Breeding Turf for Insect Resistance

New breeding genetics can reduce pesticide costs.

BY WAYNE HANNA AND KRIS BRAMAN

Insects can be devastating on turf because unless one is watching the turf closely, by the time you realize that you have a problem, many times most of the damage has already been done. Many golf course superintendents have seen armyworms move through turf in a matter of a few hours or days. Another example is chinch bugs — it is almost too late when you see the dead grass.

There are a number of ways to control insects in turf. You can spray an approved insecticide after you see the insects and/or damage. You can spray preventatively, based on environmental and seasonal conditions that favor insect infestation. Or you can plant turfgrasses with built-in genetic resistance. The latter is usually more permanent and is one of the objectives of the turf breeding program in Georgia. In addition, genetic resistance is more economical because it eliminates a large portion of the insecticide costs. Can we completely eliminate insecticide costs on turf? Probably not, but insecticide use and cost could be greatly reduced.

We do not spray insecticides on our turf breeding/research plots at the University of Georgia, Tifton Campus. The reason for not spraying is to allow us to identify plants/hybrids that have genetic mechanisms that discourage and/or reduce insects from feeding on the plants. In our field plots, we do not know if the resistance we see is truly genetic resistance, where an insect will not eat the grass, or if it is non-preference where the insect likes another plant (genotype) better. Therefore, we

Early instar fall armyworm nymphs only partially consume grass leaves, termed window-paning. The early instar stages are easier to kill than larger instar stages that consume entire leaf blades.

Table 1
Mean response of turf bermudagrass hybrids to tawny mole cricket no-choice feeding in the laboratory (34 hybrids) and in the field under "choice" feeding.

	Laboratory Tests			Field Test
Hybrid	Root Dry Weight – % of Control	Number of Eggs after 30 Days	Number of Crickets after 30 Days	Damage Rating 9 = Severe
Tifway	52	5.2	2.8	2.8
TifSport	67	0.0	1.8	3.2
Tifdwarf	44	7.9	3	7.8
Experimental Hybrids (range)	27 to 50	2.4 to 23	1.4 to 3.0	1.0 to 3.8
*LSD – 5%	ns	13	1	0.8

For differences between means to be significant, the difference must be equal to or larger than the least significant difference (LSD) value.

Table 2
Growth of fall armyworms on 34 genotypes of bermudagrass in the laboratory under no-choice.

Hybrid	Weight of 10-day-old Larva mg
Tifdwarf	59
TifEagle	60
Tifgreen	34
Tifway	48
TifSport	29
Experimental Hybrids (range)	15 ± 2 to 50 ± 5
*LSD – 5%	14

Note: The smaller the mean, the more resistance to the insect.

For differences between means to be significant, the difference must be equal to or larger than the least significant difference (LSD) value.

Table 3
Response of 19 turf bermudagrass hybrids to the bermudagrass mite in laboratory no-choice conditions (means).

Hybrid	Rating A	Rating B
TifEagle	0.3	0.1
Tifway	5.6	4.8
TifSport	4.6	4.9
Tifton 10	2.2	1.2
Experimental Hybrids (range)	0.0 to 5.7	0.0 to 5.0
*LSD – 5%	0.7	0.6

Note: Higher ratings mean more resistance.

For differences between means to be significant, the difference must be equal to or larger than the least significant difference (LSD) value.

also conduct laboratory tests, where insects are confined to a specific grass to see if the insects will eat the grass if they are hungry enough.

We have high numbers of natural infestation of tawny mole crickets in our research plots. Therefore, one of the first selection criteria that a new hybrid has to pass is whether the tawny mole cricket likes to eat it. TifSport continues to show good resistance (Table 1). In the Table 1 field experiment, TifSport and Tifway showed similar resistance to the tawny mole cricket. However, in other experiments, TifSport tends to show slightly better resistance under "choice" conditions. The experimental hybrids in the field experiment had already been selected for cricket resistance, and except for susceptible Tifdwarf, most of the experimental hybrids were quite resistant (Figure 1). The encouraging part is that some experimental hybrids appear to be more resistant to the tawny mole cricket than TifSport and Tifway.

TifSport and Tifgreen tend to show good genetic resistance to the fall armyworm under no-choice conditions in the laboratory (Table 2). However, there are advanced experimental hybrids that show even better genetic resistance based on the reduced growth/weight of the larva.

The bermudagrass mite can sometimes be missed unless one is looking for it. Telltale signs are small tufts of leaves at the ends of stems. We evaluated some advanced experimental hybrids and found that some were quite susceptible based on low and zero ratings in Table 3. Most were similar in resistance to TifSport and Tifway.

We observed variation for resistance to the two-lined spittle bug in the centipedegrass introductions and breeding lines that had received little prior breeding or selection for this insect (Table 4). The data indicate that progress can be made for improving two-lined spittle bug resistance in centipedegrass. The genotypes showing the best resistance have been placed in a random mating population for further selection and improvement.

There were no significant differences in the resistance of commercial bermudagrass cultivars to the two-lined spittle bug, except that none of the insects survived on TifSport (Table 4). The test allowed us to identify experimental bermudagrass hybrids that appeared more susceptible and more resistant than the commercial standards.

The goal of the University of Georgia turf breeding program is to develop and identify breeding lines and hybrids that not only show good turf quality but also incorporate insect and other pest resistances, drought resistance, shade resistance, etc. We feel that we are making significant progress in these areas by combining both field and laboratory evaluations of the products from the breeding program. Hopefully, the end products will be superior turf cultivars that will provide reliable performance to the customer.

Fall armyworm damage on a bermudagrass rough can be overwhelming if the entire leaves are consumed during feeding.

REFERENCES

Braman, S. K., R. R. Duncan, W. W. Hanna, and W. G. Hudson. 2000. Evaluation of turfgrasses for resistance to mole crickets (Orthoptera: Gryllotalpidae). HortScience 35:665-668.

Braman, S. K., R. R. Duncan, W. W. Hanna, and M. C. Engelke. 2004. Turfgrass cultivar species influences on survival and parasitism of fall armyworm [Spodeptea frugiperda (J. E. Smith)]. J. Economic Entomology 97:1993-1998.

Table 4
Response (means) of bermudagrass hybrids (51) and centipedegrass genotypes (76) to feeding by the two-lined spittle bug in a no-choice trial.

Hybrid or Entry	% Brown Stems on Infested Stems	Number of the Three Original Spittle Bugs Surviving After Day 30
Centipedegrass		
TifBlair	49	1
Experimental Genotypes (range)	13 to 97	0.0 to 2.7
Bermudagrass		
Tifdwarf	64	0.7
Tifway	31	0.7
TifSport	52	0.0
Experimental Hybrids (range)	12 to 97	0.0 to 2.0
*LSD – 5%	41	1.5

For differences between means to be significant, the difference must be equal to or larger than the least significant difference (LSD) value.

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