2015/16 REPORT TO THE
CALIFORNIA FRESH CARROT ADVISORY BOARD

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Project Title: Management of Palestriped Flea Beetle on Carrots

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Introduction: The larvae of palestriped flea beetle, *Systena blanda* Melsheimer can be a serious pest attacking the below ground parts of the plant and causing injury similar to that of the disease cavity spot caused by *Pythium sulcatum* and *P. violae*. Feeding damage from flea beetle larvae is easily confused with cavity spot symptoms. Adults of another flea beetle, the desert corn flea beetle *Chaetocnema ectyp*a Horn, were also found in suction and sweep samples. Moderate to severe flea beetle damage by larvae to the editable portion of the carrot crop can render the crop unmarketable. Adult flea beetles feed on the undersides of leaves, leaving small pits or irregularly shaped holes on the leaf; this damage is usually relatively minor compared to the larval feeding damage. However, large populations of adult flea beetles can kill or stunt seedlings. Older plants rarely suffer economic damage from flea beetle adult feeding, even though older leaves may be damaged. In the Imperial Valley, larvae feeding on roots have caused serious damage on occasion.

Objectives:

1. Evaluate efficacy of experimental insecticide control of palestriped flea beetle, *Systena blanda* Melsheimer and of desert corn flea beetle *Chaetocnema ectyp*a Horn to develop a database supporting registration for use in California fresh market carrots.
2. Approach insecticide manufactures to gain support for registration of insecticides on fresh market carrots in California when efficacious insecticides are identified.
3. Develop a treatment protocol for control of flea beetles on fresh market carrots.

Materials and Methods: In July 2015, the northern four acres of an eight alfalfa field grown at the UC Desert Research and Extension Center (DREC) was cut and baled. Following bale removal, a disc was used to kill the alfalfa plants and incorporate the crop residue into the soil. The four acre area was then flood irrigated to breakdown the plant residue. In September, carrot beds on 40 inch centers were listed up and shaped to prepared for a fresh carrot crop planted on 28 Septemeber 2015 with two seedlines of the carrot variety 'Forto'. The southern four acres of the alfalfa was allowed to grow until after the carrot crop emerged, hoping that adult palestriped flea beetles would migrate to the carrots. After the carrot stand was well established, the remaining four acres of alfalfa was later cut, baled and a disc was used to kill the alfalfa plants and to incorporate the crop residue; again hoping that adult palestriped flea beetles would migrate to the carrots. Two insecticide efficacy evaluation experiments for flea beetle control on carrots were conducted at DREC. Data sets for both experiments were analyzed using ANOVA ($P<0.05$) and F-protected LSD.

The first experiment used a randomized complete block design with four replications of a non-treated check compared to nine insecticide treatments evaluating their efficacy against flea beetle adults and larvae and other pest insect species present in the plots. The plots measured 6.67 ft (2-beds/plot on 40 inch centers) wide with one non-planted bed between plots and 50 ft long with 10 foot buffers between replicates. The insecticide treatments included FarMore DI400 applied directly to the carrot seed (treated by Syngenta) and eight insecticides applied directly to the bed top prior to planting and then incorporated into the soil on top of the planting bed. A list of the insecticide treatments and their application rates can be seen in Table 1. All insecticide treatments (except the FarMore DI400 seed treatment) were applied using a Lee Spider Spray TracTractor 2-row sprayer with 1-nozzle (TJ3003LP) per row delivering 36.25 gpa at 60 psi. The FarMore DI400 treated carrot seed was planted first into two seed-lines, of two beds, of the four replicates. The remaining insecticide treated plots and the untreated check plots were then planted with the non-treated carrot seed into two seed-lines, of two beds, of their four replicates, respectively. Sprinkler irrigation was used to germinate the seed, but after stand establishment, furrow irrigation was used for crop maintenance.

The second experiment also used a randomized complete block design with four replications of eight foliar insecticide sprays compared to an untreated check for evaluation of efficacy against flea beetle adults and any other insect pests present in the plots. The plots measured 13.33 ft (4-beds/plot on 40 inch centers) wide with one non-planted bed between plots and 80 ft long with 10 foot buffers between replicates. The non-insecticide treated carrot seed was sown on 28 September 2015, into two seed-lines of four beds per plot. Sprinkler irrigation was used to germinate the seed, but after stand establishment, furrow irrigation was used for crop maintenance. After the carrot crop was established, foliar spray treatments were applied on 19 October and 4 November 2015. The foliar insecticide sprays were applied using a Lee Spider Spray TracTractor 4-row sprayer with 3 (TJ-60 11003VS) nozzles per bed, delivering 64.2 gpa at 50 psi. A list of the insecticide treatments, their application rates and application dates can be seen in Table 2.

Evaluations of efficacy against flea beetle adults and other pest insects consisted of suction samples from 13.1 row-ft (0.001 acre) when plants were too small to sweep and by ten 180° sweeps with a standard 15 inch diameter insect sweep net when plants were larger. Sampling

dates for the suction samples and sweep samples are listed in the tables for each of the respective experiments. Evaluations of damage from flea beetle larval feeding on 25 carrot roots per plot were taken on the dates indicated in the tables for each experiment, respectively. Carrots were harvested from 13.1 row-ft per plot on the dates indicated in the tables for each experiment, respectively. Carrot roots were evaluated for feeding damage cavities or scaring at harvest in each experiment and separated into two groups labeled market carrots for non-blemished roots and cull carrots for roots with feeding cavities or scars; numbers of roots for each group were tallied and weighted (kg) for each treatment replicate in each experiment, respectively.

Results for Experiment I: None of the Experiment I insecticides treatments prevented had fewer flea beetle adults than the untreated check, none had fewer flea beetle cavities or scars than the untreated check (Table 3) and none of the insecticide treatments prevented flea beetle damage to the carrots (Table 6). On 12 November 2015, the Stallion soil treatment had fewer ($P<0.05$) whitefly adults compared to the untreated check, but there were no differences among the other insecticide treatments and the untreated check on 12 November or between any of the treatments on all other sampling dates and for the season averages for whitefly adults (Table 4). The FarMore DI400 seed treatment had fewer bean thrips than the untreated check on all sampling dates prior to December 1 and for the season average (Table 5), but none of the other insecticide treatment had fewer bean thrips compared to the check on any of the sampling dates and for the season averages. The FarMore DI400 seed treatment had fewer bean thrips than all other insecticide treatments except Force 3G and Stallion on 16 October. The FarMore DI400 seed treatment had fewer bean thrips than all other insecticide treatments on 12 November, fewer bean thrips that all other insecticide treatments except Brigadier on 18 November and all other insecticide treatments for the season average. There were no differences among the treatments for market carrots per 0.001 acre, for cull carrots per 0.001 acre, for total carrots per 0.001 acre, for percentages of market carrots, for kg market carrots per 0.001 acre, for kg of cull carrots per 0.001 acre, or for percentages of market carrots by weight (Table 6). The FarMore DI400 seed treatment, the Belay WDG soil treatment, the Force 3G soil treatment and the Stallion soil treatment all had had more kg for all carrots than the untreated check and the FarMore DI400 seed treatment had more kg for all carrots than the all other insecticide treatments except for the Belay WDG, Force 3G and Stallion soil treatments.

Results for Experiment II: None of the Experiment II insecticides treatments prevented had fewer flea beetle adults than the untreated check, none had fewer flea beetle cavities or scars than the untreated check (Table 7) and none of the insecticide treatments prevented flea beetle damage to the carrots (Table 10). None of the foliar insecticide treatments had fewer ($P<0.05$) whitefly adults compared to the untreated check on any of the sampling dates (Table 8). None of the foliar insecticide treatment had fewer bean thrips compared to the untreated check on 16 and 30 October, on 24 November nor on 16 December (Table 9). All insecticide treatment had fewer bean thrips than the untreated check on 12 November, on 18 November and on 1 December. Only the Asana XL, Voliam Flexi and Baythroid foliar insecticide treatments had fewer bean thrips than the untreated check on 8 December. The Venom foliar insecticide treatment had more

bean thrips than all other foliar insecticide treatments on 12 November. The Assana XL foliar insecticide treatment had fewer bean thrips than the foliar Venom treatment on 18 November. On 1 December, the foliar insecticide treatment with Radiant, Baythroid, and Sevin 80S all had fewer bean thrips than the foliar with Leverage 2.7SC. On 8 December, Asana XL had fewer bean thrips than the foliar treatments with Leverage 2.7SC, Radiant, and Venom. In Experiment II, there were no differences among the treatments for numbers of market carrots, for kg market carrots, for numbers of cull carrots, for kg of cull carrots, or for the total numbers of carrots per 0.001 acre, respectively (Table 10). There were differences ($P \leq 0.05$) among the treatment means for kg of all carrots per 0.001 acre with the greatest yield (16.11 kg) from the Radiant foliar treatment that was greater than the untreated check (12.93), Venom (13.08), Baythroid (11.54), and Leverage 2.7SC (10.65) and Leverage had less kg of carrots than all other treatments except the untreated control, Baythroid, and Venom. There were no differences for percentages of market carrots or percentages of market carrots by weight among the treatments.

Discussion: None of the soil applied or foliar insecticide treatments prevented flea beetle damage to the carrots. The FarMore DI400 seed treatment provided good control of bean thrips resulting in the highest yield in kg of carrots (20.56 kg/0.001 acre) compared to the untreated check with (16.41 kg/acre) in Experiment I. The use of seed treatments may warrant further investigation for insect control in carrots. In Experiment II, all of the foliar insecticide treatments provided some control of bean thrips. In both experiments, there were too few flea beetle adults to detect differences among the soil, seed or foliar insecticide treatments and the untreated checks. None of the insecticide treatments provided good knockdown of whitefly adults in either of the experiments. Although the palestriped flea beetle, *Systena blanda* Melsheimer was the most abundant, the desert corn flea beetle *Chaetocnema ectyp*a Horn and the larvae of both species are root feeders.

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Table 1. Soil insecticide treatments and rates for insect control on carrot at Holtville, CA, 2015.

Treatment	A.I.	Rate/acre	Method	Appl. dates
1. FarMore DI400	thiamethoxam	0.5 mg ai/seed	seed	---------
2. Capture LFR	bifenthrin	6.8 fl oz	14” band pre-plant incorporated 3”	28 Sep
3. Diazinon AG500	diazinon	4 qt	14” band pre-plant incorporated 3”	28 Sep
4. Belay WDG	clothianidin	6.4 oz	14” band pre-plant incorporated 3”	28 Sep
5. Force 3G	Tefluthrin	5.5 lb	14” band pre-plant incorporated 3”	28 Sep
6. Durivo	chlorantraniliprole & thiamethoxam	13 fl oz	14” band pre-plant incorporated 3”	28 Sep
7. Venom	dinotefuron	6 oz	14” band pre-plant incorporated 3”	28 Sep
8. Stallion	Zeta-cypermethrin & chlorpyrifos	11.75 fl oz	14” band pre-plant incorporated 3”	28 Sep
9. Brigadier	Bifenthrin & imidacloprid	25.6 fl oz	14” band pre-plant incorporated 3”	28 Sep
10. Untreated check	----------	-------	----------	----------

Table 2. Foliar insecticides and rates for insect control on carrot at Holtville, CA, 2015.

Treatment	A.I.	Rate/acre	Appl. dates
1. Gladiator	zeta-cypermethrin & avermectin B1	14fl oz	19 Oct, 4 Nov
2. Asana XL	esfenvalerate	9 fl oz	19 Oct, 4 Nov
3. Leverage 2.7SC	imidacloprid & beta-cyfluthrin	3.2 fl oz	19 Oct, 4 Nov
4. Radiant	spinetoram	7 fl oz	19 Oct, 4 Nov
5. Venom	dinotefuron	2 oz	19 Oct, 4 Nov
6. Voliam Flexi	Chlorantraniliprole & thiamethoxam	4.66 oz	19 Oct, 4 Nov
7. Baythroid	beta-cyfluthrin	2.8 fl oz	19 Oct, 4 Nov
8. Sevin XLR Plus	carbaryl	0.5 qt	19 Oct, 4 Nov
9. Untreated check	----------	-------	----------

Dyne-Amic surfactant added at 0.25% vol:vol to each spray mixture.

Table 3. Numbers of flea beetle adults on carrot tops and larval feeding cavities on carrots following soil or seed insecticide treatments, Holtville, CA, 2015/16.

Treatment formulation	Rate /ac	30 Oct FB adults /0.001 ac	12 Nov FB adults /0.001 ac	18 Nov FB adults/ 10 sweeps	24 Nov FB adults/ 10 sweeps	1Dec FB adults/ 10 sweeps	8 Dec FB adults/ 10 sweeps	16 Dec FB adults/ 10 sweeps	Avg. FB adults/ 10 sweeps	3 Feb Cavities/ 25 carrots	11 Feb Cavities/ 25 carrots
FarMore DI400	0.5 mg ai/seed	0.00	0.25	1.25	2.25	0.50	0.50	0.00	0.79	4.50	5.75
Capture LFR	6.8 fl oz	0.00	0.25	1.75	3.25	1.50	1.00	0.50	1.38	7.25	9.00
Diazinon AG500	4 qt	0.00	0.25	3.50	3.50	1.00	0.50	0.25	1.50	7.25	13.25
Belay WDG	6.4 oz	0.00	0.00	1.50	1.75	1.00	0.50	0.00	0.79	7.50	9.75
Force 3G	5.5 lb	0.00	0.00	2.50	1.50	0.25	0.00	0.00	0.71	8.50	11.75
Durivo	13 fl oz	0.00	0.25	2.50	2.00	1.75	0.75	0.25	1.25	6.75	10.00
Venom	6 oz	0.00	0.00	1.25	2.00	0.50	0.50	0.25	0.75	9.75	7.00
Stallion	11.75 fl oz	0.00	0.25	3.00	2.75	1.75	0.75	1.00	1.58	8.50	9.00
Brigadier	25.6 fl oz	0.00	0.00	1.25	2.50	1.00	0.50	0.25	0.92	11.50	13.25
Untreated check	-------	0.00	0.50	1.50	1.75	1.00	0.50	1.00	1.04	10.75	12.75

There were no differences among the means within columns; ANOVA (P=0.05).

Table 4. Numbers of whitefly adults on carrot tops following soil or seed insecticide treatments, Holtville, CA , 2015.

Treatment formulation	Rate /ac	30 Oct SPW adults/ 0.001 acre	12 Nov SPW adults/ 0.001 acre	18 Nov SPW adults/ 10 sweeps	24 Nov SPW adults/ 10 sweeps	1Dec SPW adults/ 10 sweeps	8 Dec SPW adults/ 10 sweeps	16 Dec SPW adults/ 10 sweeps	Avg. SPW adults/ 10 sweeps
FarMore DI400	0.5 mg ai/seed	9.50 a	14.25 bc	11.75 a	3.50 a	8.00 a	5.25 a	4.25a	8.07 a
Capture LFR	6.8 fl oz	10.00 a	25.00 a	15.50 a	3.75 a	3.75 a	5.25 a	3.25 a	9.50 a
Diazinon AG500	4 qt	28.75 a	19.50 ab	12.50 a	6.00 a	6.00 a	3.50 a	4.50 a	11.54 a
Belay WDG	6.4 oz	12.75 a	22.25 ab	17.00 a	7.00 a	7.00 a	4.25 a	2.25 a	10.36 a
Force 3G	5.5 lb	24.25 a	20.25 ab	25.00 a	3.75 a	1.75 a	6.75 a	6.25 a	12.57 a
Durivo	13 fl oz	13.75 a	21.50 ab	13.25 a	2.50 a	3.00 a	5.50 a	4.50 a	9.14 a
Venom	6 oz	16.75 a	26.00 a	13.00 a	2.25 a	3.50 a	3.75 a	3.50 a	9.82 a
Stallion	11.75 fl oz	20.00 a	10.00 c	10.25 a	3.00 a	3.50 a	3.75 a	4.25 a	7.82 a
Brigadier	25.6 fl oz	26.00 a	18.75 abc	5.75 a	10.00 a	3.25 a	6.00 a	2.25 a	10.29 a
Untreated check	-------	25.25 a	22.00 ab	11.25 a	4.50 a	6.00 a	4.00 a	4.75 a	11.11 a

Means within columns followed by the same letter are not significantly different; LSD (P>0.05).

Table 5. Numbers of bean thrips on carrot tops following soil or seed insecticide treatments, Holtville, CA , 2015.

Treatment formulation	Rate /acre	30 Oct BT /0.001 ac	12 Nov BT /0.001 ac	18 Nov BT / 10 sweeps[z]	24 Nov BT / 10 sweeps	1Dec BT / 10 sweeps	8 Dec BT / 10 sweeps[z]	16 Dec BT / 10 sweeps	Avg. BT / 10 sweeps[z]
FarMore DI400	0.5 mg ai/seed	4.75 c	9.50 c	47.00 b	119.75 b	28.25 a	35.00 b	10.50 a	39.39 c
Capture LFR	6.8 fl oz	24.50 ab	114.25 a	252.75 a	403.25 a	65.25 a	153.75 a	45.00 a	151.25 ab
Diazinon AG500	4 qt	29.50 ab	84.25 ab	187.50 a	461.25 a	47.75 a	139.50 a	32.25 a	140.29 ab
Belay WDG	6.4 oz	24.50 ab	102.75 ab	312.50 a	491.00 a	75.25 a	105.50 a	30.25 a	163.11 a
Force 3G	5.5 lb	18.50 bc	71.00 ab	221.00 a	336.00 a	61.75 a	108.25 a	32.00 a	121.21 ab
Durivo	13 fl oz	23.25 b	59.25 b	195.75 a	367.50 a	44.50 a	88.25 a	18.75 a	113.89 b
Venom	6 oz	19.00 bc	99.50 ab	212.25 a	388.00 a	79.75 a	140.75 a	29.00 a	138.32 ab
Stallion	11.75 fl oz	40.00 a	94.75 ab	155.75 a	353.75 a	58.25 a	100.00 a	29.50 a	118.86 ab
Brigadier	25.6 fl oz	21.50 b	94.75 ab	119.00 ab	437.75 a	61.75 a	141.25 a	43.00 a	131.29 ab
Untreated check	-------	24.75 ab	101.50 ab	252.50 a	388.25 a	73.00 a	112.75 a	43.75 a	142.36 ab

Means within columns followed by the same letter are not significantly different; LSD (P>0.05).

[z] Log_{10} (X+1) transformed data used for analysis, back-transformed means reported.

Table 6. Carrot harvest data following soil or seed insecticide treatments, Holtville, CA 2015.

Treatment formulation	Rate /ac	Market carrots/ 0.001 ac	Cull carrots/ 0.001 ac	Total carrots/ 0.001 ac	% market carrots	Kg market carrots/ 0.001 ac	Kg cull carrots/ 0.001 ac	Kg all carrots/ 0.001 ac	% market carrots by wt
FarMore DI400	0.5 mg ai/seed	207.25 a	461.75 a	669.00 a	30.9 a	7.98 a	12.59 a	20.56 a	38.7 a
Capture LFR	6.8 fl oz	178.75 a	376.25 a	555.00 a	31.6 a	7.74 a	9.83 a	17.56 cd	43.8 a
Diazinon AG500	4 qt	186.00 a	379.50 a	565.50 a	33.5 a	6.98 a	10.26 a	17.25 cd	40.3 a
Belay WDG	6.4 oz	212.50 a	492.50 a	705.00 a	30.5 a	7.78 a	12.25 a	20.03 ab	38.6 a
Force 3G	5.5 lb	194.00 a	362.25 a	556.25 a	35.4 a	8.00 a	11.08 a	19.08 abc	41.8 a
Durivo	13 fl oz	215.50 a	377.50 a	593.00 a	36.4 a	8.09 a	10.14 a	18.23 bcd	44.6 a
Venom	6 oz	206.75 a	403.50 a	610.25 a	34.0 a	7.46 a	10.54 a	18.00 bcd	41.1 a
Stallion	11.75 fl oz	219.75 a	396.75 a	616.50 a	36.3 a	9.26 a	9.63 a	18.88 abc	48.6 a
Brigadier	25.6 fl oz	176.50 a	372.00 a	548.50 a	31.3 a	6.28 a	10.66 a	16.94 cd	36.4 a
Untreated check	-------	178.50 a	376.50 a	555.00 a	32.0 a	6.56 a	9.85 a	16.41 d	40.2 a

Means within columns followed by the same letter are not significantly different; LSD (P>0.05).

Table 7. Numbers of flea beetle adults and larval feeding cavities following foliar insecticide treatments to carrots, Holtville, CA, 2015/16.

Treatment formulation	Rate /ac	16 Oct FB adults /0.001 ac	30 Oct FB adults /0.001 ac	12 Nov FB adults /0.001 ac	18 Nov FB adults/ 10 sweeps	24 Nov FB adults/ 10 sweeps	1Dec FB adults/ 10 sweeps	8 Dec FB adults/ 10 sweeps	16 Dec FB adults/ 10 sweeps	29 Jan Cavities/ 25 carrots	17 Feb Cavities/ 25 carrots
Gladiator	14fl oz	0.00	0.00	0.00	0.75	2.00	0.75	0.50	0.00	16.00	6.25
Asana XL	9 fl oz	1.50	0.00	0.00	0.50	4.50	1.50	2.00	0.25	18.00	3.00
Leverage 2.7SC	3.2 fl oz	0.50	0.25	0.00	1.50	2.75	0.75	1.75	0.25	10.00	4.50
Radiant	7 fl oz	1.00	0.00	0.25	3.25	3.50	1.00	1.75	0.00	6.50	5.50
Venom	2 oz	0.25	0.00	0.25	0.25	3.25	0.50	0.25	0.00	10.50	6.75
Voliam Flexi	4.66 oz	0.00	0.00	0.00	1.25	2.25	0.75	0.25	0.50	9.25	5.00
Baythroid	2.8 fl oz	0.25	0.00	0.00	0.00	2.50	0.00	1.25	1.25	16.00	8.75
Sevin XLR Plus	0.5 qt	0.00	0.25	0.00	0.25	2.25	1.00	0.75	0.50	9.75	3.50
Untreated check	-------	0.25	0.00	0.25	0.25	3.25	1.25	0.25	0.50	19.50	8.00

There were no differences among the means within columns; ANOVA (P=0.05).

Table 8. Whitefly adults foliar insecticide treatments to carrots, Holtville, CA , 2015.

Treatment formulation	Rate /ac	16 Oct SPW / 0.001 acre	30 Oct SPW / 0.001 acre	12 Nov SPW / 0.001 acre	18 Nov SPW / 10 sweeps	24 Nov SPW / 10 sweeps	1Dec SPW / 10 sweeps	8 Dec SPW / 10 sweeps	16 Dec SPW / 10 sweeps
Gladiator	14fl oz	41.25	63.25	5.50	6.25	26.25	8.25	19.75	23.25
Asana XL	9 fl oz	79.75	59.00	11.50	1.50	17.50	9.75	25.00	45.25
Leverage 2.7SC	3.2 fl oz	51.75	42.25	2.75	8.00	14.25	6.25	15.50	9.75
Radiant	7 fl oz	47.25	49.75	2.00	7.25	19.00	3.75	11.75	24.75
Venom	2 oz	77.25	42.25	10.50	4.50	19.25	8.75	13.50	3.50
Voliam Flexi	4.66 oz	45.50	53.75	12.50	4.25	27.75	3.25	11.50	29.00
Baythroid	2.8 fl oz	51.25	56.00	5.50	10.00	28.50	6.25	30.00	15.50
Sevin XLR Plus	0.5 qt	57.00	71.50	8.25	2.75	18.50	8.00	15.75	17.50
Untreated check	-------	60.75	45.25	18.00	5.75	28.00	12.75	13.25	17.25

Means within columns followed by the same letter are not significantly different; LSD (P>0.05).

Table 9. Bean thrips foliar insecticide treatments to carrots, Holtville, CA , 2015.

Treatment formulation	Rate /acre	16 Oct BT /0.001 ac	30 Oct BT /0.001 ac	12 Nov BT /0.001 ac	18 Nov BT / 10 sweeps	24 Nov BT / 10 sweeps	1Dec BT / 10 sweeps[z]	8 Dec BT / 10 sweeps[z]	16 Dec BT / 10 sweeps
Gladiator	14fl oz	90.25 a	45.75 bc	5.25 cd	30.75bcd	174.50 a	49.75 bc	60.00 abc	10.75 a
Asana XL	9 fl oz	129.25 a	62.25 abc	5.00 cd	6.50 d	95.50 a	30.75 bc	24.75 c	5.50 a
Leverage 2.7SC	3.2 fl oz	129.50 a	64.75 abc	18.75 c	54.75 b	176.00 a	60.25 ab	69.25 ab	10.75 a
Radiant	7 fl oz	108.50 a	93.75 a	8.25 cd	29.25 bcd	139.50 a	25.50 c	50.25 ab	6.25 a
Venom	2 oz	116.75 a	67.50 ab	34.75 b	41.25 bc	246.50 a	46.50 bc	54.75 ab	13.25 a
Voliam Flexi	4.66 oz	72.25 a	87.25 a	14.25 cd	20.00 cd	164.50 a	39.25 bc	38.00 bc	6.25 a
Baythroid	2.8 fl oz	110.75 a	62.00 abc	3.25 d	18.75 cd	72.75 a	24.00 c	31.75 bc	4.75 a
Sevin XLR Plus	0.5 qt	134.25 a	30.75 c	8.75 cd	26.00 bcd	128.00 a	37.25 c	49.50 abc	6.50 a
Untreated check	-------	184.25 a	51.75 bc	66.50 a	135.00 a	247.25 a	104.75 a	102.50 a	20.25 a

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

[z] Log_{10} (X+1) transformed data used for analysis, back-transformed means reported.

Table 10. Harvest data foliar insecticide treatments to carrots, Holtville, CA 2015.

Treatment formulation	Rate /ac	Market carrots/ 0.001 ac	Cull carrots/ 0.001 ac	Total carrots/ 0.001 ac	% market carrots	Kg market carrots/ 0.001 ac	Kg cull carrots/ 0.001 ac	Kg all carrots/ 0.001 ac	% market carrots by wt
Gladiator	14fl oz	147.25 a	269.50 a	416.75 a	35.9 a	6.56 a	8.49 a	15.05 ab	42.9 a
Asana XL	9 fl oz	128.50 a	394.00 a	552.50 a	22.4 a	5.25 a	8.83 a	14.08 abc	35.8 a
Leverage 2.7SC	3.2 fl oz	117.75 a	268.75 a	386.50 a	32.7 a	4.16 a	6.49 a	10.65 d	37.3 a
Radiant	7 fl oz	148.75 a	290.00 a	438.75 a	33.5 a	7.16 a	8.95 a	16.11 a	44.1 a
Venom	2 oz	113.50 a	289.75 a	403.25 a	31.2 a	4.88 a	8.20 a	13.08 bcd	36.6 a
Voliam Flexi	4.66 oz	147.50 a	336.25 a	483.75 a	30.3 a	5.75 a	9.68 a	15.43 ab	36.1 a
Baythroid	2.8 fl oz	86.75 a	218.25 a	305.00 a	33.3 a	4.44 a	7.10 a	11.54 cd	37.6 a
Sevin XLR Plus	0.5 qt	160.50 a	214.50 a	375.00 a	41.8 a	7.04 a	8.53 a	15.56 ab	45.1 a
Untreated check	-------	119.50 a	269.25 a	388.75 a	31.7 a	4.71 a	8.21 a	12.93 bcd	36.3 a

Means within columns followed by the same letter are not significantly different; LSD (P>0.05).