THE UNIVERSITY OF ARIZONA
Cooperative Extension

az1868 February 2021

Pythium Crown and Root Rot of Industrial Hemp

Jiahuai Hu and Robert Masson

Fig. 1. Sudden collapse of a hemp plant infected with *Pythium aphanidermatum.*

Introduction

The 2018 U.S. Farm bill changed the Controlled Substances Act and legalized cultivation of industrial hemp in the United States. In Arizona, the AZDA issues licenses and regulates the production and processing of industrial hemp. In 2019, 165 growing licenses and 43 nursery licenses were issued across the state, resulting in the planting of 5,430 acres in 13 counties. The University of Arizona, Extension Plant Pathology Laboratory, in Tucson has detected several major diseases in hemp crops grown during the 2019 – 2020 seasons. In this publication we will describe one such disease, Pythium crown and root rot. This disease has been observed in hemp grown with plastic mulch film and saturated heavy soil, and is associated with over-irrigation, poor drainage, and high temperatures. Pythium crown and root rot does not appear to be isolated to Arizona, and also has been reported in field-grown hemp in North Carolina, Indiana, California, and Nevada.

Pathogen

Several *Pythium* species including *Pythium aphanidermatum, P. ultimum,* and *P. myriotylum*. *Pythium* is a fungus-like organism, similar to, but distinctly different than true fungi. Pythium is also referred to as a "water mold" because it is well adapted to damp environments, and requires the presence of water for infection to occur. Under moist conditions, the pathogen produces abundant sporangia containing numerous single-celled, motile zoospores (asexual spores), which are effectively dispersed over short distances by splashing water or air movement. *Pythium* also produces thick-walled chlamydospores (asexual spores) to protect itself during dry conditions. Hyphae from opposite mating types meet and produce thick-walled oospores (sexual spores), causing genetic variation and making it difficult to treat.

Host Range

Wide host range, which includes most agronomic crops, such as: beets, peppers, cucurbits, cabbages, carrots, melons, corn, cotton, wheat, guayule, and turfgrasses, as well as most ornamentals such as chrysanthemum, annuals, and bedding plants.

Symptoms and Diagnosis

Hemp of any age is susceptible. Typical symptoms include pre-emergence damping off, post-emergence damping off, leaf yellowing and browning, stunting, wilting, sudden collapse of entire plant (Fig. 1, 7-9). Shriveled tissue with lesions and necrosis can often be seen at the base of the plant extending up several inches (Fig. 2). Internal tissue of main stem or branches is darkened or pinkish brown (Fig. 2 - 4). Outer cortex of root bark is often completely rotten, exposing the white core (Fig. 3 and 5).

Disease with Similar Symptoms

Fusarium wilt, cotton root rot, Sclerotinia canker, and Verticillium wilt. A laboratory test via microscopy and culture isolation is required for definitive diagnosis. Symptomatic stems and roots should be collected and wrapped in a dry paper towel, placed in a plastic bag, acid

Fig. 2. Dark staining and rot of the underlying tissues progressing upwards from crown.

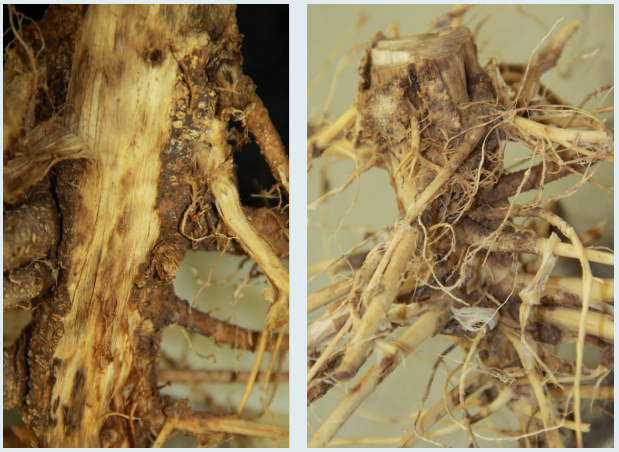


Fig. 3. Crown region of diseased plant showing necrosis and darkening of the underlying tissues extending into the roots; decayed root bark that is sloughed off readily.

Fig. 4. Staining of the stem core of a diseased plant (left), white stem core of a healthy plant (right).

Fig. 5. Root systems of a disease plant (left) and a healthy plant (right).

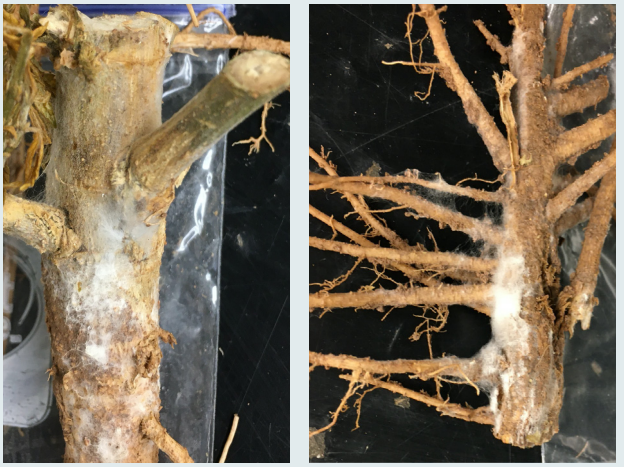
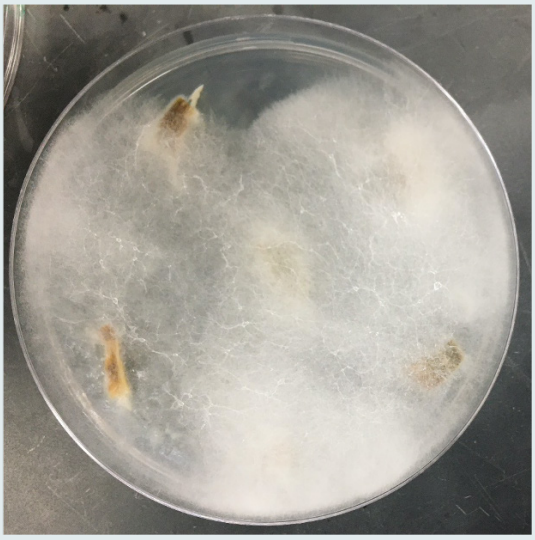


Fig. 6. Cottony mycelial growth of *Pythium* on the surface of stalk and roots under high humid conditions.

Fig. 7. Almost complete crop failure in Yuma hemp variety trial plots heavily infested with *Pythium aphanidermatum.*

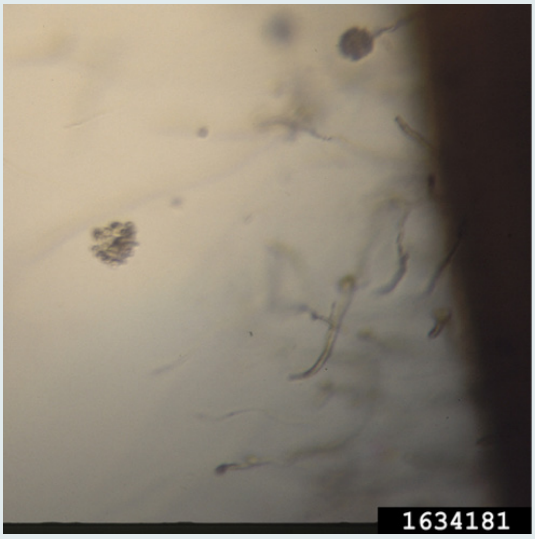
Fig. 8. A large hemp field in Graham county with high disease incidence of *Pythium* crown and root rot (note: wet soil conditions with plastic mulch film).

Fig. 9. Dislodging of a diseased plant due to rotting and internal decay at the base of the plant.

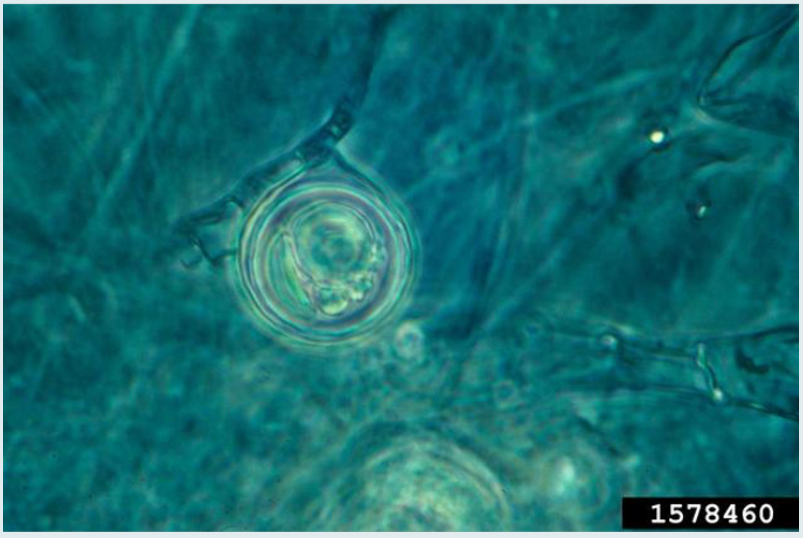


2-day-old colony on Potato Dextrose Agar

Sporangium



Zoospores (asexual spores)



Oospores (sexual spores)

Fig. 10. Life stages of *Pythium* species

cooled, and shipped **overnight** to the University of Arizona's Extension Plant Pathology Laboratory in Tucson. All submissions should be accompanied by completed Plant Disease Diagnostic Form.

Disease Cycle

Pythium species survive in soil for long periods of time primarily as oospores. Infection of hemp roots occurs by producing hyphae, threadlike, filamentous cells (Fig. 6 and 10) that extract nutrients from the host plant. Upon germination, an oospore (Fig. 10) may produce hyphae, or develop a zoosporangium, which produces motile zoospores that swim to, and infect plants. Zoosporangia (Fig. 10) can also germinate and infect plants directly. Zoospores require free water to move through the soil and infect other hemp plants. *Pythium* species can also spread to other adjacent susceptible hemp plants by mycelial growth. *Pythium* propagules can also spread by transportation of contaminated soil, plant materials, and equipment.

Wet soils provide favorable conditions for disease development in hemp. Optimal soil temperatures for *Pythium* vary from species to species, ranging across the spectrum, from cool to hot; both *P. aphanidermatum* and *P. ultimum* favors warm conditions (30-40^{0}C) making them most virulent on hemp plants grown during spring and summer in Arizona.

Management

There are currently no effective fungicides registered for use in hemp to manage *Pythium* species. On other crops, seed treatment, soil drench or foliar application with the following chemistries provides good control against damping off and Pythium crown and root rot: metalaxyl or mefenoxam, propamocarb, phosphonate, azoxystrobin, oxathiapiprolin, cyazofamid, and fluopicolide. For a field site with a known history of Pythium rot, crop rotation is not an effective measure. Instead, cultural practices such as good drainage and water management should be emphasized to create an environment where seed germination is favored, plant stress is reduced, and risk of infection by *Pythium* is minimized: 1) plant on raised beds to improve drainage and soil compaction, 2) plant in well drained soil and avoid heavy clay/silt soils, 3) monitor irrigation to avoid saturated soil conditions for prolonged periods, 4) utilize tensiometers, mobile and In-Situ digital moisture meters to monitor soil moisture conditions, 5) sterilize potting soil between plantings, 6) remove plastic mulch used for weed suppression after crop establishment to promote drier soil conditions, 7) remove and discard diseased plants and roots to reduce level of *Pythium* population in soils, 8) remove sources of *Pythium* inoculum, 9) reduce drought and nutrient stresses on hemp, and 10) plant less susceptible cultivars when they become available; at the time of this publication no cultivars have been identified that provide suitable resistance to *Pythium* species in Arizona. Consult local County Cooperative Extension offices and Arizona Department of Agriculture: Industrial Hemp Program for updated information on disease resistance in your area.

References

Arizona Department of Agriculture - Industrial Hemp Program 2019 Year End Report. Retrieved at the link.

Beckerman, J. et al. 2017. First report of *Pythium aphanidermatum* crown and root rot of industrial hemp in the United States. Plant Dis. 101(6): 1038

Beckerman, J. et al. 2018. First report of *Pythium ultimum* crown and root rot of industrial hemp in the United States. Plant Dis. 102(10): 2045

Hu, J. et al. 2021. First report of crown and root rot caused by *Pythium aphanidermatum* on industrial hemp (*Cannabis sativa*) in Arizona. Plant Dis. 105

Hu, J. et al. 2021. First report of crown and root rot casused by *Pythium myriotylum* on hemp (*Cannabis sativa*) in Arizona. Plant Dis. 105

Punja, Z.K. et al. 2018. Root and crown rot pathogens causing wilt symptoms on field-grown marijuana (*Cannabis sativa* L.) plants. Can. J. Plant Pathol. 40 (4): 528-541

THE UNIVERSITY OF ARIZONA
Cooperative Extension

AUTHORS

Dr. Jiahuai Hu
Assistant Cooperative Extension Specialist and Plant Pathologist, School of Plant Sciences

Robert Masson
Yuma County Cooperative Extension, University of Arizona, Yuma, AZ

CONTACT
Jiahuai Hu
epp@email.arizona.edu

This information has been reviewed by University faculty.
extension.arizona.edu/pubs/az1868-2021.pdf

Other titles from Arizona Cooperative Extension can be found at:
extension.arizona.edu/pubs