Survival of Different Life Stages of the Southern Chinch Bug (Hemiptera: Lygaeidae) Following Insecticidal Applications[1]

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Abstract Survival of different life stages of the southern chinch bug, *Blissus insularis* Barber, was measured after insecticidal applications of acephate, chlorpyrifos, and lambda-cyhalothrin. Adults and nymphs, but not eggs, were killed with all three insecticides sprayed at recommended field rates. Even when sprigs of St. Augustinegrass, *Stenotaphrum secundatum* (Walt.) Kuntze, were sprayed to runoff (drench), eggs were not killed. In topical treatments, only chlorpyrifos killed eggs when the insecticides were applied directly to the eggs.

Key Words *Blissus insularis,* St. Augustinegrass, southern chinch bug, acephate, chlorpyrifos, lambda-cyhalothrin, turfgrass.

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 insect pest (Crocker 1993). The importance of this insect pest is further exacerbated by its ability to develop resistance to insecticides (Reinert and Portier 1983).

Numerous studies have been conducted to determine the efficacy of chemical insecticides against southern chinch bugs. However, no study has yet determined if all stages of the insect are equally susceptible to insecticidal applications. Wilson (1929) stated that insecticides had no effect on southern chinch bug eggs, but provide no data to substantiate this claim. Kuitert and Nutter (1952) recommended two or three sequential insecticide applications for control because eggs were not affected by insecticides. However, they did not provide data for their recommendation. Komblas (1962) noted that no work had been done on the effect of insecticides on southern chinch bug eggs. He also stated that due to the incubation period of the eggs, multiple treatments would be necessary for effective control. However, no data on egg mortality due to insecticidal application were given.

The objective of this study was to determine the survival of different life stages of the southern chinch bug after insecticidal applications. This information will be useful in understanding the basic biology of the insect and developing sound strategies to control the southern chinch bug.

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Materials and Methods

Insecticidal spray test. Chinch bugs were collected from field infestations of St. Augustinegrass in Palm Beach Co., FL, during April and May 1997. Nymphs and adults were collected by suction into a modified WeedEater® Barracuda blower/vacuum model (Poulan/WeedEater, Shreveport, LA). Four, 15.2-cm diam azalea pots of St. Augustinegrass, 'Bitterblue' that had been previously flooded for about 1 h to remove any chinch bug adults or nymphs or predators were placed in plastic buckets (1 pot/bucket). Forty unsexed adults and 25 nymphs of various stages were placed into each bucket and immediately covered with a fine mesh in order to prevent movement of chinch bugs into or out of the bucket. These buckets were then kept in a greenhouse for 1 wk to provide time for oviposition in the grass. This experimental procedure guaranteed that all stages (eggs, nymphs, adults) would be present in the plants at the time of insecticidal treatment. After 1 wk, buckets were opened and any chinch bugs in the bucket or under the potted plant were aspirated and returned to the potted plant. Immediately thereafter, each of three of the plants was sprayed with an insecticide and then returned to its bucket and covered with the fine mesh. Control plants were sprayed with water. The three insecticides used were acephate, chlorpyrifos, and lambda-cyhalothrin which are labeled for control of chinch bugs in turf (Table 1). All insecticide solutions represented recommended rates for the control of the southern chinch bug and were applied within 1 h of mixing. Water was used in the control treatment. Treatments were applied using a CO_2-backpack sprayer, operated at 2.07×10^3 Pa and equipped with a T-jet #11004 flat pan nozzle. Application of insecticidal solutions were made at a rate equivalent to 8.1 L per 100 m^2. After 1 d, live adults and nymphs were aspirated out of each bucket by using flotation for 1 h with water to force the chinch bugs to the surface. Because many of the chinch bugs appeared very weak and near death, they were held in the aspirator tubes another 24 h and then survival (= movement) was determined. Eggs oviposited in the grass were extracted 48 h after insecticidal spraying. Egg collection was conducted by harvesting the stolens and leaves of each pot. These were then cut into pieces and washed

Table 1. Percent survival of different stages of the southern chinch bug after insecticidal spraying at recommended rates

Treatment*	Rate AI (kg/ha)	Mean ± SD**		
		eggs	nymphs	adults
Control	0	92.8 ± 4.5 a	32.0 ± 16.7 a	87.0 ± 11.9 a
Acephate	5.61	88.2 ± 4.5 a	0.8 ± 2.2 c	1.0 ± 2.2 c
Chlorpyrifos	1.12	94.2 ± 8.9 a	1.6 ± 1.8 c	0.5 ± 1.3 c
Lambda-cyhalothrin	0.04	92.4 ± 4.5 a	18.4 ± 14.6 b	28.5 ± 20.1 b

* acephate = Orthene® TTO, Valent USA Corporation, Walnut Creek, CA chlorpyrifos = Dursban® 50WP, DowElanco, Indianapolis, IN lambda-cyhalothrin = Scimitar® WP, Zeneca Professional Products, Wilmington, DE

** Means in the column followed by the same letter are not significantly different (alpha = 0.05) using Tukey's test (SAS 1996).

through a series of screen sieves in which the eggs were stopped in a No. 325 U.S.A. Standard Testing Sieve (45 µm mesh opening). The material in the sieve was then examined under a microscope to locate the chinch bug eggs. Ten eggs were randomly collected from each potted plant and stored on moist filter paper in a Petri dish (9.0 cm diam) in a temperature cabinet at 28°C. Eggs were held 1 mo and then survivorship determined by noting the number of empty eggs with emergence slits via microscopic examination. Each test was comprised of four potted plants (control + three insecticidal treatments). Five tests were conducted on five different dates during April through June 1997. Data from the five tests were pooled and mean differences in percentage survival of different stages (egg, nymph, adult) among treatments were determined using Tukey's test (SAS Institute 1996).

Drench test. Twenty 15 cm long sprigs of St. Augustinegrass were placed into a large plastic pan (58 × 43 × 25 cm deep). To prevent the sprigs from drying out, each sprig was placed into a small vial of water and sealed with Parafilm® (American Can Co., Greenwich, CT 06836). Several hundred chinch bug adults and nymphs collected from infested St. Augustinegrass in Palm Beach Co., FL, were then added to the pan. Then a removable clear plastic top that allowed access into the pan was secured in place. Sprigs were held in the pan for 10 d at 28°C with 14:10 h light/dark photoperiod. Thereafter, the 20 sprigs were carefully removed from the pan and divided into four equal groups. Hence, there were five sprigs in each of the four treatments (three insecticides plus control). Each group of sprigs were placed horizontally on the ground and were then sprayed with an insecticide or water as previously described, except applications continued to the point of runoff (drench). Sprigs were held 48 h in the laboratory. Sprigs were dissected and examined for eggs under a stereo-microscope. Five to 10 eggs were collected from each sprig and stored in a Petri dish as previously described. Egg survival was determined as previously described. Two tests were conducted during August to December 1997. Data from the two tests were pooled and mean differences in percentage survival of the eggs between treatments were determined using Tukey's test (SAS Institute 1996).

Topical test. Sprigs were placed in plastic pans containing chinch bugs as described in the drench test. Sprigs were removed from the pans after 7 to 10 d and examined for eggs under a microscope. Ten eggs were then placed into each Petri dish as previously described. Based on the area of a 9.0 cm diam Petri dish, 0.5 ml of each of the insecticides previously noted was used to simulate recommended rates (Table 1). A topical application of approximately 0.002 ml/egg was made using a microsyringe under microscopic examination. After each of the 10 eggs had a small droplet applied to it, the remaining solution in the syringe was evenly dispersed on the filter paper. This procedure thus simulated insecticidal spraying at recommended rates while guaranteeing that eggs had actually been in contact with the insecticides. The same procedure was used for the control using only water. After the topical application, Petri dishes were stored and egg survival determined as previously described. Four tests were conducted from September to December 1997. Each group of four Petri dishes (3 different insecticides + control) was considered one replicate. Numbers of replicates varied from 3 to 12 during the four tests because of changes in availability of eggs during testing. A total of 25 replicates was tested during the four tests. Data from the four tests were pooled and mean differences in percentage survival of the eggs between treatments were determined using Tukey's test (SAS Institute 1996).

Results and Discussion

Insecticidal spray test. Survival of different stages of southern chinch bug after insecticidal spraying at recommended rates is shown in Table 1. Adult survival was significantly lower in all three insecticidal treatments than in the control. Adult survival was very low in the acephate and chlorpyrifos treatments and higher in the lambda-cyhalothrin treatment. While nymphal survival appeared to be low in the control, this was likely an artifact caused by some nymphs molting to adults during the 7-d holding period. The holding period was necessary to obtain eggs, so some nymphal molting was unavoidable. Nonetheless, nymphal survival was significantly lower in all three insecticidal treatments than in the control. Similar to adult survival, nymphal survival was very low in the acephate and chlorpyrifos treatments and higher in the lambda-cyhalothrin treatment. Egg survival was not significantly different from the control in any of the insecticide treatments. These data suggest that either the insecticides were not reaching the eggs and/or the insecticides did not kill the eggs under our test conditions.

Drench test. Survival of southern chinch bug eggs after drenching sprigs to the point of runoff with the four treatments is shown in Table 2. There were no significant differences in egg survival among the four treatments. This is in agreement with the previous test. However, in contrast to the insecticidal spray tests described above, insecticide spray residues were not rinsed from the sprig prior to egg collection. In the insecticidal spray test, plants were submerged 24 h after spraying and rinsed 48 h after spraying to collect eggs. This procedure introduced the possibility that the insecticides were washed-off the eggs before killing them. In the drench test, eggs were dissected from sprigs without using water. Hence, if insecticides came in contact with eggs during insecticidal spraying, the insecticides were not removed by drench test procedures. These data show that even if the three insecticides were sprayed beyond the recommended rates to the point of drenching and not washed off by rain, eggs would survive and hatch in St. Augustinegrass.

Topical test. Survival of southern chinch bug eggs after topical applications with the three insecticides is shown in Table 3. Survival in the acephate and lambda-

Table 2. Percent survival of eggs of the southern chinch bug after drenching sprigs with insecticidal applications

Treatment*	Insecticide solution concentration (ppm)	Mean ± SD**
Control	0	87.3 ± 10.8 a
Acephate	6,886	86.9 ± 7.9 a
Chlorpyrifos	13,783	87.0 ± 11.6 a
Lambda-cyhalothrin	79	93.0 ± 8.2 a

* acephate = Orthene® TTO, Valent USA Corporation, Walnut Creek, CA chlorpyrifos = Dursban® 50WP, DowElanco, Indianapolis, IN lambda-cyhalothrin = Scimitar® WP, Zeneca Professional Products, Wilmington, DE

** Means in the column followed by the same letter are not significantly different (alpha = 0.005) using Tukey's test (SAS 1996).

Table 3. Percent survival of eggs of the southern chinch bug after topical application with insecticides

Treatment*	Insecticide per Petri Dish (mg AI)	Mean ± SD**
Control	0	84.8 ± 13.8 a
Acephate	3.84	83.6 ± 10.4 a
Chlorpyrifos	6.97	18.4 ± 31.5 b
Lambda-cyhalothrin	0.04	89.2 ± 10.7 a

* acephate = Orthene® TTO, Valent USA Corporation, Walnut Creek, CA chlorpyrifos = Dursban® 50WP, DowElanco, Indianapolis, IN lambda-cyhalothrin = Scimitar® WP, Zeneca Professional Products, Wilmington, DE

** Means in the column followed by the same letter are not significantly different (alpha = 0.05) using Tukey's test (SAS 1996.)

cyhalothrin treatments was not significantly different from the control. However, chinch bug survival in the chlorpyrifos treatment was significantly lower than the three other treatments including the control. Harris and Gore (1971) had previously noted that chlorpyrifos has ovicidal properties against the darksided cutworm, *Euxoa messoria* (Harris).

Adults and nymphs, but not eggs, were killed with all three insecticides applied at recommended field rates. Eggs were not killed by the three insecticides, even when sprigs of St. Augustinegrass were sprayed to drenching. In topical tests, only chlorpyrifos killed eggs when insecticides were applied directly to the eggs. Our data demonstrated that the eggs were not killed in applications of insecticides at recommended field rates because the insecticides, even if ovicidal, did not contact the eggs. This latter statement is corroborated by noting that spraying with chlorpyrifos at recommended rates and to the point of drench did not kill eggs in St. Augustinegrass sprigs, although topical application with the insecticide did kill the eggs. The reason that the insecticides sprayed on St. Augustinegrass did not come in contact with the eggs is largely, if not wholly explained, by the observation of Reinert and Kerr (1973) that the eggs are inserted into protected places. Eggs are often found in crevices at the grass node or hidden between the overlapping grass sheaths at base of the leaf blades. Interestingly, acephate and lambda-cyhalothrin would not have killed the eggs even if the insecticides had come in contact with the eggs. Our data support earlier observations which indicated that eggs of the southern chinch bug are not affected by insecticidal spraying and, thus, multiple treatments may be necessary for effective control of the pest in St. Augustinegrass.

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