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Variation in response to *Alternaria carthami* infection by a range of safflower (*Carthamus tinctorius*) varieties

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Abstract
Twenty safflower (*Carthamus tinctorius*) varieties were tested for their response to the fungal pathogen *Alternaria carthami*. The varieties tested represented a selection of domestic and international varieties, both hybrid and open pollinated, including the standard Australian variety Sironaria. An isolate of *Alternaria carthami* was selected from the New South Wales fungal germplasm bank at Tamworth as representing the region where most safflower is currently grown. The plants were inoculated using agar slabs at the sixth leaf stage. Leaf lesions were assessed six and twelve days after inoculation. Variation in the level of infection was observed among the varieties tested. Two varieties, namely UC1 and 120045 had a 100% mortality rate, whilst the lowest levels of infection were recorded in S501, Saffire, C01, Sironaria, S555 and S8154. Of these varieties Sironaria, Saffire and S555 have been reported as having promising marketability characteristics, and therefore have good potential for south-eastern Australia. The variation in infection levels present within the varieties tested also demonstrates that different levels of resistance are present within the plant population. Breeding for resistance in the future should be a priority if infection by *A. carthami* is to be minimised in commercial production.

Key Words: Australia – inoculation – leaf lesions – breeding

Introduction

Safflower (*Carthamus tinctorius*) has good potential in dryland cropping systems as a cash crop in south-eastern Australia. Although it requires a significant amount of water, safflower can be sown later in the year than most other crops (Wachsmann *et al.* 2003a) providing an option to replant fields where traditional winter crops fail to establish or alternative strategies for weed control. There has been recent interest in the evaluation of safflower for south-eastern Australia (Jochinke *et al.* 2003; Wachsmann *et al.* 2003a, 2003b, 2003c,) and some cultivar comparisons conducted (Jochinke *et al.* 2003; Wachsmann *et al.* 2003b). Despite the good agronomic performance of these cultivars, safflower has two main disease threats which recent research has not examined. These come from *Alternaria carthami* (leaf blight) and *Phytopthora cryptogea* (Phytopthora root rot). In past years, *A. carthami* has caused yield losses in safflower of up to 50% (Jackson and Berthelsen 1986) and led to the development and release of the resistant variety Sironaria in 1987 (Harrigan 1987). Sironaria is currently the most widely recognised variety in Australia, but it has a relatively low oil content and as a linoleic type, it is not suited to all markets. This paper reports on research undertaken to evaluate the response of nineteen safflower varieties to *A. carthami*.

Materials and Methods

A culture of *A. carthami* obtained from the New South Wales fungal germplasm bank at Tamworth, was selected as representing the region where most safflower is currently grown. This culture was subcultured onto 10% V8 agar and a lawn culture of *A. carthami* was allowed to form.

The nineteen safflower varieties selected were Sironaria, Safire, AC Stirling, Gila, S501, UC1, 120043, C01, GW9023, Lesaf175, S517, S9262, S710, S8154, S555, S0158, 120045, S6005 and S8134. Three plants were sown in each pot and there were five replicates of each variety. Each experimental unit for analyses consisted of one pot containing three plants.

At six leaf stage the plants were inoculated by damaging one leaf per plant with a needle and placing a 1cm square of the lawn culture (agar included) onto the wound. Plants in one pot (replicate) of each variety were pierced with the needle but not inoculated and used as a control. A plastic bag was placed over each pot to increase humidity.

Plants were assessed for disease six and twelve days after inoculation. The length of the lesion produced around the site of infection and the whole length of the leaf was measured. The percentage of total leaf length that showed symptomatic lesions was used for analysis.

The fungal pathogen was reisolated from the lesions and confirmed under the microscope as *A. carthami*.

Data were analysed by ANOVA using MINITAB® Release 14.13 and treatments were compared using least significant difference tests.

Results

Six days after inoculation the level of infection was found to vary significantly between the nineteen varieties. At this time AC Stirling was found to have the largest percentage of infected tissue followed by UC1. Five varieties were in the group with the lowest level of infection, namely S501, Sironaria, Saffire, 120043 and C01.

Twelve days after inoculation UC1 and 120045 were found to display the least resistance to *A. carthami*, both having 100 per cent infection of the inoculated leaf (figure 1). Six varieties were found to be similar with low levels of leaf infection. These resistant varieties were S501, Saffire, C01, Sironaria, S555 and S8154.

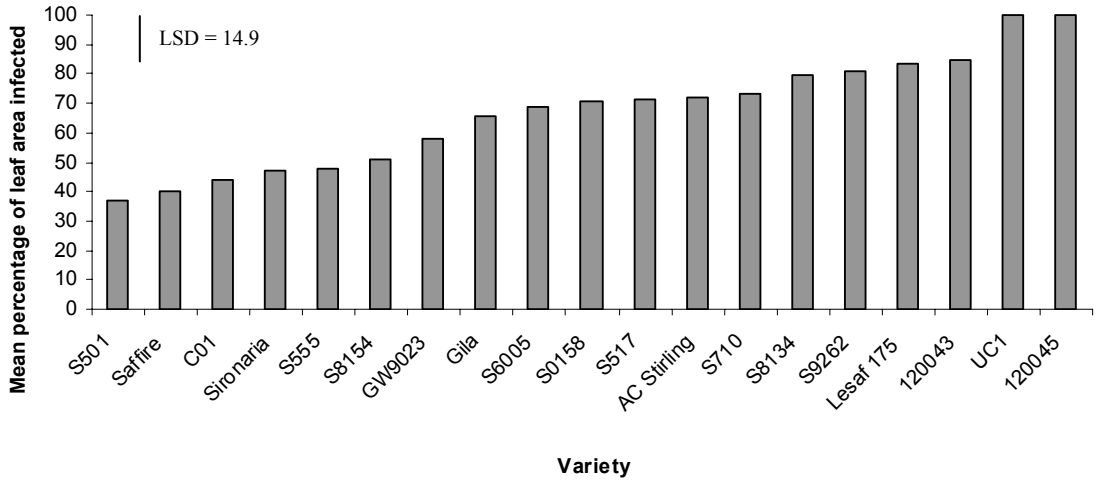

Figure 1. Mean infection ratings for each variety twelve days after inoculation (LSD calculated at P=0.05).

Some of the varieties showed large differences in the rate of infection of *A. carthami* between the two scoring intervals. For example, AC Stirling was found to have the fastest initial rate of infection, but the lowest rate of infection between day seven and twelve after inoculation.

Discussion

Significant and repeatable differences between the safflower varieties tested were found. While varieties showed some disease symptoms, at least five varieties including Sironaria were found to be significantly more resistant to *A. carthami* than the known susceptible variety Gila.

The ranking of varieties from most to least resistant at six and twelve days demonstrated that rate of infection also varied between varieties. For example the variety 120043 had significantly more disease symptoms than the known susceptible variety Gila after twelve days, but when scored six days after inoculation it was found in the most resistant group. This demonstrates that whilst initial infection is slow, disease progression may result in high levels of infection in 120043 safflower later in growth. This differential progression suggests that the use of a protectant fungicide, possibly as a seed dressing could be a useful strategy to reduce the impact of this disease by reducing early infection. On the other hand, the variety GW9023 was infected quickly by the pathogen within the first six days, so that although the rate of infection slowed down, the initial crop damage incurred could be quite detrimental.

Sironaria, Saffire and S555 have shown promising marketability characteristics (oil percentage, oleic oil content and linoleic oil content) by Jochinke *et al.* (2003). Combining this with the fact that they were in the most resistant group of varieties to *A. carthami* in this study makes them the most promising varieties for Australia's safflower industry.

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