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In this July issue of the Postings from the Palo Verde I include recent research done in pasture grass and an article on the Red Palm Weevil which is a serious threat to California's Palm industry.

- **Field Tests using Selected Insecticides in Pasture Grass (Annual bluegrass) in 2011 -** Vonny Barlow University of California, Agricultural and Natural Resources, Palo Verde Valley, Riverside County & Eric Natwick, University of California, Agricultural and Natural Resources, Desert Research & Extension Center, Imperial County

- **The Red Palm Weevil: Serious Threat to California's Palms -** Vonny Barlow, Entomology Advisor, UCCE Riverside County.

Regards:

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Field Tests using Selected Insecticides in Pasture Grass (Annual bluegrass) in 2011

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Abstract
The project completed this past summer sought to evaluate the efficacy of selected insecticides for management of the burmudagrass mirid, *Trigonotylus tenuis* (Reuter, 1895), delphacid planthopper, *Metadelphax propinqua* (Fieber, 1866), burmudagrass thrips, *Chirothrips falsus* Priesner and *Chirothrips mexicanus* Crawford, spittlebug, *Philaenus* sp., mole cricket, *Scapteriscus* sp. and complex' of Lepidoptera, Grasshoppers and leafhoppers. Burmudagrass mirid populations were significantly reduced from pre-treatment populations of 44.81 ± 4.26/ 10 sweeps (df = 30, P = <.0001) to 38.19 ± 5.21/10 sweeps 3 DAT. Use of Lambda-cyhalothrin & Thiamethoxam has greater activity against burmudagrass mirid populations compared to the industry standard use of acephate in annual bluegrass. All other insects evaluated in this study were found significantly reduced from pretreatment applications (0 DAT) but no treatment effects were observed due to variation in insect population densities found among plots. Delphacid planthopper populations were significantly reduced from pre-treatment populations of 35.48 ± 4.87/ 10 sweeps (df = 30, P = <.0001) to 17.16 ± 1.63/10 sweeps 3 DAT. Burmudagrass thrips populations were significantly reduced from pre-treatment populations of 0.75 ± 0.48/ 10 sweeps (df = 30, P = <.0001) to 70.75 ± 10.08/10 sweeps 3 DAT. Spittlebug populations were significantly reduced from pre-treatment populations of 12.75 ± 12.75/ 10 sweeps (df = 30, P = <.0001) to 0.00 ± 0.00/10 sweeps 3 DAT. Lepidoptera, Grasshoppers, Leafhoppers and Mole cricket population pressure was low across the experimental plot and were not found to be significantly impacted by treatments when compared to the pretreatment numbers on '0' DAT (df = 30, P = 0.5630, df = 30, P = 0.7090, df = 30, P = 0. 3171, df = 30, $P \approx 1$, respectively).

The Objective
Assess the efficacy of insecticide use for burmudagrass mirid, delphacid planthopper, burmudagrass thrips, spittlebug, mole cricket, and complex' of Lepidoptera, Grasshoppers and leafhopper management in annual bluegrass.

Materials & Methods
Research plots were established on 5/31/2011 on the Desert Research Extension Center (DREC), Holtville, CA (**Fig. 1**) for evaluation of selected insecticides for management of burmudagrass mirid, delphacid planthopper, burmudagrass thrips, *Chirothrips*, spittlebug, mole cricket, and complex' of Lepidoptera, Grasshoppers and leafhoppers management against untreated controls. Individual treatment plots were approximately 10 ft. x 20 ft. with total individual treatment areas (n = 4) of 800ft^2 (0.018A). Treatments were randomly assigned and blocked by replication (RCBD) with 4 replications used. Replicates were separated by 5 ft. untreated buffer rows to minimize plot contamination. All chemical applications were applied on 5/31/2011 with a CO_2 pressurized back-pack sprayer using a 10ft. 6-nozzel hand-held spray boom fitted with 8002VS Teejet nozzles with 12" spacing. Samples were taken using a standard UC sweep net (15 in. diameter) taken on 3, 7, 14 days after initial treatment (DAT) (**Tables 1-8**). Sampling consisted of 10 sweeps taken diagonally across individual treatment plots which were then placed into plastic bags for transport back to the lab. Samples were frozen to allow for sorting of samples to insect type and/or species. Data was transformed (log + 1) prior to analyzing using a repeated

measures analysis of variance (PROC MIXED) followed by a Tukey' test. SAS Inst. Inc., Cary, NC.

Results & Discussion

Burmudagrass mirid pressure averaged 47.75 ± 11.71/ 10 sweeps prior to treatment (**Table 1**). Once treatments were made, burmudagrass mirid populations were significantly (df = 6, P = 0.0376) reduced in 2 (Endigo ZC (4.0 fl. Oz./A), Endigo ZCX (4.0 fl. Oz./A) of the 8 treatments by 5 DAT (**Table 1**) and did not significantly (df = 6, P = 0.127) change over the next 2 sample dates of 7 & 14 DAT (**Table 1**). This indicates that the use of Lambda-cyhalothrin & Thiamethoxam (Endigo) has greater activity against burmudagrass mirid populations compared to the industry standard use of acephate (Orthene 97) in Burmudagrass. Delphacid planthopper populations were significantly reduced from pre-treatment populations (0 DAT) of 35.48 ± 4.87/ 10 sweeps (df = 30, P = <.0001) to 17.16 ± 1.63/10 sweeps 3 DAT across all treatments including the untreated control (**Table 2**). No significant differences were found among the 8 treatments (df = 6, P = 0.8123) in sample days 3 – 14 DAT (**Table 2**). Burmudagrass thrips (**Fig. 2**) populations significantly increased from pre-treatment populations of 0.75 ± 0.48/ 10 sweeps (df = 30, P = <.0001) to 70.75 ± 10.08/10 sweeps 3 DAT across all treatments including the untreated control (**Table 3**). Populations then decreased and remained low for the remainder of the trial (7 – 14 DAT) (**Table 3**). No significant differences were found among the 8 treatments (df = 6, P = 0.1868) in sample days 3 – 14 DAT (**Table 3**). Spittlebug populations were significantly reduced from pre-treatment populations of 12.75 ± 12.75/ 10 sweeps (df = 30, P = <.0001) to 0.00 ± 0.00/10 sweeps 3 DAT across all treatments including the untreated control (**Table 4**). Populations then remained low for the remainder of the trial (7 – 14 DAT) with no significant differences found among the 8 treatments (df = 6, P = 0.9105) in sample days 3 – 14 DAT (**Table 4**). Lepidoptera populations were not significantly reduced from pre-treatment populations of 0.03 ± 0.03/ 10 sweeps (df = 30, P = 0.5920) to 0.00 ± 0.00/10 sweeps 3 DAT (**Table 5**). Grasshoppers populations were not significantly reduced from pre-treatment populations of 0.26 ± 0.11/ 10 sweeps (df = 30, P = 0.0914) to 0.06 ± 0.04/10 sweeps 3 DAT (**Table 6**). Leafhoppers populations were significantly changed from pre-treatment populations of 0.00 ± 0.00/ 10 sweeps (df = 30, P = 0.0088) to 0.03 ± 0.03/10 sweeps 3 DAT (**Table 7**). Mole crickets populations were not significantly changed from pre-treatment populations of 0.00 ± 0.00/ 10 sweeps (df = 30, P = 1) to 0.00 ± 0.00/10 sweeps 3 DAT (**Table 8**). Mole cricket population pressure was low across all experimental plots and were not found to be significantly impacted (**Tables 5 – 8**) by treatments when compared to the pretreatment numbers on 0 DAT (df = 30, P = 0.5630, df = 30, P = 0.7090, df = 30, P = 0. 3171, df = 30, $P \approx 1$, respectively).

Summary

Burmudagrass mirid populations were significantly reduced with treatments of (Endigo ZC (4.0 fl. Oz./A), Endigo ZCX (4.0 fl. Oz./A) when compared to all treatments in this study. This suggests that the use of Lambda-cyhalothrin & Thiamethoxam (Endigo) has greater activity against burmudagrass mirid populations for a minimum of 3 days after treatment when compared to the industry standard use of acephate (Orthene 97) in Burmudagrass. All other insects evaluated in this study did not respond to treatments (**Tables 2 – 8**) due to variation in insect population densities found among plots which are difficult to manipulate (7 – 14 DAT).

Fig. 1. Conditions of Bluegrass field site at time of sampling on 6/3/2011. The trials were conducted on the Desert Research Extension Center (DREC), Holtville, CA

Fig. 2. Burmudagrass thrips as viewed under a compound microscope. Image courtesy of Steve Koike, Monterey County Plant Pathology Advisor

Tables 1-8. Insect counts/10 sweeps ± Std. Error. Holtville, CA 2011.

Table 1. Burmadagrass mirid counts/10 sweeps ± Std. Error.
Experimental treatment dates after application (DAT)

Treatment	N	5/31/2011 0 DAT	6/3/2011 3 DAT	6/7/2011 7 DAT	6/14/2011 14 DAT
1 – Untreated control	4	47.75 ± 11.71	27.00 ± 2.35a	15.25 ± 7.30a	49.67 ± 28.67a
2 – Mustang (4.3 fl. Oz./A)	4	46.25 ± 13.65	24.50 ± 5.58a	16.00 ± 5.12a	43.75 ± 17.36a
3 – Mustang Max (4.0 fl. Oz./A)	4	69.50 ± 15.97	44.50 ± 18.12a	20.25 ± 3.94a	61.25 ± 20.10a
4 – Beleaf 50 (2.8 Oz./A)	4	47.50 ± 1.44	55.25 ± 11.24a	12.25 ± 4.03a	53.25 ± 15.47a
5 – Orthene 97 (13.2 Oz./A)	4	38.25 ± 10.20	16.50 ± 3.23a	7.25 ± 1.70a	21.25 ± 5.68a
6 – Baythroid XL (13.2 fl. Oz./A)	4	22.33 ± 00.88	30.25 ± 7.36a	11.75 ± 4.37a	38.75 ± 7.33a
7 – Endigo ZC (4.0 fl. Oz./A)	4	24.25 ± 10.15	8.00 ± 2.52b	12.00 ± 4.34a	21.50 ± 3.50a
8 – Endigo ZCX (4.0 fl. Oz./A)	4	57.00 ± 8.70	8.00 ± 1.96b	9.00 ± 4.38a	19.00 ± 6.62a

Table 2. Delphacid planthopper counts/10 sweeps ± Std. Error.
Experimental treatment dates after application (DAT)

Treatment	N	5/31/2011 0 DAT	6/3/2011 3 DAT	6/7/2011 7 DAT	6/14/2011 14 DAT
1 – Untreated control	4	55.75 ± 19.92	37.75 ± 11.99a	8.50 ± 2.60a	19.00 ± 2.31a
2 – Mustang (4.3 fl. Oz./A)	4	23.25 ± 9.29	67.00 ± 23.92a	4.00 ± 1.83a	9.25 ± 3.50a
3 – Mustang Max (4.0 fl. Oz./A)	4	51.00 ± 29.12	48.25 ± 36.22a	6.00 ± 2.31a	13.75 ± 2.95a
4 – Beleaf 50 (2.8 Oz./A)	4	32.00 ± 6.79	87.25 ± 40.11a	3.00 ± 1.54a	11.00 ± 1.22a
5 – Orthene 97 (13.2 Oz./A)	4	31.50 ± 4.56	33.25 ± 9.72a	10.25 ± 3.47a	24.75 ± 5.09a
6 – Baythroid XL (13.2 fl. Oz./A)	4	23.00 ± 2.65	40.00 ± 16.87a	4.75 ± 2.63a	15.50 ± 4.66a
7 – Endigo ZC (4.0 fl. Oz./A)	4	24.75 ± 6.86	15.50 ± 3.38a	4.50 ± 2.84a	21.75 ± 5.38a
8 – Endigo ZCX (4.0 fl. Oz./A)	4	39.50 ± 5.39	39.25 ± 15.62a	2.00 ± 0.00a	22.75 ± 5.36a

Table 3. Burmudagrass thrips counts/10 sweeps ± Std. Error.
Experimental treatment dates after application (DAT)

Treatment	N	5/31/2011 0 DAT	6/3/2011 3 DAT	6/7/2011 7 DAT	6/14/2011 14 DAT
1 – Untreated control	4	0.75 ± 0.48	70.75 ± 10.08a	0.50 ± 0.50a	4.00 ± 4.00a
2 – Mustang (4.3 fl. Oz./A)	4	2.00 ± 1.68	50.25 ± 11.71a	0.00 ± 0.00a	1.25 ± 0.75a
3 – Mustang Max (4.0 fl. Oz./A)	4	9.00 ± 3.94	29.75 ± 13.89b	0.00 ± 0.00a	7.75 ± 4.64b
4 – Beleaf 50 (2.8 Oz./A)	4	1.75 ± 0.75	86.50 ± 22.13a	1.00 ± 0.71a	1.75 ± 0.63a
5 – Orthene 97 (13.2 Oz./A)	4	1.50 ± 0.96	46.25 ± 10.70a	0.50 ± 0.50a	4.75 ± 2.63a
6 – Baythroid XL (13.2 fl. Oz./A)	4	2.67 ± 1.76	47.50 ± 18.80a	0.25 ± 0.25a	1.75 ± 1.75a
7 – Endigo ZC (4.0 fl. Oz./A)	4	1.25 ± 0.95	93.75 ± 22.50a	1.00 ± 0.71a	9.25 ± 2.29b
8 – Endigo ZCX (4.0 fl. Oz./A)	4	1.75 ± 1.44	57.75 ± 13.34a	1.00 ± 0.41a	7.75 ± 4.01b

Table 4. Spittlebug counts/10 sweeps ± Std. Error.
Experimental treatment dates after application (DAT)

Treatment	N	5/31/2011 0 DAT	6/3/2011 3 DAT	6/7/2011 7 DAT	6/14/2011 14 DAT
1 – Untreated control	4	12.75 ± 12.75	0.00 ± 0.00a	0.00 ± 0.00a	0.33 ± 0.33a
2 – Mustang (4.3 fl. Oz./A)	4	2.50 ± 2.18	0.00 ± 0.00a	0.00 ± 0.00a	0.00 ± 0.00a
3 – Mustang Max (4.0 fl. Oz./A)	4	12.00 ± 11.67	0.00 ± 0.00a	0.00 ± 0.00a	0.00 ± 0.00a
4 – Beleaf 50 (2.8 Oz./A)	4	1.00 ± 1.00	0.00 ± 0.00a	0.00 ± 0.00a	0.00 ± 0.00a
5 – Orthene 97 (13.2 Oz./A)	4	2.75 ± 2.75	0.00 ± 0.00a	0.00 ± 0.00a	0.00 ± 0.00a
6 – Baythroid XL (13.2 fl. Oz./A)	4	0.67 ± 0.67	0.00 ± 0.00a	0.00 ± 0.00a	0.00 ± 0.00a
7 – Endigo ZC (4.0 fl. Oz./A)	4	1.50 ± 0.65	0.00 ± 0.00a	0.00 ± 0.00a	0.00 ± 0.00a
8 – Endigo ZCX (4.0 fl. Oz./A)	4	0.25 ± 0.25	0.00 ± 0.00a	0.00 ± 0.00a	0.00 ± 0.00a

Table 5. Lepidoptera (complex) counts/10 sweeps ± Std. Error.
Experimental treatment dates after application (DAT)

Treatment	N	5/31/2011 0 DAT	6/3/2011 3 DAT	6/7/2011 7 DAT	6/14/2011 14 DAT
1 – Untreated control	4	0.00 ± 0.00	0.00 ± 0.00a	0.00 ± 0.00a	0.00 ± 0.00a
2 – Mustang (4.3 fl. Oz./A)	4	0.00 ± 0.00	0.00 ± 0.00a	0.00 ± 0.00a	0.00 ± 0.00a
3 – Mustang Max (4.0 fl. Oz./A)	4	0.00 ± 0.00	0.00 ± 0.00a	0.00 ± 0.00a	0.00 ± 0.00a
4 – Beleaf 50 (2.8 Oz./A)	4	0.00 ± 0.00	0.25 ± 0.25a	0.00 ± 0.00a	0.00 ± 0.00a
5 – Orthene 97 (13.2 Oz./A)	4	0.00 ± 0.00	0.00 ± 0.00a	0.00 ± 0.00a	0.00 ± 0.00a
6 – Baythroid XL (13.2 fl. Oz./A)	4	0.00 ± 0.00	0.00 ± 0.00a	0.00 ± 0.00a	0.00 ± 0.00a
7 – Endigo ZC (4.0 fl. Oz./A)	4	0.00 ± 0.00	0.00 ± 0.00a	0.00 ± 0.00a	0.00 ± 0.00a
8 – Endigo ZCX (4.0 fl. Oz./A)	4	0.25 ± 0.25	0.00 ± 0.00a	0.00 ± 0.00a	0.00 ± 0.00a

Table 6. Grasshopper (complex) counts/10 sweeps ± Std. Error.
Experimental treatment dates after application (DAT)

Treatment	N	5/31/2011 0 DAT	6/3/2011 3 DAT	6/7/2011 7 DAT	6/14/2011 14 DAT
1 – Untreated control	4	0.25 ± 0.25	0.50 ± 0.50a	0.00 ± 0.00a	0.33 ± 0.33a
2 – Mustang (4.3 fl. Oz./A)	4	0.75 ± 0.75	0.00 ± 0.00a	0.00 ± 0.00a	0.25 ± 0.25a
3 – Mustang Max (4.0 fl. Oz./A)	4	0.25 ± 0.25	0.00 ± 0.00a	0.00 ± 0.00a	0.00 ± 0.00a
4 – Beleaf 50 (2.8 Oz./A)	4	0.25 ± 0.25	0.25 ± 0.25a	0.00 ± 0.00a	0.00 ± 0.00a
5 – Orthene 97 (13.2 Oz./A)	4	0.00 ± 0.00	0.00 ± 0.00a	0.00 ± 0.00a	0.00 ± 0.00a
6 – Baythroid XL (13.2 fl. Oz./A)	4	0.00 ± 0.00	0.00 ± 0.00a	0.00 ± 0.00a	0.00 ± 0.00a
7 – Endigo ZC (4.0 fl. Oz./A)	4	0.00 ± 0.00	0.00 ± 0.00a	0.25 ± 0.25a	0.00 ± 0.00a
8 – Endigo ZCX (4.0 fl. Oz./A)	4	0.50 ± 0.50	0.00 ± 0.00a	0.00 ± 0.00a	0.00 ± 0.00a

Table 7. Leafhopper (complex) counts/10 sweeps ± Std. Error.
Experimental treatment dates after application (DAT)

Treatment	N	5/31/2011 0 DAT	6/3/2011 3 DAT	6/7/2011 7 DAT	6/14/2011 14 DAT
1 – Untreated control	4	0.00 ± 0.00	0.00 ± 0.00a	0.00 ± 0.00a	0.00 ± 0.00a
2 – Mustang (4.3 fl. Oz./A)	4	0.00 ± 0.00	0.50 ± 0.50a	0.00 ± 0.00a	0.00 ± 0.00a
3 – Mustang Max (4.0 fl. Oz./A)	4	0.00 ± 0.00	0.25 ± 0.25a	0.00 ± 0.00a	0.00 ± 0.00a
4 – Beleaf 50 (2.8 Oz./A)	4	0.00 ± 0.00	0.75 ± 0.48a	0.00 ± 0.00a	0.00 ± 0.00a
5 – Orthene 97 (13.2 Oz./A)	4	0.00 ± 0.00	0.00 ± 0.00a	0.00 ± 0.00a	0.00 ± 0.00a
6 – Baythroid XL (13.2 fl. Oz./A)	4	0.00 ± 0.00	0.50 ± 0.50a	0.00 ± 0.00a	0.25 ± 0.25a
7 – Endigo ZC (4.0 fl. Oz./A)	4	0.00 ± 0.00	0.00 ± 0.00a	0.00 ± 0.00a	0.00 ± 0.00a
8 – Endigo ZCX (4.0 fl. Oz./A)	4	0.00 ± 0.00	0.00 ± 0.00a	0.00 ± 0.00a	0.00 ± 0.00a

Table 8. Mole cricket counts/10 sweeps ± Std. Error.
Experimental treatment dates after application (DAT)

Treatment	N	5/31/2011 0 DAT	6/3/2011 3 DAT	6/7/2011 7 DAT	6/14/2011 14 DAT
1 – Untreated control	4	0.00 ± 0.00	0.00 ± 0.00a	0.00 ± 0.00a	0.00 ± 0.00a
2 – Mustang (4.3 fl. Oz./A)	4	0.00 ± 0.00	0.00 ± 0.00a	0.00 ± 0.00a	0.00 ± 0.00a
3 – Mustang Max (4.0 fl. Oz./A)	4	0.00 ± 0.00	0.00 ± 0.00a	0.00 ± 0.00a	0.00 ± 0.00a
4 – Beleaf 50 (2.8 Oz./A)	4	0.00 ± 0.00	0.00 ± 0.00a	0.00 ± 0.00a	0.00 ± 0.00a
5 – Orthene 97 (13.2 Oz./A)	4	0.00 ± 0.00	0.00 ± 0.00a	0.00 ± 0.00a	0.00 ± 0.00a
6 – Baythroid XL (13.2 fl. Oz./A)	4	0.00 ± 0.00	0.00 ± 0.00a	0.00 ± 0.00a	0.00 ± 0.00a
7 – Endigo ZC (4.0 fl. Oz./A)	4	0.00 ± 0.00	0.00 ± 0.00a	0.00 ± 0.00a	0.00 ± 0.00a
8 – Endigo ZCX (4.0 fl. Oz./A)	4	0.00 ± 0.00	0.00 ± 0.00a	0.00 ± 0.00a	0.00 ± 0.00a

The Red Palm Weevil: Serious Threat to California's Palms

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The Red Palm Weevil (RPW), *Rhynchophorus ferrugineus*, was discovered in California in August 2010 from a large dying Canary Island date palm (*Phoenix canariensis*) from a residence in the city of Laguna Beach, Orange County. Both adult and larvae were discovered n the top portions of the palm trunk. The weevils were identified by experts at the USDA-ARS Systematic Entomology Laboratory in Maryland as Red Palm Weevil (RPW). This is the first record of this pest in the USA.

In response to the RPW collection in Laguna Beach, state and federal survey crews deployed pheromone baited traps. Pheromones are airborne chemicals that elicit behavioral or physiological responses in insects. RPW is highly attracted to two different types of odors: (1) volatiles emanating from unhealthy or damaged palm trees, and (2) aggregation pheromones which male weevils release to attract other male and female weevils to palm trees that are suitab le for weevil larvae to use as food. Neither the stressed palm odors or the weevil aggregation pheromone are very effective on their own. However, in combination they act as a powerful attractive to weevils. Pheromone traps make it possible to detect very low density pest populations that would otherwise be almost impossible to find.

In addition to pheromone monitoring, visual surveys of other palms in the area surrounding the find site in Laguna Beach were conducted. Survey efforts are underway around Laguna Beach to determine how widespread the RPW infestation exists and if it is possible to contain and perhaps eradicate this highly destructive palm pest.

The international trade in live palms is the most likely conduit that has allowed this pest, probably moved as eggs, larvae, or pupae hidden inside palms, to move vast distances. RPW may establish readily in new areas because it has traveled with its food supply, or there are other ornamental or date palms nearby that it can infest once larvae finish developing and emerge as new adults that abandon their original host plant. Adult weevils are strong fliers and can fly up to ≈900 yards at a time and they can move up to ≈4.3 miles in 3-5 days.

Distribution: The Red Palm Weevil is native to Southeast Asia and is known from the following regions:

- Asia: Red Palm Weevil has been recorded in Bangladesh, Cambodia, China (Guangdong, Taiwan), Pakistan, India, Indonesia, Japan, Laos, Malaysia (Sabah, Sarawak), Myanmar, Philippines, Singapore, Sri Lanka, Thailand, and Vietnam.
- Africa: Algeria, Egypt, Libya, Madagascar, Malta, Morocco.
- Middle East: Bahrain, Georgia Palestine, Syria, Iran, Iraq, Israel, Jordan, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates.
- Europe: Cyprus, France, Greece, Italy, Spain, Portugal, and Turkey.
- Oceania: Australia, Papua New Guinea, Samoa, and the Solomon Islands.
- The Caribbean: Aruba.
- United States: Laguna Beach, Orange County, California

Red Palm Weevil is widely considered to be the most damaging insect pest of palms in the world. RPW's are usually attracted to unhealthy palm trees, but they will often attack healthy palms too. Red Palm Weevil larvae feed within the apical growing point of the palms creating extensive damage to palm tissues and weakening the structure of the palm trunk. Palms damaged by RPW may exhibit the following symptoms: (1) presence of tunnels on the trunk or base of fronds. (2) Infested palms may emit "gnawing" sounds caused by larvae feeding inside. (3) Oozing of viscous fluids from tunnels. (4) Appearance of chewed plant material (frass) at the external entrances of feeding tunnels and a highly distinctive "fermented" odor. (5) Empty pupal cases and the bodies of dead adult RPW in and around heavily infested palms, and (6) breaking of the trunk, or toppling of the palm crown. Feeding damage leading to the death of infested palms is widely reported in areas invaded by this pest. The primary hosts of the Red Palm Weevil include 24 species of palms in 14 genera, including most of the common landscape palms found in California. The Canary Island date palm, one of the most conspicuous and prominent palms in California, is especially susceptible to attack. The Red Palm Weevil poses a very serious threat to California's landscape plantings of ornamental palms if it were to become established here. C

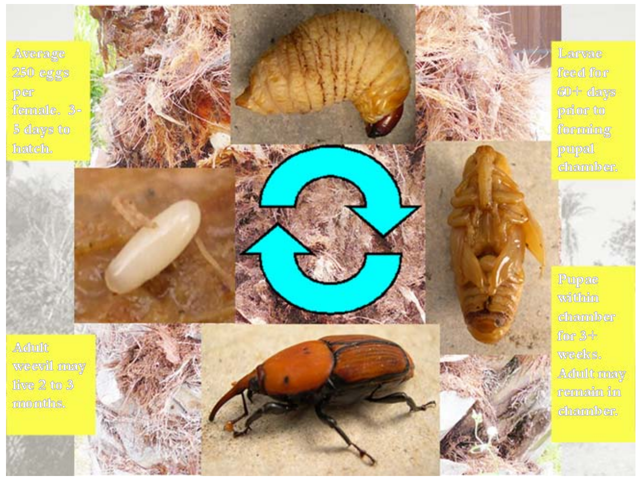
Commercial date production is impacted in areas where RPW is established, resulting in tree death or reduced vigor in infested date palms. Red Palm Weevil represents a potential threat to California's $30 million dollar date crop should it become established in date-growing areas of California. Ornamental palm tree sales are estimated at $70 million per year in California, and $127 million in Florida.

Symptoms: Early Red Palm Weevil infestations can be difficult to detect in large palms in the landscape unless access to the actively growing portions can be attained. It is important that arborists and individuals working in palm canopies be vigilant for signs of larval mines and frass (excrement) in leaf bases in the central growing point of the palm in order to detect signs of early infestation.

Larval damage to leaf bases anywhere in the canopy revealed by routine trimming may also be a sign of feeding by young Red Palm Weevil larvae. Dieback in the apical (newest, uppermost, or center) leaves in the canopy is a common symptom of larval damage to the meristem tissue and should be investigated for RPW. Frass accumulating at points of injury or at the base of offshoots may also appear in infested trees. Adult weevils are strong fliers and would appear in flight as one of the larger beetles to occur in California urban landscapes.

Identification: Adult Red Palm Weevils are very large beetles, attaining body lengths, including the snout 1.4-1.6 inches. The weevils have a long, slender snout which the female uses to penetrate palm tissue and create access wounds in which eggs are deposited. Coloration in *Rhyncophorus ferrugineus* is extremely variable and has historically led to the erroneous classification of color-defined polymorphs (variants) as distinct species. Coloration in the adult weevils is predominately reddish-brown in the most typical form. The Red Palm Weevil's collected in Laguna Beach have displayed a distinct "red striped" coloration which consists of the dorsal surfaces appearing uniformly dark brown to black, with a single, contrasting red stripe running the length of the pronotum. There are two different color types or color morphs for RPW, adults that are predominantly reddish in color, and the others that are dark with a red streak, like the Laguna Beach specimens. The Red Palm Weevil, like other beetles, develops through complete metamorphosis, with larvae and pupae developing within the trunk and apical growth tissue s of the palm meristem. Larvae are legless grubs with the body color uniformly pale yellow with a brown head. Larvae may attain lengths greater than 2 inches. Larvae feed within the soft tissues of the meristem or leaf bases creating frass filled mines, enlarging and penetrating deep within the upper trunk areas as the larvae mature. Mature larvae construct a pupal chamber or cocoon made up of coarse palm fibers in which they pupate and occupy for approximately three to four weeks. The cocoons are located within the damaged tissue of the palm.

Life Cycle: To lay eggs, females use their long beak, or rostrum, to chew a hole into palm tissue. Eggs are then laid into this hole. Eggs may be laid in wounds, cracks, and crevices in the trunk, from the collar region near the roots, up to the base of frond petioles and axils near the crown of the palm. Females can lay 58-531 eggs which hatch in about 1-6 days. Larvae that hatch from eggs, feed on the surrounding palm tissue and bore their way into the center of the palm. The tunnels larvae form as they feed fill with frass (excrement and chewed fibers that have a highly distincitve odor) and plant sap. Larvae may pass through 3-7 instars or stages that may last for about two months before the pupal stage is reached. Larvae pupate inside cocoons in the palm trunk, or in concealed places at the base of palm fronds. The pupal stage may last from 11 to 45 days. The entire life cycle, egg to adult, can take 45 to 139 days. Adult Red Palm Weevil emerge from cocoons, and females can lay eggs for around 8 to 10 weeks. Adult weevils live for about 2 to 3 months feeding on palms, and going through several cycles of mating and egg laying before dying. The sex ratio is slightly biased towards females (1 male to about 1.2 females). In Egypt, it has been estimated that RPW can have up to 21 generations per year. This pest can be reared in the laboratory on sugar cane, and a variety of artificial diets.



Control Options: Suppression of Red Palm Weevil infestations can be attempted in several ways. Insecticides are probably the most common control tool used against Red Palm Weevil, and can applied in a variety of ways for RPW suppression including applications as dusts, liquid sprays. Trunk injections or soil applications of systemic insecticides that move inside the palm poisoning weevil larvae and adults may also be effective. Good sanitation practices are needed to prevent Red Palm Weevil spreading from infested palms. Chipping, burning, and burying infested material deeply can reduce the likelihood that Red Palm Weevil will emerge and escape from infested palms. Mass trapping has been used to reduce Red Palm Weevil densities. In this instance, aggregation pheromones are loaded into bucket traps along with palm material and granular insecticides. RPW adults are attracted by the pheromones and the plant material and fly into buckets. Once inside the bucket trap, the pesticide kills the weevils before they can escape. Biological control is the use of natural enemies, like predators, parasites, and pathogens to kill a pest. Red Palm Weevil is attacked by a variety of different natural enemies including parasites and small predators that attack weevil eggs, while bacteria, fungi, and nematodes can kill weevil larvae. Many of these biological control agents do not provide adequate control of Red Palm Weevil in the field. Host plant resistance can reduce the ability of Red Palm Weevil to damage palms because the weevil is unable to effectively exploit these hosts. The California fan palm, *Washingtonia filifera,* which is native to southern California and western Arizona, and the European fan palm, *Chamaerops humilis*, appear to be resistant to Red Palm Weevil infestations.

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