guinea, French Polynesia, Guam, Cook Islands, Micronesia, Kiribati Islands, Marshall Islands, Norfolk, New Caledonia, Niue, Palau, Pitcairn, Solomon Islands, Vanuatu, Samoa and Tonga, (PIER, Holm et al. 1979, Royal Botanic Gardens, Waterhouse 1997).
- Australia (tropical); north eastern Queensland - mostly around Cairns with scattered records near Brisbane and Darwin. An introduced invasive on Christmas Island (AVH, Hnatiuk 1990, PIER). Frequent along roadsides especially in the east and also in lawns and grassy areas (Flora of Australia).
- New Zealand (sub-tropical); Kermadec Island (Sykes & West 1996).

3.2 Ecology/habitat

- A perennial, mat forming, sedge, growing up to 50cm high, and spreading by means of a creeping rhizome (PIER). The rhizomes and roots contain allelopathic oils that may contribute to its weediness (Komai & Tang 1989).
- Propagation is by rhizomes, and seed. The fruit is an achene, approximately 1.2-1.5mm long x 0.5-0.7mm wide (PIER).
- It prefers moist, fertile soil and full sunshine. It occurs in crops, gardens, lawns, pasture, plantations and roadsides (Whistler 1995, PIER). It is listed as a facultative wetland plant in Hawaii i.e. equally likely to occur in wetland or non-wetland environments (USDA). However, it probably has limited tolerance for dry conditions. Under greenhouse trials, the growth, productivity, and reproduction of *K. nemoralis* was greatly reduced by drought, and best in soils with moisture at field capacity (Rodiati et al. 2005).
- It can grow at relatively high altitudes – up to 850m in the Pacific and has been collected at 750m in Queensland (Whistler 1995, ANHSIR).
- The specimen grown in New Zealand flowered and formed seed heads but they generally failed to mature before temperatures dropped and day length shortened (James pers. comm.).
- In overseas studies, under greenhouse conditions, the first flower head emerged 10-11 weeks after sowing and mature seeds were obtained three weeks later. Seeds did not require after-ripening for successful germination, and viability remained high during storage (Sumaryono 1986).
- In the tropics, it can be competitive with other grass species and is sometimes aggressive in lawns, turf and pasture (Kawabata et al. 1994). A related species *K. polyphylla*, is a major weed of improved pastures, but can be suppressed by competition from vigorous, well managed grasses (Swarbrick 1997).
- Not recorded as toxic. Palatability to mammalian browsers unknown but a related species, *K. polyphylla* is relatively unpalatable (Swarbrick 1997, Randall 2002).
- The root is claimed to have medicinal uses (Flora of Australia).

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 mainland 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, it is only likely to establish in the northern North Island, if at all, with a small probability of growing in warm micro-climates further south.

4.2 History of spread in other countries

- An ancient introduction to the Pacific as far east as Tahiti, and a European introduction to Hawaii (Whistler 1995).
- First recorded on the Kermadec Islands in 1966/1967 in Denham Bay. By 1996 it had reduced in abundance, probably due to increased density of the understorey vegetation (Sykes & West 1996).
- Listed as an introduced invasive in parts of Samoa, Mariana Islands, Cook Islands, Fiji, French Polynesia, Hawaii, Kiribati Islands, Marshall Islands, Niue, Palau, Tonga and Christmas Island (PIER).

4.3 Natural dispersal mechanisms and human assisted means of spread

4.3.1 Natural dispersal mechanisms

- No references specifically dealing with the dispersal of this species were found. Short to medium distance dispersal is probably achieved by a variety of means.
- *K. nemoralis* is probably dispersed passively by wind or gravity.
- Seeds may be carried on the exterior of animals (e.g. on pelts, or in mud on hooves etc) and internal transport by animals and birds is possible.
- Other possibilities for dispersal include water, and by fragmentation and transport of the rhizome.

4.3.2 Human dispersal

- Human mediated dispersal is likely via transport of seeds or rhizome fragments in contaminated machinery, produce, soil, and stock feed.

4.4 Distribution of potential habitat in New Zealand

- Probably limited by climate to the northern North Island. It is unlikely to spread or establish in cooler areas further south.
- Primary habitats in New Zealand are wet, fertile sunny sites in crops, gardens, lawns, pasture, plantations and roadsides. It may also establish in marshes, ditches, and swampy forest clearings.

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

4.5.1 Predicted rate of spread

- Moderate rate of spread from local infestations by natural seed dispersal (wind/gravity, possibly water and animal external/internal).
- Slow rate of spread from the creeping rhizomes.
- Could form widespread populations quickly via human vectors; seed or rhizome fragments in contaminated soil, produce, machinery, and stock feed.

4.5.2 Constraints to spread

- Being a true tropical species it is likely to be limited by climate to the northern North Island.
- *K. nemoralis* is a preferred host of *Hieroglyphus banian*, a major agricultural pest in rice paddies in the tropics (Amlan et al. 2002).
- It may be suppressed by competition from vigorous, well managed grasses, and is probably shade intolerant.
- Palatability to mammalian browsers is unknown but it is unlikely to be a preferred forage species.

5.0 Consequences

5.1 Overseas impacts

5.1.1 Economic impacts

- Economic impacts are generally low (occasionally moderate), and are restricted to tropical regions. Industries most affected are wetland crops such as rice and taro, and dryland crops e.g. vegetables. Plantations, orchards, nurseries, gardens, pasture and lawns are less affected.
- In Asia it is recorded nowhere as a serious weed; a principal weed in the Philippines; widespread and important in Vietnam and Malaysia; locally important in Singapore; present but not important in Thailand, Laos, Brunei, Cambodia and Indonesia; present but rank as a weed unknown in Borneo and India (Holm et al. 1979, Waterhouse 1993).
- In continental Australia it is not ranked as an agricultural weed (Holm et al 1979). However, on Christmas Island it is a major weed of improved pastures, and also occurs in crops, gardens, plantations and roadsides (PIER).
- In the Pacific it is generally an unimportant, or minor, weed of wetland crops, plantations, orchards, pasture, lawns, wasteland and roadsides. It assumes intermediate importance in ornamental/vegetable gardens, and nurseries (Swarbrick 1997).
- Listed as present but not important in Fiji, Guam, Samoa and Tonga; and has intermediate importance Western Samoa, French Polynesia and Micronesia (Swarbrick 1997, Waterhouse 1997).

- A related plant, *Kyllinga polyphylla*, is a major weed of improved pastures in the Pacific, but is considered unlikely to be a weed in areas with dry soils (Swarbrick 1997).

5.1.2 Environmental impacts

- No environmental impacts known. Not listed as an environmental weed (Randall 2002). Not among the species prioritised for control on Raoul Island (West 1996).

5.1.3 Other impacts

- A minor weed in home gardens.
- Minor impacts in amenity areas.

5.2 Potential impacts in New Zealand

5.2.1 Economic

- Potential economic impacts are likely to be negligible. Its behaviour under cultivation in New Zealand suggests it is unlikely to be competitive. It may be a minor weed in irrigated crops and nurseries but impacts, if any, would probably be limited to the northern North Island. It is unlikely to be competitive with New Zealand pasture species.

5.2.2 Environmental

- Environmental impacts are also unlikely. While its potential to form dense mats is a concern, it prefers growing in full sun, seems unlikely to invade undisturbed areas, and is not known to have any environmental impacts overseas. Furthermore, it appears unlikely to be competitive in New Zealand.
- Impacts, if any, would probably be restricted to disturbed, moist or wet areas such as wetlands, marshes, or swampy forest clearings in the northern North Island.

5.2.3 Other impacts

- May be a nuisance weed in home gardens in warm areas.

6.0 Control techniques

- May be difficult to control as related species are known to have some tolerance to herbicides. Herbicides known to be available in New Zealand are underlined.
- Competition from vigorous, healthy pasture grasses may suppress it.
- Sedges are generally susceptible to 2,2-DPA (Parsons & Cuthbertson 1992).
- Not susceptible to pre-emergent applications of alachlor + chloramben or fluometuron, and atrazine + metolachlor (Melifonwu & Orkwor 1990).
- Hand weeding; however manual cultivation may spread the rhizomes and the rhizomes may be difficult to remove completely.

7.0 Uncertainty summary

- Potential distribution and economic/environmental impact is uncertain but it seems unlikely to be competitive in New Zealand. If it did establish it would probably be limited by climate to the northern North Island.

8.0 References

Amlan, D., Sarasi, D. & Parimalendu, H. 2002. Effect of food plants on the growth rate and survivability of *Hieroglyphus banyan* (Fabricius) (Orthoptera: Acridoidea), a major paddy pest in India. *Applied Entomology and Zoology* 37(1): 207-212.

ANHSIR. Australian National Herbarium Specimen Information Register.
<http://www.cpbr.gov.au/cgi-bin/ahsir?040=cyperus%20kyllingia> (13 May 2008).

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).

Flora of Australia. Online data derived from Flora of Australia volume 50 (1993).
<http://www.anbg.gov.au/abrs/online-resources/flora/redirect.jsp> (16 May 2008).

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

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.

James, Trevor. Personal communication. Weed Scientist, AgResearch, New Zealand.

Kawabata, O., Nishimoto, R.K. & Tang, C.S. 1994. Interference of two *Kyllinga* species (*Kyllinga nemoralis* and *Kyllinga brevifolia*) on bermuda grass (*Cynodon dactylon*) growth. *Weed Technology* 8(1): 83-86.

Komai, K. & Tang, C.S. 1989. Chemical constituents and inhibitory activities of essential oils from *Cyperus brevifolius* and *C. kyllingia*. *Journal of Chemical Ecology* 15(8): 2171-2176.

Melifonwu, A.A. & Orkwor, G.C. 1990. Chemical weed control in ginger (*Zingiber officinale*) production from minisets. *Nigerian Journal of Weed Science* 3:43-50.

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/kyllinga_nemoralis.htm (16 May 2008).

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

Rodiyati, A., Arisoelaningsih, E., Isagi, Y. & Nakagoshi, N. 2005. Responses of *Cyperus brevifolius* (Rottb.) Hassk. and *Cyperus kyllingia* Endl. to varying soil water availability. *Environmental and Experimental Botany* 53(3): 259-269.

Royal Botanic Gardens. World Checklist of Monocotyledons. Kew on-line database.

http://apps.kew.org/wcsp/namedetail.do?accepted_id=251375&repSynonym_id=268424&name_id=251375&status=true&checklist=monocots (14 May 2008).

Sumaryono, B. 1986. Growth and reproduction of *Cyperus kyllingia* Endl. and *Cyperus brevifolius* (Rottb.) Hassk. *Biotropia special publication* 24: 137-143.

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

Sykes, W, R, & West, C. J. 1996. New records and other information on the vascular flora of the Kermadec Islands. *New Zealand Journal of Botany* 34: 447-462.

USDA. 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?Kyllinga%20nemoralis (14 May 2008).

West, C.J. 1996. Assessment of the weed control programme on Raoul Island, Kermadec Group. Science and Research Series No.98. Department of Conservation, Wellington.
Whistler, W.A. 1995. Wayside plants of the Islands. Isle Botanica, Honolulu.

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.