THE OHIO STATE UNIVERSITY
COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES

extension.osu.edu
plantpath.osu.edu

ANAEROBIC SOIL DISINFESTATION FOR MANAGEMENT OF SOILBORNE DISEASES IN MIDWESTERN VEGETABLE PRODUCTION

HYG-3315
Agriculture and Natural Resources
Date: 12/04/2017

Anna L. Testen and Sally A. Miller

Soilborne diseases are increasingly problematic in intensive vegetable production. Several pathogens may occur together in a disease complex, which is very difficult to manage. Anaerobic soil disinfestation (ASD) is a method of soilborne disease management effective against a wide range of soilborne pathogens, including bacteria, fungi and nematodes. ASD is a three-step process in which soil is amended with a carbon source, irrigated to saturation, and tarped with plastic sheeting for several weeks. In ASD, beneficial soil microbes break down the added carbon source, depleting oxygen in the soil and producing toxic byproducts that kill soilborne pathogens.

Tomato Soilborne Pathogens Sensitive to ASD Treatment

- Fungi: *Fusarium spp., Verticillium dahliae, Rhizoctonia solani, Sclerotium rolfsii, Pyrenochaeta lycopersici, Colletotrichum coccodes*
- Oomycetes: *Phytophthora* and *Pythium* spp.
- Nematodes: Root knot nematodes (*Meloidogyne* spp.) and lesion nematodes (*Pratylenchus penetrans*)
- Bacteria: *Agrobacterium tumefaciens, Ralstonia solanacearum*

ASD is a Three-step Process

1. Soil amendment: Soil is first amended with a carbon source, providing nutrients for beneficial soil microbes. These carbon sources are applied at high rates from 4.5 to 9 tons per acre (9 tons per acres is equivalent to 0.413 pounds per square foot). Commonly used carbon sources, such as wheat bran or molasses, can be purchased at feed mills. Cover crops may be practical for on-farm production of carbon sources. Carbon sources should be rapidly broken down by soil microbes, so amendments such as straw or residues from older crops do not make effective ASD carbon sources.

Carbon sources should be spread evenly over the area to be treated. Carbon sources should be incorporated to a depth of 6 to 8 inches using either a hand-pushed or tractor-drawn rototiller (Figure 1). If molasses is used as a carbon source, it must first be diluted 1:3 to 1:4 with water prior to application (Figure 2). For systems using raised beds, the carbon amendment is applied and worked into the soil prior to bed formation.

Figure 1

Figure 2

2. Soil irrigation: The second step of ASD is soil irrigation during which soil pores are filled with water, reducing available oxygen in the soil. The objective of this step is to saturate soils to the depth of carbon source incorporation (6 to 8 inches). The irrigation step takes at least 4 hours and usually takes longer depending on soil type. Soil should be irrigated until water ponds on the soil surface and soils should not be completely flooded during treatment.

3. Soil tarping: The third and final step of ASD is to tarp the treated area with plastic mulch to prevent air exchange. Plastic mulch, either black or clear, should be laid over the treated area as soon as possible after irrigation is complete (Figure 3). The edges of the mulch must be buried in the soil or covered to prevent air exchange. A heavier grade plastic mulch should be used, and an embossed mulch can help to prevent tearing. Older plastic sheeting, such as construction sheeting or high tunnel coverings, can be reused so long as any holes are sealed with additional plastic and duct tape. Biodegradable mulch is not suitable for use in ASD. Soils can be covered before irrigation if drip tape is placed under plastic sheeting and used for irrigation.

Figure 3

Once tarped, soils should remain covered for three to five weeks. A strong odor indicates that the soil has become anaerobic and is normal to the treatment. Plastic sheeting should then be removed. After plastic removal, planting should be delayed five to seven days to allow time for the soil to dry and breathe. If ASD is applied to raised beds, holes can be cut into the plastic to allow the soil to breathe prior to transplanting.

Soil Temperatures and Tarping Duration

As a general rule of thumb, ASD treatments are more effective with warmer soil temperatures and longer tarping periods. In Ohio, a four-week-long tarping period has been used successfully. A tarping period of three weeks should be effective for most pathogens if soil temperatures are consistently greater than 85 degrees Fahrenheit.

Timing ASD Treatments

Since ASD requires at least one month from treatment initiation to planting, some planning is needed to incorporate the treatment into production schedules. For protected culture production, a spring (March or April) or fall application (September or October) may be ideally incorporated into production schedules. For open field production, it is most ideal to perform a late spring, summer or early fall ASD application.

Combining ASD with Other Soilborne Disease Management Strategies

ASD is effective in reducing soilborne disease populations but may not completely eradicate all soil pathogens. It is good practice to combine ASD with other soilborne disease management practices, such as use of disease resistance, grafting, crop rotation, sanitation and other cultural practices.