

Statement of Work

The lily leaf beetle (LLB), *Lilioceris lili* Scapoli, is a serious pest of native and exotic lilies in much of New England and has been attributed to economic losses for commercial horticulturists. Garden lilies (*Lilium* spp. and hybrids) are a popular and unique addition to gardeners' summer and early fall perennial gardens. They also constitute an important commercial commodity for bulb growers, vendors, garden centers, landscapers and landscape gardeners. However, the invasive lily leaf beetle threatens the use of garden lilies in our region. Evidence suggests that the damage caused by this beetle has resulted in many gardeners eliminating lilies from their garden choices.

Native to Europe, LLB was introduced to the eastern U.S. in 1992 and first appeared in southern Maine in 1997 (Folsom 2006, pers. comm.; Livingston et al. 1996). Since then, it has steadily moved northward and is currently the limiting factor in lily growth and production in Maine. Larvae and adult beetles attack all aboveground plant parts, and defoliation reduces plant vigor and flowering, greatly diminishing the aesthetic quality of the plant. In addition, even limited feeding by larvae reduces quality, as all larval stages envelop themselves with a fecal shield for predator protection. Insecticides are registered for LLB control. However, the risks to other invertebrates and to humans associated with these materials, require efforts to investigate alternative LLB management strategies. We feel that host plant resistance may play a significant role in reducing the impact of LLB, as well as reducing pesticide use in commercial and home settings.

The goal of this project is to investigate the genetic potential of garden lilies to reduce LLB survival and to deter larval and adult foliage feeding. Resistance to LLB in the Oriental lily hybrid 'Black Beauty' was reported by entomologists at the University of Rhode Island (Casagrande 2006, pers. comm.; MacGlaflin et al. 2002). They found a lower larval survival rate compared with other lily hybrids. Anecdotal reports of lily resistance to LLB are also reported by gardeners in our area. In 2006, we evaluated a combination of ten Oriental and Asian lily hybrids, testing for their tolerance to LLB adult and larval feeding, and their effect on larval survival. We found significantly lower damage levels and larval survival in two Oriental hybrids, 'Dizzy' and 'Time Out'. 'Dizzy' inhibited larval survival the greatest of any of the ten cultivars tested, and also sustained the least amount of leaf damage. Moderate to high tolerance was exhibited by 'Time Out'. These results encourage more testing of these and other Oriental lilies. We would also like to test our two native lilies, *L. canadensis* and *L. philadelphicum*, as well as, *L. pumilum*, a species from within the native range of the LLB. If resistant, these species may provide an alternative to susceptible exotic lilies, as well as potential strains for breeding stock.

The objective of our proposed project is to investigate the potential for host plant resistance to lily leaf beetle in the northeast region, focusing on promising Oriental cultivars and native lily species. Resistance levels in these plants will be compared with that of a known susceptible variety (cultivar 'Stargazer') and those that have been shown to have some resistance against this pest (*L. henryi*, *L. speciosum* 'Uchida', and the hybrid 'Black Beauty', (Livingston et al. 1996, MacGlaflin et al. 2002)). This research will be done in consultation with researchers Dr. Richard Casagrande and Ms. Lisa Tewksbury, at the University of Rhode Island.

Research Methodology: Both choice and no-choice assays will be conducted on ten selected lily species and hybrids to assess a) adult beetle choice for spring colonization and feeding and b) the level of survival and feeding of LLB eggs and larvae deposited on plants.

Untreated bulbs will be potted in early spring, 2007, for production of sufficient foliage for beetle colonization. For the choice experiment, potted plants will be placed in a randomized block design (6 blocks of each of 10 varieties) at our research site with known populations of LLB. Plants will be monitored several times per week and the number of colonizing adults and eggs per plant will be recorded. For the no-choice experiment, LLB adults will be collected as they colonize local lily plantings. Male and female beetles will be paired and placed in Petri dishes with lily foliage to allow for mating and initial egg laying. Lilies of the same type will be placed in individual cages. Caged plants will be maintained outside under ambient conditions and watered and fertilized as needed. When eggs begin to be laid, five mated pairs of LLB adults will be placed on lily foliage inside each cage. After 5 days, adults will be removed and all eggs will be counted on plants. This process will be repeated for a total of six replications, resulting in 60 treatment plants. All inoculated plants will be placed in a single, large screened enclosure for the duration of the study. The experimental design is randomized complete block. Regular observations will be made to determine egg hatch, the number of larvae and their stage of development (first through fourth instars), pupation and adult emergence. Visual relative defoliation ratings will be made throughout the summer to measure adult and larval feeding damage. The study will end when either plant defoliation or LLB pupation occurs.

Impacts: The economic and aesthetic influences of lily leaf beetle and the increased use of insecticides for its control warrants development of alternative IPM tactics for LLB management. Results of our 2006 study were shared with industry and homeowner groups this fall. Presentations were given at an agriculture field day at the University of Maine research farm and at a greenhouse grower meeting and a nursery, garden center and landscape gardener's meeting. Participants were enthusiastic about the potential of this research in providing an alternative to insecticides for LLB management. In 2006, our Maine research group also collaborated with University of Rhode Island entomologists on biological control of LLB using Hymenopteran parasitoids. As mentioned earlier, there is a mutual interest in host plant resistance. Together, these lines of research form a potential IPM strategy benefiting the New England region. Co-PD on this project is the Extension Horticulture specialist for the University of Maine, and she works closely with the ornamental horticulture industry in the northeast and the Maine Master Gardeners' Program. Hence, she will be well positioned to distribute the results of this work to end-users throughout the state. Collaborators in Rhode Island also have been working with green industry and homeowner programs in Rhode Island and Massachusetts and are well situated to extend results gained from this study.

Species/Cultivars to be evaluated:

1. *Lilium speciosum* 'Uchida'
2. *L. speciosum* var *rubrum*
3. *L. henryi* (native to China)
4. *L. pumila* (native to Siberia and China)
5. *L. 'Black Beauty'* (cross between *L. henryi* and *L. speciosum*)
6. *L. 'Stargazer'* (popular Oriental hybrid – likely susceptible)
7. *L. 'Dizzy'* (Oriental, potential resistant)
8. *L. 'Timeout'* (Oriental, potential resistant)
9. *L. canadensis* (native)
10. *L. philadelphicum* (native)

References

- Livingston, S.B. 1996. Biology, control, and host range of *Lilioceris lili*: a new ornamental pest in the USA. MS thesis, University of Rhode Island, Kinston, RI 78 pp.
- MacGlaflin, C., L. Tewksbury, and R.A. Casagrande. 2002. Lily leaf beetle resistance among lily hybrids. <http://www.uri.edu/cels/pls/biocontrol/powerpoint/CAITMACGLAFLINLLB-3.ppt>