WHITE BLISTER AND PETIOLE BLIGHT OF SUNFLOWERS CAUSED BY *ALBUGO TRAGOPOGONIS*.

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ABSTRACT

White blister and petiole blight of sunflowers were observed in commercial sunflower crops growing on the Darling Downs of Queensland and the northwest slopes and plains and central western slopes of New South Wales. Surveys of crops in these areas during the 1978 — 79, 1979 — 80 and 1980 — 81 seasons showed that the diseases were particularly prevalent during the 1978 — 79 season when rainfall was above average. Free water on the leaf surface was essential for the germination of sporangia and the resulting production of zoospores which entered the host via stomata. Temperatures of 10°C to 15°C were found to be optimal for the prepenetration and penetration phases of infection. The development of the white blister symptoms (post penetration phase) was favoured by temperatures between 20°C and 25°C. Petiole blight, which is characterized by the presence of numerous zoospores of *Albugo tragopogonis* in the parenchyma tissue was only observed in maturing crops (between anthesis and harvest) during the cooler, autumn months. The results of field trials on the Darling Downs of Queensland showed that one application of the fungicide metalaxyl at a rate of 0.37 g a.i./litre, gave almost complete control of petiole blight when applied at the commencement of flowering.

INTRODUCTION

White blister of sunflowers caused by *Albugo tragopogonis* Pers. ex. S.F. Gray has been reported in Argentina, Uruguay, U.S.S.R., Australia and several other countries (Zimmer and Hoes, 1978). Sackston (1957) considered that the disease had the potential to cause severe injury to sunflower plants under suitable environmental conditions in Uruguay.

Disease surveys in Queensland and New South Wales (Middleton, 1971; Stovold and Moore, 1973) showed that white blister was a common disease of sunflowers in Australia. However, these authors concluded that yield reductions resulting from white blister were insignificant. More recently it has been shown (Allen and Brown, 1980) that *A. tragopogonis* could also cause a petiole blight which can prematurely defoliate sunflower plants. Allen and Brown (1980) found that petiole blight was most prevalent during the cooler weather late in the growing season (autumn) when sunflower plants had completed anthesis. Examination of affected petioles revealed the presence of oospores which represented the sexual stage of the life cycle of *A. tragopogonis*.

The objectives of the investigations reported in this paper were (i) to study the infection process and to determine the temperature requirements of different phases of the infection process of *A. tragopogonis*, (ii) to monitor the distribution and incidence of white blister and petiole blight in commercial sunflower crops in eastern Australia and (iii) to undertake preliminary field studies to determine the importance of petiole blight in eastern Australia.

MATERIALS AND METHODS

(i) Laboratory studies on the infection process.

Sporangia of *A. tragopogonis* were collected from field grown sunflower plants. Germination was studied by direct observation of sporangia in distilled water (0.2 g sporangia/1.) on welled microscope slides and in test tubes incubated at 5, 10, 15, 20, 25, 30 and 35°C. Percentage germination was determined by examining 900 randomly selected sporangia (300 sporangia in each of three replicates) for each temperature treatment. A sporangial suspension (0.2 g sporangia/litre distilled water) that had been incubated at 15°C for eight hours was used to inoculate sunflower seedlings growing in Hoaglands solution. The first true leaf pair was immersed in the sporangial (and zoospore) suspension for three hours. The seedlings were then exposed to various temperatures in growth cabinets. The penetration and post-penetration phases of the infection process were studied using phase contrast microscopy on leaves that had been cleared and stained by the method of Shipton and Brown (1962). Further information regarding these experiments and investigations into the effects of light on the infection process have been published by Kajornchaiyakul and Brown (1976).

(ii) Disease surveys in commercial sunflower crops.

The distribution and severity of white blister and petiole blight were assessed during the 1978 — 79, 1979 — 80 and 1980 — 81 growing seasons. Disease surveys were made in commercial sunflower crops growing in the central coast, central highlands, and Darling Downs of Queensland; the northwest slopes and plains, central western slopes and Riverina of New South Wales; and the Goulburn Valley of Victoria (Figure 1). Owing to limitations imposed by distance, crops growing on Queensland's central coast and highlands, the Riverina, and in the Goulburn Valley were surveyed only once each season. Commercial crops growing in the intermediate areas were inspected every four to six weeks during the three growing seasons. The location, date of survey, cultivar (if known), previous crop and growth stage were recorded for each crop that was surveyed. The severity of white blister was expressed as the mean percentage of leaf area showing disease symptoms. The percentage of petioles showing symptoms of petiole blight was also estimated. The growth stage and disease assessment keys of Siddiqui, Brown and Allen (1975) were used in this study.

(iii) Preliminary Field studies.

Two field trials were established in commercial sunflower crops at Clifton and Yangan in the southeastern Darling Downs. The major purpose of these trials was to evaluate the effectiveness of the fungicide metalaxyl in the control of petiole blight. Each trial consisted of six replicates of two treatments (no fungicide applied and metalaxyl applied at the rate of 0.37 g active ingredient/litre until run-off). The cultivars used, plot size, treatment date (including growth stage) and assessment dates are presented in Table 1. White blister symptoms were observed on all plants in both trials at the time of treatment when an assessment of this form of the disease was made. Petiole blight was not evident in either trial at the time when the fungicide was applied. The percentage of petioles showing symptoms of petiole blight was determined in each of ten randomly selected plants in each plot at each assessment time.

Table 1. Details of field trials on the south eastern Darling Downs designed to investigate the efficacy of metalaxyl in controlling petiole blight of sunflower caused by *Albugo tragopogonis*.

Trial location	cultivar	plot size	Treatment Date	Assessment Dates
Clifton	Suncross 150	4 rows x 15 m. Only the two centre rows were treated and assessed.	15 April 1981 (growth stage 3.4* just prior to anthesis)	4 June 1981
Yangan	Sungold	3 rows x 15 m. Only the centre row treated and assessed.	15 April 1981 (growth stage 3.2 — 3.3* budding)	4 June 1981 19 June 1981

*Growth stages after Siddiqui, Brown and Allen, 1975.

RESULTS

The optimal and cardinal temperatures for the pre-penetration, penetration and post-penetration phases of the infection of sunflower by *Albugo tragopogonis* are shown in Figure 2. The infection process was most favoured by temperatures of between 10 and 15°C although the development of sori was most rapid at 20 to 25°C. Figure 1 shows the distribution and severity of white blister on sunflower in different regions during the 1978 — 79, 1979 — 80 and 1980 — 81 growing seasons. The petiole blight symptom was only observed in autumn grown crops on the Darling Downs during the 1978 — 79 and 1980 — 81 seasons and on the north west slopes and plains during the 1978 — 79 season. Severe and premature defoliation of sunflower plants associated with petiole blight was only observed in May 1979 in crops growing in the south eastern Darling Downs.

Figure 1. (A) The distribution and severity of white blister of sunflower (caused by *Albugo tragopogonis)* in eastern Australia during the 1978 — 79, 1979 — 80 and 1980 — 81 growing seasons.
(B) Map of eastern Australia showing the major sunflower production areas where disease surveys were made.

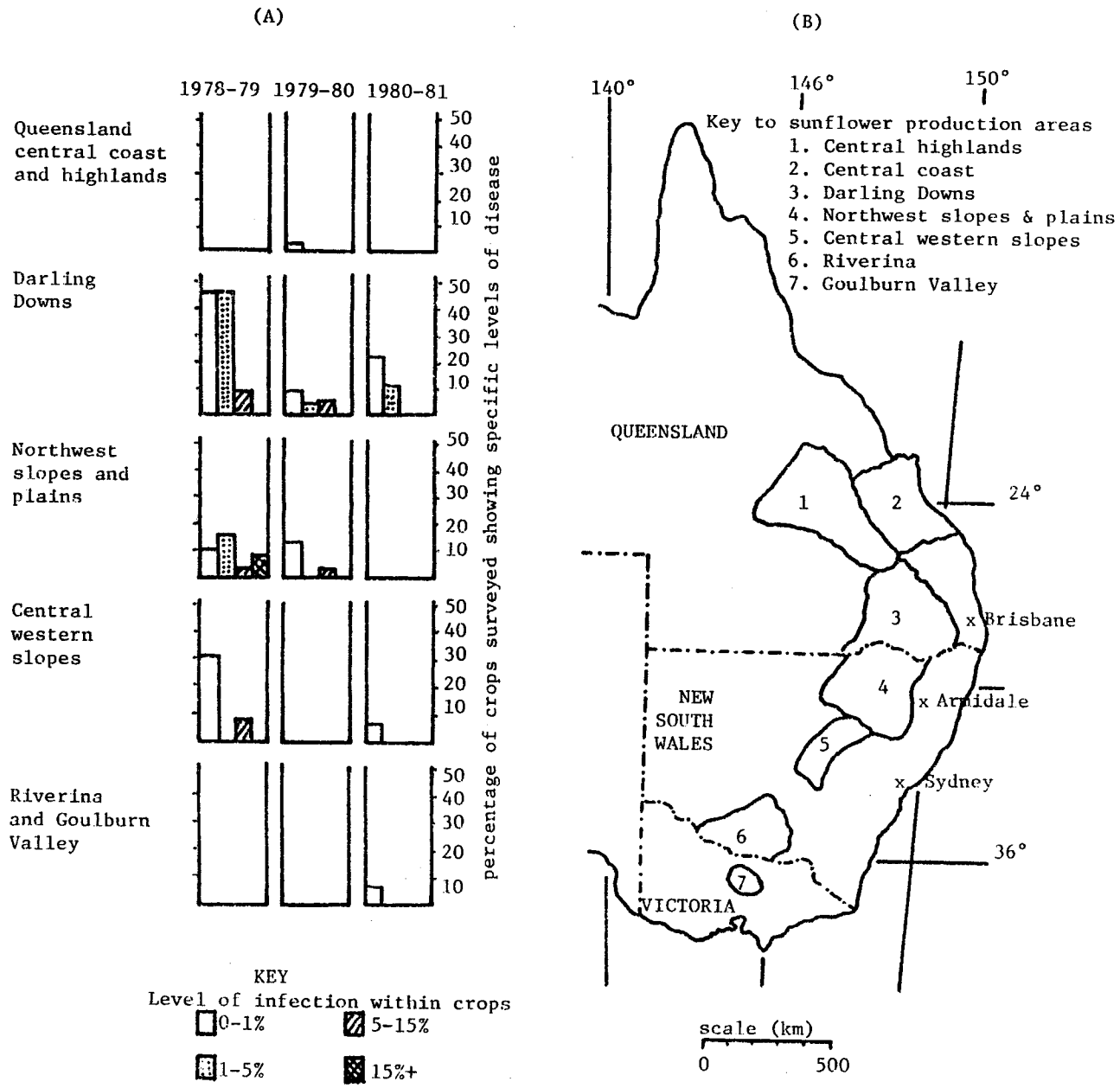
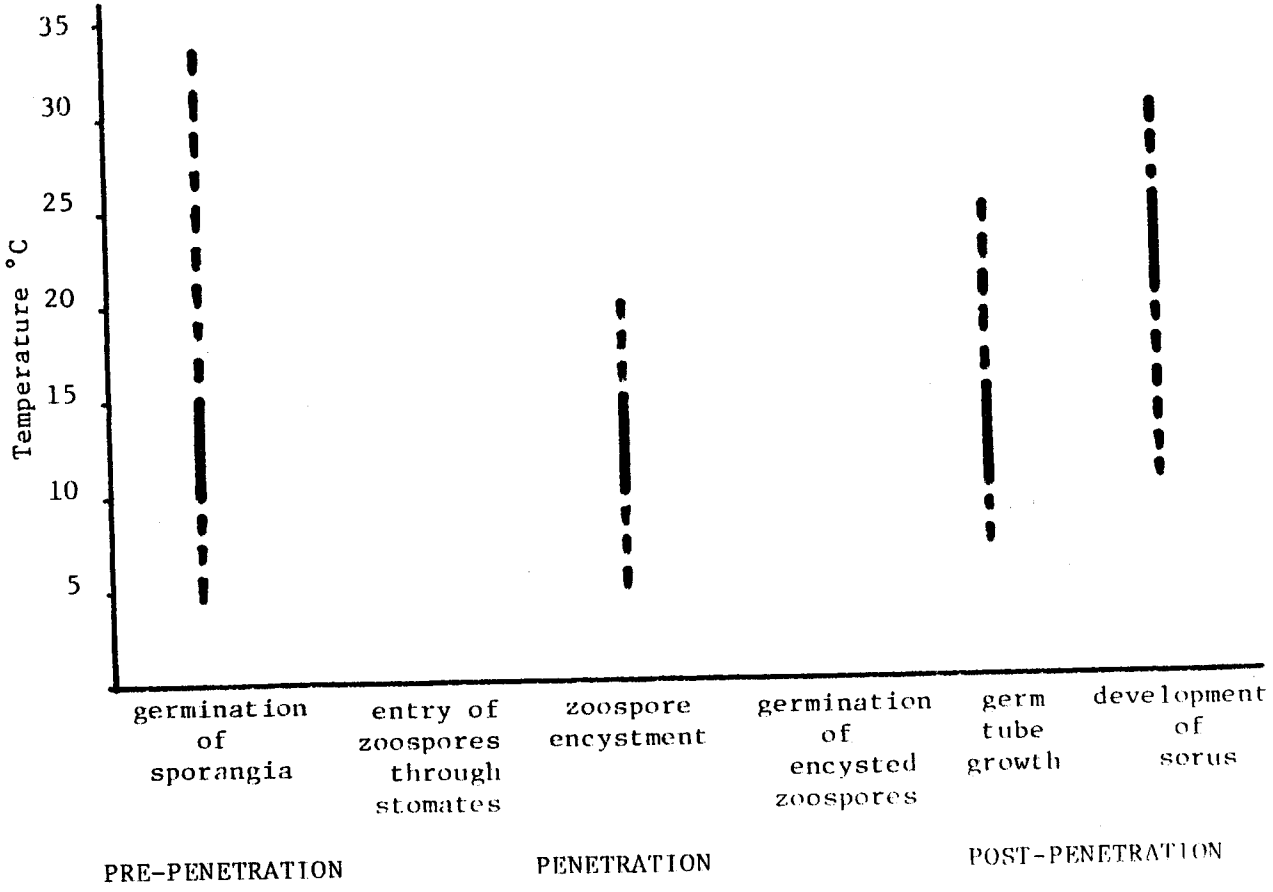


Figure 2. Optimal (——) and cardinal temperatures (– – –) for the pre-penetration, penetration and post-penetration phases of the infection of sunflower by *Albugo tragopogonis*. Adapted from Kajornchaiyakul and Brown (1976).



One application of metalaxyl at, or just prior to, anthesis gave almost complete control of the petiole blight symptom caused by *A. tragopogonis* (Table 2).

Table 2. The effect of one application of metalaxyl on the severity of petiole blight of sunflower caused by *Albugo tragopogonis*.

Trial location	growth stage at time of treatment	growth stage at time of assessment	percentage of petioles affected	
			sprayed (metalaxyl)	unsprayed (control)
Clifton	3.4	5.2	0.8%	32.3%
Yangan	3.2 — 3.3	5.1	0%	8.7%
		5.2	1.1%	16.1%

DISCUSSION

White blister and petiole blight of sunflowers were found to be most common in crops grown on the Darling Downs of Queensland and the northwest slopes and plains and central western slopes of New South Wales. This distribution is probably associated with the cool temperature and free moisture requirements of *A. tragopogonis*. The dry summers in southern New South Wales and Victoria (which experience a winter rainfall pattern) and the generally higher temperatures on Queensland's central coast and highlands do not favour infection by *A. tragopogonis*.

Petiole blight was only observed during autumn on the Darling Downs and northwest slopes and plains in the 1978 — 79 and 1980 — 81 season. Petiole blight was most severe during the 1978 — 79 season. This result correlates with the autumn rainfall experienced in the respective growing seasons (Table 3).

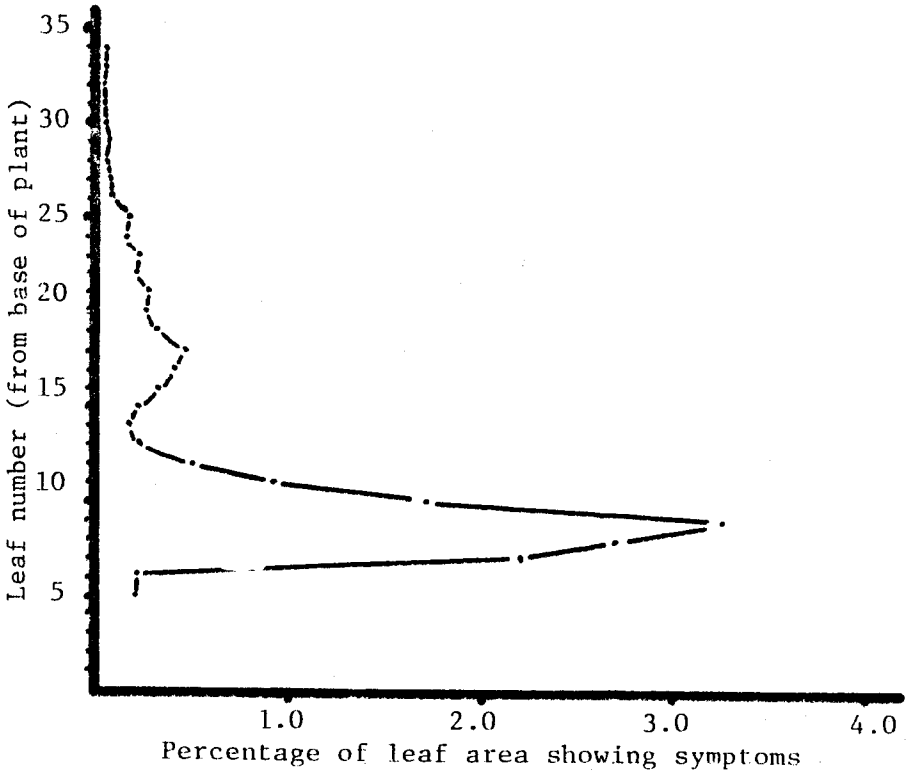
Table 3. Departure from normal (30 year average) autumn precipitation for the Darling Downs, northwest slopes and plains and central western slopes during the 1978 — 1979, 1979 — 1980 and 1980 — 1981 seasons.*

	1978 — 1979	1979 — 1980	1980 — 1981
Darling Downs	+34%	−20%	+ 9%
Northwest slopes and plains	+15%	−33%	+ 2%
Central western slopes	+36%	−15%	−27%

*data obtained from Bureau of Meteorology — Monthly Weather Bulletins.

The preliminary field trials using metalaxyl indicated that this fungicide was effective in the control of petiole blight in experimental plots. It is proposed to use this fungicide in future field trials to determine the effect of *A. tragopogonis* on the yield of sunflower. When assessing the level of white blister on plants in the Clifton trial, prior to the application of treatments, it was noted that white blister symptoms were unevenly distributed on the plant (Figure 3). Symptoms of white blister were concentrated on leaves 7 to 11 and leaves 16 to 21 (numbered from the base of the plant). It is suggested that this distribution might correlate with (i) 40 mm of rainfall over a three day period received four to five weeks after sowing and (ii) 55 mm of rainfall over a seven day period seven to eight weeks after sowing. This layered distribution of symptoms has been observed in other crops infected by *A. tragopogonis*. it is possible that leaf age and environment may interact to produce this effect.

Figure 3. The distribution of white blister symptoms on sunflower plants growing at Clifton on the south eastern Darling Downs (mean of 20 plants).



ACKNOWLEDGEMENTS

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