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White Rot: a Returning Problem for Garlic in New York

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White rot in early June
Image: Crystal Stewart

White rot is the most significant disease affecting allium production world-wide, and has resurfaced in the New York garlic industry after a long period of eradication. Positive samples were collected in 2016 from Eastern, Central and Western New York, indicating that the disease is widespread. As with other soilborne pathogen, white rot can be persistent and devastating. However, careful management can reduce inoculum, and because the pathogen is spread by seed and soil, it is also possible to prevent its spread into uninfested fields.

What is White Rot?

White Rot is caused by *Sclerotium cepivorum,* an ascomycete fungus which is related to white mold fungi (*Sclerotinia* family). The pathogen is spread through mycelia and sclerotia movement in the soil and on seed garlic, but not as airborne spores. Only 1 sclerotium per 10 liters of soil is enough to cause disease, and 10-20 sclerotia will cause upwards of 90% infestation. Generally these levels of sclerotia in the soil can be reached in 2-4 cropping cycles of alliums grown under favorable conditions (Crowe, 1980). One of the primary reasons this disease is of critical concern is that once sclerotia are in the soil, they can remain viable for up to 40 years (Schwartz and Mohan, 2008).

The disease cycle of White Rot:

White rot sclerotia will remain dormant in the soil until a suitable host (an allium) is detected through sulfur compounds secreted by the plant. Soil temperature is the greatest factor contributing to the speed of disease movement; at 48° F germination is very slow; optimum at 57-64°F, and terminates at 70°F (Schwartz and Mohan, 2008). Ideal moisture levels for disease development are the same as for crop growth.

White rot damage is generally detected first as yellowing or wilting of the foliage just prior to scape emergence, though the infestation started much earlier. The above ground symptoms can correspond with underground symptoms including degradation of the roots and basal plate, formation of black sclerotia the size of poppy seeds, and briefly a white mycelial mat on the bulb extending up to the soil line.

How do I Know it's White Rot?

Garlic can be affected by other pathogens right around scape emergence, including *Fusarium* and *Botrytis porri.* Fusarium does not form sclerotia, and is therefore easy to differentiate. Botrytis sclerotia are normally significantly larger than White Rot sclerotia (see right image on this page). However, if you are unsure about the cause of symptoms you are seeing, you can email your local extension specialist a picture or submit a sample to the diagnostic lab for identification.

White rot briefly forms a dense white mat of mycelia. This image was taken June 22. Image: Crystal Stewart

Poppy-seed sized sclerotia appear in June as the garlic sizes up. Image: Crystal Stewart

Botrytis sclerotia, by contrast, are generally significantly larger (see arrow). Image: Crystal Stewart

Control measures for White Rot:

The best control for white rot is to not bring the pathogen onto the farm. As we see with many other diseases, transmission on seed is a serious concern. Limit introduction of new seed onto your farm if possible, and purchase seed from trusted sources. Discard any seed which is visually diseased. It is also important to limit the movement of soil onto your farm, e.g. through sharing uncleaned cultivation or harvesting equipment.

If white rot is found on your farm, there is no one best answer for control. Various options have been effective in different parts of the world and under a variety of environmental conditions. A management approach which involves multiple strategies will likely be most effective.

Quarantine: Ideally the infested field should be removed from cultivation through establishment of pasture or uncultivated perennial crop. This will prevent the movement of long-lived sclerotia into other parts of the farm. If this is not possible, the infested field (or part of the field) should be taken out of garlic/onion production. Allium spp. are the only hosts of the white rot fungus, so this strategy will prevent inoculum building up in soil. If the field remains in cultivation then considerable care will be required in terms of cleaning equipment in an isolated part of the farm after it is used in the infested field, to prevent further spread to other parts of the farm.


Biofumigant mustard cover crop. Image: Justin O'Dea, CCE Ulster

Biofumigation: Isothiocyanates released by incorporation into the soil of biofumigant brassica cover crops or dried commercial preparations of brassica material will kill a proportion of sclerotia. While unlikely to eradicate white rot, if utilized over a number of years, this strategy may be a means of reducing the number of viable sclerotia in the soil.

Solarization: In Mediterranean climates solarization has proven the most effective control for white rot (Melero-Vara et al, 2000). The technique commonly used is to cultivate and irrigate the soil, then cover it with a transparent polyethylene sheet for approximately one month. This technique could be effective during hot, sunny summers, but would likely be ineffective during cool summers. Viability of sclerotia is reduced in the laboratory by 95% if exposed to 1 day at 113°F or 8 days at 95°F (McLean et al 2001). However, in nature longer periods of fluctuating sublethal temperatures can also reduce viability. In New Zealand, periods of solarization of 1-2 months leading to a maximum soil temperature (4 inches depth) of 103-109°F and mean soil temperature of 77-84°F led to significant reductions in recovery and viability of sclerotia in the topsoil (Mclean et al. 2001).

Biological controls: The use of both *Trichoderma* and *Bacillus subtilis* have provided some control of white rot in some years. As with all biologicals, effectiveness varies depending on environmental conditions. Biologicals are a promising addition to a control program, but are not being recommended as a stand-alone control.

Sclerotia Growth Stimulants: Sclerotia of white rot germinate in the presence of exudates from garlic or onion plants. However, if they germinate and fail to find a host they will die. A synthetic allium compound called diallyl disulfide was developed to 'trick' sclerotia in the soil to germinate in the absence of a suitable host, resulting in 90 percent reductions of the number of viable sclerotia in a single season (Davis, 2007). Unfortunately, this compound is no longer commercially available. Garlic powder may similarly stimulate sclerotia germination. Garlic powder applied at 125-135 lb/A incorporated to 6 inches reduced sclerotial viability by >95% (Crowe et al. 2000). However, note that this treatment did not result in eradication of White Rot, and application must be made when soil temperatures and moisture are adequate for germination of sclerotia (i.e. 50-72°F) and in the absence of Allium host plants.

There has been some experimentation with using composted onion waste to stimulate germination of sclerotia as well (Coventry, 2002). This technique shows some promise, but should be combined with other control measures. If there is interest in trying this technique, please see the complete paper cited below for protocols, or contact your local garlic specialist.

Conclusions: White rot is the most significant disease affecting allium production worldwide, and should be recognized and understood by commercial garlic growers. The best control technique is avoidance of the disease, followed by leaving infested fields and infected seed sources in favor of clean soil and seed. If these are not options, combining different control techniques may significantly reduce disease pressure. Any grower who has a history of white rot should not sell garlic for seed until moving to clean seed stock and soil.

Sources:

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