Proceedings of the Eighth International Symposium on Biological Control of Weeds
2-7 February 1992, Lincoln University, Canterbury, New Zealand.
Delfosse, E.S. and R.R. Scott (eds). DSIR/CSIRO, Melbourne, pp. 351-4 (1995).

Survey for Pathogens of *Emex australis* in South Africa

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Surveys were conducted in 1989/90 to determine the occurrence and distribution of pathogens on spiny emex, *Emex australis*, in South Africa. Five fungal pathogens, *Aecidium rubellum*, *Cercospora tripolitana*, *Colletotrichum gloeosporioides*, *Phomopsis emicis* and *Uromyces rumicis* were found. The aecidial rust *A. rubellum*, was a new record for *Emex*. Distribution maps of these fungal were prepared. *P. emicis* was most common in southern and western Cape Province where it caused a severe stem blight and infected seeds.

Introduction

Spiny emex, *Emex australis* Steinheil (Polygonaceae), has become a serious weed of crops and pastures in southern Australia since its introduction from South Africa in the 1830s (Gilbey and Weiss 1980). The first reports of pathogens on *E. australis* and their distributions in South Africa were made by Morris (1982, 1984). He reported the occurrence of four fungal diseases: dock rust, *Uromyces rumicis* (Schum.) Wint., from eastern and southern Cape Province; leaf spot, *Cercospora tripolitana* Sacc. & Trott., from the Transvaal lowveld, Natal coastal belt, Natal midlands and eastern Cape Province; anthracnose, *Colletotrichum gloeosporioides (Penz.* & Sacc.) Sacc., from south-western Cape Province; and stem blight, *Phomopsis emicis* Shivas as *Phomopsis* sp., from south-western Cape Province.

A project to assess the potential of *P. emicis* as a biological control agent for *E. australis* was initiated in 1989. The first step in this project was to determine the distribution of *P. emicis* in South Africa and collect a range of isolates for further study. At the same time a search for further pathogens of *E. australis* was made and their distributions mapped.

Methods

Study Area

In South Africa, *E. australis* was studied in 4 regions: the eastern Cape Province, which has rain throughout the year, but is semi-arid inland; the southern Cape Province which has a temperate climate, also with rain throughout the year; the western Cape Province which has a Mediterranean type climate, with wet winters (May-September) and very dry summers (December-February); and Natal, a subtropical region with wet humid summers and dry winters (Schulze 1984). The climate of the western Cape Province most closely resembled the climate in the regions of Australia that were infested with *E. australis* (Gilbey and Weiss 1980).

Sampling

Samples of diseased *E. australis* were collected and observations made during roadside and field surveys conducted in South Africa from August 1989 to August 1990. Disease symptoms that were targeted included stem and petiole blights; lesions on stems; leaf and stem spots; inflorescence collapse and discoloured immature fruits. Mature fruits, both attached to the plant as well as those that had been shed onto the ground, were sampled randomly as it was not possible to determine visually whether they were infected.

Samples were searched for in each one quarter-degree square where *E. australis* was known to occur. Fifty quarter-degree squares representing an area of approximately 73,000 km^2 were surveyed in South Africa (Table 1). For each sample the stage of plant growth and

Table 1. Distribution of sites where *Emex australis* was found in South Africa and sample sizes.

Region	Western Cape	Southern Cape	Eastern Cape	Natal	Total
No. of sites sampled	30	11	12	11	64
No. of 1/4 degree squares sampled	22	11	10	7	50
Area sampled in each region (km²)	33,000	17,600	13,600	8,800	73,000
Approx. no. of plants examined	1,500	500	300	50	2,350

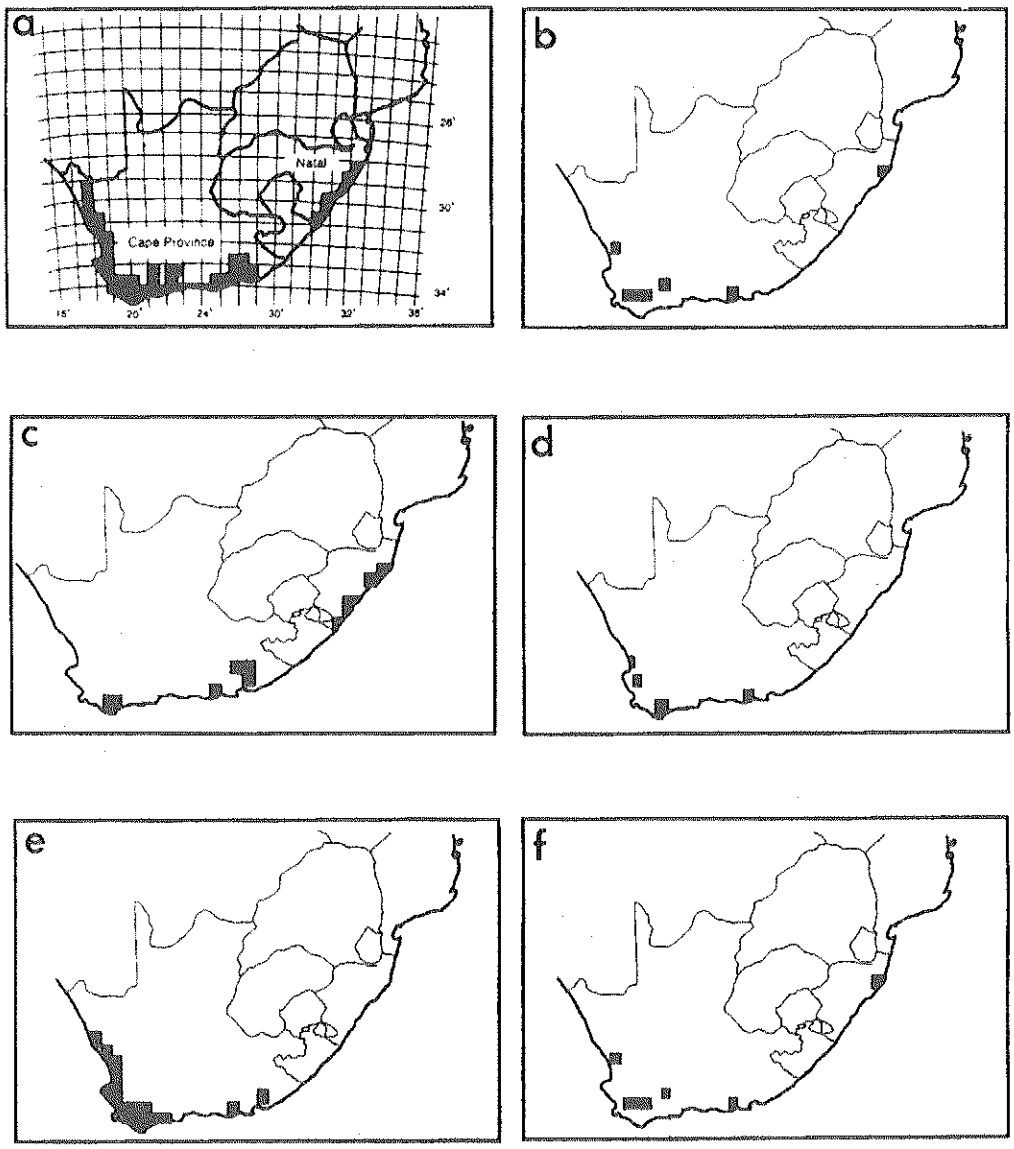

Figure 1. Distribution per quarter degree square of: (a) *Emex australis*; (b) *Aecidium rubellum*; (c) *Cercospora tripolitana*; (d) *Colletotrichum gloeosporioides*; (e) *Phomopsis emicis*; and (f) *Uromyces rumicis* in South Africa as determined by surveys during 1989-90.

the season were noted. The samples were placed into plastic bags and kept at 5°C for subsequent microbiological examination.

Pieces of infected plant tissue, excluding seeds, were surface sterilized in 1% sodium hypochlorite for 3 min, rinsed in sterile distilled water and allowed to dry on sterile filter paper. These pieces were placed onto plates of potato dextrose agar (PDA) and incubated at 25°C in the dark. Fungi that developed on these plates were brought into pure culture and identified. Isolates of *P. emicis* were kept and maintained on PDA at 5°C for future study.

Seed infection was determined by removing the seeds from mature fruits with the aid of a secateur. Twenty seeds were examined from each of 13 locations in South Africa (Table 1). The seeds were washed in 1% sodium hypochlorite for 3 min, rinsed in sterile distilled water and allowed to dry on sterile filter paper. The seeds were placed on malt extract agar (MEA) and incubated at 25°C for 3 d in the dark.

Results and Discussion

The regions in which *E. australis* was found in South Africa (Figure 1*a*) corresponded with its known distribution (Scott and Way 1990). In western Cape Province, seedlings of *E. australis* appeared from March to May and the plants senesced from October to November. During December to January plants were only found in irrigated situations and other wet areas. In the eastern and southern Cape Province the plant was present throughout the year, germinated at any time, yet remained an annual. *E. australis* was relatively uncommon in Natal.

Five fungal pathogens, *Aecidium rubellum* Gmel., *Cercospora tripolitana*, *Colletotrichum gloeosporioides*, *Phomopsis emicis* and *Uromyces rumicis*, were found on *E. australis* in South Africa (Fig. 1). Each of the pathogens was found in Cape Province. Three of these, *A. rubellum*, *C. tripolitana* and *U. rumicis*, were also found in Natal in March, 1990.

A. rubellum had not been previously recorded from *E. australis* although it had been reported on several species of *Rumex* in South Africa (Doidge 1927). This rust produced distinctive reddish lesions with yellow zonate haloes on leaves. Aecidia were produced on the adaxial leaf surface and spermagonia on the abaxial surface. The identity of *A. rubellum* was ascertained after examination by scanning electron microscopy and comparison with reference material in the *South African National Collection of Fungi*, Pretoria. *A. rubellum* caused a minor disease.

U. rumicis and C. tripolitana were identified from their characteristic spores produced in stem and leaf lesions. A severe epidemic of *U. rumicis* was observed at one location near Grahamstown in eastern Cape Province in November 1989. *C. tripolitana* was most severe late in the season and occasionally defoliated *E. australis,* especially in southern Cape Province.

Two pathogens, *C. gloeosporioides and P. emicis,* often infected plants but did not necessarily sporulate *in situ.* The identity of these fungi was determined after microbiological isolation from infected tissue. Colonies of *C. gloeosporioides and P. emicis* were readily identified by their characteristic appearances. *C. gloeosporioides* caused a minor disease and was rare in the field.

The distribution of *P. emicis* in South Africa was restricted to the western, southern and eastern regions of Cape Province. The pathogen produced a variety of symptoms on *E. australis,* including stem lesions, which were initially surrounded by distinctive red haloes; stem blight; collapsed petioles; crown rot; small discrete leaf spots; inflorescence blight; and fruit discoloration. The most conspicuous symptom of infection was stem blight which was often observed to affect all of the stems on individual plants.

In western and southern Cape Province, *P. emicis* was most frequently found on mature plants of *E. australis* towards the end of spring. It was also isolated from small discrete leaf spots on seedling and rosette plants during winter. In autumn it was isolated from dead stems of *E. australis* that had over-summered.

Seeds infected with P. emicis were found at four sites, Klawer (31°46', 18°07'), 5% of seed infected; Olifants River (31°58', 18°44'), 20%; Saldanha (32°56', 17°55'), 35%; Stanford (34°28', 19°27'), 5%. Each of these sites is in western Cape Province. No infected seeds

were found at Albertinia (34°15', 21°30'); Bitterfontein (31°01', 18°15'); Hankey (33°53', 24°52'); Hellspoort (33°07', 26°16'); Kamieskroon (30°11', 17°57'); Lambert's Bay (32°06', 18°18'); Malmesbury (33°28', 18°40'); Mosselbaai (34°11', 22°08'); Picketberg (32°52', 18°46').

The level of seed infection in the field was generally low. Seed infection appeared to cause seed mortality. There was no evidence that *P. emicis* was seed-borne, as infected seeds never germinated on either MEA or in pot experiments. Virtually all of the uninfected seeds germinated on MEA within 4 wk.

Approximately 150 African isolates of *P. emicis* were maintained in pure culture during 1989-90. Selected isolates were deposited at the Commonwealth Agricultural Bureaux International Mycological institute, Kew, England (Shivas 1992), as well as at the South African National Collection of Fungi, Pretoria. One isolate of *P. emicis* was chosen as a potential biological control candidate and introduced into quarantine at CSIRO, Canberra for host-specificity testing.

A second unidentified species of *Phomopsis* was occasionally isolated from necrotic stems of *E. australis* in Cape Province, South Africa. This species differed from *P. emicis* by the smaller size of its conidia and its inability to infect *E. australis* in glasshouse pathogenicity tests. The fungus was most likely a saprophyte that had colonised dead stems.

All of the pathogens that were found on *E. australis* in South Africa were fungal. There was no evidence of bacterial or viral diseases on *E. australis* in the field. The successful biological control of *E.* australis appears to lie with one or more of these five fungal pathogens.

Acknowledgments

This survey was part of a project done while on secondment to the Division of Plant Industry, CSIRO and funded jointly by the Wheat, Barley, Grain Legumes and Oilseeds Research Councils.

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