Natural Products for Nematode Management in Tomatoes

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Abstract

In field trials conducted on tomatoes (*Lycopersicon esculentum* 'UC82'), the natural products ReZist, ST007, Root Power, Agro-K, and DiTera were compared to an untreated control and a chemical standard (1,3-Dichloropropene) (1,3-D) for management of root-knot nematode (rkn) (*Meloidogyne javanica*). Each of two trials consisted of five replicates of ten treatments in a randomized complete block design. At harvest in the first trial, compared to untreated, Agro-K had a greater plant weight; and Root Power, 1,3-D, Agro-K, and ST007 had lower levels of rkn. At harvest in the second trial, compared to untreated, ReZist had a greater total yield and lower yield of green fruit; and ST007 and 1,3-D had a lower root gall rating.

INTRODUCTION

Root-knot nematodes (*Meloidogyne* sp.) are widely distributed throughout California and are the most important nematode pest of tomatoes (*Lycopersicon esculentum*). Current control methodology relies on the use of metam sodium, 1,3-Dichloropropene (1,3-D), and nematode resistant cultivars (UC IPM Online, 2009). Two field trials were conducted, one each in 2008 and 2009, to evaluate the effectiveness of several natural products for management of root-knot nematode (rkn), *Meloidogyne javanica*, on tomatoes.

MATERIALS AND METHODS

Two trials, each with ten treatments were conducted in subsequent years at University of California South Coast Research and Extension Center in Irvine, California USA, in a field with a history of rkn (*Meloidogyne javanica*). The previous crop was lima beans (*Phaseolus vulgaris*). The soil type was a sandy loam (66% sand, 21% silt, 13% clay, 0.6% organic matter, pH 7.6, and CEC 0.68 milimhos/cm). Each treatment consisted of 5 replicates in a randomized complete block design. Single row plots were 1.5-m wide, and 4-m long plus a 1-m buffer on either end. Three natural products were the same in both trials: ST007 (Stoller), Root Power (Stoller), DiTera (Valent). In the 2008 trial, a product from Agro-K was used. In 2009, the Agro-K treatments were replaced with a Stoller product ReZist. Each product was applied both by drip irrigation (0.5 L/hour emitters, 30-cm spacing, 1 hour duration) and by a banded surface spray (in 1 L of water per replicate) followed by irrigation. All treatments were compared to a water treated control (untreated); and the chemical standard 1,3-D (Telone II, Dow AgroSciences) applied via injection. In the first trial, 1,3-D was applied on June 3, 2008, and the other treatments were first applied at-plant on June 17. As detailed in the Tables, most treatments in both trials received repeated applications according to manufacturer's recommendations. Tomatoes ('Ace') were seeded on June 17, 2008, and harvested on October 8, 2008. In the second trial, 1,3-D was applied on May 22, 2009 and the other treatments were first applied at-plant on June 12. Tomatoes were seeded on June 12, 2009, and harvested on October 21, 2009.

Trials were sampled for nematodes pre-plant to establish the level of the population, and at harvest. Soil samples consisted of 12, 2.5-cm diameter cores per replicate to a 30-cm depth. Nematode extraction was by elutriation followed by sugar centrifugation (Byrd et al., 1976). At harvest, total fruit weight, weight of red and green

fruit, and plant weight was obtained from 5 plants per replicate. A root-gall rating was conducted on the same plants with 0 equal to no galling, and 10 heavily galled. Data were analyzed with Analysis of Variance (ANOVA) followed by Fisher's Least Significant Difference Test at *P=0.05* and *0.10*.

RESULTS AND DISCUSSION

In the 2008 trial, numerically, all treatments except Root Power via spray had a greater total yield than the untreated (Table 1). Numerically, Root Power via drip and ST007 via spray had a greater yield of red fruit than the untreated. Numerically, all treatments had a greater yield of green fruit than the untreated. Agro-K via spray had a greater plant weight than the untreated (*P=0.10*). In addition, numerically, ST007 via drip, both DiTera treatments, Agro-K via spray, and 1,3-D had greater plant weight at harvest than the untreated. Numerically, all treatments except Root Power via drip had a lower root-gall rating than the untreated (Table 2). At *P=0.05*, Root Power via spray, and 1,3-D had lower levels of rkn than the untreated. At *P=0.10*, both Agro-K treatments and ST007 via drip had lower levels of rkn than the untreated. Numerically, all treatments had a lower level of rkn at harvest than did the untreated.

In the 2009 trial, at *P=0.05*, ReZist via drip had a greater total yield than the untreated (Table 3). In addition, numerically, Root Power via spray and 1,3-D had a greater total yield than the untreated. Numerically, ReZist, Root Power, and DiTera via drip; ST007 via spray; and 1,3-D had a greater yield of red fruit than the untreated. At *P=0.05*, ReZist via drip had a lower yield of green fruit than the untreated. In addition, numerically, ST007 via drip, and Root Power and DiTera via spray had a greater yield of green fruit than the untreated. Numerically, the treatments not applied through the drip had a greater plant weight at harvest than the untreated. Numerically, with the exception of DiTera, these same treatments had a lower root-gall rating than the untreated (Table 4). At *P=0.05*, ST007 via spray and 1,3-D had a lower root-gall rating than the untreated. Numerically, all treatments except Root Power applied via drip and DiTera via spray had a lower level of rkn at harvest than did the untreated.

As we move away from traditional fumigant and nonfumigant nematicides towards natural products with different modes of action, the most effective application methods, rates, and timing, and interpretation of results become less straightforward. Several products tested appear to have value in managing nematode effects on tomatoes. In the USA, DiTera is registered as a nematicide, while Root Power, ReZist, and ST007 are registered as fertilizers. These products have also been observed (Westerdahl, pers. commun.) to mimic plant growth regulators, stimulating growth of roots or shoots, which could account for some of the results observed.

Literature Cited

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Tables

Table 1. Yield data for 2008 UC South Coast Research and Extension Center tomato trial.

Product	Method	Rate of product/ ha/application	Number of applications	Yield (kg/5 plants)											
				Fruit weight			Red fruit			Green fruit			Plant weight		
					0,1	0,1		0,1	0,1		0,1	0,1		0,1	0,1
Untreated				1,4	a	a	0,8	a	a	0,6	a	a	1,1	ab	b
ST007	Drip	0.1 L	6 (weekly)	2,4	a	a	0,7	a	a	1,7	a	a	1,3	ab	ab
ST007	Spray	0.2 L	2 (3 weeks)	2,2	a	a	1,1	a	a	1,1	a	a	0,9	b	b
Root Power	Drip	1.2 L	6 (weekly)	2,1	a	a	1,0	a	a	1,1	a	a	1,0	b	b
Root Power	Spray	2.4 L	2 (3 weeks)	1,3	a	a	0,5	a	a	0,7	a	a	1,1	b	b
DiTera	Drip	14.0 kg	4 (weekly)	2,3	a	a	0,5	a	a	1,8	a	a	1,4	ab	ab
DiTera	Spray	56 kg	1 (at-plant)	2,0	a	a	0,7	a	a	1,3	a	a	1,1	ab	b
Agro-K	Drip	4.7 L	4 (weekly)	2,1	a	a	0,5	a	a	1,6	a	a	1,1	b	b
Agro-K	Spray	4.7 L	4 (weekly)	2,4	a	a	0,6	a	a	1,7	a	a	1,9	a	a
1,3-D	Injection	84.2 L	1 (pre-plant)	2,2	a	a	0,8	a	a	1,5	a	a	1,4	ab	ab

Each figure is the mean of 5 replicates. Means not followed by the same letter are significantly different from each other according to Fisher's Protected Least Significant Difference Test at *P=0.05* or *0.10*.

Table 2. Nematode data for 2008 UC South Coast Research and Extension Center tomato trial.

Product	Method	Rate of product/ ha/application	Number of applications	Root gall rating (0-10)			Root-knot nematode/L of soil		
					0,1	0,1		0,1	0,1
Untreated				9,6	a	a	3.824	a	a
ST007	Drip	0.1 L	6 (weekly)	8,6	a	a	1.624	ab	b
ST007	Spray	0.2 L	2 (3 weeks)	9,3	a	a	1.968	ab	ab
Root Power	Drip	1.2 L	6 (weekly)	9,7	a	a	2.700	ab	ab
Root Power	Spray	2.4 L	2 (3 weeks)	8,9	a	a	1.196	b	b
DiTera	Drip	14.0 kg	4 (weekly)	8,9	a	a	3.176	ab	ab
DiTera	Spray	56 kg	1 (at-plant)	8,7	a	a	2.776	ab	ab
Agro-K	Drip	4.7 L	4 (weekly)	8,9	a	a	1.536	ab	b
Agro-K	Spray	4.7 L	4 (weekly)	8,1	a	a	1.603	ab	b
1,3-D	Injection	84.2 L	1 (pre-plant)	8,8	a	a	1.763	ab	ab

Means not followed by the same letter are significantly different from each other according to Fisher's Protected Least Significant Difference Test at *P=0.05* or *0.10*.

Table 3. Yield data for 2009 UC South Coast Research and Extension Center tomato trial.

Product	Method	Rate of product/ha/ application	Number of applications	Yield (kg/5 plants)											
				Fruit weight			Red fruit			Green fruit			Plant weight		
					0,1	0,1		0,1	0,1		0,1	0,1		0,1	0,1
Untreated				5,2	a	a	1,0	b	bc	4,2	ab	abc	1,6	a	ab
ST007	Drip	0.1 L	6 (weekly)	5,1	a	a	0,5	b	c	4,6	ab	ab	1,6	a	ab
ST007	Spray	0.2 L	2 (3 weeks)	5,0	a	a	,4	ab	bc	3,6	abc	abc	2,0	a	ab
Root Power	Drip	1.2 L	6 (weekly)	4,2	a	a	1,3	ab	bc	2,9	bc	cd	1,3	a	b
Root Power	Spray	2.4 L	2 (3 weeks)	5,5	a	a	0,6	b	bc	4,9	a	a	2,3	a	a
DiTera	Drip	14.0 kg	4 (weekly)	4,5	a	a	1,4	ab	abc	3,1	abc	bcd	1,4	a	b
DiTera	Spray	56 kg	1 (at-plant)	4,8	a	a	0,4	b	c	4,4	ab	abc	2,0	a	ab
ReZist	Drip	1.2 L	6 (weekly)	4,5	a	a	2,6	a	a	1,9	c	d	1,5	a	ab
ReZist	Spray	2.4 L	2 (3 weeks)	4,6	a	a	0,8	b	bc	3,8	ab	abc	1,9	a	ab
1,3-D	Injection	84.2 L	1 (pre-plant)	5,6	a	a	1,8	ab	ab	3,9	ab	abc	2,1	a	ab

Each figure is the mean of 5 replicates. Means not followed by the same letter are significantly different from each other according to Fisher's Protected Least Significant Difference Test at *P=0.05* or *0.10*.

Table 4. Nematode data for 2009 UC South Coast Research and Extension Center tomato trial.

Product	Method	Rate of product/ha/ application	Number of applications	Root gall rating (0-10)			Root-knot nematode/ L of soil		
					0,05	0,1		0,05	0,1
Untreated				8,1	abc	ab	554	ab	abc
ST007	Drip	0.1 L	6 (weekly)	8,1	abc	ab	496	ab	bc
ST007	Spray	0.2 L	2 (3 weeks)	6,1	cd	cd	398	ab	bc
Root Power	Drip	1.2 L	6 (weekly)	8,7	ab	ab	1.166	a	a
Root Power	Spray	2.4 L	2 (3 weeks)	7,9	abc	ab	426	ab	bc
DiTera	Drip	14.0 kg	4 (weekly)	8,9	ab	a	538	ab	abc
DiTera	Spray	56 kg	1 (at-plant)	8,5	ab	ab	906	ab	ab
ReZist	Drip	1.2 L	6 (weekly)	9,1	a	a	534	ab	abc
ReZist	Spray	2.4 L	2 (3 weeks)	7,1	bc	bc	259	b	c
1,3-D	Injection	84.2 L	1 (pre-plant)	5,1	d	d	160	b	c

Each figure is the mean of 5 replicates. Means not followed by the same letter are significantly different from each other according to Fisher's Protected Least Significant Difference Test at *P=0.05* or *0.10*.