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#### SUMMARY

Mating in *Pogonomyrmex badius* was observed at a nest site in South Carolina. The first copulation occurred at 1130 hours; duration of copulation for 3 matings ranged from 59 to 148 s. The females mated with males of the same colony; probability of intercolony mating may be a function of colony density and size.

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## AZADIRACHTIN AFFECTS GROWTH AND SURVIVAL OF IMMATURE TAWNY MOLE CRICKETS (ORTHOPTERA: GRYLLOTALPIDAE)

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*Scapteriscus* spp. mole crickets are the most damaging pests of turf and pasture grasses in the southeastern United States (Walker 1984). *Scapteriscus vicinus* Scudder, the tawny mole cricket, is the more serious of the two immigrant species in this genus occurring in Georgia because of its plant feeding habits. *Scapteriscus borellii* Giglio-Tos, the southern mole cricket, is primarily predaceous and injures turf by its tunnelling activities.

*Azadirachta indica* A. Juss. (Meliaceae), the neem tree belonging to the mahogany family, and its principle active constituent, azadirachtin, have attracted interest for their potential use in integrated pest management programs in a variety of settings. The insecticidal and antifeedant activities of neem-based compounds have been recognized for at least 20 years (Schmutterer & Ascher 1984, 1987, Jacobson 1989, Schmutterer 1990). Limited information is available, however, detailing effects of insect growth regulators on subsurface pests of principal importance in managed turfgrass systems. This study was conducted to examine the lethal and sublethal effects of azadirachtin on *S. vicinus*.

Tawny mole cricket adults were collected in April, 1992 using an acoustic trap similar to that described in Walker (1982) and confined to PVC cages containing sand and turfgrass. Eggs collected from these cages were held on moist sand in 120-ml plastic specimen cups at 30°C until emergence. Eighty nymphs were randomly selected from a cohort that hatched on June 3. Nymphs were held individually in 120-ml plastic cups. Each cup contained 60 ml of sand and common bermudagrass seedlings which had been germinated two weeks previously on a greenhouse mist bed.

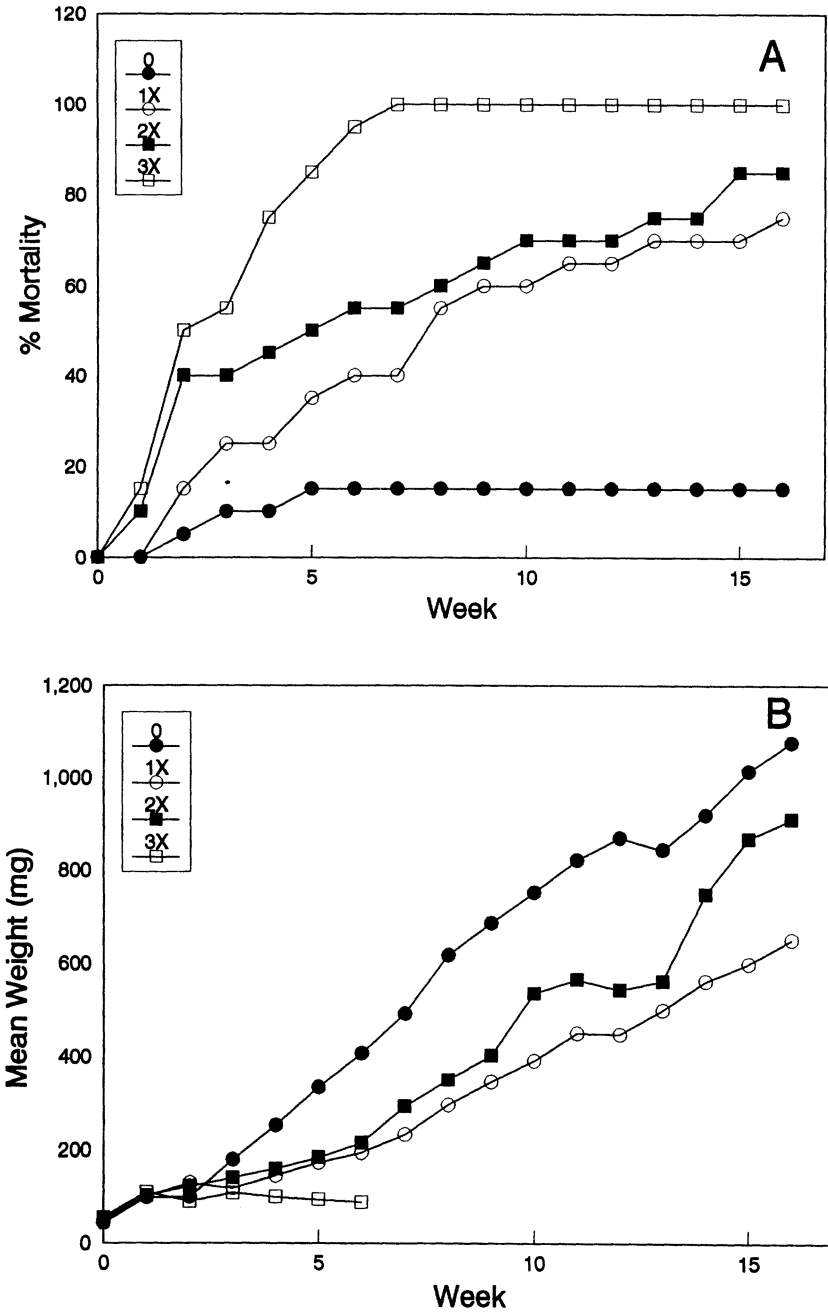


Fig. 1. Mean percent mortality (A) and mean weight (B) of tawny mole crickets induced by application of 0.3% azadirachtin at 2.3 liter/378.5 liter (1X), 4.7 liter/378.5 liter (2X), 7.1 liter/378.5 liter (3X), or water (0).

Five replicates of four individual nymphs were arranged in a randomized complete block design for a total of 20 crickets assigned to each of four treatments; 0, 2.3 (1X), 4.7 (2X), or 7.1 (3X) liters of 0.3% azadirachtin/378.5 liters of water. Each cricket was measured across the widest part of the pronotum and weighed immediately prior to confinement within the cups. Materials were applied to the bermudagrass/sand surface of each cup using a pipet four hours after crickets were caged. The control group received the same volume of water without azadirachtin. Crickets were held in an environmental chamber at 30°C and a photoperiod of 15:9 (L:D).

One and two weeks after initial application crickets were removed from the cups, weighed and measured. Mortality of individuals was recorded. Crickets were introduced to new cups containing sand and bermudagrass. Treatments were then re-applied for a total of three weekly applications of azadirachtin on July 17, 24, and 31. Thereafter, mortality and nymphal size were recorded weekly when crickets were transferred to new rearing containers. The experiment was terminated when all surviving individuals had molted to the adult stage. Data were subjected to the GLM procedure using PC SAS (1985). Mean separation was accomplished using a least significant difference test (Sokal & Rohlf 1981). Regression analysis was used to evaluate the influence of initial weight or pronotal width on longevity. Duration of development of males vs. females was compared using student's t-test.

Ten female and seven male crickets required 21.1 and 20.0 weeks, respectively, to complete the nymphal stage in the untreated controls at 30°C ( $t = -1.5$ ,  $DF = 15$ ,  $P > 0.05$ ). Six female and one male cricket completed development in the remaining treatments. Thus, seventeen weeks after the initial application was made to six week

TABLE 1. AZADIRACHTIN INDUCED MORTALITY AND REDUCED WEIGHT GAIN IN TAWNY MOLE CRICKETS.<sup>1</sup>

Treatment	Mean Weight (mg)	Mean No. Crickets (% Mortality)
<u>Pretreatment</u>		
0	41.5 ns <sup>2</sup>	4.0 ns
1X	48.5	4.0
2X	50.0	4.0
3X	54.0	4.0
<u>4 Weeks Post Treatment</u>		
0	251.4 a	3.6 a (10)
1X	145.2 b	3.0 ab (25)
2X	159.0 b	2.2 bc (45)
3X	99.1 c	1.0 c (75)
<u>8 Weeks Post Treatment</u>		
0	617.0 a	3.4 a (15)
1X	295.8 b	1.8 b (55)
2X	348.9 b	1.6 b (60)
3X	—	0 c (100)
<u>16 Weeks Post Treatment</u>		
0	1075.0 a	3.4 a (15)
1X	650.3 b	1.0 b (75)
2X	909.7 a	0.6 b (85)
3X	—	0 c (100)

<sup>1</sup>Means within columns within a date followed by the same letter are not significantly different ( $P > 0.05$ ), LSD test.

<sup>2</sup>ns = nonsignificant.

old crickets, mortality in the 3X, 2X, 1X, and controls was 100, 85, 75, and 15%, respectively (Fig. 1, Table 1). Azadirachtin applied as described was an effective insecticide for small (ca. third instar) tawny mole crickets. Two weeks were required to achieve 50% population reduction in the 3X treatment, with 100% mortality occurring at seven weeks following initial application. Mortality in the control group averaged 15% by the fifth week and stayed at that level for the remainder of the trial period.

Average nymphal weight of crickets surviving treatment was significantly ( $P < 0.05$ ) less than that of the untreated control crickets (Fig. 2, Table 1). Correspondingly limited tunnelling and feeding activities by treated crickets were also observed. Numerous records exist of antifeedant effects of neem derivatives on insects of different orders (e.g., Jacobson 1986) in addition to effects on metamorphosis, suggesting enhanced suitability for use in integrated pest management programs. Too few individuals survived treatment to determine the influence of azadirachtin on fecundity when applied to the nymphal stage. Abnormally low adult weights may, however, be indicative of reduced reproductive potential.

Longevity of treated crickets was highly influenced by initial nymphal weight (Fig. 3), as indicated by significant regressions at 1X and 2X applications ( $F = 10.3, P < 0.005$ ;  $F = 23.7, P < 0.001$ ). This suggests the existence of a threshold size for susceptibility to insect growth regulator (molt disrupting) effects of azadirachtin for tawny mole crickets. This further indicates the importance of timing of application of azadirachtin to target the most vulnerable stage (and age within a stage) of development. Initial pronotal width was also a reasonable predictor of longevity ( $F = 17.4, P < .0006, r^2 = 0.40$ ).

Interest in botanical insecticides as alternatives to synthetic pesticides will continue to increase. Insect growth regulators are attractive candidates for use against turfgrass pests because of their relatively low mammalian toxicity. Recent laboratory and field tests (Monthean & Potter 1992) revealed excellent activity of a nonsteroidal ecdysone

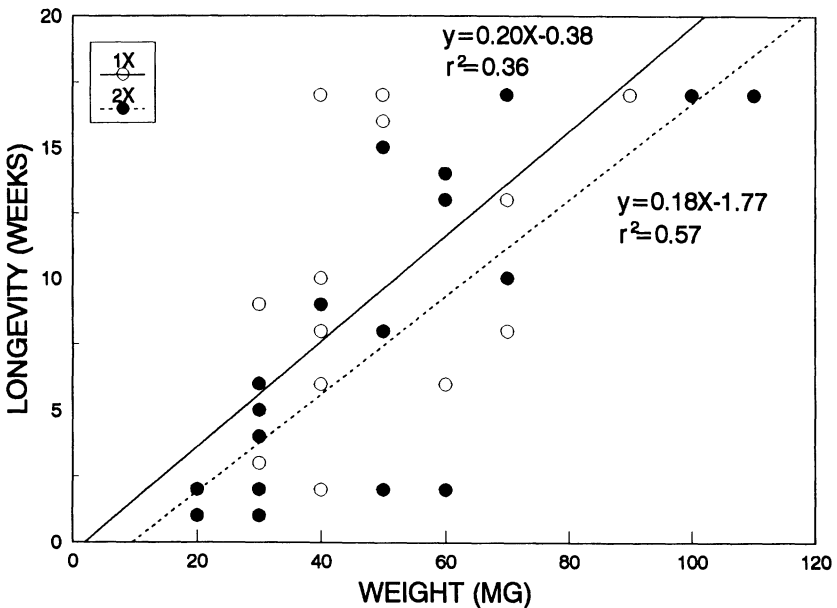


Fig. 2. Relationship between initial weight of tawny mole crickets and longevity after treatment with 0.3% azadirachtin at 2.3 liter/378.5 liter (1X) or 4.7 liter/378.5 liter (2X).

agonist against surface-feeding armyworms and subterranean white grubs. Field applications of azadirachtin show similar high rates of activity against surface-feeding caterpillars (unpublished data). Research demonstrating effects of azadirachtin application to field populations of subterranean mole crickets is needed.

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#### SUMMARY

Antifeedant and molt disruption effects of 0.3% azadirachtin applied once per week for three weeks were observed in nymphal tawny mole crickets, *Scapteriscus vicinus* Scudder, in laboratory tests. The highest concentration of formulated product (7.1 liter/378.5 liter) resulted in 100% mortality by the seventh week after initial application, compared with fifteen percent mortality in the control, and 85 and 75% mortality in the 4.7 and 2.3 liter/378.5 liter treatments, respectively. Crickets surviving treatment grew more slowly and tunneled less than their untreated counterparts.

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