ENY-004

UF UNIVERSITY of FLORIDA IFAS Extension

Cotton Nematode Management[1]

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Nematodes That Attack Cotton

The nematode pests of cotton in Florida are the cotton root-knot nematode (*Meloidogyne incognita* race 3), the reniform nematode (*Rotylenchulus reniformis*), and the sting nematode (*Belonolaimus longicaudatus*). These nematodes annually cause major losses in Florida cotton production. In addition, they are important for increasing the incidence and severity of Fusarium wilt on cotton. Though root-knot nematodes may be found in all soils where cotton is grown, reniform nematodes are found mostly in fine-textured soil with less than 80 percent sand, and sting nematodes are essentially confined to soils with more than 80 percent sand. Root-knot nematodes are known to infest at least 70 percent of cotton fields in the Florida panhandle, and the incidence of reniform nematode is approximately 50 percent in the same area. The incidence of sting nematode is not clearly known but this nematode is more likely to be found with cotton when grown in the deep sandy soils of the Florida peninsula. Field infestations containing more than one of the problem nematodes, particularly root-knot and reniform nematodes, are common.

Diagnosis

The presence or potential for nematode problems in cotton is suggested by one or more of the following: 1) Cropping history of the field, e.g. two or more years production of cotton or equally nematode-susceptible crops; 2) Above-ground symptoms including off-color and/or stunted cotton in spots or large areas of a field; 3) Below-ground symptoms such as small knots on roots or stunted and swollen root tips.

Foliar Symptoms

General foliar symptoms of nematode damage may include areas or spots in the field where plant size is reduced. Height and size of the cotton are oftentimes reduced, and this is generally seen as irregular growth in oval patterns (Figures 1 & 2). Plants also prematurely wilt on hot days and sometimes take on an off-green cast. Heavily infested fields, particularly those with reniform nematodes, will show widespread irregular cotton plant growth (wavy appearance). Severely damaged cotton plants often show nutrient deficiency symptoms which can complicate diagnosis.

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Figure 1. Stunted cotton in a field infested with reniform nematodes.

Figure 2. Older cotton showing damage in an oval pattern in the field.

Root Symptoms

All nematodes affecting cotton reduce feeder roots and produce root stunting. The nematode species differ in specific symptoms with root-knot nematodes producing very small galls or knots on the roots (Figure 3). Roots should be carefully dug with a shovel and examined closely since galling on cotton is hard to see. Sting nematodes do not cause root galling but rather root tip swellings on the cotton. These nematodes stop root growth giving the appearance that roots have been cut off. Reniform nematodes are the most difficult to diagnose in the field. They only produce overall stunted root systems which show few feeder roots. A laboratory analysis is usually necessary to confirm reniform nematodes on cotton.

Figure 3. Root galling on cotton, these small galls on cotton roots result in considerable damage to cotton.

Nematode Assays

Nematode assays must be done to accurately determine that a nematode problem is present, which nematodes are present and their population levels. Soil samples are needed for reliable identification of the responsible nematode species. Only when sufficient numbers of the suspected nematode are extracted from soil samples can a nematode disease be diagnosed and appropriate management procedures implemented. Samples are best taken anytime between October, when problem sites are still apparent in the field, until March. Later, as soil temperatures start to increase, nematode population densities start to decline in the absence of suitable host plants for the nematode. Prior to taking soil samples, contact your County Extension Agent for information concerning available sampling tools, shipment bags, and proper procedures for submitting samples.

Two nematode sampling strategies may be employed, one for current problem diagnosis and the other for predictive purposes. A general field survey should be taken every two to three years for predictive purposes. These nematode samples can be taken in conjunction with normal soil fertility samples, split and submitted to the appropriate laboratories. A soil core (1-inch wide by 8-10-inches deep) should be taken for each acre in a 10-acre block containing a uniform soil type (Figure 4). The cores should be thoroughly mixed and a one-pint sample placed in a sealed plastic bag for immediate shipment to an advisory laboratory. Where a nematode problem

is suspected, several soil cores from within and immediately around a problem site should be taken while cotton is still growing. These samples should be as described above. Portions of cotton roots should be included in the sample. Irrespective of the sampling strategy employed, soil samples should not be taken when the soil is very dry or soggy wet. Also, do not allow samples to dry out or get too hot. If poor quality soil samples are received, accuracy of nematode recovery will be greatly affected.

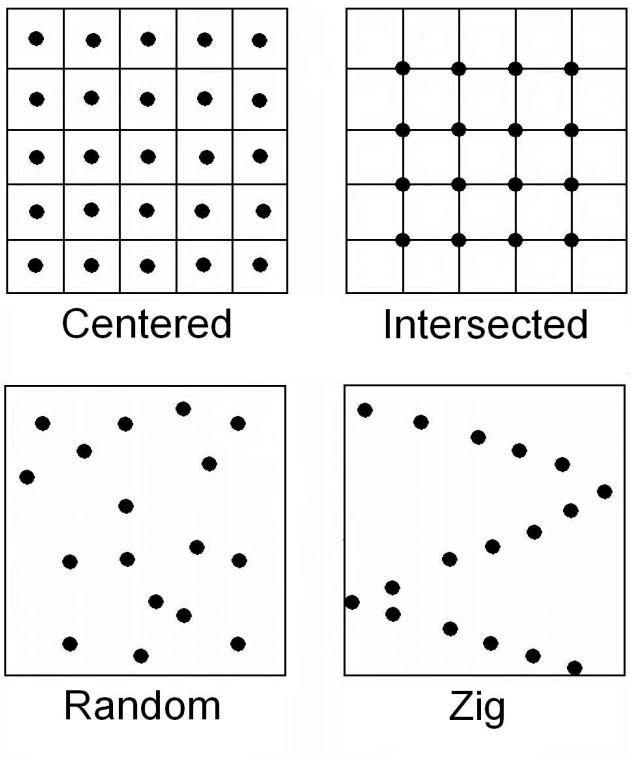

Figure 4. Ten acre sampling patterns. Take 10 to 20 soil cores.

With the advent of GPS systems, some growers are now routinely collecting soil samples from their fields with sampling area sizes of 1-5 acres. Assay results are then placed on maps and variable rate nematicide applications are made only where the nematicide is needed to improve yield (Figure 5). On one north Florida cotton farm, intensive sampling and variable rate nematicide applications have saved the grower up to 60% of nematicide costs by only targeting nematode problem areas in his fields.

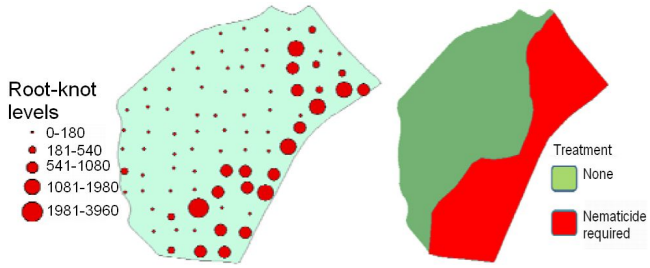

Figure 5. Root knot nematode populations found in an 80 acre cotton field (1 acre grid sample pattern) and the recommended nematicide treatment zone. Photos courtesy of Dr. Charles Overstreet, LSU Nematologist.

Management

Crop Rotation

Where practical, crop rotation is an excellent practice for managing nematode soil population densities. Rotations should include crops that are non-hosts or poor hosts of the problem nematode infesting the soil (Table 1). Identification of the nematode species is critical since it will dictate the choice of rotation crop and length of rotational interval required. As a general practice, two years rotation with a non-host crop is usually sufficient to reduce nematode populations to below damaging levels. Peanut, a non-host for the cotton root-knot and reniform nematode, is an excellent crop rotation choice. However, this rotation for only one year will not adequately reduce root-knot or reniform nematode damage for a following cotton crop. Crops in the grass family such as sorghum and some forage grasses are generally poor hosts of the cotton root-knot nematode and are non-hosts to the reniform nematode. The host status of corn and millet varies with the particular variety planted, and thus, they can not be directly recommended in a rotation system for the cotton root-knot nematode.

As indicted, peanut and all grass crops, including corn and millet, are non-hosts of the reniform nematode and are suitable for rotational management of this pest. However, depending on pre-determined soil population densities of the reniform nematode, taking cotton out of production for at least two years may be necessary to bring reniform nematode soil population densities below economic thresholds. Reniform nematode populations do not decline as rapidly as those of root-knot nematode in the absence of a host crop. Peanut, but not crops in the grass

family, is also recommended for short-term rotations for managing sting nematode on cotton. Many varieties of soybean and some vegetable crops (tomatoes, southern peas) have been bred for resistance to the cotton root-knot nematode. These varieties can be successfully used in rotation systems to manage root-knot nematodes in cotton.

Crop Destruction and Weed Management

Cotton roots may survive a long time after boll harvest. In years when there is a delay in the onset of cool fall soil temperatures (<59°F), nematodes can feed and reproduce on these and associated weed roots. This increases nematode soil population densities surviving through to the next planting season. Therefore, cotton stalks must be cut and soil must be tilled through the stubble zone immediately after harvest to destroy these breeding sites. When soils warm in the spring, weeds that are hosts to the problem nematodes may allow nematode soil population densities to increase prior to planting cotton. Consequently, use of winter cover crops is helpful to provide competition against spring weeds and also the cover crop planting process helps destroy those weeds growing in the fall. The cover crop must be a poor or non-host of the problem nematode. Winter cereals are most suitable for managing root-knot and reniform nematodes in this regard but are less effective for soils infested with sting nematode.

Use of crop rotation systems that include bahiagrass have been increasing, and this perennial grass is a non-host for nematodes affecting cotton. However, weeds must be managed in the bahiagrass or nematode populations will be maintained resulting in damage to the following cotton crop (Figure 6). A two-year bahiagrass rotation is sufficient to manage plant-parasitic nematodes in a future cotton crop **providing** broadleaf weeds are controlled early and regularly in the first year bahiagrass and this continued through the life of the rotation.

Resistance

Two cotton varieties, Phytogen 367 WF and Deltapine 174 RF, have been reported to have some resistance to the cotton root-knot nematode. These may be worth trial plantings to determine their

Figure 6. Weeds in bahiagrass pastures maintain nematodes for future crops.

performance in root-knot nematode infested Florida cotton fields. Overall, however, there are no other adapted cotton varieties with adequate resistance to any of the three problem nematodes. Since nematodes are aggravating factors in Fusarium wilt disease, only varieties with excellent Fusarium resistance should be grown in fields known to be infested with root-knot, reniform, or sting nematodes.

Nematicides

Two seed treatments containing nematicidal materials (Avicta and Aeris) and three general nematicides (Telone II, Temik 15G, and Vydate L) are approved for use in cotton production (Table 2). Before using nematicides, growers should ascertain that problem nematodes are present to justify the expense of treatment. This can only be achieved by submission of soil samples.

Telone II: In University of Florida research, Telone II has shown good nematode control and consistent efficacy for nematode management in cotton. This soil fumigant (1,3-D) is used to reduce initial nematode soil population densities prior to cotton planting. Application of the fumigant usually results in highly significant cotton yield responses in nematode-infested soils. Research over the last few years has shown an average of greater than 35 and 50 pounds of cotton lint per acre for each gallon of Telone II applied per acre to reniform and root-knot-infested soil, respectively. Telone II is applied with a single injection chisel to a depth of at least 12 inches beneath the row, seven to ten days prior to cotton planting. Deeper application is

acceptable but Telone II should not be injected into clay subsoil. Applications shallower than 12 inches have sometimes led to poor nematode management. A range of rates from three to six gallons of Telone II per acre is recommended. The three gallon rate is satisfactory for management of reniform and sting nematodes, but a minimum of four gallons per acre is necessary in root-knot nematode problem fields. Regardless of dosage rate, the fumigant should not be applied when the soil is dusty dry or wet. Sealing the chisel application slits immediately after application by bedding, press wheels, culti-packing, fluted coulters, or similar devices is necessary to prevent premature escape of the Telone II fumes.

Temik 15G: Temik 15G is a granular formulation non-fumigant nematicide applied either in-furrow or 2 or more inches deep in a narrow band (four-six-inches-wide) immediately prior to or at-planting. Recent evaluations of Temik for management of root-knot and reniform nematodes have generally shown significant yield responses to Temik 15G applications. Side-dress applications of Temik 15G at first squaring or flowering have been tested in University of Florida trials over several years. However, no consistent increases in cotton yield have been found using these applications alone or in combination with an at planting Temik application. Note: In addition to the Temik label, the Florida Department of Agriculture and Consumer Services has issued specific regulations governing the use of Temik including permitting requirements and application distances from water wells. Go to: http://www.doacs.state.fl.us/onestop/aes/temik.html

Vydate L: Vydate L is a liquid nematicide for use as a foliar application at a 2 pint/acre application at the 7th true leaf stage of cotton growth or 1 pint/acre at the 2nd to 5th leaf stage and another 1 pint/acre application 14 days later. The product label only suggests nematode suppression and indicates that preplant fumigation or at-plant infurrow application of another nematicide should have been made before foliar application of Vydate L. Few trials have been conducted in Florida with Vydate application so no recommendations can be made for product efficacy at this time.

Seed Treatments: Over the past few years, several companies have begun applying nematicidal materials to seed of cotton. The idea is to have a nematicide present at the time of seed germination, and thus provide early protection to the cotton roots. The two most widely used seed treatments are described below.

Avicta: The Avicta nematicide is sold as 'AVICTA Complete Cotton' which is a combination with Cruiser® seed treatment insecticide and Dynasty CST® seed-delivered fungicide. The active ingredient in the nematicide portion of the seed treatment combination is abamectin, a natural fermentation product of *Streptomyces avermitlis.*

Aeris: Aeris seed treatment is a combination thiodicarb and imidacloprid. The thiodicarb is the nematicidal component of the seed treatment mixture while imidacloprid is most useful for thrips control.

Nematicide Effectiveness: As an example of relative nematicidal efficacy of the above listed products, UF small plot replicated field trials over four years have shown the following percentage yield increases in field sites moderately infested with reniform nematodes: Telone II (3 gals. /A – three trials) - 32%; Temik 15G – (5 lbs. /A and 8 trials) – 12%; Aeris Seed Treatment (5 trials) – 9.5%; and Avicta Complete Cotton (9 trials) – 7.5%. Yields in these trials ranged from 1.5 to 2 bales cotton/A. Product costs versus nematicidal effectiveness needs to be carefully considered before selecting a nematicide for use in cotton.

Table 1. Recommendations of crops for use in rotation to manage nematode pests of cotton.

Crop	Root-knot nematode *Meloidogyne incognita*	Reniform nematode *Rotylenchulus reniformis*	Sting nematode *Belonolaimus longicaudatus*
Bahia grass	Recommended	Recommended	Not suitable
Corn	Recommended[1]	Recommended	Not suitable
Field pea	Not suitable[2]	Not suitable	Not suitable
Millet	Recommended	Recommended	Not suitable
Peanut	Recommended	Recommended	Recommended
Snap bean	Not suitable[2]	Not suitable	Not suitable
Soybean	Not suitable	Not suitable	Not suitable
Sorghum	Recommended	Recommended	Not suitable
Sudan grass	Recommended	Recommended	Not suitable
Tobacco	Not suitable[2]	Not suitable	Recommended
Tomato	Not suitable[2]	Not suitable	Not suitable
Watermelon	Not suitable	Not suitable	Not suitable
Winter oats	Recommended[3]	Recommended[3]	Not suitable
Winter rye	Recommended[3]	Recommended[3]	Not suitable
Winter wheat	Recommended[3]	Recommended[3]	Not suitable

[1] Some corn varieties are known to be very susceptible to root-knot nematode.
[2] Some varieties of these crops are resistant and may be suitable for rotation.
[3] Recommendation is for management of weed hosts. Planting of winter crop will have little or no influence on nematode populations under subsequent cotton.

Table 2. Rates of Telone II and Temik 15G that may be used for the management of nematodes on cotton.

Nematicide	Rate	Application/Comments[1]
Telone II	9-12 gallons / acre	4-6 gallons / acre via single injection chisel 7-10 days before planting for root-knot nematodes (36-54 fl. oz. / 1000 ft. row at 3 ft. spacing). 3 gallons / acre via single injection chisel 7-10 days before planting for reniform or sting nematodes (27 fl. oz. / 1000 ft. row at 3 ft. spacing). This is the recommended nematicide for use in nematode problem fields.
Temik 15G	3.5-10 pounds / acre	7 pounds / acre in a 4-6-inch band at planting for root-knot nematode. (8 oz. / 1000 ft. row at 3 ft. spacing). 5 pounds / acre in a 4-6-inch band at planting for reniform or sting nematode. (6 oz. / 1000 ft. row at 3 ft. spacing). For use under low to moderate nematode population pressures. See text for restrictions governing use.
Avita Complete Cotton Aeris Seed Treatment	Precoated seed treatments	For use under low nematode population pressure.

[1] **Please consult labels for pesticide handling and use restrictions.**