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Reproduction of *Meloidogyne incognita* on Winter Cover Crops Used in Cotton Production

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Abstract: Substantial reproduction of *Meloidogyne incognita* on winter cover crops may lead to damaging populations in a subsequent cotton (*Gossypium hirsutum*) crop. The amount of population increase during the winter depends on soil temperature and the host status of the cover crop. Our objectives were to quantify *M. incognita* race 3 reproduction on rye (*Secale cereale*) and several leguminous cover crops and to determine if these cover crops increase population densities of *M. incognita* and subsequent damage to cotton. The cover crops tested were 'Bigbee' berseem clover (*Trifolium alexandrinum*), 'Paradana' balansa clover (*T. balansae*), 'AU Sunrise' and 'Dixie' crimson clover (*T. incarnatum*), 'Cherokee' red clover (*T. pratense*), common and 'AU Early Cover' hairy vetch (*Vicia villosa),* 'Cahaba White' vetch (*V. sativa*), and 'Wrens Abruzzi' rye. In the greenhouse tests, egg production was greatest on berseem clover, Dixie crimson clover, AU Early Cover hairy vetch, and common hairy vetch; intermediate on Balansa clover and AU Sunrise crimson clover; and least on rye, Cahaba White vetch, and Cherokee red clover. In both 2002 and 2003 field tests, enough heat units were accumulated between 1 January and 20 May for the nematode to complete two generations. Both AU Early Cover and common hairy vetch led to greater root galling than fallow in the subsequent cotton crop; they also supported high reproduction of *M. incognita* in the greenhouse. Rye and Cahaba White vetch did not increase root galling on cotton and were relatively poor hosts for *M. incognita*. Only those legumes that increased populations of *M. incognita* reduced cotton yield. In the southern US, *M. incognita* can complete one to two generations on a susceptible winter cover crop, so cover crops that support high nematode reproduction may lead to damage and yield losses in the following cotton crop. Planting rye or *Meloidogyne*-resistant legumes as winter cover crops will lower the risk of increased nematode populations compared to most vetches and clovers.

Key words: cotton, *Gossypium hirsutum*, management, *Meloidogyne incognita*, southern root-knot nematode, winter cover crop.

Winter cover crops are planted in late summer or early fall to reduce soil erosion and loss of nutrients through leaching and runoff and to increase soil organic matter and water infiltration (Reeves, 1994 ; Lu et al., 2000; Dabney et al., 2001). Cover crops also suppress weeds and enhance natural enemies of insect pests (Dabney et al., 2001; Tillman et al., 2004). In the southeastern US, winter cereals such as wheat (*Triticum aestivum*), oats (*Avena sativum*), and rye (*Secale cereale*) are recommended cover crops in cotton (*Gossypium hirsutum*) production (Bauer and Reeves, 1999). Rye, in particular, is favored because it is cold tolerant, establishes reliably, grows rapidly, produces large amounts of biomass (Reeves, 1994), and is relatively inexpensive. There is an increasing interest in using clovers and vetches as winter covers in cotton production. Although these leguminous cover crops are more difficult to establish and do not produce as much biomass as rye, they contribute N to the subsequent crop through N_2 fixation (Reeves, 1994; Lu et al., 2000). Moreover, the low C:N ratio of legumes compared to rye results in more rapid nutrient mineralization and availability of N for plant uptake.

Some graminaceous and leguminous cover crops are hosts of *Meloidogyne incognita* race 3 (Johnson and Motsinger, 1989; Windham and Pederson, 1992; Ibrahim et al., 1993; Mercer and Miller, 1997), one of the most widespread and damaging pathogens of cotton (Blasingame and Patel, 2001). Substantial reproduction of this nematode on winter cover crops may lead to damaging population levels in the subsequent cotton crop. The amount of population increase of *M. incognita* during the winter will depend, in part, on the host status of the cover crop. Not all hosts support the same level of nematode reproduction. For example, the reproductive factor (final/initial numbers) for *M. incognita* after 6 wk was 2.6 for 'Wrens Abruzzi' rye and 13.8 for 'Redhill' barley (Ibrahim et al., 1993).

Soil temperatures over the winter also influence the amount of nematode reproduction. Soil temperatures in the southern US are high enough for *M. incognita* to complete at least one generation on a susceptible winter cover crop (Roberts et al., 1981; Johnson and Motsinger, 1990). Nevertheless, a number of field studies have shown that winter rye does not increase numbers of *M. incognita* in the following summer crop (Minton and Parker, 1987; Johnson and Motsinger, 1990; Minton, 1992; McSorley and Gallaher, 1994; Minton and Bondari, 1994). Failure of the nematode to increase on rye during the winter may be due to poor initial infection of the rye roots. At temperatures below 18 °C, *M. incognita* is inactive and will not infect roots; however, once root infection has occurred, the nematode will develop and reproduce at temperatures above 10 °C (Roberts et al., 1981; Ploeg and Maris, 1999). It is likely that a combination of low soil temperatures and a low reproductive potential on rye results in little-to-no detectable increase in nematode numbers over the winter. A winter cover crop that supports greater reproduction than rye supports may increase numbers of *M. incognita* in the following summer crop.

Our objectives were to quantify the level of reproduc-

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tion of *M. incognita* race 3 on rye and several leguminous cover crops in the greenhouse and to determine if winter cover crops increase densities of this nematode and subsequent damage to cotton in the field.

Materials and Methods

Greenhouse experiment: The reproductive potential of *M. incognita* race 3 on nine winter cover crops was determined in a greenhouse experiment. The cover crops were 'Bigbee' berseem clover (*Trifolium alexandrinum*), 'Paradana' balansa clover (*T. balansae*), 'AU Sunrise' and 'Dixie' crimson clover (*T. incarnatum*), 'Cherokee' red clover (*T. pratense*), common and 'AU Early Cover' hairy vetch (*Vicia villosa*), 'Cahaba White' vetch (*V. sativa*), and 'Wrens Abruzzi' rye (*Secale cereale*). In the first trial of the experiment, cover crops were planted in 10-cm-square pots containing 700 cm^3 of loamy sand (82% sand, 9% silt, 7% clay, 1% organic matter) that had been steam-heated at 100°C for 6 hr to kill potential plant pathogens. The seeding rate (grams per pot) was 0.02 for balansa clover, 0.06 for the other clovers, 0.13 for the vetches, and 0.32 for the rye. In the second trial, the same amounts of seed were planted in 11.5-cm-square pots (1,250 cm^3 soil) to avoid problems with drought stress encountered with the smaller pots. Two wk after planting, each pot was inoculated with 8,000 eggs of *M. incognita* race 3. The nematode was obtained from culture on 'Rutgers' tomato (*Lycopersicon esculentum*), and eggs used for inoculum were extracted from the roots with 0.5% NaOCl (Hussey and Barker, 1973). The plants were maintained in a greenhouse with soil temperatures from 17°C to 33°C, fertilized with a slow-release fertilizer (14-14-14, N-P-K), and watered one to two times daily. Nematode eggs were extracted 58 to 61 d after inoculation by cutting the roots from each pot into approximately 5-cm pieces, placing them in a 1-liter flask, and agitating for 4 min in a 1% NaOCl solution. The experiment was arranged in a complete randomized design with eight replicates for each cover crop, and the experiment was performed twice.

Field experiment: The effect of winter cover crops on population densities of *M. incognita* and subsequent nematode damage to cotton was evaluated at a field site on the University of Georgia Gibbs Farm in Tifton, GA. Soil was a Tifton loamy sand (fine, loamy, siliceous, thermic Plinthic Kandiudults; 85% sand, 11% silt, 4% clay, <1% organic matter) that was naturally infested with *M. incognita* race 3. In the previous year, the field had been planted to hairy vetch in the winter and squash (*Cucurbita moschata*) followed by southern pea (*Vigna unguiculata*) in the summer. A split-plot design with six replications was used to determine the effect of cover crop (main plots) and fumigation with 1,3-dichloropropene (1,3-D) (Telone II®, Dow AgroSciences, Indianapolis, IN) (subplots) on numbers of *M. incognita*, root-galling, and cotton yield. There were 10 cover-crop treatments (the nine cover crops tested in the greenhouse experiment plus a fallow control) with fumigated and nonfumigated subplots in each cover crop. The fumigant was used to suppress populations of *M. incognita* to determine whether the nematodes affected cotton yield. The experiment was continued for 2 yr, but plots were not re-randomized between years so that seed produced by the cover crops in the first year would not lead to cross contamination in the second year.

The main plots were 5.5-m wide by 7.6-m long. The cover crops were planted with a no-till drill with 18-cm row spacing between 7 and 13 December 2001 and between 27 November and 2 December 2002. Recommended seeding rates were used for the cover crops. Seeding rates (kg/ha) were as follows: Paradana balansa clover (5.6), Cahaba White vetch (33.6), Dixie crimson clover (16.8), hairy vetch (33.6), Bigbee berseem clover (16.8), Wrens Abruzzi rye (84.0), AU Sunrise crimson clover (16.8), Cherokee red clover (16.8), AU Early Cover hairy vetch (33.6), and fallow. The appropriate rhizobial inoculum was applied to legume seeds prior to planting. To simulate the fallow conditions most commonly encountered on farms in the southeastern US, the fallow plots were not sprayed with herbicide to control winter weeds. For each main plot, the percentage of ground covered by the legumes and rye was visually estimated on 7 May 2002 and 2 May 2003. Cover crops were irrigated once to promote emergence and stand establishment in December 2002. Cover crops were allowed to die from natural senescence in 2002 but were sprayed with glyphosate (potassium salt form, 2.52 kg a.i./ha) on 12 May 2003 prior to planting cotton.

The subplots consisted of two rows (7.6-m long) spaced 91 cm apart that received the fumigant and four rows that were not treated. The fumigant 1,3-D was applied during strip tillage by injecting 28 liters/ha (33.1 kg a.i./ha) 40 cm deep under the rows 10 d before planting cotton in 2002 and 9 d before planting cotton in 2003. Strip-tillage consisted of a single sub-soil chisel per row with shallow (10 cm) discing and rollers that left a smooth seed-bed 20-cm wide; the remaining space between rows was undisturbed. Cotton (Delta and Pine Land DP458BR) was planted (14.3 seed/m) into strip-tilled beds on 30 May 2002 and 29 May 2003. All cotton plots received 560 kg/ha 3-9-18 (N-P-K) fertilizer on 30 May 2002 and 672 kg/ha on 20 May 2003. Plots also received ammonium nitrate (34% nitrogen) on 19 July 2002 (302 kg/ha) and 17 July 2003 (308 kg/ha). Applications of insecticides and herbicides followed University of Georgia Extension Service recommendations and were the same for all plots (Brown et al., 2001). After cotton emergence, all plots were sprayed one to two times with acephate at 0.20 kg a.i./ha for thrip control. Irrigation was applied as needed through overhead sprinklers to the cotton crop. Cotton

was harvested on 22 November 2002 and 10 November 2003 from the two rows of the fumigated subplots and the center two rows of the nonfumigated subplots. Weight of seed cotton from each subplot was determined, and lint yield was estimated at 38% of the seed cotton weight.

Soil temperatures (20-cm deep) were recorded from 3 January 2002 to 24 May 2002 and from 2 December 2002 to 20 May 2003, and degree-days were calculated for each cover-crop growing season. Soil temperatures were recorded every 50 min, and a daily mean temperature was calculated. Accumulated degree-days during cover-crop growth were calculated as daily mean temperature minus the base developmental temperature of 10 °C for *M. incognita* (Vrain et al., 1978; Ploeg and Maris, 1999).

Soil samples for nematode analysis were collected from the field on 5 December 2001, 1 May 2002, 29 July 2002, 4 December 2002, 19 May 2003, 15 July 2003, and 13 November 2003. Soil samples consisted of a composite of eight to 10 cores per plot (2.5-cm-diam, approximately 20-cm deep) collected from the root zone. For the fumigated subplots, the samples were collected from the root zone of both rows, and for the nonfumigated subplots, they were collected from the center two rows of the four-row plots. Nematodes were extracted from 150 cm^3 soil by centrifugal flotation (Jenkins, 1964). Root-galling of cotton was evaluated on 6 December 2002 and 13 November 2003. Ten root systems from each plot were carefully excavated and examined. Gall ratings were assigned to each plant, and the mean value for each plot was used for statistical analysis. A 0-to-10 scale was used, in which 0 = no galling, 1 = 1 to 10% of the root system galled, 2 = 11 to 20% of the roots system galled, etc., with 10 = 91 to 100%.

Mixed model analysis of variance (PROC MIXED, v. 7; SAS Institute, Cary, NC) was used to analyze data from both the greenhouse and field experiments. In the greenhouse experiment, cover crop was classified as a fixed effect, and trial was classified as a random effect. Fisher's LSD test was used to determine differences among the cover crops in the mean number of *M. incognita* eggs. Egg counts were subjected to square root transformation before analysis. In the field experiment, cover crop and fumigation were classified as fixed effects, and year and replication were classified as random effects. Dunnett's test was used to determine differences between the fallow control and cover crops on root galling and cotton yield, and Fisher's LSD test was used to determine differences among cover crops in numbers of *M. incognita* juveniles in soil.

Results

Greenhouse experiment: Reproduction of *M. incognita* differed among the cover crops ($P < 0.0001$). The greatest numbers of nematode eggs were produced on berseem clover, Dixie crimson clover, AU Early Cover hairy vetch, and common hairy vetch (Fig. 1). Egg production was intermediate on Balansa clover and AU Sunrise crimson clover, and least on rye, Cahaba White vetch, and Cherokee red clover. The reproductive factors (Rf = final population density/initial population density) for *M. incognita* were 20 to 29 on the hairy vetches, Dixie crimson clover, and berseem clover; 14 to 15 on AU Sunrise crimson and Balansa clover; 5 on Cherokee red clover; and ≤1 on rye and Cahaba White vetch.

Field experiment: There was considerable variation in germination and/or growth of the different cover crops. Plot coverage exceeded 75% for rye, AU Early Cover hairy vetch, and Cahaba White vetch in both May 2002 and 2003 (Table 1). However, germination and growth of Dixie crimson, berseem, balansa, and Cherokee red clover were generally poor, with less than 20% plot coverage for all four clovers in 2002 and <20% coverage for the latter three in 2003. Plot coverage by common hairy vetch and AU Sunrise crimson clover was intermediate but was 50% or greater in both May 2002 and 2003. Cover crops that grew over less than 50% of the plot area would not be expected to have a significant effect on nematode reproduction; therefore, only cover crops with 50% or greater plot coverage were analyzed for their effect on *M. incognita* populations and cotton yield.

Soil temperatures were similar during the 2002 and 2003 cover-crop cycles (Fig. 2). Temperatures fluctuated around the developmental threshold for *M. incognita* (10 °C) from December through the end of February but steadily rose above the threshold from early March until the cotton was planted in May. The number of accumulated degree-days (base 10°C) from 1 January to 20 May was 1,024 in 2002 and 1,000 in 2003.

Fig. 1. Reproduction of *Meloidogyne incognita* race 3 on legume cover crops and rye. The cover crops are 'Bigbee' berseem clover (*Trifolium alexandrinum*), 'Dixie' crimson clover, 'AU Sunrise' crimson clover (*T. incarnatum*), common hairy vetch, AU Early Cover hairy vetch (*Vicia villosa),* 'Paradana balansa' clover (*T. balansae*), 'Cherokee' red clover (*T. pratense),* 'Cahaba' White vetch (*V. sativa*), and 'Wrens Abruzzi' rye *(Secale cereale*). Pots were inoculated with 8,000 nematode eggs. Eggs were extracted from roots 60 d later. Bars are the mean of eight replicates and two trials ($n = 16$). Bars with the same letter are not different ($P > 0.05$).

TABLE 1. Percentage ground coverage of field plots by different winter cover crops.

Winter cover[a]	Coverage (%)[b] 7 May 2002	2 May 2003
Berseem clover (*Trifolium alexandrinum*) cv. Bigbee	19	16
Balansa clover (*T. balansae*) cv. Paradana	3.5	12
Crimson clover (*T. incarnatum*)		
cv. AU Sunrise	51	85
cv. Dixie	20	47
Red clover (*T. pratense*) cv. Cherokee	0	3
Hairy vetch (*Vicia villosa*)		
Common	50	68
cv. AU Early Cover	94	76
Vetch (*V. sativa*) cv. Cahaba White	92	92
Rye (*Secale cereale*) cv. Wrens Abruzzi	100	97

[a] Cover crops were planted between 7 and 13 December 2001 and between 27 November and 2 December 2002.
[b] Percentage of groun covered by the winter cover crops was visually estimated in the spring of each year.

Soil temperatures reached or exceeded the activity threshold (18°C) for *M. incognita* (Roberts et al., 1981) on 6 d in late January 2002; however, soil temperatures ≥18°C did not occur until early March 2003. Prior to this point, nematodes may not have entered the roots to begin development. If 15 March is considered the starting point for nematode development, then there were 822 and 828 degree-days accumulated in 2002 and 2003, respectively.

Fumigation with 1,3-D did not have a consistent effect on either nematode populations or cotton yield in 2002 and 2003. The lack of significant effect of fumigation in the Mixed Model ANOVA was due to an interaction with year (a random effect) caused by differences in the magnitude of the effect rather than opposing effects. This analysis calculates the probability that fumigant will be significant in any given year (not just the two tested), but with only two yr of data and large differences between years, the analysis calculated a $P > 0.10$ that fumigant would have a significant effect in any given year. When the years were analyzed separately, gall indices on cotton were reduced ($P = 0.001$) from 2.5 in the nonfumigated to 1.3 in the fumigated plots in 2002 and were reduced ($P < 0.0001$) from 6.8 in the nonfumigated to 4.3 in the fumigated plots in 2003. Differences in soil population densities of *M. incognita* juveniles between fumigated and nonfumigated plots were also detected in December 2002 and in July 2003 (Table 2). When the years were analyzed separately, cotton yields (kg lint/ha) were increased ($P < 0.0001$) from 754 in the nonfumigated to 1,017 in the fumigated plots in 2002, and increased ($P < 0.0001$) from 880 in the nonfumigated to 1,362 in the fumigated in 2003.

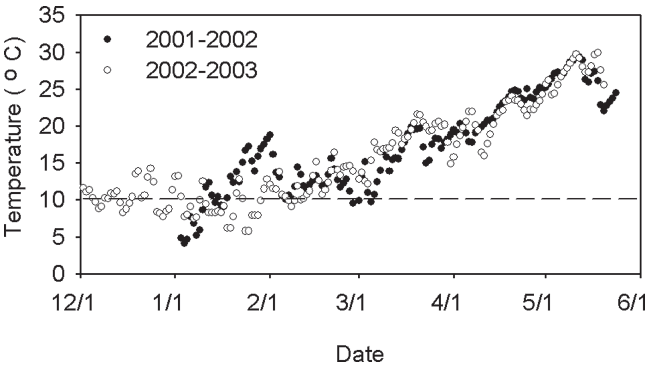

FIG. 2. Average daily soil temperatures at a 20-cm depth at the Gibbs Farm in Tifton, GA. The dashed line indicates the base developmental threshold (10°C) for *Meloidogyne incognita*.

Winter cover crops affected both the root-gall indices ($P = 0.005$) and yield ($P = 0.0005$) of the subsequent cotton crop. The cover crops had the same effect on galling and yield regardless of whether plots were fumigated or nonfumigated (i.e., no fumigant by cover crop interaction). Root galling on cotton was greater ($P \leq 0.05$) following common hairy vetch and AU Early Cover hairy vetch than following winter fallow (Fig. 3A). Cotton following the other cover crops did not differ from fallow in the amount of root galling. The dominant weeds growing in the winter fallow were corn spurry (*Spergula arvensis*) and wild radish (*Raphanus raphanistrum*); the host status of both these weeds to *M. incognita* is unknown. Numbers of *M. incognita* juveniles in the soil did not differ among the cover crops in 2002; however, when cotton was planted in May 2003, nematode numbers were greater ($P \leq 0.05$) in plots that had the two hairy vetch cultivars than in plots with the other cover crop treatments (Table 2). At mid season (July 2003) and at the end of the season (November 2003), nematode numbers were greater only in plots that had AU Early Cover hairy vetch.

Cotton yields were lower ($P \leq 0.05$) following rye and the two hairy vetch cultivars than following winter fallow (Fig. 3B). Although stand density was not determined, cotton stands following rye were lower than following the other treatments because the rye stems covered the planting furrow, thus hampering placement of many of the cotton seed in the furrow.

DISCUSSION

Trifolium spp. and *Vicia* spp. are typically excellent hosts for *M. incognita* (Malek and Jenkins, 1964; Minton et al., 1965; Quesenberry et al., 1986; Mercer and Miller, 1997). However, Cahaba White vetch and Cherokee red clover are reported to be resistant to this nematode (Minton et al., 1966; Donnelly, 1979; Gallaher et al., 1988; Quesenberry et al., 1993). The legume cover crops evaluated in this study varied in their relative host status for *M. incognita*. Berseem clover, Dixie crimson clover, and the two hairy vetches were excellent hosts for *M. incognita*, with Rf values ≥20 after 60 d (approximately two nematode generations) in the greenhouse. Our results indicate that Cahaba White vetch is highly resistant (Rf < 1), whereas Cherokee red clover is only moderately resistant (Rf = 5) to *M. incog-*

TABLE 2. Average population densities of *Meloidogyne incognita* second-stage juveniles (J2) from plots planted with different winter cover crops and fumigated and not fumigated with 1,3-dichloropropene.

	M. incognita J2/100 cm^3 soil on different sampling dates						
Cover crop[a]	5 Dec 2001	1 May[b] 2002	29 Jul 2002	4 Dec 2002	19 May 2003	15 Jul 2003	13 Nov 2003
Fallow	21[c]	8	7	18	15 b[d]	42 b	228 ab
Secale cereale 'Wrens Abruzzi'	27	2	7	3	14 b	17 b	199 b
Trifolium incarnatum 'AU Sunrise'	12	17	10	26	42 b	31 b	110 b
Vicia villosa common hairy	8	11	8	16	115 a	83 ab	198 b
V. villosa 'AU Early Cover'	12	3	15	36	151 a	122 a	354 a
V. sativa 'Cahaba White'	8	3	10	17	7 b	18 b	212 b
	NS	NS	NS	NS	$P < 0.0001$	$P = 0.025$	$P = 0.046$
Nonfumigated	15	7	9	36 a	72	91 a	229
Fumigated	—	—	—	13 b	44	13 b	206
				$P < 0.0001$	NS	$P = 0.0004$	NS

[a] Only cover crops with greater than 50% coverage are presented.
[b] Fumigant was applied after May soil samples were collected. Cotton was planted 30 May 2002 and 29 May 2003 and harvested on 22 November 2002 and 10 November 2003.
[c] Data are the means of six replicates and two fumigation treatments ($n = 12$).
[d] Means in a column followed by the same letter are not different ($P > 0.05$).

nita relative to other clovers and vetches tested in this study. Balansa clover and AU Sunrise crimson clover, though still considered excellent hosts, did not support as much nematode reproduction as the other susceptible legumes. Hairy vetch and crimson clover also are hosts for *Rotylenchulus reniformis*, another major pathogen of cotton in the southern region (Jones and McLean, 2004).

The amount of nematode reproduction in the greenhouse indicates only the potential for nematode populations to increase on a cover crop. Because nematode activity, development, and egg production are directly related to temperature, nematode populations may not substantially increase during the winter. Between 400 and 410 degree-days (base 10°C) are required for *M. incognita* to complete its life cycle (Vrain et al., 1978; Ploeg and Maris, 1999). In both 2002 and 2003, enough heat units accumulated between 1 January and 20 May for the nematode to complete two generations. Before March, soil temperatures were frequently above the base threshold for development but below the activity threshold for root penetration. However, even when March was considered the starting point for nematode development, enough heat units had accumulated for *M. incognita* to complete two generations on the cover crops. Winter and spring temperatures in 2002 and 2003 were typical for the region. Both AU Early Cover hairy vetch and common hairy vetch led to greater root galling in the subsequent cotton crop, and these two cover crops also supported high reproduction of *M. incognita* in the greenhouse experiment. Rye and Cahaba White vetch did not increase root galling on cotton compared to the fallow control; these cover crops were relatively poor hosts for *M. incognita* in the greenhouse experiment. AU Sunrise crimson clover, which was an intermediate host in the greenhouse experiment, did not increase root galling in the subsequent cotton crop. This cultivar, with an Rf value of 15, has

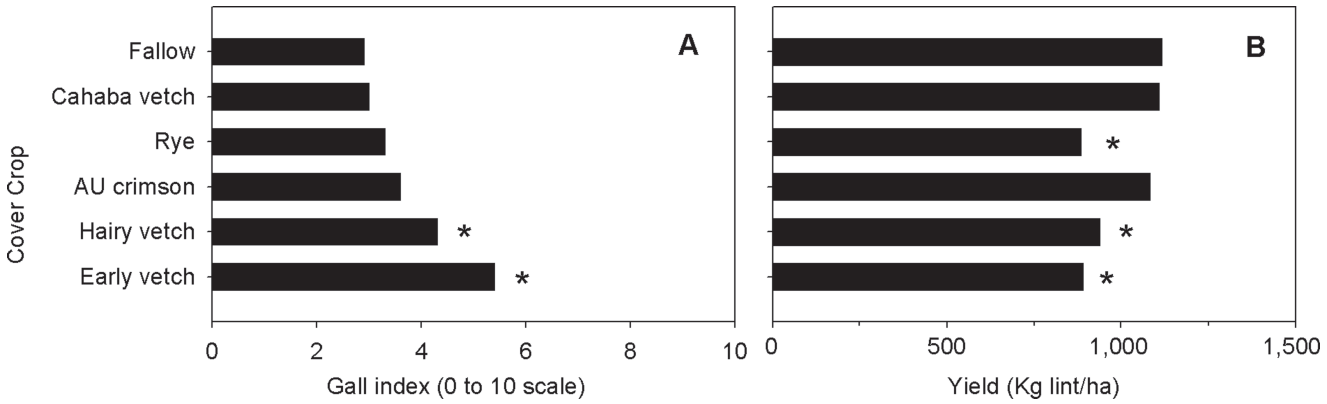

FIG. 3. Root galling (A) and yield (B) of cotton following different winter cover crops and winter fallow in a field infested with *Meloidogyne incognita* race 3. Cover crops were 'AU Sunrise' crimson clover (*Trifolium incarnatum*), common hairy vetch, AU Early Cover hairy vetch (*Vicia villosa),* 'Cahaba' White vetch (*V. sativa*), and 'Wrens Abruzzi' rye *(Secale cereale*). Root-gall indices are on a linear 0-to-10 scale based on the percentage of the root system with galls. Bars are the means of six replicates, two fumigation treatments, and 2 yr ($n = 24$). An asterisk above a bar indicates a difference from the fallow control ($P \leq 0.05$).

the potential to increase numbers of *M. incognita*, and the reason it did not do so in the field experiment is unclear. In a warmer winter or with better plant establishment, AU Sunrise may significantly increase populations of *M. incognita*. Several other studies have reported greater population increase of *M. incognita* following legumes than following cereals or fallow. Root-gall indices were higher on squash following vetch than following winter fallow (Johnson et al., 1992) and higher on soybean following Dixie crimson clover than following rye (McSorley and Gallaher, 1992). In the two studies, squash yield was not affected by the winter cover, but total dry matter of soybean was reduced following crimson clover. Wang et al. (2004) reported greater numbers of *M. incognita* juveniles in the spring following hairy vetch, lupine, and crimson clover than following rye or oats. In contrast, McSorley and Dickson (1989) did not observe an increase in numbers of juveniles following either rye or hairy vetch. In that study, the cover crops were killed early (February and April), which may have prevented completion of a nematode generation.

Cotton yields tend to be greater when planted after a winter cover crop than when the field is left fallow over the winter (Scott et al., 1990; Rothrock et al., 1995; Tillman et al., 2004). A few studies have reported lower yields when cotton was planted after a legume than after rye (Gaylor et al., 1984; Bauer and Busscher, 1996; Ruberson et al., 1997). Leguminous winter cover crops can increase seedling disease in cotton. In previous studies, the incidence of *Rhizoctonia solani* was greater and cotton stands were lower following hairy vetch and crimson clover than following winter fallow; however, the increase in disease did not result in reduced cotton yield (Rickerl et al., 1988; Rothrock et al., 1995). In our study, only those legumes that increased populations of *M. incognita* were associated with reduced cotton yield. The yield reduction in cotton following rye was apparently due to poor cotton stand rather than damage from *M. incognita*.

We conclude that in the southern region of the US, *M. incognita* can complete one to two generations on a winter cover crop. In fields infested with *M. incognita*, cover crops that support high nematode reproduction may lead to damage and yield losses in the following cotton crop. Planting rye or *Meloidogyne*-resistant legumes as winter cover crops will lower the risk of building up damaging populations of this nematode compared to most vetches and clovers.

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