MANAGEMENT OF NEMATODE PARASITES OF MAJOR CROPS IN LOUISIANA WITH AGRI-TERRA

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Plant parasitic nematodes are a serious and insidious agricultural production constraint. They are microscopic, subtle pathogens that rarely make their presence known to the untrained eye. The phytopathological literature is replete with documentation of the national and international economic impact of crop losses caused by parasitic nematodes. The pathology that nematodes cause is often inaccurately attributed to factors such as plant nutritional and/or water deficiencies or excesses, soil-inhabiting fungi, bacteria and insects, or undesirable soil structure, fertility or topography. Across major agricultural regions and crops of the world, the annual loss caused by plant-parasitic nematodes is 10-20%, an estimate that translates into hundreds of millions of dollars. In regions of the world where there is great crop diversity and where winter conditions are relatively mild, losses certainly exceed these estimates.

Pest management tactics such as the use of allelochemicals, green-manure crops, cultural practices and solarization have historically been subordinated in favor of traditional pesticides. Nematicides in particular produce undesirable ecological consequences and many are currently under close scrutiny or have been banned altogether. The development of sustainable, profitable agricultural production systems for the future must be linked to efficient, economical and environmentally responsible nematode management strategies. A new arsenal of low-rate, minimal-toxicity nematicides will play a vital role in protecting plants from nematode damage. One of this new generation of nematicides which has shown great promise is Agri-Terra, produced by Cal-Agri Products, LLC of Los Angeles, California. In the USA, this material has been tested with positive results at leading universities in California, Florida, Idaho, Louisiana, Minnesota, North Carolina , New York and Oregon. At Louisiana State University, greenhouse, microplot and field trials with Agri-Terra have been ongoing since 2000.

Results of all research trials, field and microplot, are summarized in Table 1. Across crops, years and environments, significant plant growth responses were obtained with 7 of 11 crops and significant yield responses with 5 of 11. Moreover, significant control of indigenous nematode populations was observed in every single trial, with the single exception of the field trial with pepper in which the cultivar employed in the trial was not a host of the predominant nematode species, *Rotylenchulus reniformis*, the reniform nematode. Overwhelmingly, the data for cotton, tomato, cucumber and bell pepper was the most dramatic and consistent, although excellent nematode control was observed for all crops. Tables 2-6 summarize this information in much greater detail. Data in these tables are means of 5 replications and single and double asterisks indicate differences significant at the 5 and 1% levels, respectively.

In each trial over 5 years, the yields of seed cotton (Table 2.) were at least doubled in plots that received the 112.3 L/ha rate of this new material. Concomitantly, populations of the most serious pest of cotton, the reniform nematode, were reduced by an average of 77%. Since there is currently no commercial cultivar resistance to this nematode available, this material has the potential to impact cotton production in the south and elsewhere significantly. Microplot data (Table 3.) for cotton also produced consistently positive plant responses and efficacy data. Weights of root and shoot systems were increased significantly by application of this product. Enhanced plant growth, usually visible as taller and more robust plants during the first 3 weeks following application, produced a significantly greater number of bolls per plant in 2 of the 4 trials and a significant increase in seed cotton per plant in 3 of the trials. The 2005 microplot trial was interrupted by hurricane Katrina and yield data was lost. Nematode data for all microplot trials produced efficacy results that paralleled those of field trials, with reductions in reniform populations averaging 62% over the 4 years.

The vegetable field trials, Tables 4-6, were conducted in cooperation with LSU AgCenter horticulture faculty who supervised crop establishment, production and grading of fruit so that conditions simulated a commercial operation. The only exception to this protocol was that harvesting of crops was done by hand to ensure that all produce was harvested from each plot. Yields of tomato fruit in the extra large and large size categories were increased significantly over those from non-treated control plots. Treatments did not differ significantly for fruit in the max large, medium, small and cull categories. The new material also produced significant yield enhancement of cucumber fruit in the super select and select categories. Yields of cucumbers in other size categories were not influenced significantly by treatment. Nematode populations, which were primarily reniform nematode, were reduced significantly by treatment in both tomato and cucumber field plots (data not presented). Averaged over three years in the microplot environment, 2003-2005, yields of bell pepper fruit treated with the new material were increased significantly from 0.4 to 1.2 kg per plant at harvest 1, from 0.8 to 1.2 at harvest 2 and from 0.3 to 1.1 kg per plant at harvest 3. The total season fruit yield over the three years was 1.5 kg per plant for non-treated microplots and 3.5 kg per plant for treated microplots.

Table 1. Summary of six years of microplot and field trials with Agri-Terra in Louisiana

Crop species used in trial	No. of years in Micro-plot (M)	No. of years in Field (F)	No. of years with significant growth response	No. of years with significant yield response	No. of years with significant nematode population control
Sugarcane	3	3	3M, 0F	3M, 1F	3M, 3F
Cotton	4	5	4M, 5F	4M, 5F	4M, 5F
Soybean	3	1	2M, 0F	0M, 0F	2M, 1F

Rice	3	0	1M	0M	3M
Tomato	4	1	2M, 0F	2M, 1F	4M, 1F
Bell Pepper	3	1	3M, 0F	3M, 0F	3M, 0F
Cucumber	2	1	2M, 0F	2M, 1F	2M, 1F
Lettuce	1	0	0M	0M	1M
Cabbage	1	0	0M	1M	1M
Must.Green	1	0	0M	0M	1M
Endive	1	0	0M	0M	1M

Table 2. Cotton (cvs. LA887 in 2000-2002 and Deltapine 434RR in 2003 and 2006) seed yield (kg/55.4 m) and reniform nematode soil population data from field plots treated or not treated with Agri-Terra.

Year of trial	Product at 112.3 L/ha (10 g/A)	Non-treated control	Number of *R. reniformis*/500cc soil at harvest	
			treated plots	non-treated plots
2000	5.3*	2.5	5,008**	28,755
2001	6.7**	3.1	5,736**	23,202
2002	10.8**	5.2	5,248**	17,330
2003	3.7*	0.7	3,063**	19,751
2006	6.9**	2.1	7,855**	26,847
average	6.7	2.7	5,382	23,177

Table 3. Cotton (cv. Deltapine 434RR) boll set, seed yield (g/plant), and nematode (*R. reniformis*) soil population data from microplots treated (T) or not treated (NT) with Agri-Terra.

Year of trial	Dry weight (g.) at harvest			No. of bolls per plant	Seed cotton (g) per plant	No. of nematodes per microplot at harvest
	root	top	plant			
2002-T	84.1*	229.3**	313.4*	33	52*	83,814**
2002-NT	67.3	170.7	238.0	26	31	250,657
2003-T	76.8*	326.8**	403.6**	40**	60**	108,266*
2003-NT	59.0	147.3	209.3	19	37	195,004
2004-T	90.5*	254.1*	344.6*	37*	51**	50,930**
2004-NT	73.3	179.0	252.3	24	26	277,420
2005-T	70.2*	182.6	252.8*	31	Katrina	132,184**
2005-NT	53.4	133.6	187.0	22	Katrina	220,252

Table 4. Tomato (cv. BHN 444) fruit yield (cumulative over the season) in 2006 field trial. Fruit was sized using an industry-standard template.

Tomato fruit size category	Yield (kg) from plots treated with112.3 L/ha (10 g/A) of Agri-Terra	Yield (kg) from non-treated control plots
max large	4.2	4.0
extra large	21.1**	9.9
large	45.9**	30.6
medium	23.2	14.7
small	0.6	2.1
culls	16.3	14.6

Preplant reniform nematode soil densities averaged 2,827 per 500cc. Harvest densities averaged 3,792 and 14,280 individuals in treated and non-treated plots, respectively.

Table 5. Cucumber (cv. Dasher II) fruit yield (cumulative over the season) in 2006 field trial. Fruit was sized using an industry-standard template.

Cucumber fruit size category	Yield (kg) from plots treated with112.3 L/ha (10 g/A) of Agri-Terra	Yield (kg) from non-treated control plots
super select	47.8*	35.9
select	46.5**	26.7
small-fancy	2.0	4.7
large	9.8	11.8
culls	22.9	26.5

Preplant reniform nematode soil densities averaged 2,699 per 500cc; and, harvest densities averaged 6, 908 and 24,592 individuals in treated and non-treated plots, respectively.

Table 6. Bell pepper (cv. Keystone) fruit yields per plant and root-knot nematode (*Meloidogyne incognita*) soil population data averaged over 3 years (2003-005) in microplots.

Harvest interval	Yield (kg) from microplots treated with112.3 L/ha (10 g/A) of Agri-Terra	Yield (kg) from non-treated control microplots	Number of *R. reniformis*/500cc soil at harvest	
			treated microplots	non-treated microplots
1	1.2**	0.4	476**	2,385
2	1.2*	0.8	no data	no data
3	1.1**	0.3	1,004**	6,907
season total	3.5**	1.5	----------	----------

Harvest intervals 1, 2, and 3 were 67-69, 74-77 and 93-96 days after transplanting, respectively.