New Sources of Southern Chinch Bug (Hemiptera: Blissidae) Resistance in St. Augustinegrass Varieties[1]

Huangjun Lu and Ron Cherry[2]

Everglades Research and Education Center, University of Florida, 3200 E. Palm Beach Road, Belle Glade, Florida 33430 USA

J. Entomol. Sci. 47(4): 291-296 (October 2012)

Abstract The southern chinch bug, *Blissus insularis* Barber, is the most damaging insect pest of St. Augustinegrass, *Stenotaphrum secundatum* (Walt.) Kuntze. Historically, host plant resistance has been important for control of southern chinch bugs in St. Augustinegrass. In this study we screened 36 St. Augustinegrass varieties for resistance to southern chinch bugs. Four varieties were shown to have significant resistance using 2 different testing methods. Morphological data for these 4 varieties also were measured.

Key Words chinch bugs, St. Augustinegrass, host plant resistance

St. Augustinegrass, *Stenotaphrum secundatum* (Walt.) Kuntze, is used for lawns throughout the southern United States due to its wide adaptation to varying environmental conditions. The southern chinch bug, *Blissus insularis* Barber, is the plant's most damaging insect pest. Prior to the release of resistant Floratam St. Augustinegrass in 1973 (Horn et al. 1973), control of southern chinch bug was primarily through insecticidal applications. Host plant resistance in Floratam lasted until 1985 when southern chinch bug damage on Floratam was reported in Florida (Busey and Center 1987) and later confirmed by Cherry and Nagata (1997).

Busey (1990) identified several new lines of St. Augustinegrass resistant to southern chinch bug, which led to development of the variety FX-10 St. Augustinegrass, which is resistant to southern chinch bug (Busey 1993). However, FX-10 was never extensively grown due to several negative characteristics including a very coarse appearance and tough texture (Busey 1993). More recently, Nagata and Cherry (2003) reported on the resistance of NUF-76 St. Augustinegrass to southern chinch bug. NUF-76 is unique because for the first time, resistance to southern chinch bug was identified within a diploid line of St. Augustinegrass, unlike polyploids such as Floratam and FX-10. Mechanisms of resistance in NUF-76 have been reported by Rangasamy et al. (2006, 2009a, 2009b). Although NUF-76 has been shown to be widely resistant to southern chinch bug populations in Florida (Nagata and Cherry 2003), Reinert (2008) and Reinert et al. (2011) reported that it is not resistant to some Texas populations. NUF-76 has been named Captiva for marketing purposes and is currently being sold to the general public in Florida.

[1]Received 30 November 2011; accepted for publication 01 March 2012.

[2]Address inquires to rcherry@ufl.edu.

Currently, Captiva is the only chinch bug-resistant variety of St. Augustinegrass being extensively grown on sod farms in Florida. This grass is gaining acceptance in the turf market and is expected to be a major turf in Florida in the future. However, based on past experience with Floratam, it is highly probable that chinch bugs will also overcome Captiva resistance in the future. Moreover, it is desirable to have other chinch bug resistant varieties available with different agronomic qualities (i.e., shade tolerance, drought tolerance, etc.). Hence, the object of our research was to find new St. Augustinegrass varieties with resistance to southern chinch bugs with the long-term goal of development for public use.

Materials and Methods

Chinch bug tests. A preliminary screening to detect resistance to chinch bugs was conducted at our research station on 36 untested St. Augustinegrass varieties. The response of southern chinch bugs to host plant resistance in St. Augustinegrass has been shown to vary among different populations of the insect (Busey and Center 1987). Hence, tests were conducted by collecting chinch bugs from different locations and these insects mixed into one population to obtain a better overall average response of the insects to varieties. Each location was a naturally-occurring infestation in a public or private St. Augustinegrass yard. Twelve varieties and Floratam were tested in each of 3 tests. Floratam was used because it is the most widely used variety in Florida and is susceptible to southern chinch bugs (Nagata and Cherry 2003). Ten adults and 10 large nymphs (3 - 5 instar) were placed in a 0.95-L wide-mouth glass jar. The mouth of the jar was covered with a fine mesh cloth secured by the screw-on jar ring. Each jar contained one 3-node stolon of a variety in a water-filled glass vial sealed with parafilm to provide water for the stolon. A fresh stolon and vial were added after 1 wk. Jars were stored at 28°C and 14L/10D. The use of glass jars to bioassay for plant resistance to chinch bugs was first described by Crocker et al. (1982). Jars were opened after 14 days and chinch bug survival noted.

In the jar test, 10 varieties had the lowest survival ranging from 0 - 4 bugs/jar and were selected for further testing against Floratam in more extensive tests. Chinch bugs were collected from 7 different locations in Palm Beach Co., FL, with each location being used for 1 replication. Each replication was tested as previously described. Data from the 7 replicates were pooled and analyzed using a Least Significant Difference (LSD) test (SAS 2011).

In the previous test with 10 varieties, survival of chinch bugs was significantly lower in 5 varieties than in Floratam. Hence, these 5 varieties were selected for additional resistance screening using a different method (Cherry et al. 2011). In this test, chinch bugs were tested against potted plants with stolons attached. Each replicate consisted of testing chinch bugs against one plant of each variety. One runner/plant was inserted into a 15-cm long, 4-cm diam clear plastic tube. Thereafter, a sponge was cut to size so that it wrapped around the runner and was wedged into the tube nearest the plant, thus preventing chinch bug escapes at that end. Ten adults and 10 large nymphs were placed in each tube. The other end was closed with a fine mesh cloth held in place with rubber bands to prevent chinch bug escape. Plants with tubes were held at ambient conditions as previously described. Plants were provided water every 3 - 4 days. Also, water was lightly sprayed into tubes every 3 - 4 days to provide moisture for the chinch bugs. After 14 d, tubes were opened and chinch bug survival determined. Five replicates were conducted over a 6-month period, and data pooled for analysis. A LSD test (SAS 2011) was used to compare mean differences in chinch bug survival between varieties.

Variety morphology. Four varieties showed significant resistance to chinch bugs in both jar tests and tube tests. Morphological measurements were made on these varieties and the widely-used chinch bug susceptible Floratam variety. These measurements were made to determine the potential usefulness of the varieties for commercial releases. After chinch bug tests, stolons fed upon were removed and plants were then moved to an outside bench receiving direct sunlight and 6 g fertilizer containing nitrogen, phosphorus, and potassium (Scotts™ 14 - 14 - 14) was applied to each pot. The plants were kept under a mist system that automatically turned on for 5 min per day. Data on morphological traits were collected from each plant 1 month post fertilizer application. The morphological traits measured in this study included leaf blade length, width, sheath length, and internode length of the first fully-expanded node from the tip of the longest stolon. In addition, leaf color of each variety was recorded as dark green, green, or light green, and leaf texture as coarse, medium, or fine. Differences in mean leaf blade length, width, sheath length, and internode length were determined using the LSD method (SAS 2011).

Results and Discussion

Chinch bug tests. Smith (1989) discusses modalities of plant resistance to insects commonly referred to in plant resistance literature. These terms were originally defined by Painter (1951). The first is antibiosis in which the biology of the pest insect is adversely affected. The second is antixenosis in which the plant acts as a poor host and the insect then selects an alternate host plant. The third is tolerance in which the inherent genetic qualities of the plant afford it the ability to withstand or recover from insect damage. Our nonchoice tests on confined chinch bugs measured antibiosis through survival although other modalities of plant resistance may be present in the varieties.

Survival of chinch bugs in glass jars is shown in Table 1. Using this method, these data show that 5 varieties were significantly more resistant to the chinch bugs than the widely-used Floratam.

Survival of chinch bugs on live stolons in tubes is shown in Table 2. Variety 1441 was not significantly different from Floratam in this test. We do not know why this variety showed different resistance in the jar test using cut stolons (Table 1) versus the tube test using intact stolons. However, 4 of the 5 varieties were consistent in showing resistance in both tests (Tables 1 and 2) using the 2 methods. In an earlier study (Nagata and Cherry 2003), St. Augustinegrass varieties found to be resistant to multiple populations from Palm Beach Co. were later found to be resistant to chinch bug populations throughout Florida.

As noted earlier, 12 yrs after Floratam was released, populations of southern chinch bugs in Florida were first found which had overcome its resistance. Floratam is now susceptible to most, if not all, FL chinch bugs (Nagata and Cherry 2003). Captiva is currently being sold in Florida as the only southern chinch bug resistant variety of St. Augustinegrass. It is probable that southern chinch bugs in Florida will eventually overcome its host plant resistance as they did Floratam, especially if Captiva becomes widely used as Floratam was. The 4 chinch bug resistant varieties identified in this study may be developed as future alternatives to Captiva depending on their mechanisms of resistance. Mechanisms of Captiva resistance have been studied (Rangasamy et al. 2006, 2009a, 2009b). Currently, we have little understanding of resistance factors in

Table 1. Survival of chinch bugs held two weeks on eleven St. Augustinegrass varieties. Bugs held in glass jars using method of Crocker et al. (1982).

Variety	Mean ± SD	Range
Floratam	13.7 ± 4.6 a	4 - 18
1223	14.7 ± 3.7 a	10 - 19
1433	10.6 ± 6.4 ab	1 - 17
4382	10.4 ± 5.6 ab	5 - 18
1262	10.1 ± 6.5 ab	2 - 19
4822	9.4 ± 6.9 abc	2 - 17
4872	7.0 ± 4.1 bcd	1 - 13
1441	6.4 ± 3.2 bcd	3 - 13
3241	5.9 ± 5.5 bcd	0 - 15
3231	4.1 ± 4.3 cd	0 - 11
5441	2.9 ± 2.9 d	1 - 9

Means followed by the same letter are not significantly different (alpha = 0.05) using a LSD test (SAS 2011).

the 4 varieties in this study. Also, other agronomic factors (i.e., drought tolerance, disease resistance, shade tolerance, etc.) may make one or more varieties useful replacements or compliments to Captiva in Florida lawns.

Variety morphology. The quality of St. Augustinegrass lawns is dependent on leaf color, leaf texture, and turf density. Shorter and narrower leaves produce a desirable fine-textured grass (Nagata and Cherry 2003). In this study, all the new varieties had significantly shorter leaf blades and sheathes than Floratam (Table 3). Floratam, a coarse-textured variety (Trenholm et al. 2011), also had significantly greater leaf width than variety 3,231. Variety 5,441 was similar to Floratam in internode length but all other varieties had shorter internodes. The leaf colors of all new varieties are green except for 3,231 which produces dark green leaves. All new varieties possess the

Table 2. Survival of chinch bugs held two weeks on six St. Augustinegrass varieties. Bugs held in clear plastic tubes using method of Cherry et al. (2011).

Variety	Mean ± SD	Range
Floratam	13.4 ± 4.2 a	7 - 18
1441	11.4 ± 6.6 a	4 - 18
3231	5.4 ± 5.9 b	2 - 16
4872	3.8 ± 4.1 b	0 - 9
3241	3.6 ± 3.3 b	0 - 7
5441	3.0 ± 1.0 b	2 - 17

Means followed by the same letter are not significantly different (alpha = 0.05) using a LSD test (SAS 2011).

Table 3. Morphological characteristics of Floratam and four chinch bug resistant varieties of St. Augustinegrass.

Variety	Leaf blade length (mm)	Leaf width (mm)	Sheath length (mm)	Internode length (mm)	Leaf color	Leaf texture
Floratam	32.2 ± 3.1a	7.2 ± 0.8a	23.4 ± 2.3a	53.0 ± 6.7ab	Green	Coarse
3231	17.0 ± 3.7d	5.6 ± 0.5b	15.8 ± 2.2c	44.0 ± 6.5cd	Dark green	Fine
3241	19.4 ± 4.0cd	7.0 ± 1.0a	16.2 ± 1.8c	48.0 ± 8.3bc	Green	Fine
4872	22.0 ± 3.5bc	6.4 ± 0.5ab	20.2 ± 1.5b	45.0 ± 8.7bcd	Green	Fine
5441	24.4 ± 4.2b	6.6 ± 1.1ab	20.6 ± 2.5b	58.0 ± 9.1a	Green	Fine

Means in a column followed by the same letter are not significantly different (alpha = 0.05) using a protected LSD test (SAS 2011).

characteristics of short, narrow leaves with green or dark green color and fine texture desirable for a high quality grass. Further tests will be conducted on these varieties for disease susceptibility, drought tolerance, etc. to determine the usefulness of the varieties for potential release.

References Cited

Busey, P. 1990. Polyploid *Stenotaphrum* germplasm: resistance to the polyploid damaging population chinch bug. Crop Sci. 30: 588-593.

Busey, P. 1993. Registration of FX-10 St. Augustinegrass. Crop Sci. 33: 214-215.

Busey, P. and B. Center. 1987. Southern chinch bug (Hemiptera: Heteroptera: Lygaeidae) overcomes resistance in St. Augustinegrass. J. Econ. Entomol. 80: 608-611.

Cherry, R. and R. Nagata. 1997. Ovipositional preference and survival of southern chinch bugs (*Blissus insularis* Barber) on different grasses. Int. Turfgrass Soc. Res. J. 8: 981-986.

Cherry, R., A. Wright, R. Raid and Y. Luo. 2011. Effect of fertilization on resistance of Captiva St. Augustinegrass to southern chinch bugs (Hemiptera: Blissidae) and gray leaf spot disease. J. Entomol. Sci. 46: 96-101.

Crocker, R., R. Tolar and C. Simpson. 1982. Bioassay of St. Augustinegrass lines for resistance to southern chinch bug (Hemiptera: Lygaeidae) and to St. Augustinegrass decline virus. J. Econ. Entomol. 75: 515-516.

Horn, G., A. Dudeck and T. Toler. 1973. Floratam St. Augustinegrass: a fast growing new variety for ornamental turf resistant to St. Augustinegrass decline and chinch bugs. Florida Agric. Exp. Stn. Circ. S-224.

Nagata, R. and R. Cherry. 2003. New source of southern chinch bug (Hemiptera: Lygaeidae) resistance in a diploid selection of St. Augustinegrass. J. Entomol. Sci. 38: 654-659.

Painter, R. 1951. Insect resistance in crop plants. Univ. of Kansas Press, Lawrence.

Rangasamy, M., H. McAuslane, R. Cherry and R. Nagata. 2006. Categories of resistance in St. Augustinegrass lines to southern chinch bug (Hemiptera: Blissidae). J. Econ. Entomol. 99: 1446-1451.

Rangasamy, M., B. Rathinasabapathi, H. McAuslane, R. Cherry and R. Nagata. 2009a. Role of leaf sheath lignification and anatomy in resistance against southern chinch bug (Hemiptera: Blissidae) in St. Augustinegrass. J. Econ. Entomol. 102: 432-439.

Rangasamy, M., B. Rathinasabapathi, H. McAuslane, R. Cherry and R. Nagata. 2009b. Oxidative responses of St. Augustinegrass to feeding of the southern chinch bug, *Blissus insularis* Barber. J. Chem. Ecol. 35: 796-805.

Reinert, J. 2008. Do we have St. Augustinegrass with resistance to the Texas-biotype of super chinch bugs? No! The Pallet. June: 6, 10, 16, 18.

Reinert, J., A. Chandra and M. Engelke. 2011. Susceptibility of genera and cultivars of turfgrass to southern chinch bug *Blissus insularis* (Hemiptera: Blissidae). Fla. Entomol. 94: 158-163.

SAS. 2011. SAS Institute. Cary, NC.

Smith, C. 1989. Plant resistance to insects. John Wiley and Sons, New York.

Trenholm, L., J. Cisar and J. Unruh. 2011. St. Augustinegrass for Florida lawns. University of Florida IFAS Extension, EDIS-ENH5: http://edis.ifas.ufl.edu/lh010.