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 (Buchloe 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. Augustinegrass (Stenotaphrum secundatum Walt. Kuntze), en el sur de U.S.A. La susceptibilidad de materias 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 cultivares de bermudagrass (Cynodon 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 mombaçal (Cynodon spp.), centipedegrass (Eremochloa ophiuroides (Munro) Hack.), seashore paspalum (Paspalum vaginatum Swartz), bahiagrass (Paspalum notatum Flugge), y tall fescue (Festuca arundinacea Schreb.).

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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. leucopterus L. damages grasses by “removal of the syneric 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 (*Zoyisia* 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 back-filled 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 wiling 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...
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

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**TABLE 1. RATE OF REPRODUCTION AND DEVELOPMENT OF SOUTHERN CHINCH BUG ON CULTIVARS AND GENERA OF TURFGRASS.**

| Genera of grasses Cultivars | Nymphs | Adults | Total (N + A) |
|-----------------------------|--------|--------|--------------|
|                             | 1st a, b | 5th a, b | (N) | (A) | (N + A) |
| 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    |

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

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).
The transformations

suitability among the 8 types of turfgrass tested.

by genus only) and analyzed to determine
each contained 2 species, but were ana-
lyzed by genus only) and analyzed to determine
suitability among the 8 types of turfgrass tested. The transformations \( \sqrt{n + 0.001} \) 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 gen-
era 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 poten-
tial on each cultivar. Caging was necessary to con-
fine 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 num-
bers 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 to-
tal), 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 Ra-
leigh produced significantly more SCB than ei-
ther 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 individ-
ual 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 aver-
age of 1.3 and 1.1 total bugs, respectively. Moreover, all of the bugs on these 2 cultivars had de-
veloped 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 experi-
ment with the same population of SCB, adult sur-
vival 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). How-
ever, when Floratam and FX-10 were first re-
leased (Horn et al. 1973; Busey 1993), both culti-
vars consistently provided >80% antibiosis within
7 d for populations of SCB adults that were col-
lected 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 develop-
ning 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 sep-
arations were recorded (Table 1). Palisades pro-
duced a significantly higher number of SCB than
‘Cavalier’ (mean total of only 1 SCB), but the pop-
ulation 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 ac-
ceptable reproductive hosts with mean develop-
ment 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 dam-
age on Stenotaphrum. Three of the replicate
plants of Palisades had total populations >23 SCB. Also, 1 replicate plant each of Zorro, Emer-
al., and Empire had total populations of 27, 26, and 14 SCB, respectively. Population develop-
en on Cavalier in the present study with B. in-
sularis 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 ‘Ze-
th’, ‘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. occid-
us 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 to-
tal of 10.0 bugs per plant (Table 1). This would be equivalent to 56.5 bugs 0.1 m² 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 develop-
ment 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 de-
scribed _Cynodon_ as a breeding host for the SCB. However, Kelsheimer & Kerr (1957) reported _Cy-
nodon_ 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 _Blis-
sus_ 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 _Ere-

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