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Use of Nematicides Alone and in Combination with Metam Sodium for Suppression of Columbia Root Knot Nematodes in Fresh-Market Russet Potatoes

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Introduction

Columbia root knot nematode (*Meloidogyne chitwoodi*) CRKN is one of the most damaging pests for Tulelake potato growers. Infested potato fields run a high risk of significant infection and crop loss. Growers should always practice prevention and adequate crop rotation to minimize crop losses. Fumigation with 1,3-dichoropropene and/or metam sodium are recommended if growers must plant potatoes in infested fields, but fumigation with both products is very expensive and product availability in the case of 1,3-dochoropropene is restricted most years. Growers are looking for alternative nematode controls with lower cost and less environmental risk.

This study was established to evaluate the efficacy and crop safety of new nematicides for CRKN suppression in potatoes. The study was established in a field with a significant population of Columbia root knot nematode that caused crop loss in previous potato crops. Data included live nematode counts in the soil at planting and harvest, post-harvest nematode tuber infection, and tuber yield and quality at harvest. ***Some pesticides listed in this report may not be labeled for use in potatoes grown in CA. Please consult pesticide labels for use instructions.***

2017 Site Information

- **Soil type-** silt loam
- **Growing season-** early May to late September
- **Irrigation –** solid-set sprinklers
- **Potatoes-** 36 inch beds with 10 inch spacing; Russet Norkotah
- **Design-** Split block with 4 blocks (reps)

2017 Study Methods

Metam sodium was applied at 40 GPA using roto-till incorporation 2 1/2 weeks before planting. Nimitz applied pre-plant was roto-till incorporated at the same time as metam sodium. All nematicides applied at planting were applied in-furrow (5-6 inch band) after seed placement and before furrow closure. Potatoes were grown using conventional production practices. Additional nematicides were NOT applied to the trial area except for Vydate at 2.1 pt/A on August 2nd.

Nematode soil sampling consisted of collecting 6 soil cores (2-8 inch depth) in each plot. Samples were analyzed by the UC Davis Nematology Lab for live nematodes. Potato stand and vigor was measured in-season. Potatoes were harvested from the center two rows (4 row plots) and graded for yield, size, and quality. A fifty pound sub-sample was saved at harvest for post-harvest evaluations in December. Tubers were stored at 50 degrees until post-harvest evaluation to encourage nematode development. Twenty five tubers were hand-peeled and evaluated for nematode infection. Tubers with nematode infection were grouped according to their number of infection sites. The percent of tubers with CRKN infection, CRKN tuber infection severity, and the % of CRKN culled tubers was calculated for each plot using established protocol developed by Russ Ingham at Oregon State University. Data was analyzed using a Mixed Model and Tukey's HSD mean comparison.

Study Results

Metam fumigation used alone and in combination with nematicides did not influence potato stand, vigor, average tuber size, tubers per plant, total yield, and US #1 yield (Table 1). CRKN tuber infection ranged from 68 to 92% (Table 2). The severity of CRKN infection ranged from 0.91 to 2.42, but there were not significant treatment differences likely due to large plot to plot variability (Table 2). Potato pack-out revenue factoring in nematode damage was different between treatments (Table 2). Treatments with Vapam and Nimitz applied pre-plant and Nimitz applied in-furrow had the highest pack-out revenue ($4068/A). The untreated control and neem oil in-furrow had the lowest pack-out revenue. CRKN soil counts increased significantly from planting to harvest for all treatments (Table 3). There were no significant differences between treatments with regard to CRKN soil counts likely due to high plot to plot variability.

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Table 1. Potato Production Results for Nematicide Treatments Tested in 2017.

		7/6/2017	8/1/2017	Harvest Evaluation 10/12/17							
		potato stand	mid-season vine vigor	average tuber size	tubers per plant	total yield including culls	US # 1 yield	culls & 2's yield	% US #1 yield	% culls & 2's yield	pack-out potato revenue*
trt #	Treatment	%	0-10 scale	ounces	#	cwt/A	cwt/A	cwt/A	%	%	$/A
1	Untreated	100	7.75	6.4	7.85	548	456	29 ab	67.05	5.22	4302
2	Vapam pre-plant at 40 GPA	97	7.75	6.15	8.25	543	444	31 ab	66.1	5.62	4246
3	Vapam + Velum Prime 6.5 fl. oz in-furrow	99	8	6.7	8.13	603	487	52 a	67.46	6.66	4447
4	Vapam + Vydate C-LV 4.2 pt/A in-furrow	99	8	6.125	7.9	525	429	23 b	64.47	3.4	4182
5	Vapam + Nimitz 5 pt/A roto-incorporated pre-plant	97	8	6.266	8.3	556	462	27 ab	66	5.96	4446
6	Vapam + Nimitz 2.5 pt/A roto-incorporated pre-plant and 2.5 pints/A in-furrow	100	7.5	6.475	7.375	527	443	30 ab	69.87	5.45	4238
7	Velum Prime 6.5 fl. oz/A in-furrow	98	8	6.525	7.675	538	449	26 ab	66.95	5.1	4230
8	Vydate C-LV 4.2 pt/A in-furrow	98	8	6.225	8.35	556	462	25 b	68.07	4.22	4447
9	Nimitz 5 pt/A roto-incorporated pre-plant	99	7.75	6.575	7.675	548	457	30 ab	67.32	5.47	4181
10	Monterey Neem Oil at 1% v/v in-furrow	99	8	6.475	6.975	491	396	36 ab	65.27	7.02	3729
	P-value for treatment ANOVA	NS	NS	NS	NS	NS	NS	0.0426	NS	NS	NS

* Pack-out revenue in this table based on tuber grades without factoring in nematode damage and culls due to nematode damage.

Table 2. Post-Harvest Results for Columbia Root Knot Nematode Tuber Infection in 2017

		11/28-12/1 post harvest			
		CRKN tuber infection rate	Percent of tubers that would fail grade test due to CRKN infection	CRKN infection severity Index	Potato pack-out revenue factoring in culled potatoes due to nematode damage
trt #	Treatment	%	0-10 scale	0-6 scale (6 = worst)	$/acre
1	Untreated	83	35 ab	1.87	2796.17 bc
2	Vapam pre-plant at 40 GPA	81.38	28.89 ab	1.7475	3014.86 ab
3	Vapam + Velum Prime 6.5 fl. oz in-furrow	67.55	11.77 ab	1.0533	3913.15 ab
4	Vapam + Vydate C-LV 4.2 pt/A in-furrow	79	23 ab	1.5	3219.98 ab
5	Vapam + Nimitz 5 pt/A roto-incorporated pre-plant	68	14.66 ab	1.1733	3779.18 ab
6	Vapam + Nimitz 2.5 pt/A roto-incorporated pre-plant and 2.5 pints/A in-furrow	71	4 b	0.91	4068.91 a
7	Velum Prime 6.5 fl. oz/A in-furrow	87	30 ab	1.78	2961.01 ab
8	Vydate C-LV 4.2 pt/A in-furrow	85	17 ab	1.37	3690.91 ab
9	Nimitz 5 pt/A roto-incorporated pre-plant	86	16 ab	1.34	3512.15 ab
10	Monterey Neem Oil at 1% v/v in-furrow	92	53 a	2.42	1752.64 c
	P-value for treatment ANOVA	0.1857	0.0614	0.1046	0.0001

Tubers were stored at 50 degree F for two months to encourage nematode development.
25 tubers were hand-peeled and evaluated for nematode infection.
Tubers with nematode infection sites were indexed based on: 0 = 0, 1 = 1-3, 2 = 4-5, 3 = 6-9, 4 = 10-49, 5 =50-99, 6 = 100 or more infection sites.
% of tubers with CRKN infection, CRKN tuber infection index, & % CRKN culled tubers were calculated used established protocol.
Vydate was chemigation applied at 2.1 pt/A over the entire trial area on August 2nd.

Table 3. Soil CRKN Nematode Counts & % Change in Counts from Planting to Harvest in 2017

*** Negative % change represents a decrease in nematodes from planting to harvest ***

		Harvest Count	% Change in Counts (2-8 inch soil depth) (200 g soil)			
		Melodiogyne (CRKN)	Meloidogyne (CRKN)	Tylenchidae (cyst)	Pratylenchus (lesion)	All Nematodes
trt #	Treatment	# / 200g soil	%			
1	Untreated	2343 a	958 a	-63 a	-76 ab	-25 a
2	Vapam pre-plant at 40 GPA	1666 a	2135 a	-72 a	-6 a	-31 a
3	Vapam + Velum Prime 6.5 fl. oz in-furrow	2623 a	5565 a	-89 a	-76 ab	40 a
4	Vapam + Vydate C-LV 4.2 pt/A in-furrow	2010 a	812 a	-87 a	-87 ab	-45 a
5	Vapam + Nimitz 5 pt/A roto-incorporated pre-plant	1766 a	4864 a	-88 a	-66 ab	40 a
6	Vapam + Nimitz 2.5 pt/A roto-incorporated pre-plant and 2.5 pints/A in-furrow	1670 a	1851 a	-89 a	-92 b	-30 a
7	Velum Prime 6.5 fl. oz/A in-furrow	2116 a	786 a	-79 a	-87 b	-44 a
8	Vydate C-LV 4.2 pt/A in-furrow	2336 a	1083 a	-72 a	-70 ab	-30 a
9	Nimitz 5 pt/A roto-incorporated pre-plant	1711 a	1359 a	-44 a	-68 ab	3 a
10	Monterey Neem Oil at 1% v/v in-furrow	1692 a	4777 a	-79 a	-82 ab	-5 a
	P-value for treatment ANOVA	0.985	0.1398	0.4301	0.051	0.7786

Six soil cores per plot were collected from a 2-8 inch soil depth in the middle two harvest rows immediately before planting and at harvest.
Soil samples collected at planting do not reflect reduction in nematode population caused by pre-plant fumigation