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IFAS EXTENSION

Soil Organic Matter, Green Manures and Cover Crops For Nematode Management[1]

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Vegetables, flowers and landscape plants grown in soil that is high in organic matter often are damaged less by nematodes than are plants in soil of low organic matter content. Any kind of organic soil amendment, including compost, green manures, and lightly incorporated organic mulches, can have this effect. Organic amendments both improve tolerance of the plant host and apparently reduce nematode populations. However, they can not magically eliminate a severe nematode infestation overnight. They are better suited to keeping nematode populations relatively low than reducing high ones. There are several ways in which organic soil amendments may help reduce nematode injury to plants.

SOIL ORGANIC MATTER

Soil organic matter is any material in the soil that was originally produced by living organisms. At any given time, it consists of a range of materials varying from the intact original tissues of plants (mainly) and animals to the substantially decomposed mixture of materials known as humus. The original tissues contain a wide range of organic compounds which typically decompose at different rates.

In a soil which at first has no readily decomposable materials, adding fresh tissue under favorable conditions immediately starts rapid multiplication of bacteria, fungi, and actinomycetes, which are soon actively decomposing the fresh tissue. As the most readily available energy sources (carbohydrates, fats, proteins) are used up, those microorganisms again become relatively inactive, leaving behind a dark mixture usually referred to as humus. Newly-formed humus is a combination of resistant materials from the original plant tissue and compounds synthesized as part of the microorganisms' tissue which remain as the organisms die. It is quite resistant to further microbial attack, so its nitrogen and other essential nutrients are protected from ready solubility and dissipation.

Humus holds water and minerals extremely well; it sticks together very well, so helps soil establish and maintain a strong crumb structure; it provides some nutrients as it is slowly decayed by microbial activity.

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Adding Organic Matter to Soil

We can add organic matter to soil in several forms, including:

- **compost** -- organic material that has been substantially decomposed under somewhat controlled conditions, so that most of the readily-exploited nutrients are exhausted
- **undecomposed plant and animal material** -- often leaves and garden waste that were set aside at clean-up or harvest (e.g., fresh pine straw and sawdust)
- **green manure** -- fresh plant material grown purposely to be incorporated into the soil on the site where it was grown while it is lush.

Compostwill provide mineral nutrients plants need, and be converted into humus. Since the readily-available nutrients are mostly consumed in the composting process, compost will not stimulate activity of the same kinds of microorganisms as will fresh tissue, nor the amount of microbial activity.

Whole, but not fresh, organic matterhas many of the nutrients that fresh green material has, but must have moisture added for decomposition to proceed. Many sugars, starches, etc. become available for microbial use more slowly once the material has had a chance to dry out, so the decomposition process takes longer. Older tissues often contain less of those readily-available nutrients, and more of those that are present are tied up in complex compounds that are resistant to microbial attack.

Green manuring(discussed in detail below) is turning under of a green crop to better the condition of the soil. Material so added, if soil is in proper condition and well managed, can help maintain or raise the organic matter content of the soil, and thus its ability to produce crops, in several ways.

Humus and partly decomposed soil organic matter can greatly increase the water- and nutrient-holding capacities of sandy soils, reducing some of the major stresses which magnify the effects of nematode damage to roots. Mulches of organic materials which help keep roots cool and reduce evaporation from soil also help reduce stress, and add humus as they decompose.

Soil Biological Activity

Decomposing organic matter is food for many soil microbes (fungi, actinomycetes, and bacteria). Some of those creatures are natural enemies of plant nematodes; increasing their numbers enhances "natural" nematode control.

Chemical By-Products

Decomposition of some organic amendments, including some green manures and oily plant residues such as cottonseed meal, has been shown to release chemicals which are directly toxic to nematodes. Those chemicals may reduce nematode numbers directly, in addition to the other benefits derived from soil organic amendments.

"Nematicidal" Miracle Products

Claims of nematode control are made for many products sold as soil amendments and additives, but objective research data rarely accompany those claims. If a product's claims cannot be supported with evidence from well-designed research, preferably conducted by scientists who are in no way connected with the product, be very cautious about depending on it for nematode control.

GREEN MANURES

Green manuring is the practice of growing lush plants on the site into which you wish to incorporate organic matter, then turning (tilling, plowing, spading) it into the soil while it is still fresh. The plant material used in this way is called a green manure. The plant material may or may not be cut free from its roots before being incorporated into the soil, depending on what is needed to be able to handle it. Green manuring is popular among "pure" organic gardeners and farmers; it is equally appreciated by many farmers who use some practices that are not acceptable to organic enthusiasts. It is widely adopted

simply because adding large amounts of green plant material benefits many soil characteristics, including drainage and water retention, nutrient content and form of storage, and level of microbiological activity in the soil.

- Green manuring supplies soil organic matter, as already discussed.

- It can conserve or even add nutrients. Nitrogen used by the green manure crop has been protected from leaching loss and microbial degradation that could take place if the land were left fallow. Other nutrients such as potassium, phosphorus, magnesium, and iron can be similarly conserved through green manuring. Using a legume can increase soil nitrogen levels through N fixation by the Rhizobium bacteria associated with most legume roots.

- Microbiological benefits--there is a substantial increase in activity of soil fungi and bacteria that do many useful things. Generally, the more diverse and greater the soil microbial population, the more productive the soil will be.

- Conservation of top-soil against loss by erosion can be a substantial nutrient conservation benefit of green manuring.

Green manuring has also been demonstrated to reduce levels of nematodes in the soil in some cases, in addition to reducing the sensitivity of plants to modest levels of nematode injury by improving the soil environment of their roots.

To be useful as a green manure, a plant should: 1) grow rapidly; 2) produce abundant and succulent tops; 3) grow well in the conditions of the site. The higher the moisture content of the material, the more rapidly will it break down and its benefits be realized. When other conditions are equal, it is better to use a legume because of the nitrogen fixation and the microbial activity it promotes.

Crops that are selected for use as green manures are usually chosen for their ability to grow very rapidly and produce a large mass of top growth at the season and site. Cool season grasses are often used in Florida for fall and winter green manure crops; legumes are often desirable because they naturally convert nitrogen from the air into plant nutrients, thus increasing the levels of that most critical nutrient in the soil when the plant tissues are incorporated into the soil.

It is generally best to turn green crops under when their succulence is near the maximum, yet when enough top growth has been produced; this is often at or slightly past the half-mature stage.

If a "nematicidal" crop such as those discussed below can be used as a green manure, it may have an even greater effect on nematodes in the soil, by beginning their reduction as a cover crop before it is turned into the soil. For instance, hairy indigo is valuable in both ways in North and Central Florida.

Risks in Green Manuring

Take care to avoid planting green manure crops that can encourage reproduction of nematodes, especially root-knot nematodes. Increasing a nematode population on a green manure crop canoffset all benefits that would otherwise be gained. If at all possible, choose crops for green manuring that are known to inhibit root knot nematodes.

"NEMATICIDAL" COVER CROPS

Several plants have been found to help control some kinds of nematodes when grown for several months in soil where they are present, if no good hosts of those nematode species are present. These plants may reduce nematode populations significantly more than fallowing or growing a crop on which the nematodes do not feed. Control sometimes equals that from chemical treatments. In other words, using these plants as cover crops may significantly reduce nematode injury to susceptible crops grown in the next season. They rarely, if ever, protect plants from nematodes when planted among or beside them

(companion planting or inter-planting) under field conditions in Florida. A few plants known to help reduce important nematode pests in Florida are listed in Table 1.

Table 1.

Table 1. Effects of some cover crops on nematodes important as plant pests in Florida.

	Nematodes		
Plant Species	Root-knot	Sting	Lesion
Pangola digitgrass,*Digitaria decumbens*	G*	P	P
Transvala digitgrass,*Digitaria decumbens*	F	G	P
French marigold,*Tagetes patula*	G**	P	G
Hairy Indigo,*Indigofera hirsuta*	G	G	G
Showy crotalaria,*Crotalaria spectabilis*	G	G	P

*G = good control of the most common species of this nematode; P = poor or no control of this nematode; F = fair control.** Effectiveness differs among varieties of marigolds; one report stated yellow or gold "Petite French" types to be most effective against the greatest number of root-knot nematode species.