Greenhouse Pest Message, November 26, 2024
Charles Krasnow, UConn Extension

Growing vegetables and flowers in soil beds is a popular and effective method for producing high value crops. Soil disinfestation is an important management practice, and can improve the quality of flowers or vegetables that are grown on farms in CT. Soil beds in high tunnels, direct soil planting under cover, and stock plant maintenance in greenhouses in soil are all examples where soil disinfestation can be used. Disinfestation methods are important, especially when the same soil is being planted into every year. Specific pathogens reside in the soil, such as *Phytophthora*, *Fusarium*, and *Pythium*, that can cause significant losses in intensive flower and vegetable production. These pathogens produce thick-walled spores that overwinter in the soil and germinate to infect when a susceptible crop is planted. Without soil disinfestation, the pathogens can spread quickly. There are a number of methods to control or reduce pathogens in soil. The goal with these treatments is not to sterilize the soil (which can leave a biological vacuum), but to get rid of pathogens or reduce them to very low levels so that beneficial microorganisms are more effective and improve plant health.

Steam sterilization: this method has been used in ornamental production very successfully for a long time. It involves using a heat source to boil water and the steam is sent through pipes to the soil. The temperature of the soil should be approx. 180°F for 30 minutes. There are different methods for this. Steam pipes can be set on the soil surface and then a tarp is laid over the soil and pipes. This mainly disinfests the top few inches of soil. The steam pipes can be buried, which provides a more thorough treatment but is very labor intensive to set up. This is usually a permanent or semi-permanent set-up and is more costly. Container steaming is frequently used for pots and tools, but can also sterilize soil. It is labor intensive and only sterilizes relatively small quantities of soil in each batch. The photos below shows beds for *Dianthus* tarped and being steam sterilized, and a steam wagon for pots and soil.

After this treatment is applied, recolonization of the soil by beneficials is desired. Sanitation practices are important at this point so that pathogens are not reintroduced into the planting area, such as on cuttings or in irrigation water.

***Brassica* fumigation**: is a great method for organic production. It involves growing a Brassica crop that is high in glucosinolates (a chemical compound that breaks down into ITC, a potent natural fumigant). Once the plants are at the correct maturity, the Brassicas are chopped and tilled into the soil. Usually, the soil is packed down or tarped to keep the gasses contained. Use caution, as the gasses released are very strong and can irritate nasal and eyes. Optimizing the chopping process is important, as cell contents must be mixed in order to have the maximum content of gasses released. High concentrations of the glucosinolates are found in *Brassica juncea* and *Sinapis alba*, which are usually included in "biofumigant" seed mixes.

The University of Kentucky has done research on biofumigation, with detailed information on timing and variety selection:
https://www.uky.edu/ccd/sites/www.uky.edu.ccd/files/biofumigation.pdf

Soil amendment: this method involves adding organic matter to the soil, such as compost or brassica seed meal, that increase the numbers of beneficial bacteria in the soil. It is often used with other treatments such as solarization. There are tons of research studies on soil amendments, but mostly about the benefits to soil health and not pathogen reduction. Biochar, compost, manure, ash, clay, and more, offer additional benefits, however, there is limited direct effect on pathogens (some exceptions exist where the soil pH changes significantly, or certain nutrients are added at high levels). Compost may have effects on soil pathogens, however, the effect has been shown to be short lived. These treatments have additional benefits such as promoting biological activity, soil stability, nutrient availability, and water holding capacity.

Cornell has a good fact sheet on amendments: https://cals.cornell.edu/national-good-agricultural-practices-program/resources/educational-materials/decision-trees/soil-amendments#:~:text=A%20soil%20amendment%20refers%20to,in%20manure%2Dbased%20soil%20amendments. Bayer has a short article on soil health in high tunnels that includes pathogen control and the benefits of adding organic matter: https://www.vegetables.bayer.com/us/en-

us/resources/growing-tips-and-innovation-articles/agronomic-spotlights/soil-health-in-high-tunnel-systems.html

Fumigation: in general, this is not a recommended practice for an enclosed structure. Most fumigants are toxic and need specialized applicators. They can be applied as a liquid that is injected into the soil, and then covered with virtually impenetrable film in a single pass, or are added to pans that are under a tarp or plastic. Fumigants have strict rules on buffer zones. In a nursery setting, fumigants may be more applicable, but still require specialized handling practices, and application timing to ensure the soil has the correct moisture and temperature. Methyl bromide alternatives such as iodomethane/chloropicrin (Midas), metam sodium (Vapam), metam potassium (K-Pam), chloropicrin (100% Chlor-O-Pic), and 1,3-dichloropropene/chloropicrin (Telone C-35), and the biofumigant, furfural (MultiGuard), have been tested in field studies. None of these fumigants were as effective against a broad spectrum of weeds, insects, and pathogens as Methyl bromide, which has been banned due to adverse effects on the environment. There is specialized training for anyone who wants to use fumigation, as all fumigants are restricted use. https://www.epa.gov/soil-fumigants/soil-fumigant-training-certified-applicators

Soil solarization: this method has been used for over 50 years, mostly in areas that have high sun intensity. The soil is tarped with clear plastic, and heats naturally, reducing or killing pathogen spores in the soil. It is simple, low cost, and easy to use, however, the treatment time is usually for 4 weeks, which can be prohibitive for many operations. This method may be used with biofumigation.

Conclusion: there are numerous methods to disinfest soil in high tunnels and other covered structures and improve soil health. Each of these methods if used correctly can reduce pathogens in the soil to low levels. Additionally, other IPM tactics can be incorporated with soil disinfestation practices, such as planting resistant varieties, grafting onto resistant rootstock (vegetables), and application of biocontrols to recolonize the soil after treatment.