POTENTIAL RESISTANCE IN ZOYSIAGRASSES TO TAWNY MOLE CRICKETS (ORTHOPTERA: GRYLLOTALPIDAE)

S.K. BRAMAN[1], A.F. PENDLEY[1], R.N. CARROW[2] AND M.C. ENGELKE[3]
[1] Department of Entomology and [2] Department of Crop & Soil Science, University of Georgia, College of Agriculture and Environmental Sciences Experiment Stations, Georgia Station, Griffin, GA 30223

[3] Texas A&M University, Research & Extension Ctr., 17360 Coit Road., Dallas, TX 75252

ABSTRACT

Reduction in growth by tawny mole crickets, *Scapteriscus vicinus* Scudder, at densities equivalent to 15 adults per 0.09 m^2 varied among nine experimental and three commercially available zoysiagrass (*Zoysia* Willd.) cultivars. Reductions in root dry weights after a four week infestation period were similar among all cultivars, and averaged 27.1% less than non-infested controls. Shoot dry weight reduction was most severe for DALZ 8516, DALZ 9006, and Meyer zoysia. The cultivars that retained the highest percentage of their normal growth were DALZ 8502, DALZ 8514, DALZ 8701, and Emerald zoysia. Crickets fed on cultivars that were least damaged usually produced the least number of eggs. However, when the most severely injured selection (DALZ 8516) served as the host, a similarly low number of eggs was observed. Crickets fed on Meyer zoysia and DALZ 8508 produced the greatest number of eggs.

Key Words: Host plant resistance, *Scapteriscus* spp., turfgrass

RESUMEN

La reducción del crecimiento de los grillotopos aleonados, Scapteriscus vicinus Scudder, a densidades equivalentes a 15 adultos por 0.09 m2, varió en nueve cultivares experimentales y tres comerciales de hierba zoysia (Zoysia Willd.). Las reducciones en el peso seco de las raices fueron similares en todos los cultivares, luego de un período de 4 semanas infestación, y promediaron un 27.1% menos que los testigos no infestados. La reducción en el peso seco de los brotes fue mas severa en las zoysias DALZ 8516, DALZ 9006 Y Meyer. Los cultivares que retuvieron el mas alto porcentaje de su crecimiento normal fueron DALZ 8502, DALZ 8516, DALZ 8701 y Emerald. Los grillos que se alimentaron de los cultivares menos dañados, usualmente produjeron menor numero de huevos. Sin embargo, cuando el clon mas severamente danado (DALZ 8516) sirvió como hospedante, fue observado un numero de huevos similarmente bajo. Los grillos alimentados de las zoysias Meyer y DALZ 8508 prdujeron el mayor número de huevos.

Mole crickets in the genus *Scapteriscus* have become the most serious pests of turfgrasses in the southeastern United States since their entry into this country, probably via the ballast of ships at approximately 1900 (Walker & Nickle 1981, Nickle & Castner 1984, Walker 1984). The tawny mole cricket, *Scapteriscus vicinus* Scudder, is the

more damaging of the two species common in Georgia. Management of these pests has involved chemical, cultural, and classical biological control efforts (Walker 1984, Hudson et al. 1988).

Laboratory and field screening has identified turfgrass genotypes that are relatively resistant, tolerant, or less preferred by various insects and mites (see reviews by Reinert 1982, Quisenberry 1990). Limited research has focused on resistance to mole crickets and white grubs (Potter & Braman 1991). Resistant cultivars are needed to provide a safe, economical control strategy for these serious turf pests. Herein, we report the results of a greenhouse study that evaluated nine experimental and three commercially available zoysiagrass (*Zoysia* Willd.) cultivars for their susceptibility to mole cricket injury and suitability as oviposition substrates.

MATERIALS AND METHODS

Zoysiagrass plugs (4.6 x 4.6 x 6.3 cm) of 12 cultivars were transplanted into granular calcinated clay (Turface, Applied Industrial Materials, Corp., Deerfield, IL) in plastic pots (15 cm diam) in a greenhouse. Pots were watered daily and fertilized once per week with a solution containing 250 ppm NPK (Peters® 20-20-20). Milorganite was applied (2.25 gm per pot) once per month. Turf was cut weekly to a height of 5 cm Experimental cultivars included a range of leaf textures, colors, and growth rates (Carrow 1992). Six months after transplanting, plugs were transferred to PVC tubes (38 cm tall; 15 cm diam) containing fine sand (children's play sand). These tubes were covered at the bottom with plastic petri dish lids and were placed into wooden box frames and equipped with drip irrigation. Watering and fertilization regimes were maintained as before for one month before infestation with adult crickets.

Adult *S. vicinus* were collected in Tifton, GA during April, 1992 using a standard acoustic trap similar to that described by Walker (1982). Twenty-four treatments (12 cultivars each infested with mole crickets and the same 12 cultivars non-infested) were arranged in a randomized complete block design with 7 replications (168 total tubes). Two female and one male mole cricket were introduced into each of the 84 tubes designated as infested treatments (252 total crickets were used). Each container was covered with 32-mesh saran screen (Chicopee Manufacturing Co., Gainesville, GA) to prevent escape of crickets. Non-infested cages were also covered with screens to ensure equivalent light, temperature and humidity conditions. Water and fertilizer regimes were maintained as described previously. Greenhouse microplots were destructively sampled after four weeks of exposure to crickets.

Top growth was clipped to a height of 5 cm two weeks after crickets were introduced into the PVC containers. Clippings were placed in paper bags, oven dried for 7 days, and then weighed. Top growth dry weight was also recorded four weeks after cricket infestation. Numbers of green shoots per 18 cm^2, selected at random from the 182 cm^2 surface of each tube, and root dry weights were determined at the termination of the experiment.

Sand from each experimental PVC microplot (1343 kg total for all plots) was sifted to recover mole cricket adults and eggs. Adult survival and numbers of eggs were recorded and compared among cultivars using the GLM procedure (SAS 1985). Numbers of eggs per cultivar were also regressed against injury. Means were separated following a significant analysis of variance by a least significant difference test (Sokal & Rohlf 1981). Growth reductions of roots, shoots, and shoot density (expressed as a percentage of non-infested plants for each cultivar) were transformed using an arcsine square root of the proportion before being subjected to analysis of variance and mean separation using a least significant difference test.

Results and Discussion

Reduction in top growth two weeks after infestation was statistically similar among all cultivars ($F=1.50$; df=11,66; $P>0.05$; Table 1). Growth of cricket-infested plants averaged 67.9% of non-infested plants at that time. Reduction in shoot dry weights differed ($F=4.17$; df=11,66; $P=0.0001$) among cultivars four weeks after infestation. DALZ 8516 achieved only 10.1% of its normal growth when infested with mole crickets. DALZ 8502, however, maintained 55% of its normal growth even under this high infestation level. The pest density used in this study was equivalent to 15 adult crickets per 0.09 m^2 (= 1 ft^2). This represents more than 15 times the pest density requiring chemical intervention to protect turf. Total reduction in top growth for the entire four week period ranged from 35.7 to 74.8% (inverse of the extremes presented in Table 1).

Shoot density followed a pattern similar to that of clipped dry weights. Root weight reduction, however, was similar ($F=1.45$; df=11,66; $P>0.05$) among all cultivars evaluated and averaged 72.9% of non-infested controls (Table 1). The majority of the damage observed was confined to the crown of each infested zoysiagrass plug. Dead turf was first visible at the center of each plug and expanded outward with increasing time of exposure.

Adult survival at the termination of the four week exposure period was not significantly affected by cultivar ($F=1.58$; df=11,66; $P>0.05$) and averaged 70.0% on all cultivars (data not given). Egg production during this time period, however, differed ($F=2.63$; df=11,66; $P=0.003$) among cultivars (Fig.1). Mean numbers of eggs per cultivar ranged from 4.5 to 35.4. In general, tubes containing cultivars that were least damaged (DALZ 8502, DALZ 8514, Emerald, DALZ 8701, and DALZ 8507) also contained lower numbers of eggs, except for DALZ 8516, which was the most severely damaged, but contained relatively few eggs. Meyer zoysia and DALZ 8508 supported the greatest egg production. Regression of number of eggs per cultivar against injury was significant ($F=16.9$; df=11,82; $P=0.0001$; $r^2=0.2$), however, the low r^2 value indicated that plant injury explained little of the variation for numbers of eggs laid.

TABLE 1. Zoysiagrass response to adult S. vicinus induced injury.

	Mean ± s.e. % of Noninfested Controls (n=7)[1]				
	Shoot Dry Weight			Root Dry	Shoot Density
Cultivar	2 wk	4 wk	Total	Weight	per 18 cm^2
DALZ8502	87.7 ± 0.2	55.4 ± 0.1a	64.3 ± 0.1a	72.0 ± 0.1	49.8 ± 0.1b
DALZ8514	73.0 ± 0.1	41.6 ± 0.1ab	55.0 ± 0.1ab	97.8 ± 0.1	43.9 ± 0.1bc
Emerald	100.3 ± 0.5	41.0 ± 0.1ab	54.7 ± 0.1ab	72.5 ± 0.1	41.0 ± 0.1bc
DALZ8701	72.4 ± 0.1	42.2 ± 0.1ab	52.9 ± 0.1ab	72.5 ± 0.1	80.9 ± 0.2a
DALZ8507	75.5 ± 0.2	34.1 ± 0.1abc	50.7 ± 0.1ab	75.9 ± 0.1	30.9 ± 0.1abc
DALZ8508	75.6 ± 0.1	23.0 ± 0.1bc	41.6 ± 0.1abc	69.1 ± 0.1	23.0 ± 0.1ab
El Toro	59.4 ± 0.1	27.6 ± 0.1bc	41.3 ± 0.1abc	72.3 ± 0.1	43.5 ± 0.2bc
DALZ8512	60.6 ± 0.1	25.1 ± 0.1bc	38.8 ± 0.1bc	76.2 ± 0.1	20.2 ± 0.1cd
DALZ8501	58.2 ± 0.1	21.5 ± 0.1bc	37.4 ± 0.1bc	69.5 ± 0.1	28.7 ± 0.1bc
Meyer	55.5 ± 0.1	19.1 ± 0.1bc	34.9 ± 0.1bc	62.9 ± 0.1	23.1 ± 0.1bcd
DALZ9006	48.6 ± 0.1	25.1 ± 0.1bc	34.7 ± 0.1bc	60.5 ± 0.1	34.7 ± 0.1bcd
DALZ8516	49.0 ± 0.1	10.1 ± 0.1bc	25.2 ± 0.1c	72.1 ± 0.1	9.0 ± 0.1d

[1]Means within a column followed by no letter or the same letter are not significantly different (P>0.05;LSD test)

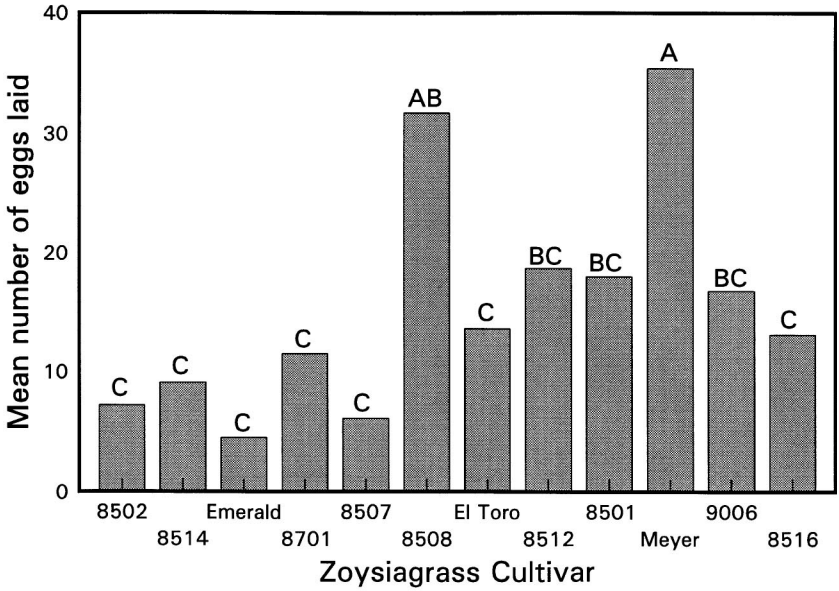

Fig. 1. Mean numbers of eggs laid during a four week period on 12 zoysiagrass cultivars. Bars with different letters were significantly different (P<0.05;LSD).

Results of this no-choice evaluation of 12 cultivars of zoysiagrass under intense mole cricket pressure revealed distinct differences in susceptibility to injury and suitability for egg production by the tawny mole cricket. Reinert & Busey (1984) showed that mole crickets preferred the finer textured varieties within a species of grass. They discussed the need to define the relative contribution of nonpreference and host plant tolerance. The results reported in the present study suggest a similar tolerance of injury and reduced suitability for oviposition among fine textured (DALZ 8502) and wider bladed (DALZ 8514) zoysiagrass selections. In large monocultures, such as golf courses, parks, commercial properties, etc., nonpreference in the absence of other resistance mechanisms has a limited value. The potential for resistance in zoysiagrass to damage by tawny mole crickets demonstrated in this study offers characteristics in addition to nonpreference that should permit selected cultivars to be planted with reduced risk of mole cricket injury.

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