Management and control options for tutsan (*Hypericum androsaemum*) in hill country pastures: a review

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Abstract Tutsan (*Hypericum androsaemum*) is a highly invasive semi-evergreen shrubby weed found throughout New Zealand. Described as a serious pasture weed in 1937, it has been held in check for many years by tutsan rust. Recently it has spread rapidly into pasture, forestry and conservation areas. Present methods available for managing tutsan are proving inadequate and unsustainable. This review paper provides an overview of tutsan's biology, ecology, habitat and its current distribution in New Zealand. It details possible management strategies and control options with emphasis on control by herbicides. The paper identifies a number of potential herbicides which, although not currently registered for control of tutsan, have shown good efficacy on this weed and could be developed for use on agricultural land through further research. Herbicides currently registered for control of tutsan in Australia as well as the current recommendations in Victoria and Western Australia are also summarised.

Keywords tutsan, *Hypericum androsaemum*, chemical control, biological control, scrub weed, pastures.

INTRODUCTION

Tutsan (*Hypericum androsaemum*) is a highly invasive semi-evergreen shrubby weed found throughout New Zealand. Its weediness was not noticed in New Zealand until the 1920s (Johns 1967), but it was described as a serious pasture weed widespread near bush margins in both islands of New Zealand by Hilgendorf (1937). In many areas the growth and consequent invasiveness of this weed had been held in check by a pathogen, tutsan rust (*Melampsora hypericorum*). However, over the past few years a strain of tutsan in the central North Island may have developed a resistance to this rust. Recently tutsan appears to have spread into valuable

pasture, production forestry, and conservation areas, and has formed monocultures in some areas. The plant is estimated to have greater than 60% cover at altitudes over 1500 ha in Taumarunui alone, and threatens a much greater area than that (New Zealand Biosecurity Institute 2015). Tutsan is also found, and is of concern, in seven other regions throughout New Zealand.

Present methods for managing tutsan are proving inadequate and unsustainable. Spraying is difficult because there is only one chemical currently registered for tutsan control in New Zealand, and the results from the off-label use of herbicides have not been scientifically reported.

The plant also infests areas in which mechanical and/or chemical control options are difficult or impractical owing to the topography. Although its shade tolerance and ability to invade forests render biological control a desirable option, attempts through lesser St John's wort beetle (*Chrysolina hyperici*) and the rust (*Melampsora hypericorum*) have been short lived and unsatisfactory (Miller 1970; Whatman 1967).

Due to seriousness of the problem in the Taumarunui area a Tutsan Action Group (TAG) was formed to develop strategies for management and control of this persistent weed. Its intention in the long term is to search for and develop a successful biological control. However, in the short term there is also a desire to investigate and recommend suitable chemical control options to stop the fast spread of this weed in hill country (New Zealand Biosecurity Institute 2015). As a first step, a literature review was undertaken on the biology and ecology of tutsan and the research undertaken for controlling this weed, including a survey of control options that may have been used in New Zealand but have not been published. This paper presents the outcome of that review and also offers recommendations for further research into chemical control options.

BIOLOGY OF TUTSAN

Tutsan is a member of the Hypericaceae family and belongs to the genus *Hypericum*, which includes some 400 species from temperate and subtropical regions (Webb et al. 1988). In New Zealand there are four indigenous and 10 naturalised species (Heenan 2008) and one member of this genus, St John's wort (*Hypericum perforatum*), was previously a significant weed in New Zealand pastures but successfully controlled through the introduction of two foliage feeding beetles (*Chrysolina* spp) as classical biocontrol agents.

Tutsan is a semi-woody, semi-evergreen, hairless perennial small shrub up to 1.5 m tall, with invasive fibrous roots. It is often recognised by its attractive large yellow flowers which are followed by red berries that ripen to black colour (Popay et al. 2010). Both flowers and fruit are present prior to Christmas, which is why the

plant is sometimes referred to as 'Christmas berry' by gardeners and may partly explain why it is so widespread. The leaves are in opposite pairs, stalkless, broad oval, entire and up to 10 cm long by 5 cm wide. These are pleasant smelling, bluish green underneath with translucent glands, turning to red in autumn. The stems are semi-woody, ridged and often reddish. The flowers are up to 25 mm in diameter, yellow in colour, with five petals, five unequal sepals and long stamens. Flowers are formed in 2 to 8-flowered, flat-topped terminal inflorescences. The plants usually flower from November to February. The fruits are round green berries about 1 cm in diameter, ripening to fleshy red, then black with dark reddish purple juice. The seeds are cylindrical or curved, 0.9-1.0 mm long.

Its botanical name, *Hypericum*, is Greek meaning above a picture where it was hung to ward off evil spirits, and *androsaemum*, which means man's blood, referring to the colour of the sap. Tutsan comes from the French *toute-sain* meaning all heal, referring to its medicinal uses and in particular the placement of its leaves on open wounds.

ECOLGY AND HABITAT OF TUTSAN

Tutsan prospers in humid and sub-humid warm-temperate regions, occurring in high rainfall areas of more than 750 mm per annum. (Parsons & Cuthbertson 2001). In New Zealand it is usually a weed of poor pastures and waste places in cool, high rainfall areas. It is frequent in Taumarunui district and widespread from Nelson and Marlborough to Southland. It can spread rapidly in rough, non-top-dressed country where the sward is poor and dense infestations can out-compete desired pasture species leading to their decline and death. From cultivation and garden surrounds it has also escaped in open forest and forest margins. It is a problem weed in re-generating forests (Sullivan et al. 2007). It can form dense stands where its long, drooping branches and rotting leaves smother existing low growing plant communities and seriously inhibit regeneration of native plant seedlings. Its biological success is mainly attributed to

high seeding per plant, seed bank persistence of >5 years, and its tolerance of shade, hot or cold temperatures, high to moderate rainfall, grazing and treading damage. It establishes quickly in disturbed areas on south-facing slopes and cliffs in forests and pastures. In addition its fleshy fruits are effectively dispersed by birds, and possibly also by goats, possums and soil and water movement (Whatman 1967; Owen 1997; WeedBusters 2015). It has a small seed (<1 mm long) that is dispersed by birds and wind, with large areas able to be invaded in a very short time. Partial seed dormancy could be experienced due to the presence of a chemical inhibitor (Crak et al. 2006).

Apart from the young seedling stage, tutsan is considered unpalatable to stock (Syme 1942; Johns 1967). According to Shepherd (2004) all parts of the plant, particularly the fruit, are poisonous due to the presence of hypericin, causing nausea and diarrhoea in humans. However, several studies carried out to specifically detect hypericin in tutsan have produced negative results (Rees 1969; Kitanov 2001; Maggi et al. 2004). In New Zealand, tutsan was suspected of poisoning cattle in the Auckland area (Connor 1977), but feeding experiments have shown that it is unpalatable and there was no evidence that it was photosensitising or otherwise harmful to sheep (Cunningham et al 1947). Despite these reports it is still mentioned in many publications as being poisonous (e.g. NZBI 2015; Tutsan Action Group 2009; Lamp & Collet 1989) and generally considered to be highly toxic to stock by farmers and rural professionals. Its fleshy ripe fruit can also stain and downgrade wool (Johns 1967).

Like some other species in the genus *Hypericum*, there are also some beneficial uses of tutsan. Due to its attractive, large yellow coloured flowers, it is valued in many places as an ornamental plant (Deiser & Eichin 2000). Attempts have been made to develop infertile, non-invasive cultivars of tutsan with desirable ornamental features for the horticultural industry (Trueblood et al. 2010). It is also known for its medicinal properties and is widely used in folk medicine (Guedes et al. 2004) and for treatment of skin injuries and burns (Morteza-Semnani

& Saeedi 2005). Considerable research has been done to investigate the chemically important compounds of tutsan (e.g. Smelcerovic et al. 2008) and the biochemical composition of the above ground biomass was found to vary with altitude (Stoyanova & Apostolova 1992).

DISTRIBUTION OF TUTSAN

Globally, tutsan has an extensive native range including Europe, north-west Africa and temperate Asia (Davis 1967; USDA 2009). It can tolerate a wide temperature range from a maximum of 38°C to a minimum of -12°C (Van Der Veken et al. 2004). It grows in various soil types and tolerates a wide range of pH levels (Hutchinson 1967). These findings suggest that large tracts of New Zealand could provide a suitable habitat for tutsan. With a 'weediness score' of 27 out of 36 and a 'biological success rating' of 13 out of 18 (both at the higher/weedier range), tutsan has the potential to become a serious conservation weed in New Zealand (Owen 1997; Howell 2008). It can impact seriously on the plant community structure by having a major effect on many native species or on the composition and density of dominant species (Owen 1997).

First recorded in 1870 (Owen 1997), it is now established throughout New Zealand, including Stewart, Chatham and Campbell Islands (Sykes 1982). It is locally abundant in North Island in Taumarunui, Te Awamutu, Ruapehu and Whakatane districts (Whatman 1967) and moister areas of South Island from Nelson and Marlborough to Southland (Popay et al. 2010). In Australia, particularly Victoria and Tasmania, tutsan has become invasive (Thomas 2007). It is a declared noxious weed in Victoria and Western Australia (Shepherd 2004). Tutsan is designated an 'Unwanted Organism' in New Zealand and is listed under the National Pest Plant Accord. It is therefore an offence under Sections 52 and 53 of the Biosecurity Act (1993) to knowingly propagate, distribute, spread, sell, offer for sale or display tutsan in New Zealand (MAF BNZ 2009)

CONTROL OPTIONS FOR TUTSAN

Tutsan often grows in places where employing both mechanical and chemical control methods

is very difficult. It can easily re-sprout if control measures do not provide complete kill. Thus long term control of extensive infestations can become uneconomic and unsustainable. It is important to be vigilant and pull out isolated plants as they emerge and re-plant bare sites with more desirable, competitive plants to prevent tutsan re-growth.

Biological control

The prospects for biological control of tutsan in New Zealand were assessed by Landcare Research for the Tutsan Action Group and are summarised in a report by Groenteman (2009). An opportunistic but unsuccessful attempt was made in the late 1940s using the St John's wort biocontrol agent, the beetle *Chrysolina hyperici*. Early reports indicated that the beetle readily consumed tutsan in Nelson and Otago regions (Miller 1949). However, beetles released between 1947 and 1950 at various locations either failed to attack tutsan or disappeared within a few years (Miller 1970). In recent studies, early instar larvae of *Chrysolina* spp. suffered high mortality when offered tutsan in no-choice laboratory feeding experiments, and the survivors' development was severely impeded (Groenteman 2009). It would appear that tutsan is a sub-optimal host for the beetles on which they cannot persist, and explains why beetles released in the 1940s did not survive.

The rust fungus *Melampsora hypericorum*, which was found to have self-introduced in the state of Victoria around 1991, caused variable levels of damage to tutsan, but the plant was generally well controlled there (McLaren et al. 1997). Several strains of this rust were identified in Australia and these varied in their virulence to tutsan. This rust was first recorded in New Zealand in 1952 from tutsan in the Wellington region (Baker 1955). It is unclear how the fungus had arrived here and its effectiveness in controlling tutsan has been variable (Baker 1955; Whatman 1967).

Recent work has suggested there are two main strains of the rust present in New Zealand. Although this tutsan rust is common, it is not providing sufficient control in the North Island

(Groenteman 2009). The reasons are not well understood as to whether it is due to environmental conditions, tutsan susceptibility or pathogenicity of the rust. Casonato et al. (1999) found intrinsic resistance in some tutsan populations and suggested that environmental conditions also play a role, with infection occurring only over a very narrow range of temperatures.

Mechanical control

Grubbing or hand digging of young plants is effective over limited tutsan infestations, but impractical and expensive for large infestations. When removed, the plants should be left on site to decompose. Control of established plants requires ensuring that as much of the root material as possible is removed and buried or composted. This may need to be followed up every few months to remove any remaining roots and prevent re-infestation. Mowing is not effective because the plant is a perennial and recovers quickly after cutting (Syme 1942). Council mowing of roadsides is believed to have increased tutsan spread in recent years through the distribution of seed (Craig Davey, Horizons Regional Council, personal communication). This is difficult to manage as the dried berries may be present on the plants for more than 6 months after maturing. Thus roadside mowing should be carefully managed to lessen the likelihood of seed being moved around by mowers.

It is important to improve the fertility of infested sites as improved grass growth may help prevent tutsan seedling growth. Applying fertiliser and over-sowing with desirable pasture species and grazing with stock must be a part of any successful control and management strategy.

Chemical control

Historically, the phenoxy herbicide, 2,4,5-T applied between January and March provided a rapid knockdown of foliage and smaller branches, but basal re-growth occurred in spring and a repeat application the following year was considered necessary (Whatman 1967; Johns 1967). Tutsan was fairly tolerant, however, to other phenoxy herbicides like 2,4-D available at

the time (Lynch 1947; Whatman 1967). Some successful control using the persistent residual herbicide picloram alone or in combination with 2,4,5-T was reported in the 1960s (Patterson 1965; Moffat 1965). Soon after its introduction, a 2,4,5-T+picloram formulation (Tordon Brushkiller) was recommended as the best option for long term control (McLaren 1971), but this herbicide had long term adverse effects on clover.

The only chemical specifically registered for control of tutsan in New Zealand at present is a picloram formulation (Picloram 20 Granular). Being a systemic herbicide, picloram is absorbed by leaves, stems and roots and moves rapidly in the plant to interfere with cell division and elongation. The recommendation for tutsan is to apply the picloram granules at 55 g/m², evenly over the top of the plant, extending the area treated out to 30 cm beyond the drip line. Best results are achieved on light sandy or stony soils with application in late winter to early spring when favourable growth conditions exist at the time of treatment. Application during cold winter or dry summer periods and on peat or heavy clay soils may result in poor control. Rain is required to move the chemical from granule into the soil. When treating bushes on steep slopes, more granules should be applied on the uphill side as some downward leaching will occur. Poisonous plants may become more palatable after treatment, so livestock should be kept out until plants have died down. Otherwise, no withholding period is required.

Picloram has a long residual life in the soil, so care is needed in its usage. It is degraded only slowly by soil microorganisms, with a reported half-life of 30–330 days. It is toxic to clovers and a waiting period of 6–15 months may be required before clovers can be successfully established in treated areas (McDiarmid 1975).

In Australia a mixture of picloram + 2,4-D (75+300 g/litre) is also registered for control of tutsan in some states. Also, the non-selective contact herbicide that contains 680 g/litre pine oil in the form of an emulsifiable concentrate (Organic Interceptor) is registered for control of tutsan. It can be applied with a knapsack, hand-held or large conventional equipment, which

provides sufficient spray volume for thorough coverage and wetting. The pine oil formulation is available and registered for weed control in New Zealand, but not specifically for tutsan.

There are a number of other herbicides that are registered for control of brush weeds in New Zealand, but not specifically for control of tutsan (Table 1). These may have potential for tutsan control. More details are provided on the product labels or resources such as New Zealand Novachem Agrichemical Manual (2015). These products are often recommended for control of tutsan in many publications in New Zealand and Australia.

Control strategies for tutsan recommended by regional councils in New Zealand

Three regional councils where tutsan is prevalent suggest possible strategies for its control on their websites. These are briefly summarised below.

Waikato Regional Council

- Dig and bury/compost.
- ‘Weed wipe’ with glyphosate, metsulfuron-methyl or triclopyr between November and January.
- Cut down and paint stump with metsulfuron-methyl.
- Root-inject the herbicide for small infestations.
- Control re-growth annually, re-plant site with desirable species.

Horizons Regional Council

- Treat with picloram (Tordon 2G) or picloram/triclopyr (Tordon Brush killer) or similar before December.
- Treat re-growth as per above recommendation.
- Apply fertiliser, over-sow and graze with stock.

Taranaki Regional Council

- Hand pull young plants or seedlings.
- Treat with picloram (Tordon 2G) in July-January or a picloram/triclopyr mix before December.

Table 1 Potential brush weed herbicides not specifically registered for control of tutsan in New Zealand.

Herbicide	Product	ai (g/litre)	Time of application	Method of application	Comments
Picloram + triclopyr + aminopyralid	Tordon Brushkiller XT	100 + 300 + 8	Spring to early summer	Handgun, knapsack, mist blower, aerial	Very injurious to legumes, but not grasses (persists for 6-12 months)
Picloram + triclopyr	Various	100 + 300	Spring to early summer	All as above	Very injurious to legumes
aminopyralid + triclopyr	Tordon Pasture Boss	30 + 200	Active growth	Boom, spot spray	Injurious to legumes
Triclopyr	Various	600	Nov – Feb	Hand gun, knapsack, wick wiper, aerial	Injurious to legumes
Triclopyr + fatty acids	X-tree basal	120 + 600	Spring or winter	Spray boom, basal	Does not need to be diluted. Registered for use only on conservation or non-grazed forestry land
Glyphosate	Various	360 – 800	Nov – Feb	Hand gun, knapsack, wick wiper, spray boom	Non-selective, slow acting
Metsulfuron-methyl	Various	600	Active growth	Hand gun, knapsack, wick wiper, spray boom	Injurious to both ryegrass and clovers (persists 2-6 months)

Anecdotal management strategies being used in New Zealand

Telephone and email conversations were held with 14 council staff, farmers and contractors from Waikato and Manawatu regions to gauge the most favoured management practices for tutsan. A formulation of picloram + triclopyr + aminopyralid (Tordon Brushkiller™ XT) was the preferred product for most people interviewed and by far the most widely used product. However, a triclopyr + fatty acids formulation (X-Tree Basal) was gaining a small but enthusiastic following. This is quite understandable as it was applied to the whole plant as per the instructions for use as a basal treatment, i.e. undiluted. This means that the plants were receiving a very high dose of triclopyr. There was some enthusiasm

for using lime. In poor low fertility pastures the application of lime frequently improves soil fertility and releases some nutrients. This would promote growth of the pasture making it more competitive to tutsan. There was unanimous agreement as to how much of a problem tutsan was becoming and how difficult it was to control.

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