NOTE

Methods for Insecticidal Evaluations for Southern Chinch Bugs (Hemiptera: Lygaeidae)[1]

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St. Augustinegrass, *Stenotaphrum secundatum* (Walt.) Kuntze, lawns are utilized throughout the southern United States for their climatic adaptation and their ability to tolerate full sun to moderate shade. The southern chinch bug, *Blissus insularis* Barber, is the plant's most damaging pest (Crocker 1993, International Turfgrass Soc. J. 7: 358-365). The adaptability of this insect pest is shown by its ability to develop resistance to insecticides (Reinert and Portier, 1983, J. Econ. Entomol. 76: 1187-1190) and overcome host plant resistance (Busey and Center, 1987, J. Econ. Entomol. 80: 608-611; Cherry and Nagata, 1997, International Turfgrass Soc. J. 8: 981-986).

In the past and currently, chemical insecticides are frequently used to control outbreaks of southern chinch bugs. Insecticidal evaluations have been largely sampled by flotation (Kerr, 1966, Fla. Entomol. 49: 9-18) with tests generally being conducted on small plots on private lawns or research centers. However, southern chinch bugs are extremely aggregated (Cherry, 2001, Fla. Entomol. 84: 151-153) making field sampling difficult. Also, when using small plots there exists the problem of chinch bugs migrating between plots (Reinert, 1972, Fla. Entomol. 55: 231-235). And last, there are the problems of interference in tests and liability issues when conducting insecticide evaluations on homeowner's lawns. To address these problems, an insecticide screening technique for southern chinch bugs using open-ended cylinders was reported by Crocker and Simpson (1981, J. Econ. Entomol. 74: 730-731). Their technique was designed to reduce experimental variability, preserve habitat-insect-insecticide interactions, and reduce migration problems. More recently, we have been using potted plants to evaluate insecticide efficacy against southern chinch bugs. The cylinder and potted plant methods are attractive alternatives to the more laborious and highly variable plot studies used for insecticide evaluations for southern chinch bugs. However, as noted by Crocker and Simpson (1981), research is needed to demonstrate how readily data from the cylinder technique can be applied

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to field control situations. Also, how the potted plant method compares to the cylinder and plot method in measuring insecticide efficacy against southern chinch bugs is unknown. This study compares insecticide efficacy data against southern chinch bugs from the three methods.

All tests were conducted at the Everglades Research and Education Center at Belle Glade, Florida. Naturally-occurring chinch bug infestations were located by visual examination of yellow, damaged St. Augustinegrass. Thereafter, two 4 × 4 m plots were delineated within the infested areas. One day before treatment, chinch bugs were sampled in each plot by flotation. Flotation consisted of locating chinch bugs in damaged grass in the center of the plot. Then a 30 cm diam by 15 cm high PVC cylinder was pounded 10 cm into the ground, flooded with water for 10 min, and chinch bugs which surfaced were counted.

Potted plants used were St. Augustinegrass (Bitterblue variety) grown in 13-cm diam pots containing Fafard #2 potting medium (Conrad Fafard Inc., Agawam, MA) and silica sand (1:1 by volume). These plants were submerged and held for 4 h in buckets of water before tests in order to remove any chinch bugs. One day before treatment, two plants were placed into plastic buckets (one plant/bucket). Thirty chinch bugs were placed on each plant and the bucket covered with fine mesh cloth to contain the insects. The cloth was held in place with rubber bands around the bucket and the buckets were stored in a laboratory. Chinch bugs used in potted plant tests and cylinder tests were field collected medium to large nymphs (third to fifth instar) and adults. Small nymphs were not used in the potted plant and cylinder tests because of high mortality in handling small nymphs and difficulty in finding them during flotation.

Cylinders were cut from commercial PVC pipes and were 15 cm diam by 12 cm length. Two cylinders were placed one m apart and dug and pounded into green healthy appearing St. Augustinegrass near the research plots so that the rim of each cylinder was about 5 cm above ground level. Each of these cylinders was flooded with water for a few minutes to remove any chinch bugs within the cylinders. One day before treatment, 30 chinch bugs as previously described were put into each cylinder and then a fine mesh cloth placed over the cylinder to contain the insects. The cloth was held in place with rubber bands around the cylinder and was loose so that rain would run into the cylinder through the cloth, thus approximating field conditions.

Insecticidal treatments were made using chlorpyrifos because this chemical has contact activity, but not systemic activity which would complicate analysis. Formulations used were Dursban Pro (Dow Elanco, Indianapolis, IN) in spray treatments and Dursban 1G (Real-Kill 1% G, Realex Inc., St. Louis, MO) in granular treatments. Spray and granular insecticide applications were tested because these are the two types of application methods used for chinch bug control. Three rates of insecticide (1120, 560, 112 g AI/ha) were used in tests in order to give a range of % control for correlation analysis. Each application method (spray or granular) was tested three times at each of the three rates. Spray applications were applied using a CO_2 backpack sprayer and granular applications were applied using a hand shaker.

Eighteen insecticide tests were conducted on different days from October 2000 to May 2001. In each test, one plot, one potted plant, and one cylinder were treated at the same time with each being paired with an untreated check. The bucket with the potted plant and the cylinder had the cloth tops removed, the treatment applied, and then the cloth quickly replaced. Potted plants in buckets were then stored in a greenhouse while cylinders remained in the field. Three days after treatment, survival of chinch bugs in plots, potted plants, and cylinders was measured. Plots were sampled for chinch bugs as described previously with the flotation conducted 10 cm away from the original sample because chinch bugs are so highly aggregated. Test cylinders in the field were dug up and placed in buckets. These buckets and buckets containing potted plants were taken to a laboratory and slowly flooded for 2 h, and live chinch bugs surfacing were counted.

The percent control of chinch bugs for each of the three methods in each test was determined from their untreated checks using Abbott's formula (Abbott, 1925, J. Econ. Entomol. 18: 265-267). Abbott's formula was used in order to convert data to percentage control for each method, thus allowing comparison between methods. In order to measure the intensity of association between the methods, Pearson correlation coefficients (SAS, 1996, SAS Institute, Cary, NC) were determined for percent control between plots, potted plants, and cylinders for spray applications and granular applications. Also, in order to compare the actual mean control observed using the three methods, ANOVA and Tukey's test (SAS 1996) was used for mean analysis of percent control between the three methods for spray and granular applications.

In granular applications, the correlation coefficient between plots and potted plants was 0.79 and the correlation coefficient between plots and cylinders was 0.78. In spray applications, the correlation coefficient between plots and potted plants was 0.73 and the correlation coefficient between plots and cylinders was 0.92. These positive correlations show that as one method (plots) increased in % control at higher insecticide rates the other methods (potted plants and cylinders) also increased in % control and the associations (correlations) between the methods were all statistically significant (alpha = 0.05). The mean percent control between the three methods was not significantly different in granular applications (Table 1). These data show both the potted plant method and cylinder method gave similar chinch bug control data as would be expected in plot tests. In spray applications, there was no significant difference in means of control between plots and cylinders. However, the potted plant control was significantly higher than plot control. These latter data show that the potted plant method in the spray application overestimated chinch bug control mea-

Table 1. Percent control of southern chinch bugs using different methods

	Granular applications		
	Mean*	SD	Range
Plot	40.1A	36.6	0–99
Potted Plant	34.1A	29.1	0–78
Cylinder	34.0A	24.7	0–70
		Spray applications	
Plot	39.1B	33.2	0–100
Potted Plant	92.9A	10.9	74–100
Cylinder	62.0AB	40.0	0–100

* Means within each application method (spray vs granular) followed by the same letter are not significantly different (alpha = 0.05) as determined by Tukey's test (SAS 1996).

sured in plots. Reasons for this overestimation are not known, but may include less thatch in potted plants, more insecticide exposure due to plants being sprayed in buckets, possible fumigant effects of plants being stored in buckets, etc.

In summary, the cylinder method of Crocker and Simpson (1981) showed similar insecticidal control of southern chinch bugs compared to plots in both granular and spray applications. In contrast, the potted plant method showed significantly higher chinch bug control than plots in spray applications. As noted earlier, there are many problems in using plots to evaluate insecticides for southern chinch bug control. Our data show that the cylinder method is a useful alternative to plot research for insecticidal evaluations against southern chinch bugs.

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