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Enhanced Biodegradation of Nemacur™

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Important Terms:

- history soil has received repeated applications of a specific organic pesticide
- non-history soil has no history of specific organic pesticide treatments
- problem soil indicates an organic pesticide does not control the pest as expected; lack of control is often linked to repeated applications.
- enhanced biodegradation is defined as the accelerated decomposition of a particular compound as influenced by previous exposure; often results in a loss of efficacy.

Nemacur™ (common chemical name: fenamiphos) is an organic pesticide used to control certain nematodes and insects in turf (Martin, 2000). In fenamiphos-history or problem soils, if this detoxification occurs at an accelerated rate, then the compound is ineffective; thus the pesticide has never reached the target pest. Microorganisms in the soil/root mix, such as bacteria and fungi, are responsible for the transformation of this complex organic compound into simple and harmless end products such as CO_2 and H_2O. If this transformation occurs at accelerated rates, then enhanced biodegradation is taking place (Skipper et al., 2001).

Objective. Ongoing research at Clemson University during 2001-2002 will study the phenomenon of enhanced biodegradation of Nemacur™ in history and problem soils. Three South Carolina Golf Courses that had indicated poor performance by this pesticide were selected from surveys sent during the year 2000 to members of CGCSA.

Methods and Materials. This research began in July, 2001 at Colleton River Plantation, Bluffton; Country Club of South Carolina, Florence; Spanish Wells Club, Hilton Head with the following treatments applied. The experimental design was a randomized complete block design with four (4) replications of each treatment. Plots were 4' X 6'.

Colleton River Plantation and **Spanish Wells Club**: sixteen (16) 4' X 6' plots have been laid out. Four (4) reps with four (4) treatments were carried out on July 5th.
The treatments (x 4 reps) were as follows:
1- Control (no chemicals applied)
2- Inhibitor 2 lbs. ai / A.
3- Nemacur 10G™ @ 10 lbs. ai/A.

4- Inhibitor + Nemacur 10G™ (both @ above rates in 2 & 3)

Country Club of South Carolina: twenty-four (24) plots have been laid out. Four (4) reps with six (6) treatments were carried out on July 6th.
The treatments (x 4 reps were as follows:
1- Control (no chemicals applied)
2- Inhibitor 2 lbs. ai / A.
3- Inhibitor 4 lbs. ai / A.
4- Nemacur 10G™ @ 10 lbs. ai/A.
5- Inhibitor + Nemacur 10G™ ; Inhibitor 2 lbs. ai / A.
6- Inhibitor + Nemacur 10G™ ;Inhibitor 4 lbs. ai / A.

Core soil samples will be taken monthly at all three golf courses for the purpose of extracting, counting and identifying nematode species in each plot and for the ring labeled ^{14}C-fenamiphos enhanced biodegradation studies. The individual plots will be graded monthly for turf quality and percent coverage. Studies will also include the application of a nonphytotoxic inhibitor of a microbial activity, dietholate ($C_{10}H_{15}O_3PS$), which has reduced microbial degradation of the preemergent herbicide, butylate, in butylate-history soils (Skipper, 1990). Dietholate was incorporated with Nemacur™ to study its effectiveness, if any, in fenamiphos-history or problem soils at these three South Carolina Golf Courses.

Enhanced biodegradation of fenamiphos will be investigated by measuring the evolution of $^{14}CO_2$ from ring labeled ^{14}C-fenamiphos. A static flow system, for measuring the evolution of $^{14}CO_2$ will be carried out by utilizing soil biometer flasks developed by Bartha and Pramer (1969) and Skipper et al. (1986). Amounts of $^{14}CO_2$ evolved in the suspected history and problem soils will be compared to amounts of $^{14}CO_2$ evolved in non-history soils.

Results and Discussion

Sting nematode counts decreased by 50% at Spanish Wells with the lower rate of inhibitor + Nemacur with respect to the control (Table 1). Sting nematode counts decreased 50% at Country Club of South Carolina after treatments of inhibitor + Nemacur (10 + 2 ai/A) and 70% with inhibitor + Nemacur (10 + 4 ai/A) with respect to the control (Table 2). However, sting nematode counts remained higher than threshold (10/100 cc of soil) at both courses after treatments. Extensive visual damage to bermudagrass was seen at both courses one month after treatments. No visual improvement to turf quality was seen at Spanish Wells Club and Country Club of South Carolina. In Figure 3, damage to the turf has extended past the area of research at Country Club of South Carolina. Damage to #1 green at Spanish Wells can be seen in Figure 4. Sting nematode was not detected at Colleton River Plantation (Table 3). No visual damage was noted from lance and ring nematodes at this location. Further evaluations of turf quality will be carried out following additional samplings in September. Enhanced biodegradation of Nemacur studies have not been completed at this time.

SUMMARY

Even though there was a reduction in sting nematode counts after treatments with the inhibitor + Nemacur, sting counts were well above damage thresholds at both Spanish Wells Club and Country Club of South Carolina and caused extensive damage to turf at both locations. If the causative factor were judged to be enhanced biodegradation, a second or third application of Nemacur to achieve control would most likely be ineffective and serve only to enlarge the microbial populations responsible for biodegradation of Nemacur.

References Cited:

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Table 1. Response of nematodes to Nemacur and Microbial Inhibitor at Spanish Wells Club, Hilton Head.

		Nematode Species					
		Initial Assay			30 DAT*		
Treatment	Rate	Sting	Ring	Lance	String	Ring	Lance
	ai/A	Numbers/100 cc					
Control	--	50	124	4	70	110	10
Inhibitor	2	40	94	80	62	70	86
Nemacur	10	44	114	26	33	122	74
Nem + Inh	10 + 2	46	64	136	29	46	236

Treatments applied July 5, 2001. Statistical analysis is in progress.
*No visual improvement was observed in turf quality by any treatment.

Table 2. Response of nematodes to Nemacur and Microbial Inhibitor at Country Club of South Carolina, Florence.

		Nematode Species			
		Initial Assay		30 DAT*	
Treatment	Rate	Sting	Ring	String	Ring
	ai/A	Numbers/100 cc			
Control	--	14	174	42	152
Inhibitor A	2	15	68	33	116
Inhibitor B	4	11	102	27	62
Nemacur	10	9	60	30	98
Nem + Inh A	10 + 2	16	122	28	118
Nem + Inh B	10 + 4	12	92	17	68

Treatments applied July 6, 2001. Statistical analysis is in progress.
*No visual improvement was observed in turf quality by any treatment.

Table 3. Response of nematodes to Nemacur and Microbial Inhibitor at Colleton River Plantation, Hilton Head.

		Nematode Species			
		Initial Assay		30 DAT*	
Treatment	Rate	Ring	Lance	Ring	Lance
	ai/A	Numbers/100 cc			
Control	--	124	388	110	332
Inhibitor	2	58	649	46	448
Nemacur	10	146	584	108	480
Nem + Inh	10 + 2	106	536	86	520

Treatments applied July 5, 2001
*No visual improvement in turf quality by any treatment