Field Crops Studies (2021) XIV(2-3-4): 137-142
http://fcs.dai-gt.org/bg/
ISSN: 2535-1133 (Online)
ISSN: 1312-3882 (Print)

ORIGINAL PAPER

# Study on the reaction of *Helianthus debilis* accessions to *Phomopsis helianthi* Munt.-Cvet.

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Received: August 2021 / Accepted: September 2021 /
Published: December 2021 

## Abstract

*Petrova, M., Encheva, V. & Valkova, D. (2021). Study on the reaction of Helianthus debilis accessions to Phomopsis helianthi Munt.-Cvet. Field Crops Studies, XIV(2-3-4), 137-142.*

Stem canker (*Phomopsis helianthi* Munt.-Cvet et.al) is a key disease of sunflower and it is widespread in Europe, Russia, Asia, Australia, North and Latin America. In Bulgaria, the pathogen causes significant damage to sunflower production, and its control is extremely difficult. One of the ways to reduce the impact of the disease is the use of resistant hybrids. The most effective source of Phomopsis resistance is the use of wild species diversity within a genus *Helianthus*. Twelve specimens of the species *Helianthus debilis* were examined for their response to the Phomopsis pathogen. The 4-level scale of Kiryakov and Entcheva was used. Among the tested wild annual species of genus *Helianthus*, accessions E-011, E-012, E-137, E-089, E-138, E-139, E-014, E-141 exhibited very resistant type of reaction. Accessions E-136, E-013 and E-010 demonstrated resistant reaction to the pathogen. One accession (E-082) responded with moderately resistant reaction.

**Keywords:** *Phomopsis, Resistance, Wild Sunflower Species*

## Introduction

Stem canker caused by *Phomopsis helianthi* Munt.-Cvet et.al (teleomorph *Diaporthe helianthi*) is a key disease of sunflower in Bulgaria (Entcheva, 2002). It is widespread in Europe, Russia, Asia, Australia, North and Latin America (Allen et al., 1980; Mihaljevic et al., 1980; Madjidich-Ghassemi, 1988; Entcheva &

Shindrova, 1990; Lesovoy & Parfenyuk, 1996; Gulya, 1997). In Bulgaria, attack by this pathogen was reported by Entcheva & Shindrova (1990).

The damages caused by this disease are related to the climatic conditions, the aggressiveness of the isolates in the population of the pathogen and the susceptibility of the hybrids (Viguié et al., 1999; Encheva, 2002). According to Rozhkova (2010), in years with conditions favorable for the development of the pathogen, the losses may reach up to 50 %.

The development and introduction in production of resistant hybrids is the most efficient method for control of the disease. Finding sources of resistance is of primary importance for the breeding process. The use of wild species-carriers of genes for resistance to the fungal diseases is considered the best solution (Dozet, 1990; Nikolova et al., 2001; Treitz, 2003; Encheva & Valkova, 2012).

The genetic variability of the cultivated sunflower and its biotic resistance could be increased by interspecific hybridization with wild *Helianthus* species. Wild relatives of crop plants are often genetically much more diverse than the related cultivated species. Genetic diversity in wild populations contributes to long-term survival of species by allowing them to adapt quickly to changes in their environment. The wild sunflower species possess high tolerance to different types of biotic and abiotic stress factors and are adapted to a wide range of habitats.

For many years now the wild sunflower species collection of Dobrudzha Agricultural Institute – General Toshevo has been an important source of initial material for breeding for resistance to economically important diseases, including stem canker of sunflower (Encheva et al., 2006). Nikolova & Encheva (1994) observed field resistance to Phomopsis stem canker (PhSC) in progenies of interspecific hybrids derived from annual *Helianthus* species. Christov (2008) and Encheva et al. (2006) identified annual species (e.g. *H. annuus*, *H. argophyllus* and *H. debilis*) as potential sources of PhSC resistance in some half-sib families based on field screening. These results show that the use of some wild species has a considerable potential for developing of resistant sunflower hybrids.

The aim of this study was to determine the response of annual wild sunflower species accessions from *H. debilis* to the causative agent of stem canker with a view of finding resistant donors for the purposes of breeding.

## Material and methods

### Plant material

This study involved accessions from species *H. debilis, ssp. cucumerifolius* (E-012 and E-137), *H. debilis, ssp. silvestris* (E-013, E-089, E-138 and E-139), *H. debilis, ssp. tardiflorus* (E-014 и E-141), *H. debilis, ssp. vestitus* (E-010), *H. debilis, ssp. debilis* (E-011), *H. debilis* (E-082, E-136). The used accessions are maintained

in the collection of wild species registered at FAO. They were sown in 5 m rows, with interspacing 1.5 m between the rows and 0.7 m between the plants in the row.

**Infection background and determination of accessions' reaction**

The investigation was carried out in 2020 at Dobrudzha Agricultural Institute under artificial infection conditions, which were maintained annually. The inoculation of the accessions was done at budding stage according to the methodology of Encheva and Kiryakov (2002). For this purpose, the petioles of single leaves from the middle of the plant were cut 3 cm from the node. A plastic straw closed at one end (6 x 25 mm) was inserted in the incision; the straw contained agar disk with mycelium incised from the periphery of a 5-day old culture of isolate PH 20.1.1 on nutrition medium PDA. To maintain high moisture, a moist cotton piece was inserted in the straw before taking the inoculum. Six plants from each accession were inoculated. The reaction of the accessions (AR) was read 10 days after inoculation according to the following scale:

0 – no symptoms,
1 – spots on stem sized up to 5 cm,
2 – spots on stem exceeding 5 cm in size,
3 – the spot covers the adjacent nodes,
4 – breaking of the stem.

The ranking of the accessions was based on the middle disease index (MDI) calculated by the formula MDI= Σ(n x ds) x N (n=number of plants, ds = AR+1 – attacking rate (1-5), N=total number of plants), as follows: very resistant – 1.0 (VR); resistant – 1.1-2 (R); moderately resistant – 2.1-3.0 (MR); Susceptible –3.1 – 4.0 (S); Very susceptible - over 4.1 (VS).

## Results and discussion

The reaction of the investigated accessions from *Helianthus debilis* to the isolate of *Phomopsis helianthi* varied from very resistant to moderately resistant (Table 1). Very resistant reaction of the tested plants was demonstrated by eight of the accessions (E-011, E-012, E-137, E-089, E-138, E-139, E-014, E-141). Accessions E-136 (*H. debilis*), E-013 (*H. debilis* ssp. *silvestris*) and E-010 (*H. debilis* ssp. *vestitus*) exhibited moderate resistance, the variation of the rank of the individual plants being from very resistant to moderately resistant (E-136), and very resistant to resistant (E-013 and E-010). E-082 (*H. debilis*) responded with moderately resistant reaction, the variation being within the range from resistant to susceptible reaction of the tested plants.

Table 1. Reaction of *Helianthus debilis* accessions to isolate PH 20.1.1 of *Phomopsis helianthi*

| Code | Accession | MDI | Variability | | Type of resistance |
|---|---|---|---|---|---|
| | | | Min. | Max. | |
| E-010 | *Helianthus debilis,* ssp. *vestitus* | 2,0 | 1 | 3 | R |
| E-082 | *Helianthus debilis* | 5,7 | 3 | 7 | MR |
| E-011 | *Helianthus debilis*, ssp. *debilis* | 1,0 | 1 | 1 | VR |
| E-012 | *Helianthus debilis*, ssp. *cucumerifolius* | 1,0 | 1 | 1 | VR |
| E-137 | *Helianthus debilis*, ssp. *cucumerifolius* | 1,0 | 1 | 1 | VR |
| E-013 | *Helianthus debilis*, ssp. *silvestris* | 1,7 | 1 | 3 | R |
| E-089 | *Helianthus debilis*, ssp. *silvestris* | 1,0 | 1 | 1 | VR |
| E-136 | *Helianthus debilis* | 2,0 | 1 | 5 | R |
| E-138 | *Helianthus debilis*, ssp. *silvestris* | 1,0 | 1 | 1 | VR |
| E-139 | *Helianthus debilis*, ssp. *silvestris* | 1,0 | 1 | 1 | VR |
| E-014 | *Helianthus debilis*, ssp. *tardiflorus* | 1,0 | 1 | 1 | VR |
| E-141 | *Helianthus debilis*, ssp. *tardiflorus* | 1,0 | 1 | 1 | VR |

## Discussion

Investigating the resistance of annual and perennial accessions of genus *Helianthus*, Entcheva et al. (2014) found out that accessions E-137 and E-138 from species *Helianthus debilis* had resistance to the isolate used in the study, while E-012, E-089 and E-082 were moderately resistant. In our study, E-012, E-137, E-089 and E-138 demonstrated very resistant reaction, and E-082 did not change its response. The reason for this can be both the climatic conditions (Masirevic, 2000) and the aggressiveness of the isolates (Entcheva, 2002). While studying the reaction of nine sunflower hybrids to eight isolates of *Phomopsis helianthi*, Entcheva (2002) established significant differences in their resistance depending on the aggressiveness of the isolates.

## Conclusion

Among the tested wild annual species of genus *Helianthus*, eight accessions (E-011, E-012, E-137, E-089, E-138, E-139, E-014, E-141) exhibited very resistant type of reaction. Three of the accessions demonstrated resistant reaction to the pathogen (E-136, E-013, E-010). One of them (E-082) responded with moderately resistant reaction.

The collection of DAI – General Toshevo has a rich variety of accessions from the *Helianthus* species, which can be used as donors for resistance to stem canker in the sunflower breeding program.

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