ARIZONA ICEBERG LETTUCE RESEARCH COUNCIL

FINAL REPORT

Project title: Effect of reduced water usage during summer soil flooding to manage Sclerotinia drop on lettuce

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Introduction

Several years ago the Arizona Iceberg Lettuce Research Council helped fund research to evaluate potential cultural methods for reducing populations of *Sclerotinia minor* and *S. sclerotiorum* in soil. These fungi are the soil-borne pathogens responsible for lettuce drop. Our research demonstrated that flooding soil for at least 3-weeks in the summer destroyed virtually all of the resistant structures (sclerotia) of both pathogens, suggesting a highly effective cultural means of managing lettuce drop. This summer soil flooding technique is now being used to manage lettuce drop. However, there are concerns that extensive flooding of soil may be adversely affecting the water table and damaging drainage infrastructure.

Currently, fungicides generally reduce the number of lettuce plants lost to lettuce drop by about 50 to 60% at best compared to nontreated plants. The ability of summer soil flooding to virtually eradicate the lettuce drop pathogens from soil is a valuable disease management tool for growers. Although summer soil flooding may not be appropriate for all ground planted to lettuce, it is an important component of an effective integrated management program for lettuce drop. However, there is an urgent need to further define the method of water delivery and the duration of soil wetness required to destroy sclerotia of *S. minor* and *S. sclerotiorum* in soil.

The specific objective of this research was to examine the effect of different methods of applying water and the duration of soil wetness on the resultant proportion of sclerotia of *S. minor* and *S. sclerotiorum* that were destroyed. Specifically, for 1-, 2-, or 3-week periods of time, we compared continuous maintenance of surface water on soil to application of water for shorter time intervals.

Materials and Methods

Plots 10 feet wide and 60 feet long were established at The University of Arizona Yuma Agricultural Center during July-August, 2013. Sclerotia of *S. minor* and *S. sclerotiorum* were produced in the laboratory. Packets made from shade cloth and each containing 15 sclerotia of *S. minor* or *S. sclerotiorum* were placed at depths of 0, 2, and 4 inches in soil within plots. Five replicate packets of sclerotia for each pathogen at each depth were placed into each plot listed below. The soil in plots was subjected to one of the following irrigation regimes.

1. Apply and maintain water for 1 week.
2. Apply and maintain water for 2 weeks.
3. Apply and maintain water for 3 weeks.
4. Apply and maintain water for 8 hours in the first week
5. Apply and maintain water for 8 hours in the first and second weeks.
6. Apply and maintain water for 8 hours in the first, second, and third weeks.
7. Apply and maintain water for 8 hours twice a week (Monday & Thursday or Tuesday & Friday) for 3 weeks.
8. No irrigation.

When water was applied to plots, at least 1-inch of free water was maintained on the soil surface for the duration of each flooding period. At the conclusion of the 3-week irrigation treatments, sclerotia of each *Sclerotinia* species from soil depths of 0, 2, and 4 inches were recovered, washed, surface-sterilized, and placed onto acidified potato dextrose agar within pertri dishes to determine the percentage of tested sclerotia that were able to germinate and produce mycelium and daughter sclerotia. Soil temperature was recorded in an irrigated and the nonirrigated plot.

Results and Discussion

The effect of the various soil flooding treatments on viability of sclerotia of *Sclerotinia minor* and *S. sclerotiorum* is summarized in Table 1. In general, sclerotia of *S. minor* were more susceptible to all tested soil flooding treatments compared to sclerotia of *S. sclerotiorum*. Among treatments, a 2- and 3-week continuous flooding period reduced sclerotia germination most effectively for both pathogens.

The various 8-hour soil flooding sequences reduced sclerotia viability of *S. minior* well when they were 2- or 4-inches deep in soil, but not when sclerotia were on the soil surface. The increased survival on the soil surface is likely due to rapid drying of sclerotia after each flooding event. On the other hand, the 8-hour flooding sequences had little effect in reducing viability of *S. sclerotiorum* sclerotia at any soil depth.

Viability of sclerotia of *S. sclerotiorum* in the nonirrigated plot was lower than that in plots receiving the various 8-hour flooding treatments. P. B. Adams noted in a paper published in 1987 that the time required to kill 50% of sclerotia of *Sclerotinia minor* at soil temperatures of 35, 40, 45, and 50°C was 624, 38, 3, and 2 hours, respectively. The temperature of soil in the plot irrigated for 1 week compared to soil temperature in the nonirrigated plot is shown in Table 2. Recorded mean minimum and maximum soil temperatures ranged from 29 to 40°C in irrigated soil compared to 33 to 49°C in nonirrigated soil. It is possible that higher temperatures in the nonirrigated compared to irrigated soil could account for the noted reduced viability of sclerotia of *S. sclerotiorum* in nonirrigated soil.

The data from this one-year study should be considered to be preliminary in nature, subject to confirmation by data obtained from at least one additional trial. This is especially true since just over 1-inch of rain fell on all plots from Aug 22nd to 26th, near the conclusion of the experiment.

Reference

Adams, P. B. 1987. Effects of soil temperature, moisture, and depth on survival and activity of *Sclerotinia minor, Sclerotium cepivorum,* and *Sporidesmium sclerotivorum*. Plant Disease 71:170-174.

Table 1. Effect of flooding duration and depth of sclerotia in soil on viability of sclerotia of *Sclerotinia minor* and *S. sclerotiorum*.

Soil treatment	Depth of sclerotia in soil (inches)	Percent germination of sclerotia	
		S. minor	***S. sclerotiorum***
Flood for 1 week	0	6	0
	2	0	18
	4	0	56
Flood for 2 weeks	0	0	0
	2	0	0
	4	0	8
Flood for 3 weeks	0	0	0
	2	0	16
	4	0	0
Flood for 8 hours in first week	0	36	76
	2	4	52
	4	0	56
Flood for 8 hours in 1st and 2nd week	0	20	88
	2	0	56
	4	0	88
Flood for 8 hours in 1st, 2nd, and 3rd week	0	4	72
	2	0	92
	4	0	88
Flood for 8 hours, twice a week, for 3 weeks	0	12	76
	2	22	92
	4	10	84
No application of water *	0	30	24
	2	0	16
	4	0	16

* 1.08 inches of rain fell on all plots from Aug 22nd to 26th. Sclerotia were recovered from all plots on Aug 27th.

Table 2. Minimum and maximum temperature of soil.*

Soil moisture status	Soil temperature in °F (°C)			
	Minimum		Maximum	
	1.5 inches	3 inches	1.5 inches	3 inches
Flooded for 1 week	84 (29)	86 (30)	104 (40)	98 (37)
Nonirrigated	91 (33)	93 (34)	120 (49)	98 (37)

***** Mean daily minimum and maximum soil temperature recorded from 2 to 12 days after cessation of flooding in the plot flooded continuously for 1 week.