Evaluation of an Onion Soil Amendment to Reduce White Rot Sclerotia in Garlic

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Abstract

White rot is one of the most important diseases of onion, garlic, and other *Allium* crops. The pathogen survives in the soil as sclerotia, which specifically germinate in response to chemical compounds elicited by *Allium* species. Onion soil amendment, a byproduct of onion processing activities, is a potential source of naturally occurring sclerotia germination stimulant compounds. The objective of this research is to determine the effectiveness of onion soil amendment, with and without tarping and fungicides, at reducing *S. cepivorum* populations in field soils. Field plots were established and treated with onion soil amendment or left untreated. One half of the plots were covered with tarps for 6 days after onion soil amendment application and the other half were left uncovered. Soils were sampled before treatment applications and periodically throughout the season to quantify the number of viable sclerotia in each plot. Garlic was planted and an in-furrow treatment of tebuconazole was applied to half of the plots. Significant effects of onion soil amendment or tarping were not observed and significant interactions were not detected ($P > 0.05$). The combined effects of onion soil amendment, tarping, and tebuconazole on white rot symptoms, marketable yield, and post-harvest sclerotia populations will be determined after harvesting garlic in 2015.

Introduction

White rot, caused by the fungus *Sclerotium cepivorum*, is a major disease of onion, garlic, and other *Allium* crops. The soilborne fungus can survive in a dormant state in fields for decades without a host and are stimulated to germinate in response to chemical compounds elicited by the roots of *Allium* hosts. Very low populations of the fungus are required to cause severe losses. Sclerotia can be moved from field to field in soil, water, and on bulbs used for planting. Severely infested fields are often abandoned from onion and garlic production. A need currently exists to develop strategies to reduce white rot populations in infested fields.

Sclerotia germination stimulants, which mimic the chemical compounds released by *Allium* roots, have a great potential for managing white rot. An onion soil amendment derived from onion processing is a potential source of naturally-occurring germination stimulant compounds that is inexpensive, renewable, and available in large quantities. Although sclerotia germination stimulants can be effective at reducing white rot populations in the soil, they do not provide complete control when used alone. Covering treated areas with tarps may decrease volatilization of germination stimulants and increase the effectiveness of these compounds. Other studies have shown that combining onion soil amendments with fungicide applications can reduce white rot and increase marketable yield. The objective of this research is to determine the effectiveness of onion soil amendment, with and without tarping and fungicides, at reducing *S. cepivorum* populations in field soils.

Materials and Methods

Field plots were established in a white rot infested field located at the Central Oregon Agricultural Research Center. Each plot was 30 ft long and 10 ft wide. Soils were sampled from each plot between April 29 and May 2 to determine populations of *S. cepivorum* prior to treatments. A total of 14 soil cores, each approximately 9” deep and 0.75” in diameter, were taken equidistantly within each plot and bulked together into a single sample for each plot. A 250 cc subsample was taken from each sample for assay. Soil was briefly blended and sclerotia were concentrated from soil by size (sieving through 2 mm screen) and by density (flotation on a 2.5M sucrose solution). The remaining soil residue with sclerotia was collected and observed under a dissecting microscope. Sclerotia recovered from soil assays were counted and frozen in water prior to plating for viability. If more than 50 intact sclerotia were counted, then 50 sclerotia were randomly selected and tested for viability by plating on water agar. If 50 or fewer sclerotia were counted, then all intact sclerotia were tested for viability. Sclerotia were washed, surface-sterilized for 2.5 minutes in 10% bleach, rinsed twice with sterilized water, cracked using forceps, and placed on water agar plates to induce growth. Petri plates were incubated in the dark for 2 weeks at room temperature. Sclerotia that developed characteristic mycelial growth and produced microconidia in the agar were considered to be viable sclerotia of *S. cepivorum*. Sclerotia that did not germinate in 3 weeks were considered to be dead.

Treatments consisted of: 1) onion soil amendment; 2) tarp covering for 6 days after onion soil amendment application; and 3) tebuconazole applied in-furrow at planting. Plots were arranged in a split-split block design and replicated 4 times. Onion soil amendment treatments included rates of 0-, 2-, and 5 gal/acre. Onion soil amendment applications were performed on May 15 when the mean soil temperature at a 4 in depth was 62°F. Applications were made using five XR Teejet 8008VS nozzles arranged on a boom mounted to a 4-wheeler. Plots were irrigated after onion soil amendment applications and 6 mm clear polyethylene tarps were installed on the following day. Non-tarped plots were included as controls. Tarps were removed on May 22 and plots were irrigated periodically to maintain adequate soil moisture. Post-treatment soil samples were taken on June 25-26 and August 27 and assayed for white rot sclerotia as described above.

Garlic was hand-planted in two rows per 36 inch bed at spacing of approximately 9 plants per foot row on September 29-30 and irrigated as needed. Tebuconazole (20.5 oz/acre) was applied to half of the plots in a 4 to 6 inch band over the furrow in a total volume of 40 gal/acre. The remaining plots were left as non-fungicide treated controls. The incidence of white rot will be monitored monthly in the spring, and the marketable yield will be determined for each plot at harvest. After harvest and tillage, the number of viable sclerotia will be quantified in soils after harvest as described above.

Results and Discussion

The mean number of viable sclerotia ranged from 73 to 110 sclerotia/liter soil at the first sampling period in April-May and from 66 to 94 sclerotia/liter soil at the final sampling period in August. Significant effects of onion soil amendment or tarping were not observed and significant interactions were not detected ($P > 0.05$). The combined effects of fungicide treatment, onion soil amendment, and tarping on white rot symptoms, marketable yield, and post-harvest sclerotia populations will be determined in 2015.

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Figures

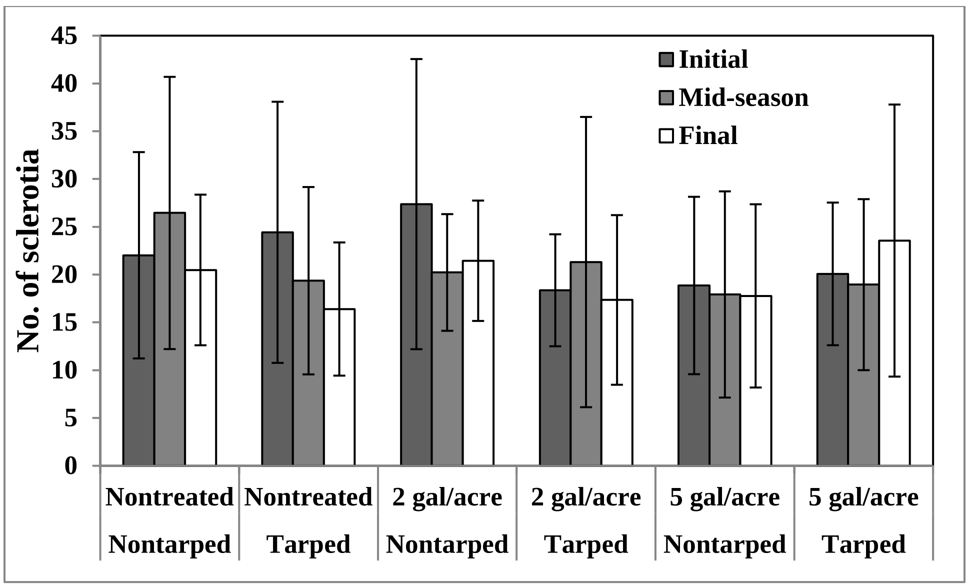

Figure 1. Sclerotia counts before (initial) and after (mid-season and final) treatment with onion soil amendment at 0-, 2-, and 5 gal/acre rates and with and without tarping. Error bars indicate standard deviation values.