Interpreting and Forecasting Phenology of the Annual Bluegrass Weevil in Golf Course Landscapes

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Objectives:

1. Describe patterns of variation in population fluctuations and phenology.
2. Describe the overwintering strategy by establishing the factors that affect site selection and success.
3. Document the relationship between overwintering sites and developmental sites.
4. Develop and validate a degree-day model to forecast phenology.

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Project Duration: three years
Total Funding: $90,000

The annual bluegrass weevil (ABW) is a burgeoning pest throughout the Northeast and mid-Atlantic states. The stem-boring and crown-feeding larvae cause highly visible damage to short-cut *Poa annua*, a major component of golf course playing surfaces. Management options are largely limited to pyrethroids, and applications may be made 2-5 times a season. Despite its impact, gaps in our understanding of ABW ecology lead to poor targeting of insecticides.

We are defining the association between ABW and the golf course landscape. Our goal is to better understand the spatial, temporal, and dynamic aspects of the relationship between overwintering and developmental sites, and how this might be exploited to improve integrated pest management. Detailed population surveys are being conducted at two sites in Upstate NY to describe patterns of variation in population ecology across year, site ,and habitat. Overwintering site selection and preferences are being examined in a series of surveys and experiments, and information on directional movement is being gathered through collections in linear pitfall traps.

Three years (2004-2006) of population data have been collected, two fully analyzed. Based on extractions of larvae from soil cores and collections of adults flushed by disclosing solution, 3,841 larvae and 8,575 adults were sampled. Five larval instars were confirmed based on head capsule width. Adults were also identified as male and female, callow and mature.

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Sex ratio and abundance varied between management habitat. Males were more abundant in the rough where the mean sex ratio (male:female) was 1.7:1, versus 1:1 in the fairway. In terms of insect load, larvae and adults were 7.6-9.5 more abundant on the fairway than the rough. Across the fairway itself, abundance was consistently greater near the edge at one site, but insects were evenly distributed across the fairway at the other site. Therefore, insect distribution does not fully explain the prevalence of damage on fairway edges.

With two of three years analyzed, degree-day is a better fit than Julian date at predicting occurrence of the first generation. Given low variation in R^2 values, using the most convenient base temperature model may be feasible. The third year of data is being incorporated in order to improve the predictive model. Based on streamlined protocols, we will partner with collaborators in 2008 to conduct population surveys across the Northeast and fully validate the model.

Field surveys showed that overwintering adults tend to settle along the tree line adjacent to the fairway, establishing up to 60 m from the fairway and 10 m into the woods. Little or no overwintering occurs on the fairway or adjacent rough. In a choice experiment, we showed that white pine litter is not a preferred overwintering substrate. Adults preferred to settle in rough-mown grass and a combination of pine and deciduous litter over fairway-mown grass and pine litter alone.

Captures in linear pitfall traps are greatest in spring. At one site, directional movement toward the fairway in spring was confirmed, but there was no evidence for reverse movement in the fall. Overall, results have led us to propose a new conceptual model of flux between habitats and overwintering site selection. Our working theory is that spring immigration occurs by walking with orientation to low-mown turf. Fall emigration occurs through flight with orientation to defined tree lines. Through a "snow-fence" effect, adults stop flying at the tree line, drop to the ground, and settle into overwintering substrates.

Summary Points

- Most population parameters (e.g. shape of the fluctuation curve, number of generations, and generation time) vary more between years than between sites.
- Sex ratio and abundance vary dramatically between rough and fairway habitats. Across the fairway, insect distribution does not explain the prevalence of damage along the edge.
- Degree-days are better than calendar date at predicting phenology, and a preliminary model has high predictive power for timing of the first generation.
- Overwintering adults tend to settle along tree lines adjacent to the fairway, as far as 10 m into the woods and 60 m from the edge of the fairway. Little to no overwintering occurs on the fairway and bordering rough. Pine litter is not preferred over other overwintering substrates.
- It is hypothesized that adults immigrate to fairways in spring largely by walking with orientation to low cut turf, but they emigrate in fall largely by flying with orientation to defined tree lines where they settle into preferred overwintering sites.