Results of these studies may be very useful to plant breeding programmes, particularly those which pyramid resistance genes to maintain or improve resistance.

We realize that generation time, pustule number and pustule size of rust can be varied by a number of factors including climate, uredospore and plant age and uredospore density on leaves. However, the data we obtained in controlled conditions indicate that the isolate from collections prior to 1980 would develop more slowly on the hybrids Hysun 31, Suncross 52 and Sunace than on the open-pollinated cultivars Polestar and Sunfola 68-2. Therefore, in the field, we would expect a lower intensity of rust on these hybrids than on the open-pollinated cultivars. With the isolate collected from hybrids in 1980, we would expect that rust development would be fairly similar on these three hybrids and the open-pollinated cultivars, and that rust intensities on these cultivars in the field, would be similar. Whether yield loss caused by the rust on these hybrids is equivalent to that on open-pollinated cultivars, has yet to be determined and is currently being investigated.

Hence there is some evidence that the increased intensity of rust on some hybrid cultivars in Queensland may be due to a change in the rust population. This new population is more aggressive on these hybrid cultivars but other hybrid cultivars are still highly resistant to it. With our current differentials it is not possible to differentiate this population from race group 1. More work is required to elucidate some of the questions that this research has posed.

ACKNOWLEDGEMENTS

We wish to thank the Australian Oilseeds Research Committee who provided funds for this research.

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OCCURRENCE OF SUNFLOWER DISEASES IN PORTUGAL IN THE LAST FOUR YEARS (1978 — 1981).

MAUD L. de BARROS
Missao de Estudos Agronomicos do Ultramar (JICU), Ap. 3014, 1301 Lisboa Codex, Portugal.

ABSTRACT

Symptoms of head rot *(Rhizopus arrhizus)*, gray rot *(Botrytis cinerea)*, white rot *(Sclerotinia sclerotiorum)*, leaf spot *(Alternaria* sp.*)*, collar rot *(Fusarium* sp. and *Sclerotium rolfsii)*, rust *(Puccinia helianthi)*, wilt *(Fusarium oxysporum)* and head drop *(undetermined)* on different stages of sunflower development are described, as well as their intensity of occurrence in the growing seasons of 1978 — 1981. The most harmful parasites in Portugal were *R. arrhizus* in 78 — 79 and *F. oxysporum* during 80 — 81. Satisfactory results have been achieved using different methods of inoculation of *R. arrhizus* in greenhouse. Pathogenecity tests were also undertaken for *B. cinerea* and *F. oxysporum* under greenhouse conditions.

INTRODUCTION

Sunflower growing areas in Portugal are mainly situated in the Alentejo and Ribatejo regions and the cultivars mostly used are Smena, Peredovik and also some spanish hybrids. From field surveys undertaken during the growing seasons of 1978 — 1981, a number of diseases have been reported and most of the causal organisms identified (Barros, 1978, 1980). This paper presents the results of the field surveys during the last four years and Table 1, summarizes sunflower diseases in Portugal and their occurrence.

DISEASES

Head rot *(Rhizopus arrhizus* Fisher*)*, appears as a brown spot on the back of the flowering and ripening heads, spreading rapidly as a soft rot. We began the study of this disease in 1977 and we consider it as a first record for Portugal (Barros, 1980). It was firstly observed at Elvas and Beja (Alentejo) and Vila Franca de Xira (Ribatejo). Intensity of infection was of medium attack (2)* during 1978 and 1979, being in regression — weak attack in 1980 and scarce in 1981.

Gray rot *(Botrytis cinerea* Pers. ex Pers.*)*, was observed attacking young sunflowers before budding at Alcacer do Sal (Alentejo), 1978 — weak to medium attack — and at Evora and Elvas, later in the same year attacking the base of the stem of older sunflowers. Symptoms observed were of typical gray rot, showing a velvet gray mass of conidia. Scarce in 1980.

White rot *(Sclerotinia sclerotiorum* (Lib.) De By.*)*, observed in 1977 in the Alentejo (Evora and Arraiolos), showing some importance — weak attack — at Vila Franca de Xira (1978), where we could observe well developed plants completely destroyed, presenting a rot at collar and stem zones with cellulosic tissues entirely destroyed. Large and irregular sclerotia and the presence of mycelium were observed in the fields. Scarce in 1980 and not observed during 1981.

Leaf spot *(Alternaria* sp.*)*, observed only on old leaves and sepals. Weak occurrence of no economic importance.

Collar rot *(Fusarium* sp.*)*, inducing a constriction at the base of the stem, observed at Vila Franca de Xira (1977), Alcacer do Sal (1978), Elvas (1977 and 1978) — weak occurrence — and not detected during 1980 and 1981. A different collar rot presenting an external white mycelium, due to *Sclerotium rolfsii* Sacc. was recorded for the first time at Elvas in 1978. Incidence scarce.

Rust *(Puccinia helianthi* Schw.*)* was recorded for the first time on *Helianthus annuus* L. in Portugal in 1976 (Dias & Lucas, 1978) but reporting only the urediniospores. Teliospores were observed and described for the first time in Portugal — Beja and Ferreira do Alentejo, 1979 — (Barros, 1980)

on leaves of well developed mature sunflowers. Teliospores were grouped in prominent sori (telia) of dark brown to blackish coloration and the spots of the uredinia were of lighter brown color which permits to distinguish easily these two types of infection in the same leaf, even to the naked eye. Occurrence restricted to the above referred areas in 1979 and not important during 1980 — 81.

Wilt *(Fusarium oxysporum* Snyder & Hansen*)*, occurs between budding and full flowering stages. Early attacked plants become "mummified" at the budding stage and dry quickly in an erect position. Roots observed were heavily covered by mycelium easily visible to the naked eye (Barros, 1981). These symptoms have been observed during the last two seasons (1980 — 81), widespread in almost all sunflower areas of Ribatejo and Alentejo with variable occurrence from (1) to (2) and (3) specially at Beja in 1981.

Head drop (undetermined), observed on full flowering heads independently on heavy or small ones. There is no conspicuous prior rot but the peduncle, just behind the head or close to the first node, appears broken and the head drops off. These symptons were observed for the first time in the Alentejo (Elvas and Evora) in 1980 (Barros, 1981). Collected material is under study and occurrence in the fields is scarce. We assume these symptoms correspond to the head drop condition cited for Spain (Sackston, 1978). According to this author the cause is unknown, possibly physiological or due to insect attack.

* In a scale of evaluation from 0 to 4 adopted by the FAO Research Subnetwork On Sunflower Diseases (Acimovic, 1979):(0) = healthy plants; (1) = weak attack (damages ranging to 25%); (2) = medium attack (from 26% to 50%); (3) = strong attack (from 51% to 75%) and (4) = very strong attack (from 76% to 100%).

Table 1 — list of sunflower diseases in Portugal and their intensity of occurrence (1978 — 1981).

Disease (common name)	Pathogen	Occurrence 1978 — 1979	1980 — 1981
Head rot	*Rhizopus arrhizus*	medium	weak to scarce
Gray rot	*Botrytis cinerea*	weak	scarce
White rot	*Sclerotinia sclerotiorum*	weak	scarce
Leaf spot	*Alternaria* sp.	not important	not important
Collar rot	*Fusarium* sp.	weak	—
	Sclerotium rolfsii	scarce	—
Rust	*Puccinia helianthi*	scarce	—
Wilt	*Fusarium oxysporum*	—	medium to strong
Head drop	undetermined	—	scarce

EXPERIMENTAL PROCEDURES AND RESULTS

The method employed for checking the intensity of occurrence of diseases was: observation on 100 plants in five spots (total 500 plants), checked along the diagonal for plots with areas from 10 to 100 ha or, 20 plants in five spots (total 100) for smaller areas (< 10 ha), employing the scale of evaluation from 0 to 4 referred above, according to Acimovic (1979).

Collected material was isolated and identified in laboratory. Pathogenecity tests, undertaken on sunflower cultivars under greenhouse conditions, gave satisfactory results for *F. oxysporum* (disks of inoculum deposited at the secondary roots level of the cv. Peredovik, Smena and Argentario before budding stage) and specially for the isolates of *B. cinerea* (symptoms obtained on 100% of inoculated plants of cv. Peredovik, Smena and Ronsum 52, using the same procedure). In what concerns *R. arrhizus* tests, with the last three cultavars, shows that like the control sunflowers, neither injury alone nor the presence of inoculum on uninjured heads presented any symptoms — 0%; inoculum in distilled water suspension, sprayed on injured heads showed little infection; on the other hand, 58.4% of infection was achieved introducing disks of inoculum near the sepals and 100% of infection if injury was made and inoculum disks were introduced closer to the middle of the back of heads. These results prove that this fungus is a wound parasite.

No differences were noted concerning susceptibility to these three pathogens, among the sunflower cultivars used in pathogenecity tests.

DISCUSSION

As can be seen from Table 1, there is a decrease in the incidence of *B. cinerea, S. sclerotiorum* and specially of *R. arrhizus* during the biennium of 80 — 81.

Climatic conditions required for the development of these three fungi were not possibly achieved due to lack of rain in Portugal during winter and spring, particularly in 1981, associated with high summer temperatures observed and a heat wave occurrence in June 1981, that may explain such decrease. Also, as the Fusarium wilt disease appeared early and many sunflowers could not achieve full flowering stage and dry immediately after, we can assume the regression of *R. arrhizus* as a consequence of the prior wilt disease occurrence in the fields.

ACKNOWLEDGEMENTS

Thanks are due to Dr. Maria T. Lucas for critically reading the manuscript.

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