

CALIFORNIA LEAFY GREENS RESEARCH PROGRAM

April 1, 2021 – March 31, 2022

Title: Pythium Wilt Management in Lettuce Through Improved Irrigation Practices

Project Investigators:

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ABSTRACT

Pythium wilt, caused by *Pythium uncinulatum*, infects the roots of lettuce plants. The pathogen survives in the soil in the form of resting spores called oospores, which are resistant to desiccation and temperature changes, and can survive in the soil for several years even in the absence of the host. Upon detecting the presence of the crop, oospores can germinate and infect plant roots directly, or form swimming zoospores, which can spread through water towards roots of the host plant. They attach to and infect the roots. Given that the pathogen needs saturated soil conditions to initiate infection, disease is often most prevalent in wetter parts of the field such as at the head or tail ends of the rows. Under severe infestations and especially with susceptible lettuce varieties, it can occur throughout the planting. To evaluate the role of water in the disease development of Pythium wilt, four trials were conducted with a cooperating grower and one site at the USDA research station in which different levels of irrigation water were applied to replicated plots. Evaluations of total number of plants and the percent of wilting/dying plants in the plots were conducted. The percent of wilting/dying plants caused by Pythium wilt, lettuce drop and Botrytis rot were determined in each plot. Higher levels of Pythium infections were not observed in these studies.

OBJECTIVES

Evaluate the effect of water management on the incidence of *Pythium uncinulatum* in lettuce: Conduct trials to evaluate water management effects on pythium occurrence and severity and yield in commercial lettuce fields. Quantify pythium populations in soils and disease occurrence of irrigation treatments. Extend results to the leafy green industry through seminar presentations and newsletter articles.

PROCEDURES

Objective 1. *Evaluate water management effects on pythium occurrence and severity and yield in commercial lettuce fields.* Four trials were conducted evaluating the impact of the amount of irrigation water on the incidence of Pythium wilt of lettuce. Irrigation regimes were established that compared 100% of crop ET (as estimated by CropManage) with higher irrigation amounts to

determine if excess irrigation applications increased the incidence of Pythium wilt (Table 1). The water treatments were applied during the drip irrigation phase of the crop cycle (the last half). The irrigation treatments were applied with separate manifolds that fed each treatment. Each manifold had a flow meter and valves that were operated during the crop cycle by irrigators to apply the correct quantity of water. At the end of the crop cycle total lettuce plants per plot were counted as well as total wilting/dying plant per plot. Ten wilting/dying plants were evaluated to determine the percent of plants that were affected by Pythium wilt, lettuce drop, Botrytis crown rot or a vascular wilt (Verticillium and/or Fusarium). **Trial No. 1:** Conducted on an organic romaine lettuce planting south of Gonzales on a Salinas clay loam soil. The lettuce was transplanted in six seedlines on 80-inch wide beds on May, 6 and 100, 150 and 200% of crop ET were applied over the crop cycle. The number of wilted plants per 100 feet of row were counted on July 8. The cause of wilting for each plant was determined. **Trial No. 2:** Conducted on a conventional romaine lettuce east of Salinas on Chualar loam soil. The lettuce was planted in six seedlines on 80-inch wide beds on July 13 and 100, 150 and 200% of crop ET was applied over the crop cycle. The number of wilted plants per 100 feet of row were counted on August 25 and 30. All wilted plants were affected by Pythium wilt. **Trial No. 3:** Conducted at the Spence USDA research station and was grown conventionally. The lettuce was planted on July 27 in two seedlines on 40-inch wide beds and 100 and 200% of crop ET was applied from thinning to crop maturity. The number of wilted plants per 100 feet of row were counted on September 28. The percent of plants wilted due to Pythium wilt and Fusarium wilt was determined for 10 plants from each plot. **Trial No. 4.** Conducted on conventional romaine lettuce south of Salinas on Salinas Clay Loam soil. The lettuce was planted in six seedlines on 80-inch wide beds on September 1 and 100, 150 and 200% of crop ET was applied over the crop cycle. The number of wilted plants per 100 feet of row were counted on October 22 and 27.

The volume of water applied to the treatments was monitored using flowmeters (Seametric, Ag3000) interfaced with dataloggers to track the irrigation time and application rate. Soil moisture of the treatments was monitored using tensiometers installed at an 8 to 12-inch depth. Canopy photos of the crop was collected to at 1 to 2-week intervals to monitor the fraction cover development during the season. Yield was estimated by either hand harvest of subplots with the treatments or commercial harvest of strips the length of the field.

Objective 2. *Quantify Pythium populations in soils and disease occurrence in irrigation treatments.*

Pythium occurrence will be assessed at weekly intervals by visually monitoring the number of dying or dead plants in the field. Tissue samples will be collected from symptomatic roots, and isolation and culturing methods optimized during the 2020 season will be used to confirm the presence/absence of the pathogen.

Pathogen density concentration in soil from different treatments will be assessed using culture dependent methods (Alcala et al 2016). Briefly, 10-g sample would be added to 100 ml of 0.1% water agar (WA) mix. After shaking vigorously (10min, 250 rpm), fivefold dilutions will be prepared, and aliquots (3, 0.5-ml) of each dilution will be each spread on the surface of a WA

plate. Plates will be incubated at room temperature, and colonies counted after 24, 30, and 36 h to calculate CFU per gram of soil.

Objective 3. *Extend results to the leafy green industry.* Results will be communicated through a technical report, newsletter articles that summarize the key findings of the project, field demonstrations, and industry seminars.

RESULTS

The percent of wilted plants in each treatment is shown in Table 2. Each field had different proportions of pathogens that affected the plants. Trials 1 and 2 had low levels of affected plants, but in Trial 1 the majority of affected plants were infected with *Sclerotinia* and *Botrytis* bottom rot, and *Pythium* wilt was less of an issue in this field. In Trial 2, *Pythium* wilt was the only soilborne disease affecting the lettuce, but the incidence of the disease was low. There was no difference among irrigation treatments in trials 1 and 2. In trial 3 there was significant level of *Pythium* wilt, but there were no significant differences between irrigation treatments. In trial 4 there was moderate levels of wilt in the field. There were higher levels of *Sclerotinia* than *Pythium* wilt in the field, but the irrigation levels did not affect disease development. *Pythium* was only the dominant soilborne disease in only one of these four trials. Irrigation amounts did not aggravate levels of *Pythium* wilt in any of these four fields. These results do not fit with our concept that excess water and/or poor drainage may aggravate *Pythium* wilt disease in lettuce and will need to be repeated to confirm these results.

Table 1. Water applied during the drip irrigation phase

Irrigation treatment	Applied water	Recommended applied water	Crop ET
	----- inches -----		
	----- Trial 1 -----		
100% ETc	5.9	7.7	6.9
150% ETc	9.1	8.1	7.2
200% ETc	15.2	8.1	7.2
	----- Trial 2 -----		
100% ETc	6.1	5.0	4.5
150% ETc	6.3	5.0	4.5
200% ETc	7.7	5.0	4.5
	----- Trial 3 -----		
100% ETc	5.3	5.3	4.7
200% ETc	10.6	5.3	4.7
	----- Trial 4 -----		
100% ETc	4.8	4.3	3.7

150% ETc	5.9	4.3	3.7
200% ETc	9.7	4.3	3.7

Table 2. Number of wilted plants in each irrigation treatment

Irrigation Treatment	Total wilted plants Percent	-----Percent of wilted plants-----		
		Pythium wilt	Sclerotinia	Vascular wilt
-----Trial 1-----				
100% ET	4.1	41.4	39.0	19.5
150% ET	4.5	40.0	46.7	13.3
200% ET	4.4	34.1	59.1	6.8
Pr>F treat	0.9465	0.8756	0.3286	0.1351
-----Trial 2-----				
100% ET	5.3	100.0	0.0	0.0
150% ET	5.0	100.0	0.0	0.0
200% ET	5.0	100.0	0.0	0.0
Pr>F treat	0.9372	---	---	---
-----Trial 3-----				
100% ET	25.9	95.0	0.0	5.0
200% ET	32.8	90.0	0.0	10.0
Pr>F treat	0.1282	---	---	---
-----Trial 4-----				
100% ET	14.9	31.3	68.8	0.0
150% ET	15.9	46.3	53.8	0.0
200% ET	15.4	37.5	62.5	0.0
Pr>F treat	0.7115	0.3936	0.3936	---