St. John's wort (*Hypericum perforatum*) in Western Australia

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Abstract

St. John's wort (*Hypericum perforatum*) is a minor localized weed in south-west Australia where its distribution and abundance have been stable in recent years. Factors significantly contributing to the weed's status may include:

i. noxious weed legislation that ensured regular inspection and chemical control activities,
ii. the successfully established biological control agent, *Chrysolina quadrigemina* and
iii. climate.

These factors should form the basis for future research activities in Western Australia before the introduction of further biological control agents is considered.

Introduction

St. John's wort was first collected in Western Australia by C.A. Gardner in 1934 (Hamilton 1946) and was identified as *H. perforatum* var. *angustifolium* (Clusiaceae). The weed is believed to have been introduced late last century, or early this century, with fodder imported for horses and oxen involved with the timber industry. Hamilton (1946) noted that 'prolific growth' was not reported until 1935.

St. John's wort has not achieved the prominence in Western Australia that it has attained elsewhere in Mediterranean-type climates of the world, for example in California. Nevertheless, the plant has been subjected to control activities since its discovery in the State. In this note we summarize what is known about St. John's wort and its control in Western Australia.

Distribution

St. John's wort is restricted to high rainfall areas of south-western Western Australia. It occurs mainly as scattered small populations, with the greatest densities being found from Dwellingup, Boddington, Balingup, Greenbushes, Nannup, Manjimup, Karridale to Pemberton (Figure 1). Recorded populations near Perth, Northam and Narrogin (Figure 1) are not thought to be extant. Only a few populations occur in pastures. Most major infestations are found along roadsides and on the sites of former timber camps, former milling towns (e.g. Holyoake) and neglected small-holdings located within forested country.

The initial extent of St. John's wort infestation in 1935 was 70 acres (28 ha) between Margaret River and Augusta (centred on Karridale, Figure 1), with smaller infestations later reported over the range currently occupied (Figure 1) (Hamilton 1946). In recent years the average area reported each year to be infested by St. John's wort in Western Australia is about 44 ha on 11 properties (Table 1). While these data reflect the resources and effort made in inspecting the weed, they do represent the minimum levels of infestation. The actual area is estimated to be relatively static at around 200–300 ha (Agriculture Protection Board of Western Australia 1988).

In recent years there has been little spread of the weed. Only one new infestation was reported between 1988 and 1992. The lack of spread may partly be because there is little agricultural activity in infested areas that could lead to dispersal of rhizomes by cultivation etc., or the spread of seeds in contaminated hay or via stock movement.

Early control activities

The first weed control trials were in 1936. Salt was used extensively in the early trials (Hamilton 1946). After a decade of control attempts, Hamilton (1946) concluded that eradication would be difficult. In 1950 St. John's wort was declared a noxious weed under the new Agriculture and Related Resources Protection Act. It was noted that maintaining a dense pasture, especially one containing subterranean clover and kikuyu grass, helped suppress the weed (Meadly 1956). Also, the new, cheap, easily-applied herbicides (such as 2,4-D ester) appeared in the early 1950s and their application resulted in a substantial

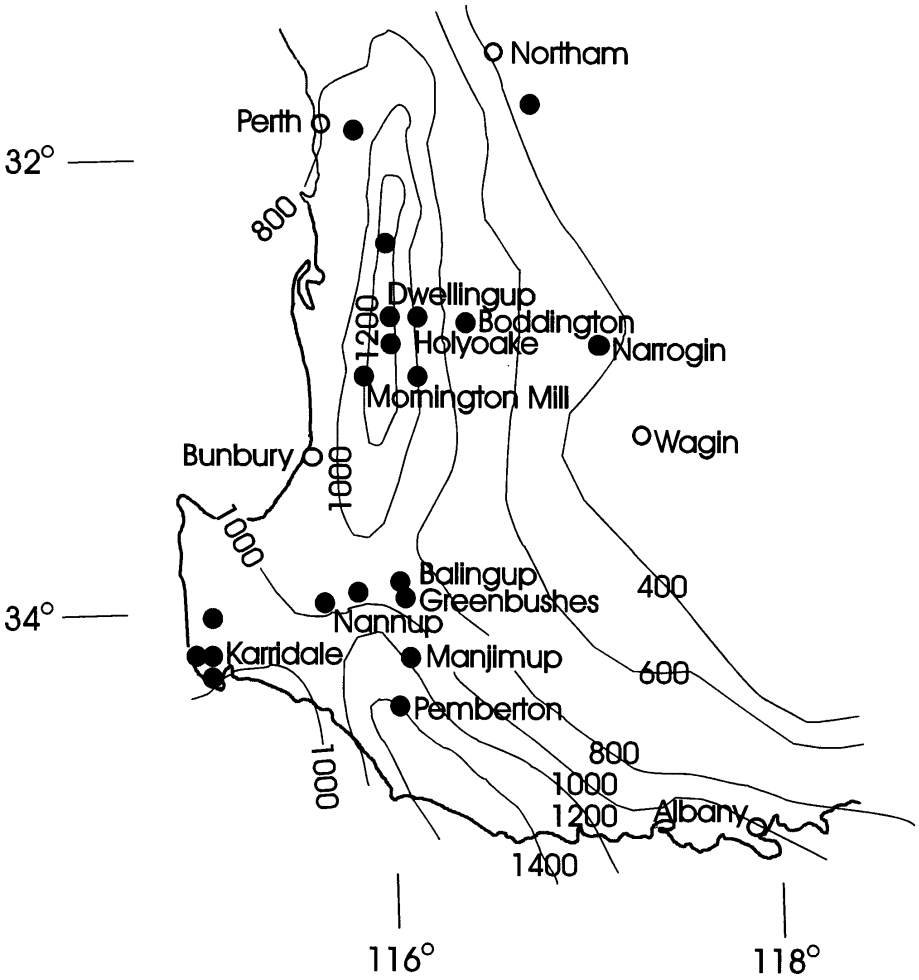

Figure 1. Distribution of St. John's wort (*Hypericum perforatum*) in Western Australia. Dots indicate localities where plants have been recorded either as herbarium specimens or in the records of Agriculture Western Australia. Isohytes indicate average annual rainfall in mm.

reduction in the extent of St. John's wort (Meadly 1956).

Biological control

Four colonies of the biological control agents, *Chrysolina quadrigemina* (Sufrian) and *Chrysolina hyperici* (Forster) (these were originally identified as *Chrysomela gemellata* (Rossi) and *Chrysomela hyperici* (Forster)) were sent from Bright, Victoria to Western Australia by the Council for Scientific and Industrial Research and released in November 1948 at Holyoake, Mornington Mills and Karridale in Western Australia (Figure 1). It was estimated that about 100 000 beetles (presumably adults) were released (Western Australia Department of Agriculture 1948). A further consignment was received from Victoria in November 1949 and released in the Karridale district (Western Australia Department of Agriculture 1950). Establishment of the beetles and destruction of one small outbreak of the weed was reported the following year.

In 1952 G.R.W. Meadly wrote 'Some encouraging results have been obtained [by the chrysomelids], but this method cannot be regarded as highly reliable'. It is likely that the beneficial aspects of biological control were eclipsed by the arrival of the modern herbicides that were easy to apply, cheap and gave readily observable results. By 1956 the familiar pattern of beetles controlling plants in pasture, but not in shaded areas, had been observed (Meadly 1956).

Huffaker, a leading biological control entomologist from California, visited Australia in 1963 to examine St. John's wort. He reported that the control of St. John's wort in Western Australia was potentially similar to the situation in California where high levels of persistent control occurred (Huffaker 1967). He stated that 'very effective, well synchronized attack [by the chrysomelid] that resulted in a high degree of death of the defoliated plants observed was obvious in West Australia'.

Chrysolina quadrigemina adults were present on St. John's wort at Holyoake in November 1992, and at Karridale in December 1994. The fate of *C. hyperici* is unknown. Four other insects species have been established as biological control agents in eastern Australia (Campbell *et al.* 1995), but have not been released in Western Australia. This is presumably due to the minor nature of the weed problem in Western Australia.

Current status and control measures

Between 1986 and 1992, the Agricultural Protection Board of Western Australia treated an average of 56 ha of St. John's wort infestations by herbicide each year (Table 1). In 1989 the declaration of St. John's wort under the Agriculture and Related Resources Act was cancelled in south-west areas (Agriculture Protection Board of Western Australia 1989). In other areas of the State, where the plant is presently absent, it remains a declared plant in the P1 (plants which must not be introduced to the State) and P2 (plants which must be eradicated) categories.

Current recommended chemical control measures are to use 2,4-D amine or ester for spot applications and boom-spraying. Diuron can also be used for spot-treatment of small infestations and glyphosate is used for non-selective control (Peirce and Smith 1994).

Discussion

Five Clusiaceae species occur in Western Australian flora; three native species, *Calophyllum sil* Lauterb., *Hypericum gramineum* G. Forster, *H. japonicum* Thunb. and the introduced *H. androsaemum* L. and *H. perforatum* L. (Green 1985, Keighery 1995). However, there has been no critical reassessment of the taxonomy of these species. Detailed identification of the *Hypericum* populations in Western Australia may be important to ensure correct matching of biological control agents (e.g. the mite, *Aculus hyperici* Liro) to their host plant.

Gordon and Kluge (1991) comment on the lack of invasion by St. John's wort into fynbos (native heath) vegetation in south-west South Africa. However, St. John's wort is regarded as a major environmental weed in eastern Australia (this workshop). There appears to be little invasion of native vegetation in Western Australia at present, even though the plant has been present in forested areas for a considerable time. It remains to be seen if the recent removal of St. John's wort from noxious weed lists leads to a change in its abundance and distribution. In South Africa, St. John's wort occurs in a similar climate to south-west Australia and is now regarded as under satisfactory biological control mainly due to *C. quadrigemina*. Gordon and Kluge (1991) conclude that other factors such as climate, unsuitable habitats and lack of dispersal agents may have contributed to containing the weed and these factors may also be relevant to the situation in south-west Australia.

As is unfortunately often the case, the biological control attempts in Western Australia have not been subjected to critical assessment that measures their impact on St. John's wort. Huffaker's (1967) inference that biological control had been successful in Western Australia may be valid because the ability of the weed to recover from *C. quadrigemina* attack is known to be increased by summer rainfall and variability in winter rainfall in south-eastern Australia (Huffaker 1967, Julien 1992), but these factors are both negligible in south-west Australia. The chrysomelid–St. John's wort interaction may be the best example of successful biological control in Western Australia, so successful that the weed is now comparatively insignificant and its biological control agent almost forgotten.

Clarification of the weed's identification and an assessment of the potential spread and impact of existing biological control agents would provide a basis for further biological control releases. Some of the available agents (e.g. the aphid *Aphis chloris*) would be relatively simple to release in Western Australia. However, it appears that the weed is under successful biological control by the chrysomelids in open or pasture areas and future control attempts should be directed at the plant in shaded or forested areas.

Conclusions

The availability of additional agents opens the opportunity for further releases in Western Australia. The minor importance of the weed make it unlikely that funding would be attracted to implement a large scale research program. However, the biology and ecology of the weed and the control agents represents an excellent

Table 1. Records of the number of properties and area infested and treated for St. John's wort in Western Australia. Data were taken from the Annual reports of the Agricultural Protection Board, Western Australia (1986–1992).

Year	New properties infested	New area infested (ha)	No. properties	Area infested (ha)	No. properties treated	Area treated (ha)
1986 / 87	–*	–	–	–	59	200
1987 / 88	–	–	10	60	31	71
1988 / 89	1	1	18	80	10	10
1989 / 90	0	0	11	34	10	23
1990 / 91	0	0	5	25	2	20
1991 / 92	0	0	11	20	5	11

* not recorded.

opportunity for basic studies, perhaps at the post graduate student level.

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Population dynamics of St. John's wort in south-eastern Australia

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Summary

A thorough understanding of the ecology of St. John's wort and the processes that drive the population dynamics of infestations is a key to the management of this weed. However, while some aspects of the weed's biology have been studied in the seventy years of research on its control in Australia, there has been only one study devoted to its ecology; in the Ovens Valley, Victoria, over a two year period. To complement this detailed work and provide a picture of longer term fluctuations, four St. John's wort populations were monitored over a period of seven years, from 1981–87. This paper summarizes the type of data collected, and uses it, together with that from the Ovens Valley study, to define those properties of St. John's wort that have contributed to its success as a weed and which may render it vulnerable to particular methods of control.

Introduction

Since its introduction into Australia in the late nineteenth century, St. John's wort (*Hypericum perforatum* L.) has spread widely and invaded a number of different habitat types, ranging from prime agricultural land to native *Eucalyptus* forest (Campbell *et al.* 1995). Aspects of the general biology of the weed that favour its success in colonizing and persisting in new areas are now reasonably well understood in the light of numerous efforts to control the weed (see Campbell *et al.* 1995), but, apart from a two year study in the Ovens Valley, Victoria, by N. Clark (1953), there has been no attempt to specifically investigate the population dynamics of infestations of the weed over a longer period. Given that St. John's wort is a relatively long-lived perennial, such information is a key element in the development of management strategies for the weed.

N. Clark's (1953) studies indicated that St. John's wort can have quite different forms and population structures, depending on the habitat in which it grows (Table 1). In Type B infestations, on poorer shallow soils, the weed is smaller and tends to sucker more frequently. Stresses such as low nutrient levels, shading, defoliation and fire (N. Clark 1953, Briese 1996) tend to promote such vegetative reproduction and in fact render such infestations relatively resistant to control. Where soils are better, larger deep-rooted plants may give the impression of a more vigorous infestation, but in fact, plants of these Type A infestations are more susceptible to stresses such as defoliation (N. Clark 1953). Moreover, once the weed is reduced the richer soils can more readily support competing vegetation and so St. John's wort is more readily controlled. This partly explains the original success of biological control agents in areas where good agricultural land was infested. The problem remaining is that the majority of land currently infested by St. John's wort falls into the Type B category, with over 80% of infestations occurring under native forest (Shepherd 1983) or in poorer quality pastoral land.

In addition to aspects of the physical habitat, factors such as rainfall pattern can affect stem and seed production (by as much as 7.5 to 26-fold, respectively (Campbell *et al.* 1995)), while insect defoliation can cause fluctuations in crown density and stem production (Clark and Clark 1952). To better understand the longer term changes in infestations of St. John's wort in such habitats, a study was undertaken by CSIRO Entomology between 1981 and 1987 at four sites in south-eastern Australia, infested in varying degrees by

Table 1. Characteristics of the two types of St. John's wort infestation recognised by N. Clark (1953). The infestations have been designated Type A and Type B for this paper.

Parameter	Type A	Type B
Location	deeper soils	shallow or stony soils
Densities (plants per m^2)	12–37	12–124
Plant height	taller	shorter
Number of stems	multistemmed	fewer stems
Root system	deep tap-root	shallow lateral roots
Vegetative growth	rare	common
Maximum age of plants	usually more than 3 years	usually less than 3 years
Response to defoliation	more susceptible	less susceptible