Nimitz (MCW-2) for Management of Root-Knot Nematode in Tomatoes

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Abstract

In two field trials conducted on tomatoes, Nimitz (MCW-2, fluensulfone) was evaluated (*P≤0.05*) for management of root-knot nematode (RKN) (*Meloidogyne javanica*). Each trial was a randomized complete block with 5 replicates per treatment. Treatments in the first trial were Nimitz at 2, 3, 4, 6, and 8 kg ai/ha, oxamyl (Vydate), metam sodium (MS), 1,3-dichloropropene (1,3-D, Telone II) and untreated control. At harvest, 4 kg Nimitz had a greater weight of fruit plus foliage. MS had a greater weight of fruit plus foliage and a greater weight of fruit. 3, 4, and 8 kg Nimitz and 1,3-D had a lower root gall rating (RG). 4 and 8 kg Nimitz and 1,3-D had fewer RKN. Treatments in the second trial included combinations of Nimitz, methyl bromide/chloropicrin (MBrCP), 1,3-D, chloropicrin (CP), metam postassium (KPam), oxamyl, azoxystrobin (Quadris), metalaxyl (Ridomil), halosulfuron-methyl (Sandea), metribuzin (Canopy), metolachlor (Parallel), an untreated control, and a hand weeded control. The herbicides tested exhibited a range of weed control from low (1,3-D, <10% overall control) to good (CP+KPam+Nimitz, >65% overall control at 2 or 4 kg) with some differences on particular weed species. Nimitz at 2 and 4 kg when used in combination with CP and KPam had greater yields than untreated control. MBrCP and all treatments containing Nimitz had lower RG at harvest than untreated control. Based on the results of these trials, Nimitz shows promise for use in IPM programs for managing root-knot nematode on tomatoes.

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, and nematode resistant varieties (UC IPM Online, 2009). Two field trials were conducted to evaluate the effectiveness of Nimitz (MCW-2, fluensulfone) for management of the root-knot nematode, *Meloidogyne javanica*, and for weed control on tomatoes.

MATERIALS AND METHODS

Two randomized complete block field trials with 5 replicates per treatment were conducted in subsequent years at University of California South Coast Research and Extension Center in Irvine, California USA. The test sites were in a field with a history of root-knot nematode (*Meloidogyne javanica*, RKN) and tests were conducted to evaluate the effectiveness (*P≤0.05*) of Nimitz (MCW-2, fluensulfone) compared to an untreated

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control and standard chemical treatments. The previous crop was lima beans (*Phaseolus vulgaris*). Single row plots were 4 m long plus a 1-m buffer on either end. 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). Soil samples for nematodes were taken pre-plant to establish the presence of the population, and at harvest. Five weeks after planting, 5 selected plants from each replicate were evaluated for total weight, shoot weight, weight of roots, and root gall rating (RG). Soil samples consisted of 12, 2.5-cm diameter cores per replicate to a 30-cm depth. Nematodes were extracted from 1-L soil by elutriation followed by sugar centrifugation (Byrd et al., 1976). RGs with 0 = no galling, and 10 = heavily galled were also conducted at harvest. At harvest, plant weight, total fruit weight, and weight of red and green fruit was obtained from 5 plants per replicate. Data were analyzed with Analysis of Variance (ANOVA) followed by Fisher's Least Significant Difference Test.

Treatments in the first trial were Nimitz (MCW-2, fluensulfone 480 EC, Makhteshim-Agan) at 2, 3, 4, 6, and 8 kg ai/ha, oxamyl (Vydate L, Vyd, Dupont) at 1.12 kg/ha, metam sodium (MS, Amvac) at 561 L/ha, 1,3-dichloropropene (Telone II, 1,3-D, Dow AgroSciences) at 112 L/ha, and untreated control. 1,3-D was injected 14-days preplant (May 26, 2010). MS, Nimitz and Vyd, were applied 7-days preplant (June 2, 2010) via surface spray followed by tilling to a 10 cm depth, and sprinkler irrigation. Tomato ('Ace') seed was seeded on June 10, 2010. A once over harvest was conducted on October 28, 2010.

The second trial included nematicides, fungicides and herbicides. Treatments included combinations of Nimitz (2 and 4 kg ai/ha), methyl bromide/chloropicrin (392 kg/ha, MBrCP, TriCal), 1,3-D (112 L/ha), chloropicrin (168 kg/ha, CP, TriCal), metam postassium (561 L/ha, KPam, KP, Amvac), Vyd (1.12 kg/ha), azoxystrobin (1.13 L/ha, Quadris, Quad, Syngenta), metalaxyl (1.17 L/ha, Ridomil, Rid, Syngenta), halosulfuron-methyl (0.07 kg/ha, Sandea, Sand, Gowan), metribuzin (0.56 kg/ha, Canopy, Metr, Dupont), metolachlor (1.17 L/ha, Parallel, Parall, Makhteshim-Agan), an untreated control, and a hand weeded control (Table 3). 1,3-D was injected June 1, 2011. MBrCP was injected June 9, 2011. CP was injected June 10, 2011. Nimitz, and KP were applied June 15, 2011 via surface spray, followed by tilling to a 10 cm depth, and sprinkler irrigation. Vyd, Quad, Parall, and Rid were applied June 22, 2011. Metr and Sand were applied July 13, 2011. Tomatoes ('Ace') were seeded on June 22, 2011. Weed evaluations were conducted 7-weeks after planting. Plots were visually evaluated by estimating overall percent weed cover, percent cover of all grasses and sedges combined, percent cover of all broadleaf weeds combined, as well as percent cover for each individual weed species found in a plot. Overall percent weed control, as compared to the untreated control was also estimated. Harvest was on October 21, 2011.

RESULTS AND DISCUSSION

Treatments were evaluated at ($P \leq 0.05$) compared to an untreated control. In the first trial, 4 kg Nimitz had a greater total weight (fruit plus foliage) and plant weight (Table 1). MS had a greater total weight, and a greater weight of fruit. At 5-weeks after planting, the Nimitz treatments and 1,3-D had a lower RG than untreated (Table 2). At harvest, 3, 4, and 8 kg Nimitz and 1,3-D had a lower RG (Table 2). 4 and 8 kg Nimitz treatments and 1,3-D had fewer RKN (Table 2).

In the second trial, at five weeks after planting, MBrCP, CP + KP + 1,3-D, and CP + KP + Nimitz 2 kg had a greater plant, shoot and root weight than the untreated control (Table 3). At harvest, CP + KP + Nimitz 2 kg, and CP + KP + Nimitz 4 kg, had greater total, fruit, and red fruit weights than untreated (Table 4). 1,3-D had a greater plant weight than untreated. At harvest, all treatments except Rid + Quad + Sand + Metr + Parall, CP + KP + 1,3-D, and 1,3-D had a lower RG than untreated (Table 5).

Rid + Quad + Sand + Metr + Parall, MBrCP, CP + KP + 1,3-D, CP + KP + Nimitz 2 kg, CP + KP + Nimitz 4 kg, and hand weeded control had lower percent weed cover than untreated (Table 6). All treatments except Nimitz 4 kg + Vyd + Quad + Rid + Metr + Parall, and 1,3-D had lower percent cover of grasses than untreated. MBrCP, and CP +

KP + Nimitz 2 kg had lower percent cover of broadleaves than untreated. All treatments except Nimitz 4 kg + Vyd + Quad + Rid + Metr + Parall, and 1,3-D had greater percent weed control than untreated.

Looking at individual weed species, MBrCP, and CP + KP + 1,3-D, had more yellow nutsedge (*Cyperus esculentus*) than untreated (Table 7). All treatments except Nimitz 4 kg + Vyd + Quad + Rid + Metr + Parall and 1,3-D had less Mexican sprangletop (*Leptochloa fusca* ssp. *uninervia*) than untreated. MBrCP, CP + KP + 1,3-D, CP + KP + Nimitz 2 kg, and hand weeded control had less purslane (*Portulaca oleracea*) than untreated. 1,3-D had more yellow foxtail (*Setaria pumila*) and black nightshade (*Solanum nigrum)* than untreated (data not shown). There were no differences in pigweed (*Amaranthus retroflexus*) control (data not shown).

CONCLUSIONS

Early in the first trial, RGs for all Nimitz treatments were equivalent to 1,3-D and significantly lower than untreated indicating excellent control of RKN. There was also a trend for the 3 lowest rates of Nimitz to have larger plants than the untreated (data not shown). At harvest, all Nimitz treatments showed additional evidence of RKN control through lower RGs or numbers of nematodes in soil. Tomatoes have a relatively high tolerance to RKN compared to many other crops, making statistically significant yield increases at harvest difficult to obtain. In this trial, the 4 kg rate of Nimitz and MS were the only treatments to show significant yield increases.

The second trial tested various combinations of nematicides, herbicides and fungicides. Both weed and nematode pressure appear to have impacted yields. Both rates of Nimitz when used in combination with CP and KP had better plant growth at 5 weeks after planting than did Nimitz treatments combined with Quad + Rid + Metr + Parall, or Vyd + Quad + Rid + Metr + Parall. At harvest, these same two treatments in combination with CP and KP had the greatest yields with respect to total weight of plants plus fruit, total fruit weight, and weight of red fruit. MBrCP, and all four Nimitz treatments exhibited excellent control of RKN as exhibited by low RGs at harvest. Overall, the herbicides tested exhibited a range of weed control from low (1,3-D, <10% overall control) to good (CP +KP+Nimitz, >65% overall control at 2 or 4 kg) with some differences on particular weed species. Based on the results of these trials, Nimitz shows promise for use in IPM programs for managing RKN on tomatoes.

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Tables

Table 1. Yield data for 2010 tomato trial.

Treatment	Yield (kg/5 plants)		
	Total	Fruit	Plant
Untreated	4.43 b	2.91 b	1.52 b
2 kg Nimitz	6.02 ab	3.86 ab	2.15 ab
3 kg Nimitz	5.14 ab	3.83 ab	1.31 b
4 kg Nimitz	7.09 a	3.93 ab	3.16 a
8 kg Nimitz	5.49 ab	4.12 ab	1.37 b
1,3-D	5.49 ab	4.13 ab	1.36 b
MS	6.64 a	4.76 a	1.88 ab
Oxamyl	5.61 ab	3.98 ab	1.63 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.

Table 2. Nematode data for 2010 tomato trial.

Treatment	Gall rating		Nematodes/
	5 weeks	Harvest	L of soil
Untreated	2.40 a	9.80 a	3176 ab
2 kg Nimitz	0.40 b	8.00 ab	2660 abc
3 kg Nimitz	0.60 b	7.33 b	2276 abc
4 kg Nimitz	0.20 b	7.07 b	1424 c
8 kg Nimitz	0.40 b	5.13 c	944 c
1,3-D	0.20 b	7.67 b	1334 c
MS	1.60 ab	9.73 a	4248 a
Oxamyl	1.20 ab	9.73 a	1820 bc

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.

Table 3. Early season data for 2011 tomato trial.

Treatment	Five weeks after planting weight (g)		
	Plant	Shoot	Root
Untreated	4.2 b	3.8 b	0.4 c
Rid+Quad+Sand+Metr+Parall	2.8 b	2.4 b	0.3 c
MBrCP	17.0 a	15.9 a	1.1 ab
CP+KP+1,3-D	16.8 a	15.5 a	1.3 ab
CP+KP+Nimitz 2 kg	19.0 a	17.5 a	1.5 a
CP+KP+ Nimitz 4 kg	10.0 ab	9.3 ab	0.7 bc
Nimitz 4 kg+Quad+Rid+Metr+Parall	3.2 b	2.9 b	0.2 c
Nimitz 4 kg+Vyd+Quad+Rid+Metr+Parall	1.6 b	1.4 b	0.2 c
Hand weeded control	4.2 b	3.8 b	0.4 c
1,3-D	3.3 b	3.0 b	0.3 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.

Table 4. Yield data for 2011 tomato trial.

Treatment	Yield (kg/5 plants)			
	Total	Fruit	Red	Plant
Untreated	2.1 cd	1.8 cde	0.2 b	0.3 b
Rid+Quad+Sand+Metr+Parall	2.5 bcd	1.9 bcde	0.1 b	0.6 ab
MBrCP	2.9 abcd	2.3 abcd	0.4 b	0.6 ab
CP+KP+1,3-D	3.4 abc	2.7 abc	0.3 b	0.7 ab
CP+KP+Nimitz 2 kg	4.0 a	3.3 a	1.5 a	0.7 ab
CP+KP+ Nimitz 4 kg	3.8 ab	3.1 ab	1.5 a	0.7 ab
Nimitz 4 kg+Quad+Rid+Metr+Parall	2.1 cd	1.6 cde	0.1 b	0.6 ab
Nimitz 4 kg+Vyd+Quad+Rid+Metr+Parall	2.1 cd	1.2 de	0.3 b	0.9 ab
Hand weeded control	2.8 abcd	2.3 abcd	0.7 ab	0.5 ab
1,3-D	1.9 d	0.8 e	0.1 b	1.0 a

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.

Table 5. Nematode data for 2011 tomato trial.

Treatment	Gall rating (0-10)	Nematodes/L of soil
Untreated	7.3 a	206.4 ab
Rid+Quad+Sand+Metr+Parall	4.3 abc	466.4 a
MBrCP	1.1 cd	45.6 c
CP+KP+1,3-D	5.2 ab	136.0 bc
CP+KP+Nimitz 2 kg	1.3 cd	326.4 abc
CP+KP+ Nimitz 4 kg	0.4 d	98.4 abc
Nimitz 4 kg+Quad+Rid+Metr+Parall	2.2 bcd	216.0 ab
Nimitz 4 kg+Vyd+Quad+Rid+Metr+Parall	0.3 d	91.2 abc
Hand weeded control	2.5 bcd	719.2 abc
1,3-D	4.3 abc	92.0 abc

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.

Table 6. Estimated percent weed cover and control in 2011 tomato trial.

Treatment	Percent			Control
	Cover	Cover grasses	Cover broadleaves	
Untreated	71 ab	33 a	25 ab	0 f
Rid+Quad+Sand+Metr+Parall	41 cde	8 b	34 a	34 cde
MBrCP	33 de	3 b	0 c	55 abc
CP+KP+1,3-D	48 cd	8 b	4 bc	40 bcd
CP+KP+Nimitz 2 kg	23 ef	2 b	3 c	67 a
CP+KP+ Nimitz 4 kg	27 ef	3 b	6 bc	64 ab
Nimitz 4 kg+Quad+Rid+Metr+Parall	55 bc	12 b	38 a	40 bcd
Nimitz 4 kg+Vyd+Quad+Rid+Metr+Parall	54 bc	18 ab	39 a	22 def
Hand weeded control	12 f	2 b	4 bc	81 a
1,3-D	79 a	34 a	42 a	9 ef

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.

Table 7. Estimated percent weed cover in 2011 tomato trial.

Treatment	Yellow nutsedge	Mexican sprangletop	Purslane
Untreated	11 cd	33 a	22 ab
Rid+Quad+Sand+Metr+Parall	2 d	7 b	28 a
MBrCP	30 ab	3 b	0 c
CP+KP+1,3-D	35 a	8 b	4 c
CP+KP+Nimitz 2 kg	18 bc	2 b	3 c
CP+KP+ Nimitz 4 kg	18 bc	3 b	6 bc
Nimitz 4 kg+Quad+Rid+Metr+Parall	10 cd	12 b	32 a
Nimitz 4 kg+Vyd+Quad+Rid+Metr+Parall	8 cd	18 ab	27 a
Hand weeded control	5 cd	2 b	2 c
1,3-D	11 cd	33 a	27 a

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.