NYWGF RESEARCH - FINAL REPORT

Funding for fiscal year: 2024-2025

SECTION 1:

Project title: Life cycle and parasitism potential of grape berry moth larval parasitoids

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New Research ☒ **Continued Research** ☐

Amount Funded **$**16,162

SECTION 2:

Project Summary Impact Statement:

The aim of this proposal was to determine the life cycle and parasitism potential of two grape berry moth (GBM) larval parasitoid species commonly found in vineyards at the Lake Erie Grape Belt. GBM is an important pest of grapes in the Northeast U.S. This insect pest has several larval parasitoids naturally present in the Northeast grape growing region. However, very little is known about these parasitoid species and their potential for GBM control in field conditions. This study focused on two GBM larval parasitoids: the endoparasitoid *Enytus obliteratus* (Hymenoptera: Ichneumonidae) and the ectoparasitoid *Bracon variabilis* (Hymenoptera: Braconidae). We collected GBM-infested grapes from wild grapes and various vineyards in the Lake Erie Region and took them to the laboratory to monitor the emergence of parasitoids; once emerged, the parasitoids were reared on GBM larvae and monitored periodically to determine the duration of the different life stages and their reproduction capacity. *E. obliteratus* completed its life cycle (from egg to adult) in about 21 +/- 2.166 days at 25°C; the parasitism rates in the field were from 9 to16%, and the average progeny per female was 8 +/- 5.56 individuals in laboratory conditions. *B. variabilis* completes its life cycle in about 17 days, the parasitism rate in field conditions was from 37 to 51%, and the average progeny per female was 3.7 +/- 1.1 individuals in laboratory conditions. We conclude that these two parasitoid species are promising biocontrol agents of GBM in the field. *E. obliteratus* was easier to rear in the laboratory. Rearing *B. variabilis* was very time-consuming and didn't seem to be a feasible option. For *B. variabilis* efforts should focus on conservation rather than augmentation with field releases.

Objective:

To determine the life cycle and parasitism potential of two grape berry moth larval parasitoids

Materials & Methods:

GBM parasitoid collection and rearing: GBM larval parasitoids were collected from wild grapes and commercial vineyards from Erie County (Pennsylvania) during the 2024 growing season. GBM-infested grapes were collected from the field, taken to the lab, and reared in plastic containers in a growth chamber at 25 ± 1 °C, 75% humidity, and a photoperiod of 16:8 h [L:D]. The emergence of parasitoid pupae and adults was inspected daily. Upon adult emergence, male and female parasitoids were transferred to plastic cages containing diluted honey and water in cotton balls as a food source; the cage also contained living GBM stages for oviposition. GBM larvae were provided daily and retrieved 24 h later during the lifetime of the adult parasitoids. We recorded the number of parasitoids that emerged and their developmental time.

Determination of parasitoid life cycles, parasitism rates, longevity, and reproductive capacity: We determined the life cycle of two common GBM larval parasitoid species previously identified in the Lake Erie Grape Growing Region (*Enytus obliteratus* (Cresson, 1864) (Hymenoptera: Ichneumonidae) and *Bracon variabilis* (Provancher, 1988) (Hymenoptera: Braconidae)). To determine their life cycle, recently emerged female and male adult parasitoids were coupled in individual, ventilated plastic containers (30 cm in height, 10 cm in diameter) and provided with food in the form of water and 50% honey solution in cotton balls. For *E. obliteratus,* we provided the adults with grapes infested with first-instar GBM larvae, and for *B. variabilis,* we provided grapes infested with young four-instar GBM larvae. The GBM larvae were provided daily and retrieved the following day from each container. The parasitoid-exposed grapes containing GBM larvae inside were then placed in plastic containers and properly labeled with the parasitoid species they were exposed to, parasitoid couple number, stage of GBM larvae, date of parasitoid exposure, and date of retrieval. These grapes were inspected periodically to determine the date at which parasitoid pupae developed. Each parasitoid pupa was individualized, labeled, and periodically inspected to determine the date of adult emergence. Furthermore, male and female couples hatching from these individualized pupae were fed with honey and water, and provided with GBM-infested grapes daily. Each parasitoid couple was inspected daily to record their survival (or adult longevity).

Life cycles: For each parasitoid species, we determined the duration in days from egg to pupa, duration of the pupa stage, adult (male and female) longevity, and the total number of days from egg to adult emergence. We also took pictures of each developmental stage to properly document the duration and characteristics of their life cycle when preying on GBM.

Parasitism rate: GBM-infested grapes were offered daily to the parasitoid couples. These grapes were retrieved the following day and properly labeled with the parasitoid species, couple number, stage of GBM larvae, date of parasitoid exposure, and date of retrieval. These grapes were inspected periodically to determine the number of parasitoids and the number of GBM that emerged. The percent of parasitism was calculated as the number of parasitoids that emerged divided by the sum of parasitoids and moths that emerged. The

resulting number was multiplied by 100. The parasitism rate was calculated from recently emerged and mated couples to their time of death.

Longevity: Survival of the parasitoid couples mentioned above was used to calculate the longevity of adult parasitoids as the average number of days alive.

Reproductive capacity: The progeny generated by each of the parasitoid couples mentioned above, was used to determine their average reproductive capacity through time.

Data analysis: Basic descriptive statistics of means, medians, confidence intervals, and percentages were used to analyze the data from these experiments.

Data collection:
The following data were collected in this study:

- Duration in days of parasitoid living stages (egg, larva, pupa and adult)
- Parasitism rates
- Progeny generated by parasitoid couples

Our Results are presented in graphs and tables in the Attachments section below.

Results/Outcomes/Next Steps:

Enytus obliteratus.
E. obliteratus belongs to the family Ichneumonidae and completes its life cycle (from egg to adult) in about 21 +/- 2.166 (n = 38) days at 25°C (Figure 1). Parasitoid females lay eggs on first and second-instar GBM larvae that are either walking on the grape surface or that have already burrowed inside the grapes.

E. obliteratus is an endoparasitoid whose larva develops inside the GBM larva and pupates outside the grapes. At 25°C, the larval stage lasted 11.53 +/- 1.36 (n = 15) days, and the pupa lasted 6 +/- 0.133 (n = 15) days. The adult females lived for 19.205 +/- 7.86 (n = 39) days. The males lived for 11.625 +/- 5.575 (n = 40) days.

The parasitism rates in the field were from 9-16%, but in the laboratory, they were lower. The average progeny per couple was 8 +/- 5.56 (n = 17) individuals.

Bracon variabilis.
B. variabilis belongs to the family Braconidae and completes its life cycle in about 17 days (Figure 2). Parasitoid females lay eggs on third and fourth-instar GBM larvae that are feeding inside the grapes. They use the same holes made by the GBM larvae in the grapes to parasitize them.

B. variabilis is an ectoparasitoid whose larvae develop on the GBM larva until it consumes it. *B. variabilis* pupates inside the grapes. At 25°C, the duration of the egg + larva stages was, on average, 9 days (n = 24). The pupae lasted 8 +/- 1.913 (n = 23) days. The adult females lived for 20.538 +/- 3.97 (n = 13) days. The males lived for 15.363 +/- 4.082 (n = 11) days.

The parasitism rate in field conditions was from 37 to 51%, but in the laboratory was lower. The average progeny per female was 3.7 +/- 1.1 (n = 10) individuals.

Of the two parasitoid species, *E. obliteratus* was easier to rear in the laboratory. Rearing *B. variabilis* was very time-consuming and didn't seem to be a feasible option. For *B. variabilis* efforts should focus on conservation rather than augmentation with field releases.

Technology Transfer Plan:
Relevant results from this project will be published in one peer-reviewed scientific journal. We will also prepare an extension article to disseminate some of these results. Additionally, these results will be presented in growers' meetings in both NY and PA.

Attachments

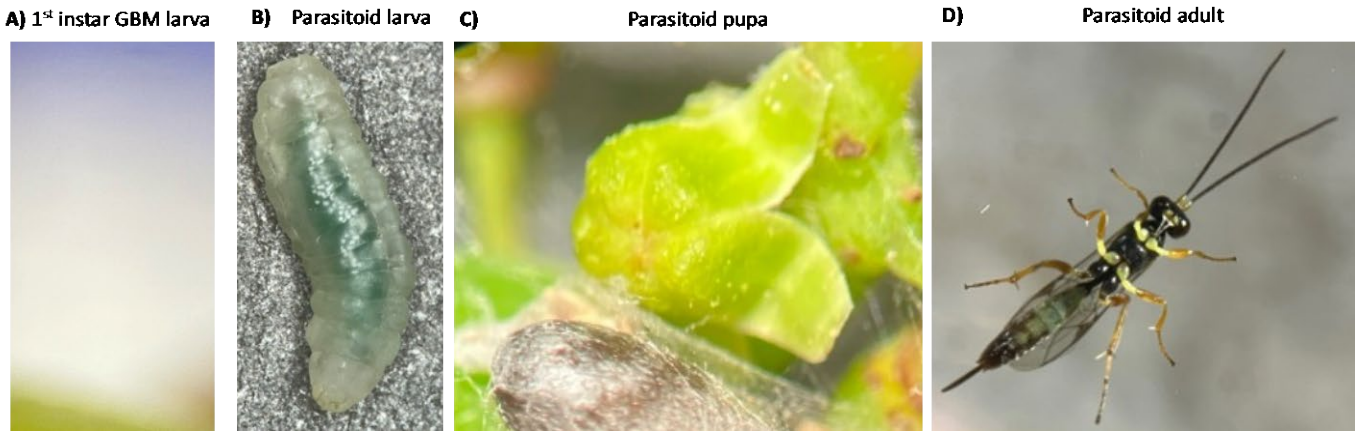

Figure 1: A) First-instar GBM larva burrowing into a grape. B) Last larval instar of the parasitoid *Enytus obliteratus,* C) Pupa of *E. obliteratus,* D) *E. obliteratus* Adult.

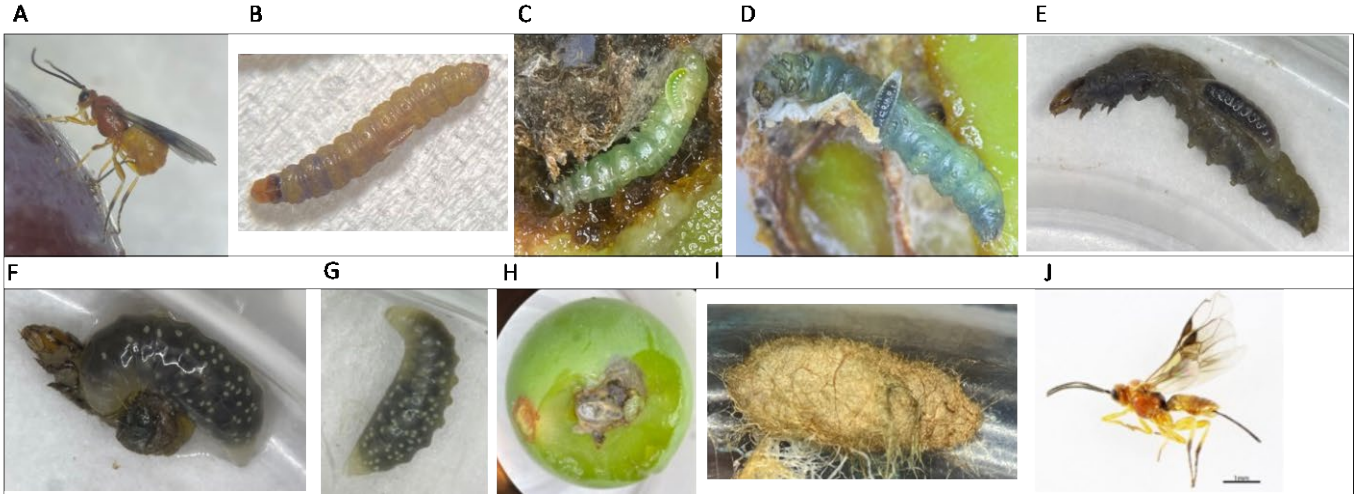

Figure 2: A) Female of *B. variabilis*, B) Last-instar GBM larva with a small clear larva of *B. variabilis* on top. C-D) immobilized last-instar GBM larva with a small larva of *B. variabilis* on top. E) Last-instar GBM larva with a *B. variabilis* larva on top. F) Last-instar larva of *B. variabilis* consuming a GBM

larva. G) Last-instar larva of *B. variabilis*, H) pupa of *B. variabilis* inside a grape. I) pupa of *B. variabilis*. J) *B. variabilis* adult.

SECTION 3:

Project summary and objectives:

The grape berry moth is an important pest of vineyards in the Northeast U.S. whose feeding activity reduces yield and decreases fruit quality. This insect pest has several natural enemies that could be used in biological control programs. We investigated the life cycle and parasitism potential of two common grape berry moth larval parasitoids: *Enytus obliteratus* and *Bracon variabilis.* These parasitoid species complete their life cycle in less than 21 days and have parasitism rates that range from 9 to 51% in field conditions.

Importance of research to the NY wine industry:

The grape berry moth has been a problem in vineyards in the Northeast U.S. for several decades. This insect is commonly controlled with insecticides, some of which are losing effectiveness due to insect resistance development. Therefore, there is a need to develop more sustainable management strategies that could include the use of natural enemies commonly present in the Northeast U.S. region. The results of this study provide information on the life cycle of two important parasitoid species that have high parasitism rates in the field and inform on the feasibility of using them for grape berry moth control.

Project Results/next steps:

E. obliteratus belongs to the family Ichneumonidae and completes its life cycle (from egg to adult) in about 21 days at 25°C (Figure 1). Parasitoid females lay eggs on first and second-instar grape berry moth larvae that are either walking on the grape surface or that have already burrowed inside the grapes. The parasitism rates in the field ranged from 9 to 16% and the average progeny per female was 8 +/- 5.56 (n = 17) individuals in laboratory conditions.

B. variabilis belongs to the family Braconidae and completes its life cycle in about 17 days (Figure 2). Parasitoid females lay eggs on third and fourth-instar grape berry moth larvae that are feeding inside the grapes. They use the same holes made by the grape berry moth larvae to parasitize them. The parasitism rates in field conditions ranged from 37 to 51%, and the average progeny per female was 3.7 +/- 1.1 (n = 10) individuals in laboratory conditions.

Of the two parasitoid species, *E. obliteratus* was easier to rear in the laboratory. Rearing *B. variabilis* was very time-consuming and didn't seem to be a feasible option. For *B. variabilis* efforts should focus on conservation rather than augmentation with field releases.

Further studies could focus on elucidating strategies to preserve these parasitoids in the field and increase their numbers to benefit from their pest control service.

Supporting attachments:

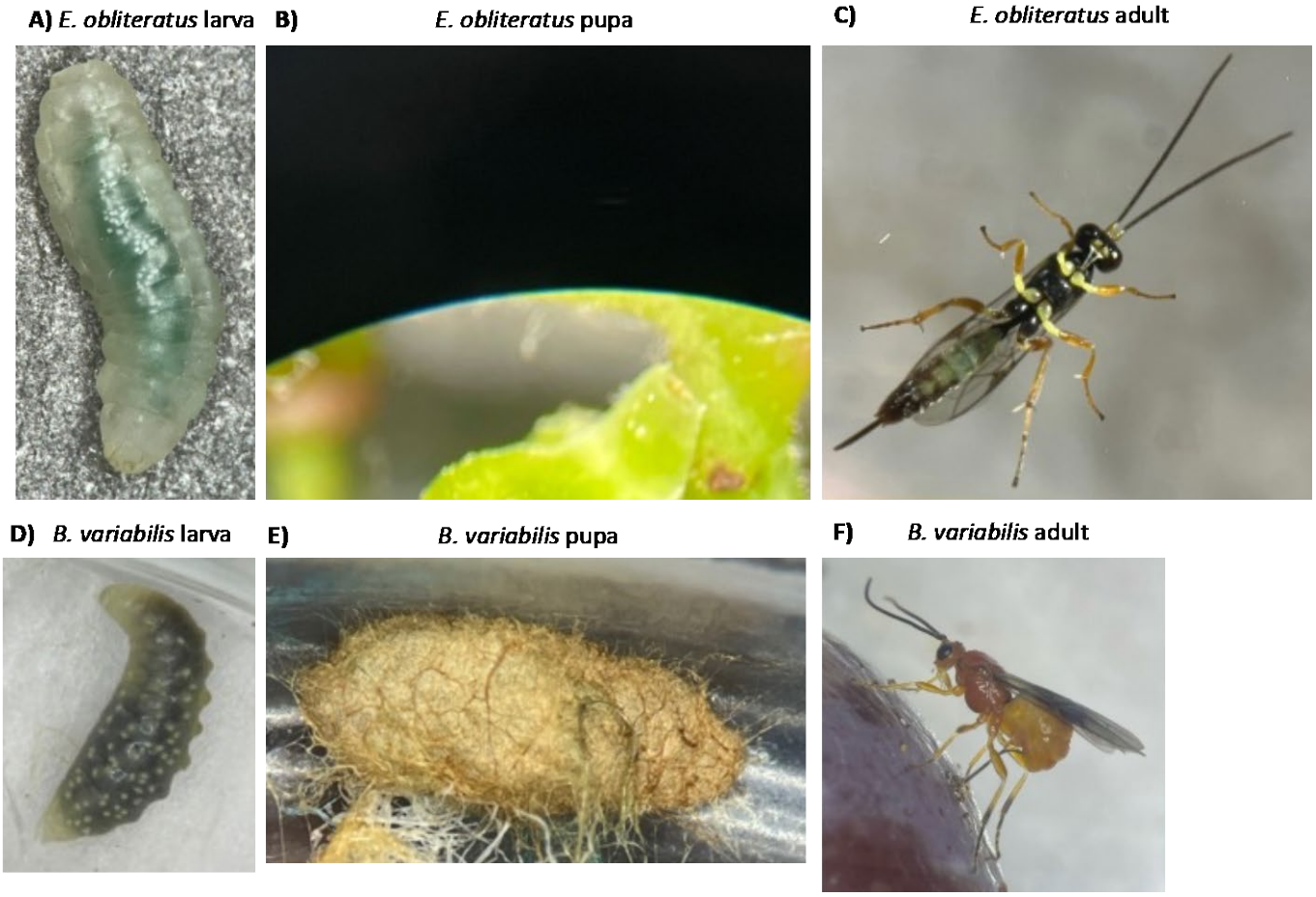

Figure 1. Living stages of two grape berry moth larval parasitoids: *Enytus obliteratus* and *Bracon variabilis* **(A)** last-instar larva of *E. obliteratus*, **(B)** *E. obliteratus* pupa, **(C)** *E. obliteratus* adult **(D)** Last-instar larva of *B. variabilis,* **(E)** *B. variabilis* pupa, and **(F)** *B. variabilis* adult.