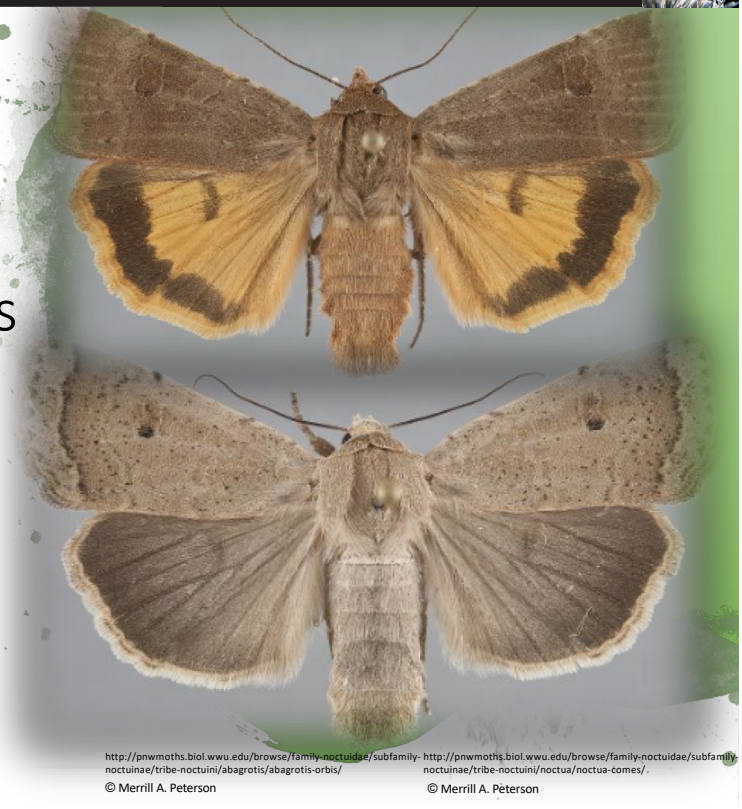
institute for sustainable horticulture

Novel approaches to IPM strategies for climbing cutworms *Noctua comes* and *Abagrotis orbis* in wine grapes in the Okanagan Valley

Gabriel Arruda, M. Franklin, S. Tahriri Adabi, A. Huang, and D. Henderson



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KWANTLEN POLYTECHNIC UNIVERSITY
INSTITUTE FOR SUSTAINABLE HORTICULTURE

PPMA Symposium and AGM
March 4th, 2019

Outline

- Background on cutworms damages to vineyards
- Biological control
- Target pests and their lifecycle
- Nematodes and *Beauveria* trials
- Results

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Background

- Cutworm refers to numerous lepidopteran species
- Responsible for 98% of damage to grape buds in the Okanagan Valley region
- *Abagrotis orbis*, *A. reedi*, and *A. nefascia* were responsible for 85% of it
- *Noctua comes* is an invasive species
- Economic threshold: 3% bud damage

(Lowery & DeLury 2013)

https://amctours.com/products/last-minute-kelowna-wine-tours

https://bcwgc.org/sites/default/files/project/admin/flies/pests_of_grape_0.pdf

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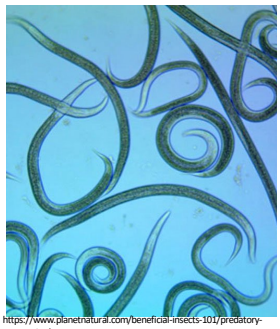

https://www.planetnatural.com/beneficial-insects-101/predatory-nematodes/

Photos by Amy Huang

Biological Control

- Chemical insecticide treatments each spring
- Biocontrols are living organisms such as nematodes, entomopathogenic fungi, and bacteria.
- Cutworms in vineyards show optimal growth at low temperatures (~15°C).
- Suitable biological control agents will need to work effectively at these temperatures.

Target pests

Abagrotis orbis (Grote, 1876)

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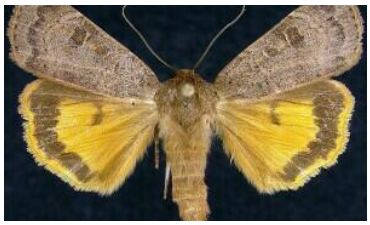
Noctua comes (Hübner, 1813)



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http://sysbio.univ-lille1.fr/fiche/noctua-comes

Objectives

Overall Objective

To contribute to an Integrated Pest Management strategy which makes best use of nematode and fungal entomopathogen biocontrol tools to manage cutworms in Canadian wine grapes.

Specific Objectives

1. **To assess the efficacy of commercially available nematode species and fungal entomopathogen *Beauveria bassiana* against *A. orbis* and *N. comes* at a range of temperatures.**
2. To determine the most promising combination of these biocontrol agents for efficacy against *A. orbis* and *N. comes*.

Cutworms lifecycle

- Small larvae spend the winter in the soil
- Resume feeding and complete development in spring.
- Single generation each year

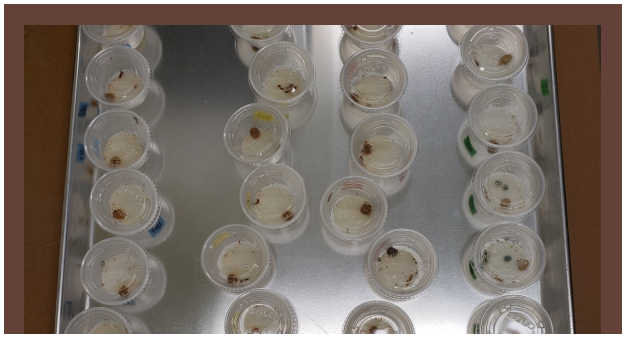
Fall
Eggs and small larvae

Early Spring
Larvae

Late Spring
Pupae

Early Summer
Moths

Photos by Gabriel Arruda and Coel Ediger



Photos by Amy Huang

Nematode Trials

- Species tested:
  - *Heterorhabditis bacteriophora*
  - *Steinernema carpocapsae*
  - *Steinernema feltiae*
- Applied to filter paper in solo cups
  - 2nd instar larvae – 900 nematodes per cup
  - 4th instar larvae – 1500 nematodes per cup
- Placed larvae with diet plug in cup
- Assessed for mortality daily.

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N. comes Nematodes – 15°C

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N. comes Nematodes – 17°C

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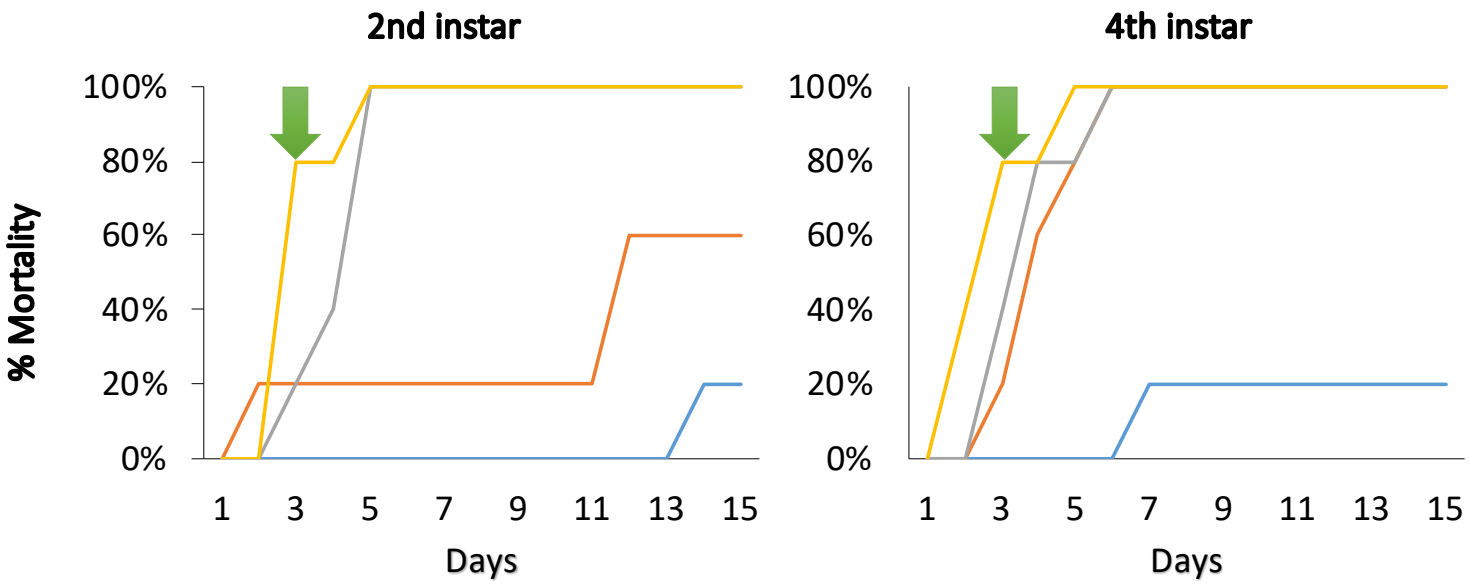
N. comes Nematodes – 20°C



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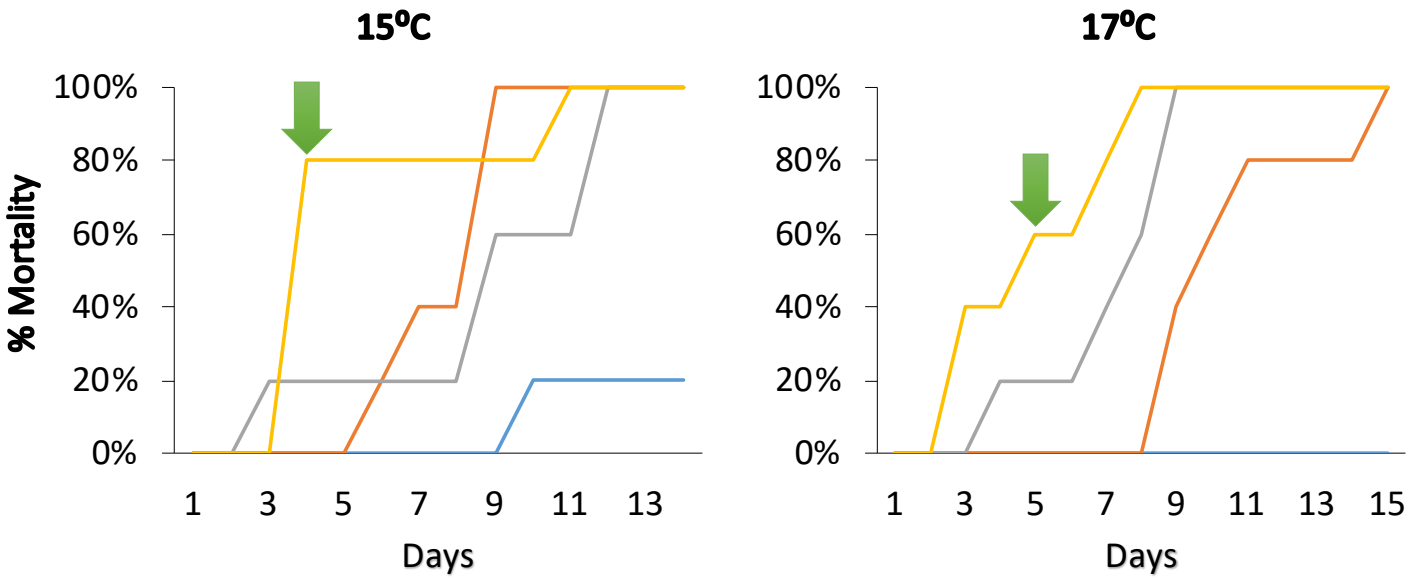
A. orbis
Nematodes – 2nd instar



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A. orbis
Nematodes – 2nd instar

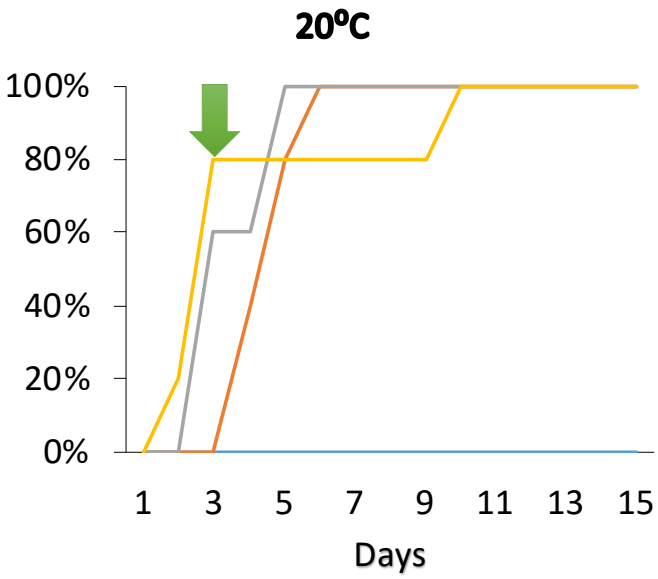
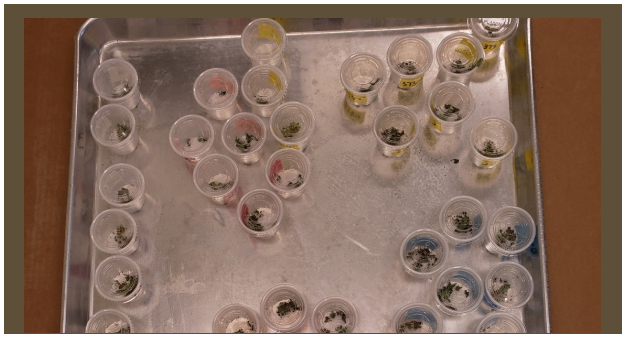


Table 1. More efficacious nematode species against target pests

Species	Instar	15°C	17°C	20°C
A. orbis	2nd	**S. feltiae**	**S. feltiae**	All
	4th	----------In progress----------		
N. comes	2nd	**S. feltiae**	**S. feltiae**	S. feltiae or S. carpocapsae
	4th	**S. feltiae**	**S. feltiae**	All

Results Summary
Nematodes



Photos by Amy Huang

Beauveria bassiana trials

- Isolates tested:
  - 2 from the Okanagan Valley (Tom Lowery – Ag. Canada)
  - 3 from the Fraser Valley (Institute for Sustainable Horticulture)
- Dipped kale leaf disks in suspension of *B. bassiana* ($4x10^8$ spores/ml)
- Placed larvae in cup with leaf disk
- Assessed for mortality and fed leaf material daily.

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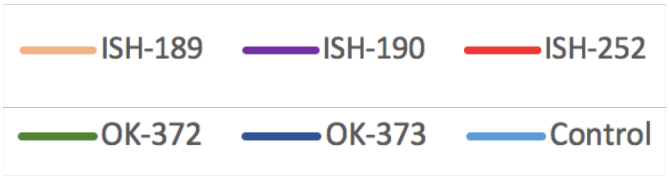
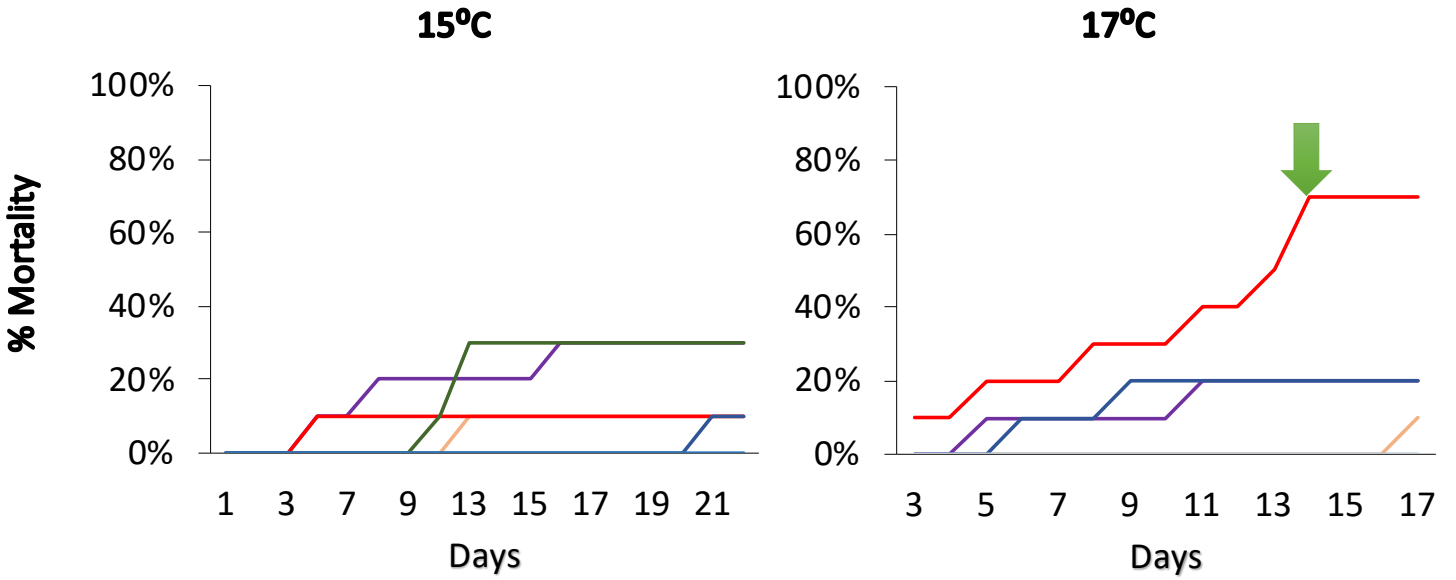
N. comes
B. bassiana – 2nd instar





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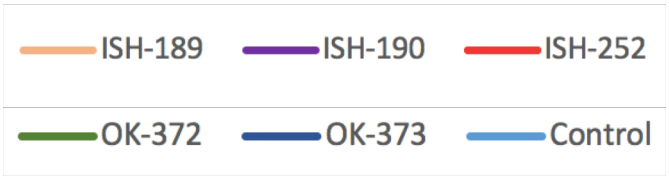
N. comes
B. bassiana – 2nd instar



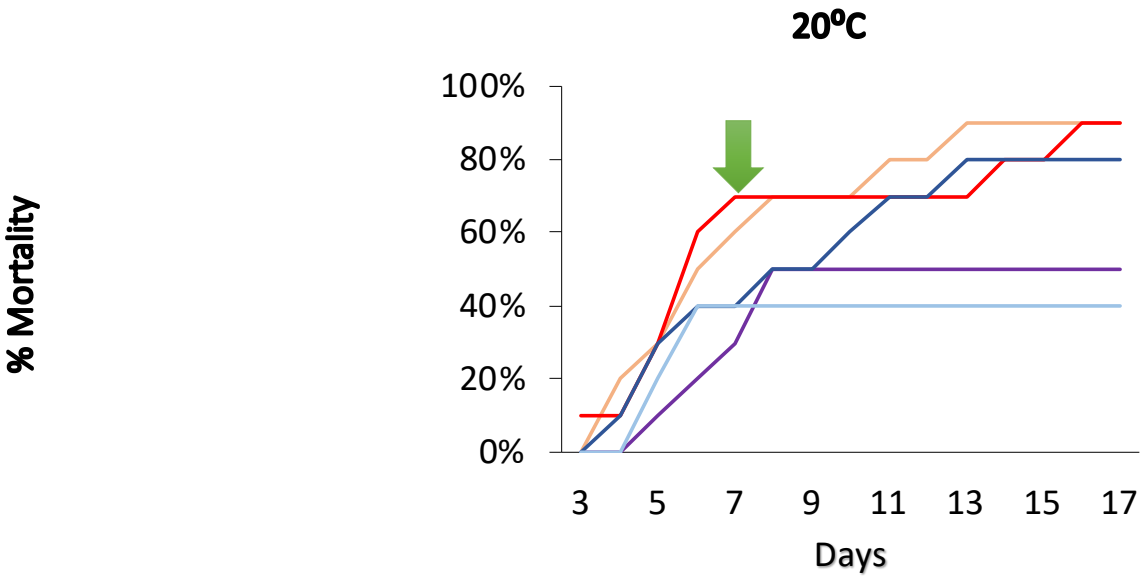


Table 2. More efficacious *B. bassiana* isolates against target pests

Species	Instar	15°C	17°C	20°C
A. orbis	2nd	----------In progress----------		
	4th			
N. comes	2nd	None	**ISH-252**	**ISH-252** or ISH-189
	4th	----------In progress----------		

Results Summary
Beauveria bassiana

General Summary

- *S. feltiae* had the highest efficacy for both cutworms species at low temperatures (15, 17°C)
- All 3 species of nematodes were efficacious at higher temperatures (20, 25°C)
- No *B. bassiana* isolates were efficacious at 15°C for the control of *N. comes*
- However, isolates ISH-189 and ISH-252 showed efficacy at 17 and 20°C
- Targeting small larvae in the fall when soil temperatures are warm may be the best strategy.
- Combinations of nematodes and *B. bassiana* may improve efficacy at 15°C.

Canadian Grapevine Certification Network

CGCN-RCCV

Réseau Canadien de Certification de la Vigne

CANADIAN AGRICULTURAL PARTNERSHIP | PARTENARIAT CANADIEN pour l'AGRICULTURE

Agriculture and Agri-Food Canada

Agriculture et Agroalimentaire Canada

Acknowledgments

Special thanks to:

Current and former members of the ISH lab:

Coel Ediger, Anna Westhaver, Wajahat Farooq, Heather Little, Basanti Bandekar, An Nguyen, Annerys Carabeo Perez, Andres Torres, Rachel Hagel, Matilda Tabert, Lisa Wegener, Yan Han, Elena Devanadera, and Elizabeth Hudgins.

Rob Mattson for cutworms (Eco-Care Technologies)

Tom Lowery for cutworms and *B. bassiana* isolates (Ag. Canada)

References

Icons made by Freepik, Kiranshastry, Nhor Phai, photo3idea_studio, Smashicons, and turkkub on www.flaticon.com

Lacey, L. A. (1997). *Manual of Techniques in Insect Pathology*. Wapato, USA.

Lowery, T., & DeLury, N. (2013). *Research update: management of cutworm pests of grape*. Paper presented at the British Columbia Wine Grape Council Enology and Viticulture Conference, Penticton, BC. Retrieved from https://bcwgc.org/sites/default/files/media/files/Lowery-%20Managing%20cutworm%20pests.pdf

Lowery, T., Johnson, T. S., Cossentine, J.E., & Cory, J. (2012). *Cool caterpillars: low temperature biological control of a climbing cutworm*. Entomological Society of America (ESA) 60th Annual Meeting, Knoxville Convention Centre, Knoxville, TN, USA. Abstract retrieved from personal email.

Lowery, T., Weis, M., & Buchler, H. (n.d.). *Insect and mite pests of grape in the southern interior of B.C.* Retrieved from https://bcwgc.org/sites/default/files/project/admin/flies/pests_of_grape_0.pdf

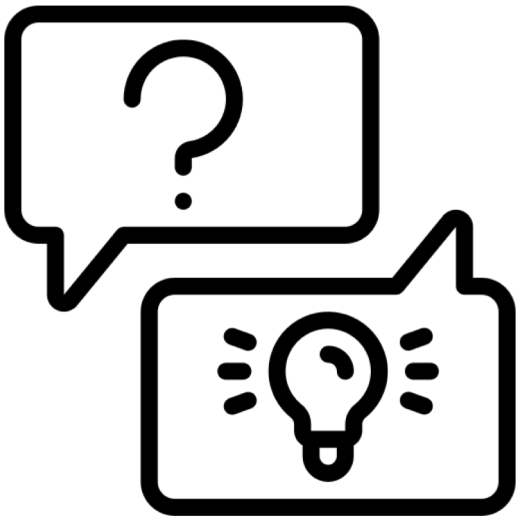
Moth Photographers Group. (n.d.). *933676.00 – 11027 – Abagrotis orbis – (Grote, 1876)*. Retrieved from http://mothphotographersgroup.msstate.edu/species.php?hodges=11027

Moth Photographers Group. (n.d.). *933552.00 – 11003.2 – Noctua comes – Lesser Yellow Underwing Moth – Hübner, [1813]*. Retrieved from http://mothphotographersgroup.msstate.edu/species.php?hodges=11003.2

Pacific Northwest Moths. (n.d.). *Noctua comes Hübner, [1813].* Retrieved from http://pnwmoths.biol.wwu.edu/browse/family-noctuidae/subfamily-noctuinae/tribe-noctuini/noctua/noctua-comes/

Pacific Northwest Moths. (n.d.). *Abagrotis orbis (Grote, 1876)*. Retrieved from http://pnwmoths.biol.wwu.edu/browse/family-noctuidae/subfamily-noctuinae/tribe-noctuini/abagrotis/abagrotis-orbis/

Tahiri, S., Little, H., Wegener, L., & Williamson, A. (2017). *Efficacy of two native Beauveria bassiana isolates from climbing cutworm pests of grapes against common Lepidopteran pests in berry and vegetable crops*. Unpublished report retrieved from personal email.



Questions?

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