were more or less susceptible. Inoculation tests indicated the absence of correlation between male sterile cytoplasm and susceptibility to *D. helianthi.* Some inbreds of *H. annuus* x *H. tuberosus* consistently showed the greatest ability to survive. In addition, a similar response was obtained in a line derived from the crossing *H. annuus* x *H. argophylus.* Even in these relatively resistant lines necrosis occurred, but the lesions were limited to the cortical tissues and infected plants could set seed.

As the fungus invades the stems (Muntanola-Cvetkovic *et al.,* in press), it seems that the ability of plants to survive is due to the pathogen not being able to enter the interior of the stem.

One could suggest, therefore, that complete immunity may not be essential for control of *Phomopsis-Diaporthe* disease under field conditions.

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A LEAF SPOT DISEASE OF SUNFLOWER CAUSED BY SEPTORIA SP.

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ABSTRACT

A sunflower leaf spot disease caused by a fungus belonging to the genus Septoria has been observed in Vojvodina since July 1980. This disease, which probably existed earlier in the region but was not observed, has become more agressive in 1981 and by its damage can be compared to the well-known *S. helianthi* Ell. et Kell. However, the symptoms of the lesions, as well as the morphological characteristics of the pathogenic organism are quite different. By its microscopic structure the Septoria isolated at Vojvodina differs too from other species of Septoria reported on *Helianthus sp.* The same organism has been observed in wild species and in interspecific hybrids of the genus *Helianthus.*

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THE DISTRIBUTION AND INCIDENCE OF CHARCOAL ROT OF SUNFLOWER IN EASTERN AUSTRALIA.

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ABSTRACT

Over 500 commercial sunflower crops throughout eastern Australia were surveyed for disease incidence during the 1978 — 79, 1979 — 80 and 1980 — 81 growing seasons. Charcoal rot, which is cause by *Macrophomina phaseolina,* was common in all sunflower production areas. The disease was present in 122 (54%) of the 226 maturing crops (between anthesis and harvest) surveyed. The mean incidence of charcoal rot within crops ready for harvest was 70%. The disease was not found in crops prior to the flowering stage of plant growth. A relationship was shown to exist between high levels of disease and dry weather conditions although 13 of the crops in which charcoal rot was observed had been irrigated.

INTRODUCTION

Zimmer and Hoes (1978) considered that *Macrophomina phaseolina* (Tassi) Goid, was pathogenic on at least 284 plant species. Susceptible crops include sunflower, cotton, soybean, peanut, sorghum, maize, tomato, tobacco, potato, sesame, citrus, eucalypts and conifers (Dhingra and Sinclair, 1977).

Charcoal rot of sunflower, caused by *M. phaseolina*, has been responsible for severe yield losses in several sunflower growing areas. Acimovic (1962) reported that the disease caused a serious wilt of sunflowers in Yugoslavia during 1961 and reduced total yield by 20 to 50%. Tikhonov, Nedelko and Perestova (1976) reported that charcoal rot reduced seed yield of sunflower in the Krasnodar Territory of the U.S.S.R. by an average of 36 per cent over the three year period 1971 to 1973.

Several authors have shown that disease development is favoured by high temperatures, low soil moisture and maturing host plants (Norton, 1953; Edmunds, 1964; Edmunds and Voigt, 1966; Ghaffar and Erwin, 1969). Edmunds and Voigt (1966) claimed that the development of disease symptoms in sorghum only occurred after plants had commenced to produce seed. Wyllie and Clavert (1969) reported that seed development induced a primary stress in plants and that this predisposed soybeans to the development of symptoms of charcoal rot. These authors suggested that plants could be infected by the pathogen long before the sympoms became obvious. Tikhonov *et al.*, (1976) showed that sunflower plants could become infected with *M. phaseolina* soon after germination. They considered that the infection process progressed relatively slowly until the budding stage of plant growth. When plants were subsequently exposed to stress conditions during the flowering and seed development stage of growth the pathogen developed more rapidly, entered the vascular tissue and caused the symptoms of charcoal rot to develop.

Information provided in 1972 by the State Departments of Agriculture in Australia (*personal communications*) indicated that charcoal rot of sunflowers were present but not important in New South Wales and Queensland and had not been recorded in sunflower crops grown in Victoria, Tasmania, South Australia and Western Australia. Stovold and Moore (1973) regarded charcoal rot as a minor disease of sunflowers in New South Wales and suggested that there was some doubt as to the true role of *M. phaseolina* in causing the disease. Middleton (1973) reported that charcoal rot was regularly seen in mature sunflower stalks in Queensland but suggested that the disease did not cause any loss in seed yield.

The incidence and severity of various diseases in commercial sunflower crops growing throughout eastern Australia was surveyed during the 1978 — 79, 1979 — 80 and 1980 — 81 seasons. One of the purposes of these surveys was to investigate the distribution, incidence and importance of charcoal rot.

METHODS

The large distances separating the major sunflower production areas (Figure 1) made it impossible to regularly survey crops growing in the Goulburn Valley, Riverina and Queensland's central coast and highlands. The number of surveys in these areas was limited to one per year. In contrast, sunflower crops grown on the Darling Downs of Queensland, the northwest slopes and plains of New South Wales and the northern part of the central western slopes of New South Wales were surveyed at about four to six week intervals throughout the three growing seasons. The wide range of sowing dates available to growers in many of these areas made it necessary to conduct surveys over a nine month period extending from October through to June.

The 1978 — 79, 1979 — 80 and 1980 — 81 growing seasons were characterised by summers that were dryer than usual in most areas. Southern New South Wales and Victoria experience a winter rainfall pattern and consequently the majority of sunflower crops are grown under irrigation. The other sunflower production areas considered in this survey normally have a definite summer rainfall pattern and only a small proportion of sunflower crops in these areas are irrigated. Temperatures during the 1979 — 80 growing season were generally higher than those that occurred in the 1978 — 79 and 1980 — 81 seasons.

The incidence of charcoal rot was recorded as the percentage of plants showing disease symptoms within a crop. At least 100 randomly selected plants were examined at each site. The location, cultivar (if known), previous cropping history, date of survey and the growth stage of the crop (based on the scale of Siddiqui, Brown and Allen, 1975) were recorded. During the surveys 521 commercial sunflower crops were examined.

RESULTS

The results of individual crop surveys were divided into five groups of the basis of geographical distribution and are presented in Figure 1. Figure 2 shows the occurrence and severity of charcoal rot of sunflowers in relation to the growth stage of the host. The relationships between high levels of charcoal rot in mature crops (between petal fall and harvest) during the 1978 — 79, 1979 — 80 and 1980 — 81 growing seasons and the percentage departure from the normal (30 year average) seasonal precipitation is shown in Table 1. These data indicate a correlation between high incidences of charcoal rot and abnormally dry seasons.

Table 1. The incidence of high levels of charcoal rot in mature crops during the 1978 — 1979, 1979 — 1980 and 1980 — 1981 seasons and the percentage departure from the normal (30 year average) seasonal precipitation for these respective growing seasons.

growing season	percentage of mature crops (growth stage 5) surveyed that had more than 15% of plants infected	percentage departure from normal (30 year average) seasonal precipitation
1978 — 1979	10.9%	− 1%
1979 — 1980	34.3%	−19%
1980 — 1981	33.3%	−11%

Cropping history was recorded for 64 infected crops and 72 per cent of these crops were found to be growing in fields where a susceptible crop had been grown during the previous season. Previous crops included sunflower (34%), sorghum (33%), non-susceptible wheat (28%), maize (3%) and soybean (2%). Sclerotia of *M. phaseolina* were frequently observed in sorghum and sunflower debris from previous crops.

Examples of plant lodging as a result of infection by *M. phaseolina* were not observed during any of the surveys. Charcoal rot was observed in thirteen irrigated crops. However, the incidence of the disease in these crops was generally very low.

DISCUSSION

Several authors have described the symptoms of charcoal rot of sunflower caused by *M. Phaseolina*. In Canada, Chan and Sackston (1969) considered that a necrotic spotting of leaves was an early symptom of the infection of sunflowers by the charcoal rot pathogen. Orellana (1970) in the United States found that the symptoms of charcoal rot included wilting and chlorosis of leaves followed by the premature death of the plant. Bekesi, Voros and Calvert (1970) reported that the infection of sunflower by *M. phaseolina* in Hungary caused a sudden wilting of the plants after the anthesis stage of plant growth. In our study, the only symptoms associated with infection by *M. phaseolina* were premature death of plants and a dark discoloration at the base of the stems.

Sclerotia were always present in the lower area of the stems of infected plants. The variability in the type of symptoms reported by various authors could be explained by variability in pathogenicity among isolates of the pathogen (Mihaljcevic, 1978, Chan and Sackston, 1972) and by differences in resistance or susceptibility of various sunflower cultivars (Orellana, 1970; Mihaljcevic, 1978). Middleton (1973) claimed that the environment in Australia was different from that in other countries and suggested that this affected the expression of the disease in commercial sunflower crops in Australia.

Disease incidence appeared to be strongly correlated with increasing host maturity (Figure 2) coupled with dry weather conditions. An analysis of the results showed that charcoal rot was most prevalent in February and December 1979, April 1980 and April 1981. The monthly precipitation and mean daily temperature (averaged over the survey area) were calculated for these four months and also for the preceding month (Table 2). The deviation from the normal (30 year average) precipitation and temperature conditions is also shown in Table 2. High incidences of charcoal rot coincided in all cases with periods of below average precipitation and above average temperatures during the month of survey and/or the preceding month.

Table 2. Average monthly precipitation and mean daily temperatures[a] for periods during which high incidences of charcoal rot were observed[b].

months & years during which highest incidences of charcoal rot were observed	Percentage of maturing crops surveyed that had more than 15% of plants infected with charcoal rot	precipitation during month of survey: mean monthly total	precipitation during month of survey: diff. from 30 yr. average	precipitation during month preceding survey: mean monthly total	precipitation during month preceding survey: diff. from 30 yr. average	temperature °C (mean daily) during month of survey: mean temp.	temperature °C (mean daily) during month of survey: diff. from 30 yr. average	temperature °C (mean daily) during month preceding survey: mean temp.	temperature °C (mean daily) during month preceding survey: diff. from 30 yr. average
Feb. 1979	31%	36mm	−49%	30mm	−61%	24.9°C	+0.3°C	26.0°C	+0.9°C
Dec. 1979	43%	32mm	−57%	64mm	+11%	26.2°C	+2.1°C	22.0°C	+0.8°C
April 1980	42%	12mm	−67%	29mm	−46%	20.0°C	+0.2°C	+0.8°C	23.0°C
April 1981	43%	37mm	+ 1%	21mm	−61%	19.9°C	+0.7°C	23.1°C	+0.3°C

a — derived from Bureau of Meteorology — Monthly Weather Bulletins and averaged over the survey area.
b — derived from surveys of 226 maturing commercial crops (growth stage 5.1 to 5.3) over three growing seasons.

Charcoal rot was most prevalent in mature sunflower crops grown on the northwest slopes and plains of New South Wales and the northern part of the central western slopes of New South Wales (Figure 1). The disease was present in other areas but not to the same extent. Factors that may have contributed to this result included the predominance of irrigation farming in southern areas, the higher rainfall (600 — 800 mm/year) experienced in northern areas (particularly the central coast of Queensland) and the number of timing of disease surveys in these distant areas.

Figure 1 (A) The distribution and incidence of charcoal rot of sunflowers in eastern Australia during the 1978 — 79, 1979 — 80 and 1980 — 81 growing seasons.
(B) A map of eastern Australia showing the major sunflower production areas in which disease surveys were undertaken.

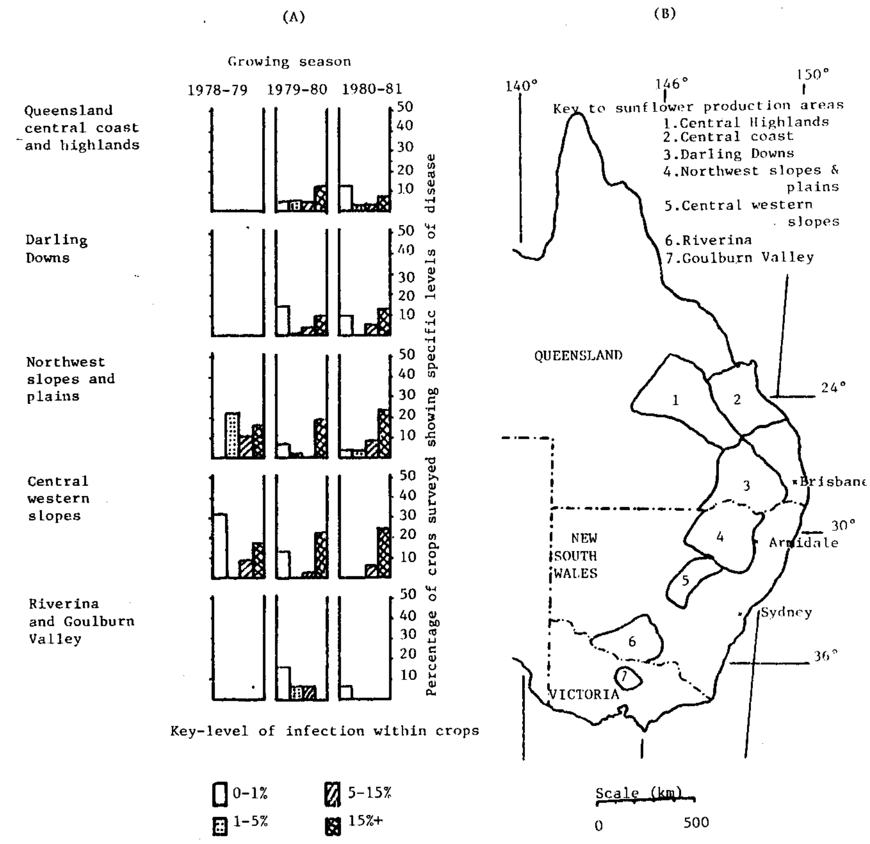
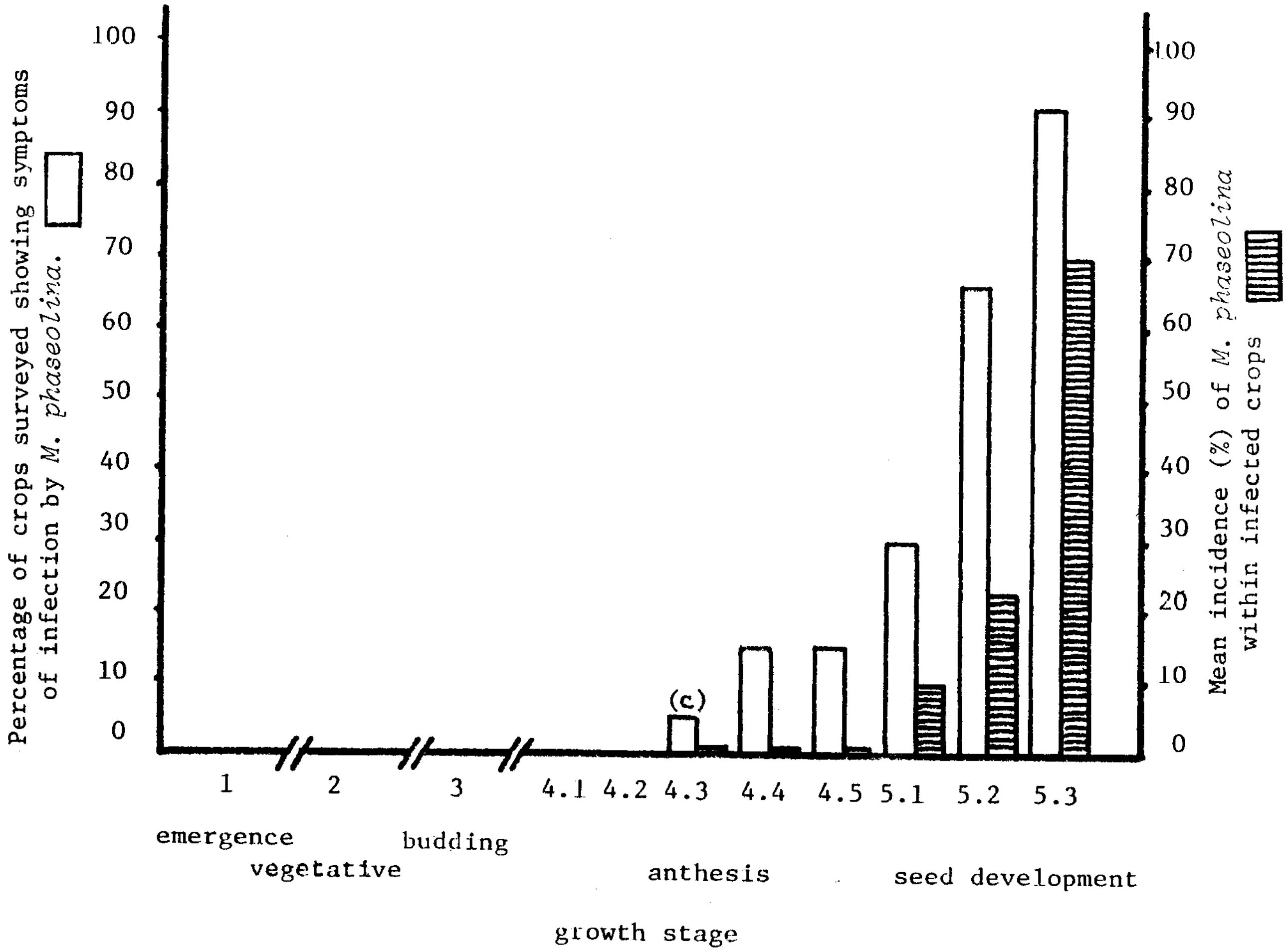


Figure 2. The distribution and incidence of charcoal rot of sunflowers with reference to the growth stage[a] of the host[b].
(a) growth stages after Siddiqui Brown and Allen (1975)
(b) based on results of disease surveys through eastern Australia during the 1978 — 79, 1979 — 80 and 1980 — 81 growing seasons.
(c) two crops at this growth stage were infected
(i) in association with atrazine damage
(ii) an open pollinated crop with a wide variability in growth stage (ie 4.3 — 5.2)



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EFFECT OF STAND DENSITY ON THE OCCURRENCE OF CHARCOAL ROT AND OIL YIELD OF SOME SUNFLOWER HYBRIDS.

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ABSTRACT

Yugoslav hybrids NS-H-26 and NS-H-67 were tested for three years to determine the effect of stand density on their seed yield, oil content, and oil yield under conditions in which *Macrophomina phaseoli* Ashby is the principal cause of premature drying up of sunflowers. Changes in stand density did not affect the intensity of occurrence of charcoal rot although it was established that the disease requires a specific combination of air and soil temperatures, rainfall, and condition of host plant. The yields of seed and oil depended on stand density and the meteorological conditions of the test years. The density of 47,000 plants per hectare brought highest yields. The occurrence of perceptible symptoms of charcoal rot at the end of sunflower vegetation did not bring conspicuous yield reductions in the test years.

INTRODUCTION

Sunflower hybrids replaced the varieties VNIIMK 8931 and Peredovic in the commercial production in Yugoslavia. The work on the development of hybrids included also agrotechnical studies aimed at the maximum adaptation of environment to the biological requirements of the hybrids. Stand density was an important factor. The majority of the new hybrids favored thicker stands.

Complex interactions exist among plants in thick stands — competition for soil water and nutrients (Diakov, 1976; Ostrovsky, 1976), effect of the above-ground plant parts on the formation of a specific phytoclimate in the crop (Vrebalov, 1966; Stanojevic, 1981).

This study was undertaken to establish the effect of stand density on seed and oil yields in conditions in which *Macrophomina phaseoli* Ashby is the principal cause of premature drying up of sunflowers.

MATERIALS AND METHODS

Experiments were conducted at the experimental field in Zajecar during the period 1977 — 1979. NS-H-26 and NS-H-67 were planted in a field in which sunflower had not been grown before, at the densities of 36,000, 47,000, 57,000 and 67,000 plants per ha, applying conventional cultural practices.

The experiment was conducted after the method of random block in five replications. Rainfall and temperature data were collected in the course of the vegetative seasons. During the stage of oil synthesis, soil moisture decreases below lentocapillary limit were registered for the soil layer to a depth of 100 cm. The percentage of infected plants was determined at maturity. NMR method was used for oil content determinations. The results were statistically calculated.

RESULTS AND DISCUSSION

The stand densities examined did not affect the intensity of occurrence of charcoal rot. There were no increases in the intensity of the disease in the plots with thicker stands. The differences obtained in individual years were not statistically significant.

In contrast, there were large differences in the percentage of infected plants from year to year. The lowest percentage was found in 1977, the highest in 1979. The plots had similar percentages in 1978 and 1979, significantly higher than in 1977 (Table 1).

Table 1. Effect of stand density on the percentage of plants infected by charcoal rot.

Stand	NS-H-26				NS-H-67			
Pl./ha	Year			Average	Year			Average
	1977	1978	1979	%	1977	1978	1979	%
67,000	15.1	63.9	81.8	50.2	33.6	37.6	69.8	47.0
57,000	17.2	75.4	80.4	57.7	34.3	39.8	59.4	44.5
47,000	22.3	72.3	72.0	55.5	36.4	54.2	69.9	53.3
36,000	13.5	76.4	69.8	56.6	41.7	50.3	55.8	54.3
Average:	17.0	72.0	76.0	55.0	36.5	45.4	63.7	48.5
LSD 5%				10.64				11.92
LSD 1%				14.09				15.42