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Jessica Gibbs College of DuPage, essai\_gibbs@cod.edu

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# The Investigation of Competition Between *Eurosta Solidaginis* (Fitch) and *Rhopalomyia Solidaginis* (Loew), Two Gall makers of *Solidago Altissima* (Asteraceae)

by Jessica Gibbs

(Honors Biology 1151)

## ABSTRACT

Solidago altissima, or the tall goldenrod, is a very common wildflower species found in Midwestern America. It is a perennial that is host to several gall-making insects. The two flies that are being evaluated in this study for competition for the host goldenrod's resources are *Rhopalomyia solidaginis* and *Eurosta solidaginis*. *E. solidaginis* forms a ball gall when the female inserts an egg into the goldenrod's stem and the resulting larva initiates the spherical growth. Multiple larvae of midge, *R. solidaginis*, form a flower gall composed of a tight cluster of leaves. The gall serves as shelter and food for the one to fourteen larvae. In this study, a negative correlation was found in the distribution of galls of the two flies, indicating that there was no competition between the two species. Fluctuation in the population sizes between the two species appeared attributable to the distribution of their host, the tall goldenrod.

## INTRODUCTION

Solidago altissima (Asteraceae), or the tall goldenrod, is common throughout the upper Midwest region along swamps, ditches, and hills (Voss and Eifert 1978). The flower blooms between July and October. The plants are characterized by tall stems topped with a large mass of gold flowers. *S. altissima* host a wide variety of insects which form galls on their stems and leaves (Levine 1995). Galls are formed when insects lay eggs within the stem, flowers, roots, or leaves of the plant and have an adverse affect, typically using the host's resources (Levine 1995). Two common types of galls formed on *S. altissima* in the study site located in northeastern Illinois are the ball gall and the flower gall.

The ball gall formed by the fly *Eurosta solidaginis* along the stem of *S. altissima* (Levine 1995). *E. solidaginis* commonly forms only a single ball gall on the stem of goldenrods, but, occasionally, two or more galls will be found at different heights in dense stands of *S. altissima* (Zurovchak and Shealer 1996). Adult *E. solidaginis* mate after emerging from the ball gall in late May. Females then oviposit into the stem of a goldenrod, inserting a single egg at a time. After a few days, the hatching larva chews through the meristematic substances contained in the goldenrod stem and creates a large swelling, the ball gall. The larva remains in the gall until the following May, pupates and matures to the adult stage within weeks (Horner and Abrahamson 1998). Evidence suggests that *E. solidaginis* populations suffer from the effects of intraspecific larval competition in stems supporting multiple galls (Hess et al. 1996).

*R. solidaginis* creates a flower gall that appears as a green flower containing many leaflets on the apical region of goldenrods. A female *R. solidaginis* will lay multiple egg clusters on the terminal buds of *S. altissima*. When the larvae hatch, they crawl between the bud scales which prompt the goldenrod to form multi-chambered galls around each larva. Once maturing, the adults mate for a single day, lay eggs, and die. This complete life cycle is between 60 and 70 days (Briggs and Latto 2001).

Both R. solidaginis and E. solidaginis live off a common host. Because of this, competition

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between the species or within species is a possibility. The objective of this experiment is to determine if there is competition between *R. solidaginis* and *E. solidaginis*, and, if so, to determine if one is dominant over the other.

#### METHODS

The study site borders a marsh on the southwest side of the East Prairie on the main campus of College of DuPage, Illinois. The patch of tall goldenrod under study was 8m x 100m in dimension and is bordered by a stand of cattails (*Typha latifolia* L.) to the west of the patch and 8 ha of reconstructed tallgrass prairie to the east. Major grasses in the tallgrass prairie are big bluestem (*Andropogon gerardii* Vitman), Indian grass (*Sorghastrum nutans* [L.] Nash), and prairie dropseed (*Sporobolous heterolepis* Gray). Sixty-eight randomly selected 1m<sup>2</sup> plots were analyzed for counts of tall goldenrod, ball galls, and flower galls.

Patterns of dispersion for goldenrod, the flower gall, and ball gall were determined from the variance to mean ratio of counts. A ratio greater than 1 indicates clumping, less than 1, uniform dispersion, and equal to 1, a random dispersion. Spearman correlation was used to test for relationships between counts in paired comparisons. Statistical significance was determined where  $P \leq 0.05$ .

## RESULTS

Counts and variance (s<sup>2</sup>) to mean ratios for the tall goldenrod, flower gall, and ball gall are summarized in Table 1. Patterns of dispersion indicated clumping for each organism. Counts of the flower gall and ball gall were significantly correlated to counts of tall goldenrod (Spearman R = 0.69 and 0.37, respectively. All N = 66.). No correlation was found between the dispersions of the flower gall and ball gall (Spearman R = 0.21; N = 66).

## DISCUSSION

There was no negative correlation found between the distributions of *R. solidaginis* and *E. solidaginis*, indicating an absence of detectable competition between the gall makers. Flower galls were far more abundant than ball galls where both distributions were linked to the abundance of *S. altissima*. One reason for the absence of competition is that interspecific competition is unlikely in gall forming species (Price 1997). The reason for this is that the organisms have such a short time to find a host plant and reproduce that they do not have time to actively compete with other species. With no competition, *S. altissima* is a very good host that can be easily taken advantage of by gall makers.

Some studies have found that clustered populations, where the insects emerge at the same time, are beneficial to the survival of the gall-makers species (Gillott 1995). Synchronized eclosion increases the chances of finding a mate, food, and oviposition sites and helps an insect escape by predator satiation. Adults of both *R. solidaginis* and *E. solidaginis* emerge together during spring.

Members of *E. solidaginis* have one generation per year, mate and oviposit over 20 days, and usually insert only one egg per *S. altissima* (Horner and Abrahamson 1998). Contrarily, *R. solidaginis* has four generations a year, mate and oviposit over one day, and insert multiple eggs per plant tip. Both gall makers are fairly weak flyers, which limits dispersal, so finding these species in this study to be in a clumped pattern is expected. Limits in dispersal can offer a mechanism by which competing species can co-exist on a single limited resources (Briggs and Latto 2000).

Very little documented research of the ecology of *R. solidaginis* is available. Because of this neglect, data are unavailable that indicate if the species competes with other species. More research

should be conducted on R. solidaginis and its requisites for survival.

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Organism	$\overline{x} \pm SD$ count	$s^2/\overline{x}$
Tall goldenrod	25.9 <u>+</u> 18.7	13.5
Flower gall	3.4 <u>+</u> 4.5	6.0
Ball gall	0.3 <u>+</u> 0.7	1.6

Table 1. Count summaries (x  $\pm$  SD; all N = 66) and variance (s<sup>2</sup>) to mean ratios for tall goldenrod, flower galls, and ball galls