THE JOY OF THE STINKING ROSE

Growing garlic is very satisfying, and for farmers who include garlic in a diversified array of crops, quite lucrative. For some there still remains a mystique about successfully growing garlic …I try to dispel this for beginning gardeners by asking how difficult it is to plant tulip bulbs?!

However simple the process may be, there are some potentially very serious pests and diseases that gardeners and farmers should be aware of. In Maine where I farm, two very serious diseases have only recently been identified. Many growers are simply unaware of these problems and as a result can easily contribute to the spread of the problems.

I my case I innocently, and ignorantly, bought some seed garlic from out-of-state. (The offending source is still in business). The seed was contaminated with Allium White Rot, which will now live on my farm in perpetuity. I learned enough, quickly enough, and have not spread the disease to anyone else. This demonstrates the first principle in a list of recommendations for disease prevention: never invest in seed grown in a field that you cannot see or seed that is not tested.

The following is a brief overview of the main disease and pest problems garlic growers can encounter. And since this short list does not cover all the bases, I’ve provided references for further reading and/or research. And then I’ve outlined our “adventures” with Allium White Rot. I sincerely hope that by telling OUR story others might be spared the loss of crop, the expense, and the potential spreading of this particularly deadly problem.

EMBELLISIA

Embellisia or Skin Blotch of garlic is typically a cosmetic issue for garlic growers or vendors and is easily managed. The pathogen, Embellisia allii, overwinters in plant debris and on diseased bulbs and cloves. As with many fungi Embellisia is more problematic in a wet year. It is important to dry down and store garlic where there is ample air movement and humidity lower than 70%. Sanitation, rotation, and planting only disease free stock are the best controls.

Reference: University of Maine Cooperative Extension Bulletin #1204

BOTRYTIS

Botrytis, sometimes called Neck Rot, is fairly new in Maine. In the field the infected plant will be stunted with dead or dying leaves. The pathogen Botryotinia (Botrytis porri), initially causes a water soaked appearance, usually at the soil line. It spreads quickly, and is more problematic in a wetter season. Eventually the pathogen forms sclerotia – resting bodies – on the neck of the plant. Sclerotia can survive in the soil for many years.

To avoid Botrytis neck rot it is necessary to use clean seed, space plants to allow good air movement, use good weed control, harvest without damaging garlic bulbs, cure properly, and use a long crop rotation.

References: University of Maine Cooperative Extension Bulletin #1207

and Diseases of Garlic, Various Pests, plantclinic.cornell.edu

FUSARIUM

Basal Rot, Fusarium culmorum, is slow to develop and like most diseases first shows as yellowing of the plant in the field. The fungus causes both pre- and post-harvest rotting. This fungus prefers hot weather and can be opportunistic, attacking plants already weakened by insects or other disease. The pathogen is spread on infected seed and by moving soil, plant debris, tools, and in irrigation water. Prompt removal of affected plants is important as well as using clean seed.

Reference: Diseases of Garlic, Various Pests, plantclinic.cornell.edu

BLUE MOLD

Blue Mold of garlic, Penicillium hirsutum, most often develops in stored garlic bulbs, and as the Penicillium pathogen does not survive long in the soil, infected seed is the usual source of contamination. Symptoms in the field are yellowing and stunting of the plant.

Management of Blue Mold includes important care while harvesting and curing. Avoid trimming the tops and roots too close after harvesting as this opens the plant to easy infection. Cure the garlic in single layers in a warm dry place that has good air movement. After 3 to 4 weeks move to actual storage, again in a very dry location with good air movement.

Blue Mold is most commonly spread while cracking the bulbs before planting. If possible cull out diseased bulbs BEFORE cracking. Plant as soon as possible after cracking to prevent exposure to spores.

References: University of Maine Cooperative Extension Bulletin #1206e

and Disease of Garlic, Various Pests, plantclinis.cornell.edu

BLOAT NEMATODE

Bloat Nematode was first found In Maine in 2004 and is increasingly causing a lot of economic problems for garlic growers. The garlic bloat nematode, Ditylenchus dipsaci, is a microscopic unsegmented roundworm. The tiny worm doesn’t move much, but is easily spread on infected bulbs and cloves and in soil that is moved by tools, feet, and equipment. The entire life cycle of the nematode occurs within the plant tissue, even continuing in storage. In addition the nematode can be harbored by a long list of alternate hosts including: all other alliums, flower bulbs, iris, gladiolas, alfalfa, celery, parsley, salsify, hairy nightshade, and Canada Thistle.

In the field plants will be stunted and yellowing and may die prematurely. Early infestation may show no symptoms. Typically, however, at harvest the bulb will be missing half or more of its roots. Cool moist conditions favor infestation as the nematode moves to the soil surface after a rain.

Management of Bloat Nematode begins with planting clean seed, preferably tested. A soil test can help ensure that a field is unaffected. As an early infestation of seed can be symptomless, no seed from an infested field should be planted or sold as seed. However, bulbs from an infected field can be sold as table stock and should be clearly labeled.

All clothing, shoes, tools, and equipment that moves soil in any way, should be thoroughly sanitized. A long rotation, 5 years preferably, and avoidance of all alternative host plants can be enough to prevent reoccurrence.

Reference: University of Maine Cooperative Extension Bulletin #1205e

And Disease of Garlic, Various Pests, plantclinic.cornell.edu

ALLIUM WHITE ROT

Allium White Rot (AWR) caused by the fungus Sclerotium cepivorum, is perhaps the most devastating allium disease. An AWR infection means total loss of the infected crop and land that many never be suitable for subsequent allium crops. AWR is easily spread on seed garlic, in compost, by livestock, and on hands, feet, tools, and is easily moved by water. The sclerotia of AWR have a potential dormancy of 20-25 years, and will rest in the soil until the presence of an allium plant prompts germination. There is no simple way of killing the sclerotia to begin with, and literally no acceptable organic method.

As with many disease problems, the first warning of AWR presence in the field is early yellowing and drying of foliage. Eventually the plant will dry to a stick. Upon digging it up, the stem and bulb below the soil line will be covered with active white (and sometimes blue and green) mold. At this point the fungus will have completed it’s life cycle and will be producing formant sclerotia. AWR does not propagate with spores.

Since we have been working on a program to reduce the presence of sclerotia in our gardens, it is frequently possible for us to remove a single isolated plant when we find a problem. We dig it and the surrounding soil – at least a foot in all directions – and dispose of the entire mess at the landfill. The area is filled with new soil and in subsequent years is treated with a biostimulant (see below) to germinate and kill and remaining sclerotia.

As with all other garlic diseases the first and most important thing is not to have it to begin with. Second, being 100% responsible about not spreading it to other farms is paramount. Know your seed source: see the garlic in the field if possible or have tested. If you find a problem in your crop have it identified immediately and deal with it appropriately.

References: SARE Grant final report FNE11-721

and Disease of Garlic, Various Pests, plantclinic.cornell.edu

OUR AWR AND SARE GRANT ADVENTURES

In order to successfully apply for and win a SARE grant, you need to have a problem and need to be passionate about solving it. We certainly had a problem. The grant writing process forced me to study extensively. Thank goodness for the Internet and the ability to explore papers and articles from all over the world.

In my case garlic was a very high value crop for us. We grew about 3,000 heads every year, making it our major cash crop. We sold garlic seed, table stock garlic, and dried tremendous quantities to sell as garlic powder and use as an ingredient in value-added culinary herb products.

THE STORY

Part of the fun of growing garlic is trying new varieties. So in 2004 I bought some garlic from out-of-state, from a supposedly reliable retailer. I can’t actually PROVE that’s where the disease came from, but …I’ve since learned that there are serious AWR problems from California north to Washington state. The company is still in business.

The one raised bed planted with that seed obviously became sick, so we destroyed the plants and replanted the bed to perennial herbs. I should have had an actual ID of the disease, but didn’t.

This demonstrated the first two lessons of our experience:

FIRST lesson, do not buy garlic from out-of-state!

SECOND lesson, always get an ID for problems

Since we have a four year rotation, our garlic crop moved around our gardens slowly …and the next problem came in 2007, in a completely different area that was still in open garden (as opposed to raised beds). After learning what the disease was – AWR of course – I abandoned that garden entirely, planted it to grass, and have subsequently planted it to fruit trees. The loss that year was tremendous …over 2,000 bulbs were affected …a loss of over $2,500.

Again a couple years went by uneventfully. Then in 2010 two more beds of garlic went down to AWR, again in completely different areas of the gardens. One area was directly down hill from the original bed and the other was completely new. Needless to say I was irate and this was the last straw! I called in Dr. Steve Johnson, crop specialist at UMO and my local Extension guru, Dave Fuller. Steve and Dave came to do the ID, looked at the situation, and made some serious observations:

The AWR obviously came on the seed purchased from out-of-state.

AWR moves in water, and we are on a slope. The new areas were down hill from the original problem bed.

AWR can be moved by chickens …our chickens are free range for part of the year.

AWR can be moved on tools and hands, in compost, on seeds, etc.

And then Dr. Johnson casually mentioned the idea of biostimulation… The rest is history! I spent the next 6 months learning more about AWR, that it is a worldwide problem, methods that have been used to combat it (and in some areas to ignore it) and the “funny” idea of biostimulation. I found a name cropping up consistently in articles and papers on AWR and biostimulation, and contacted Dr. Fred Crowe, Professor Emeritus, Oregon State University. For information about Cr. Crowe’s current work see the site www.deerfieldfarmgarlic.com.

Dr. Crowe “sowed the seed” for a SARE grant, and in 2011 I won the first of two grants to determine if biostimulation could be a potential tool for controlling AWR, especially in an Organic farm setting.

HOW WE DID IT …

A definition of biostimulation is needed:

In a nutshell biostimulation means providing a false feast for the dormant disease sclerotia. The odor and flavor in garlic – and the entire onion family – is provided by the pervasive sulphur compound allicin. The compound is actually exuded by the living roots of garlic and all allium plants, providing the stimulus to awaken dormant sclerotia.

Using biostimulation you provide the stimulation without a plant host. So the dormant sclerotia wake up, and with no actual plant to live on, they die!

We used two biostimulants:

- garlic juice squeezed from OG garlic using a commercial juicer

- and healthy green garlic tops from the previous years crop ground with water in our Cuisinart and then frozen to use the following spring.

The garlic juice was applied in solution with water …we soaked the soil in each bed with the solution, and vigorously dug it in. The green material was spread about ¼” thick and seriously dug in. Both of these materials were dug in to a depth of 8-10 inches. We actually had to buy new pitchforks!

Annual assays of the number of sclerotia found and germinated in the lab are showing the numbers actually decreasing. In 2011 we began our relationship with Nematodes, Inc., the lab recommended by Dr. Crowe. Our first assay provided a baseline with numbers of sclerotia found in each sample, and the number that actually germinated. And each spring since, just before applying the biostimulants, we’ve taken samples and sent them off for analysis. With only two exceptions, there has been a steady decrease in the number of sclerotia. In two beds there was in increase in 2014. Interestingly they were both beds treated with garlic juice. After talking with Dr. Crowe about this we supposed that the volatility of the juice – compared with the solid green plant material – might have been an unexpected factor.

SANITATION NEEDS

The most important lesson we’ve learned is the need for sanitation. It’s one thing to read words like “sanitation is key”, and another entire matter to live daily with the need to keep a disease where it IS …there are lots of ways to spread AWR. We expected some of the sanitation needs and totally tripped over a lot more.

We have dedicated tools. There is no AWR in our upper (literally up hill) gardens and we intend to keep it that way. This means two sets of tools. In the lower gardens every tool and hand is washed when moving from bed to bed. There are compost bins for the upper gardens only. In the lower garden all weeds etc. are either composted in place – first and easiest choice – destroyed by burning, or taken to landfill.

We do not move anything casually. All tools, buckets, and wheelbarrows are washed after every use. All stakes, trellises, tomato towers, etc. are washed at the end of the season. All wash water is dumped in a protected hole – we dig a new hole yearly. We stay out of the lower gardens on rainy days to prevent moving pathogen on muddy shoes. Our chickens are no longer free-range. The actual result is that the pathogen is still showing up, but only from previous contamination.

THE CLOSING CHAPTER – STILL IN PROCESS

The final step in the process is a test planting. I wanted to try different methods of planting alliums in our beds to see if one method might be more successful than the others. So in mid/late February, when I normally start onions from seed for our regular plantings, I started storage onions and short season mini-onions, specifically for the SARE beds. These plugs were all planted in the SARE beds, randomly placed, on approximately June 1st. About three weeks later we put in a third planting, a succession crop of scallions, direct seeded.

A SUCCESS! The first planting of mini-onions was harvested on August 2nd, and on August 3rd I delivered samples to the Plant Disease Diagnostic Laboratory at the University of Maine. Much to my surprise and gratification only two of the 36 sample we submitted showed any sign of AWR! This is showing that plugs of short season onions can be pulled profitably before there is wholesale infestation. In addition they provided some biostimulation effect.

My expectation is that some of the storage onions will be infected as they will be in the ground much longer. And I have no idea what will happen with the direct-seeded scallions as they too will be in the ground for a longer period of time. When these crops are harvested they will go directly to the lab for analysis.

The final two stages of the SARE Grant requirements involve a final report, complete with statistics, and an extensive educational outreach. I will continue to present talks about the results of the study, locally, and when asked. The final report for our grant, Farmer Grant FNE13-782 will be available in April 2016 at the SARE website, www.nesare.org.

WRAP-UP

So here we are in the final stages of this study after four long years. Along the way we’ve learned some tough lessons, mostly about sanitation, and we’ve lost a couple more beds from previous contamination each year, again in totally different locations. We’ll continue to remove individual infected plants and do extensive biostimulation …

Needless to say I have an intense respect for AWR. I sincerely hope that in the final analysis – literally the analysis of the data from the SARE Grant – we will have contributed significantly to understanding and combatting this deadly disease.

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