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Disease management & resource discussion

Sam Markell, Bob Harveson, Febina Mathew, Charles Block, Tom Gulya, Sue Thompson and Mal Ryley

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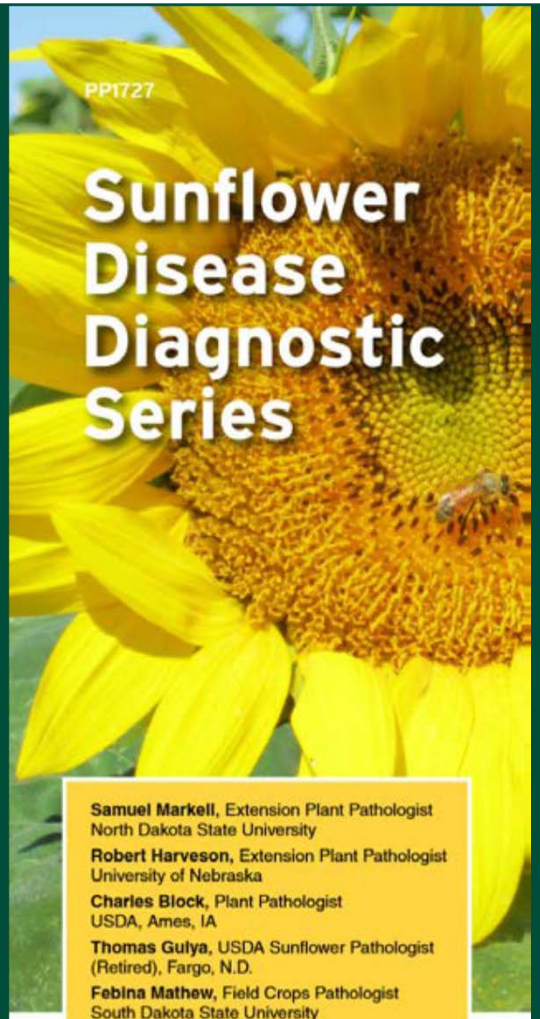

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Sclerotinia head rot

Sclerotinia sclerotiorum

Figure 1

Figure 2

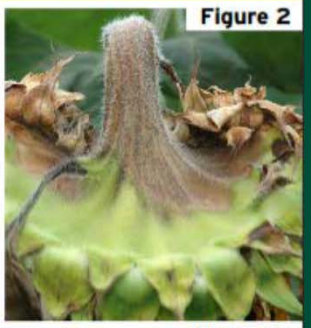

Figure 3

Figure 4

PP1727-3
Sunflower Disease Diagnostic Series

Sclerotinia head rot

Sclerotinia sclerotiorum

AUTHORS: Sam Markell, Tom Gulya, Charlie Block and Bob Harveson

SYMPTOMS

- **Lesions begin as large, soft (mushy), brown areas on the back of heads that turn tan-cream, typically odorless**
- **White mold (mycelium) and hard black structures (sclerotia) form inside head**
- **Heads will shred, and disintegration and/or decapitation may occur**

FIGURE 1 – Apothecia (grows from sclerotia and produces ascospores)

FIGURE 2 – Soft brown area on the back of head

FIGURE 3 – A shredded sunflower with sclerotia

FIGURE 4 – White mycelium and black sclerotia on the face of a skeletonized sunflower head

FACTORS FAVORING DEVELOPMENT

- Wet soils prior to bloom (facilitates apothecia production)
- Frequent wetness during or after bloom, including rain, fog, heavy dew
- Temperatures 85 F or below

IMPORTANT FACTS

- The same pathogen causes sclerotinia wilt and sclerotinia mid-stem rot
- The pathogen can survive for many years in the soil as sclerotia
- Management tools are limited
- Most common in the U.S. northern Great Plains
- Can be confused with Rhizopus head rot

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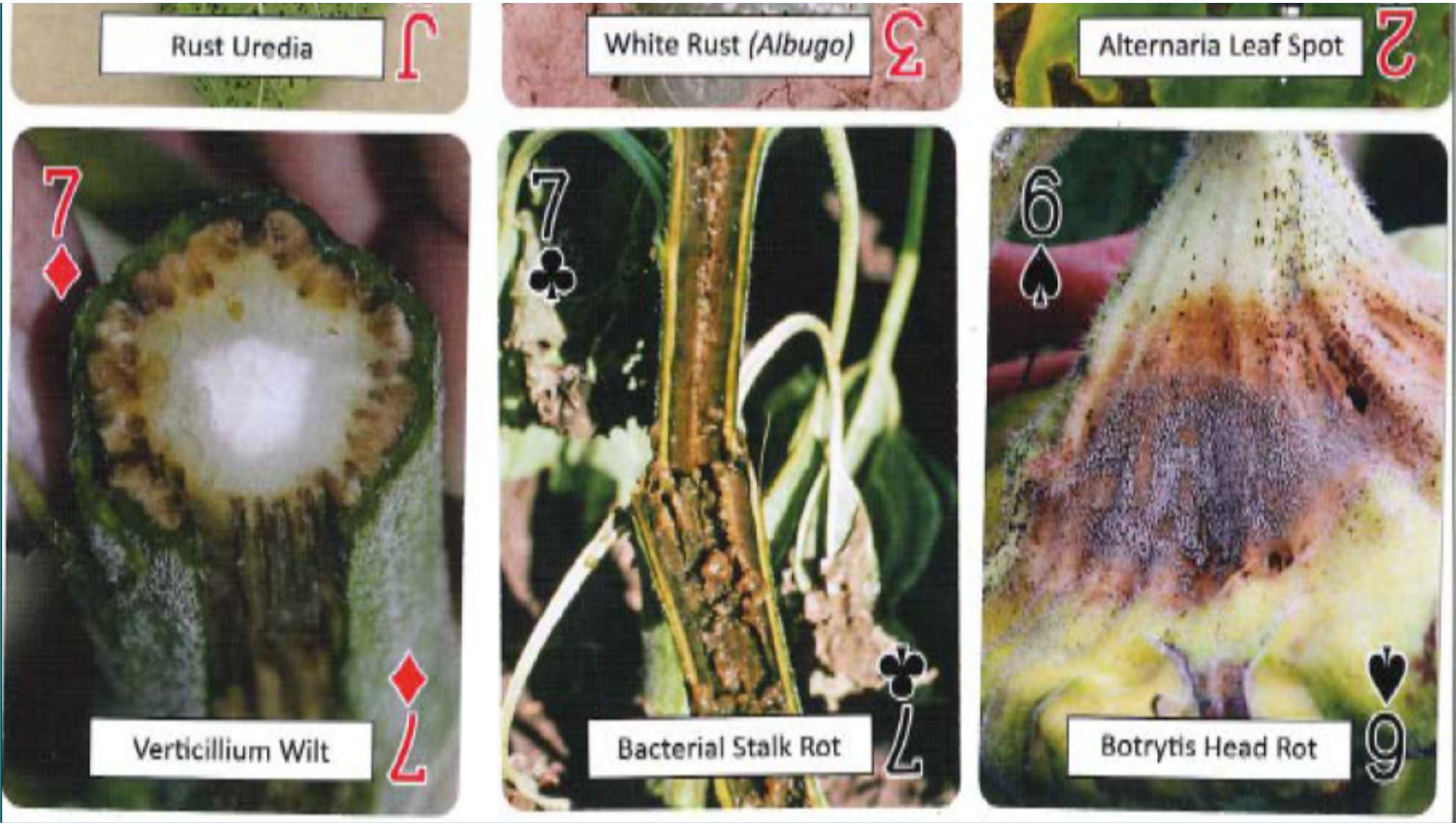
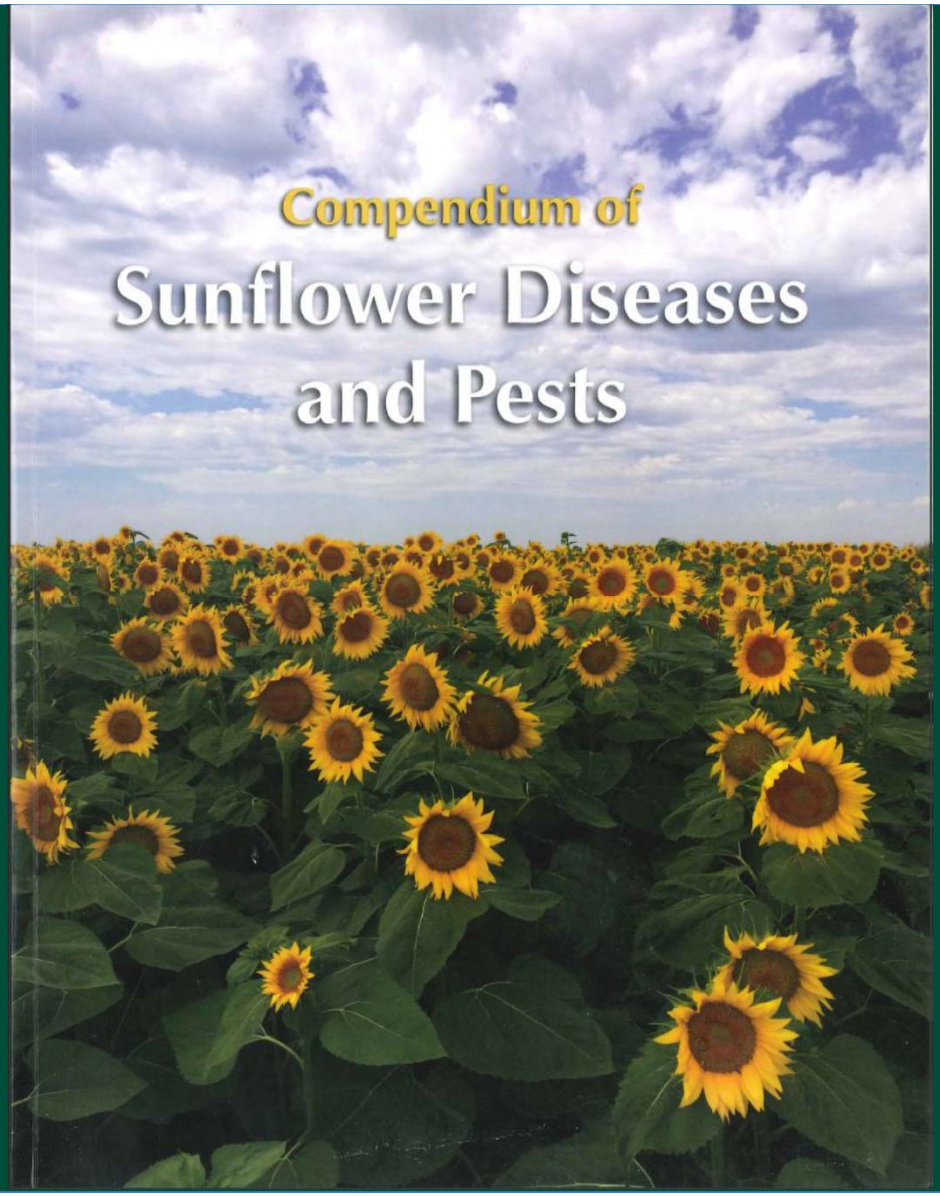

Rust Uredia
White Rust (Albugo)
Alternaria Leaf Spot
Verticillium Wilt
Bacterial Stalk Rot
Botrytis Head Rot



Compendium of Sunflower Diseases and Pests

Edited by

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APS PRESS
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St. Paul, Minnesota, U.S.A.


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NDSU Pest Management
Select a crop and pest type to begin finding pesticide information!
And don't forget about our new image gallery!
Chickpea (Garbanzo Bean)
Corn
Dry Bean
Field Pea
Lentil
Potato
Small Grains
Soybean
Sugarbeet
Sunflower


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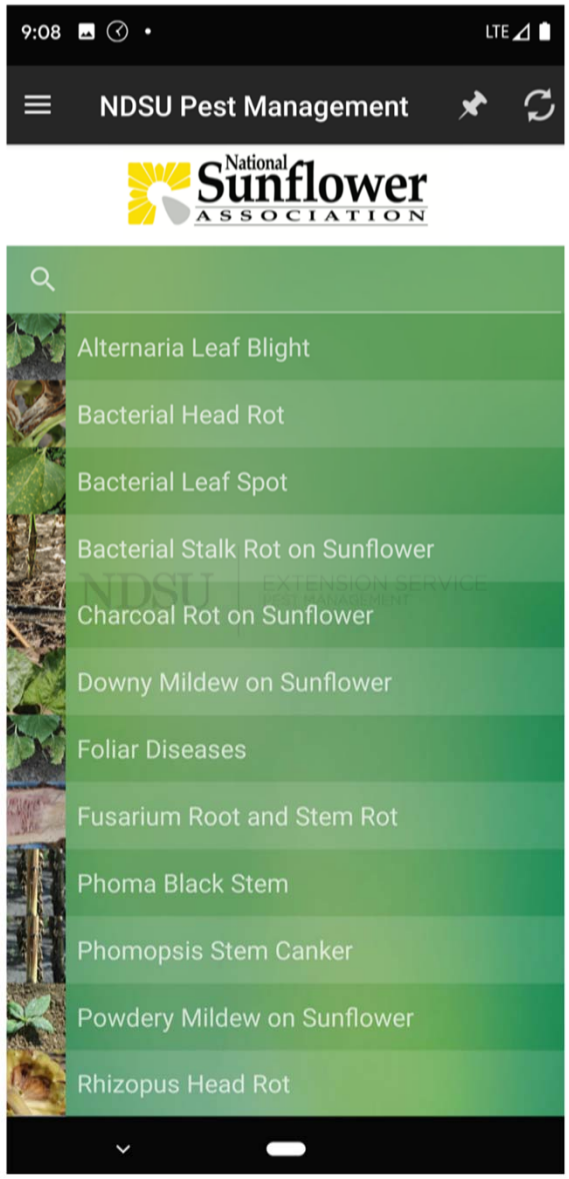
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Charcoal Rot on Sunflower
Downy Mildew on Sunflower
Foliar Diseases
Fusarium Root and Stem Rot
Phoma Black Stem
Phomopsis Stem Canker
Powdery Mildew on Sunflower
Rhizopus Head Rot


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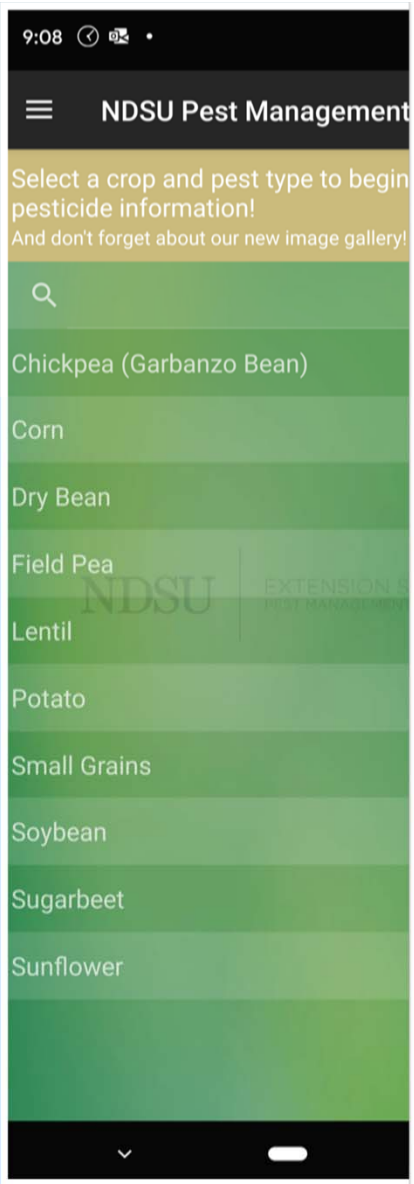
Pest Image Detail
Rust on Sunflower - uredinia
Contributed By: Sam Markell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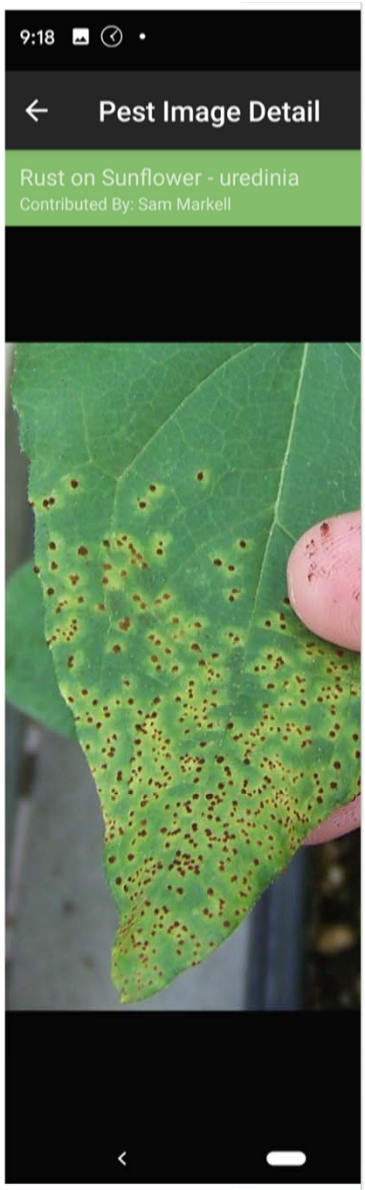
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Rust on Sunflower - uredinia
Contributed By: Sam Markell


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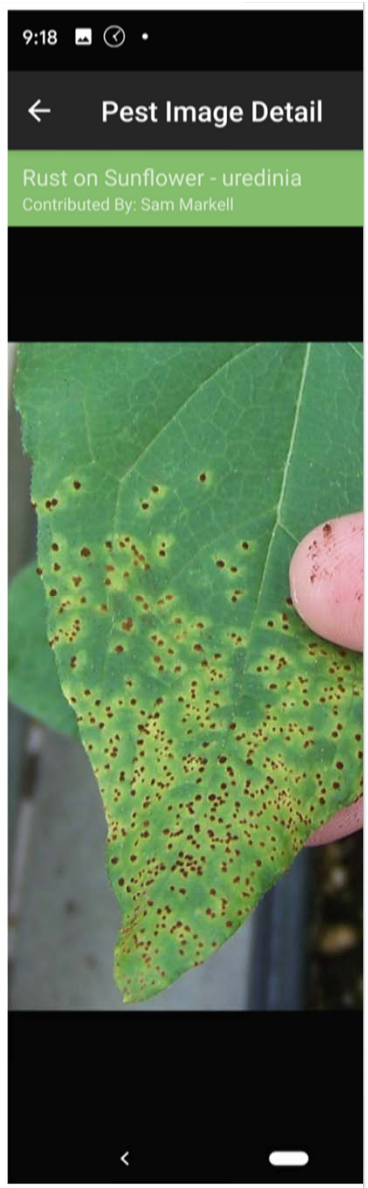
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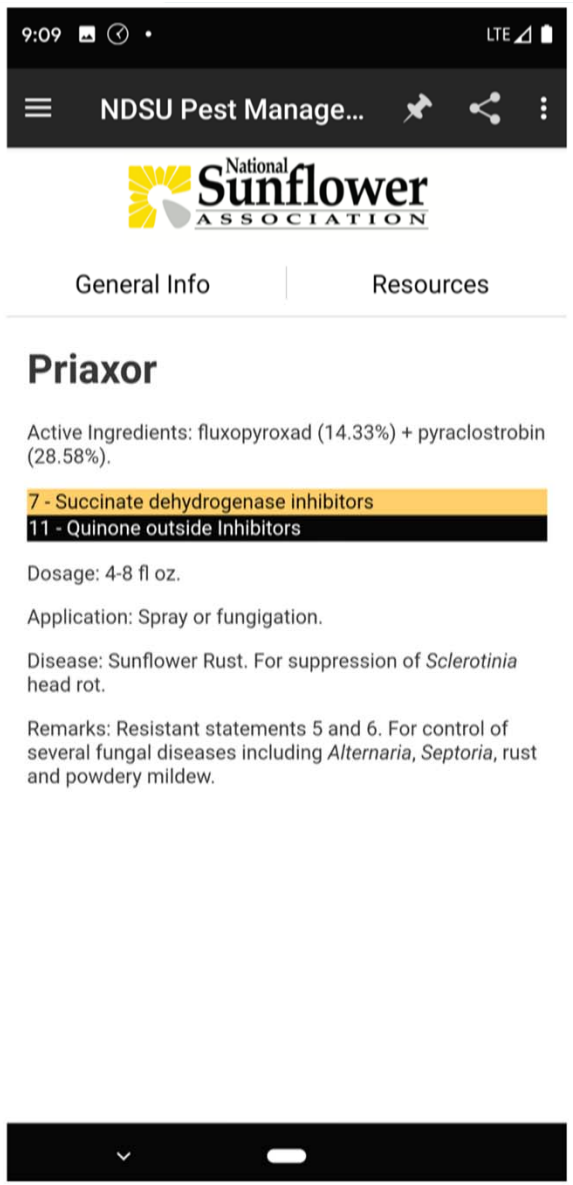
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NDSU Pest Manage...
General Info
Resources
Priaxor
Active Ingredients: fluxopyroxad (14.33%) + pyraclostrobin (28.58%).
7 - Succinate dehydrogenase inhibitors
11 - Quinone outside Inhibitors
Dosage: 4-8 fl oz.
Application: Spray or fungigation.
Disease: Sunflower Rust. For suppression of Sclerotinia head rot.
Remarks: Resistant statements 5 and 6. For control of several fungal diseases including Alternaria, Septoria, rust and powdery mildew.

Phomopsis Stem Canker of Sunflower

Mathew, F., Harveson, R., Gulya, T., Thompson, S., Block, C., and Markell, S. 2018. Phomopsis Stem Canker of Sunflower. *Plant Health Instructor*. DOI: 10.1094/PHI-I-2018-1103-01

DISEASE: **Phomopsis stem canker of sunflower**

PATHOGEN: ***Diaporthe helianthi* Muntañola-Cvetkovic, Mihaljcevic and Petrov (syn. *Phomopsis helianthi*), *Diaporthe gulyae* Shivas, Thompson and Young, several species of *Diaporthe* (syn. *Phomopsis*)**

HOSTS: **Sunflower (*Helianthus annuus*)**

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Figure 1- Leaf infection from Phomopsis stem canker.

Phomopsis stem canker is a major yield limiting disease of sunflower (*Helianthus annuus* L.) in the world (Harveson et al. 2016). The disease was first described in 1980 from the Vojvodina region of the former Yugoslavia and the causal fungus was *Diaporthe helianthi* (syn. *Phomopsis helianthi*) (Muntañola-Cvetkovic et al. 1985). Following this first disease report, Phomopsis stem canker was reported in the 1980s and 1990s from several sunflower producing countries including Hungary (Nemeth et al.1981), Bulgaria (Mihailova 1984), the United States (Hajdu et al. 1984; Herr et al. 1983; Yang et al. 1984), France (Lamarque and Perny 1985; Regnault 1985), Ukraine and Moldova (Bogdanova et al.1986), and Russia (Scripka et al. 1993). In all these countries, *D. helianthi* was assumed to be the sole causal agent of Phomopsis stem canker although several researchers suspected that the disease may be caused by more than one species of *Diaporthe* (Aćimović and Štraser 1982; Herr et al. 1983; Yang and Gulya 1984).

Plant Health Progress ◆ 2018 ◆ 19:82–91 https://doi.org/10.1094/PHP-12-17-0083-DG

Diagnostic Guide

Sunflower Stalk Diseases Initiated Through Leaf Infections

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Accepted for publication 13 February 2018.

Stalk diseases in sunflower (*Helianthus annuus* L.) can be broadly categorized into two major groups: those that are initiated through leaf infections that progress to the petiole attachment on plant stems, and those diseases caused by soilborne pathogens infecting plants through the roots. This article will concentrate on comparing and contrasting three stalk diseases on sunflower that originate via leaf infections: Phoma black stem, Phomopsis stem canker, and bacterial stalk rot.

Host: Sunflower (*H. annuus* L.)

Disease: Phoma black stem.

Pathogen: *Phoma macdonaldii* (syn. *Leptosphaeria lindquistii* Frezzi) (Frezzi 1968). Originally classified as *Phoma oleracea* var. *helianthi-tuberosi* Sacc. (MacDonald 1964), which is a synonym of the saprophyte *Phoma herbarum* Westend. *P. macdonaldii* is tentatively being reclassified as *Plenodomus lindquistii* (Frezzi) Gruyter, Aveskamp & Verkley (Aveskamp et al. 2008). Other species of *Phoma*, all saprophytes or opportunistic pathogens, have been isolated from various *Helianthus* species on live or overwintered tissue, including *Phoma nebulosa* (Fr.) Mont., *P. septicidalis* Boerema (*Coniothryium telephii* [Allescher] Verkley & Gruyte), *P. acutata* Fuckel (*Leptosphaeria doliolum* [Fries] Cesati & de Notaris), and *P. sanguinaolenta* Grove (*L. purpurea* Rehm) (Boerema et al. 2004).

Taxonomy: Kingdom Fungi; phylum Ascomycota; subdivision Pleosporomycetidae; class Dothideomycetes; order Pleosporales; family Leptosphariaceae; genus *Leptospharia*; and species *L. lindquistii*.

Symptoms and Signs

Stem lesions most frequently result from leaf infections that progress down the petiole to the stem (MacDonald 1964; Maric and Schneider 1979) (Fig. 1). Airborne ascospores of *L. lindquistii* germinate in guttation drops at leaf margins and colonize major leaf veins, turning them necrotic, with little or no chlorosis, and thus the foliar disease phase is often overlooked. Once the pathogen reaches the petiole, it becomes noticeably black, and the entire leaf blade wilts as the water supply is curtained. The initial infections usually occur on lower leaves of the canopy, thus further escaping notice. As the pathogen reaches the base of the petiole, a black circular to elliptical lesion will form that can eventually encircle the stem (Fig. 2). The margin is often distinctly delimited and seldom exceeds 5 to 6 cm in length. In contrast, a Phomopsis stem canker lesion is light to dark brown in color and can achieve 15 to 20 cm in length (Fig. 3). *Phoma* lesions are also usually superficial, and there is no pith degradation (Fig. 4), whereas a *Phomopsis* lesion will result in pith degradation to the point of producing a hollow stem and eventual lodging at that point (Fig. 5). Once mature, the small, black pycnidia, mostly buried in the epidermis, may be observed with a hand lens of 5 to 10x. The fruiting structures of the sexual stage (*L. lindquistii*), properly termed pseudothecia, all form after the stems have overwintered (Donald et al. 1986; Frezzi 1968).

Basal stem lesions (Fig. 6), occurring at the soil line, can occur with *Phoma*-contaminated seeds, or owing to early seedling infection via roots (Al Fadil et al. 2009; Donald et al. 1987; Masirevic et al. 2014). Basal stem lesions are similar in appearance to those occurring at leaf axils. When stem-feeding insects such as *Apion* and *Cylindrocopturus* stem weevils oviposit in leaf axils, a stem lesion will form without leaf infection. When the eggs hatch, the *Phoma*-contaminated larvae will burrow upward into the pith, carrying *Phoma*, and cause extensive pith degradation, premature maturity, and death of the plant (Donald and Venette 1983; Gaudet and Schulz 1984; Gulya and Charlet 1984).

Host Range

The primary host of *P. macdonaldii* is cultivated sunflower (*H. annuus* L.). The pathogen has also been isolated from lesions on annual and perennial wild *Helianthus* species, all native to North America. It does not infect other Asteraceae genera, but there are many other *Phoma* species reported on other Asteraceae (Boerema et al. 2004).

Geographic Distribution

P. macdonaldii, originally identified in North America (MacDonald 1964), has been recorded from many countries in North and South America (Bruni 1965; Gulya and MacArthur 1984; Kandel and Gulya 2016), Europe (Maric and Schneider 1979; Penaud and Peres 1994), Asia, Africa, and Australia (Miric et al. 1999; Wu et al. 2012). In contrast to its impact on the U.S. crop (Carson 1991), unless vectored by stem-boring insects, *P. macdonaldii* is felt to be a significant pathogen on sunflower in Europe, where significant yield losses have been reported from France (Penaud and Peres 1994).

†Corresponding author: Robert Harveson; E-mail: rharveson2@unl.edu

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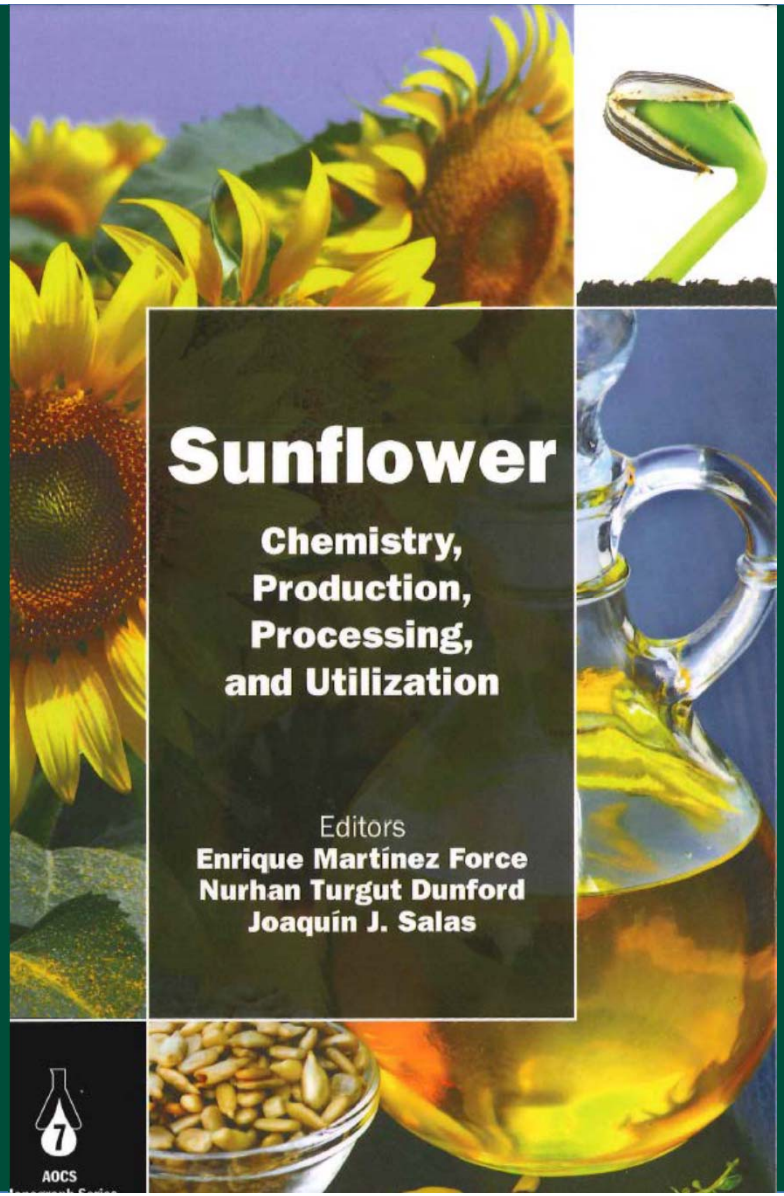

4

Sunflower Diseases

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Introduction

Sunflowers are native to North America, with 51 species of annual and perennial types found, but the primary cultivated sunflower worldwide is the herbaceous annual *Helianthus annuus*. The range of sunflower cultivation spread from its origins in the United States and Canada to become widely grown in temperate zones of Europe, Asia, South America, and Australia. Sunflower is a known host for over 30 pathogens, but the relative importance of specific diseases varies with geographic region. Differences in climate, pathogen distribution, and cropping practices affect the prevalence of individual diseases in each region. For example, charcoal rot is mainly found in warmer regions where high temperatures and low soil moisture predispose plants to infection. In contrast, downy mildew is found in regions where emerging seedlings are exposed to low temperatures and wet soils. Some diseases, such as rust, Sclerotinia head rot, and Sclerotinia stalk rot and wilt are widespread, threatening sunflower production in nearly every sunflower growing region. In this chapter, two tables of selected diseases are presented. Table 4.A lists diseases considered to be of widespread importance. Table 4.B lists selected diseases of regional importance or those that may occur sporadically. Individual diseases and their effects on sunflower production are discussed in more detail. These include downy mildew, Phomopsis stem canker, rust, Rhizopus head rot, Sclerotinia head rot, Sclerotinia stalk rot and wilt, and Verticillium wilt.

Downy Mildew

Introduction and Disease History

Downy mildew of sunflower is caused by the obligate fungal pathogen *Plasmopara halstedii*. The pathogen of sunflower was first found in the late 1890s in the Northeastern

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The Sunflower Pathology Working Group

NOVEMBER 15, 2018

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Robert M. Harveson, Extension Plant Pathologist, Panhandle R&E Center; Sam Markell, North Dakota State University; Febina Mathew, South Da University; Charlie Block, Iowa State University; Tom Gulya, USDA (retired); Sue Thompson, University of Southern Queensland, Australia (retir Malcom Ryley, University of Southern Queensland, Australia (retired)

Sunflower is an economically important field crop in the United States, with 2 to 2.5 million acres planted across the Great Plains, t majority in North and South Dakota with substantially high production also in Minnesota, Kansas, Colorado, and Nebraska.

Two types of sunflowers are grown: oilseed, which is consumed as oil, and confectionary, which is grown for direct human consumption. Both types provide an important source of income. While sunflowers produced for oil are competitively priced with other oilseed crops, confectionary types bring a more lucrative premium price.

Figure 1. Sunflower field at the university's High Plains Agricultural Lab near Sidney.

Sunflowers can be impacted by dozens of diseases. Based on annual surveys conducted by the National Sunflower Association, diseases are routinely one of the three biggest yield-limiting factors.

Despite the economic importance of sunflower and the substantial impact that diseases have on its production, there have been very few sunflower pathology resources available to assist sunflower growers, sunflower seed companies and agricultural professionals. This is true for both Extension, and academic reference material. Thus identifying a disease correctly is likely a significant challenge for anyone in the industry.

Accurate identification is the first step toward the successful use of IPM (integrated pest management) or any management techni

Creation of the SPWG

In 2013, the Sunflower Pathology Working Group (SPWG) was established with the mission of helping educate and ultimately man sunflower diseases by increasing knowledge and awareness of diseases through the production and distribution of both extension academic research-related literature pertaining to diseases in the sunflower crop. This effort has been funded through the North Central IPM Center Working Group Program, which in turn is provided through grants by the U.S. National Institute of Food and Agriculture.

Our group initially began with four pathologists (including myself) from California, North Dakota, Nebraska, and Iowa. It has expanded to include another pathologist from South Dakota and internationally, two from Australia, which also produces sunflowers.

Our initial objectives were:

1. to identify what information growers needed most and in what media format;

'Most Wanted' List

Dangerous fugitives have been spotted stealing yield during harvest. Take note of locations and prepare to apprehend in 2019.

By Sam Markell, Bob Harveson and Febina Mathew*

#1: Phomopsis Stem Canker

Deadly fugitive that has resurfaced in the last decade.

Last Spotted: Phomopsis stem canker has ravaged Northwest Minnesota and Eastern North Dakota in recent years and has stolen yield as far south as the High Plains.

Description: Phomopsis stem canker appears as a large (often greater than 6 inches) and brown stem lesions, always centered on a petiole. The stem becomes hollow underneath the lesion, is easily punctured with thumb pressure and frequently results in lodging.

Commonly Known Hangouts: The fugitive will survive the winter on sunflower residue but may also survive on weed hosts. The fugitive flourishes in wet weather, but can still cause infections with average rainfall. An aggressive attack by this fugitive early in the season will devastate a crop.

Apprehension in 2019: Difficult. Consult your seed company for a hybrid less susceptible to the disease. Strobilurin fungicides (FRAC 11: such as Headline, Quadris, etc.) applied in early reproductive growth stages have shown some promise, but are not guaranteed to slow this fugitive down.

#2: White Mold

Deadly fugitive that attacks sunflower in three different ways.

Last Spotted: Most common in the Dakotas and Minnesota. Also spotted in High Plains.

Description: The fugitive can attack the base of the stem (causing wilt), the middle of the stem (stem rot) or the sunflower head (head rot). Plants under attack express a water soaked lesions that become tan, enlarges and eventually shreds. The fugitive often leaves evidence behind in form of hard black sclerotia and fluffy white fungal growth.

Commonly Known Hangouts: The fugitive attacks other broadleaf crops (soybean, dry bean, canola, potatoes, etc.) and survives as sclerotia for many years, lying dormant until it re-emerges with a vengeance. You're likely ive in locales with wet so emperatures (60s-70s F) p ness (rain, frequent heavy canopies).

Apprehension in 2019: long crop rotation (four ye susceptible hybrid may slo down. In the High Plains, also reduce irrigation late deterrent.

#3: Rus

Fugitive attacks s throughout the Plain likely to steal yield fro

Last Spotted: Texas to

Description: Dusty ci pustules that harden and t end of the season.

Commonly Known Ha fugitive frequents locales ture (dew and fog).

Apprehension in 2019 tion of a hybrid with resis prevent rust. If spotted, m cides are effective — but early in an epidemic.

Do not take your eyes the fugitive is in the neigh 2019. This fugitive is not and clandestine attacks.

*Sam Markell is extension plant pathologist with North Dakota State University. Bob Harveson is plant pathologist at the University of Nebraska's Panhandle Research & Extension Center. Febina Mathew is plant pathologist with South Dakota State University.

Disease Trends 2002 - 2017

As Indicated By Findings of The NSA Sunflower Survey

The National Sunflower Association has conducted the Sunflower Crop Survey since 2002. With the exception of 2004, the survey was carried out annually until becoming a biennial survey in 2013. Volunteers from all levels of the sunflower industry visit sunflower fields to survey the crop. They look for yield and production practices, weeds, insects, diseases, and bird damage.

The collected data are useful to all involved in the sunflower industry. For producers, the information can help them make better management decisions. Researchers use the information to guide future research. And the National Sunflower Association relies on the data to determine which areas of research to fund.

Dr. Sam Markell of the NDSU Department of Plant Pathology and other pathologists have taken the data specific to disease and further examined the trends in disease. Markell shared those findings at the 2019 NSA Research Forum.

Markell says comparing sunflower disease issues in North Dakota to those in Texas wouldn't make sense, because the climate, soils and other growing conditions are so different in those areas. So, he and his team separated the growing areas into these four geographic regions:

- Region 1 — North Dakota and Minnesota
- Region 2 — South Dakota
- Region 3 — Nebraska, Colorado and Kansas
- Region 4 — Texas

"There is so much difference in the growing factors in those states, that we felt splitting them into regions made the most sense," Markell states. "In North Dakota and Minnesota, temperatures are cooler and there's not a lot of irrigation. Compare that to Texas where temperatures are extremely hot and 75% of the crop is irrigated. Those things make a difference when we look at the disease trends."

Across all the years, survey crews looked at more than 2,200 fields in the Dakotas, Minnesota, Nebraska, Kansas, Colorado and Texas. Markell says on the disease side, as many as 10 different diseases were identified. He focused his presentation on the top five diseases: downy mildew, rust, Sclerotinia head rot, Rhizopus head rot and Phomopsis stem canker. Here is a brief summary on his observations for each of the diseases in the various regions:

Downy Mildew

Markell says downy mildew might be the only disease that is under-estimated on the survey.

"Downy mildew often strikes early in the season," he explains. "Plants will die before the survey is done at the end of the growing season; so those plants that had downy mildew are not around when we are surveying fields. I'd say it's probably underrepresented by about 50%."

Markell says downy mildew shows up in every region, but is most prevalent in Region 1 — which, he explains, stands to reason because the disease thrives in cooler temperatures common in North Dakota and Minnesota. Although he expected to see more of the disease in Texas because of irrigation, it has only shown up in one year of survey in the Lone Star State.

Rust

Markell says rust is the most common of the top five diseases in the sunflower survey.

"We found rust in every region we surveyed; and there are regions where we are approaching 100% of fields with rust," he told the Research Forum crowd. "But that doesn't mean it is severe; it simply means it is occurring."

Still, rust can lead to high yield loss. The economic threshold for spraying is 1% during bloom; and when surveys (which are conducted at the end of the season) show as little as 3 to 4% rust occurrence, yield was likely lost. Markell says some fields with 20% rust are completely wiped out.

According to Markell, rust spiked in the Central Plains and in North Dakota in 2009, leading to high yield loss. That's when the National Sunflower Association decided to fund research on rust. He says that research — and the development of the fungicide thresholds used today — would not have happened had it not been for the NSA survey.

Sclerotinia Head Rot

Markell says Sclerotinia head rot is most common in Region 1, as the disease thrives in the cooler weather in North Dakota and Minnesota. There isn't much Sclerotinia south of South Dakota, he says.

"There really isn't a lot of Sclerotinia head rot in South Dakota, even. I expected more in the High Plains and in Texas because of irrigation, but the heat makes the disease reasonably uncommon," he points out.

Markell says the data collected on Sclerotinia through the sunflower survey across the years has proven valuable to researchers. "We don't have a lot of details on what level of yield loss the disease causes on a large scale," the NDSU plant pathologist points out. "We have data from research plots; but this survey gives us a better look at the big picture. Demonstrating how much yield loss Sclerotinia head rot causes is critical when researchers try to leverage research funding from other sources, such as the National Sclerotinia Initiative."

Photos Courtesy IPM Sunflower Disease Working Group

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