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

Daniel C. Peck
Cornell University

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.

Start Date: 2006
Project Duration: three years
Total Funding: $90,000

The annual bluegrass weevil (ABW) is a burgeoning pest throughout the Northeast and Mid-Atlantic. 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 two to five times a season. Despite its impact, gaps in our understanding of ABW ecology lead to poor targeting of insecticides.

We are interpreting 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. These data are being used to develop a forecasting model that predicts ABW phenology. 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.

M.S. student Maria Derval Diaz conducts surveys of annual bluegrass weevil populations, removing soil cores to extract larvae and flushing adults with a soapy disclosing solution.

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, 1,125 larvae and 4,673 adults were sampled. Five larval instars were confirmed based on head capsule width. Adults were also identified as male and female, callow and mature.

Population data were analyzed in terms of shape of the fluctuation curve, abundance, synchrony, number of generations, sex ratio, timing of the developmental stages, and generation time. These parameters varied more between years than sites. For instance, each site had 1-2 generations in 2004, but 2-3 in 2005, and generation time was 52-61 days in 2004, but 37-47 in 2005. There was no divergence in male and female population curves. In addition to variation across year and site, data will also be assessed for variation between rough and fairway habitats.

Degree-day was 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. An initial validation will be conducted in 2007 by using a streamlined protocol to describe population development in one original site plus three others across NY. We will partner with collaborators in 2008 to conduct population surveys across the Northeast and fully validate the model.

Two surveys and two experiments (2004-2006) were conducted to gather information on overwintering site preferences. 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. Given a choice, adults preferred to settle in rough-mown grass and a combination of pine and deciduous litter over fairway-mown grass and pine litter alone.

Results from linear pitfall trap surveys (2005) showed captures to be greatest in spring. At one site, directional movement toward the fairway in spring was confirmed, but not reverse movement in the fall. This has led to a new conceptual model of flux between habitats and overwintering site selection. Our working theory is that adults largely fly (not walk) toward overwintering sites, orienting to the tree line. Once there, they drop to the ground, and settle into their preferred substrate. These ideas will be tested in 2007 and 2008.

Summary Points

- Seasonal fluctuations and population phenology vary more between years than between sites in parameters such as shape of the fluctuation curve, number of generations, and generation time.
- Degree-days are better than calendar date at predicting ABW phenology, and a preliminary model (based on two years and two sites) 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.