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GENERALIST PREDATORS AND PREDATION OF BLACK CUTWORM *AGROTIS IPSILON* LARVAE IN CLOSE MOWN CREEPING BENTGRASS

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Predators play a significant role in regulating pest outbreaks in turfgrass (Potter 2001). The most common predaceous arthropods recorded from turfgrass are spiders, predatory beetles (Carabidae and Staphylinidae) (Kunkel et al. 1999; Rothwell & Smitley 1999), predatory hemipterans, and ants (López & Potter 2003; Frank & Shrewsbury 2004a). Natural enemies and their effects can be monitored by pitfall traps (e.g., Kunkel et al. 1999; Frank & Shrewsbury 2004a) or by exposing prey overnight without direct observation (Kunkel et al. 1999; Lopez & Potter 2000; Frank & Shrewsbury 2004a). Furthermore, most studies are conducted in roughs or fairways, which have more biodiversity (Lopez & Potter 2000), greater mowing height, and are less intensely managed than greens. Predation and predator abundance can be significantly different based on mowing heights (Rothwell & Smitley 1999). A better understanding of ecosystem services in putting greens may provide insights into reducing pesticide inputs. The objectives of this study were to determine the types of nocturnal predators in putting greens and determine which taxa are involved in predation of black cutworm larvae (*Agrotis ipsilon* Hufnagel) in close-mown bentgrass.

Black cutworms provide a model system to investigate predation in turfgrass. Black cutworm larvae feed nocturnally on creeping bentgrass (*Agrostis stolonifera* L.) greens causing pock marks that interfere with ball roll and aesthetics (Potter 1998). Predation trials were conducted at the Turfgrass Research Unit, Auburn, Alabama and the Grand National Golf Course, Opelika, Alabama. Plots or greens had not been sprayed with insecticides for at least 2 wk prior to each experiment. At the Turfgrass Research Unit, 2 plots of creeping bentgrass were used. A 706 m^2 plot was used for larval predation trials, and a 929 m^2 plot for predator surveys. Turfgrass in these plots was maintained at 0.33 cm with surrounding turf 2.54 cm high. Putting greens have 'Dominant' creeping bentgrass, whereas 'El Toro' zoysiagrass (*Zoysia japonica* Steud), and 'Tifway' bermudagrass (*Cynodon dactylon* L. Pers *Cynodon transvaalensis* Burtt-Davy) were established in collars. Greens and collars are maintained at 0.36 and 1.27 cm, respectively.

Larvae were obtained from a commercial insectary and reared on artificial diet. Two predation trials were conducted at the Turfgrass Research Unit overnight on 2 Jun and 30 Jun 2010 using free-moving larvae. For each trial, 45 third instar black cutworm larvae were released onto the grass at dusk (i.e., 1930 to 2000 h). The location of each larva was marked with a wooden swab (VWR Scientific, Radnor, Pennsylvania) placed within 5 cm of the larva. A similar trial was conducted at the golf course on 10 Jun 2010 on 4 greens. Fifteen larvae were placed on each green approximately 2 m apart and the location of each marked as previously described. Observations were made by approaching each larva with a flashlight every 30 to 45 min from release until 0100 h the next morning. As the larvae moved, the location of the applicator stick was also moved.

In all 3 trials, no predators attacked the free-moving larvae. Therefore, pinned larvae (Frank and Shrewsbury 2004) were used to facilitate the direct observation of predation. On 3 Sep 2010, 6 greens at the golf course were selected. On each, 6 third instar larvae were pinned through the last abdominal segment with an insect pin and into the grass 2 m from the edge of the green. Another 6 larvae were similarly pinned 2 m outside the green in the collar (positive control). Pinned larvae were placed between 1930 and 2000 h, marked with a flag, and then checked periodically for predation from 2000 to 0300 h the next morning. Larvae were checked with flashlights with a red filter and, when predation was observed, the larva and the associated natural enemy were collected into a vial in 70% ethanol for identification.

Surveys of natural enemies in creeping bentgrass were conducted overnight, coincident with predation studies, on 30 Jun at the turfgrass unit, and on 10 Jun and 3 Sep 2010 at the golf course. On 10 Jun 2005, 1 green was used, whereas 6 greens were surveyed in the 3 Sep 2010 trial. Surveys were conducted by 2 persons walking the length and width of each plot or green with flashlights. Arthropods encountered were collected into separate vials for each green\plot with 70% ethanol for later identification.

More pinned larvae were attacked in the collar versus the adjacent putting greens (Table 1). Greater predation in the collar was expected since turf maintained at higher mowing heights harbors fewer pest species (Rothwell & Smitley 1999), and greater populations of natural enemies (López & Potter 2003) than adjacent shorter turf. Ants, primarily *Solenopsis invicta* Buren

TABLE 1. GENERALIST PREDATORS AND NUMBERS OF RECORDED ATTACKS ON PINNED BLACK CUTWORM LARVAE IN BENTGRASS PUTTING GREENS AND ADJACENT COLLARS.

Family	Green	Collar
Carabidae	1	2
Cicindellidae	1	0
Formicidae	3	9
Predaceous larvae	0	2
Total	5	13
Percent of larvae attacked	10.3 ± 4.7	26.4± 6.9

were the most common predator attacking larvae in the collar (Table 1). The metallic Florida tiger beetle (*Tetracha floridensis* Leng & Mutchler) only attacked larvae in greens but tiger beetles and ground beetles were the collected on every survey date and during the predation experiment (Tables 1 and 2). Overall, 6 taxonomic groups of predators were collected from greens and 5 from research plots (Table 2). At the beginning, it was unclear if results from previous studies in other turf habitats would translate to putting greens. The same groups, however, have been reported from previous studies of fairways and roughs (Kunkel et al. 1999). Several beetles were observed along the edges as well as the centers of greens indicating that they are patrolling entire greens. Because greens are more intensely managed, it is likely that these predators foraged into putting greens, but use higher mown areas as their main habitats (Maier & Potter 2005). Newer, more target selective insecticides can further help to conserve these natural enemies even in intensely managed putting greens (Potter 2001).

SUMMARY

Night surveys of creeping bentgrass (*Agrostis stolonifera* L.) putting greens and close-mown research plots yielded 8 taxa of generalist arthropod predators, mainly ants and predatory beetles. Predatory beetles and ants were also observed attacking sentinel black cutworm larvae on bentgrass putting greens. Also these predators have been commonly reported in previous studies in turfgrass.

TABLE 2. NOCTURNAL GENERALIST PREDATORS AND INCIDENCE IN CREEPING BENTGRASS.

Family	Green	Research plots
Carabidae		
Harpalus spp.	4	4
Calosoma spp.	1	0
Staphylinidae		
Paederinae	2	0
Cicindellidae (*T. floridana*)	3	2
Formicidae	3	9
Solenopsis invicta	1	1
Other	0	1
Reduvidae	1	0
Araneae	0	1

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