2016-23-573

Effects of mowing height and nitrogen fertilization on annual bluegrass weevil oviposition, larval development, and turfgrass damage

Dr. Benjamin A. McGraw; Pennsylvania State University

Start Date: 2015
Duration: 3 years
Total funding: $45,000

Objectives:

(1) Determine the effects that putting green mowing heights have on ABW adult survival, diel activity, larval growth and development, and turfgrass damage
(2) Determine the impacts that early-season N fertility regimes have on adult preference and larval development; characterize the interactions between mowing height and fertility on larval abundance and turfgrass damage expression

The annual bluegrass weevil (ABW), *Listronotus maculicollis*, is the most destructive insect pest of golf course turf in eastern North America. Golf course superintendents primarily manage the insect with sequential applications of chemical insecticides, typically covering a majority of, if not all short-mown surfaces. Putting greens (which receive the most frequent insecticide applications) are rarely damaged, yet collars adjacent to the same putting greens are commonly damaged. These observations led our laboratory to investigate the effects that putting green cultural practices have on the ability for ABW populations to establish in low mowing heights.

Objective 1*: Determine the effects that putting green mowing heights have on ABW adult survival, diel activity, larval growth and development, and turfgrass damage*

Greenhouse studies demonstrated that between 26 and 38% of adults were removed when turf was mowed at 2.54 mm (0.100”), but the effect diminished with increasing mowing heights. The majority of adults survived mowing, indicating a potential for adults to reinvade turf stands adjacent to areas where grass clippings are discarded. Females oviposited in all mowing height treatments in laboratory and field experiments. However, behavior was influenced by plant height, as significantly fewer eggs were placed inside of the turfgrass stem at the lowest mowing height (Figure 1). Larval development was not affected by egg placement or turf height, and significant numbers of larvae were capable of developing to damaging stages (fourth- and fifth-instar larvae) in all treatments.

Field studies were initiated in 2017 to compare the effect of double-cutting versus the effect of a single mowing. Height-of-cut, but not frequency, had a significant effect on the number of adults removed with the lowest treatment capable of removing ~ 50% of infested adults (Figure 2). The greatest benefit to adult removal with double cutting was observed at the 3.8 mm (0.150”) treatment. Both mowing frequency treatments had minimal impacts on adult mortality, though significantly more adults were killed in double cutting treatments with increasingly lower mowing heights.

Laboratory studies using time lapse photography revealed that temperature has a significant effect on adult activity on top of the canopy. Activity was greatest between 15 and 20^{o} C and only low percentages were observed on top of the canopy when temperature were 10^{o} C or less. A novel mark-release technique, combining fluorescent marks with still photography allowed for an hourly census of adult activity in the field. Adult activity on top of the turfgrass canopy was greatest during the day and strongly correlated with temperature early in the season (April, May). However, adult activity in June was highest briefly after sunrise, then declined once temperatures exceeded 20^{o} C. A polynomial regression model predicts that adults are most active on the surface between 14 and 20^{o} C. Timing mowing events around these conditions in spring may lead to improved removal.

Objective 2*: Determine the impacts that early-season N fertility regimes have on adult preference and larval development; characterize the interactions between mowing height and fertility on larval abundance and turfgrass damage expression*

ABW ovipositional preference and larval development was assessed for three early-season N-fertility regimes. In choice-assays, significantly more adults were found in high-N plots (48.8 kg N ha^{-1} mo^{-1} or 1 lb N M^{-1} mo^{-1}) in 2015, but not in 2016 studies. However, significantly more eggs were detected in the medium-N treatments (19.5 kg N ha^{-1} mo^{-1} or 0.4 lb N M^{-1} mo^{-1}) in both years. This is the rate currently recommended for managing anthracnose (*Colletotrichum cereale*) in *P. annua* greens in the Northeast. No significant differences were detected between N fertility treatments in the field for either late-instar larval (4th and 5th instars) or pupal densities. Although statistical differences were not detected, more larvae were recovered from the low-N treatment (4.9 kg N ha-1 mo-1 or 0.1 lb N M-1 mo-1). Additionally, larval fitness (as measured by 5th instar weight) was not affected by N-fertility treatment.

The effect of nitrogen fertility and plant growth regulation (PGR) on *L. maculicollis* oviposition/larval survival was assessed in no-choice field studies in 2017. A 3 (fertility) × 4 (regulation) factorial design was employed to determine the effect of each variable as well as the combined effect on larval abundance. No significant differences were detected between nitrogen treatments, though strong statistical differences were found between PGR treatments as well as N × PGR (Figure 3). Fewer larvae were found in plots treated with trinexapac-ethyl (Primo) than those treated with ethephon- (Proxy) or those without growth regulation. No significant differences were detected between Primo- and Primo + Proxy-treated plots. More studies are needed to further elucidate mechanisms behind the differences (e.g. nutritional differences, plant architecture) in larval abundance in regulated treatments.

Bullet Points (2015-17):

1. Moderate percentages of ABW adults (~ 40%) were removed with a single, low mown treatment (2.5 mm or 0.100”). The effect of mowing on adult removal diminished with increasing mowing heights. Most adults (> 96%) survived mowing (all heights combined).

2. Females were capable of ovipositing into the lowest putting green heights, though more eggs were placed outside the turfgrass stem or sheath as mowing height decreased.

3. Adult activity on top of the turfgrass canopy was greatest when temperatures were between 14 and 18^{o} C (57 and 64^{o} F).

4. Significantly more eggs were collected from moderate-fertility (0.1 lb N M^{-1} wk^{-1}) treatments than low- or high-N treatments in choice tests. However, nitrogen fertility did not affect larval abundance in no-choice field studies.

5. Larvae were capable of developing in all mowing height and fertility treatments. No significant differences in larval fitness were detected between treatments.

6. Significant differences were detected in larval abundance (but not fitness) in plant growth regulated turf (trinexapac ethyl, trinexapac ethyl + ethephon) compared to untreated plots.

Figure 1. Differences in adult oviposition behavior was noted between putting green-height and taller turfgrass. Left: eggs are deposited inside the stem of the plant at fairway-height (12.5 mm/0.500”). Right: Many of the eggs deposited in putting-green heights (< 3.8 mm/ 0.125”) were loose or outside of the plant.

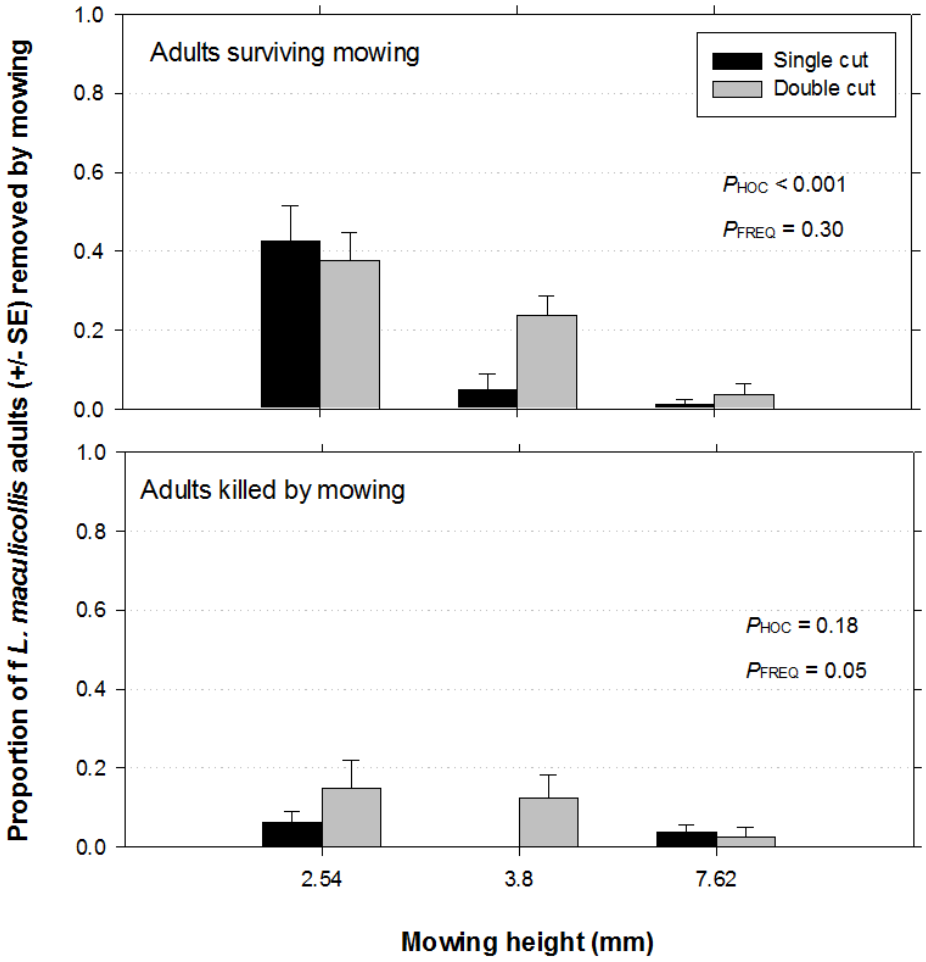

Figure 2. Effect of putting green mowing height-of-cut (HOC) and frequency (single and double cut) on the removal of *L. maculicollis* adults (2017). Polynomial contrasts were performed where ANOVA revealed significant effects at $\alpha = 0.05$ level.

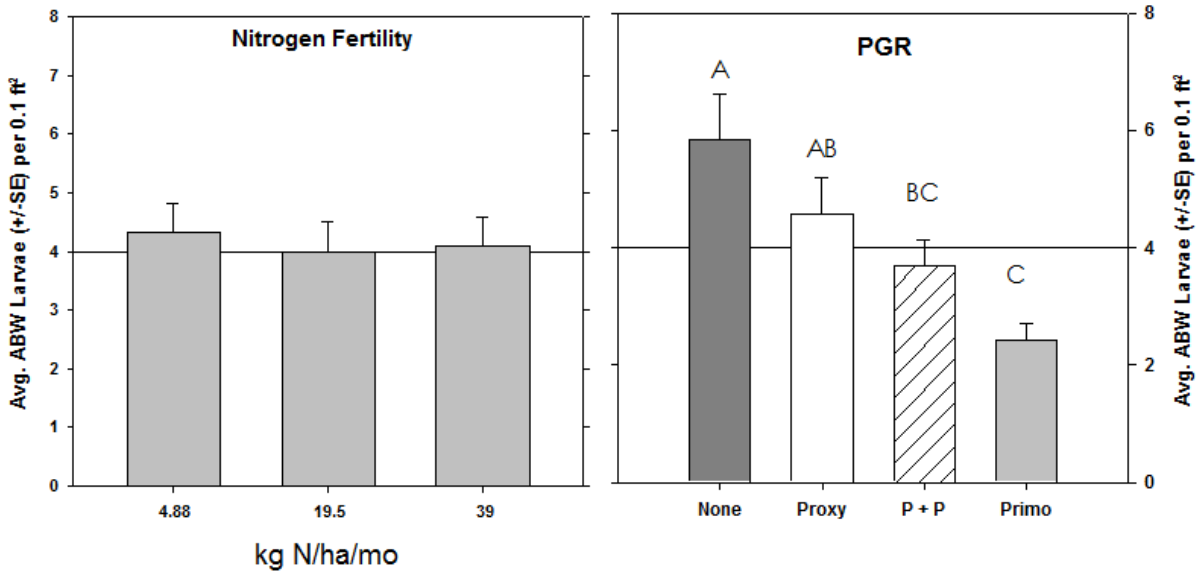

Figure 3. Effect of early-season nitrogen fertility and plant growth regulation on *L. maculicollis* larval abundance in no-choice field studies (2017). No significant differences were detected for fertility treatments. Significant differences were detect between PGR treatments and PGR × Fertility treatments. The solid line represents the damage threshold for *L. maculicollis* (40 larvae/ft^2).