Hoophouse

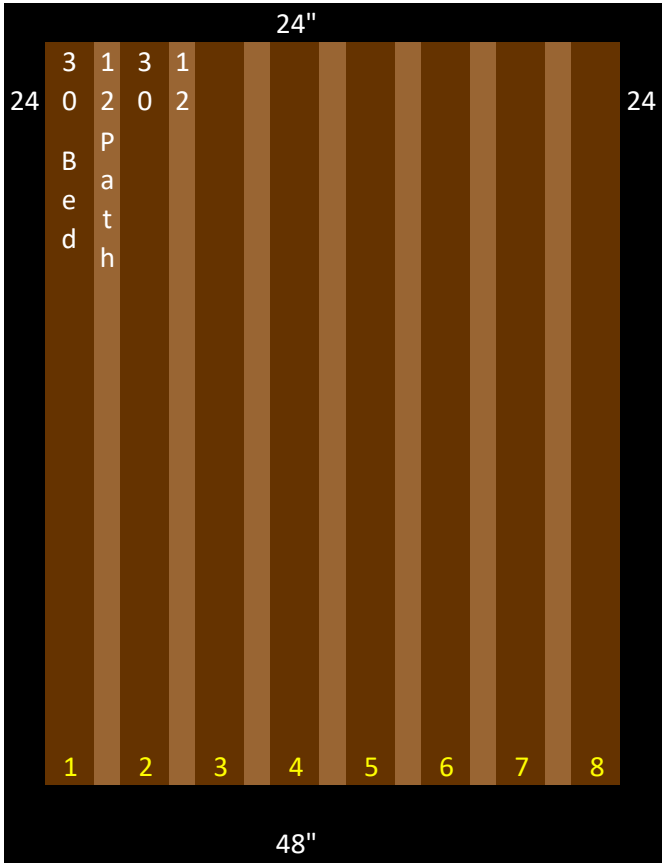
Moderator: Allison Stawara, Michigan State University Extension

9:00 am	Hoophouse Soil Health and Fertility • Rachel Cross, Spirit of Walloon Market Garden
9:30 am	Biological Control in Hoophouse Production • Elizabeth Buck, Cornell University
10:00 am	Anaerobic Disinfestation • Sally Miller, Ohio State University
10:30 am	Water, Weeds & Spacing • Jeremy Moghtader, University of Michigan

Hoophouse Bed and Path Spacing for Various Crops

Utilizing landscape fabric, drip/overhead irrigation, and crop spacing for watering, weed suppression and crop growth

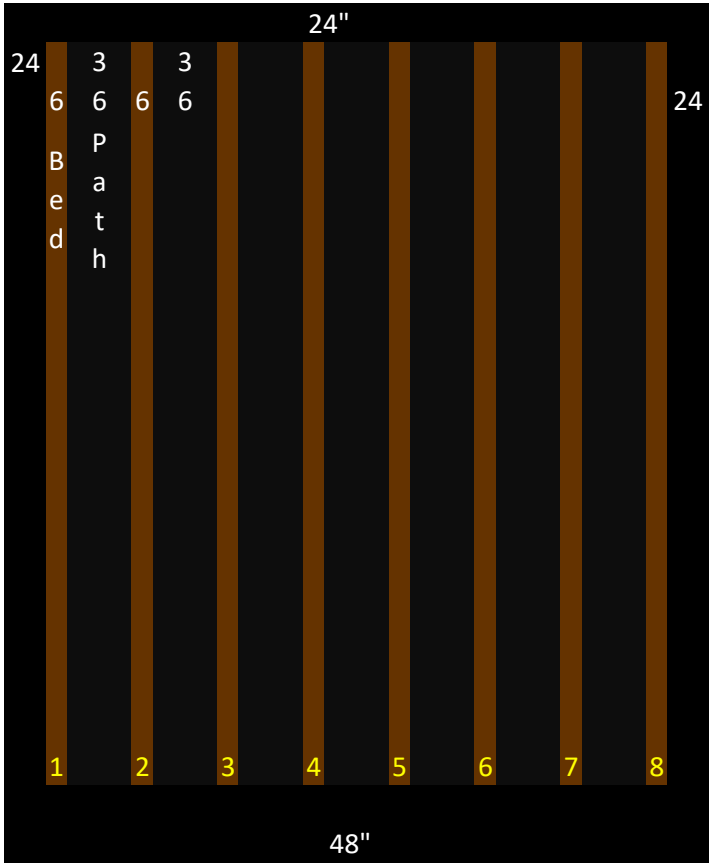
30'x96' Hoop
30"bed, 12"path system
8 beds/house



Front

Salanova, Head lettuce 3 rows/bed, 8" inrow
Kale 2 rows/bed, 12"inrow
Spinach 5 rows/bed, baby greens 16 rows/bed)
Irrigation:
Drip lettuce planting
Overhead for kale and spinach establishment
Drip lettuce and spinach maintaininace (disease mgnt)

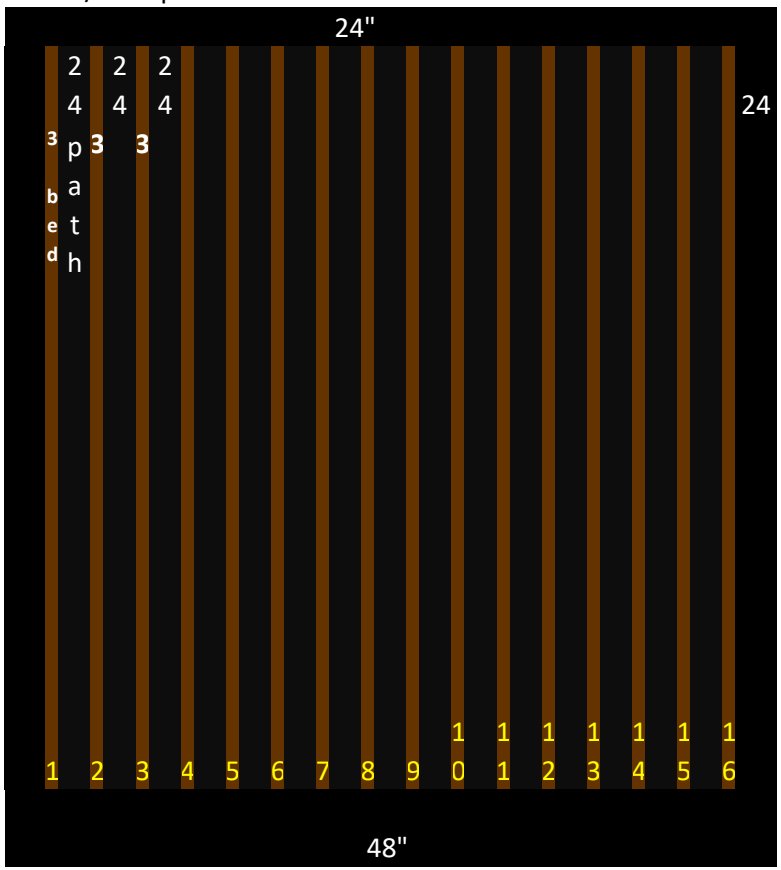
30'x96' Hoop
6" bed, 36" path system = 42" on center row system
8 row/beds per house



Front

Tomatoes & Cukes 36" landscape fabric
1 row per bed
Cukes 12" in row
Tomatoes 16" in row
Irrigation:
Drip tomato planting (with some early overhead)
Overhead for early cuke establishment
followed by drip

30'x96' Hoop
3"bed, 24"path system = 27" on center row system
8 row/beds per house



Front

Peppers 24" landscape fabric
1 row per bed
12" in row
Irrigation:
Overhead for early pepper establishment
Drip and overhead for pepper maitainance

Other Notes
We use Dewitt Sunbelt Landscape Fabric
Fertility tends to be pre-plant application of Revita Pro 5-4-5
composted poultry litter based blended amendment, ~90lbs/acre
Base Fertility: 50 yards leaf compost per house
Overhead irrigation is Jain greenspin
Drip we use 2" oval with valved connectors as header
Well puts out 36gmp from 2 inch frost free hydrant and can water
4, 30x96ft hoops at once

11/26/2019
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Campus Farm, Part of Matthaei Botanical Gardens and Nichols Arboretum

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

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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.

Managing Pests in High Tunnel Winter Greens Crops

Elizabeth Buck
Fresh Market Vegetable Specialist
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Overview

Most cold-season pests will happily feed all winter inside a high tunnel, taking a brief hiatus during the coldest part of winter. Slugs are the most common diners and will feed on any available crop. Aphids will move in as their summer food sources die back, and late emerging cabbage pests often find winter high tunnel crops. It is not uncommon to see crucifer-feeding caterpillars pupating overwinter in a tunnel, and butterflies can emerge in March.

Pest populations left unchecked in the fall will be a much larger, more difficult issue in the spring. Two reasons why: 1) the pests continue to multiply, and do so quickly with sunny days in late winter. 2) The control tactics simply do not work well in the middle of winter – cold temperatures and dense canopies render them ineffective.

To successfully grow a low-cull winter greens crop, you have to adopt proactive management of pests (and disease). Simple things like cleaning up weeds around and in the tunnel will help minimize aphid problems. The presence of weedy sowthistles, lambsquarters, and pigweeds can draw aphids into a tunnel. Chickweed is a terrible winter tunnel weed that creates a thick, moist canopy environment that is ideal slug habitat. Increasing airflow will also help to decrease humidity, which diminishes the favorability of the tunnel environment for slugs and several crop diseases.

Finally, commit to weekly scouting and aggressive treatment. Here's how to be most efficient. This process should take less than 30 minutes a week/3000 sq ft of a 5-6 species planting. Pest infestations typically start to show up between mid-September and late November.

Pest ID, Thresholds, and Controls

Aphids look like small sesame seeds and can be black, green, rosy, gray, and even yellow. They blend in with the foliage. Look for them on leaf undersides, and protected areas of plants like curled leaf margins, petiole bases, hearts, and next to midribs. **Action threshold**: 1 aphid/leaf. Aphids can be treated with a number of biological controls and biorational pesticides. The best choice is dependent on the crop, time of year, and greenhouse temperatures.

Caterpillars come in 2 types: "cabbage" caterpillars (diamond backs, imported cabbage worms, and loopers) tend to be in the upper 2/3rds of a canopy, on either leaf surface. They are often found on the leaf, though may blend in well, and can be quite small when young. Armyworms and cutworms will feed aggressively and leave tremendous damage on young plantings. They'll go after chard, beets, and lettuce, and transplants before most cole crops. You're more likely to see their feeding or large frass pellets than the actual worms. Caterpillars leave frass pellets that may fall to the base or center of a leaf/plant, and feed by biting, not peeling layers off the leaf. **Action threshold for "cabbage type":** presence on more than one plant, or more than one caterpillar per plant. **Action threshold for other**

caterpillars: presence. Caterpillar pests can be effectively treated with Bt products when greenhouse temperatures are favorable.

Slugs are particularly tricky. The "look for a slime trail" method can be unreliable. Dugs like to hide in dark, damp places during the day. A better scouting technique is to put a small piece of scrap wood or shingle down in a couple locations and check underneath. Look in any place that stays moist, like edges of houses, in dense plantings, under plastic, or in weedy patches. On the crop itself, look for stringy, messy frass and characteristic "layer by layer" feeding patterns. **Action threshold**: The best method is to assume that you will have slugs. Reduce the population by applying slug bait at planting when the crop is small and easy to treat. Reapply as needed, which is dependent upon your crop, harvest method and damage tolerance.

Scouting Protocols

Kale: Aphids, slugs, and cabbage worms

Pick a plant. Start at the bottom and work your way to the top, giving it a general look for feeding damage, frass, and slime trails. Closely inspect three leaves for damage. The first should be low on the plant, ideally touching but not on the ground. Look for slug feeding, slime, or frass. Aphids will often show up first on lower kale leaves – be sure to look closely along the midrib and in the frilly tips. Next pick a middle leaf, look for aphids and slugs and caterpillars. Caterpillars on middle leaves tend to be on both surfaces and may be small. Choose a small upper leaf that has lots of frills and roll them back to check for caterpillars and frass in the center of the leaf. Check for aphids on all parts, including the frilly margins. Repeat for 10-15 plants. Scouting is similar for leafy brassicas.

Spinach: Aphids, slugs, spinach crown mite

Pick 3-6 spots in a planting. At each spot examine 5 plants for slug feeding and abnormally shaped new growth. Spinach crown mite is invisible to the naked eye, but it will present as new growth with small holes in the leaves, puckering, and deformed leaf margins. Examine the leaves for aphids. Pick one plant at each spot and tear it apart, looking for aphids at the base of the leaves and in the crown.

Beets, chard: Aphids, caterpillars, slugs

Caterpillar feeding is very obvious and fairly destructive. You'll have no problem finding it. Slug feeding is common on chard, but not so common on beets. Be sure to check for slug feeding on the juicy leaf stalks. Frass will often roll down to the leaf bases. When beets get aphids, they tend to be badly infested. Catch it early by examining 10-15 plants, checking 2 large and 2 small leaves for aphids. Be sure to look in rolled leaf margins.

Lettuce and heading brassicas: Aphids, slugs, caterpillars

Pick 3-6 spots and examine 3-5 plants per spot, more plants if you do fewer spots. Pick one side of the plant and start looking at leaves – both surfaces and don't forget to check on the stalks and leaf bases. Check each leaf following one path to center. Write down the total number of aphids and leaves examined, and divide aphids by leaf to get your pest population. Make note of any slug/caterpillar activity. Remember that frass will often fall to the base of the leaves.