**ML 2015, Ch 76 Art 2, Sec 6a Project Abstract**
For the Period Ending December 31, 2021

**PROJECT TITLE: Subproject #3:** Biological control of the soybean aphid by *Aphelinus certus*
**PROJECT MANAGER:** George E. Heimpel
**AFFILIATION:** Dept. of Entomology, University of Minnesota
**MAILING ADDRESS:** 1980 Folwell Ave
**CITY/STATE/ZIP:** St. Paul, MN 55108
**PHONE:** 612-624-3480
**E-MAIL:** heimp001@umn.edu
**WEBSITE:** https://entomology.umn.edu/people/george-heimpel
**FUNDING SOURCE:** Environment and Natural Resources Trust Fund
**LEGAL CITATION:** MINNESOTA INVASIVE TERRESTRIAL PLANTS AND PESTS CENTER
ML 2015, Ch. 76, Art. 2, Sec. 6a

**APPROPRIATION AMOUNT**: $479,859
**AMOUNT SPENT:** $479,859
**AMOUNT REMAINING:** $0

**Sound bite of Project Outcomes and Results**
Results of this study indicate that the parasitoid *Aphelinus certus* provides sufficient mortality of soybean aphids to substantially decrease the need to apply insecticides against this pest.

**Overall Project Outcome and Result**
Prior to the year 2000, the approximately seven million acres of soybeans in Minnesota suffered very little insect damage and were seldom subjected to insecticide applications. This changed with the arrival of the soybean aphid from Asia during that year. This aphid rapidly became the most important insect pest of soybeans due to its ability to substantially lower soybean yield when present at high densities on plants. This led to a 'new normal' that included widespread insecticide use in soybeans in Minnesota, with areas in excess of one million acres sprayed in bad aphid years. While predatory insects were capable of suppressing populations in some years, this level of control was not consistent. We noted the arrival of a new natural enemy of soybean aphid in Minnesota in 2011, however – the parasitoid *Aphelinus certus* – that appeared to have the potential to be a game changer. This insect lays its eggs into soybean aphids, and the developing larvae kill the aphids from within. Our main objective was to determine the extent to which this parasitoid could control populations of soybean aphids below the level that necessitates insecticide use. We also hoped to elucidate agronomic strategies that could lead to increased control by this parasitoid. Based upon a combination of laboratory, field and theoretical studies, we were able to show that *A. certus* is indeed capable for suppressing soybean aphid densities below the threshold levels that farmers use to initiate insecticide use. Our theoretical simulations suggested that such control occurs in approximately 10% of fields during a given year. These studies also pointed to overwintering success of the parasitoids as a critical factor determining the strength of aphid suppression. It therefore stands to reason that any agronomic factors that increase overwintering success improve the parasitoid's capability of suppressing soybean aphid.

**Project Results Use and Dissemination**
This research led to new analytical tools to analyze the ability of the parasitoid *Aphelinus certus* to control populations of the soybean aphid. It also provided novel information on the primary overwintering site of the parasitoid (within soybean fields) and aspects of its overwintering and diapausing strategy. This information can be used to predict when *A. certus* adults will emerge in a given field season. Lastly, the research quantified the extent of control provided by this parasitoid and generated novel hypotheses for how control can be improved.

We generated an analytical tool using a stage-based matrix modeling approach and published it in an open access Journal. This model can be modified based on environmental and life-history characteristics for this or similar host-parasitoid systems and the underlying R code is available upon request from the authors.