(D12)

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

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

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Asian citrus psyllid (ACP): *Diaphorina citri* Kuwayama
Citrus leafminer (CLM): *Phyllocnistis citrella* Stainton
Lady beetles: *Curinus coeruleus* (Mulsant)*, Olla v-nigrum* (Mulsant)*, Harmonia axyridis* (Pallas)
and *Cycloneda sanguinea* (L.)

Feeding of nymphs and adults of ACP causes distortion of young citrus leaves and can result in acquisition and transmission of the bacterium *Candidatus* Liberibacter asiaticus responsible for the citrus greening or huanglongbing disease. Feeding by the CLM larvae damages the leaf and exposes it to infection by the bacterium *Xanthomonas citri* responsible for the citrus canker disease. Therefore, both pests need to be controlled to reduce 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. Fourteen treatments and an untreated check were randomly distributed across 4 replicates in 30 rows that included a buffer row between each treated row. Treated rows consisted of 20 trees divided into four plots of 5 trees each. Treatments were applied on 22 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 fifteen ATR-80 ceramic hollow cone nozzles directed at the tree on 3, 5 foot booms to deliver 66 gpa at a tractor speed of 1.5 mph. A pre-treatment sampling was conducted on 20 Jun and treatment evaluations were made 3, 10, 17, and 24 DAT on 15 Jun and 2, 9, and 16 Jul, respectively. One and three trees were observed per plot for pre and post treatment samplings, respectively. Adult ACP density was estimated on each of 3 trees by counting the number of insects falling on a clipboard covered with an 8 ½ × 11 inch white paper sheet placed under randomly chosen branches which were then tapped 3 times with the hand. Ten randomly selected shoots were examined and the number infested with ACP eggs or nymphs recorded. The infestation on each shoot was rated for the presence of ACP stages 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 was collected and examined in the laboratory under a microscope to count eggs and live and dead instars of ACP. The number of larvae and adults of four predatory coccinellid species were recorded during a one min observation on each tree. A well developed shoot with pale green leaves was randomly selected from each sample tree and all live CLM larvae were counted on five expanded leaves. All data were subjected to ANOVA to evaluate treatment effects on ACP, CLM, and lady beetle numbers and means were separated using LSD ($P = 0.05$). Numbers of ladybeetles were combined over all dates and transformed by $\log(x + 1)$ prior to analysis. Only the reported variables were evaluated on any specific date.

Greatest reduction in percentage shoots infested with ACP nymphs and eggs compared to the untreated check over the 3 to 24 DAT interval were provided by Provado + 435 oil, MANA 8412-094B, GF-1640 + 435 oil, and the high rate of Actara (Table 1). These treatments and the high rate of Agri-Mek with 435 oil reduced nymphal ACP densities during 3 to 10 DAT. The high rate of Actara and MANA 8412-094B reduced the infestation rating through 24 DAT, whereas Provado, Agri-Mek + 435 oil, GF-1640 + 435 oil, and Portal did so from 10 to 17 DAT. All treatments except 435 oil, QRD 400 + 435 oil and the low rate of Agri-Mek + 435 oil significantly reduced adult ACP numbers compared to the untreated check at 3 DAT, although most reduction was seen with the high rate of Actara (no adults), followed by Provado + 435 oil, GF-1640 + 435 oil, MANA 8412-094B, Portal with or without 435 oil, and the high rate of Agri-Mek + 435 oil. There were no treatment effects at 10 and 17 DAT although significant reduction in adult ACP numbers was seen at 24 DAT in treatments with Provado, Agri-Mek, MSR, GF-1640, QRD 400, low rate of Actara, and Portal.

All treatments reduced the number of lady beetles observed compared to untreated check (Table 2). The activity of lady beetles on untreated trees may explain the relatively low number of psyllids seen there and thus the lack of significant differences among many of the treatments later in the trial.MANA AG 8412-094B was the most effective treatment in reducing CLM larvae compared to the untreated check during 3 to 24 DAT (Table 3). Micromite, the low rate of MSR, GF-1640, and the high rate of Agri-Mek were the other effective treatments during the same time but not as consistent as MANA AG 8412-094B.

Table 1.

Treatment/formulation	Rate amt form/acre	Percentage shoots infested with ACP eggs and nymphs				ACP nymphs/infested shoot				Infestation rating (0-3)*/flush			ACP Adults/tap sample			
		3 DAT	10 DAT	17 DAT	24 DAT	3 DAT	10 DAT	17 DAT	24 DAT	10 DAT	17 DAT	24 DAT	3 DAT	10 DAT	17 DAT	24 DAT
Untreated check	---	81.7abcd	83.3ab	46.7abcd	86.1a	57.5ab	15.0bcd	29.9a	21.8a	1.81ab	0.63abcd	1.32abc	1.7a	2.8a	3.3a	3.1a
435 Oil	2 gal	93.3ab	92.5a	50.0abc	85.8a	64.3a	23.0abc	15.8a	18.7a	2.03a	0.88a	1.39ab	1.8a	2.2a	3.1a	2.6abc
Provado 1.6 F + 435 Oil	12 fl oz + 2 gal	31.7g	59.2cd	41.7bcde	61.7bcd	7.2fg	16.7bcd	26.8a	25.4a	0.83ef	0.68abc	0.87cdef	0.2de	1.2a	1.8a	0.9de
Agri-Mek 0.15 EC + 435 Oil	10 fl oz + 2 gal	71.7bcde	72.5bcd	34.6cde	61.3bcd	34.5bcd	22.2abcd	6.5a	8.4a	1.26cde	0.49cde	0.83def	1.3ab	1.8a	2.6a	1.6cde
Agri-Mek 0.15 EC + 435 Oil	20 fl oz + 2 gal	61.7de	63.8cd	57.6ab	66.3abcd	12.8defg	19.3abcd	31.7a	16.6a	1.01def	0.88a	1.08abcd	0.5cde	1.0a	2.2a	0.9de
MSR 2E	24 fl oz	65.8cde	74.2bc	34.8cde	54.6cd	27.3def	13.9bcd	5.8a	9.2a	1.28cde	0.51cde	0.73def	0.8bcd	2.3a	2.2a	1.3de
MSR 2E	48 fl oz	54.2ef	69.2bcd	31.4de	72.7abc	23.6defg	9.2bcd	11.1a	17.3a	1.08de	0.41cde	0.92cde	0.8bcd	0.7a	1.1a	1.8bcde
GF-1640 + 435 Oil	4 oz + 2 gal	50.8efg	54.9de	43.3bcde	50.1cd	7.8fg	19.3abcd	8.9a	15.9a	0.83ef	0.64abcd	0.58ef	0.2de	0.9a	2.2a	0.8e
QRD 400 + 435 Oil	128 fl oz + 2 gal	86.9abc	82.5ab	60.8a	65.9abcd	37.1bcd	21.6abcd	29.5a	14.4a	1.39bcd	0.83ab	0.89cdef	1.3ab	1.3a	1.5a	1.3cde
Actara 25WG	4 oz	62.5de	68.3bcd	41.7bcde	68.0abc	22.6defg	34.7a	16.8a	11.2a	0.98def	0.58bcde	0.93bcde	0.4cde	0.8a	1.9a	0.8e
Actara 25WG	5.5 oz	59.2e	25.0fg	28.3e	43.4d	0.7g	6.5cd	7.7a	10.1a	0.30g	0.33e	0.48ef	0.0e	1.2a	1.0a	2.2abcd
Micromite 80WGS	6.25 oz	93.6ab	84.2ab	38.5cde	81.7ab	53.3abc	25.4ab	4.8a	42.8a	1.66abc	0.54cde	1.48a	0.9bc	2.3a	1.3a	2.9ab
Portal 5 EC	64 fl oz	57.5ef	73.3bc	41.1cde	80.0ab	29.8cdef	13.8bcd	16.3a	31.8a	1.18cde	0.57bcde	0.93bcde	0.3cde	1.0a	2.5a	1.1de
Portal 5 EC + 435 Oil	64 fl oz + 2 gal	68.3cde	39.2ef	31.7de	80.4ab	32.8bcde	6.2d	15.8a	18.7a	0.54fg	0.44cde	1.14abcd	0.3cde	1.3a	2.0a	1.0de
MANA AG 8412-094B 4 SC	4.8 fl oz	36.1fg	20.0g	29.9e	44.2d	8.5efg	5.9d	5.4a	18.8a	0.27g	0.38de	0.44f	0.2de	1.8a	2.1a	3.2a

*0 = none, 1 = eggs and first instars, 2 = second and third instars, 3 = fourth and fifth instars

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

Table 2.

Treatment/ formulation	Rate amt form/acre	Lady beetles (adults + larvae)/ 1 min observation/tree Avg of all species and sampling dates
Untreated check	---	1.3a
435 Oil	2 gal	0.8b
Provado 1.6 F + 435 Oil	12 fl oz + 2 gal	0.3c
Agri-Mek 0.15 EC + 435 Oil	10 fl oz + 2 gal	0.4bc
Agri-Mek 0.15 EC + 435 Oil	20 fl oz + 2 gal	0.3c
MSR 2E	24 fl oz	0.5bc
MSR 2E	48 fl oz	0.2c
GF-1640 + 435 Oil	4 oz + 2 gal	0.3c
QRD 400 + 435 Oil	128 fl oz + 2 gal	0.6bc
Actara 25WP	4 oz	0.2c
Actara 25WP	5.5 oz	0.3c
Micromite 80 WGS	6.25 oz	0.5bc
Portal 5 EC	64 fl oz	0.2c
Portal 5 EC + 435 Oil	64 fl oz + 2 gal	0.2c
MANA AG 8412-094B 4 SC	4.8 fl oz	0.3c

Lady beetles numbers were low, therefore, totals over four sampling dates are combined. Means within columns followed by the same letter are not significantly different (LSD, $P = 0.05$).

Table 3.

Treatment/ formulation	Rate amt form/acre	CLM larvae/5 leaves/flush			
		3 DAT	10 DAT	17 DAT	24 DAT
Untreated check	---	4.3a	1.3ab	2.8abc	3.7a
435 Oil	2 gal	3.3ab	1.2abc	2.5abc	3.0abc
Provado 1.6 F + 435 Oil	12 fl oz + 2 gal	0.0e	1.1abc	3.2ab	3.4abc
Agri-Mek 0.15 EC + 435 Oil	10 fl oz + 2 gal	0.0e	0.9bcd	2.6abc	3.0abc
Agri-Mek 0.15 EC + 435 Oil	20 fl oz + 2 gal	0.6de	0.3cde	1.5c	2.2bcd
MSR 2E	24 fl oz	2.7bc	1.3ab	2.8abc	1.5de
MSR 2E	48 fl oz	3.6ab	1.8a	2.2bc	3.2abc
GF-1640 + 435 Oil	4 oz + 2 gal	0.0e	0.2de	1.4c	2.0cde
QRD 400 + 435 Oil	128 fl oz + 2 gal	1.1de	0.8bcde	2.7abc	3.5ab
Actara 25WG	4 oz	1.9cd	0.8bcde	1.8bc	2.9abcd
Actara 25WG	5.5 oz	0.4e	0.9bcd	2.8abc	2.5abcd
Micromite 80WGS	6.25 oz	1.0de	0.2de	1.3c	2.4abcd
Portal 5 EC	64 fl oz	0.1e	0.8bcde	3.8a	2.8abcd
Portal 5 EC + 435 Oil	64 fl oz + 2 gal	0.4e	0.8bcde	1.5c	3.6ab
MANA AG 8412-094B 4 SC	4.8 fl oz	0.0e	0.0e	1.5c	0.6e

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