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STUDIES OF ALTERNARIA BLACK SPOT  
(ALTERNARIA HELIANTHI HANSF.) OF  
SUNFLOWER IN YUGOSLAVIA

*Alternaria* black spot (*A. helianthi*) became a very serious disease causing great damages to sunflower in Yugoslavia. It appears in epidemic form nearly every year and, in association with some other diseases (caused by *S. bataticola*, *S. sclerotiorum*, *P. helianthi*), represents the main limiting factor of sunflower production in this country.

The first record of the presence of this disease in Yugoslavia was reported by Aćimović (1966). A relatively long time after the first description of this disease there was a confusion in identification of the fungus. In the beginning *A. helianthi* was described as the causer of brown spot on *Helianthus annuus* L. (Hansford, 1943). Pavgi and Upadhyay (1964) described *A. helianthi* as new species of *Helminthosporium* on sunflower in Africa. In Japan, Takano (1963) reported the presence of a fungus similar to *Alternaria* or *Helminthosporium* from the diseased leaves of cultivated *Helianthus annuus*, but without describing it. Tubaki and Nishihara (1969) restudied the collected diseased material of sunflower from Japan and they concluded that the fungus should belong to the genus *Alternaria*, because of the presence of longitudinal septa in the conidia. Therefore, these authors proposed a new name for the fungus - *A. helianthi* Hansf.

Symptoms of the disease appear on leaf, leaf petioles, stem and head. The spots on the leaves are unequal in shape, size and colour in the different sunflower genotypes. They are in the beginning in the form of minute brown spots,

enlarging later, and becoming roughly discrete, occasionally with typical concentric rings. More numerous dark linear necrotic lesions appear on leaf petioles. The spots on the stem are at first discrete, slightly sunken, elongated, superficial lesions which later split open. Under favourable conditions, the lesions enlarge and become more numerous, girdling the entire stem with black colour. Affected plants with heavy stem infection prematurely die. Brown to black spots of different shape and size appear in petals and sepals and on the base of the head. We propose to call this disease *Alternaria* black spot of sunflower.

### Some Biological Characteristics of This Fungus

The fungus isolated from different diseased parts of sunflower plants was identified as *A. helianthi*. In pathogenicity test with artificial inoculation of various inbred lines, hybrids and varieties in growth chamber, glass house and in field condition, the same symptoms were found on the plants as described earlier, and from these lesions the fungus was regularly reisolated.

*A. helianthi* grows very slowly on PDA and sporulates heavily, producing 2-6 conidiophores (30-110 X 6-10  $\mu$ ) and large conidia (25-125 X 12.5-35  $\mu$ ) which are mainly transversely septate. Sporulation on diseased tissue in moist condition is usually abundant, more heavily on petioles and head, less on stem and least on leaf. Differences in sporulation have been found on different sunflower genotypes. Under favourable conditions conidia germinate within 1 hour, but with the age of culture on PDA, it takes sometimes 1-24 hours. The fungus grows on PDA from 1 to 33°C, the optimum being 23-25°C. For successful infection a minimal period of 12 hours in saturated atmosphere is required. In test conditions the minimal incubation period was 24 hours.

In natural conditions of the main sunflower growing region in Yugoslavia, the most important source of inoculum are plant debris in the infected sunflower field. During winter conidia lose their viability. Fungus mycelia survive in infected tissue which produce conidia in the next spring or summer.

Sunflower seed can also be infected and in this way it is possible to transmit the fungus from one to another season or from country to country, but this source of infection is probably negligible.

### Epidemiology of Alternaria Black Spot of Sunflower

This study was carried out in the field conditions during 1974 and 1975. The development of the disease was accompanied by the growing intensity of attack from appearance of the first symptom till maturity of the plants. Before flowering the disease occurs sporadically on older leaves, but later on it gradually attacks leaf petioles, afterward stem and in the wax stage heads. The heaviest infestation on leaf and stem usually appears in the period between milk and wax stage which causes premature death of plants. Besides meteorological factors, the development of the disease is influenced by weakening and senescence of plants.

Under natural conditions of infection it has been found that downy mildew (*P. helianthi*) plants are less attacked by *A. helianthi* than healthy one. The same result was also found on artificially inoculated plants.

### Problem of Sunflower Resistance to Alternaria Black Spot

Reaction of 1650 inbred lines was studied for the last two year under natural conditions of infection. Great differences were observed in reaction of sunflower genotypes to this disease.

Most of them are very susceptible and no one was genetically resistant to this disease. Few of them are moderately resistant. Similar reaction was found under artificial condition. A better result of sunflower genotype reaction to the disease may be achieved in glass house. This is especially true of mixed infection of leaves by *Septoria* and *Alternaria* or *Phoma* and *Alternaria* on the stem which are sometimes very difficult to distinguish only on the basis of symptoms. To find out suitable procedure in breeding programme for resistance, different methods and time of inoculation were applied in field and glass house conditions. We achieved positive response in inoculating plants with conidia of the fungus grown on artificial media or produced in moist chamber on naturally infected head. The best time for inoculation in glass house conditions is in the milk stage but in field conditions inoculation should be made at 10-15 leaf stage and in some years it should be repeated 2-3 times as successful infection depends on weather condition.

#### Damage Caused by *Alternaria* Black Spot and the Possibilities of Chemical Control of the Disease

A field trial was given and three treatments were chosen to study these questions on the variety VNIIMK in 1975. In the first treatment plants were artificially inoculated in budding stage, in the second treatment plants were kept under natural conditions of infection and in the third treatment fungicide used was Benlate (methyl 1 - (butylcarbamoil)-2-benzimidazole carbanate) at the rate of 0.5%, sprayed at an interval of 10-15 days. Considerable reduction on disease severity was observed on all parts of the plants, especially on stem in plots where chemical control was applied, and the seed yield was higher over artificially and naturally infected plots (Table). This result shows considerable in-

fluence of the disease on sunflower yield. It may be mentioned that chemical control have reduced some other diseases especially Phome on the stem. Chemical control of Alternaria black spot could be of great value, but it needs more detailed studies before its application in practice.

Table

Effectivity of Chemical Control of Alternaria  
Black Spot

Treatment	Seed yield, c/ha	Yield decrease at chemical treatment	
		c/ha	%
Natural infection			
(0.5 Benlate, 5 sprayings)	36.78		
Artificial inocula- tion (without spray- ing)	30.24	-6.54	-17.80
Natural infection (without spraying)	31.62	-5.16	-14.10

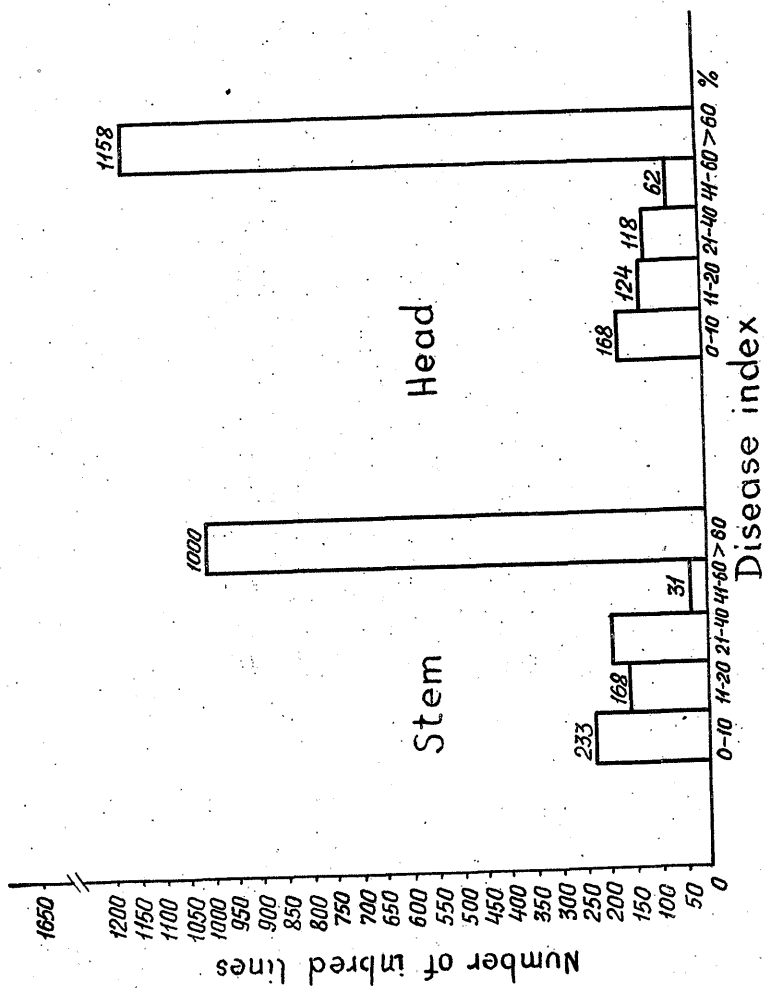


Fig. 1. Distribution of the number of inbred lines according to their reaction to Alternaria black spot on stem and head

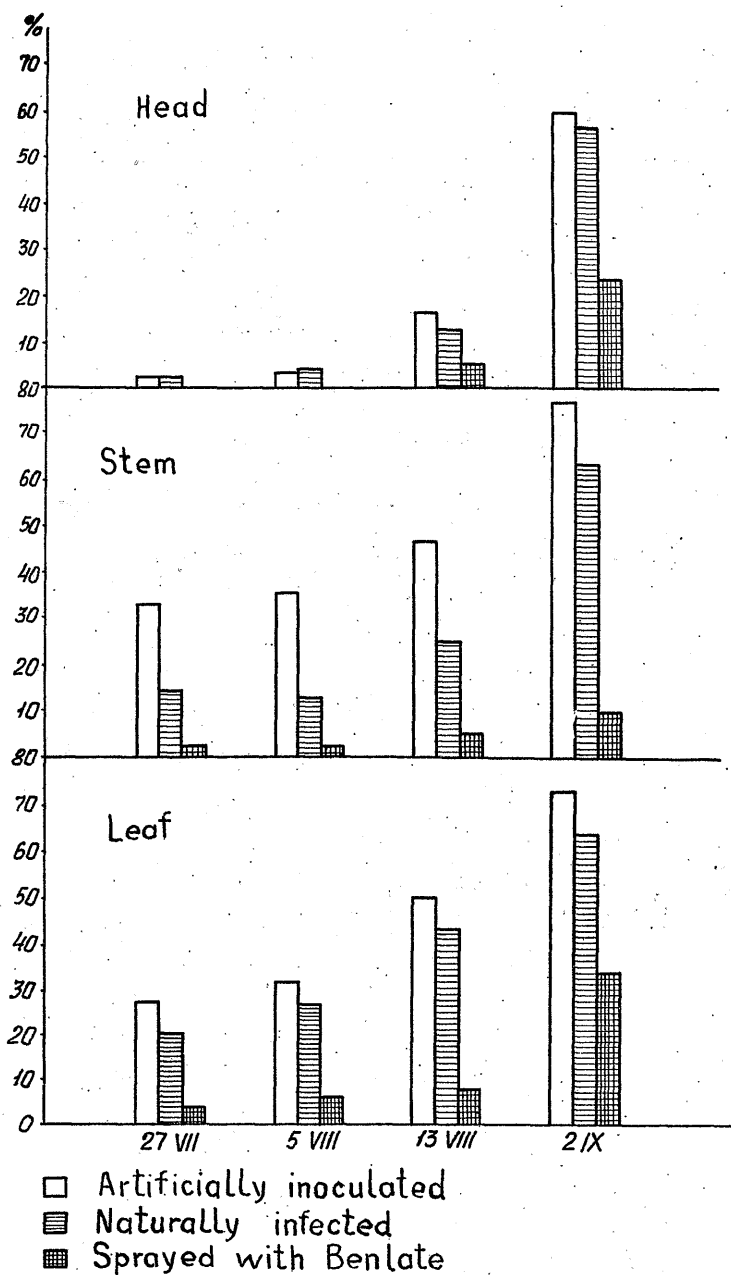


Fig. 2. Development of *Alternaria* black spot of sunflower on artificially inoculated, naturally infected and chemically protected plants with Benlate in 1975

## References

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