Department of **Agriculture and Fisheries**
Biosecurity Queensland

Invasive plant risk assessment

St John's wort

Hypericum perforatum

Steve Csurhes and Dr Yuchan Zhou

First published 2008
Updated 2016

Queensland Government

Contents

Summary

St John's wort (*Hypericum perforatum*) is a weed of agriculture and natural areas in more than 20 countries. It was a significant pest in North America, where it had infested more than 2 million hectares by 1940, prior to being brought under control by Chrysolina beetles. In Australia, it has been declared noxious in the Australian Capital Territory, New South Wales, Victoria, Western Australia and Tasmania. Animal production losses on pastures infested with St John's wort in New South Wales have been estimated at $22.5 million per annum (Bourke 1997).

The leaves and flowers contain hypericin, which causes photo-sensitisation when ingested by grazing animals, resulting in health problems, production losses and death. While its negative impacts are substantial, it continues to be promoted and sold for its perceived horticultural and medicinal values.

St John's wort is native to Europe, western Asia and North Africa. It is highly adaptable and invades a range of habitats including open forest, woodland, rangeland and prairie communities. Climatically, H. perforatum is adapted to temperate areas. Currently, it exists as very small populations near Stanthorpe and Toowoomba. However, it has the potential to become more widespread and abundant in cooler, upland areas of southern Queensland (Stanthorpe/Warwick area north to Toowoomba). Over the past 25 years, its population expansion in Queensland has been greatly reduced by an annual control program.

Identity and taxonomy

Species: *Hypericum perforatum*

Common names: St John's Wort, perforate St John's wort, common St John's wort, klamath weed, hypericum, goat weed

Synonyms: *Hypericum officinale* (Gater), *H. perforatum* var. *perforatum, H. perforatum* var. *angustifolium, H. perforatum* var. *microphyllum, H. perforatum* var. *veronense, H. veronense, H. vulgare* (Bauhin) (GISD 2007)

Family: Clusiaceae (previously also in Hypericaceae).

The family Clusiaceae comprises about 50 genera and 1200 species. The genus *Hypericum* has about 450 species. Species vary from annual or perennial herbs to shrubs and trees in all temperate areas of the world (Robson 2003). Their leaves are arranged in opposite pairs along the stems and can be either deciduous or evergreen. Flowers are pale to dark yellow, with five (rarely four) petals. The fruit is usually a dry capsule, which splits to release numerous small seeds. In some species, the fruits are fleshy and berry-like. Plants of this genus have been transported and cultivated worldwide. Some species have subsequently become invasive. The most abundant species in Australia are St John's wort (*Hypericum perforatum*) and tutsan (*H. androsaemum*) (Groves 1997).

All members of the genus may be referred to as St John's worts, though they are also commonly called hypericums.

Description

St John's wort is a perennial, rhizomatous herb with two growth stages: (1) in autumn and winter it grows as a flat, low rosette with spindly stems and a dense mat of leaves; and (2) in spring and summer it adopts an erect, twiggy form with one or more woody stems 30–120 cm tall. Stems have two opposite longitudinal ridges. Its roots can penetrate the soil to a depth of 1 m. Shallow rhizomes produce new aerial growth each year. Leaves are opposite, ovate to oblong or linear in shape; dotted with tiny translucent, black oil glands that are visible when held against light.

Hypericin, a red pigment concentrated in the black oil glands, is toxic to livestock when consumed in quantity. Flowers are bright yellow, 1–2 cm in diameter, with five petals and black glands on the margins (Figure 1). Flowers have narrow sepals that are much smaller than the petals and numerous stamens fused at the base into three bundles.

Fruits are sticky three-chambered capsules, containing densely pitted seeds about 1 mm long (Briese *et al.* 2000).

Figure 1. Flowers of St John's wort

St John's wort is an auto-tetraploid (due to doubling of the chromosomes of a single parent species rather than to hybridisation) and occasionally hybridises with its diploid sister species, *H. maculatum* (Compendium Botanicum 2008).

Several varieties and hybrids of St John's wort were identified in Europe (Europaea 2005). These included var. *perforatum* with broad leaves and var. *angustifolium* with narrow leaves, and also a smaller variety, var. *microphyllum* (Campbell *et al.* 1997).

Related species

Two indigenous species, *H. gramineum* and *H. japonicum*, can co-occur with St John's wort and be confused with it. Both native species can be distinguished by the absence of oil glands on their leaves and petals, the presence of four longitudinal ridges on the stem (two for St John's wort) and the stamens not being fused into bundles. *H. gramineum* ('small St John's wort') has leaves with recurved margins and petals less than 8 mm long (while St John's wort has petals more than 8 mm long). *H. japonicum* ('matted St John's wort') is a prostrate or procumbent plant, rarely more than 8 cm high. Its leaves are less than 10 mm long (Briese *et al.* 2000).

H. androsaemum (tutsan) is an erect, perennial shrub to 1.5 m tall; reddish stems with two opposite longitudinal ridges. Leaves are 10 cm long with minute oil glands on their lower surfaces. Flowers are yellow; petals 5, sometimes with black dots along their margins. This species is native to Europe, Asia and North Africa (Parsons and Cuthbertson 1992). In 1980, tutsan was estimated to infest more than 200 000 ha in Victoria (Lane *et al.* 1980). It is a declared plant in Victoria.

H. triquetrifolium Turra (tangled hypericum or wavy-leaf St John's wort) is a perennial herb growing to 45 cm tall, with tangled branches. Both leaves and stems have numerous, tiny, black oil glands. Leaves are arrow-head shaped with wavy margins. This species is native to eastern Europe and the Mediterranean. It is a prohibited weed in Victoria and Western Australia (DPI Victoria).

Origin and worldwide distribution

St John's wort is native to Europe, western Asia and North Africa. Over its range, it displays variable morphology (Briese *et al.* 2000). It is now widely distributed throughout the temperate areas of the world, including North America, South America, Central America, India, New Zealand, Australia, Japan, South Africa, Mascarene Islands and Papua New Guinea (GISD 2007).

St John's wort is considered a weed over much of its native range, particularly in Turkey, Italy, France, Hungary and Sweden, mainly in poor pastures, neglected areas, and occasionally in crops (Parsons & Cuthbertson 1992). Its wide distribution may, in part, be attributed to its cultivation as a medicinal or garden plant (Crompton *et al.* 1988).

St John's wort was introduced to Australia in the 1800s, possibly in 1857 when it appeared in a catalogue of plants growing in the Melbourne Botanic Gardens (Parsons & Cuthbertson 1992). It has now spread to all states of Australia, except the Northern Territory. St John's wort occupies more than 188 000 ha in New South Wales and 175 000 ha in Victoria. It invades poorly managed grazing land, sparse bushland, roadsides and neglected areas such as abandoned mine sites (Parsons & Cuthbertson 1992). A number of different varieties or forms exist in Australia with the 'narrow-leaf' variety being most common (Campbell *et al.* 1997).

Ecology and preferred habitat

H. perforatum is adapted to a wide range of environmental conditions across its native and introduced range (Maron *et al.* 2004). It can tolerate a variety of soils, from dry, rocky, shallow soils to deep, fertile soils. Growth is most prolific in areas where rainfall exceeds 760 mm per annum (Buckley et al. 2003). Soil pH tolerance ranges from 4.3–7.6 (ANHP 2005). It can tolerate drought and disturbance by storing food reserves in its root-crown (Buckley *et al*. 2003).

In Australia, St John's wort occurs in grasslands, open Eucalyptus and Callitris woodlands, along river banks, cleared pasture land and forest plantations. It is common on less intensively managed lands such as travelling stock reserves, commons, water catchment reserves, roadsides, power easements and railway verges (Briese *et al.* 2000). Its morphology can vary depending on the habitat in which it grows; deep soils favour the development of larger, multi-stem plants with vertical roots and long-lived crowns, while in shallow or stony soils, plants are smaller with fewer stems; production of prolific lateral roots and suckering becomes more common (Clark 1953; Briese 1997; Briese *et al.* 2000).

Vegetative propagation (from rhizomes associated with the root-crown) seems to be stimulated by grazing, fire and defoliation (Clark 1953; Tisdale *et al*. 1959). Frost can damage the plant, but it generally recovers. While the plant's root-crown can persist through summer drought, extended drought can cause death (Briese *et al.* 2000).

St John's wort prefers rangelands and pastures (especially when poorly managed), fields, roadsides and forest clearings in temperate regions with cool, moist winters and dry summers. It grows best in open, disturbed sites and on slightly acidic to neutral soils. It does not tolerate saturated soils (CDFA 2008).

In the Pacific north-west, St John's wort occurs in a range of habitats and plant communities, including forest, woodland, rangeland, and prairie communities. In forested areas, St John's wort can be quick to colonise areas following disturbance events, such as road construction, logging, grazing and fire. In forest zones in Idaho, it is most common in open ponderosa pine and in logged and burned areas in Douglas-fir/western hemlock *(Pseudotsuga menziesii/ Tsuga heterophylla*), and fir-spruce (*Abies-Picea* spp.) zones (Tisdale *et al.* 1959; Ruggiero *et al.* 1991; Spies 1991). In the Lochsa River area in north-central Idaho, St John's wort occurs on sites that were previously coniferous forest types until burned in 1919 and 1934. Similar site characteristics were described for areas where St John's wort is invasive in Australia (Campbell & Delfosse 1984; Clark 1953) and a large proportion of infestations (c. 80%) occur under native *Eucalyptus* forests (Briese 1997). Even in forested areas, where St John's wort is not obvious in the above-ground vegetation, it can persist as seeds in the soil seed-bank and establish after disturbance (Warr *et al.* 1994).

St John's wort occurs in parts of the Quillayute Prairie along the coastal plain of the western Olympic Peninsula, Washington (US), areas that are dominated by bracken fern (*Pteridium aquilinum* var. *pubescens*) (Streatfeild & Frenkel 1997). It also occurs among tufted hairgrass, witchgrass (*Panicum capillare*) and non-native species such as colonial bentgrass (*Agrostis capillaris*), sweet vernalgrass (*Anthoxanthum odoratum*), and hairy catsear (*Hypochaeris radicata*) on wetland prairie in Oregon's Willamette Valley (Wilson *et al.* 2004).

In the interior valleys of western Oregon and Washington, St John's wort occurs in grasslands and oak woodlands among species such as Oregon white oak (*Quercus garryana*), Oregon ash (*Fraxinus latifolia*), sweetbriar rose, Himalayan blackberry (*Rubus discolor*), poison-oak (*Toxicodendron diversilobum*), Douglas hawthorn (*Crataegus douglasii*), scotchbroom (*Cytisus scoparius*), and creeping bentgrass (*Agrostis stolonifera*) (Tveten & Fonda 1999;, Clark & Wilson 2001; Thompson 2001).

Reproduction and dispersal

St John's wort reproduces from seeds or from suckers growing each year from shallow rhizomes associated with its root-crown.

Flowering occurs in late spring and summer. Flowers are pollinated by insects (CDFA 2008). Plants can develop seeds with or without pollination (facultative apomixis). Each plant typically produces an average of 15 000–33 000 seeds annually. Seeds can remain viable in the soil for ~10 years or more, and at least five years when submerged in freshwater. Seeds and capsules are dispersed by water. The plant's sticky fruits can adhere to machinery, tyres, shoes, clothing and feet, fur, or feathers of animals. Seeds are hard-coated and those consumed by animals remain intact and viable (CDFA 2008).

Fresh seeds remain dormant for 4–6 months before geminating (Briese *et al*. 2000). Germination occurs from autumn to spring. Brief exposure to fire (100–140˚C) often increases germination. Calcium ions in water appear to inhibit germination of some biotypes (CDFA 2008).

Seedlings grow slowly and are susceptible to drought and competition from surrounding vegetation. In an average year, very few seedlings survive to maturity. Once established, lateral spread of individual plants occurs primarily through suckering. The risk of spread into a new region is greatest in a 'wet year' following a drought. Such conditions favour the survival of newly germinated seedling, probably because of reduced competition (Briese *et al*. 2000).

Use

St John's wort has a long history of use as an anti-inflammatory, astringent and antiseptic. It has been used for centuries to treat mental disorders and nerve pain. In ancient times, it was used as a sedative and a treatment for malaria, as well as a balm for wounds, burns and insect bites. Today, St John's wort is widely percieved as a herbal treatment for depression (Fegert *et al*. 2006). The compound hyperforin in the plant is is also believed to have excellent antibacterial properties. Hyperforin appears to be responsible for decreasing alcohol consumption (Wright *et al*. 2003). However, skin contact with the sap, or ingestion of the plant, can cause photosensitivity in some people (Plants For A Future 2004).

The plant contains many biologically active compounds including rutin, pectin, choline, sitosterol, hypericin and pseudohypericin. The last two compounds have been shown to have potent anti-retroviral activity and they are being researched in the treatment of AIDS (Foster & Duke 1990).

The plant can be cut and dried for medicinal use, or as a herbal tea. The flowers and stems have been used to produce red and yellow dyes.

History as a weed elsewhere

Although St John's wort is perceived to have both horticulutral and medicinal values, and is grown commercially in some regions of south-east Europe, it is an invasive weed in more than 20 countries (Groves 1997; North West Weeds 2007). It is a major weed in the United States and Canada (INVADERS Database 2001).

St John's wort is an invasive weed of natural and agroecosystems across south-eastern Australia, where it infests an estimated 400 000 ha. Some 80% of this area supports natural vegetation, mainly open woodland (Briese *et al*. 2000).

In pastures, St John's wort is poisonous to livestock. It contains a compound called hypericin, which causes photo-sensitisation when ingested by mammals. This results in blisters on weakly pigmented parts of exposed skin. All livestock groups forced to graze pastures dominated by St John's wort will inevitably experience health problems and production losses (Bourke 1997), though sensitivity varies between animal species and breeds of domestic stock. Cattle are highly sensitive to hypericin poisoning. Black-faced meat sheep are more tolerant than white-faced wool sheep. Recently shorn sheep grazing during fine weather are at higher risk (Briese *et al*. 2000). The plant can also cause central nervous system depression, spontaneous abortion, and can cause problems leading to death. Animal production losses on pastures infested with St John's wort in New South Wales have been estimated at $22.5 million per annum (Bourke 1997).

Pest potential in Queensland

Climatically, St John's wort is adapted to temperate areas. Currently, it exists as very small populations near Stanthorpe and Toowoomba. However, it has the potential to become more widespread and abundant in cooler, upland areas of southern Queensland (Stanthorpe/ Warwick area north to Toowoomba). A prediction of this species' potential range is provided in Figure 2.

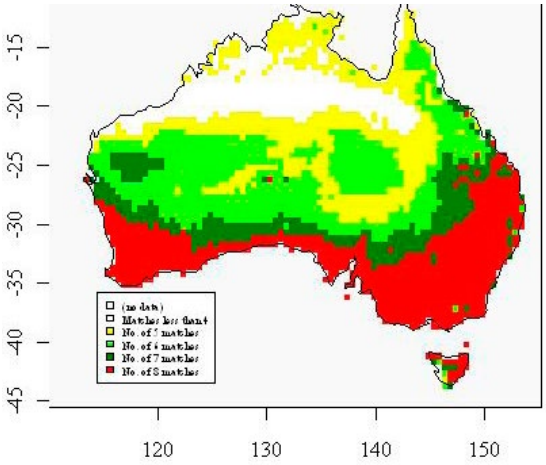

Figure 2. Potential range of St John's wort in Australia, as predicted by CLIMATE modelling software (red areas indicate suitable climate, green areas are marginally suitable, yellow and white are unsuitable).

Over the past 25 years, its population expansion in Queensland has been greatly reduced by an annual control program.

References

ANHP (2005). Alaska Natural Heritage Program (ANHP), Common St John's wort, Environment and Natural Resource Institute, University of Alaska Anchorage, http://akweeds.uaa.alaska.edu/pdfs/species_bios_pdfs/Species_bios_HYPE.pdf

Bourke, CA (1997). Effects of Hypericum perforatum (St John's wort) on animal health and production, *Plant Protection Quarterly* 12: 91–92.

Briese, D, Campbell, M and Faithfull, I (2000). *Best practice management guide for environmental weeds*, Weeds CRC, www.waite.adelaide.edu.au/CRCWMS

Briese, DT (1997). Population dynamics of St John's wort in southeastern Australia, *Plant Protection Quarterly* 12: 59–63.

Buckley, YM, Briese, DT and Rees, M (2003). Demography and management of the invasive plant species *Hypericum perforatum*. I. Using multi-level mixed-effects models for characterizing growth, survival, and fecundity in a long-term data set, *Journal of Applied Ecology* 40: 481–493.

Campbell, MH and Delfosse, ES (1984). The biology of Australian weeds. 13. *Hypericum perforatum* L., *The Journal of the Australian Institute of Agricultural Science* 50: 63–73.

Campbell, MH, May, CE, Southwell, IA, Tomlinson, JD and Michael, PW (1997). Variation in Hypericum perforatum L. (St John's wort) in New South Wales, *Plant Protection Quarterly* 12: 64–66.

Campbell, MH and Nicol, HI (1997). Improving herbicide effectiveness on *Hypericum perforatum* L. (St John's wort) and replacing it with pastures sown on non-arable land, *Plant Protection Quarterly* 12: 93–96.

CDFA (2008). California Department of Food and Agriculture (CDFA), Plant health and Pest Prevention Services, www.cdfa.ca.gov/phpps/ipc/weedinfo/hypericum.htm

Clark, DL and Wilson, MV (2001). Fire, mowing, and hand-removal of woody species in restoring a native wetland prairie in the Willamette Valley of Oregon, *Wetlands*, 21: 135–144.

Clark, N (1953). The biology of *Hypericum perforatum* L. var. *angustifolium* DC (St John's wort) in the Ovens Valley, Victoria, with particular reference to entomological control, *Australian Journal of Botany* 1: 95–120.

Compendium Botanicum (2008). *Missouri Botanical Garden*, Compendium Botanicum, 1995–2008, www.wlbcenter.org/herbarium/compendium_model.aspx?id=5

Crompton, CW, Hall, IV, Jensen, KIN and Hilderbrand, PD (1988). The biology of Canadian weeds, 83, *Hypericum perforatum* L., *Canadian Journal of Plant Science* 68: 149–162.

DPI Victoria, www.dpi.vic.gov.au

Europaea, F (2005). Flora Europaea, The Royal Botanic Garden Edinburgh, www.rbge.org.uk/forms/fe.html

Fegert , JM, Kölch, M, Zito JM, Glaeske G and KJ (2006). Antidepressant use in children and adolescents in Germany, *J Child Adolesc Psychopharmacol*, 16: 197–206.

Foster, S. and Duke, JAA (1990). *Field Guide to Medicinal Plants*, Eastern and Central N. America, Houghton Mifflin Co.

GISD (2007). Global Invasive Species Database (GISD), *Hypericum perforatum* (herb), www.invasivespecies.net/database/species/ecology.asp?si=1197&fr=1&sts=

Groves, RH (1997). St John's wort: *Hypericum perforatum* L.

Integrated control and management, Plant Protection Quarterly 12: 51–52.

INVADERS Database (2001). INVADERS Database, University of Montana, Division of Biological Sciences, http://invader.dbs.umt.edu/

Jupp, PW, Briese, DT and Cullen, JM (1997). Evidence for resistance in Hypericum perforatum to a biological control agent, the eriophyid mite *Aculus hyperici,* Plant Protection Quarterly 12: 67–70.

Lane, DWA, Riches, K and Combellack, H (1980). A survey of distribution of the noxious weeds in Victoria, unpublished report, Department of Conservation and Natural Resources, Keith Turnbull Research Institute, Victoria.

Mahr, FA, Kwong, RM, McLaren, DA and Jupp, PW (1997). Redistribution and present status of the mite Aculus hyperici for the control of St John's wort, *Hypericum perforatum,* in Australia, *Plant Protection Quarterly* 12: 84–88.

Maron, JL, Vila, M, Bommarco, R, Elmendorf, S and Beardsley, P (2004). Rapid evolution of an invasive plant, *Ecological Monographs* 74: 261–280.

Mayo, GM and Roush, RT (1997). Genetic variability of *Hypericum perforatum* L. (Clusiaceae) and the detection of resistance to the biological control agent Aculus hyperici Liro (Eriophyidae), *Plant Protection Quarterly* 12: 70–72.

Missouri Botanic Gardens database (2008).

North West Weeds (2007), www.northwestweeds.nsw.gov.au/st_johns_wort.htm

Parsons, WT and Cuthbertson, EG (1992). *Noxious weeds of Australia*, p. 692, Melbourne, Indata Press.

Plants For A Future (2004). Plants For A Future Database (1996–2003), www.pfaf.org/database

Robson, NKB. (2003). *Hypericum botany. Hypericum*: the Genus *Hypericum*. Medicinal and Aromatic Plants—Industrial Profiles, Ernst, E, (ed.), Taylor and Francis, London.

Ruggiero, LF, Jones, LLC and Aubry, KB (1991). Plant and animal habitat associations in Douglas-fir forests of the Pacific Northwest: an overview, Wildlife and vegetation of unmanaged Douglas-fir forests, Ruggiero, LFA, Aubry, KB, Carey, AB and Huff, MH (eds), Portland, Gen. Tech. Rep. PNW-GTR-285.

Spies, TA (1991). Plant species diversity and occurrence in young, mature, and old-growth Douglas-fir stands in western Oregon and Washington, *Wildlife and vegetation of unmanaged Douglas-fir forests*, Ruggiero, LFA, Aubry, KB, Carey, AB and Huff, MH (eds), Gen. Tech. Rep. PNW-GTR-285, Portland.

Streatfeild, R and Frenkel, RE (1997). Ecological survey and interpretation of the Willamette Floodplain Research Natural Area, WL Finley National Wildlife Refuge, Oregon, USA, *Natural Areas Journal* 17: 346–354.

Syrett, P (1997). Biological control of St John's wort in New Zealand, *Plant Protection Quarterly* 12: 88–90.

Thompson, RL (2001). Botanical survey of Myrtle Island Research Natural Area, Oregon. Gen. Tech. Rep. PNW-GTR-507, Portland.

Tisdale, EW, Hironaka, M and Pringle, WL (1959). Observations on the autecology of *Hypericum perforatum,* Ecology 40: 54–62.

Tveten, RK and Fonda, RW (1999). Fire effects on prairies and oak woodlands on Fort Lewis, Washington. Northwest Science 73: 145–158.

USDA (undated). Plants database, www.plants.usda.gov

Walker, LW (2000). St John's wort (*Hypericum perforatum* L. Clusiaceae): biochemical, morphological, and genetic variation within and among wild populations of the northwestern United States. Portland, or Portland State University. 162 p. Thesis.

Warr, SJ, Kent, M and Thompson, K (1994). Seed bank composition and variability in five woodlands in south-west England, *Journal of Biogeography* 21: 151–168.

Weeds Australia (undated), www.weeds.org.au/

Western Australian Department of Agriculture and Food (2008). Declared plants in Western Australia, www.agric.wa.gov.au

Wilson, MV, Ingersoll, CA, Wilson, MG and Clark, DL (2004). Why pest plant control and native plant establishment failed: a restoration autopsy, *Natural Areas Journal* 24: 23–31.

Wright, CW, Gott, M, Grayson, B, Smith, AG, Sunter, A, Neill, JC and Hanna, M (2003). Correlation of hyperforin content of *Hypericum perforatum* (St John's wort) extracts with their effects on alcohol drinking in C57Bl/6J mice: A preliminary study, *Journal of Psychopharmacology* 17: 403-408