Susceptibility of Genera and Cultivars of Turfgrass to Southern Chinch Bug Blissus insularis (Hemiptera: Blissidae)

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SUSCEPTIBILITY OF GENERA AND CULTIVARS OF TURFGRASS TO SOUTHERN CHINCH BUG *BLISSUS INSULARIS* (HEMIPTERA: BLISSIDAE)

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Abstract

The southern chinch bug (*Blissus insularis* Barber) is the most damaging insect pest of St. Augustinegrass (*Stenotaphrum secundatum* Walt. Kuntze), across the southern U.S.A. Susceptibility to the southern chinch bug and reproductive potential of the bugs on 24 cultivars from 7 genera in 8 turfgrasses were evaluated under greenhouse conditions. *Stenotaphrum secundatum* ('Raleigh', 'Texas Common', and 'Captiva') cultivars were the most susceptible among all the turfgrass genera and each produced populations ≥97.5 bugs per 15-cm diameter plant within the 11-week test period from Jul to Sep 2008. Substantial populations also developed on zoysiagrass (*Zoysia* spp.) ('Emerald', 'Empire', 'Palisades', and 'Zorro') cultivars and on '609' buffalograss (*Buchloë dactyloides* (Nutt.) Engelm.). Low population development was recorded on cultivars of bermudagrass (*Cynodon* spp.), centipedegrass (*Eremochloa ophiuroides* (Munro) Hack.), seashore paspalum (*Paspalum vaginatum* Swartz), bahiagrass (*Paspalum notatum* Flugge), and tall fescue (*Festuca arundinacea* Schreb.).

Key Words: turfgrass pests, host plant resistance, host range, pest management, host plants

Resumen

La chinche sureña del pasto (*Blissus insularis* Barber) es el insecto mas dañino para St. Augustingrass (*Stenotaphrum secundatum* Walt. Kuntze), en el sur de U.S.A. La susceptibilidad de materiales y el potencial reproductivo del insecto fueron evaluados en 24 cultivares pertenecientes a siete géneros de pasto para césped en condiciones de invernadero. Los cultivares de *S. secundatum* ('Raleigh', 'Texas Common', y 'Captiva') fueron los mas susceptibles con poblaciones de ≥97.5 chinches por planta en maceta de 15 cm de diámetro, en 11 semanas de evaluacion de julio a septiembre 2008. Considerables niveles de poblaciones también fueron registrados en zoysiagrass (*Zoysia* spp.) (cultivares 'Emerald', 'Empire', 'Palisades', y 'Zorro'), así como en el cultivar '609' de buffalograss (*Buchloe dactyloides* (Nutt.) Engelm.). Bajos niveles de desarrollo se registraron en cultivares de bermudagrass (*Cynodon* spp.), centipedegrass (*Eremochloa ophiuroides* (Munro) Hack.), seashore paspalum (*Paspalum vaginatum* Swartz), bahiagrass (*Paspalum notatum* Flugge), y tall fescue (*Festuca arundinacea* Schreb.).

The authors provided the translation by Carlos Campos

The southern chinch bug (SCB) (*Blissus insularis* Barber) (Hemiptera: Blissidae) is the most damaging insect pest of St. Augustinegrass (*Stenotaphrum secundatum* Walt. Kuntze), across the southern U.S.A., Bermuda, Mexico, and throughout the Caribbean Archipelago (Henry & Froeschner 1988; Sweet 2000). In the U.S.A. it is found from South Carolina to Florida, westward to Oklahoma and along the Gulf Coast to Texas and in California, Hawaii, Puerto Rico, and Guam (Reinert et al. 1995; Mortorell 1976; Vittum et al. 1999).

This pest begins to damage St. Augustine lawns as early as Mar in parts of Southern Florida and Texas and first instars have been found during all 12 months in Southern Florida (Reinert, unpublished data). Damage begins as small patches of dead grass early in the season, with entire lawns killed as the summer progresses. During heavy infestations, large populations will progress from one lawn to another as they move from one city block to the next (Reinert & Kerr 1973). According to Painter (1928) *B. leucopterous* L. damages grasses by "removal of the synergic food-bearing solutions which flow to the roots by way of the phloem; the stopping up of the sieve tubes, and perhaps also the removal of water from the xylem, together with the stoppage of the tracheids." It is believed that this same process takes place when SCB feeds at the node and the crown area of *Stenotaphrum*, which mimics the effects of a toxin being injected into the plant. SCB infestations soon turn the grass yellow, brown, and it eventually dies within a few days. Both nymphs and adults feed in aggregates in localized areas early in the season, with these areas coalescing

into large dead areas or entire lawns as the season progresses (Reinert et al. 1995).

Stenotaphrum is cultivated extensively in subtropical and tropical climates around the world (Busey 2003; Sauer 1972). It is used widely across the southern U.S.A. as a turfgrass in urban landscapes, including residential and commercial lawns, parks, some sports complexes, and as a pasture grass (Busey 2003; Sauer 1972). *Stenotaphrum* has long been considered the primary host of the SCB (Reinert & Kerr 1973; Reinert et al. 1995; Vittum et al. 1999). The SCB has been identified on 9 other grass hosts (Cherry & Nagata 1997; Slater 1976).

Resistant cultivars 'Floratam', 'Floralawn', 'FX-10', and 'Captiva' have been developed and deployed to help manage this pest (Busey 1993; Cherry & Nagata 1997; Dudeck et al. 1986; Horn, et al. 1973; Reinert & Dudeck 1974). Recently, populations of SCB have been identified that have overcome the resistance in each of these cultivars (Busey & Center 1987; Cherry & Nagata 1997; Reinert 2008).

This study was established to characterize the reproductive potential and development of the SCB on 24 cultivars of turfgrass from 7 genera in 8 turfgrasses used across the Southern U.S.A.

MATERIALS AND METHODS

This study was conducted under greenhouse conditions during Jul-Sep 2008 at the Texas AgriLife Research and Extension Center at Dallas, TX, U.S.A. A total of 24 cultivars (Table 1) including St. Augustinegrass, (5) zoysiagrass (*Zoysia* spp.) (5), bermudagrass (*Cynodon* spp.) (5), buffalograss (*Buchloë dactyloides* (Nutt.) Engelm.) (2), centipedegrass (*Eremochloa ophiuroides* (Munro) Hack.) (1), seashore paspalum (*Paspalum vaginatum* Swartz) (2), bahiagrass (*Paspalum notatum* Flugge) (2), and tall fescue (*Festuca arundinacea* Schreb.) (2) were evaluated for their susceptibility to SCB infestation and development.

Plugs of grass grown either in the field or greenhouse were divided and planted into 18-cell trays and allowed to grow to cover the whole cell. Cells measured 7.5 × 7.5 cm and 4 cm deep. Plants were fertilized bi-monthly during establishment with Miracle-Gro All Purpose fertilizer (24-8-16 + B (200 ppm), Cu (700 ppm), Fe (1500 ppm), Mn (500 ppm), Mo (5 ppm), Zn (600 ppm)) (Scotts, 14111 Scottslawn Road, Marysville, Ohio) at ~8.25 kg of N ha^{-1} month^{-1}. Once sufficient growth was achieved to provide near complete coverage of the entire cell (ca. 14 weeks), plugs from 4 cells of each cultivar were repotted into 15-cm diam plastic pots and allowed to establish for 2 weeks. Each pot was filled with soil within 2.5 cm of the top. Potted plants were then fitted with a cylindrical plastic cage (a modification of Starks & Burton 1977) to exclude extraneous insects and to confine the SCB. Cages were made of Lexan® 8010 Film (0.2 mm thickness) (General Electric Plastics, 4600 AC Bergen op Zoom, The Netherlands) and measured 32.5 cm tall and 2.5 cm in diam and were vented on opposite sides with two, 8-cm diameter ventilation holes to allow air circulation within the cage. Ventilation holes and the top end of the cage were covered with Voile 118" Decorator Fabric in White # 235-004-81 (Hancock Fabrics, Plano, Texas, hancockfabrics.com) cut 15 mm larger than the holes and secured with glue.

On 6-8 Jul 2008, 10 adults (5 male and 5 female) were introduced into each cage. Before bugs were introduced, each pot was filled to the top with fine topdressing sand. When each cage was inserted over the plant in the pot the area between the cage and the wall of the pot was backfilled with additional sand to form an escape-proof barrier to the confined insects.

Pots were maintained in the greenhouse in a randomized complete block design with 4 replicates and held on full size aluminum sheet pans that were 45 cm × 65 cm 18 gauge (WINCO Industries Co., Lodi, New Jersey). Potted plants were provided sub-surface irrigation by filling the pans with 1.5-2.0 cm of water as needed to avoid wilting of the test grasses. Watering was done every 3-4 d. After the pots were allowed to soak-up water for about 2 h, the excess water was drained to avoid causing deterioration of the root system. Cages had to be opened about every 2 weeks so the grass could be clipped, since there was not enough room for the continued plant growth. The clipping process was done over one of the aluminum sheet pans so that any SCB adults or nymphs that were removed with the clippings or that tried to escape could be collected with a hand aspirator and returned to the grass when the cage was put back in the pot.

SCB for this experiment were collected by vacuum sampling the bugs from a residential lawn of *S. secundatum* in the Houston, Texas area. A modification of the procedure for vacuuming (Nagata & Cherry 2007; and personal communication) was used. An Echo Shred 'N' Vac® model ES-210 (Echo Inc., Lake Zurich, Illinois) leaf blower/vacuum was modified by cutting-off the distal 15-cm end of the vacuum tube. This unit has an 87.5 cm long intake tube (11.25 cm diam) and produces 225.31 km/h (140 mph) of vacuum. A 20-cm long piece of French drain pipe (10.3 cm outside diameter) that fit loosely within the intake tube was shimmed to fit the inside diam of the vacuum tube by wrapping it with duct tape, close to each end, so it would fit snugly inside to reattach the 2 pieces of the intake vacuum tube. When the 2 pieces of tube were re-joined, a 20-cm diameter piece of polyester Tricot interlocking netting (mesh size ca. 9.6 × 8 per cm, 24 × 20 per inch) cut

TABLE 1. Rate of reproduction and development of southern chinch bug on cultivars and genera of turfgrass.

Genera of grasses Cultivars	Nymphs			Adults[a, b] (A)	Total[a, b] (N + A)
	1st [a, b]	5th[a, b]	Total nymphs[a, b] (N)		
Stenotaphrum secundatum (St Augustinegrass)					
Raleigh	34.3 a*	45.8 a*	163.0 a*	17.8 a*	180.8 a* A**
TX Common	25.3 a	30.0 b	117.5 ab	4.3 b	121.8 b A
Captiva	30.7 a	18.5 b	93.3 b	4.3 bc	97.6 b A
FX-10	1.0 bc	0.0 c	1.3 d	0.0 d	1.3 d B
Floratam	0.8 bc	0.3 c	1.1 d	0.0 d	1.1 d B
Zoysia spp. (Zoysiagrass)					
Palisades	5.8 b	0.5 c	16.5 c	2.5 bcd	19.0 c A
Emerald	1.3 bc	1.0 c	8.8 cd	1.0 cd	9.8 cd AB
Zorro	1.3 bc	2.3 c	8.0 cd	0.0 d	8.0 cd AB
Empire	0.8 bc	0.8 c	4.3 cd	1.3 bcd	5.6 cd AB
Cavalier	0.0 c	0.0 c	0.3 d	0.8 d	1.1 d B
Buchloë dactyloides (Buffalograss)					
609	3.7 bc	0.3 c	7.5 cd	2.5 bcd	10.0 cd ns
Prairie	0.8 bc	0.0 c	1.0 cd	0.8 d	1.8 d
Festuca arundinacea (Tall Fescue)					
Rebel	2.0 bc	1.0 c	5.0 cd	1.0 cd	6.0 cd ns
Paladin	2.8 bc	0.0 c	3.3 cd	0.8 d	4.1 cd
Cynodon spp. (Bermudagrass)					
Tifton 10	1.3 bc	0.5 c	2.8 cd	0.3 d	3.1 cd ns
Tifway	0.0 c	1.3 c	1.3 cd	0.0 d	1.3 d
Texturf 10	0.3 c	0.0 c	0.5 d	0.0 d	0.5 d
TifSport	0.0 c	0.0 c	0.0 d	0.0 d	0.0 d
Common	0.0 c	0.0 c	0.0 d	0.0 d	0.0 d
Paspalum notatum (Bahiagrass)					
Argintine	1.8 bc	0.0 c	2.0 cd	0.0 d	2.0 d ns
Pensacola	0.0 c	0.0 c	0.0 d	0.0 d	0.0 d
Paspalum vaginatum (Seashore Paspalum)					
Seadwarf	0.3 c	0.0 c	1.5 cd	0.5 d	2.0 cd ns
AZ-1	0.0 c	0.0 c	0.0 d	0.0 d	0.0 d
Eremochloa ophiuroides (Centipedegrass)					
Tifblaire	0.0 c	0.3 c	0.3 d	0.3 d	0.6 d

[a]Mean number of 1st, 5th instars, total nymphs, adults, and total population on each turfgrass cultivar after an 11-week development period.

[b]Data in each column was transformed as $\sqrt{(n + 0.001)}$ for analysis; untransformed means are reported.

*Means in a column followed by the same lower case letter are not significantly different by Fishers protected LSD ($P = 0.05$) (Analysis among all turf groups).

**Means in the total column for each grass followed by the same upper case letter are not significantly different by Fishers protected LSD ($P = 0.05$) or by Student's *t*-test. (Analysis within a turf group only).

from the material of a BioQuip® superior aerial net (Cat. No. 7215NA, BioQuip® Products, Rancho Dominguez, CA), material was inserted at the outer end of the French drain insert to form a 15-cm deep collecting basin to catch insects that were dislodged as the grass was vacuumed.

The potted plants were maintained in the greenhouse until the week of 22 Sep 2008, when the total number of bugs produced on each plant was assayed. Plants in the experiment (1 replicate at a time) were individually submerged in 18.9-liter plastic buckets of water (the plant was weighted with a stone so it would stay submerged) and all SCB nymphs and adults that floated to the surface within 30 min were removed, identified by instars, and counted. After a plant had been submerged for 5 min and again at 15 min, the canopy of the plant was agitated by

hand to dislodge any bugs that had failed to let loose and float to the surface. This procedure was a modification of the flotation method that has been used widely to accurately assay field populations of SCB for chemical efficacy tests (Reinert 1974, 1982).

Data Analysis and Statistics

Data for the number of SCB for each growth stage for each cultivar were analyzed by Analysis of Variance (ANOVA) (PROC GLM) for a randomized complete block design with 4 replications to test for differences in the number of progeny that had developed on each cultivar. Data for cultivars were also grouped by species of grass (*Zoysia* and *Cynodon* each contained 2 species, but were analyzed by genus only) and analyzed to determine suitability among the 8 types of turfgrass tested. The transformations √ (n + 0.001) was used on each data set to achieve normality and homogeneity of variance before analysis (Kuehl 2000) but untransformed means are presented. Means were compared at the 5% level of significance with Fisher's least-significant difference (LSD) multiple range test. For the total population column, means were also compared within each grass genera by Student's *t*-test (SAS Institute 2009).

Results and Discussion

This method of caging the SCB on potted grass plants in a no-choice experiment worked well to assay the reproductive and developmental potential on each cultivar. Caging was necessary to confine the bugs on the grasses, but the main problem with this type and size of cage was that cages were not large enough to accommodate the growth potential of several of the grasses, and they had to be opened during the experiment to clip and remove leaf material from many of the cultivars. The modified Echo® blower/vacuum also worked well for collecting large numbers of SCB specimens for this type of study.

Stenotaphrum (St. Augustinegrass)

Stenotaphrum, as expected, served as the best host among the 8 turfgrass groups. The highest population was produced on 'Raleigh' with all 5 instars and adults present in substantial numbers for a mean of 163.0 nymphs, 17.8 adults, and a total population of 180.8 bugs per plant after the 11-week test period (Table 1). 'Texas Common' was the second best host (117.5 nymphs, 121.8 total), followed by 'Captiva' with 93.3 nymphs and 97.5 total bugs produced on it. Analysis conducted across all 8 groups of turfgrass showed that Raleigh produced significantly more SCB than either Texas Common or Captiva, but all 3 cultivars serve as good reproductive hosts and all 3 mean

populations far exceeded the accepted damage threshold level of 20 to 30 bugs per 0.1 m² (Reinert 1972; Buss & Unruh 2006). The highest individual SCB population on any of the replicate plants of Raleigh, Texas Common, and Captiva was 311, 252, and 155, respectively. Neither 'FX-10' nor 'Floratam' served as an acceptable host with this population of SCB and they yielded only an average of 1.3 and 1.1 total bugs, respectively. Moreover, all of the bugs on these 2 cultivars had developed on only 1 replicate plant. Additionally, they were all first instars, except for 1 third instar on 1 of the FX-10 replicate plants and 1 fifth instar on 1 Floratam replicate plant. Analysis conducted only on the 5 cultivars of *Stenotaphrum* showed that population levels on FX-10 and Floratam were not significantly different, and they were significantly lower than those on the 3 susceptible cultivars (Raleigh, Texas Common, and Captiva).

In a related study in a lab no-choice experiment with the same population of SCB, adult survival was high on Raleigh, Texas Common, and Captiva (72-78%), but survival on Floratam and FX-10 was only 48 and 58%, respectively, after 7 d of confinement (Reinert unpublished data). However, when Floratam and FX-10 were first released (Horn et al. 1973; Busey 1993), both cultivars consistently provided >80% antibiosis within 7 d for populations of SCB adults that were collected from lawns in Florida (Reinert & Dudeck 1974; Reinert 1978). More recently, however, Cherry & Nagata (1997) showed that oviposition of eggs was high and survival on Floratam, Seville, Bitterblue, and FX-10 cultivars was 88.6 to 75.6% for populations of SCB collected from Florida lawns.

Zoysia (Zoysiagrass)

Among the 5 *Zoysia* cultivars, 'Palisades' served as the best host for SCB with the developing population consisting of all 5 instars and adults. A mean of 16.5 nymphs and 19.0 total bugs had developed on this cultivar during the 11-week test period. When the *Zoysia* cultivars were analyzed either among the total cultivars or separately for the genus, the same statistical separations were recorded (Table 1). Palisades produced a significantly higher number of SCB than 'Cavalier' (mean total of only 1 SCB), but the population on Palisades was not significantly higher than either 'Emerald', 'Zorro', or 'Empire'.

Although *Zoysia* is not normally considered a primary host of the SCB (Reinert et al. 1995), this study shows certain cultivars, Palisades along with Emerald, Zorro, and Empire can serve as acceptable reproductive hosts with mean development of ≥5.5 total bugs during this study. This would be an equivalent of 31 bugs per 0.1 m², which is within the considered threshold of damage on *Stenotaphrum*. Three of the replicate

plants of Palisades had total populations >23 SCB. Also, 1 replicate plant each of Zorro, Emerald, and Empire had total populations of 27, 26, and 14 SCB, respectively. Population development on Cavalier in the present study with *B. insularis* was the lowest among the *Zoysia* cultivars tested with an average of 1.1 bugs per replicate plant.

Studies with a related *Blissus* species, the western chinch bug (*B. occiduus* Barber*)*, showed that *Zoysia* and particularly the cultivars 'Zenith', 'Meyer', and 'Crowne', serve as acceptable hosts for that species as well (Eickhoff et al. 2006, 2007). Populations of *B. occiduus* preferred both *Buchloë* and *Zoysia*. Cavalier along with Emerald and Zorro produced the lowest number of *B. occiduus* in their greenhouse study and these cultivars were listed as moderately resistant (Eickhoff et al. 2007). Cavalier expresses good resistance to both species of *Blissus*.

Buchloë (Buffalograss)

For the 2 cultivars of *Buchloë*, only '609" served as a good host for SCB with 7.5 nymphs and a total of 10.0 bugs per plant (Table 1). This would be equivalent to 56.5 bugs 0.1 m^2 which is within the threshold of damage on *Stenotaphrum*. Although there was a large difference between the mean number of SCB that developed on the 2 cultivars, there was no significant difference due to a large amount of variance among the replicates.

Other Turfgrass Genera

Surprisingly, both cultivars of *Festuca*, 'Rebel', and 'Paladin', did support low development of SCB with total mean numbers of 6 and 4.1 bugs per replicate plant, respectively (Table 1). The development on the 5 *Cynodon* cultivars was very low. Poor development of SCB has also been reported on *Cynodon* (no cultivar identified) by Cherry & Nagata (1997). Slater (1976) in his study of host relationships of Blissinae described *Cynodon* as a breeding host for the SCB. However, Kelsheimer & Kerr (1957) reported *Cynodon* to be rarely attacked by the SCB. One of the authors has received numerous reports of chinch bug feeding on and damage to *Cynodon* in Florida, Texas, and in island nations throughout the Caribbean, but most likely these populations and their damage were caused by another *Blissus* species. Cynodon has been reported as a host of *B. leucopterus leucopterus* Say (Lynch et al. 1987).

The 2 cultivars of *P. notatum*, 2 cultivars of *P. vaginatum*, and 1 cultivar of *Eremochloa* did not support much SCB development (<2.0 bugs per plant) in this study. Also, only 1 adult developed on 1 of the *Eremochloa* cv. 'Tifblaire' replicate plants. Kelsheimer & Kerr (1957) reported *Eremochloa* to be an occasional host for the SCB. Additionally, Kerr (1966) reported that SCB will attack other lawn grasses (*P. notatum*, *Cynodon*, *Eremochloa*, and *Zoysia*) but mostly it is a problem on *Stenotaphrum*. Other common hosts include crabgrass (*Digitaria* spp.), torpedograss (*Panicum repens* L.), and pangolagrass (*Digitaria eriantha* Steud) (Slater & Baranowski 1990).

This study confirms the high suitability of *Stenotaphrum* as a developmental host for the SCB. We also show that 4 cultivars of *Zoysia* and the cultivar 609 *Buchloë* serve as good breeding hosts and may have potential for damage by SCB.

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