ARIZONA ICEBERG LETTUCE RESEARCH COUNCIL

FINAL REPORT

Project title: Influence of the crop following lettuce on subsequent severity of Sclerotinia drop.

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Introduction

Sclerotinia drop, caused by the fungal pathogens *Sclerotinia minor* and *S. sclerotiorum,* is an annual concern to Arizona lettuce producers. Infected lettuce plants usually die, so that plant loss is directly related to disease incidence. Both plant pathogens produce survival structures called sclerotia as the infected lettuce plant becomes fully colonized by the fungal pathogen and dies. Sclerotia produced by *S. minor* are smaller but more numerous than those produced by *S. sclerotiorum*. Sclerotia within and on infected plant tissue are incorporated into the soil at the end of that crop's life along with plant residue. A heavily infected lettuce planting will produce a vast amount of sclerotia. The number of viable sclerotia will decline over time; however, sufficient quantities of sclerotia remain to initiate disease in the next lettuce crop. The resulting severity of Sclerotinia drop is dependent on the number of sclerotia in the field capable of initiating disease as well as the favorability of environmental conditions for disease development.

Lettuce is not the only host for *S. minor* and *S. sclerotiorum*. Published reports (2,4) list over 94 different plant species as hosts for *S. minor* and 408 species as hosts for *S. sclerotiorum*. Some of these hosts, such as celery, cauliflower, broccoli, and other cool-season crops, are grown in Arizona at the same time of the year as lettuce. On the other hand, some of the listed hosts are warm-season crops planted after lettuce. For example, cantaloupe is listed as a host for *S. minor* and melons, cotton, wheat, and sudan grass are listed as hosts for *S. sclerotiorum*. We have not seen obvious symptoms due to either of these pathogens on any of these crops; however, it is possible that one or more of them could be serving as hosts on which the pathogen may grow in a limited manner, not expressing symptoms, but producing sclerotia. This could be a mechanism by which viable populations of sclerotia in soil are sustained between lettuce crops. A similar situation was revealed in California with the lettuce Fusarium wilt pathogen (3), where the lettuce pathogen could colonize and grow on the roots of some plants other than lettuce without producing the characteristic wilt symptoms observed on lettuce.

Following a lettuce crop intentionally infected with *S. minor* or *S. sclerotiorum*, the specific objective of this proposal is to test the possible effect of a spring-summer fallow or planting cantaloupes, cotton, sudan grass, or wheat on the incidence of Sclerotinia drop in a subsequent planting of lettuce. This objective will be addressed by means of a greenhouse study and a field trial.

Materials and Methods

Greenhouse study. To assess the potential ability of *S. minor* and *S. sclerotiorum* to colonize and affect the growth of cantaloupes, cotton, sudan grass, or wheat, a known number of sclerotia were placed in field soil within a series of pots in the greenhouse. Seeds of one of these plants were sown into each pot in the spring and the resulting plants were grown to maturity. Five replicate pots for each plant and pathogen type were prepared. Control plants were grown in soil without added sclerotia. At plant maturity, growth of plants in soil containing sclerotia were compared to control plants grown in soil not containing sclerotia by recording the fresh weight of plant roots.

Field trial. A planting of lettuce 'Winterhaven' was established at The University of Arizona Yuma Agricultural Center during the 2011-12 lettuce production season. After thinning, one large block was infested with *S. minor* and another block infested with *S. sclerotiorum* by incorporating sclerotia produced in the laboratory into the lettuce beds. The lettuce planting was grown to maturity and Sclerotinia drop developed in blocks infested with both pathogens. At crop maturity, plant residue and sclerotia were incorporated into the soil. Within each of the two large blocks, five different treatment plots were established, which included a spring-summer fallow or sowing of cantaloupes, cotton, sudan grass, or wheat. Each treatment plot was replicated four times within each large block to facilitate statistical analysis of data. Crops were grown to maturity, crop residue incorporated into soil, then another sowing of lettuce 'Winterhaven' occurred in the fall of 2012 in all plots. This lettuce crop was grown to maturity, at which time the incidence of Sclerotinia drop was recorded and compared in plots subjected to the spring-summer fallow or planted to the crops stated earlier.

Results and Discussion

In the greenhouse study, there was no difference in growth and root weight for plants of all types tested when grown in soil containing sclerotia of *S. minor* or *S. sclerotiorum* compared to the same plant types grown in soil without sclerotia. Plants and soil in the greenhouse were subjected to higher temperatures than those recorded outside, which may have affected the results of this greenhouse trial.

The findings from the field trial are summarized below in the Table. For soil containing sclerotia of *S. minor*, the largest reduction (97.6%) in Sclerotinia drop incidence from first to second lettuce planting was recorded when land after the first planting was subjected to a spring-summer fallow. On the other hand, growing cantaloupes or wheat between the two lettuce plantings resulted in respective 65.1 and 65.0 % reductions in Sclerotinia drop in the second lettuce planting. Growing cotton or sudan grass after the first lettuce crop resulted in respective drops of 88.0 and 84.2% in Sclerotinia drop incidence in the second lettuce planting. In plots infested with *S. sclerotiorum*, reductions in Sclerotinia drop incidence ranging from 98.5 to 99.6% occurred when the first planting of lettuce was separated from the second planting of this crop by a spring-summer fallow or growing of cantaloupes, cotton, sudan grass, or wheat.

In plots infested with *S. minor*, the lower magnitude of disease decrease in the second lettuce plantings preceded by cantaloupes, cotton, sudan grass, or wheat compared to a spring-summer fallow could be due to the higher soil temperatures in fallow nonirrigated soil. A recently completed study funded by the Arizona Iceberg Lettuce Research Council suggested a relationship between high soil temperatures recorded in nonirrigated field soil and decreased viability of sclerotia of *S. minor* and *S. sclerotiorum*.

In plots infested with *S. sclerotiorum*, the higher reduction in disease incidence from the first to the second lettuce planting when separated by growing crops of cantaloupes, cotton, sudan grass, or wheat, compared to data from plots infested with *S. minor*, could be a result of the relative number of sclerotia produced by each lettuce pathogen in the first lettuce planting. P. B. Adams reported (1) that on average *S. minor* produced about 3,500 sclerotia on a single infected lettuce plant. In comparison, we have noted that *S. sclerotiorum* on average produces 10% or less of this amount of sclerotia per infected lettuce plant. Given the preparation of beds following the first lettuce planting for sowing of the following crop and more bed soil manipulation prior to the second lettuce planting, the number of sclerotia available near the soil surface to initiate infection of the second lettuce planting would be much less in plots containing *S. sclerotiorum* compared to those containing *S. minor*. This difference in population of sclerotia for the two pathogens may partially explain the higher reduction in disease recorded from the first to the second lettuce planting in plots infested with *S. sclerotiorum* compared to *S. minor*.

The data from the field study are interesting but should be considered to be preliminary in nature, subject to confirmation by at least one additional field trial. Since the greenhouse study did not yield usable data and did not accurately represent field environmental conditions, this study would not be repeated.

References

1. Adams, P. B. 1967. Production of sclerotia of *Sclerotinia minor* on lettuce in the field and their distribution in soil after disking. Plant Dis. 70:1043-1046.
2. Boland, G. J., and Hall, R. 1994. Index of plant hosts of *Sclerotinia sclerotiorum*. Can. J. Plant Pathol. 16:93-108.
3. Hubbard, J. C., and Gerik, J. S. 1993. A new wilt disease of lettuce incited by *Fusarium oxysporum* f. sp. *lactucum* forma specialis nov. Plant Dis. 77:750-754.
4. Melzer, M. S., Smith, E. A., and Boland, G. J. 1997. Index of plant hosts of *Sclerotinia minor*. Can. J. Plant Pathol. 19:272-280.

Table. Effect of soil treatment between successive plantings of lettuce on the incidence of Sclerotinia drop in the second lettuce crop.

Treatment	**Percent reduction of Sclerotinia drop in the presence of** [x]	
	S. minor	***S. sclerotiorum***
Spring-summer fallow (no crop grown)	97.6 a [y]	99.0 ab [z]
Cotton planted	88.0 b	96.1 c
Sudan grass planted	84.2 b	99.6 a
Cantaloupes planted	65.1 c	98.2 bc
Wheat planted	65.0 c	98.5 abc

[x] Percent reduction in incidence of Sclerotinia drop in lettuce planting following indicated crops or spring-summer fallow compared to disease incidence in the first lettuce planting.

[y] Values in this column followed by a different letter are significantly different ($P = 0.05$) according to Fisher's protected least significant difference.

[z] Since values in this data set were not normally distributed, an Analysis of Variance using the Kruskal-Wallis OneWay Analysis of Variance on Ranks was employed. Values in this column followed by a different letter are significantly different ($P = 0.05$) according to the Tukey Test.