Management of Root-Knot Nematodes and other Soilborne Pests in Floriculture Production Systems

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INTRODUCTION

Plant-parasitic nematodes, particularly root-knot nematodes (*Meloidogyne* spp.), are important pests of field-grown floriculture crops in Florida. Methods for managing nematodes can impact other problems as well, including weeds and soilborne diseases. The goal of this project is to develop management strategies for nematodes and other soilborne pests in floriculture production systems. A number of research experiments have been conducted, primarily focusing on susceptibility of flower species to nematodes and other pests, and on integrated management of nematodes and other soilborne problems using soil solarization. Key findings of this research project are summarized here; detailed information is provided in the publications listed below.

SUSCEPTIBILITY OF FLOWER SPECIES

Susceptibility of Flower Species and Cultivars to Root-Knot Nematodes

- Several greenhouse experiments were conducted to evaluate response of flowers to *M. incognita*, *M. javanica*, and *M. arenaria* (See sample data set, Table 1).
- Results with the 3 nematode species were fairly similar.
- Susceptible to root-knot nematodes: snapdragon, nasturtium
- Resistant or low susceptibility to root-knot nematodes: marigold, zinnia, salvia, carnation
- Intermediate response or low susceptibility: delphinium
- If growers produce several flower species, some opportunity for crop rotation may be possible. Snapdragon is highly susceptible to root-knot nematodes, delphinium may be a better choice for an infested site.

Susceptibility to Soilborne Diseases

- Severe damage and losses to snapdragon from soilborne disease following flooding or excessive rainfall in production sites.
- *Pythium aphanidermatum* and *Fusarium oxysporum* isolated from infected snapdragon plants from production sites.
- Greenhouse tests confirmed pathogenicity from *Pythium* isolate but not from *Fusarium* isolate.
- Management of *Pythium* needed in field sites because severe rainfall events are unpredictable.

Marigold

- Some marigold cultivars can be suppressive to root-knot and/or lesion (*Pratylenchus* spp.) nematodes
- Marigolds are not suppressive to some nematodes, such as sting (*Belonolaimus* spp.) and stubby-root (*Paratrichodorus* spp.)
- Cultivars of French (*Tagetes patula*) and African (*T. erecta*) marigolds were often resistant to several Meloidogyne species, but exceptions exist, some cultivars are known with some degree of susceptibility.
- Marigolds might be used as a rotation crop for reducing nematode populations.

PUBLICATIONS -- Susceptibility

- Krueger, R., K.E. Dover, R. McSorley, and K.-H. Wang. 2007. Marigolds (*Tagetes* spp.) for nematode management. ENY-056, EDIS, Florida Cooperative Extension Service, IFAS, University of Florida, Gainesville, FL. http://edis.ifas.ufl.edu/NG045
- Om, N., R. McSorley, and J.J. Frederick. 2008. Response of cut flowers and bedding plants to root-knot nematodes. Proc. Fla. State Hort. Soc. 121:370-373.
- Wang, K.-H., R. McSorley, and E.R. Malek. 2007. Pathogenicity of *Pythium aphanidermatum* and *Fusarium oxysporum* on snapdragon. Proc. Fla. State Hort. Soc. 120:365-369.

WHAT IS SOIL SOLARIZATION?

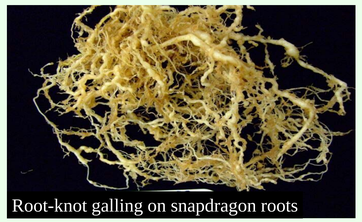
1. Cover soil with clear plastic film or sheet

2. Seal in edges of plastic with soil

3. Leave clear plastic in place for at least 6 weeks

4. Solar heat under plastic kills weeds and soilborne pests

In Florida, solarization is done in summer, when no crops are in the field. Fall-winter-spring are production seasons for field-grown flower crops



Root-knot galling on snapdragon roots

Breaks or tears can develop in some plastics

Left: zinnia plants in greenhouse test

Right: African marigold, *Tagetes erecta*

Table 1. Susceptibility of cut flowers to *Meloidogyne incognita* race 2 in greenhouse test, October 2007.

Plant	Cultivar	Gall Index	Nematodes/ root system
Snapdragon	Potomac Pink	2.00 a	2022.0 b
Nasturtium	Dwarf Jewel	1.50 a	1067.0 a
Marigold	Snow Drift	0.00 b	11.0 bc
Marigold	Petite	0.00 b	3.0 bc
Marigold	Jaguar	0.00 b	1.0 c
Zinnia	Thumbelina	0.00 b	1.0 c
Zinnia	Envy	0.00 b	0.0 c

Means followed by same letters within a column did not differ (P=0.05) by Waller-Duncan test

Snapdragon plot in field test

SOIL SOLARIZATION FOR PEST MANAGEMENT

Solarization and Weed Management in Winter Flower Crop

- In a production site, solarization conducted during the summer suppressed white clover (*Trifolium repens*) better than fumigation with methyl bromide.
- Winter weeds like white clover are problematic for growers because they emerge in the winter growing season in flower crops for which no herbicides are available.

Solarization vs Methyl Bromide for Managing Severe Nematode and Disease Problems on Snapdragon

- Soil solarization and methyl bromide fumigation were compared in a site with unusually severe pressure from root-knot nematodes, Pythium, and weeds.
- Combining solarization with reduced-risk fungicides did not improve disease control over use of solarization alone.
- In some cases, solarization provided results similar to methyl bromide for managing weeds, plant disease mortality, and low nematode populations.
- Methyl bromide was superior to solarization in managing higher nematode populations and and improving flower yield.
- Although solarization can manage nematodes over the short-term (3-4 months), populations recover and management is difficult in a long crop (6-8 months) like snapdragon, especially when soilborne disease is present as well.

Optimizing Plastic Films for Solarization

- Field tests conducted with different kinds of plastic films for solarization during July and August, to evaluate durability of plastic and control of weeds, particularly purple nutsedge (*Cyperus rotundus*).
- Clear plastic films consistently outperformed white plastic.
- Durability of different plastic films varied, and was evaluated by counting the number of breaks or tears that developed over time.
- Weed suppression varied among clear plastic films, depending on film durability.
- Optimum performance in weed control and durability occurred with clear, UV-stabilized films, especially Polydak® (Ginegar Plastics Products, Ginegar, Israel).

PUBLICATIONS -- Solarization

- Gill, H.K., R. McSorley, and D.D. Treadwell. 2009. Comparative performance of different plastic films for soil solarization and weed suppression. HortTechnology: (in press).
- McSorley, R., E.N. Rosskopf, and N. Kokalis-Burelle. 2007. Similarities and differences in flower and vegetable production in Florida. Pp. 41-1 to 41-2 in G.L. Obenauf, ed. 2007 Annual International Research Conference on Methyl Bromide Alternatives and Emissions Reductions. Methyl Bromide Alternatives Outreach, Fresno, CA.
- McSorley, R., K.-H. Wang, E.N. Rosskopf, and N. Kokalis-Burelle. 2008. Methyl bromide alternatives for floriculture porduction in a problem site. Pp. 54-1 to 54-3 in G.L. Obenauf, ed. 2008 Annual International Research Conference on Methyl Bromide Alternatives and Emissions Reductions. Methyl Bromide Alternatives Outreach, Fresno, CA.
- McSorley, R., K.-H. Wang, E.N. Rosskopf, N. Kokalis-Burelle, H.N. HansPetersen, H.K. Gill, and R. Krueger. 2009. Nonfumigant alternatives to methyl bromide for management of nematodes, soilborne diseases, and weeds in production of snapdragon (*Antirrhinum majus*). Internat. J. Pest Manage.: (in press).
- McSorley, R., K.-H. Wang, and N. Kokalis-Burelle. 2006. Solarization as an alternative to methyl bromide in Florida floriculture. Pp. 19-1 to 19-3 in G.L. Obenauf, ed. 2006 Annual International Research Conference on Methyl Bromide Alternatives and Emissions Reductions. Methyl Bromide Alternatives Outreach, Fresno, CA.
- Wang, K.-H., and R. McSorley. 2008. Exposure time to lethal temperatures for *Meloidogyne incognita* suppression and its implication in soil solarization. J. Nematol. 40:7-12.