HSPI The Open Access Publisher

J P S P JOURNAL OF PLANT SCIENCE AND PHYTOPATHOLOGY
ISSN 2575-0135

Research Article

Sunflower Diseases and Downy Mildew (*Plasmopara halstedii*) in Adana

Hale Gunacti*

Biological Control Research Institute, Adana, Turkey

Abstract

Sunflower (*Helianthus annuus* L.) is one of the most important vegetable oil sources in the world and in our country. The preference for sunflower oil in the consumption of vegetable oil increases the importance of sunflowers in our country. Rust, downy mildew, Verticillium wilt, Sclerotinia stalk and head rot, charcoal rot, blight, and leaf spot are some of the important diseases most commonly seen in sunflowers. In some years, depending on the climatic conditions, Downy mildew (*Plasmopara halstedii*) is widely observed and it causes an epidemic in sunflower-planted areas in the Adana province. Genetically resistant hybrids have started to be grown in Turkey in recent years due to the resistance of downy mildew disease to fungicides. The aim of the study was to determine the status of sunflower diseases and Downy Mildew disease in Adana.

More Information

***Address for correspondence:** Hale Gunacti, Biological Control Research Institute, Adana, Turkey, Email: hale.gunacti@tarimorman.gov.tr

Submitted: June 15, 2023
Approved: July 27, 2023
Published: July 28, 2023

How to cite this article: Gunacti H. Sunflower Diseases and Downy Mildew (*Plasmopara halstedii*) in Adana. J Plant Sci Phytopathol. 2023; 7: 066-068.

DOI: 10.29328/journal.jpsp.1001107

Keywords: Downy mildew; Sunflower; Disease

Check for updates

OPEN ACCESS

Introduction

Sunflower (*Helianthus annuus* L.) is one of the most important oilseed crops in the world, being cultivated in more than 70 countries with a total production of 52 million tons in 2020. Sunflower cropped area is increasing in Turkey with 6,167,800 da in the last growing season 5.854.000 da with production of 5.100.000 and 754.00 da of seed and oil, respectively. About 600,000 hectares of sunflower are cultivated 46% of the sunflower crops are located in Trakya-Marmara, 16% in Central Anatolia, 4,4% in the Aegean, 5,3% in the Black Sea, 18% in the Mediterranean and 10,3% in the Eastern and Southeast Anatolian region of our country [1].

Diseases are one of the most important factors affecting grain and oil yield in sunflowers as in other cultivated plants. Downy mildew and head rot are the most severe diseases in Çukurova. Other important diseases occurring worldwide like powdery mildew, Phomopsis stem canker, Charcoal rot, Alternaria leaf spot Sclerotinia wilt, and Sunflower rust, are likely to affect sunflowers, under very diverse climatic conditions. Once installed on the crop, sunflower diseases are hard to control. Effective control is based on an integrated program, which includes zoning for climate risk and diverse cultural practices.

Knowing the pathogens that cause productivity losses in the sunflower and conducting a conscious fight against them is very important in order to prevent the loss of yield. Improving productivity in sunflower farming, along with the spread of high-efficiency and high-quality seed use, is possible through the on-site and timely implementation of research-based technical applications.

Materials and methods

Trial areas were followed up from the planting of sunflower plants, plants showing signs of disease in non-periodic survey studies were brought to the laboratory and their diagnoses were made. Sunflower plants showing signs of disease were brought to the laboratory and as a result of the necessary macroscopic and microscopic examinations, diseases developed from which applications were recorded. The plant samples brought to the laboratory were examined macroscopically and then hyphae, spores, etc. were found on infected surfaces or cross-sections of infected areas. The presence of fungal structures has been determined microscopically (Barnett and Hunter, 1972). In isolation studies, infected tissue fragments were incubated at 24 °C by planting Potato Dextrose Agar (PDA) into Petri dishes after surface sterilization at 1% NaOCl. In addition, if necessary, infected tissues were diagnosed by placing them in a moisture circle after disinfecting the surface with 70% alcohol, encouraging the formation of superficial micelles and spores. The diagnosis of obligate pathogens was made by examining the spore and misle structures under a microscope. Fungal masses that develop after isolation or on tissue surfaces

have been microscopically examined to determine possible pathogens. For this purpose, the formation of hyphae with or without compartments, branching pattern, conidiophore structure, conidia formation, shape, color, and size of conidia, sporangium, zoospores, pycnidium, ascocarp vb. the presence and properties of fungal tissues such as spore structures have been studied (Alexopoulos, 1966; Barnett and Hunter, 1972).

Results and discussion

In this study, the most important fungal diseases affecting sunflowers in our region were determined as *Plasmopara halstedii, Macrophomina phasolina, Sclerotinia sclerotiorum, Rhizopus arrhizus,* and *Botrytis cinerea.* As is well known, humidity and climate factors play an important role in the prevalence of fungal diseases. These diseases are seen in large areas, especially in light, rainy and humid seasons, and cause significant yield losses [2,3]. For example, humidity and temperature increase *Rhizopus arrhizus* increases the severity of the disease. Optimal conditions for the development of the disease were found to be 20-30 °C temperature and relative humidity [4-6]. Grey mould caused by *Botrytis cinerea Pers.* is an important disease of sunflower and many other major crops [7,8]. In Adana incidence and severity of grey mould on sunflowers have attained a (high) magnitude over the last few years. Again, Verticillium wilt and Pythium sp are seen in sunflowers, they are located in a soil-based place and there is no chemical control. In the fight against sunflower diseases, cultural methods gain importance and it is recommended to pay attention to the use of resistant varieties, as well as to the cultivation program, balanced irrigation, and fertilization [9]. In addition, the application of alternation constitutes the most appropriate method of struggle against soil-borne diseases of sunflowers. *Macrophomina phaseolina* is a soil and seed-borne fungal pathogen that causes coal rot disease in sunflowers. The disease factor overwinters in a free state in the soil or in plant residues in the soil, especially in the form of microsclerotes on sunflower stems. Microsclerotes are round-shaped and black-colored durable structures. The fungus can maintain its vitality in the soil for 2-15 years [10].

Downy mildew (*Plasmophora helianthii*)

In our region, Downy mildew disease is one of the most important diseases with economic importance in sunflower and its causative agent is *Plasmopara halstedii.* This disease, which was first detected in the USA in 1883, is seen in almost every country in the world where sunflower is grown. The disease was detected for the first time in Turkey in Sakarya province in 1958 [11]. Sunflower downy mildew is a soil-borne disease, and it infects sunflower plants by spending the winter in seeds, soil, and plant debris. It causes systemic and local infections in the plant (Spring, et al. 1991). Symptoms vary depending on the time the plant is caught. Sunflower plants caught in this disease at an early stage cannot develop normally and remain stunted. Discoloration and necrotic lesions occur on the leaves as if they were initially soaked in water (Figure 1). The diseased plant forms an early stage table, yellowing of its leaves and white powdery mildew spores on the underside and white on the underside (Figure 2). The infection is usually caused by seeds and plant residues in the soil [12,13].

The intensity of downy mildew disease varies depending on the environmental conditions in which the sunflower is grown, the amount of precipitation, and the temperature. If the season is rainy, the relative humidity is very high and the air temperature is below 20 °C, the intensity of the disease increases, it has been determined that up to 80% - 90% of downy mildew epidemic occurs in sunflower production areas. More than 55 new species of *Plasmopara halstedii* have been identified as a result of the research [14-16].

The main causes of the large-scale epidemic of downy mildew are oospores or zoospores carried by irrigation water or rainwater, zoospores from wild sunflowers or wind from nearby fields, soilborne inoculums from infected products left over from the previous year [2]. Seedlings are susceptible to systemic infection for a relatively short period of time. In greenhouse studies, the development of systemic symptoms failed in seedlings older than 10 days (Zimmer, 1975), but fungus caused root symptoms (Zimmer, 1973). In America (Zimmer, 1975) and India (Patil, et al. 1992) in field studies, it was found that the seedling rate at which systemic symptoms develop depends on the amount of precipitation within 3 to 15 days after October. If this period is dry and the soil temperature is also high, or if there is a rapid increase, then the severity of the systemic symptom will be low. In the fight against the disease, it is strongly recommended to plant resistant varieties, use clean seeds, and spray seeds with fungicides before planting

Figure 1: Leaves soaked in water and underside spore masses caused by Sunflower Downy Mildew.

Figure 2: Leaves discoloration and underside spore masses caused by Sunflower Downy Mildew.

seeds in sensitive varieties. Avoiding frequent planting and regular weed control are the recommended cultural control methods against downy mildew disease, which causes more damage in humid conditions. Due to the humid and rainy climate conditions that our region has, the regional producer suffers a huge loss of yield due to the sunflower plant's most important disease. Because of the absence of disease-resistant and region-compatible varieties, the existing varieties develop resistance to the active substance metalaxyl fungicide used in the fight against disease; the regional producer suffers from loss of yield each year and incurs additional fungus cost to control.

Chemical control

Seed spraying can effectively control the disease. It has been determined that metalaxyl is the most effective fungicide in the chemical control against downy mildew disease in sunflowers (Viranyi and Oros 1991). The fungicides used against the disease are given in Table 1.

Table 1: Fungicides commonly used in Adana sunflower production.

Active substance name	Dosage
Metalaxyl % 35	500 g/100 kg seed
Metalaxyl 200 g/L FS	1L/100 kg seed
Metalaxyl 350 g/L FS	250 cc/100 kg seed
Propamocarb hydrochloride 722 g/l SL	500 cc/100 kg seed

Conclusion

Sunflowers are an important vegetable oil source, but they are vulnerable to fungal diseases. Downy mildew is a major concern, especially in the Adana province of Turkey. It is caused by the fungus Plasmopara halstedii and can lead to substantial yield losses. The prevalence of fungal diseases is influenced by climatic conditions, such as humidity and temperature. Effective disease management relies on a comprehensive and integrated approach, encompassing cultural practices, resistant varieties, balanced irrigation, and fertilization. Research-based technical approaches, along with adopting resistant varieties and appropriate cultural practices, can contribute to improving productivity in sunflower farming and reducing yield losses caused by diseases. Chemical control methods, such as seed spraying with the fungicide metalaxyl, can be effective in managing downy mildew. However, the development of resistance in existing varieties against metalaxyl poses a challenge. Safeguarding sunflower crops from fungal diseases requires ongoing research, collaboration among researchers, farmers, and agricultural authorities, and the implementation of best practices to ensure sustainable sunflower production.

References

1. TURKSTAT (2021). Turkish Statistical Institute Official Website Data: http:www.tuik.gov.tr
2. Zimmer DE, Hoes JA. Diseases. In: Sunflower science and technology (Ed. by Carter, J.F.). American Society of Agronomy, Madison, USA. 1978; 225-262.
3. Kolte SJ. Diseases of annual edible oilseed crops. Sunflower, safflower & niger seed diseases. CRC Press, Inc., Boca Raton, USA. 1985; 3.
4. Wilson KI, Al-Beldawi AS, Dwazah K. Rhizopus stem rot of Nicotiana glauca. Plant Disease. 1983; 67: 526-527.
5. Gulya TJ, Woods DM, Bell R, Mancl MK. Diseases of sunflowers in California. Plant Disease. 1991; 75: 572-574.
6. Bhutta AR, Bhatti MHR, Ahmad SI, Ahmad I. Prevalence and incidence of sunflower diseases in Pakistan. Hellia. 1993; 16: 93-98.
7. Moore WC. British parasitic fungi. Cambridge University press. 1959.
8. Jarvis WR. Bonyotinia and Borryrrs species: Tàxonomy, physiology and pâthogenicity. Monogr. Research Branch, Canada Department of Agriculture, Ottawa. 1977.
9. Jiskani MM. Assistant Professor Dıseases of Oıl Seed Crops and Theır Control. (Plant Pathology), Sindh Agriculture University, Tandojam. Pakistan. 1987.
10. Khan SN. Macrophomina phaseolina as causal agent for charcoal rot of sunflower. Mycopathology. 2007; 5:111-118.
11. Oksal E. Sunflower Mildew Agent Plasmopara halstedii (Farl.) Berl. & de Toni's Breeds in Turkey and Determination of the Reactions of Some Commercial Sunflower Varieties to These Breeds. PhD Thesis, Ankara University, Faculty of Agriculture, Institute of Science and Technology, Ankara. 2014; 77.
12. Mouzeyar S, Labrouhe DT, Vear F. Histopathological studies of resistance of sunflower (Helianthus annuus L.) to downy mildew (Plasmopara halstedii) J. Phytopathol. 1993; 139: 289–297.
13. Gascuel Q, Martinez Y, Boniface MC, Vear F, Pichon M, Godiard L. The sunflower downy mildew pathogen Plasmopara halstedii. Mol Plant Pathol. 2015 Feb;16(2):109-22. doi: 10.1111/mpp.12164. Epub 2014 Dec 4. PMID: 25476405; PMCID: PMC6638465.
14. Gulya T. Distribution of Plasmopara halstedii races from sunflower around the world. Proc 2nd Int Downy Mildew Symp. Advances in Downy Mildew Research. Olomouc, Czech Republic. 2007; 121-134.
15. Viranyi F, Gulya T, Labrouhe T. Recent changes in the pathogenic variability of Plasmopara halstedii (sunflower downy mildew) populations from different continents, Helia. 2015; DOI 10.1515/helia-20150009.
16. Trojanová Z, Sedlarova S, Gulya T, Lebeda A. Methodology of Virulence Screening and Race Characterization of Plasmopara halstedii, and Resistance Evaluation in Sunflower-a Review. Plant Pathology. 2016; 10.1111/ppa.12593, 125-140.
17. Sakr N. A Plant Mixture Model against Plasmopara halstedii (Sunflower Downy Mildew). Journal of Plant Protection Research. 2010; 50(2): 125-129.
18. Sanchez J, Gallego E. Fitopatogenicidad de Pythium spp. presentes en el agua de riego del Poniente almeriense (sureste de España) [Phytopathogenicity of Pythium spp.from the irrigation water of the Poniente Almeriense (south-eastern Spain)]. Rev Iberoam Micol. 2002 Sep;19(3):177-80. Spanish. PMID: 12825999.