Evaluation of Insecticides to Control the Asian Ambrosia Beetle, *Xylosandrus crassiusculus*, In Nursery Stock

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Results Summary: Insecticides were evaluated in field bioassays for their efficacy against the Asian ambrosia beetle (AAB), *Xylosandrus crassiusculus.* The insecticides Ammo 2.5EC, Asana XL, Celero 16WSG, Dursban Turf, Dupont E2445, Lorsban 4E, Onyx, Talstar F and Thiodan 3EC were tested at different rates versus an untreated control. None of the insecticides in any test completely prevented attacks by AAB. In corollary research we have developed the following working threshold for AAB in nursery stock with trunk diameters of 7 cm or less: with <5 AAB attacks most trees survive, with >5 and <10 AAB attacks some trees die, and with >10 AAB attacks most trees die. Therefore, the mean attacks per treatment were compared statistically to the untreated control. Based on the tentative threshold Asana XL, Celero, Discus, Dupont-E2445 and Thiodan were generally ineffective at all rates tested. Onyx, Talstar and Ammo were superior to Dursban/Lorsban when used at higher rates. The active ingredient bifenthrin is the only insecticide that consistently provided reduction in AAB attacks suitable for use under commercial conditions. However, it is necessary to use higher rates to attain satisfactory results. Given the conservative nature of the tests and the results with different rates, bifenthrin can be recommended for use against AAB.

Experimental Design and Methods and Materials: For the bioassays, we used cut bolts from the exotic plant *Albizia julibrissin*, "mimosa", a natural host of AAB in the U.S. Bolts ca. 46 cm long x 2-7 cm in diameter were collected from the field and randomly assigned to and labeled by treatment. Bolts were treated immediately with insecticide by dipping the bolts for 5 sec into the insecticide solution. After the bolts dried a few minutes, they were placed in the field and subjected to our proprietary induction technique and exposed to attack by AAB. Because cut bolts are used, any resistance inherent in a tree has been removed. Therefore, we consider these bioassays to be very conservative. Each test consisted of six replicate bolts per insecticide treatment along with six control bolts. The bolts were arrayed in the field in a randomized complete block design with 1 replicate per treatment per block. Blocks were separated by 20-50 m in a location with known populations and/or active infestations of AAB. AAB attacks observed on each bolt were counted and recorded daily for 7-12 days. The tests were terminated when the number of AAB attacks on the control bolts exceeded an average of 20 per bolt or the time after treatment reached 21 days. Seven to 12 days of field exposure are usually required to attain the number of attacks on the test bolts. Attacks were scored as successful only if the AAB frass sticks were produced from the galleries. This was assessed by removing the bark from each bolt and examining the individual galleries. The mean number of successful attacks per bolt per treatment was used to evaluate the efficacy of the insecticides. Analysis of variance using the Proc Mixed procedure from SAS 8.1 (Littell et al. 1996) was conducted to analyze the results.

Summary Tables:

Table 1: Mean ± standard error the number of attacks per bolt by Asian ambrosia beetle in response to insecticide treated bolts in July, 2004 at Quincy, FL. Means followed by the same letter are significantly different from the control as determined by a least squares means test at P< 0.05.

Treatment	Rate gms ai/100gal	Mean Attacks ± SEM
Control	------	12.5 ± 2.6A
Dursban Turf	92.8	8.0 ± 1.9
Ammo 2.5E	66.3	6.3 ± 1.1A
Onyx	212.3	6.5 ± 2.4A
Talstar F	41.0	8.7 ± 0.9
Thiodan 3EC	83.0	10.7 ± 2.1

Table 2: Mean ± standard error the number of attacks per bolt by Asian ambrosia beetle in response to insecticide treated bolts in February 2005 at Quincy, FL. Means followed by the same letter are significantly different from the control as determined by a least squares means test at P< 0.05.

Treatment	Rate gms ai/100gal	Mean Attacks ± SEM
Control	------	48.3 ± 32.2A
Asana XL	8.0	27.2 ± 7.6
Bifenthrin 8% (ME)	42.5	10.2 ± 4.0
Bifenthrin 8% (ME)	85.0	13.5 ± 4.4
Onyx	212.3	0.2 ± 0.2A

Table 3: Mean ± standard error the number of attacks per bolt by Asian ambrosia beetle in response to insecticide treated bolts in April 2005 at Quincy, FL. Means followed by the same letter are significantly different from the control as determined by a least squares means test at P< 0.05.

Treatment	Rate gms ai/100gal	Mean Attacks ± SEM
Control	------	15.0 ± 2.0 A
Asana XL	76.5	5.2 ± 1.5 A
Asana XL	153.5	3.8 ± 1.4 A
Bifenthrin 8%	170.0	0.7 ± 0.3 A
Lorsban 4E	676.5	2.7 ± 1.4 A
Onyx	212.3	0.0 ± 0.0 A
Talstar F	135.3	0.5 ± 0.2 A

Table 4: Mean ± standard error the number of attacks per bolt by Asian ambrosia beetle in response to insecticide treated bolts in June 2005 at Quincy, FL. Means followed by the same letter are significantly different from the control as determined by a least squares means test at P< 0.05. RATES???

Treatment	Rate gms ai/100gal	Mean Attacks ± SEM

Control	------	13.8 ± 1.8 A
Ammo 2.5EC	144.9	10.5 ± 2.2
Asana XL	95.9	11.3 ± 1.1
Celero 16 WSG	170.0	8.2 ± 1.4 A
Discus	19.8 + 83.3[a]	6.3 ± 1.2 A
Lorsban 4E	474.0	6.7 ± 1.0 A
Onyx	212.3	4.2 ± 1.0 A
Talstar F	214.0	5.0 ± 0.8 A

[a]: cyfluthrin and imidacloprid, respectively.

Table 5: Mean ± standard error the number of attacks per bolt by Asian ambrosia beetle in response to insecticide treated bolts in July 2005 in north Florida. Means followed by the same letter are significantly different from the control as determined by a least squares means test at P< 0.05. Results are from each of two locations 50 miles apart. *Note: low numbers of responding beetles in these two tests render the results inconclusive.* However, no insecticide completely prevented attacks from the Asian ambrosia beetle.

Treatment	Rate gms ai/100gal	Monticello Mean Attacks ± SEM	Quincy Mean Attacks ± SEM
Control	------	3.0 ± 0.8	6.3 ± 1.5 A
Discus	19.8 + 83.3[a]	2.0 ± 1.4	1.8 ± 1.5 A
Discus	39.6 + 169.6[a]	1.5 ± 0.9	3.8 ± 0.8
E2445	47.0	5.3 ± 0.7	6.2 ± 1.2
E2445	189.4	6.3 ± 1.6	6.3 ± 2.6
E2445	754.4	3.5 ± 2.4	6.3 ± 3.4
Celero 16WSG	38.8	2.3 ± 1.5	2.8 ± 1.5
Celero 16WSG	77.6	2.2 ± 0.8	4.7 ± 3.4
Onyx	212.3	2.3 ± 0.7	2.5 ± 1.6

[a]: cyfluthrin and imidacloprid, respectively.

Literature:

Littell, R., G. Milliken, W. Stroup and R. Wolfinger. 1996. SAS system for mixed models. SAS Institute, Cary, NC, 633 pp.