ROLE OF AERIAL INFECTION IN SUNFLOWER PHOMOPSIS *(PHOMOPSIS [DIAPORTHE] HELIANTHI)* EPIPHYTOLOGY

V. I Terekhov, I. I. Begunov, and **A. G. Begunova,** All-Russian Research Institute of Biological Plant Protection, 350039, Krasnodar, Russia
E-mail: vniibzr@internet.kuban.ru

Abstract

Perithecia are the fruiting bodies of *Phomopsis helianthi* (Munt.-Cvet. et al.) which are produced in crop residues. During the spring-autumn vegetation season an infection rate in sunflower (*Helianthus annuus* L.) plants depends on the amount of ascospores which are produced in asci in the perithecia. The activity of ascospore emission is limited by precipitation intensity. The maximum activity was observed three or four days after precipitation.

Introduction

In the recent years sunflower Phomopsis (*Phomopsis helianthi/Diaporte helianthi*) has been one of the most harmful quarantined diseases which continuously expand their areas. The disease became a limiting factor for sunflower production because it not only lead to oil seed yield losses, but also caused sunflower oil deterioration. Nowadays, the disease has spread through practically the whole territory of the North Caucasus. The absence of resistant varieties and hybrids creates the prerequisites for Phomopsis epiphytotics in this region.

From the point of view of epiphytology the "host-pathogen-weather" system includes the following key parameters: seasonal growth rate of the share of infected plants, their infection severity and as a result disease harmfulness. The main process that controls those parameters consists of the circulation of the pathogen when it is at its saprophytic stage both in plant residues and oil seeds.

The initial Phomopsis infection source includes the ascospores which are produced in perithecia under higher humidity conditions with the temperature above 10C. The perithecia appear in overwintered plant residues. Therefore, it is undoubtedly very important to develop the approaches to evaluate the ecological resources which synchronously or asynchronously rule over the parameters of anemochorous disease spread at a "green plant" stage. In other words, it is necessary to take a step towards development of methodology for controlling the date of airborne ascospore occurrence within the near-ground layer, and, in this connection, evaluate the periods of possible reinfection in plants due to the ascospore emission from primary infection localization focuses.

Materials and Methods

A special two-year field experiment for studying ascospore emission from the primary infection focus included the following steps: overwintered plant residues were put into interrows after sunflower germination. The plants grown without infection served as a control.

Ascospore levels in the air (from the beginning of the two-leaf stage) and the beginning of spore flight was determined by using horizontal spore traps (standard slides). Simultaneously, the meteorological situation (temperature, relative humidity, durability of moistering plants with water drops) in the near-ground atmospheric layer was observed. At the same time, appearance and development of Phomopsis infection symptoms in sunflower plants were visually registered. The experiment was conducted in parallel in two sunflower varieties, 'Flagman' and 'Rodnik.'

Results and Discussion

The ascospores were detected for the first time in 1998 on May 20 and in 1999 on May 25 at the two-leaf stage. The mass emission of ascospores from perithecia was observed three or four days after precipitation (Figures 1, 2). Afterward, the intensity of ascospore emission reduced abruptly. The amounts of the spores detected in the air significantly varied through the vegetational season. In 1998 the greatest ascospore amounts (122 ascospores per slide) were registered within the near-ground atmosphere during intensive rainfall (from May 29 to June 7, Figure 1). In 1999 the same spore amounts were determined in the time period from June 21 to July 5, when total rainfall made up 130 mm. The relative humidity during those periods ranged from 76% to 91% (1998) and from 58% to 90% (1999). The air temperature was optimal for development and maturing of perithecia and ascospores and averaged 20.8C in 1998 and 21.4C in 1999. As a whole, the emission of ascospores was observed from May to August and occurred as consecutive waves, the frequency of which depended on rainfall frequency. Phomopsis infection in sunflower plants was identified in the first half of the vegetational season. The first necrotic spots on the leaves of the second and the third tiers appeared at of 8-10 true-leaf stage. The following were the dynamics of Phomopsis infection in sunflower plants of the variety Flagman at Krasnodar, 1999 (Table 1).

Table 1. Phomopsis infection of variety Flagman at Krasnodar in 1999.

Date	06.07	26.07	03.09
Development rate (%)	18	47	93

The dates of Phomopsis development rate in the sunflower variety Rodnik are comparable with the variety Flagman.

During the evaluation on July 6 the disease symptoms manifested themselves as multiple brown-grey spots on leaves which had appeared at the edge of the leaf blade, were directed to the main ribs and developed towards the leaf stalk via the petiole as a triangle with an apex at the front of the developing spot. As it is known, the parasite development precedes the toxin production by the fungus and that leads to the appearance of a zone with a characteristic yellow spot dotted with necrotic brown spots.

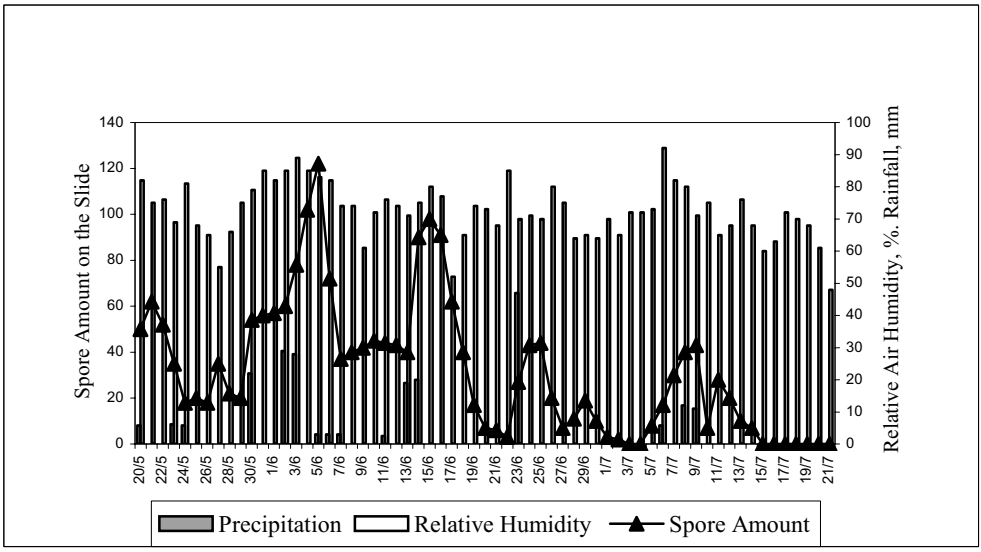

Figure 1. Emission dynamics of sunflower Phomopsis ascospores dependent on rainfed and relative air humidity (Krasnodar, Russia, 1998).

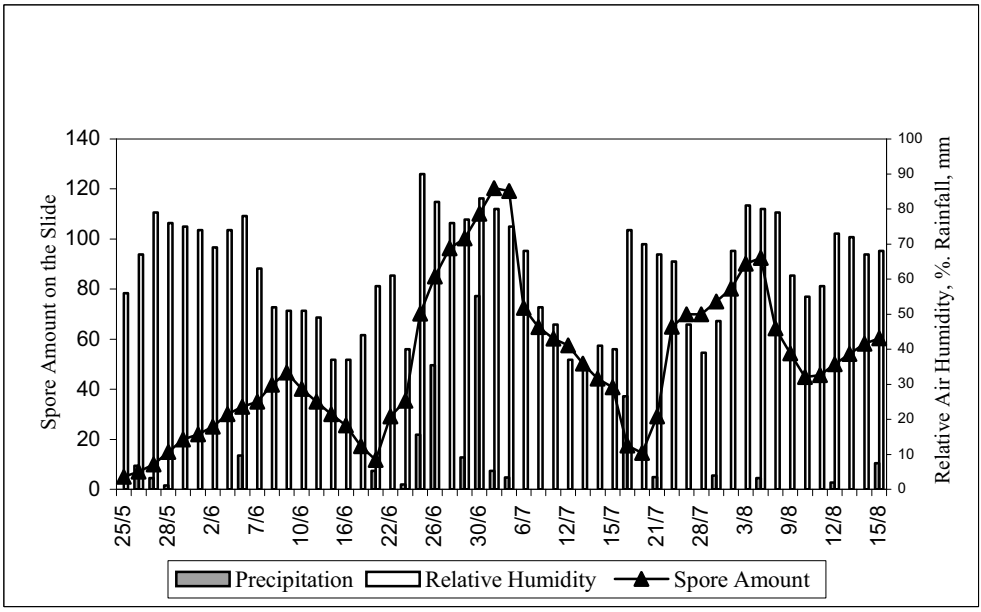

Figure 2. Emission dynamics of sunflower Phomopsis ascospores dependent on rainfed and relative air humidity (Krasnodar Region, 1999).

The first spots on the stem around the point of the petiole attachment (with different brown color intensity and clearly marked edges) appeared on July 13. By the second evaluation on July 26 the lesions on the stem increased in size, spread as "oil spots" to several internodes, and sometimes roughness was observed near a lesion edge. The leaves up to the sixth or seventh tier dried up entirely.

The infected sunflower leaves, petioles and stems were collected to identify the parasite. Pycnidia were identified with a microscope on leaf petioles and stems. Those pycnidia later grew in size after being placed on a moist chamber, and jelly-like muddy white-yellow drops appeared at the top of them. Multiple colorless bent and occasionally straight unicellular β-pycnospores were identified in the drops by microscope. Their sizes ranged between 17.5 and 42.5 μm. During the third evaluation at the 12th organogenesis stage (physiological maturity) the spots were observed to increase lengthwise up to 30 cm and acquire a grey or brown-grey color. The pathogen softened plant tissue in the spot zone and as a result the stem was destroyed and broken. A mass of pycnidia broke out on the dark brown tissue.

Sunflower heads were also infected by Phomopsis but to a variable degree. At the end of the vegetation season they were absolutely dry; their seeds were wrinkled and aborted and had small usually dark-colored kernels that were easily detached from their coats.

Conclusions

Based on this research a conclusion may be drawn that plant infection caused by this fungus occurs through leaves, petioles and stem tissue. The first disease symptoms usually appear at the lower parts of the plant. The ascospore sporulation under field experiment conditions has a clear correlation with a previous moistening of the perithecia.