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Impact of In-Row Planting Patterns on Reniform Nematodes Using Precision Agriculture in Cotton[1]

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This article is intended to inform cotton producers and associated agricultural professionals of a practical method to help manage plant-parasitic nematodes in cotton.

Reniform (*Rotylenchulus reniformis*) and other plant-parasitic nematodes have become an increasingly important problem in cotton production in the southeastern United States. Management of nematodes is accomplished through crop rotation, nematicides, or a combination of these practices because complete resistance of cotton cultivars is not available. However, certain varieties have some level of resistance to root-knot nematode, and, as of 2021, to reniform nematode as well. For many growers, rotation is not seen as an option due to low alternative commodity prices, and the most effective nematicides are very costly or have been taken off the market. Thus, practices that provide more flexibility to manage nematodes need to be developed. Our research using strip-till planting has centered on small changes to cultural practices that could potentially reduce cotton losses from nematodes at little cost to growers. In this preliminary trial, cotton planted strip-till between previous cotton rows showed positive results. Cotton lint yield increased by 29% when planted between previous rows compared to planting into the old cotton row. Further tests confirm the usefulness of planting between previous cotton rows to reduce subsequent losses from reniform nematodes. Precision farming techniques allow farmers to plant back over the row from the previous year so they can take advantage of the subsoil slot or starter fertilizer applied near the row. However, this may result in a yield reduction that is consistent for each year that cotton continues without rotation. The perennial nature of cotton allows roots to continue growing late into the fall until a killing frost occurs. In some years, the root system is not completely killed; nematodes that have colonized on the roots persist and quickly migrate to the new crop the next year when planting over the same row occurs.

For this experiment, a two-year study was conducted at the UF/IFAS North Florida Research and Education Center near Quincy, Florida. A reniform-infested field that was a loamy sand soil (80% sand, 8% silt, 12% clay) was selected for the study and contained. Cotton was grown on this site the year before and the mowed stubble was left undisturbed over the winter. Two cotton cultivars were planted using strip-tillage in June of each year. The two treatments consisted of planting cotton directly in-row over the old cotton stubble or planting between the previous cotton rows. The treatments were alternated, replicated six times, and planted using 36-inch-wide row spacing. Cotton was maintained using standard cultural practices for Florida. Soil samples for nematode analysis and plant yield were

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collected from two rows per plot. When soil samples were taken concurrently in the cotton row and between rows, individual cores were taken across from each other to ensure comparable sampling areas. Soil was collected for reniform nematode extraction and counted using standard techniques. Cotton was harvested with a spindle picker in early December in the two studies, and subsamples were ginned for lint yield.

In the first study (i.e., Test 1), reniform nematode population densities at 28 days after planting were lower in cotton planted between previous rows than in cotton planted over the previous rows (Table 1). As the season progressed, reniform nematode population densities in-row in both treatments increased and were roughly equal 76 days after planting. Samples taken after 136 days were collected both in-row and between rows of the two treatments. Reniform nematode population densities were about three times higher when cotton was planted in-row (mean: 1,603 nematodes/100 cm^3 soil) compared to row middle populations (mean: 544 nematodes/100 cm^3 soil). Cotton yield mirrored early-season nematode population density. Yield was significantly higher in cotton planted between previous cotton rows compared to in-row planting.

In Year 2, initial reniform nematode population densities were estimated to be about two and a half times lower between previous-year cotton rows than those taken in the two-year-old cotton row (Table 2). At both the Day 81 and Day 153 sampling dates, reniform population densities did not differ between the two in-row treatments (Table 3). Additionally, nematode population densities between row middles of both previous-year treatments did not differ from each other but were significantly lower than those found in the planted row of either treatment. Due to the initially lower populations of reniform nematodes in row middles, cotton lint yield was significantly higher than yield for in-row plantings (Table 2).

Present information supports the idea that planting cotton in previous row middles when strip-till planting will help to avoid a portion of potential yield losses due to previous reniform infestation. This is likely due to lower population densities of reniform nematodes between rows as compared to in-row populations where source inoculum originates. Auto-steer and other current technology make it possible for growers to plant between previous cotton, avoiding the old rows. As nematode population is determined throughout the field by direct sampling and georeferencing, variable-rate nematicide application becomes feasible and could become more commonplace. In addition, shifting to row-middle plantings in strip-till and using autosteering technology do not involve additional grower expense, so any yield improvement would be profitable for the cotton farmer.

Concerns about compaction have often been the reason for planting back over the old row instead of row middles. This research indicates that where reniform nematodes (and probably root-knot nematodes) are a problem, it pays to strip-till in row middles. Compaction in row middles can be managed with the use of chisels or subsoilers. Another concern is that cotton stalks that were mowed off from the previous cotton crop could puncture tires if row-middle planting occurs the following year. This problem can be overcome by mowing stalks higher so that stalks will be pushed over as the tractor tire runs over them.

In addition to crop rotation, nematicide application, and use of resistant cultivars, we can take advantage of data georeferencing to improve planting patterns. For more information on nematode management strategies, visit Ask IFAS (https://edis.ifas.ufl.edu/entity/topic/nematode_management).

Table 1. Comparative reniform nematode population densities in cotton planted in the row or between rows of a previous cotton crop, Test 1.

Planting Method†	Days after Planting			Lint (lb/A)
	28	76	136	
	Nematodes/100 cm³ Soil			
In-row†	431a	971a‡	1500a	303b
Row middle	179b	793a	1702a	394a

† In-row planting indicates that cotton was seeded over the row from the previous year; row-middle cotton was planted between rows from the previous year.
‡ Column means followed by the same letter are not significantly different ($P \leq 0.05$).

Table 2. Initial populations of reniform nematodes and lint yield of cotton planted in-row and in row middles of a previous cotton crop, Test 2.

Planting Method†	Yield (lb/A)	Nematodes/100 cm³ Soil§
In-row	453b‡	240a
Row middle	714a	92b

§ Indicates initial nematode population densities; samples were collected 11 days prior to planting.
† In-row planting indicates cotton was seeded over the row from the previous year; row-middle cotton was planted between rows from the previous year.
‡ Column means followed by the same letter are not significantly different ($P \leq 0.05$).

Table 3. Comparative reniform nematode population densities in cotton planted in-row and in row middles of a previous cotton crop.

Sampling Method†	Days after Planting	
	81	153
	Nematodes/100 cm³ Soil	
In-row planting		
In-row samples	328a‡	378ab
Row-middle samples	81b	168b
Row-middle planting		
In-row samples	330a	624a
Row-middle samples	205ab	316b

† In-row planting indicates cotton was seeded over the row from the previous year; row-middle cotton was planted between rows from the previous year.
‡ Column means followed by the same letter are not significantly different ($P \leq 0.05$).