Post-harvest Metam Sodium Fumigation for Control of White Rot Inoculum (*Sclerotium cepivorum*)

Fred Crowe, Bob Crocker, and Rhonda Simmons

Introduction

Essentially all sclerotia of the Allium white rot fungus *Sclerotium cepivorum* are stimulated to germinate during a season when Alliums are grown and when soil temperatures are conducive for germination. Nearly no secondary sclerotia develop, few new sclerotia form on roots, and no new sclerotia reproduce on organic matter in the soil. Thus, essentially all sclerotia present in the field at the end of a disease cycle are new and located near where bulbs rotted or are located even shallower in and on soil following harvest operations. We hypothesized that such sclerotia should be easier to control by fumigation because fumigants could be concentrated in the upper 4-5 inches of soil. In contrast, if sclerotia first were distributed more deeply by tillage, fumigants would need to be moved to greater depths and more product might be required to maintain high concentration. Secondarily, post-harvest fumigation might also control garlic volunteer plants. However, results reported here from metam sodium fumigation in a nonreplicated single strip of a white-rot-infested garlic field that had not been tilled since harvest suggest that sclerotial kill was not substantially greater than that reported in other fumigation studies with non-tarped metam sodium applied to more deeply tilled soils.

Materials and Methods

The field selected was uniformly infested with lab-grown sclerotia of *S. cepivorum* in the summer of 2004, and cropped to garlic during 2004-2005. The garlic was harvested in July of 2005 and a 12-ft strip along the north edge of the field was never tilled in anticipation of shallow metam sodium fumigation. For various unrelated reasons, we were unable to fumigate for the remainder of 2005. Metam sodium was applied in the late spring of 2006. Volunteer garlic already had been controlled by herbicide sprays, so garlic volunteer control was not evaluated.

Air and soil temperatures were recorded nearby at the Central Oregon Agricultural Research Center by the AgriMet weather reporting system. The spring of 2006 was cool and damp. Soil warm-up was later than in many years. After soil temperature rose above 60°F at 4 inches, metam sodium was applied as described below on July 11. In subsequent weeks, soil temperature at 4 inches fluctuated between 60-74°F, well within the range for reliable activity of metam sodium; 40-90°F is the acceptable temperature range stated on the product label. See the table below:

Post-fumigation (≥July 11)	Weekly minimum (°F)	Weekly maximum (°F)
7/11-17	64.4	72.5
7/18-24	62.4	73.7
7/25-31	60.1	74.4

Prior to irrigation, soil was tilled 3-4 inches to break up clods, and irrigated. There was good soil moisture at depth already. The soil is a Madras Loam. Vapam® (42 percent metam sodium) was provided by Round Butte Seed Growers and Amvac. Soil was damp but not wet on the day of fumigation. Fumigation was at 8:30 a.m. on July 11. Vapam was applied in the morning when air temperature was about 50°F. There was no wind and the sun had not heated the soil surface. Vapam was applied full strength at 75 gal/acre using a single "floodjet" nozzle (Field Jet no. 5). The spread of the spray was predetermined to be relatively even across the 12-ft strip. The spray rig made multiple passes along the 120-ft-long strip until the full amount was dispensed. Within 2 minutes of spray completion, the Vapam was incorporated 4-5 inches deep using a rototiller. Within another 2 minutes, a roller packed down the soil slightly. Within another 2 minutes, sprinkler irrigation was started to further seal in the metam sodium. No odor of metam sodium was detected during this process. Irrigation was repeated approximately every 7 days for 4 weeks.

Multiple pre-and postfumigation soil samples were taken just prior to fumigation along the centerline of the strip and in the field adjacent to that strip. Because fumigation was not replicated, no statistical analysis was possible. No Vapam odor was detected on August 1 when postfumigation soil samples were collected along the centerline of the fumigated strip and from the adjacent field. Soil was sampled prefumigation on the day of fumigation (July 11), and again on August 11. Both pre- and postfumigation assays yielded approximately 1,000 intact sclerotial bodies characteristic of *S. cepivorum* per liter of soil. Because fumigated sclerotia do not rapidly decay, the best measure of kill is sclerotial viability – in this case, sclerotia were surface sterilized with 0.5 percent sodium hypochlorite (NaOCl), cracked and placed on agar and forced to grow if alive, as a measure of viability. Results are shown in the table below:

Treatment	Pre-fumigation viability (July 11)	Post-fumigation viability (Aug 11)
Vapam, 75 gal/acre	99.1%	22.2%
No fumigation	99.0%	98.2%

Results and Discussion

Application of metam sodium resulted in 22 percent versus 98 percent survival of sclerotia. Twenty-two percent survival is comparable to 20-30 percent survival reported in other studies on fumigation of metam sodium for sclerotia of *Sclerotium cepivorum* when applied in a similar manner, although there is a report of near 100 percent kill for metam sodium applied under plastic tarp. We had hoped to find sclerotial reduced to 5 percent or less, or perhaps even approaching 2 percent or less with tarped methyl bromide applications. However, vigor on agar of sclerotia from the fumigated strip was reduced for some but not all sclerotia, in contrast to uniformly high vigor for nonfumigated sclerotia. Data are not shown for this. It is possible that sclerotia weakened by fumigation have reduced longevity and reduced ability to grow, thus reducing their ability to incite disease. This was not measured to date in this study, but soil assays will be taken later to determine whether viability has declined further among weakened sclerotia.

Metam sodium clearly did reduce the soil population of sclerotia. However, postfumigation inoculum density (roughly 200 viable sclerotia/l soil) still was very high considering that 1 and 10 sclerotia/l of soil may result in 40 percent and more than 95 percent white rot infected garlic bulbs at harvest. Thus, postfumigation populations in this fumigated strip remain far too high to replant garlic without loss of nearly all plants to white rot disease.