USGA Turfgrass and Environmental Research Grant
2016 Summary – Year-End Report (1st year)

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

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

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

Start Date: 2016
Project Duration: Three years
Total Funding: $ 45,000

Introduction:

Putting green mowing height had a significant effect on adult removal in greenhouse trials. The lowest treatment (2.5 mm or 0.100") removed approximately 40% of the adults in both years of the study (Fig. 1). However, adult removal greatly diminished as mowing height increased. Removal was minimal at medium (3.2 mm/0.125" = 7- 13%) and high (3.8 mm/0.150" = 2- 7%) green heights, as well as collar- and fairway-treatments (< 1%). In both years of the study, most of the adults (96% +) survived mowing. This suggests that attention must be given to where clippings are disposed to minimize the potential for weevils to reinvade high-valued turf areas.

Laboratory and field experiments determined that ABW females readily lay eggs in green-height turf and larvae are capable of developing to damaging stages. In 2015, significantly more eggs were laid in the low- and medium-height treatments in no-choice assays (Fig. 2). However, we observed a deviation from normal egg laying behavior. Most eggs were deposited loosely, rather than under the leaf sheath or in the stem of the plant (Fig. 3). Significantly more loose eggs were observed as mowing heights decreased. Despite ovipositional differences, mowing height did not have a significant effect on either larval abundance (4th instar – pupa) or larval fitness (5th instar weight).

Observational studies were conducted to determine periods when adults were most active on top of the turfgrass canopy and therefore most susceptible to removal. Time-lapse (laboratory) or modified-still photography (field) was used to describe adult vertical activity with UV- or fluorescent-marked weevils. No distinct patterns were detected in laboratory

experiments when holding weevils at constant temperatures. However, activity was significantly increased when temperatures were between 15 and 25° C (59 ° – 77° F). Adult vertical movement in the field was largely influenced by temperature (Fig. 4.). Activity on top of the canopy was linearly correlated with temperatures in April and May. However, June observations showed that weevil activity was negatively correlated with temperatures, as weevils moved below the canopy when temperatures exceeded 20° C (69° F). A second-order polynomial model developed from the combined data predicts that adult activity on top of the canopy is greatest between 14 and 18° C (57 and 64° F).

***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, we found significantly more eggs 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 (4^{th} and 5^{th} 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 5^{th} instar weight) was not affected by N-fertility treatment.

Future research (2017):

We have completed mowing studies relative to Objective 1. However, our laboratory will continue to conduct research in this area to validate the temperature model and investigate variables (e.g. double-cutting, brushing) to improve adult removal. Nitrogen fertilization and growth regulation studies will be conducted in 2017 to complete Objective 2.

Bullet Points:

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.

2. Most adults (> 96%) survived the act of mowing. No significant differences were detected between mowing treatments in the number of adults killed by the mower.

3. 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.

4. Adult activity on top of the turfgrass canopy was greatest when temperatures were between 14 and 18° C (57 and 64° F).

5. Significantly more eggs were collected from moderate fertility (0.1 lb N M^{-1} wk^{-1}) treatments than low- or high-N treatments.

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

Figure 1. Effect of putting green mowing height on the removal of *L. maculicollis* adults in greenhouse studies using a bench-mounted reel mower (2015-16). Columns with the same letters (capital or lowercase) are not significantly different from one another at the α = 0.05 level).

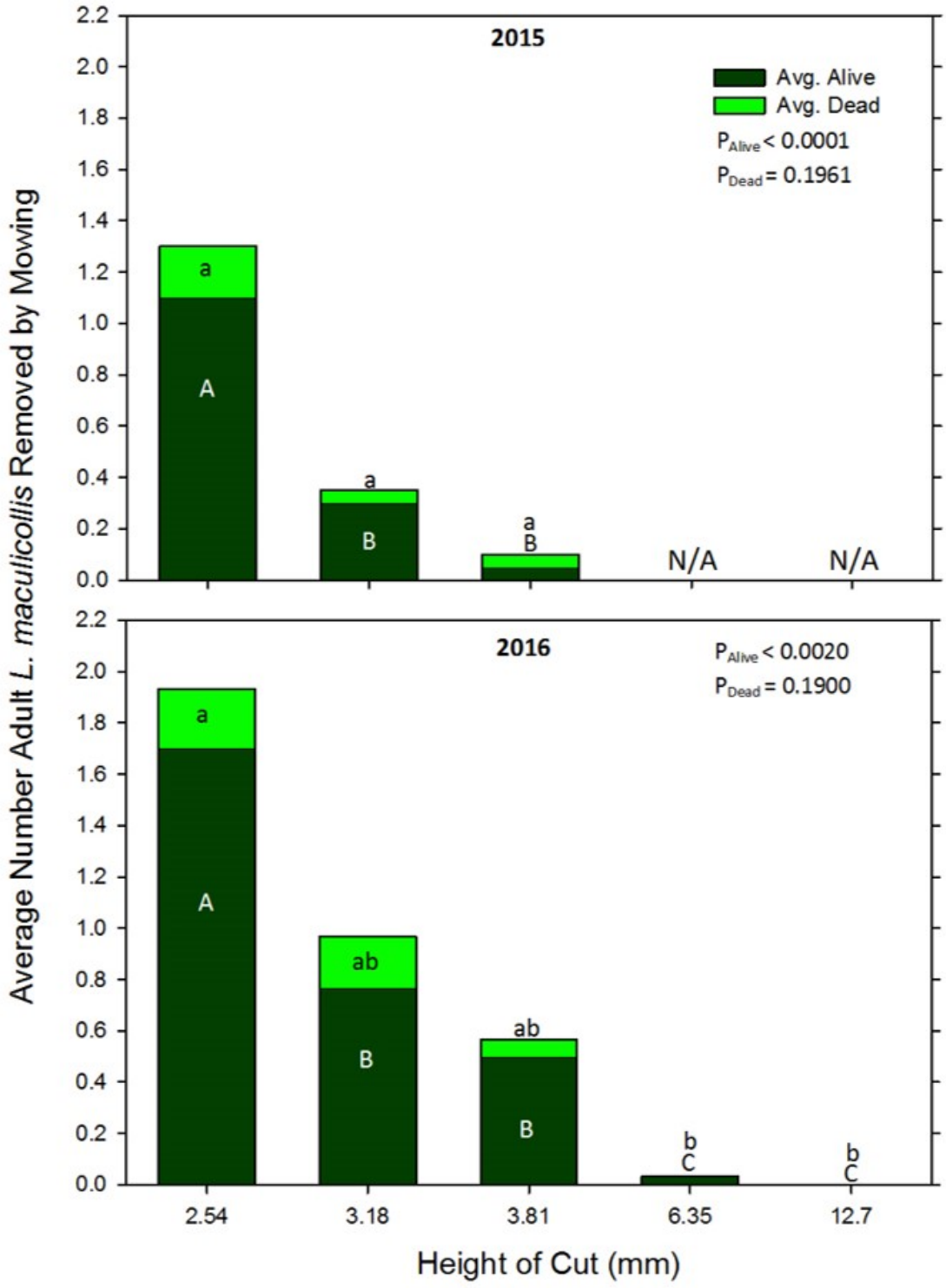

Figure 2. Number of *L. maculicollis* eggs oviposited by mowing height treatment in no-choice assays (2015-16). Columns within years with the same letters (capital or lowercase) are not significantly different from one another at the α = 0.05 level).

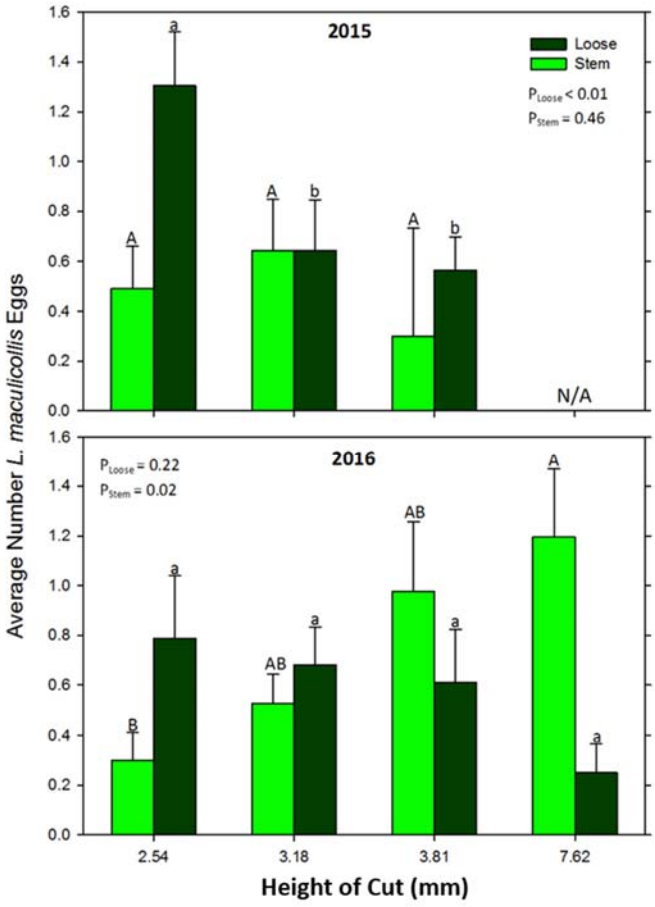

Figure 3. Differences in adult oviposition behavior was noted between putting green-height and higher turfgrasses. Left: eggs are deposited inside the stem of the plant at fairway-height (12.5 mm/0.500”). Right: Many of the eggs deposited in putting-green heights were loose or outside of the plant.

Figure 4. Average number of *L. maculicollis* adults on top of the canopy and temperature over three 24-hr field observations during spring. Still photographs of marked weevils were made hourly. Hours shaded in grey represent periods of darkness.