PATHOGENICITY OF *SCLEROTINIA SCLEROTIORUM* ON COMMON THISTLE SPECIES AND OTHER PASTURE WEEDS

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SUMMARY

A strain of *Sclerotinia sclerotiorum*, isolated from Californian thistle (*Cirsium arvense*), was inoculated onto eight other pasture weeds using a mycelium-on-wheat preparation. The ranking of the species from highest to lowest mortality was: Californian thistle, Scotch thistle (*Cirsium vulgare*), nodding thistle (*Carduus nutans*), ragwort (*Senecio jacobaea*) and winged thistle (*Carduus tenuiflorus*). Only localized infection on the leaf lamina occurred on hawkbeard (*Crepis capillaris*), broad-leaved dock (*Rumex obtusifolius*), dandelion (*Taraxacum officinale*) and catsear (*Hypochaeris radicata*), resulting in little overall effect on the plant growth. *S. sclerotiorum* is sufficiently virulent against Scotch thistle, nodding thistles and ragwort, to be considered as having potential for development as a mycoherbicide to control these pasture weeds.

Keywords: *Sclerotinia sclerotiorum*, mycoherbicide, weeds, pasture, host range.

INTRODUCTION

A survey of potential microbial biological control agents for Californian thistle (*Cirsium arvense* L. (Scop.)) resulted in nine plant pathogens being isolated (Waipara *et al.* 1990, unpublished). One of these, *Sclerotinia sclerotiorum* (Lib.) de Bary was subsequently shown in greenhouse and field experiments to be a virulent pathogen on Californian thistle (Bourdôt *et al.* 1993), and is being further investigated as a potential mycoherbicide. *Sclerotinia sclerotiorum*, however, has a broad host range and of the 101 host species listed in Pennycook (1989), 14 can be classed as weeds.

Some of these prospective target weeds are thistles which cause substantial pasture production loss. *Carduus* spp. are reported as being the second most serious weed group in New Zealand (Syrett 1988), and Bourdôt and Kelly (1986) found that Scotch thistle is the second most important thistle in terms of ground covered during summer in high production pastures. Scotch, winged and nodding thistles jointly cause an estimated loss of \$110/ha (Kelly and Popay 1985). Johnston (1990) reported that ragwort, also a possible candidate host target for the pathogen, was the third worst weed in New Zealand, being a particular problem in areas of low productivity where chemical control is uneconomic. Docks have been listed as a host to *S. sclerotiorum* (Pennycook 1989), and flat weeds such as catsear, hawkbeard and dandelion have been the target of this pathogen as a mycoherbicide (Millar *et al.* 1992). Although they are of minor importance as pastoral weeds compared to the thistles and ragwort, they do cause problems in turf, where weed control is a significant cost component of turf maintenance (Robinson 1980).

This report compares the susceptibility of nine pasture and turf weed species to a strain of *S. sclerotiorum* when inoculated under greenhouse conditions.

METHODS

The isolate of *S. sclerotiorum* used in this study was S9, isolated from Californian thistle. Inoculum was prepared by growing the pathogen on kibbled wheat, milling to a fine granule and applying to pre-misted plants at an equivalent rate of 50 g/m², containing approx. 15,000 colony forming units per gram. Two experiments were

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conducted. In the first, 12 plants, one plant per pot, were inoculated for each of the following weeds: nodding thistle (*Carduus nutans* L.), winged thistle (*Carduus tenuiflorus* Curt.), Scotch thistle (*Cirsium vulgare* (Savi) Ten.), and broad-leaved dock (*Rumex obtusifolius* L.) and assessed every 24 h for 12 days. In the second experiment, eight plants each of hawkbeard (*Crepis capillaris* (L.) Wallr.), catsear (*Hypochaeris radicata* L.), dandelion (*Taraxacum officinale* Webber) and ragwort (*Senecio jacobaea* L.) were inoculated and assessed at 4, 7, 9 and 11 days after inoculation. In both experiments, Californian thistle plants were inoculated as a standard. All plants were kept at high humidity for 72 h at 22°C, and then bottom watered and maintained under greenhouse conditions.

Disease progress was measured by visually scoring the percentage area of each leaf on each plant exhibiting necrosis. A score of 100 indicates complete plant death, while 50 indicates that only half the area of leaf laminae was necrotic. The total number of plants that died within the duration of the leaf necrosis scoring was noted, and the remaining plants observed for a further 7 days under the same conditions, with any further deaths being recorded.

RESULTS AND DISCUSSION

Sclerotinia sclerotiorum initiated infection on all inoculated species, but the infection symptoms ranged from superficial lesions on leaf laminae to general necrosis and death of the plants. Progressions of disease on inoculated hosts over an 11-12 day period in the two experiments are shown in Fig. 1. Virulence was greatest on the original host, Californian thistle, for which there was 100% mortality at 11-12 days. Both Scotch and nodding thistles were less diseased than Californian thistle at 7 days, but by 12 days, the three species were similarly affected. Infection on Scotch and nodding thistles was mainly initiated in the rosette crown, rotting out apical meristems to cause rapid plant death with general leaf collapse. The percentage of the plants that died during the experiments is given in Table 1, and shows that only Californian, Scotch and nodding thistles had substantial levels of mortality. Winged thistle and dock were insufficiently affected by this strain of *S. sclerotiorum* to suffer substantial mortality, and all plants, save for one winged thistle which died, were able to grow away from the infection.

TABLE 1: Percentage of plants that died and final percentage leaf area exhibiting necrosis from inoculation of nine weeds with a mycelium-on-wheat preparation of *Sclerotinia sclerotiorum*. Percentage plant death was measured 12 days after treatment in Experiment 1 and 18 days in Experiment 2. Percentage leaf necrosis data is extracted from the last assessment date in Fig. 1.

Host	% Mortality	% Leaf necrosis
Experiment 1:		
<i>Cirsium arvense</i> -Californian thistle	100	100
<i>Cirsium vulgare</i> -Scotch thistle	75	95
<i>Carduus nutans</i> -Nodding thistle	58	94
<i>Carduus tenuiflorus</i> -Winged thistle	8	40
<i>Rumex obtusifolius</i> -Dock	0	32
LSD(5%)	-	11
Experiment 2:		
<i>C. arvense</i>	100	100
<i>Senecio jacobaea</i> -Ragwort	50	69
<i>Crepis capillaris</i> -Hawkbeard	0	56
<i>Taraxacum officinale</i> -Dandelion	0	13
<i>Hypochaeris radicata</i> -Catsear	0	6
LSD (5%)	-	14

Figure 1: The development of infection of *Sclerotinia sclerotiorum* on nine weeds inoculated in two greenhouse experiments using a mycelium-on-wheat inoculum. Experiment 1: *Cirsium arvense* (▲); *Cirsium vulgare* (+); *Carduus nutans* (●); *Carduus tenuiflorus* (✦); *Rumex obtusifolius* (○). Experiment 2: *C. arvense* (▲); *Senecio jacobaea* (■); *Crepis capillaris* (◆); *Taraxacum officinale* (▼); *Hypochaeris radicata* (×). Vertical bars in each graph are LSD (5%) for comparing between weeds.

A disease rating of 69 on ragwort 11 days after inoculation was lower ($P < 0.05$) than that on the Californian thistle standard. Initial infections on ragwort spread from leaf axils or rosette crowns and then to the entire plant but at a slower rate than in susceptible thistles. Four of the eight ragwort plants died within 18 days of treatment.

Hawkbeard, dandelion and catsear were all infected to varying degrees by the pathogen with overall disease progress being slow. No plants were killed and leaf mortality was low. Even though many of the inoculated weeds did not die through infection by *S. sclerotiorum*, the plants were weakened by the initial infection, and in field situations would probably become less competitive with grasses and clovers that are unaffected by this treatment (Hurrell and Bourdôt 1993).

Nodding thistle and ragwort have not previously been recorded as a host of *S. sclerotiorum* in New Zealand.

The lower pathogenicity of this S9 strain of *S. sclerotiorum* towards certain hosts such as dock and winged thistle under greenhouse conditions, could be characteristic of this strain only. There is no physiological specialisation in the pathogen (Mordue and Holliday 1976), but hosts are known to react differentially to a range of strains (Riddle *et al.* 1991; Harvey and Waipara, unpublished). Thus, other strains may be more pathogenic on these weeds and therefore selections for each host is a necessary direction for further work. *Sclerotinia sclerotiorum* is sufficiently virulent against ragwort, Scotch and nodding thistles to be considered as having potential for development as a mycoherbicide to control these serious pasture weeds.

Grasses are seldom recorded as hosts to *S. sclerotiorum* (Mordue and Holliday 1976) but some forage species such as chicory (*Cichorium intybus* L.) are recorded as hosts, and in situations where these are part of the present or future planned sward, caution would have to be exercised. Experiments at Lincoln have demonstrated that no grass or clover damage is caused by this pathogen when applied as a mycoherbicide to a pasture (Hurrell and Bourdôt 1993).

S. sclerotiorum is an ubiquitous pathogen in New Zealand and so its development as a mycoherbicide avoids the complications of introducing exotic organisms into a region. Trials are now required to ascertain the effect of S9 and other strains of *S. sclerotiorum* on these weeds under field conditions.

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