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Control of Royal Palm Bug (*Xylastodoris luteolus*) Populations with Soil Applied Neonicotinoid Insecticides

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The royal palm [*Roystonia regia* (Kunth) O.F. Cook] is a majestic and prized palm tree in South Florida landscapes and has relatively few pests. However, sudden population flare-ups of the royal palm bug (RPB) [*Xylastodoris luteolus* Barber (Hemiptera: Thaumastocoridae)] can be severely damaging. Damage appears as tan-gray, ragged new growth that reduces aesthetics and may affect photosynthetic ability. This study was conducted to evaluate the efficacy of soil-applied neonicotinoid systemic insecticides. All three active ingredients were tested at 0.05 oz a.i. (1.4 g) per inch trunk diameter. All of the treatments tested: Merit 2F (imidacloprid), Safari 2G and Safari 20 SG (dinotefuran), and Arena 50 WDG (clothianidin) provided excellent RPB control at 30 and 75 days after treatment. ELISA analysis of palm foliage showed dinotefuran translocated fastest, followed by imidacloprid then clothianidin. Compared to high-pressure foliar spraying, soil application of systemic insecticides is preferred in urban landscapes because the drift risk is eliminated. This is especially apt when treating tall palms with small canopy areas (in relation to hardwood tree canopies). High-visibility, specimen royal palms used to be treated preventively due to a presumed, long translocation period of imidacloprid. Now palms can be effectively treated curatively, since translocation occurs within 30 days.

The royal palm bug (RPB) [*Xylastodoris luteolus* Barber] is an occasional pest of royal palms [*Roystonia regia* (Kunth) O.F. Cook] in the landscape. This bug has as an irregular pattern of abundance. In normal years they are found in low levels infesting few trees. However, in certain years, extremely high populations develop and cause severe damage to royal palms. Damaging populations have been reported in 1921, 1957, and 1975 on the east coast of Florida (Baranowski, 1966; Reinert, 1975). Feeding by adults and nymphs occurs in the spear leaf and newly expanding fronds (Fig. 1). As the fronds unfurl, the damaged leaflets are tan-gray, stunted and eventually become ragged (Figs. 2 and 3). This reduces the aesthetic value and, with repeated attacks, may reduce photosynthetic ability of the tree. Damage is most severe in spring and early summer. The populations then apparently subside until the following spring (Howard and Stopek, 1999).

Fig. 1. Royal palm bugs feeding between leaflets on the spear leaf. Note the black fecal spotting.

Fig. 2. Ragged royal palm leaflets at the tip and half way down the frond due to feeding damage of royal palm bugs.

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Fig. 3. Ragged royal palm leaflets on four palm fronds caused by royal palm bug feeding damage.

RPB has been described from Florida and Cuba (Reinert, 1975). In Florida, they have been collected as far north as Largo on the west coast and Vero Beach on the east coast. RPB biology and morphology have been detailed by Baranowski (1966). Adults are small 1/12- to 1/10-inch- (2–2.5 mm) long insects with tan-yellowish bodies, red eyes, and somewhat transparent wings (Fig. 4). Nymphs range from 1/14 to 1/12 inch (0.7–2 mm) in length. Females deposit one to two eggs per day on the leaflet midrib. When nymphs hatch they feed inside folded leaflets and undergo five stadia. The duration of the life cycle averages 28 d from egg to adult.

RPB adults and nymphs are flattened dorso-ventrally, and prefer to feed and rest in tight spaces. Feeding damage occurs initially as stippling of tissue as the bugs suck out cell contents. This is followed by browning (necrosis) and an eventual ragged appearance of the leaflets. The bugs feed between newly unfolding leaflets. They enter the tip of the spear leaf as it begins to unfurl then progress to the leaflets down the rachis. If damage is severe, both the aesthetic value and photosynthetic ability of the palm may be reduced. Reinert (1975) reported some palms died if no control measures were undertaken. The water-soluble powder formulation of the systemic insecticide, Merit (imidacloprid, Bayer Crop Science, Kansas City, MO) has been used effectively for the last 10 to 12 years or so as a soil drench. This study was conducted to evaluate the efficacy of several newer formulations of imidacloprid and two more recently developed systemic neonicotinoid insecticides for RPB control.

Fig. 4. Close-up of royal palm bug adult (center) and nymphs. Note the lighter colored, stippled plant tissue caused by their feeding activity (photo by Lyle J. Buss, UF/IFAS).

Materials and Methods

Heavily infested palms were selected for the study. The palms were uniform in size and about 30 ft (9.1 m) tall, with an average trunk diameter at breast height (DBH) of 20 inches (50.8 cm), and growing in a landscaped setting in Ft. Myers, FL. Soil type was sandy and the palms were individually mulched with no turf competition. Treatments included five insecticide products and an untreated control. The products were all tested at 0.05 oz (1.4 g) a.i. per inch DBH: Safari® 20 SG and Safari® 2G (both dinotefuran; Valent U.S.A. Corp., Walnut Creek, CA); Arena® 50 WDG (clothianidin; Valent U.S.A. Corp.); CoreTect™ (imidacloprid 20% a.i. plus fertilizer 12–9–4, in 0.08 oz (2.4 g)/tablet; Bayer Crop Science); and Merit® 2F (imidacloprid; Bayer Crop Science). Safari 2G was applied broadcast to the soil surface within an 8- to 12-inch (20.3–30.5 cm) distance from the trunk. Safari 20 SG, Arena, and Merit were applied as soil drenches with a watering can at the base of the trunk with the required amount of insecticide in 64 oz (1.9 L) water per 1 inch (2.54 cm) DBH. The CoreTect tablets were inserted into the root zone soil to a depth of 1.5 inches (3.81 cm), at a spacing of 3 inches (7.6 cm) between tablets. Tablet placement was within 12 to 17 inches (30.5–43.2 cm) of the trunk. All treatments were applied on 11 Apr. 2009.

RPB populations were evaluated in the field by counting the number of live adults and nymphs on five randomly selected, unfolded leaflets per tree utilizing an aerial lift (bucket) courtesy of The Davey Tree Expert Co., Naples, FL (Fig. 5). Only leaflets from the newest unfolding frond or from the unfurling tip of the spear leaf were selected for population counts. Evaluations of RPB numbers were made pretreatment on 11 Apr. and at 30 and 75 d after treatment (DAT). The experimental design was RCB with five replications (trees) per treatment. Data were analyzed with analysis of variance followed by the Student-Neuman-Keuls test for mean separation (ARM 6, Gylling Data Management, Brookings, SD). During the first half of the study, due to the lack of precipitation, palms were given 1 inch (2.54 cm) of irrigation weekly. Later, 10 inches (25.4 cm) of precipitation occurred during the second half of the study.

Fig. 5. Sampling of royal palm bug populations was conducted in the field utilizing an aerial lift (bucket).

Table 1. Suppression of royal palm bug populations with soil applied systemic insecticides in Ft. Myers, FL, in 2009. There were five palms per treatment and insects were counted on five leaflets per palm.

		Avg live adults and nymphs/5 leaflets[z]		
		11 Apr.	9 May	20 June[y]
Treatment[x]	Rate[w]	Pretreatment	30 DAT[v]	75 DAT
Safari 20 SG (dinotefuran)	7.2 g	479 a	7 b	0.4 b
Arena 50 WDG (clothianidin)	2.9 g	459 a	107 b	0.0 b
Safari 2G	72 g	365 a	8 b	0.2 b
CoreTect (imidacloprid)	3 tablets	390 a	50 b	0.6 b
Merit 2F (imidacloprid)	6 mL	595 a	18 b	3.0 b
Control		430 a	310 a	266.0 a

[z]Means within columns not followed by the same letter are significantly different (Student-Neuman-Keuls test, $P < 0.05$).
[y]Original data were transformed to Log (X + 1) for statistical analysis. Untransformed data are presented.
[x]All treatments were applied on 11 Apr. 2009.
[w]Rate per inch (2.54 cm) DBH.
[v]Days after treatment.

In addition, ELISA (enzyme-linked immunosorbent assay) analyses were conducted to determine the concentration of all treatments (except CoreTect) in the foliage. Five randomly selected leaflets per palm were cut and placed in plastic storage bags. The samples were then frozen until the ELISA analysis. Sampling was done 30 and 75 DAT. Two separate test kits were used in the analysis, one for imidacloprid, the other for dinotefuran and clothianidin. Test kits used were the SmartAssay™ Series for dinotefuran and clothianidin (HORIBA Ltd, Kyoto 601-8510 Japan) and for imidacloprid, the QuantiPlate™ Kit (catalog no. EP 006, EnviroLogix Inc., Portland, ME).

The amount used for analysis ranged from 0.1 g to 1 g of leaf material. Solvent volume was directly proportional to sample weight: 10 mL of solvent for 1 g of sample. Matrix effects from naturally occurring plant compounds were eliminated from the untreated control through multiple dilutions until a non-detectable level was reached following methodology of Byrne et al. (2005).

Results

Palms with high pretreatment counts were selected for this study. Group means ranged from 365 to 595 RPB per palm on 11 Apr. (Table 1). Compared to the control, with an average of 310 RPB per palm, all treatments resulted in statistically significant RPB reductions, ranging from 7 to 107 RPB, by 9 May (30 DAT; Table 1). By 20 June (75 DAT), all of the treatments had resulted in, essentially, complete control. Because the 20 June data contained several zero values, the Log (X + 1) transformation was utilized for statistical analysis. Untransformed data are presented in Table 1.

ELISA analyses showed that Safari (dinotefuran) and Merit (imidacloprid) were present in palm foliage by 30 DAT, but Arena (clothianidin) was not detected until 75 DAT (Table 2). In these composite, unreplicated assays, neonicotinoid concentrations increased between 30 and 75 DAT in palms treated with Merit 2F and Safari 20 SG, but declined in palms treated with Safari 2G. On both sample dates, Safari (dinotefuran) concentrations were much higher in foliage than Merit (imidacloprid) or Arena (clothianidin) concentrations. Variability in speed of uptake and peak concentration may be due to differences in physical and chemical properties. Per individual manufacturer's MSDS sheets, dinotefuran is much more water soluble than either imidacloprid or clothianidin (39,800 mg/L, 514 mg/L, and 259 mg/L, respectively). In addition, dinotefuran is less tightly bound to soil (Koc 30.0) than either imidacloprid (Koc 262.0) or clothianidin (Koc 160.0); hence, higher amounts of dinotefuran are more quickly absorbed by roots and transported via the xylem into the foliage. No phytotoxicity was observed with any of the treatments.

Discussion

In the past, control efforts included foliar applications of systemic and contact insecticides (Reinert, 1975). Most of the earlier products were organophosphates and their uses have been cancelled. Howard and Stopek (1999) investigated the use of imidacloprid as a soil drench and recommended applications before damage onset. In this study, all of the products were applied when damage by RPB was noticed in the spring. Both Safari formulations were translocated fairly rapidly, with Merit 2F at a somewhat lower rate (Table 2). Arena 50 WDG provided reduction in RPB populations at 30 DAT but was not detected in foliage until 75 DAT. The lack of detection during the early sampling date was likely a consequence of the ELISA test kit sensitivity.

RPB damage is not seen at severe levels very often. In most years, the damage levels are low to nonexistent. The latter was attributed in part by Reinert (1975) to washing action of heavy summer rainfalls, typical in south Florida, and to predators such as the spiders *Hentzia grenada* and *Theridion* sp. With the exception of the occasional jumping spider (Salticidae), and an unidentified pirate bug, not many predators were observed during this study. Howard and Stopek (1999) speculated the lack of severely cold temperatures (freezing) may contribute to RPB population buildup. Accordingly, the high populations encountered in this

Table 2. Insecticide concentration (ppb of active ingredient) in royal palm foliage using ELISA (enzyme-linked immunosorbent assay) analysis at 30 and 75 days after treatment on 11 Apr. 2009.

	30 DAT[z]	75 DAT
Safari 20 SG (dinotefuran)	3,260	6,656
Arena 50 WDG (clothianidin)	0	902
Safari 2G (dinotefuran)	7,725	3,519
Merit 2F (imidacloprid)	326	1325
Control	0	0

[z]Days after treatment.

study may have been due to mild winter temperatures, above freezing, the past three winters in Ft. Myers (National Weather Service, 2007 to 2009).

Our results show the newer systemic insecticides are effective and there is faster insecticide movement, 30 d or maybe less, into the canopy than previously demonstrated with imidacloprid. Howard and Stopek (1999) did not evaluate efficacy until 6 months after application with Merit 75 WP. The fairly rapid uptake documented in this study provides better pest management flexibility. Treatment can wait (depending on the local aesthetic threshold) until slight damage is observed. This allows treatment of only infested palms. Previously, because it was believed the insecticide (imidacloprid) movement was slow (months), it was common to treat every palm with a soil drench before an infestation was confirmed.

Literature Cited

Baranowski, R.M. 1966. The royal palm bug, *Xylastodoris luteolus* Barber (Hemiptera: Thaumastocoridae). Entomol. Circ. No. 46, FDACS. Div. Plant Ind. Gainesville.

Byrne, F.J., N.C. Toscano, A.A. Urena, and J.G. Morse. 2005. Quantification of imidacloprid toxicity to avocado thrips, *Scirtothrips perseae* Nakahara (Thysanoptera:Thripidae), using a combined bioassay and ELISA approach. Pest Mgt. Sci. 61:754–758.

Howard, F.W. and A. Stopek. 1999. Control of royal palm bug, *Xylastodoris luteolus* (Hemiptera: Thaumastocoridae), with imidacloprid: A refinement in the method. Palms 43(4):174–176.

National Weather Service, 2009. Climatological data annual summary. Vol. 113, No. 13.

National Weather Service, 2008. Climatological data annual summary. Vol. 112, No. 12.

National Weather Service, 2007. Climatological data annual summary. Vol. 111, No. 11.

Reinert, J.A. 1975. Royal palm bug, *Xylastodoris luteolus*, damage and control on royal palms in Florida. Proc. Fla. State Hort. Soc. 88:591–593.