

TNF Garlic Article Part 2

As we get ready to welcome another crop of garlic, let's mentally walk through its spring and summer months and think about the potential challenges the crop may face from pests and diseases, ways to gauge its maturity, and proven techniques to dry and store your crop. Unfortunately, the pest and disease landscape continues to rapidly evolve, so I'm sure that there will be updates to this information in the coming years.

During my previous garlic article (VOL X), I talked about soil preparation for fertility and weed control, planting, and bed preparation and cover. This time we'll start by thinking of the garlic as it is emerging from the soil in the spring. With healthy seed, a good growing environment, and good winter cover, garlic should emerge uniformly as the soil temperature inches towards 40 degrees Fahrenheit, making it one of the earliest emerging plants in the spring. There is little to do with the garlic crop during its first month of growth unless you have decided to side-dress with a soluble form of nitrogen. If this is the case, note that research has shown that garlic stops taking up nitrogen by May 31st, and that the sooner a side-dress is applied the better uptake is. Remember from the last article that organic nitrogen availability increases dramatically as soils warm. This is part of why using a fairly large clove for planting stock is beneficial. The clove itself is about 7% nitrogen and serves as the plant's first source of fertility.

This first month of growth is when you may see any lingering issues caused by an increasingly challenging pest known as dry bulb mite (*Eriophyid tulipiferae*). These microscopic mites live under the wrapper leaves and may be planted with the garlic in the fall. Many die in the winter in saturated soils, but if they survive they may move to the growing point of the garlic and can cause it to emerge with off colors or twisted and distorted initial leaves. Often the first two to four leaves are affected and then the plant begins to outgrow the feeding damage and develops normally. I'll cover management strategies for this pest in the storage section of this article, since this pest is primarily a problem in storage.

Main season disease management:

As the garlic reaches the 4-5 leaf stage it finishes absorbing the seed clove and begins growing independently on its new root system. This is when we first see Fusarium basal rot (*Fusarium culmorum*) is affecting our plants. Fusarium will cause a firm (dry) rot of the basal plate, and may kill off many of the roots as it progresses. Often the diseased area is pinkish brown.

Around this same time Botrytis rot (*Botrytis porri*) may start to develop. Botrytis causes the plant to degrade near the soil line, causing leaves to die prematurely. As it advances reproductive structures called sclerotia may form near the soil line. They are about the size of a peppercorn and may be lumpy.

The final and most impactful disease that can be caught at this point in the season through scape formation is White Rot (*Sclerotinia cepivorum*). While quite uncommon in the northeast, it is an important disease to be aware of because it can be spread on seed garlic. Once this disease is introduced to a farm, it can persist for 20 years in the soil, rendering the ground unfit for any allium crop. It is quite distinctive in the field, with poppy-seed sized sclerotia and a mat of fluffy white hyphae at the soil level in June. Plants often die in small clumps from this disease which spreads underground from plant to plant. No garlic from a field with White Rot should be sold as seed, and equipment should be thoroughly cleaned before moving from fields with White Rot to clean fields.

Fusarium and botrytis are largely managed through cultural controls. Pulling diseased plants and disposing of them around the time you remove scapes helps to limit spread and makes space for healthy plants to grow. If you are seeing more than 5% of these diseases in your garlic year after year you may also want to make changes to improve soil drainage and air circulation within the crop.

Main season insect management

The new bug on the block is Allium Leaf Miner (*Phytomyza gymnostoma*), commonly known as ALM. This insect was detected in 2015 in Pennsylvania and has been slowly spreading throughout the northeast. The adult ALM is a small fly which emerges in the spring. In 2023 the flight began in March in Pennsylvania but would happen later in cooler states. The spring flight lasts for about a month, during which adults lay eggs along the tip of leaves of alliums in a telltale line of dots. Larvae travel down through the leaf to the bulb, where they will pupate. Spring damage can be devastating to onions but is often quite minor in garlic. There have been limited cases where a grower experienced heavy loss, but for the most part ALM is a nuisance in garlic. This is in part because the larvae seem to make it to the bulb right as it is rapidly sizing and are often crushed by the expansion. If the larvae head for the center of the bulb they may be able to pupate there. Adults will then emerge again around September for a second flight, which has been particularly damaging to leek crops. ALM flies emerge from the garlic before planting occurs.

Allium Leaf Miners are best controlled organically through exclusion. Keeping insect netting on through the spring flight eliminates them completely and is the method of choice. For large plantings where this is not feasible, growers may scout their fields and if significant egg laying is happening, two well-timed applications of Entrust (*Spinosad*) have been effective at providing control. No other organic control options have been effective.

Pictures of ALM feeding and pupae here

The other pest that should be kept in mind is Garlic Bloat Nematode (*Ditylenchus dipsaci*), or GBN. GBN levels have remained low throughout the Northeast for most of the last decade, but the issue is far from eradicated. If you have garlic in which some roots are completely missing but others look completely healthy, or your garlic wrappers appear puffy and distorted, you might have GBN. This disease is hard to positively identify by sight, and we recommend testing for it through your state lab. The best way to manage GBN is to avoid bringing it to the farm, but if you do test positive, rotating out of the field where it tested positive for 4-6 years and starting with clean seed is the recommended control measure. Do not sell garlic that tests positive for GBN as seed, but it may be used as food.

Insect and disease considerations from scape removal to harvest

Aside from the areas of Vermont and Northern NY which have leek moth, there are no significant insect issues in garlic after ALM flight has ended. Garlic can become infested with thrips, but they do not affect the final yield. There are, however, a few diseases to be aware of.

Fusarium may continue to develop through the season, and affected plants should be rogued again before harvest. The other emergent disease issue is Anthracnose on garlic (*Colletotrichum fioriniae*). Anthracnose has a wide host range, including celery and fennel. Initially we thought this disease only infected the scapes, but more recently it has been recovered on the bulb, where it degrades the outer layers of wrapper leaves. We are still learning about this disease's impact on garlic and are

recommending growers maintain good crop rotations and select disease-free seed. When culling plants doing poorly before harvest it is likely that plants with garlic Anthracnose would be pulled as well. They often have reddish wrapper leaves which slough off easily when the garlic is pulled.

Garlic harvest considerations: timing

From the many ways that folks have to determine when to harvest, these few rise to the top as consistently helpful. I like to use them in combination gain a complete picture of what's happening with the garlic.

- 1) Bottom leaves are dying: This indicator gives you a sense of how many wrappers are left on the head of garlic. If a plant's leaves are all yellowing or browning, it means that they are all susceptible to decay. I use this tool with garlic that is stressed to tell me when it really has to come out of the ground, regardless of other factors. If you have less than 4 leaves that are looking good, you may have 4 or less wrapper leaves left, and could struggle to get the garlic clean while maintaining the intact head. Conversely, there are times when the leaves all stay green but the garlic is ready to harvest by other measures. In those cases, you'll just have lots of wrapper leaves, which is never a problem.
- 2) Scapes are standing straight up: I like to leave a few scapes in each variety, because they are a good indicator that garlic is fully matured. Plus they look cool.
- 3) My go-to (the David Stern special): Cut the garlic in half perpendicular to the scape. When a gap has formed between the cloves and the scape, the cloves are pushing away from each other and the garlic is nearing maximum size. Related to this, you can feel the tips of the cloves. When they start to push away from the scape they stick out a little. Both of these indicators tell you that the garlic is ready to harvest and will split open if left to grow too much longer.

The reasons to let garlic fully mature are two-fold. One is simply that it weighs more. The second is that the cloves get tighter up against the wrapper leaves, which makes a better seal. Garlic that is harvested before it's mature doesn't tend to keep as well.

Post-harvest handling research review: Curing

The results of both on-farm and lab-based trials have been remarkably consistent. Here's the summary of key points, and the details follow below:

- 1) You can immediately top garlic (including cutting it to the final stem length) and you won't lose weight, size, or storage life
- 2) Drying garlic warm (90°-110°F), in a high tunnel/greenhouse with shade cloth or heated room, speeds the process, improves storage, and can help control diseases and eriophyid mites

Research on topping garlic:

We completed replicated trials at three sites two years in a row comparing uncut garlic stems to garlic cut at 10, 6, and 1.5 inches long. In each of those cases, there were no significant differences in disease incidence or in the final average weight of the bulbs. A later trial with Chris Callahan of UVM compared stem lengths in climate controlled driers and found that not only was there no difference in weight between stem lengths, but also that the shorter stems dried faster than the longer stems.

On a practical note, growers cut stems in many ways. A sickle-bar mower makes a nice clean cut, but some growers have used other mowers with success. Cutting garlic by hand immediately out of the field is easier than cutting it when it is dry, and growers may find that taking the time to do this makes sense. The other benefit of this system is that you are leaving all the moisture that was in the stems and leaves in the field rather than bringing it into the drying area.

Research on curing garlic:

The same trials referenced above included curing treatments. Across on-farm trials, garlic in high tunnels dried an average of three days faster than in open air structures. Garlic dried in tunnels also had slightly lower disease incidence (*Aspergillus* and *Embellisia*) in two of the three sites, though disease was not severe in any site or treatment in those years. Notably, lab experiments showed that drying garlic at low relative humidity (70%) leads to better storage life, so anything that can be done to keep the relative humidity low during drying is beneficial. Garlic can be over-dried, and should be moved out of drying conditions and into storage when the innermost wrapper leaf is completely dry.

A more recently discovered benefit of being able to heat garlic during the drying process is that doing so can help control dry bulb mites. Heating garlic to between 113° and 119° F for one hour during the drying process kills mite eggs (Courtin et al, 2000). This process should be done with complete attention to prevent bulbs reaching an internal temperature of 120°, at which point waxy breakdown occurs. In preliminary work with Callahan, we realized that the surface of garlic bulbs remains cooler than the air temperature until the garlic is dry due to evaporative cooling. Therefore, bringing garlic to a high temperature as it completes drying is the best option to reach the correct temperature.

Mites are able to move into the space between cloves, which makes the heat exposure method useful but not foolproof. Storage control measures can follow up on this treatment.

Post-harvest handling research review: Storage

The storage treatments in our experiment were cold (32°F) and moderate relative humidity (70%), cold and high relative humidity (90%), room temperature (65°F) and moderate relative humidity, and room temperature and high relative humidity. Within these conditions, it should not be surprising that cold and dry conditions lead to the least mass loss and highest marketable yield after 204 days. The relationship between curing and storage treatments within this experiment is worth noting:

Marketable yield percentages at various curing and storage conditions at 204 days. Source: Chris Callahan, UVM.

	All Sample 1 - Large, Trimmed			
	Cured Warm, Humid (80 F, 90%RH)	Cured Warm, Dry (80 F, 70%)	Cured Hot, Humid (105 F, 90%)	Cured Hot, Dry (105 F, 70%)
Stored Cold, Dry (32F, 70%RH)	0%	86%	84%	87%
Stored Warm, Dry (60F, 70%)	60%	36%	59%	57%
Storage Warm, Humid (60F, 90%)	24%	82%	43%	63%

Storing garlic at 32 degrees will vernalize it, and it will sprout immediately upon entering warmer temperatures. If storing garlic in this way, plan to be able to use it very quickly after it leaves storage. Planting stock can easily handle room temperature and maintain quality. However, room temperature is also the ideal conditions for dry bulb mites to reproduce. At 70°F they can reproduce every week, leading to population explosions! Mites cause garlic to shrivel and turn yellow, and may leave the surface with a powdery or sparkly coating. You won't see the actual mites with the naked eye, but they are quite striking under magnification.

Photos of infested cloves and mites under magnification

Dry bulb mite control in storage:

In order to control mites that survive curing and emerge during storage, we added the extra control measure of *Stratiolaelaps scimitus* predatory mites. Mites are sprinkled over crates of garlic in storage, where they hunt for dry bulb mites. Our initial results varied, with incomplete control in some applications, but on average applications reduced mite severity. After this initial work we are recommending *S. scimitus* applications as one tool in the toolbox, with the understanding that effectiveness of biocontrols is variable. If you are interested in trying this approach, *S. scimitus* mites can be purchased from Applied Bio-nomics through these distributors: <https://www.appliedbio-nomics.com/distributors/>

Hopefully all of this information leaves you feeling like you have more tools to manage your garlic successfully, though it may have also put a few more issues on your radar. There are many service providers throughout the Northeast who are enthusiastic about keeping your garlic healthy, so if you are seeing problems and are unsure what to do, reach out to your Cooperative Extension or MOFGA resources. And if you have follow-up questions for me, I can be reached at cls263@cornell.edu

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