CAPS Pest Datasheets provide pest-specific information to support planning and early detection surveys

Magnaporthiopsis maydis

Scientific Name
Magnaporthiopsis maydis (Samra, Sabet & Hingorani) Klaubauf, Lebrun & Crous, 2014

Synonym(s):
Cephalosporium maydis Samra, Sabet & Hingorani 1963
Harpophora maydis (Samra, Sabet and Hingorani) Gams, 2000

Common Name
Late wilt of corn, Late wilt, Late wilt of maize, 'Shallal' disease of maize

Type of Pest
Fungus

Taxonomic Position
Class: Sordariomycetes **Order:** Magnaporthales **Family:** Magnaporthaceae

Figure 1. Late wilt diseased field symptoms: drying out ascends upwards in the plant, including leaf yellowing and dehydration, and color alteration of the lower stem and internode. Wilted Jubilee cv. plants photographed in the southern area (No. 10) of a maize field in Kibbutz Naot Mordechai in the Hula Valley (Upper Galilee, northern Israel) 75 d after sowing (28/6/08, 15 days after fertilization). Photo and caption courtesy of Degani and Cernica, (2014)

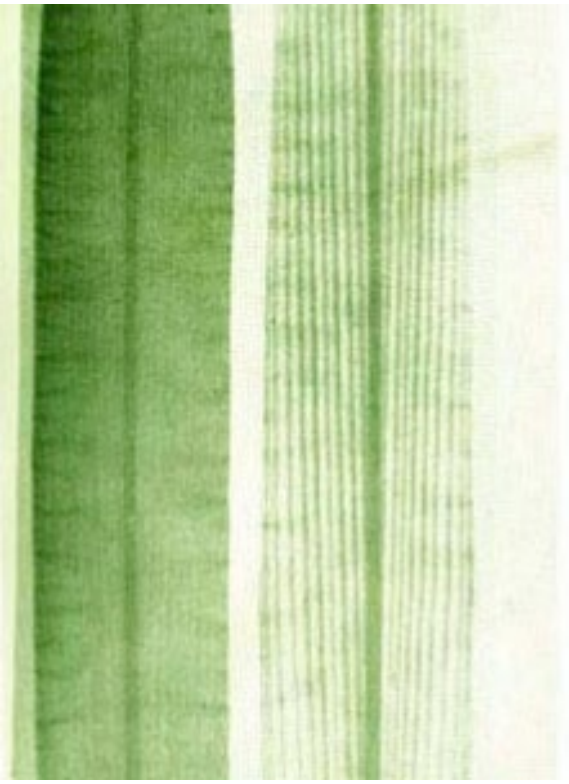

Figure 2: Leaf streaking of *Magnaporthiopsis maydis* infected plant (right) compared with a healthy leaf (left). Photo from Sabet et al. (1966c)

Figure 3: Progressive development of yellow to reddish-brown streaks caused by M. maydis on infected lower cornstalks. Photo courtesy of H. Warren

Pest Recognition

This section describes characteristics and symptoms of the organism listed for the purpose of assisting surveyors: recognize possible infestations/infections in the field, select survey sites, and collect symptomatic material. For morphological descriptions, see the Identification/Diagnostic resources on the AMPS pest page on the CAPS Resource and Collaboration website.

Magnaporthiopsis maydis is a soil- and seed-borne fungus that causes wilting of corn plants just before maturity (Degani et al., 2019). Since the appearance of initial symptoms is delayed until flowering, this disease is designated as a “late wilt” (Samra et al., 1963). Sometimes, stalk rot diseases are noticed only during the final stages of disease when the stalks begin to fall over (Jain et al., 1974).

Symptoms

Corn: During early stages of infection, root tips of infected corn are stained red and small necrotic lesions (2–4 mm) appear on the roots as early as three weeks after infection (Tej et al., 2018). Aboveground plant parts generally remain symptomless until tasseling, when a rapid wilting of infected plants occurs (Fig. 1). Wilting progresses from the lower to the upper parts of the plant. Eventually, leaves lose color (Fig. 2) and

develop a scorched appearance. The stalk becomes reddish brown (Fig. 3) (Samra et al., 1963; White, 1999).

In advanced stages, lower portions of the stalk may become dry, shrunken, and hollow (Fig. 4). Stalk symptoms may look slightly different depending on the extent of secondary infection. Secondary infection by other organisms frequently progresses into stalk rot, which appears soft and wet (Jain et al., 1974). Stalk rot is often accompanied by a sweet smell. Kernels that form may develop poorly (Fig. 5) (Drori et al., 2013; Samra et al., 1963).

Figure 4. Dry hollow *M. maydis* infected corn stalk. Photo courtesy of CIMMYT

Easily Mistaken Species

Without some training, surveyors may not recognize *M. maydis* and distinguish it from stress factors such as lack of water or nutrients (Sabet et al., 1966b). In addition, there are numerous other fungal pathogens that infect and cause stalk rot on corn in the United States, including *Fusarium graminearum* [*Gibberella zae* (Schwein)], *Macrophomina phaseolina*, and *Stenocarpella maydis* (White, 1999). Molecular identification is required for final confirmation of this pathogen.

Biology and Ecology

Magnaporthiopsis maydis causes vascular wilt disease of corn (Degani et al., 2019). It reproduces asexually and can survive for at least 15 months in soil through the production of sclerotia (Sabet, 1984), which are small, dark brown pigmented clusters of thick-walled cells (Payak et al., 1970; Samra et al., 1963). Sclerotia assist with the pathogen's survival in soil, seed, and crop residue and serve as primary inoculum for infection in a following season (Agrios, 2005).

Magnaporthiopsis maydis penetrates the root of its host (Sabet et al., 1970b) and moves upward, blocking water transport and causing the host to wilt (White, 1999). Young plants are most susceptible to infection by *M. maydis*. Plants become resistant to infection about 50 days after planting (Sabet et al., 1970b).

Late wilt thrives in rough-textured soil where the environment is hot and humid (Khokhar et al., 2014; Samra and Sabet, 1966; Singh and Siradhana, 1987a). The minimum temperature for growth of *M. maydis* is 54°F, the optimum temperature is 77–86°F, and the maximum temperature is 86°F. Low soil moisture (25% saturation) is favorable for *M. maydis* survival, and high soil moisture (100% saturation) adversely affects the pathogen (Dawood et al., 1979; Khokhar et al., 2014). A slightly acidic soil of pH 6.5 contributes to the highest degree of disease incidence (Singh and Siradhana, 1987a).

Figure 5: *Magnaporthiopsis maydis* infection on corn. Penn State Department of Plant Pathology & Environmental Microbiology Archives, bugwood.org

Magnaporthiopsis maydis can infect and colonize kernels, causing rot of seeds and seedlings in severe infections (Fig. 5) (Jain et al., 1974; White, 1999). The fungus can survive in corn seed for up to 10 months (Singh and Siradhana, 1987), although specific conditions, such as host cultivar, can affect seed transmission rates (Michail et al., 1999).

Known Hosts

Corn is the primary host of *M. maydis* (Samra et al., 1963). The pathogen can infect other plant species, but economic damage is only reported in corn.

The host list below includes cultivated and wild plants that 1) are infected or infested by the pest under natural conditions, 2) are frequently described as major, primary, or preferred hosts, and 3) have primary evidence for feeding and damage documented in the literature. Plants are highlighted in bold if they are commercially produced and the pest causes economically significant damage.

Preferred hosts

***Zea mays* (corn)**[*] (Samra et al., 1963).

Magnaporthiopsis maydis also infects *Citrullus lanatus* (watermelon)[*], *Gossypium hirsutum* L. (cotton)[*], *Lupinus albus* L. (white lupine)[*], and *Setaria viridis* (L.) P. Beauv.

[*] Hosts with U.S. distribution

(green foxtail) * (Sabet et al., 1966a; Sahab et al., 1985; Samra et al., 1963; Degani et al., 2019; Dor and Degani, 2019).

Pest Importance

Magnaporthiopsis maydis can cause substantial losses in corn production (Jain et al., 1974) and can infect ninety percent of susceptible host plants. Yield losses of up to forty percent have been reported in corn in Egypt (White, 1999; Zeller et al., 2002) and India (Jain et al., 1974). In Portugal and Spain, disease incidence of sixty percent has been reported in corn (Molinero-Ruiz et al., 2010).

Corn is the most widely cultivated feed grain in the United States and was grown on over 90 million acres nationwide in 2020 (USDA ERS, 2021a). The estimated annual value of the U.S. corn harvest is $52.7 billion (National Corn Growers Association, 2019). A favorable environment and susceptible cultivars for *M. maydis* occurs throughout the Midwestern Corn Belt (Bergstrom et al., 2008).

Magnaporthiopsis maydis is listed as a harmful organism in Brazil (PExD, 2021). This pathogen, under the synonym *Cephalosporium maydis*, is also listed as a harmful organism in China, Mexico, Namibia, New Zealand, South Africa, Thailand, and Uganda (PExD, 2021). If *M. maydis* becomes established in the United States, there may be trade implications with these countries.

Known Vectors (or associated insects)

This species is not a known vector, is not known to be vectored, and does not have any associated organisms.

Known Distribution

Asia: Egypt, India, and Israel. **Europe:** Hungary, Portugal and Spain (Drori et al., 2009; Drori et al., 2013; Molinero-Ruiz et al., 2010; Payak et al., 1970; Pecsi and Nemeth, 1998; Samra et al., 1962).

This species is native to Egypt and India (Chalkley, 2010). There are also unconfirmed reports of *M. maydis* in Romania and Kenya (Bergstrom et al., 2008).

Pathway

The most likely pathway of entry for *M. maydis* is through transport of infected host seed. This pathogen is known to survive in seed for ten months or longer (Degani and Cernica, 2014). Currently, *Zea mays* seed is imported from some countries, including Hungary, Israel, Portugal, and Spain (USDA, 2021).

Use the PPQ Commodity Import and Export manuals listed below to determine 1) if host plants or material are allowed to enter the United States from countries where the organism is present and 2) what phytosanitary measures (e.g., inspections,

phytosanitary certificates, post entry quarantines, mandatory treatments) are in use. These manuals are updated regularly.

Fruits and Vegetables Import Requirements (FAVIR) Online Database: The FAVIR database lists all import requirements for fruits and vegetables. To search by commodity, select '**Approved Name'** at the top left of the page. Select the commodity from the drop down menu and then click '**Search**'. Click on the 'Commodity Summary' tab for details.https://epermits.aphis.usda.gov/manual/index.cfm?action=pubHome

Plants for Planting Manual: This manual is a resource for regulating imported plants or plant parts for propagation, including buds, bulbs, corms, cuttings, layers, pollen, scions, seeds, tissue, tubers, and like structures.
https://www.aphis.usda.gov/import_export/plants/manuals/ports/downloads/plants_for_planting.pdf

Cut Flowers and Greenery Import Manual: This manual is a resource for regulating imported fresh, cut plants used for decoration and for protecting plants from extinction due to trade.
https://www.aphis.usda.gov/import_export/plants/manuals/ports/downloads/cut_flower_imports.pdf

Miscellaneous and Processed Products Import Manual: This manual is a resource for regulating imported processed plant and non-plant products that may introduce exotic pests.
https://www.aphis.usda.gov/import_export/plants/manuals/ports/downloads/miscellaneous.pdf

Treatment Manual: This manual provides information about treatments applied to imported and domestic commodities to limit the movement of agricultural pests into or within the United States.
https://www.aphis.usda.gov/import_export/plants/manuals/ports/downloads/treatment.pdf

Potential Distribution within the United States

Based on the known distribution of *M. maydis* in the world, this pathogen is established in plant hardiness zones 6-12 (Takeuchi, 2018). These zones encompass the climate in most of the continental United States and Hawaii, with the exception of the upper Midwest and New England regions (Takeuchi, 2018). States in the southern and southeastern regions have the most suitable climate for *M. maydis* development (Bergstrom et al., 2008). States that produce large amounts of corn are also particularly vulnerable to *M. maydis* establishment. According to a model from the USDA Recovery Plan that factors in climatic suitability along with host presence, states with the highest risk of establishment of *M. maydis* are Arkansas, Illinois, Indiana, Mississippi, Missouri, Tennessee, and Texas (Bergstrom et al., 2008).

Survey and Key Diagnostics

Approved Methods for Pest Surveillance*:

For the current approved methods and guidance for survey and identification, see Approved Methods for Pest Surveillance (AMPS) pest page on the CAPS Resource and Collaboration website, at https://caps.ceris.purdue.edu/approved-methods.

References

Agrios, G. N. 2005. Plant Pathology, 5th edition (5th). Elsevier Academic Press, Burlington, MA.

Bergstrom, G., J. Leslie, H. Lipps, H. Warren, P. Esker, C. Grau, T. Botratynski, R. Bulluck, J. Floyd, and R. Bennett. 2008. Recovery plan for late wilt of corn caused by *Harpophora maydis* syn. Cephalosporium maydis:24.

Chalkley, D. 2010. Late wilt of maize-- *Harpophora maydis*. Systematic Mycology and Microbiology Laboratory, ARS, USDA.

Dawood, N., K. Sabet, and K. Sabet. 1979. Formation and survival of the sclerotia of *Cephalosporium maydis*. Agricultural Research Review 57(2):185-199.

Degani, O., and G. Cernica. 2014. Diagnosis and control of *Harpophora maydis*, the cause of late wilt in maize. Advances in Microbiology 4(02):94.

Degani, O., S. Dor, D. Movshovitz, and O. Rabinovitz. 2019. Methods for studying *Magnaporthiopsis maydis*, the maize late wilt causal agent. Agronomy 9.

Dor, S., and O. Degani. 2019. Uncovering the Host Range for Maize Pathogen *Magnaporthiopsis maydis*. Plants 8(8):259.

Drori, R., D. Goldberg, O. Rabinovitz, A. Sharon, M. Levy, and O. Degani. 2009. Molecular diagnostic for *Harpophora maydis*, the cause of maize late wilt disease in Israel. Phytoparasitica 37:263-282.

Drori, R., A. Sharon, D. Goldberg, O. Rabinovitz, M. Levy, and O. Degani. 2013. Molecular diagnosis for *Harpophora maydis*, the cause of maize late wilt in Israel. Phytopathologia Mediterranea:16-29.

Gams, W. 2000. Phialophora and some similar morphologically little-differentiated anamorphs of divergent ascomycetes. Studies in mycology:187-200.

Jain, K., S. Dage, and K. Kothari. 1974. Stalk rots of maize in Rajasthan. Farm and factory.

Klaubauf, S., D. Tharreau, E. Fournier, J. Z. Groenewald, P. W. Crous, R. P. De Vries, and M.-H. Lebrun. 2014. Resolving the polyphyletic nature of *Pyricularia* (*Pyriculariaceae*). Studies in mycology 79:85-120.

Michail, S., M. Abou-Elseoud, and M. N. Eldin. 1999. Seed health testing of corn for *Cephalosporium maydis*. Acta Phytopathologica et Entomologica Hungarica 34(1/2):35-41.

Molinero-Ruiz, M., J. M. Melero-Vara, and A. Mateos. 2010. *Cephalosporium maydis*, the cause of late wilt in maize, a pathogen new to Portugal and Spain. Plant Disease 94(3):379-379.

National Corn Growers Association. 2019. U.S. Corn at a Glance 2019. Last accessed February 17, 2021, http://www.worldofcorn.com/#us-corn-at-a-glance

Payak, M., S. Lal, and B. Renfro. 1970. *Cephalosporium maydis* - a new threat to Maize in India. Indian Phytopathology 23(3):562-569.
Pecsi, S., and L. Nemeth. 1998. Appearance of *Cephalosporium maydis* Samra Sabet and Hingorani in Hungary. Pages 873-877 *in* Proceedings, 50th international symposium on crop protection, Gent, 5 May 1998. Part III.
PExD. 2021. Phytosanitary Certificate Issuance & Tracking System (PCIT). United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine. Accessed, September 28, 2021 from, https://pcit.aphis.usda.gov/pcit/faces/signIn.jsf.
Sabet, K., A. Samra, and I. Mansour. 1966a. Interaction between *Fusarium oxysporum* f. *vasinfectum* and *Cephalosporium maydis* on cotton and maize. Annals of Applied Biology 58(1):93-101.
Sabet, K., A. Samra, and I. Mansour. 1966b. Late-wilt of maize and a study of the causal organism. Investigations on Stalk-Rot Diseases of Maize in UAR:8-45.
Sabet, K., A. Samra, and M. Abd-el-Rahim. 1966c. Seed transmission of stalk-rot fungi and effect of seed treatment. pp 94-116. In: Samra, A.S. and Sabet, K.A. (eds). Investigations on Stalk-rot Disease of Maize in U.A.R. Ministry of Agriculture, Government Printing Offices, Cairo, Egypt.
Sabet, K., A. Zaher, A. Samra, and I. Mansour. 1970b. Pathogenic behaviour of *Cephalosporium maydis* and *C. acremonium*. Annals of Applied Biology 66(2):257-263.
Sabet, K. K. 1984. A technique for sclerotial production by *Cephalosporium maydis*. FAO Plant Protection Bulletin 32(4):141-142.
Sahab, A., A. Osman, N. Soleman, and M. Mikhail. 1985. Studies on root-rot of lupin in Egypt and its control. Egyptian Journal of Phytopathology 17(1):23-35.
Samra, A., and K. Sabet. 1966. Investigations on stalk-rot disease of maize in UAR: an introductory note. Ministry of Agriculture Plant Protection Department Bulletin:1-7.
Samra, A., K. Sabet, and M. Hingorani. 1962. A new wilt disease of Maize in Egypt. Plant Disease Reporter 46(7).
Samra, A., K. Sabet, and M. Hingorani. 1963. Late wilt disease of maize caused by *Cephalosporium maydis*. Phytopathology 53(4):402-406.
Singh, S., and B. Siradhana. 1987. Survival of *Cephalosporium maydis*, incitant of late wilt disease of maize. Indian Journal of Mycology and Plant Pathology 17(1):83-85.
Tej, R., C. Rodríguez-Mallol, R. Rodríguez-Arcos, N. Karray-Bouraoui, and L. Molinero-Ruiz. 2018. Inhibitory Effect of Lycium europaeum Extracts on Phytopathogenic Soil-borne Fungi and the Reduction of Late Wilt in Maize. European journal of plant pathology 152(1):249-265.
USDA. 2021. Plants for Planting Manual. United States Department of Agriculture (USDA), Washington D.C.
USDA ERS. 2021a. Corn and other feedgrains. United States Department of Agriculture, Economic Research Service. Last accessed February 17, 2021, https://www.ers.usda.gov/topics/crops/corn-and-other-feedgrains/.

USDA ERS. 2021b. Sugar and sweeteners outlook: February 2021 summary. Last accessed https://www.ers.usda.gov/topics/crops/sugar-sweeteners/market-outlook/.
White, D. G. (ed.). 1999. Compendium of Corn Diseases, Third Edition edition. APS Press, St. Paul, MN. 78 pp.
Zeller, K. A., A.-S. M. Ismael, E. M. El-Assiuty, Z. M. Fahmy, F. M. Bekheet, and J. F. Leslie. 2002. Relative competitiveness and virulence of four clonal lineages of *Cephalosporium maydi*s from Egypt toward greenhouse-grown maize. Plant Disease 86(4):373-378.

USDA-APHIS-PPQ-ST staff developed this datasheet. Cite this document as:

PPQ. 2021. Cooperative Agricultural Pest Survey (CAPS) Pest Datasheet for *Magnaporthiopsis maydis* (Magnaporthaceae): Late wilt of corn. United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine USDA-APHIS-PPQ, , Raleigh, NC.

Versions

Version 1: Completed July, 2013

Version 2: Updated in September 2021. Comprehensive revision of document and update into the newest CAPS datasheet template.

Reviewer(s)

Dr. Ofir Degani, Galilee Research Institute, Israel
Dr. Don Huber, professor emeritus, Purdue University