# Potential of native pathogens for control of saffron thistle

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## Summary

**Saffron thistle (*Carthamus lanatus*) is a widespread weed of cropping and pastoral areas throughout the wheat belt of Australia. It causes economic losses in both of these agricultural systems. Isolates of *Phomopsis* spp. have been collected from the field from both attacked thistles, and from seed from disease free plants. Data for pathogenicity tests on 23 isolates are presented, which suggest that five highly virulent strains have potential for development as bioherbicides.**

## Introduction

Saffron thistle (*Carthamus lanatus* L.) is an important winter growing annual weed of cropping and pastoral areas throughout the wheat belt of Australia, causing a yield reduction in cereals of up to 70% (Watson 1990). Contamination of grain with saffron thistle seed leads to downgrading and financial dockage. In pasture, the thorny nature of the thistle reduces livestock access to palatable pasture. Spines of saffron thistle cause damage to the eyes, mouth and hooves of livestock, and predispose stock to diseases such as scabby mouth and pink eye (Watson 1990).

Current control methods aim to exhaust seed reserves in the soil by using a combination of mechanical, chemical and cultural practices (Fromm 1990). Saffron thistles seed can remain viable in the soil for up to eight years (Quinlivan and Peirce 1968). To achieve effective control it is important to prevent seed set over several years. The delayed germination of saffron thistle within seasons adversely effects the outcome of any applied control strategy. This paper outlines the failure of current control strategies to impact on saffron thistle populations and investigates the potential for biological control.

## Saffron thistle distribution

In 1995 a questionnaire was sent to 53 New South Wales (NSW) district agronomists requesting information on saffron thistle:

- the presence of infestations,
- the presence of infestations which are considered to be a problem,
- the crop / pasture situation in which it was considered to be a problem, and
- the need for control.

Of the 89% response, 85% reported infestations, which occurred in all cropping / pasture situations. The highest incidence was in pastures (82%), followed by cereal crops (46%), lucerne (29%), oilseed crops (24%) and grain legume crops (24%) (Crump *et al.* 1996a). Control of saffron thistle was considered to be warranted in 63% of the surveyed districts.

An earlier survey (Briese 1988) concluded that saffron thistle was the most economically important thistle in NSW. The results from the current survey show that its significance has not altered, indicating that current control strategies do not lead to a long term reduction in the population of the weed. Possible reasons for this failure include:

- The timing of herbicide application. The majority of the control methods have to be carried out at the most susceptible growth stage to provide effective control. For example, once stem elongation occurs the phenoxy herbicides do not provide reliable control.
- The damage to non-target species. Many herbicides used to control saffron thistle can cause damage to non-target species.
- The cost associated with control. The seed of saffron thistle can remain viable for up to eight years, therefore control strategies need to be implemented for three consecutive years in order to reduce the seed reserves in the soil (Watson 1990). The cost associated with control can be expensive especially in low value crops such as pasture in inaccessible areas.
- The pattern of germination. The germination of saffron thistle is staggered within a season, therefore there is a need to repeat control strategies throughout a season.

The failure of current control strategies to reduce thistle populations highlights the need for alternative control strategies, such as biological control.

## Biological control of saffron thistle

The classical biological approach involves the 'introduction of an exotic beneficial organism into an area where an exotic pest has become established in the absence of the natural enemies that existed in its original home' (Burge 1988). If conditions are favourable the biocontrol agent becomes established and flourishes in its new habitat. The major constraint to the application of classical biological control for saffron thistle is its genetically similar background with safflower (*Carthamus tinctorius* L.). The discovery of suitable biocontrol agents which are specific to saffron thistle and not damaging to safflower has been limited to date (Wasphere 1984).

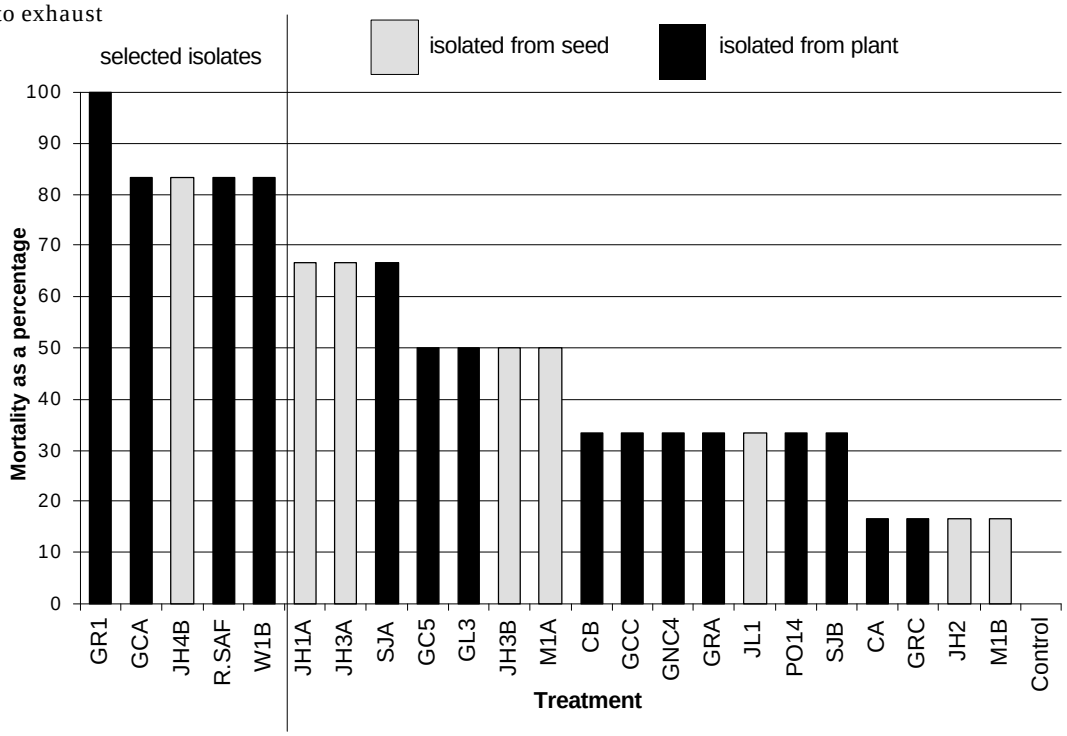


**Figure 1. The variation in pathogenicity of *Phomopsis* spp. isolates on saffron thistle. Note only isolates which cause mortality are presented.**

The adoption of an inundative approach to biological control overcomes some of the constraints applied to classical biological control. The inundative approach, which includes the bioherbicide technique, utilizes organisms with poor means of dispersal, therefore, reduces the spread to non-target species. The bioherbicide tactic can utilize indigenous pathogens eliminating the quarantine requirement and the risk involved in the introduction of foreign organisms associated with traditional approaches to biological control. Bioherbicides rely on the application of the pathogen in high concentrations to create a disease epidemic (Charudattan 1988). After infection the pathogen is reduced to low levels or does not survive. The use of the bioherbicide tactic to control saffron thistle has several advantages in comparison to conventional control:

- Bioherbicides are cheaper to develop and register than conventional herbicides, resulting in a lower cost to the user. This would be particularly advantageous in low-value pasture situations where current control methods are uneconomical.
- Bioherbicides can be targeted to provide control without damaging non-target species.
- The sustainable management of saffron thistle with bioherbicides has the potential to reduce chemical usage with associated environmental benefits.

Overseas explorations have identified several plant pathogens including *Septoria* spp. and *Puccinia* spp. (Evans 1995). The impact that these pathogens would have on thistle populations in Australia requires investigation. Research on indigenous fungi is complementing these international research investigations. The Australian isolates of *Phomopsis* spp. were collected from diseased plant material from sites in NSW. *Phomopsis* spp. were also obtained from seed collected from apparently disease free plants from Junee (47.5%), Mangoplah (10%), Warren (5%) and Barabba (0%) (Crump *et al.* 1995). Pathogenicity tests conducted on 45 isolates of *Phomopsis* spp. have shown plants could be killed in 4-10 days (Crump *et al.* 1996b). The most virulent isolates have been selected for further investigations (Figure 1). Preliminary results indicate that these isolates are suitable for the inundative biological control of saffron thistle in Australia.

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