

Diagnostic Resources for Pests and Beneficial Insects on Specialty Crops

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Enhancing Market Competitiveness of Arizona Specialty Crops

Arizona is home to extremely insect diversity, with minimal estimates of 20,000 species in our state. Many pest and beneficial species occur on specialty crops, thus being of economic importance to Arizona stakeholders and crop production. Accurate species identification is essential to select best control methods, and knowing which species are beneficial for controlling pest species helps maintain a natural balance of interactions within crop fields. In a collaborative effort with Extension faculty statewide and Arizona growers, we provided modern diagnostic resources for pest and beneficial insect species from specialty crops. These resources include a publicly available database of DNA sequence data (DNA barcodes) to promote molecular-based species identification tied to high-resolution images and georeferences of associated voucher specimens.

Outcomes enhance the competitiveness of specialty crops in Arizona by:

- **developing educational resources** for specialty crop producers and pest managers, enabling accurate identification of species occurring in specialty crops
- working with Arizona Pest Management Center, Cooperative Extension personnel and other networks to **promote availability of these resources**
- **providing diagnostic support for specialty crop producers** by promoting the College of Agriculture, Life and Environmental Science (CALES) Cooperative Extension and Insect Diagnostics Clinic

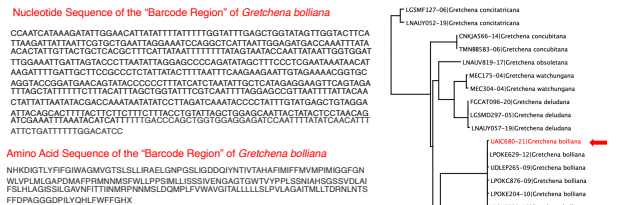
Need for Accurate Insect Diagnostics

Insect feeding can cause a wide variety of damage to specialty crops and proper identifications are essential to determine control methods. Preliminary data suggests nearly 50 insect species are associated with specialty crops in Arizona. Accurate identification of these species is critical since not all insects cause damage and, in fact, some act as beneficial predators on pest species.

Species names provide the critical link to everything we know about that species, including its biology, life-history, feeding preferences, preferred habitat, and geographical distribution. Therefore, accurate species identifications provide the foundation for science informed decision making for pest control.

DNA Barcoding Prevents Misidentification

Many small insects are difficult to identify using traditional methods. A recent example on the importance of DNA Barcoding involved the identification of the Pecan Bud Moth (*Gretchena bolliana*) in Arizona for the first time. To confirm morphological identification, we obtained nucleotide sequence of the DNA barcoding region of the COI gene from the Arizona specimens. We compared this sequence with those from expertly-identified tortricid moths in the Barcode of Life Database (BOLD). We found 99.85% similarity to sequences obtained from *Gretchena bolliana* collected in Oklahoma and Texas. Such a high degree of similarity in this region of the genome has been shown to be a reliable tool to verify many species-level identifications.



Search Result of UAIC *Gretchena bolliana* Sequence on BOLD

Query: UAIC680-21 | *Gretchena bolliana*
Top Hit: Arthropoda, Insecta, Lepidoptera, Tortricidae,
Gretchena bolliana (99.85%)

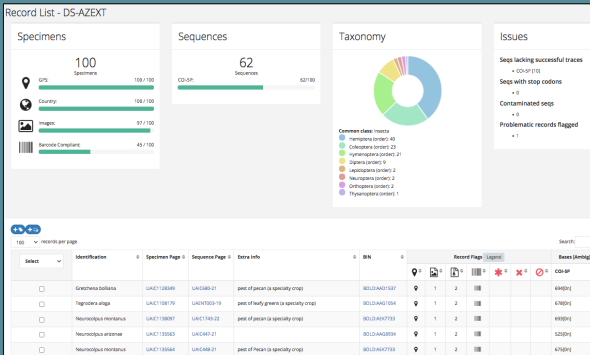
The submitted sequence has been matched to *Gretchena bolliana*. This identification is solid unless there is a very closely allied congeneric species that has not yet been analyzed. Such cases are rare.

BARCODE OF LIFE DATA SYSTEM v4

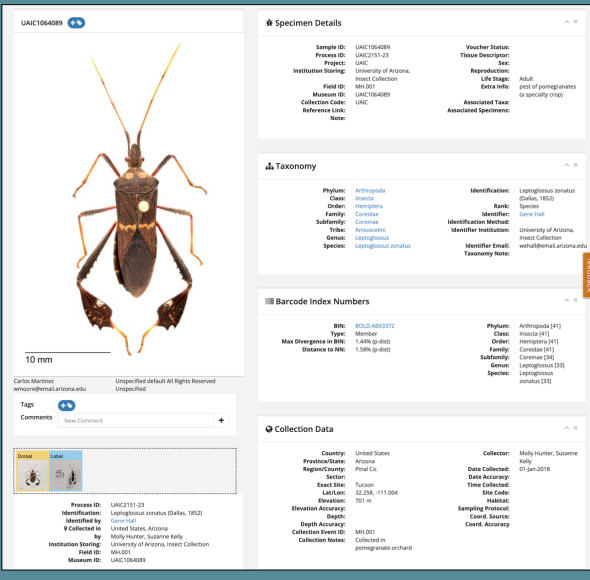
Advancing biodiversity science through DNA-based species identification.

We created an expandable, publicly available BOLD dataset specific to pest and beneficial insects of importance to agriculture in Arizona. This dataset currently contains 100 specimen records, all georeferenced and with high resolution specimen photos. Sixty-two of these records also include high quality DNA barcodes. All 100 specimens are fully curated, labeled as being DNA Barcode voucher specimens, and deposited in the UAIC. These data are available to growers, stakeholders, researchers, and PCAs, ensuring long-term accurate species identification.

Overview of records in DS-AZEXT Arthropod Pests in Arizona on BOLD



Example specimen page in DS-AZEXT Arthropod Pests in Arizona on BOLD



University of Arizona Insect Collection (UAIC)

The UAIC maintains the **largest collection in the world of Arizona insects**, including pest and beneficial species associated with specialty crops. It is an irreplaceable reference library of pest and non-pest insect species, facilitating insect identification requests submitted to the UA from locations statewide as part of CALES Cooperative Extension's Insect Diagnostic Clinic, including pest species from growers, PCAs, and Extension Agents.

UAIC Barcoded Voucher Specimens



We are generating a new collection of barcoded voucher specimens which are incorporated into the UAIC main collection. We are also building a new collection of total genomic DNA extracted from these specimens.

High-Resolution Images Facilitate Accurate Identification

Each DNA voucher specimen is also photographed with our Visionary Digital Imaging System. These photographs are associated with each specimen record on BOLD. High-resolution images also support accurate species-level identifications.

UAIC Digitized Specimen Records

Hundreds of UAIC specimens for over 30 pest and non-pest species were georeferenced, digitized and made publicly available online through Ecdysis.



Through collaborations and research, we have:

- established a new collection of DNA barcoded voucher specimens curated and maintained in perpetuity in the UAIC.
- developed educational resources for specialty crop producers and pest managers, enabling accurate identification of pest and non-pest insect species.
- worked with the U of A's Arizona Pest Management Center and Cooperative Extension personnel to promote pest and non-pest education.
- provided diagnostic support by promoting CALES Cooperative Extension Insect Diagnostics Clinic as an identification resource for specialty crop growers in Arizona.
- generated and published 62 DNA Barcodes for specialty crop insect species.



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