Screening of entomopathogenic fungi from West Central Nebraska against key pests of corn

Oliveira-Hofman, C.¹, Meinke, L.J.¹, Adesemoye, A.O.², and Peterson, J.A.* ³

¹Dept. of Entomology, University of Nebraska-Lincoln, Lincoln, NE 68583-0816
²Dept. of Plant Pathology, University of Nebraska-Lincoln, West Central Research & Extension Center, North Platte, NE 69101
³Dept. of Entomology, University of Nebraska-Lincoln, West Central Research & Extension Center, North Platte, NE 69101. Email: coliveirahofman@gmail.com

Introduction

- The western corn rootworm (WCRW), Diabrotica virgifera virgifera LeConte (Coleoptera: Chrysomelidae) is a highly adaptable pest and cases of resistance to Bt crops and insecticides in the Corn Belt have been reported (1, 2, 3, 4).
- Integrating biological control into the scope of management practices against the WCRW might help us suppress populations and delay resistance issues.
- Entomopathogenic fungi have been tested against the WCRW with low to moderate mortality rates (5, 6, 7, 8).
- Any control applied to the soil against the WCRW may also impact secondary targets that spend part of their life cycle in the soil such as the western bean cutworm, Striacosta albicosta Smith (Lepidoptera: Noctuidae).
- Nebraska is currently the third largest maize grower in the country and WCRW and WBC are two of the state’s biggest pests.

Research Objective

Screen entomopathogenic fungi (EPF) from irrigated corn fields against the WCRW for potential biological control and screen selected strains against the WBC.

Fungal Strains Background

Native entomopathogenic fungi were collected in 2014 and 2015

High WCRW-pressure sites (n=4)
- Commercial corn
- Cry3Bb1 or Cry3Bb1+Cry34/35Ab1
- Continuous corn (>5 yrs)
- Center pivot irrigation

Low WCRW-pressure site (n=1)
- 1ª year corn in 2014

Isolation and Identification of Fungal Strains

Soil baiting assays with G. mellonella and T. molitor:
- Fungi recovered from inoculated cadavers.
- Strains isolated in selective media.
- Gene amplification using ITS and Bt primers.

Bioassay Methods

Conidia from 14-day old plates were washed with 0.1% Tween 80 and inocula were adjusted for viability. All bioassays cup were sandwiched between café-trays lined with moist paper towels and then placed into an incubator set at 65% RH, 26.3 ± 0.5°C.

- 48 fungal strains tested from Figs. 3 and 4 at 1 x 10³ spores/gram of soil or maximum obtained concentration.
- Inoculated soil dispersed into three 2-oz cups, each with three 3-day-old corn seedlings.
- Inoculum incorporated into sterile soil at 25% water holding capacity (WHC).
- Controls received 0.1% Tween 80.
- Ten third instar larvae added/cup. Total of 30 larvae/strain.
- Mortality checked at 9 days and corrected with Abbott’s formula.
- Analysis: least square means (Tukey’s adjustment) in RStudio glm package.

Results

WCRW soil assay
- All but three strains (E999: A. flavus, E325: Taiangliangia sp., and E331: T. trachyspermus) had greater than zero WCRW corrected mortality.
- Many strains exhibited poor sporulation and/or germination, thus inoculum containing colonies varied significantly.
- However, strains with lower spore concentrations were still able to kill WCRW.
- Mean negative control mortality was 12.2%.
- Strains with “***” (E1089, E1000, E653, E645, E380, E138, E1022, E1026) were significantly greater than control mortality before Abbott’s correction at (p < 0.05).

WCRW dipping assay
- All negative control larvae were alive in the end of the study and strain mortality ranged from 13.3- 57.3%.
- Strain with “***” (E1016) was significantly different than control mortality at (p < 0.10).

WBC assay
- Negative control mortality was 6.2% and corrected strains’ mortality ranged from 13.3- 57.3%.
- Low availability of insects didn’t allow for replications and statistical analysis.

Discussion

- This research indicates that native EPFs are capable of causing WCRW and WBC mortality.
- In Iowa, native M. anisopliae and B. bassiana from the soil caused similar WCRW mortality levels (8).
- There is a significant knowledge gap on what other EPFs are pathogenic to the WCRW besides Metarhizium and Beauveria.
- Some genera tested herein are not exclusively entomopathogenic, e.g., Fusarium (plant pathogen) and Trichoderma (biofungicide), but rather contain species that have shown entomopathogenicity or toxins against certain insects.
- There is an overlap (May-July) in which larvae and pupae of both WCRW and WBC are present in the soil at the same time and a strain that can be used for both species simultaneously may benefit fields in which both pests are a problem.
- Next step will be to explore the feasibility of M. robertsi strains for the control of both pests in field trials, which will establish ground work for the integration of EPF in maize IPM.

References

2. Parmi et al. 2006. Crop Protection. 25(3):269-274

Acknowledgements

The authors would like to acknowledge Dr. Stefan Jaronksi, Dr. Gary Yuen and Christy Jochum for providing experimental advice. We would also like to thank Deborah Mentenzao, Priscila Luz and Dr. Katharine Swoboda Bhatiaria for providing WBC prepupae. Many thanks to Joseph Schenk, Tyler Juhlin, Emily Reinders, Darlene Souza, Jim Brown, Ethan Hoffart and Alex Lehmann for technical assistance with experiments. Funding for this study was provided by the Nebraska Corn Board (Project ID 42057).