Reasons for the unusual manifestations of Albugo on sunflower in South Africa

P.S. VAN WYK and A. VILJOEN
Grain Crops Institute, Private Bag X1251,
Potchefstroom 2520, Republic of South Africa

Abstract
Environmental conditions prevailing during the white rust epidemic of sunflower in 1992/93 were analysed and their contribution to disease development are discussed. Three major factors contributed to the development of the disease: i) Climatic conditions were extremely favourable and triggered the epidemic, ii) The pathogen was widespread and present in large numbers, and iii) Most of the favoured cultivars (hybrids) were susceptible and their susceptibility was enhanced by herbicides.

Introduction
White rust on sunflower was first reported in South Africa in 1929 and the causal organism listed as being *Cystopus tragopogonis* (Pers.) Schroet. (VAN DER BIJL 1929, VERWOERD 1929). The disease has not been regarded as important and even severe leaf infections did not affect yield (MALAN 1989, VERMEULEN unpublished data).

During the 1992/93 production season, plants in many fields over a large geographical area lodged during the early flowering stage (VAN WYK and RONG 1993). Several plants, however, lodged at a much later stage, well after seedfill (VAN WYK et al. 1995). Stems of plants broke at lesions infected by numerous oospores of *Albugo tragopogonis* (DC) S.F. Gray. Losses in yield of 80-100% were frequently reported. During the following season, losses were less frequent and less severe (VAN WYK unpublished data).

A research programme was launched in August 1994 to address this problem. In order to control the disease, it was necessary to identify the reason/s for the new manifestation of *A. tragopogonis*. This paper considers possible factors that contributed to the occurrence of the disease.

A The environment
I) Intra seasonal variation
Successful germination of oospores and sporangia and subsequent infection of the host depends on free water and temperatures between 10 and 15 C. Optimal conditions for infection during normal growing seasons will usually

be encountered from September to November, and from February to April. During these periods, low temperatures and high rainfall result in high relative humidity and dew formation. From December to midsummer conditions become unfavourable for infection and spread of the pathogen. In early plantings, infections of the lower leaves are common, but plants tend to "outgrow" the disease. In contrast, plants from late plantings may be free from disease during the early stages, but become heavily infected during the later stages. The epidemic during 1992/93 also manifested on later plantings.

II) Inter seasonal variation

Climatic conditions, especially rainfall, often vary from season to season. Long-term cycles have been recognised (TYSON 1987) designating the 80's as a decade of below average rainfall. The early 90's had much more rain and during the 1992/93 growing season an abnormally wet late season was experienced. Conditions for disease development, therefore, reached an optimum during the latter part of the 1992/93 growing season.

B The pathogen

White rust lesions on sunflower leaves produce large numbers of oospores. These oospores are thick walled and can survive for >15 years in the soil. If the production history of sunflower is considered, it seems possible that soil in all sunflower fields in South Africa became infested over the years. The degree of infestation will, however, differ considerably from field to field. If the possibility of secondary spread of sporangia is considered, a homogenous spread of inoculum is available for infection of sunflower plants throughout the season.

One possibility that could reduce the spread of this disease is the feeding of two species of beetles. During the early growing season *Astylus atromaculatus* Blanchard and *Formicomus rubricollis* Laferte suppress the secondary spread of the disease by devouring large numbers of sporangia (VILJOEN et al. 1996). These beetles are even more effective as conditions become less favourable for disease development during the mid season. During the late season, however, *Astylus* beetles move from white rust lesions to flowers and to maize plumes and silks. Although *F. rubricollis* continue to feed on white rust, their feeding seems to have little impact on the disease during conducive periods.

C The host

Prior to the introduction of sunflower hybrids during the early seventies, open pollinated varieties like Frans Lever, Smena and Kort Rus were the only ones

available. Although they were susceptible to *Albugo* infections, the disease was not regarded as a serious threat. Several breeding programmes were initiated and the majority of the South African cultivars presently available were developed during the eighties. Resistance to white rust was not a primary selection criterion for the following reasons:- i) White rust resistance was not an important issue based on the history of the disease, and ii) Occurrence of white rust was sporadic and largely absent during this notoriously dry decade. Recent cultivar trials indicated that most South African cultivars are highly susceptible to white rust. Newly introduced cultivars from Australia outranked the South African cultivars in resistance trials. This is not surprising, as Australian breeders recognised the importance of *Albugo* as a pathogen several years ago (ALLEN & BROWN 1980).

The introduction of herbicides in sunflower production began in the late seventies. Trifluralin, alachlor and metolachlor were introduced first. These were followed by alachlor/bifenox, dimetanamide and metazachlor during the late eighties and early nineties. In trials held at our research station, it was found that disease development and lodging due to *A. tragopogonis* increased significantly in certain cultivar/herbicide combinations. Herbicides were widely used by 1992/93 and >90% of all fields were treated with one of the abovementioned herbicides. Predisposition of sunflower by herbicides, therefore, probably contributed to the white rust epidemic in 1992/93.

Discussion

In the 1992/93 season cool wet weather was experienced from early February to the end of the growing season in late April. More than 80% of all fields were planted with only five of the available cultivars. These cultivars later proved to be susceptible to white blister rust. Most fields were treated with herbicides and since sunflowers have been cultivated widely and frequently on all fields, inoculum was present at high levels in almost all areas. This resulted in an unexpected epidemic.

Present status

Farmers have been advised to plant earlier in the season where possible. Cultivars have been screened for resistance and for compatibility with herbicides. Resistant lines have been identified for late plantings and as an interim measure, metalaxyl may be sprayed at stage 5 with a single application.

References

ALLEN, J., and BROWN, J.F. 1980. White blister, petiole greying and defoliation of sunflowers caused by *Albugo tragopogonis*. Australian Plant Pathology 9: 8-9.

MALAN, D.E. 1989. Blaarvleksiektes van sonneblomme in die 1988/89 seisoen. Oilseed News. June 1989.

TYSON, P.D. 1987. Climatic change and variability in Southern Africa. Oxford Univ. Press. Cape Town. 220 pp.

VAN DER BIJL, P.A. 1929. The fungous flora of the Western Province of the Cape. In: Botanical features of the South-western Cape Province, Cape Town pp. 99-117.

VAN WYK, P.S., and RONG, I.H. 1993. Omval van sonneblom in die afgelope seisoen. Oilseeds News. September 1993.

VAN WYK, P.S., JONES, B.L., VILJOEN, A., and RONG, I.H. 1995. Early lodging, a novel manifestation of *Albugo tragopogonis* infection on sunflower in South Africa. Helia 18: 83-90.

VERWOERD, L. 1929. A preliminary check list of diseases of cultivated plants in the winter rainfall area of the Cape Province. Union of South Africa, Dept. Agric. Sci. Bull. 88, 28pp.

VILJOEN, A., DU PLESSIS, H., VAN WYK, P.S., and HAMILTON-ATTWELL, V.A. 1996. Feeding of *Formicomus rubricollis* and *Astylus atromaculatus* on white blister rust of sunflower. African Plant Protection (submitted for publication).