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ORANGE: *Citrus sinensis* (L.) Osbeck, 'Valencia'

CONTROL OF ASIAN CITRUS PSYLLID AND CITRUS LEAFMINER THROUGH SPRAY APPLICATIONS OF INSECTICIDES ON ORANGE, 2007

Philip A. Stansly

University of Florida/ IFAS

Southwest Florida Res. and Ed. Center

2686 State Road 29 North

Immokalee, FL 34142-9515

Phone: (239) 658-3427

Fax: (239) 658-3469

Email: pstansly@ufl.edu

Jawwad A. Qureshi and Barry C. Kostyk

Asian citrus psyllid (ACP): *Diaphorina citri* Kuwayama

Citrus leafminer (CLM), *Phyllocnistis citrella* Stainton

Asian citrus psyllid (ACP) and citrus leafminer (CLM) have recently become two key pests of citrus in Florida, due primarily to their interactions with plant disease. ACP is an efficient vector of the bacterium, *Candidatus* Liberibacter asiaticus responsible for greening or "Huanglongbing" disease of citrus while feeding by CLM larvae exposes tender leaf tissue to infection by the

bacterium *Xanthomonas citri* responsible for the citrus canker disease. Therefore, both pests need to be controlled to reduce the spread of these diseases. The experimental block at the Southwest Florida Research and Education Center (SWFREC), Immokalee, Florida consisted of 12-yr-old sweet orange *Citrus sinensis* (L) Osbeck 'Valencia' trees planted on double-row raised beds at a density of 132 trees/acre. Trees were irrigated by micro-sprinklers and subjected to conventional cultural practices. Bed sides of the trees were pruned with a tractor-mounted box blade mower to induce new flush and encourage psyllid infestation. Eleven treatments and an untreated check were randomly distributed across 4 replicates in 23 rows that included a buffer row after every treated row. Each replicate contained 3 treated rows of 20 trees each divided into four, 5-tree plots.

Treatments were applied on 4 Jun 2007 to the bed side of the trees using a tractor mounted hydraulic sprayer operating at a pressure of 150 psi with an array of twelve ATR-80 ceramic hollow cone nozzles directed at the tree on 3, 5 foot booms to deliver 54 gpa at a tractor speed of 1.5 mph. A pre-treatment sampling was conducted on 31-May and post-treatment evaluations were made 3, 7, 14, 24, and 49 DAT. One and three trees were observed per plot for pre and post-treatment samplings, respectively. Adult psyllid density was estimated by counting individuals falling on an 8 ½ × 11 inch white paper sheet (on a clipboard) placed at random under branches which were then tapped three times. Ten randomly selected shoots were observed and the number infested with psyllid eggs or nymphs recorded. Abundance of ACP immatures on each shoot was rated on a 0 to 3 scale: 0 = none, 1 = eggs and first instars, 2 = second and third instars, 3 = fourth and fifth instars. One infested flush of these was collected and examined in the laboratory under a microscope to count eggs and different instars of *D. citri*. A well developed shoot with pale green leaves was randomly selected and all live CLM larvae

were counted on five expanded leaves. Additionally, leaves with and without fresh mines were counted per shoot to asses the level of protection afforded by the treatments. The number of larvae and adults of four predatory coccinellids, *Curinus coeruleus* Mulsant, *Olla v-nigrum* Mulsant, *Harmonia axyridis* Pallas and *Cycloneda sanguinea* (L.) were recorded during one minute observation on each tree. All data were subjected to ANOVA to evaluate treatment effects on ACP, CLM, and ladybeetles and means were separated using LSD contingent on a significant treatment effect ($P < 0.05$). Numbers of ladybeetles were combined and transformed by log(x+1) for analysis. Only the reported variables were evaluated on any specific date.

Significantly more leaves undamaged by CLM per shoot compared to the control were seen at 24 DAT with all treatments except Sevin. Most undamaged leaves were seen with Provado alone at 10 oz or at 5 oz + Induce, although not different from any other treatment including Provado or Movento + 435 Oil. Fewer CLM larvae than the untreated check were seen at that time, with the high rate of Movento + MSO oil, the low rate Movento + Induce, and the low rate of both Movento and Provado + and Induce. No significant effects on CLM were seen at 49 DAT.

A mean of 17% psyllid-infested shoots and 0.65 adult ACP per tap were seen at 3 DAT with no significant treatment effects. However, fewer nymphs were seen on infested flush from treated trees compared to the control except for the high rate of Provado alone. At 7 DAT, least shoot infestation was seen with the high rate of Provado + Induce, although not different from the low rate of Provado + Induce or the high rate of Provado alone, both of which were not different from Movento + 435 oil or either rate of Provado + Induce. Movento in any treatment combination with significant effect was not different from Sevin. A mean of 5.4 nymphs per infested shoot were observed, with no significant treatment effect. However, all except the high

rate of Movento with Kinetic significantly reduced adult numbers compared to untreated the untreated check. Fewest adults were seen with either rate of Provado + Induce, although not different from either rate of Movento + Induce, Movento + Provado + Induce, or 10 oz Movento + 435 Oil. At 14 DAT, shoot infestation was 93% with no significant differences. However, more nymphs were seen on infested shoots from untreated trees than treated trees except for Sevin XLR, Movento + MSO, or Movento + Kinetic which was not different from any treatment. Fewest adults were seen with the high rate of Provado alone, but not significantly fewer than all other treatments different from the control. At 24 DAT, the shoot infestation rating was higher on untreated trees compared to all other treatments except those with Provado. Shoot infestation was rated lowest on trees treated with Movento + 435 Oil, though not significantly different from Movento at either rate + Induce. No other significant treatment effects on ACP were observed. Percentage infested shoots was the only significant treatment effect at 49 DAT and was lowest on trees treated with either Provado alone or the high rate of Movento + 435 Oil, although not significantly different from Provado at 10 oz + Induce or any treatment including Movento and Induce. Summarizing some of these results it would appear that Induce and 435 Oil were more effective adjuvants for Movento than MSO or Kinetic. It is unlikely that predation from ladybeetles affected any of these results as no treatment effects on these predators were seen noted before 49 DAT. At that time, more adults + larvae were seen on untreated trees than all other treatments except Movento + MSO. No ladybeetles were seen in the treatments with the high rate of Provado + Induce and the high rate of Movento + Kinetic.

Treatment/ formulation	**Rate amt product/ acre or % v/v**	**Undamaged Leaves (%)**	**CLM larvae/5 leaves/flush**	**Ladybeetles (adults + larvae)/ 1 min observation/tree**
		24 DAT	24 DAT	49 DAT
Untreated check	--	3.0 e	1.8 ab	0.6 a
Provado 1.6 F	10 fl oz	61.1 a	0.9 bc	0.1 bc
Provado 1.6 F + Induce	5 fl oz + 0.25%	61.5 a	1.0 bc	0.1 bc
Provado 1.6 F + Induce	10 fl oz + 0.25%	54.6 ab	1.2 abc	0.0 c
Movento + 435 Oil	10 fl oz + 2.5%	47. 1 abc	1.0 bc	0.2 bc
Movento + MSO Seed Oil	10 fl oz + 0.25%	39.6 bcd	0.3 c	0.3 ab
Movento + Induce	5 fl oz + 0.25%	37.5 bcd	0.3 c	0.1 bc
Movento + Induce	10 fl oz + 0.25%	35.5 cd	0.8 bc	0.1 bc
Movento + Kinetic	10 fl oz + 0.10%	21. 8 d	1.1 abc	0.0 c
Movento + Provado 1.6 F + Induce	5 fl oz + 5 fl oz + 0.25%	54. 1 abc	0.3 c	0.2 bc
Movento + Provado 1.6 F + Induce	10 fl oz + 5 fl oz + 0.25%	55.3 ab	2.1 a	0.1 bc
Sevin XLR	48 fl oz	21. 6 de	1.2 abc	0.2 bc

Means within columns not followed by the same letter are significantly different (LSD, $P < 0.05$).

Treatment/ formulation	**Rate amt product/ acre or % v/v**	**Percent shoots infested with ACP eggs and nymphs**		**Nymphs/infested shoot**			**Infestation rating***	**ACP Adults/tap sample**
		7 DAT	49 DAT	3 DAT	14 DAT	24 DAT	7 DAT	14 DAT
Untreated check	--	92.5 a	81.7 bc	16.9 a	28.5 a	2.3 bcd	3.9 a	1.4 a
Provado 1.6 F	10 fl oz	33.3 de	80.8 c	8.0 a	7.6 d	2.4 abcd	0.9 cd	0.5 bc
Provado 1.6 F + Induce	5 fl oz + 0.25%	29.2 de	97.3 a	6.6 b	11.9 cd	2.6 abc	0.5 d	0.9 abc
Provado 1.6 F + Induce	10 fl oz + 0.25%	21.7 e	91.7 abc	2.9 b	12.1 cd	2.7 ab	0.3 d	0.2 c
Movento + 435 Oil	10 fl oz + 2.5%	44.2 cd	79.8 c	2.5 b	10.2 cd	1.8 e	0.9 cd	0.9 abc
Movento + MSO Seed Oil	10 fl oz + 0.25%	95.8 a	87.8 abc	5.3 b	25.9 ab	2.2 cd	1.9 bc	0.8 abc
Movento + Induce	5 fl oz + 0.25%	87.0 a	89.8 abc	1.6 b	22.8 abc	2.1 de	1.4 cd	0.9 abc
Movento + Induce	10 fl oz + 0.25%	76.2 ab	82.9 bc	6.8 b	12.5 cd	2.1 de	1.3 cd	1.1 ab
Movento + Kinetic	10 fl oz + 0.10%	87.5 a	99.2 a	1.6 b	19.0 abcd	2.3 cd	2.8 ab	0.8 abc
Movento+Provado1.6F+ Induce	5 fl oz + 5 fl oz + 0.25%	44.3 cd	90.8 abc	7.9 b	14.5 bcd	2.8 a	1.5 bcd	0.4 bc
Movento+Provado1.6F+ Induce	10 fl oz + 5 fl oz + 0.25%	47.3 cd	82.8 bc	5.8 b	14.3 bcd	2.7 ab	0.8 cd	0.2 c
Sevin XLR	48 fl oz	64.6 bc	94.8 ab	1.3 b	29.1 a	2.4 abcd	0.8 cd	0.3 c

*****ACP per shoot: 0 = none, 1 = eggs and first instars, 2 = second and third instars, 3 = fourth and fifth instars
Means within columns not followed by the same letter are significantly different (LSD, $P < 0.05$).

II. MATERIALS TESTED FOR ARTHROPOD MANAGEMENT

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Brand Name	Formulation	Common Name	Composition*	Manufacturer**
Provado	SC	imidacloprid	1-[(6-Chloro-3-pyridinyl)methyl]-N-nitro-2-imidazolidinimine	Bayer Crop Science
Movento	SC	spirotetramat	Experimental	Bayer Crop Science P.O. Box 18300 Greensboro, NC 27419

Sevin	SC	carbaryl	1-naphthyl N-methylcarbamate	Bayer Crop Science
Induce	90%L	non-ionic adjuvant	Proprietary bland of Alkyl Aryl Polyoxylkane Ethers, Free Fatty Acids, and Dimothyl Polysiloxane	Helena Chemical Company 225 Schilling Blvd. Collierville, TN 38017
Kinetic	99%L	non-ionic adjuvant	Proprietary blend of polyalkleneoxide modified polydimethylsiloxane and polyoxyproplylene-polyoxyethylene copolymers	Helena Chemical Company 225 Schilling Blvd. Collierville, TN 38017
MSO	EC			Helena Chemical Company 225 Schilling Blvd. Collierville, TN 38017
435 oil 98.8	98.8%L	horticultural spray oil	Refined petroleum distillate	Drexel Chemical Company P.O. Box 13327 Memphis, TN 38113-0327