Researchers Turn to Turfgrass Instead of Chemicals to Deter Pests

By Kris Braman

Each turfgrass species and cultivar has particular optimal growth requirements. Water, fertility and mowing height differ. Similarly, insect pest management needs vary with grass type.

As chemical pest management tools become less available, researchers at the University of Georgia are seeking alternative methods in the management of common turfgrass pests. Their foundation management strategy, they stress, should always be to deploy pest-resistant plants. Why spend time and money fighting a pest problem when it can be simply avoided with plants that are less susceptible?

It is important to keep in mind, however, that sustainable systems always use multiple tactics for pest suppression. In other words, we don't want to simply replace chemical control with highly pest-resistant plants. That approach simply increases selection pressure for pests to overcome the pest resistance provided by the plant material and become "resistant to the resistance."

Research at the University of Georgia is seeking to develop strategies that complement or better yet synergize one another, believing that this approach makes more economic (and environmental) sense.

Cultivar effects

Interactions between host plant resistance and biological control (control by natural enemies) may be advantageous or disadvantageous for pest management. Numerous beneficial insects and their relatives inhabit turfgrass (Braman and Pendley 1993, Terry et al. 1993, Heng-Moss et al. 1998).

Turfgrass cultivars have rarely been tested for extrinsic resistance characteristics, such as occurrence and performance of beneficial arthropods on plants with resistance to known turf pests. Among the six turfgrass cultivars tested at the university, predaceous big-eyed bug (*Geocoris uliginosus*) nymphs varied in ability to reduce numbers of fall armyworm (*Spodoptera frugiperda*) larvae. The six grasses tested — Sea Isle 1 and 561-79 seashore paspalum; TifSport and TifEagle bermudagrass; and Cavalier and Palisades zoysiagrass — represented a range in resistance to the armyworm (Braman et al. 200b, 2002; Reinert et al. 1997).

Pests feeding on resistant grasses rather than susceptible grasses remained for a longer period in a size range susceptible to predation.

In general, zoysiagrass is more resistant than bermudagrass or paspalum, but cultivars vary widely in their resistance status.

Resistance to other common turf pests has also been evaluated on these grasses (Braman et al 1994, 2000a, Reinert 1993, Shortman et al. 2002). In the laboratory, the greatest reduction in fall armyworm larvae by a low density of big-eyed bugs occurred on the resistant Cavalier zoysiagrass.

A seven-fold difference in the weight of 10-day-old larvae between those feeding on susceptible vs. resistant grasses suggested that larvae, on the resistant grass, remained for a longer period in a size range susceptible to predation. Results of laboratory studies were not directly translated to the field, where a diverse predatory arthropod community varied in composition depending on turfgrass cultivar.

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In the field, the greatest reduction in *S. frugiperda* larvae by a low density of big-eyed bugs occurred on Sea Isle 1 and 561-79 seashore paspalum. In the field, vacuum samples indicated that predaceous Heteroptera (including big-eyed bugs) were most abundant in paspalum grasses and bermudagrasses, while ground beetles, rove beetles and spiders were more common in zoysiagrasses.

By contrast, pitfall traps indicated that other species of ground beetles were more common in bermudagrasses; spiders and rove beetles were similar among grass taxa; and tiger beetles were most common in paspalumgrasses and bermudagrasses. Predation was never significantly decreased on resistant turfgrass cultivars in any of the experiments, indicating no negative effect of resistant grasses on natural control by predators.

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Based on our findings, it is important to recognize the benefit of these naturally occurring beneficial insects in the turfgrass system and to conserve them where possible. It could easily be assumed, for example, that tiger beetle larvae that often make their pits in the ground in thinning turf are responsible for the turf damage. Remember fishing doodlebugs out of their pits in the ground with a long grass stem? Those ferocious jaws that grabbed onto the stem when you pulled them out of the soil are used to capture other insects, including grubs or large armyworms that probably caused the turf to thin out in the first place.

By simply learning to recognize the beneficials, one can avoid unnecessary and counterproductive pesticide applications. Color pictures and descriptions of the common beneficials and turfgrass pests can be viewed by visiting the insect sections on the UGA Turf Web site at *www.Georgiaturf.com*.

When the same six turfgrass genotypes were tested for their influence on parasitism of fall armyworm, the percentage of parasitism by a small braconid wasp (*Aleiodes laphygmae*) was greatest during July. A total of 20,400 first instar larvae were placed in the field; 2,368 were recovered; 468 parasitoids were subsequently reared; 92.2 percent were *A. laphygmae*.

The consistent numerical dominance of *A. laphygmae* in the turfgrass environment is a departure from the minor role observed for this species in agricultural crops such as corn and sorghum where fall armyworm is also an economic pest. In turf the greatest percentage reduction in fall armyworm larvae by *A. laphygmae* occurred on the armyworm-susceptible seashore paspalums (51.9 percent on Sea Isle-1 in July), followed by bermudagrass and then zoysiagrass. No parasitoids were reared from larvae collected from resistant Cavalier zoysiagrass. Percent parasitism of *S. frugiperda* in this field study decreased with increasing resistance levels to the host insect. However, substantial parasitism on TifSport, a cultivar of bermudagrass demonstrating low levels of resistance to fall armyworm, suggests a promising potential synergy between modest levels of

FIGURE 1

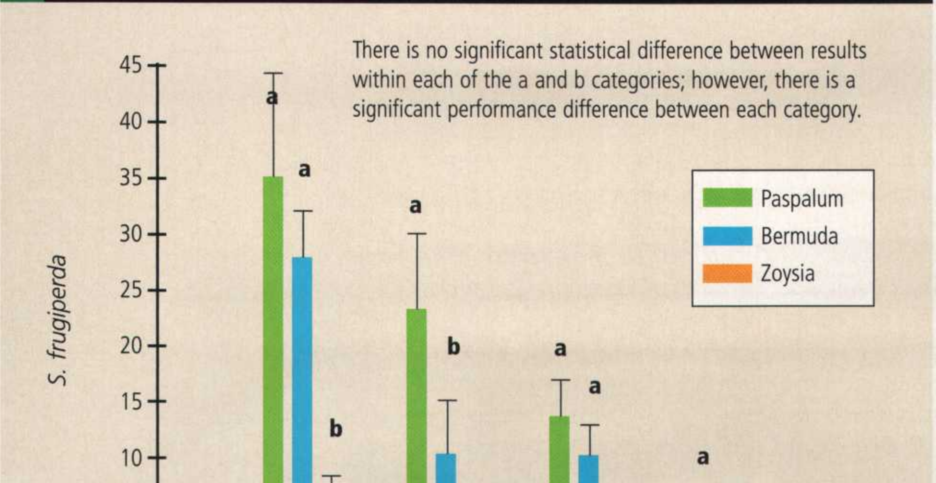
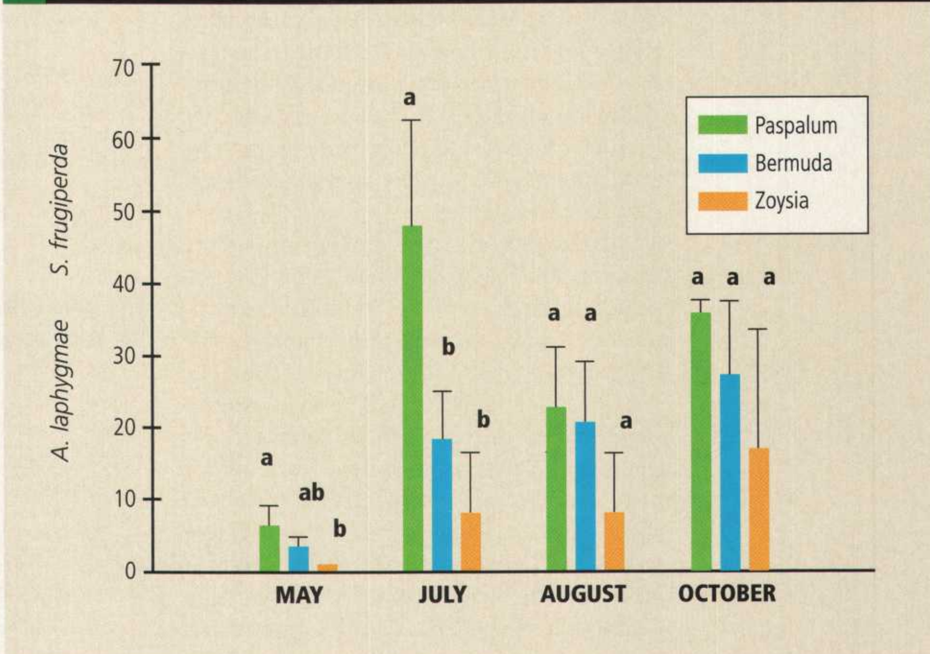


FIGURE 2



host resistance and pest suppression by natural enemies.

The high levels of parasitism observed in the more susceptible paspalums, in addition to earlier observations of significant predation, suggest potential candidates for conservation biological control efforts that target the specific parasitoids and predators that occur in abundance in these grasses.

Chemical control

The effect of insecticides on pests also varies with turf types and resistance status in ways that may enhance the activity of the pesticide. The residual activity of six concentrations of chlorpyrifos (Chlorpyrifos Pro 2), spinosad (Conserve), and halofenozide (Mach 2) on fall armyworm, as mediated by five different turfgrass cultivars expressing varying levels of resistance, was evaluated in greenhouse trials.

Similarly, varying concentrations of halofenozide were applied to six turfgrass cultivars in the field and mortality of neonate (newly hatched) and third instar (mid stage) fall armyworms was assessed. Reduced rates of chlorpyrifos resulted in lower fall armyworm survival on resistant zoysiagrass cultivars relative to that on bermuda or paspalum.

In a separate trial, survival on the same zoysiagrasses following spinosad treatment was equal to or greater than the more susceptible bermuda or paspalum. In another greenhouse trial, reduced rates of halofenozide resulted in lower survival on resistant zoysiagrasses at some concentrations at seven days exposure but not at 14 days compared to more susceptible grasses. In the field, at the full labeled rate, 100-percent mortality was observed regardless of turfgrass cultivar. Larval survival on the most susceptible turf, TifEagle, was higher than that on the remaining turf cultivars at the intermediate rate applied. Larvae exposed to treated turf as third instars displayed a trend toward greater survival at intermediate rates on the two paspalums, Sea Isle 1 and 561-79, while a trend toward lower survival was observed on Palisades and Cavalier zoysiagrasses.

The three insecticides that our lab evaluated have very different modes of action and activity spectrums. Chlorpyrifos is an organophosphate insecticide and an acetylcholinesterase inhibitor involving phosphorylation of the enzyme. It kills by both contact and ingestion. Chlorpyrifos has certainly been one of the most widely used insecticides in turf insect control. As a broad-spectrum insecticide, it can be harmful to natural enemies. As a result of the Food Quality Protection Act review process, it has been removed from use on residential turf, although commercial and production uses are still permitted. Spinosad and halofenozide are alternatives for fall armyworm suppression that have a narrower spectrum of activity and demonstrated improved margin of safety to many beneficial insects. Spinosad is a naturalyte, derived from a soil-dwelling actinomycetes bacteria, *Saccharopolyspora spinosa*. It is a mixture of the two metabolites, spinosyn A and D, produced by the bacteria.

The unique mode of action involves excitation of the insect nervous system by affecting the nicotinic acetylcholine receptors and also affects the GABA (gamma-aminobutyric acid) receptor function. Spinosad acts as a contact

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and stomach poison. Halofenozide is a diacylhydrazine molting accelerator that acts as an agonist of the insect steroidal hormone 20-hydroxyecdysone required for the molting process. Ingestion causes larvae to attempt a premature, lethal molt. It also has some systemic and considerable residual activity.

Factors potentially contributing to the variation in responses that we observed include different modes of action of insecticides, host plant resistance mechanisms, differential foliar consumption rates and insecticide dose in relation to body weight. Development of management guidelines for pest management practitioners in the future must address the complexity of potential interactions and may require case-by-case evaluation. There is no better substitute for building your own Integrated Pest Management data base that draws on individual experience with turf types that you grow and the pests (and beneficials) common to your area.

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