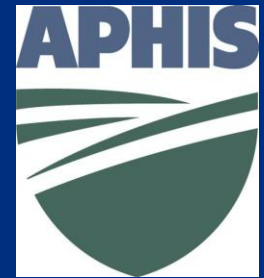


QUARANTINE SIGNIFICANT LEPIDOPTERA OF CONCERN TO THE SOUTHERN UNITED STATES



STEVEN PASSOA
USDA/APHIS/PPQ

2007



Fig. 1

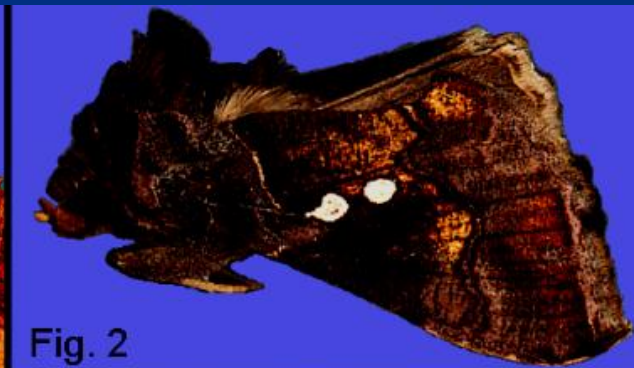


Fig. 2

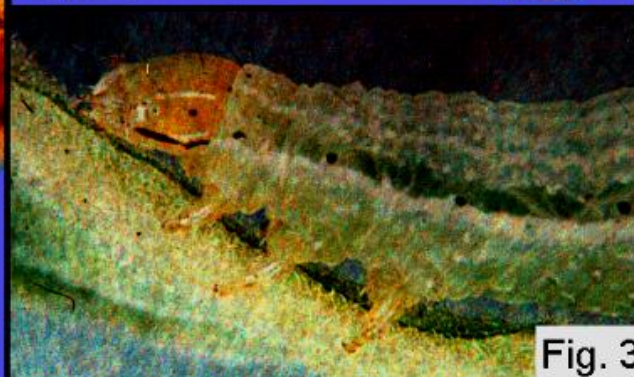


Fig. 3

LEPIDOPTERA GOALS

- Learn techniques of specimen preparation and submission for CAPS Lepidoptera
- Develop a list of Lepidoptera of regulatory concern to the southern USA
- Learn to SCREEN samples for these species in the stage most likely to be seen by diagnostic labs using the MAJOR characters. Some species are only defined by a combination of features. In those cases, using the associated key and references listed is more accurate.
- Give examples from the major superfamilies
- Distributions and hosts mentioned are the most likely pathways

DEVELOP A LIST

- Criteria originally modified from biocontrol of weeds list in July 1991 memo, then modified by NEPSC committee
- Now widely used in APHIS as mini-PRA
- Survey methodology and taxonomic recognition added to economic criteria
- Results are either threats (no pathway), CAPS targets (need to survey), or a dead survey (not practical to consider)

WHY LABS HATE TO IDENTIFY LEPIDOPTERA

- Secret society of critical characters
- Constant name changes
- Characters hard to see, covered with scales, or both

EGGS

- Two types
- Do not kill important finds and sent urgent
- Plan to rear them in a quarantine facility
- Spodoptera and Lymantria (and others) cover the eggs with scales from the female's body



LARVAE

- Associate leaf miners with the mine and host
- Mouthparts are the “genitalia” of the larval world
- Fill vials so there is no air bubble when shipping
- “Burp” rubber stoppers and parafilm screw top vials
- Can kill and ship in vinegar
- Put loose parts in small vials



PUPAE

- Finding the cast larval skin is critical (can be dissected and mounted)
- The form of the cocoon is important, include the cocoon
- Can sometimes dissect out genitalia of pharate adult



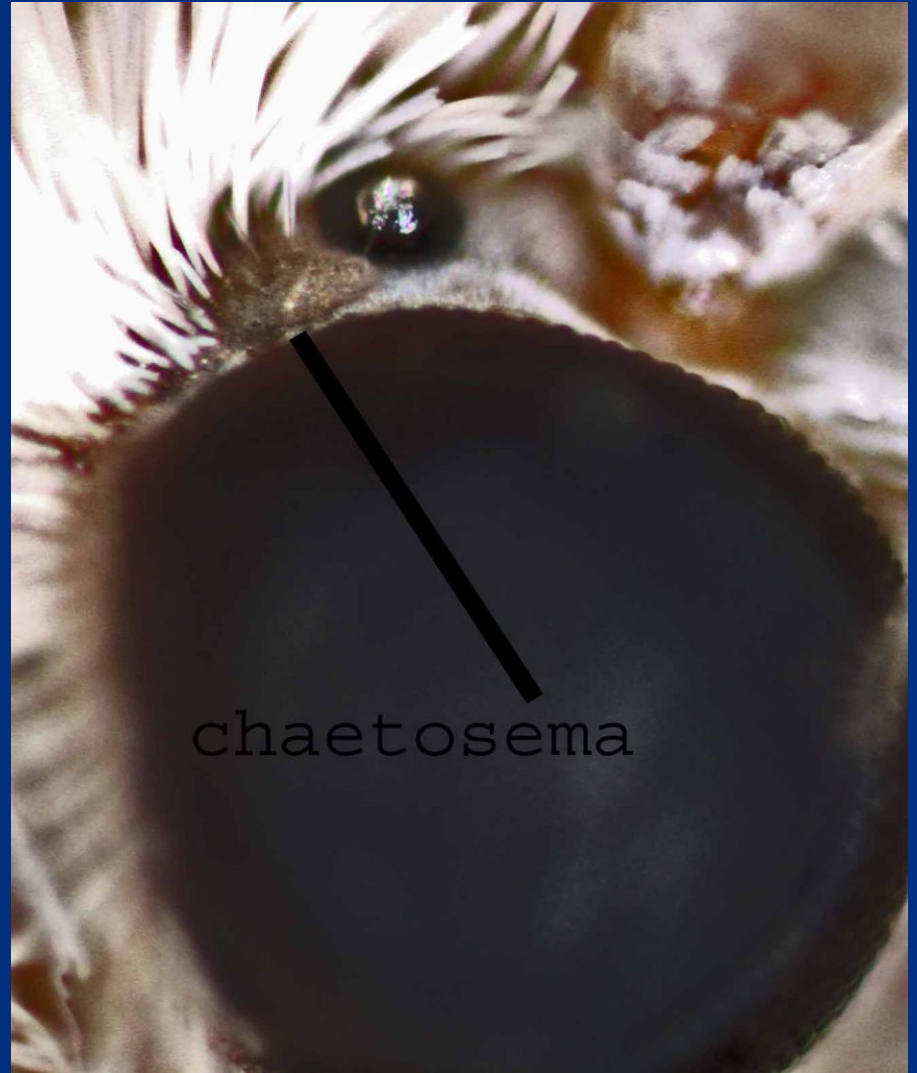
ADULT MORPHOLOGY FOR STICKY TRAPS

- Gelechioidea = upturned palpi, proboscis scaled
- Pyraloidea= abdominal tympanum, proboscis scaled
- Tortricoidea= chaetosema present (specialized scales off a wartlike bump next to the ocelli)
- Noctuoidea= thoracic tympanum
- Geometridae= abdominal tympanum, proboscis not scaled
- Butterflies/skippers= clubbed (or hooked) antennae

ADULT CHARACTERS



ADULT CHARACTERS

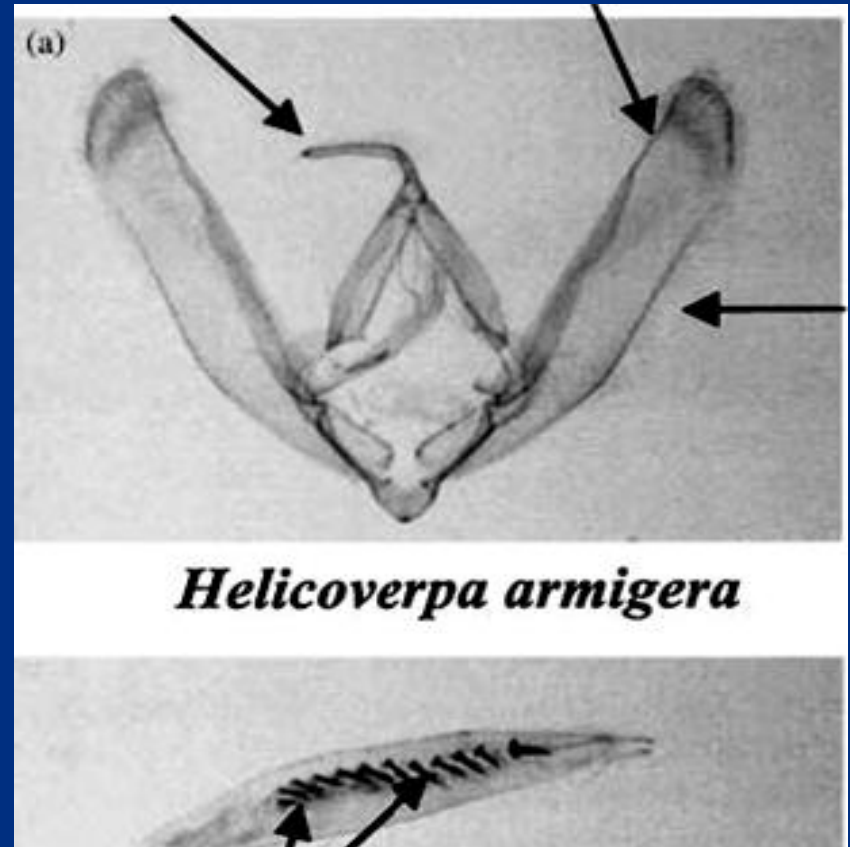


MALE GENITAL MORPHOLOGY

- Not important to learn detailed morphology, just try to match a known picture
- Major parts are valve, aedeagus, and cornuti
- Females not a concern with sticky traps
- Sticky traps collect targets, non-targets, and species that rest in protected areas

uncus

valve



▪ Aedeagus with cornuti

Spodoptera litura/littoralis and non-targets rice cutworm, Egyptian cottonworm

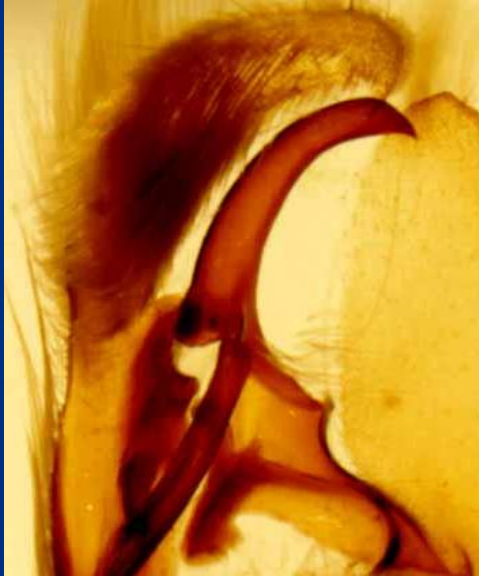
- Cu vein with “silver fork” with a long stem and 3 unequal prongs, partially covered in males by white band
- Hindwing bright shiny white



Clasper of male valve in *litura* and *littoralis* relatively straight, apex rounded



Spodoptera non targets



**Clasper thick,
curved =latifascia**



**Two bands on
thorax= dolichos**

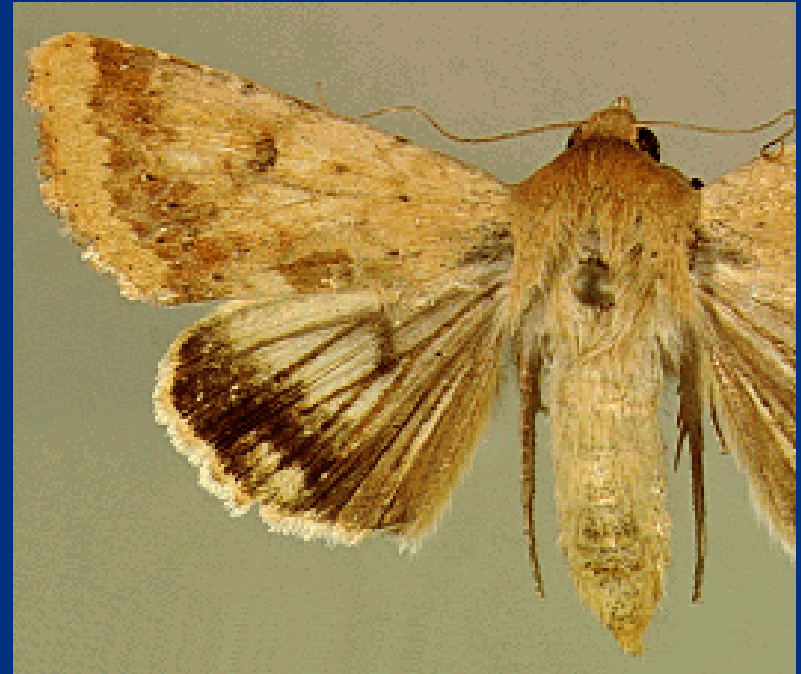
**Clasper evenly curved,
apex truncate= ornithogalli**



Helicoverpa armigera/zea

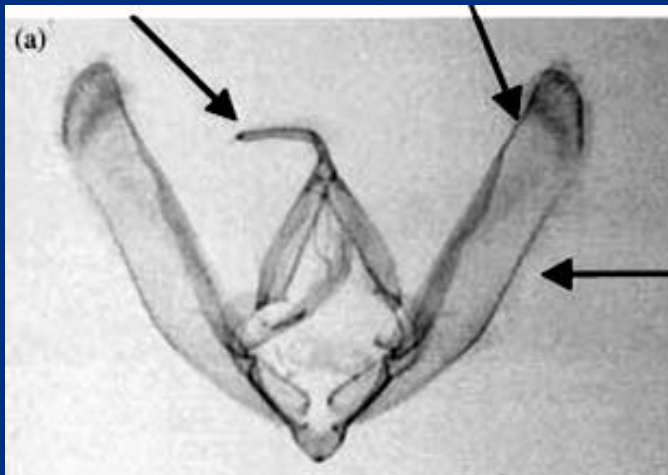
Old World bollworm/corn earworm

- Two recent systems:
Pogue/Texas A + M study
and EPPO standards for
identification
- I don't recommend KOH
of whole bodies unless the
genitalia is very distinctive
or the target can be
recognized even when the
wings are damaged
- To screen: hindwing with
broad band, often with 1-2
spots (H. zea/armigera)



Helicoverpa armigera/zea

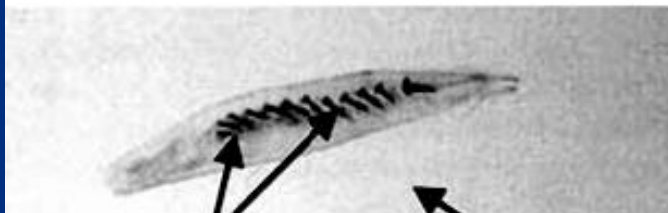
Inner margin of valve straight in armigera (EPPO 2003)



Helicoverpa armigera

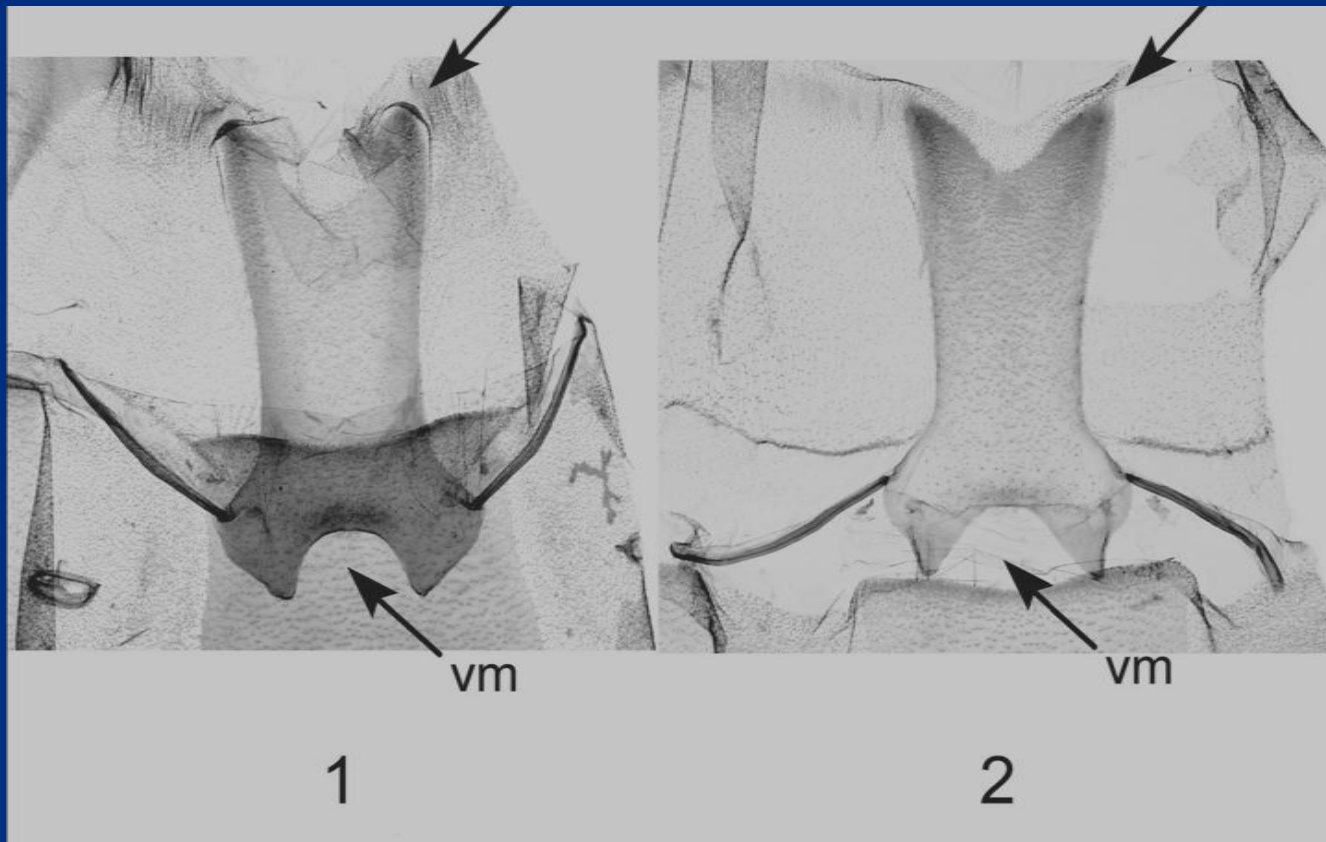


Helicoverpa zea



Helicoverpa armigera/zea

Ventral margin of 8th sternite in armigera truncate, not evenly rounded (Pogue 2004, fig. 2)



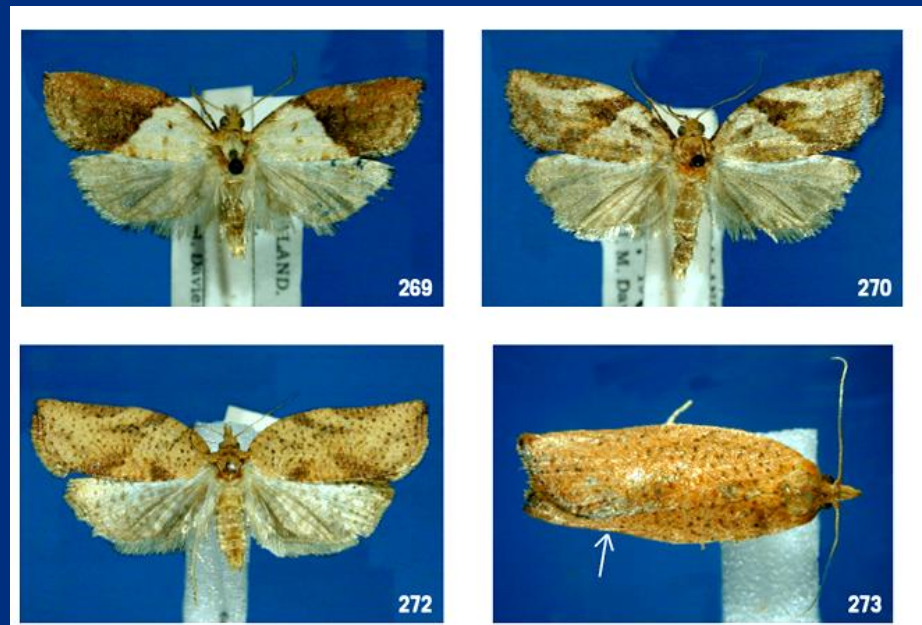
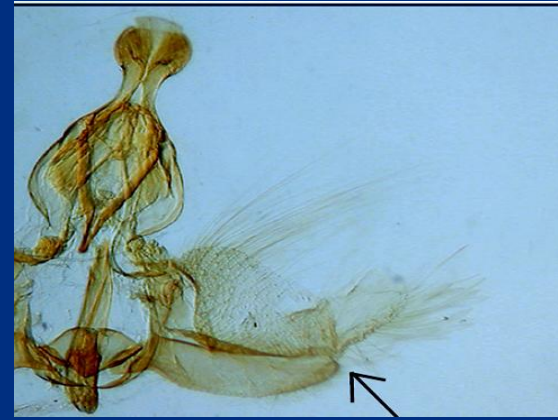
Thaumatotibia leucotreta (Tortricidae) false codling moth

- Hind leg with scale tuft (also many other moths)



LIGHT BROWN APPLE MOTH SURVEY IN YOUR FUTURE ???

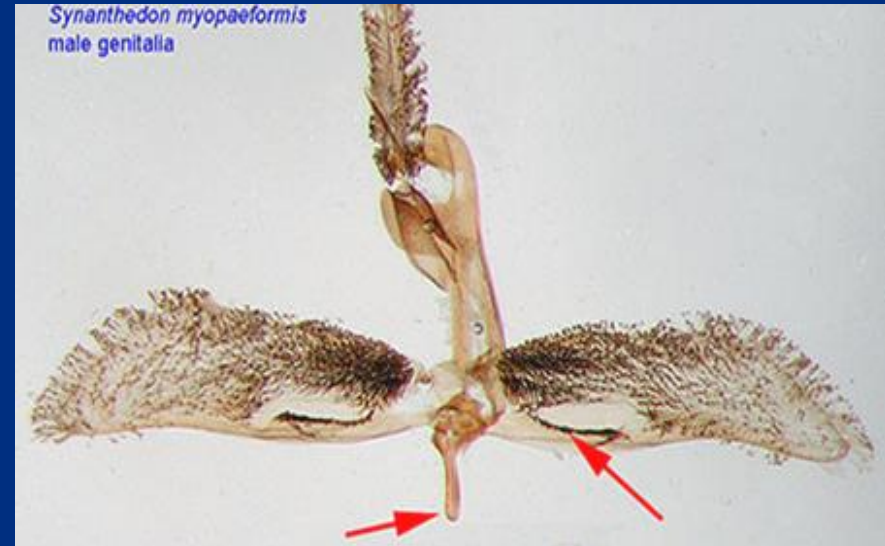
- Someone who can recognize tortricids and prepare genitalia will be needed, LBAM is variable in color
- Based on a very few LBAM traps from the NER in 1990's, *Choristoneura rosaceana* will be the most common tortricid non-target. *Pyrausta* will attract attention too.
- Valve with membranous lobe at apex (Dougdale et al. 2005)



Synanthedon myopaeformis (Sesiidae) and Lymantria (Lymantriidae): two final examples

- “Same old same old”.
- Find the genitalia of the target, prepare the sample, compare the unknown to the target genitalia, then decide
- **Don’t be afraid to “Google”, just be afraid to trust it**

**Gypsy moth can be identified by the genitalia,
even without the rest of the moth (Ferguson 1978)**



CATERPILLAR MORPHOLOGY

- Names of primary setae based on location on body (dorsal, subdorsal, lateral, subventral, ventral)
- Hairy caterpillars have “secondary setae”
- Terms of orientation (anteroventrad = in front and below)
- Pinaculum (pinacula plural) = setal base
- Eyes of caterpillars are called stemma (stemmata plural)
- Muscle attachments are called tonofibrillary platelets

Opogona sacchari (Tineidae) the banana moth

- 2 stemmata (one hard to see), from living tissue of nursery stock and ornamentals (never stored products)
- See Davis and Pena (1990) and Heppner et al. (1987). There is a related species in California



Phyllocnistis citrella (Gracillariidae) citrus leaf miner

- Serpentine miner on citrus with central frass tract, mature larva with two thin anal “tails” (absent in prepupa)
- Can complicate ID by not sending mine or host. Can be confused with other gracillariids mining fruit (orange peel miner has no central frass mine). See Heppner (1993, 1995)



Cossidae/Sesiidae

- Larvae bore in tree trunks, may see cast pupal skins with rows of abdominal spines (cherry bark tortrix, linden bark borer, are two exceptions not in these families)
- Butterworms are imported as bait. Mezcal worm is usually a cossid)
- See Passoa (1992)



Blastobasis graminea (Coleophoridae)

- Submental pit present
- Sugarcane (sometimes corn, sorghum), often associated with Diatraea damage. Bores in living tissue. New World only.
- See Adamski (1999)

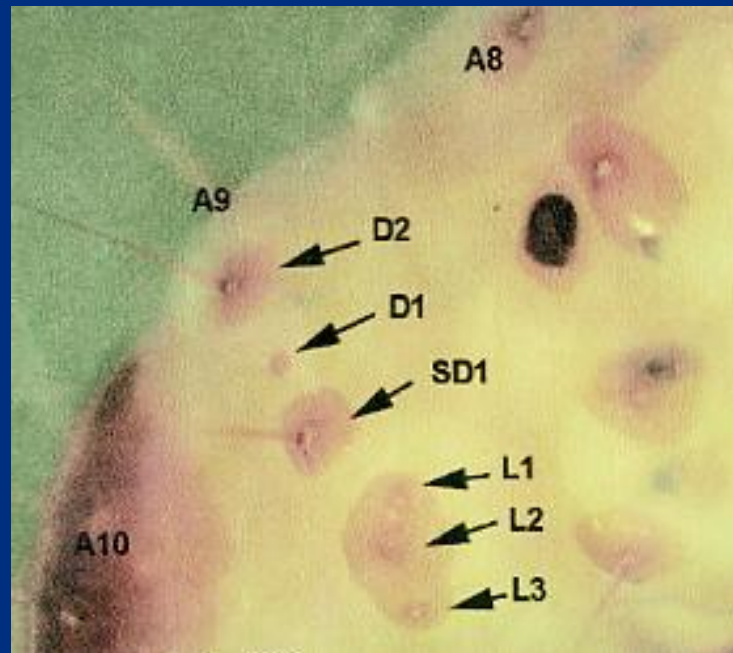


Typical blastobasid submental pit



Pectinophora scutigera, Platyedra subcinerea; Gnorimoschemini on potato (Gelechiidae)

- Cotton gelechiids: see Powell et al. (2001), Hodges (1984), Capps (1958)
- Potato gelechiids (Latin America): see Povolny (1990, 1994)
- No pathways are obvious at this time and larval identification even to family is complicated (Stehr 1987, Passoa 1995)



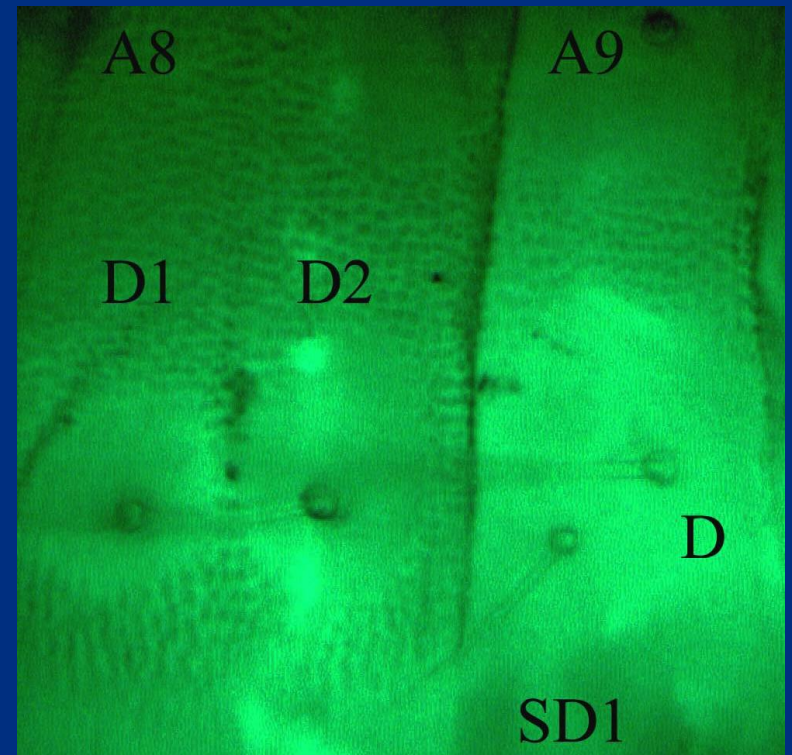
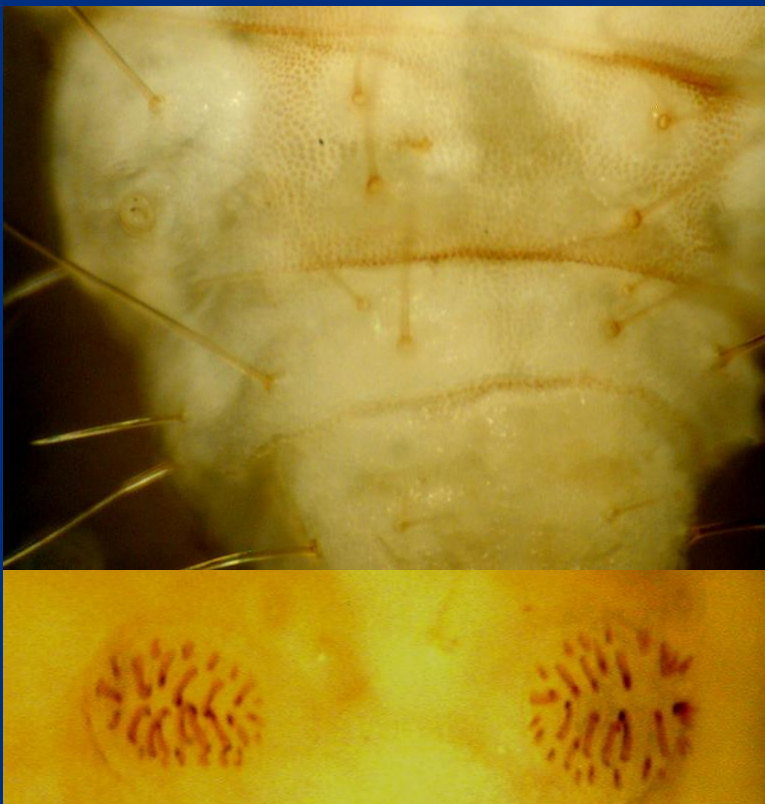
Acrolepiopsis assectella (Acrolepiidae) leek moth

- SD1 pinaculum of A1-7 joined to spiracles
- Crochets usually with extra row inside
- Canada on onions to Georgia, see Landry (in press)



Prays citri (Yponomeutidae)

- Crochets biserial to multiserial, D and SD setae of A9 fused
- Buds of citrus
- See USDA (1967)



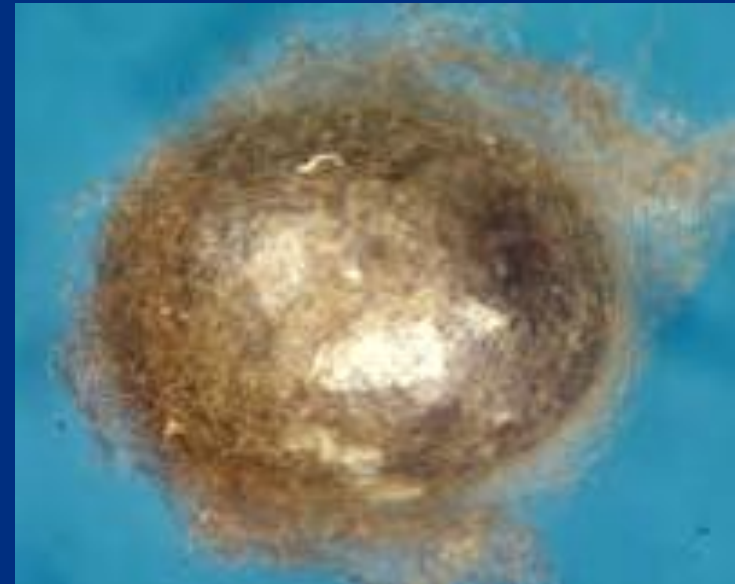
Pryeria sinica (Zygaenidae) euonymous leaf notcher

- Mature larva striped, notches leaves of Euonymous from Md or Va
- See Brown et al. (2004)



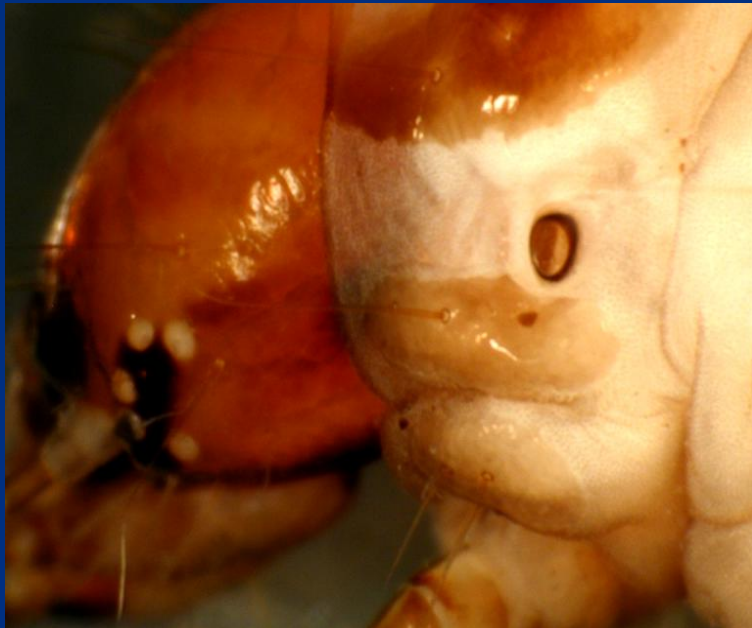
Darna pallivitta (Limacodidae)

- Dorsal scoli white with red on middle of abdomen. Larva is urticating, might be confused with *Euclea delphinii*
- Palms and other plants from Hawaii. Pupae of zygaenoids are intercepted, this may be a pathway
- See Epstein (2003), Wagner (2005)



Thaumatotibia leucotreta group (Tortricidae) false codling moth

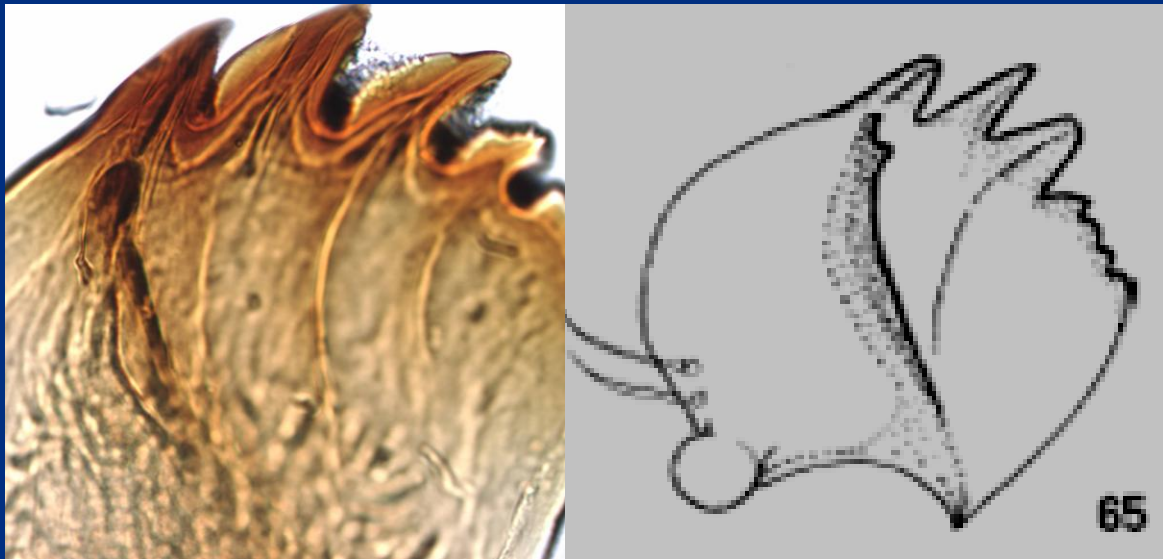
- Prespiracular pinaculum extends below and beyond spiracle, spiracle of A8 near posterior margin of segment
- Found in citrus from California from S. Africa
- See Komai (1999)



Epiphyas postvittana (Tortricidae)

light brown apple moth

- Mandible is supposed to have two inner teeth. INKTO specimens don't exactly match figures in Dugdale et al. (2005)
- Green larva with characters of the tribe (see MacKay 1962)



Epinotia aporema (Tortricidae)

- Genal band extends to stemmata
- Rarely a leaf feeder, usually bores in buds and pods of legumes
- See Schwartz et al. (1978)



Papilio demoleus (Papilionidae)

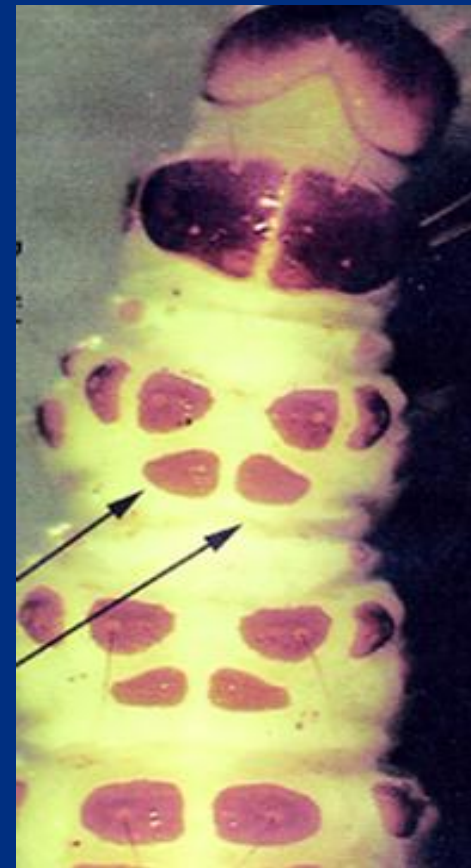
lime swallowtail

- Osmeterium present; anterior transverse bands present; posterior segments never all white as in *P. cressphontes*. Early instars have scoli.
- Citrus. See Goyle (1990)



Maruca vitrata (Crambidae)

- Meso and metathorax with pinacula lacking setae posterior to the D setae
- Legume borer
- Periodically found in S. USA, not established ???
Stray in Heppner (2005)
- See Passoa and Bean (2001),
Passoa (1985)



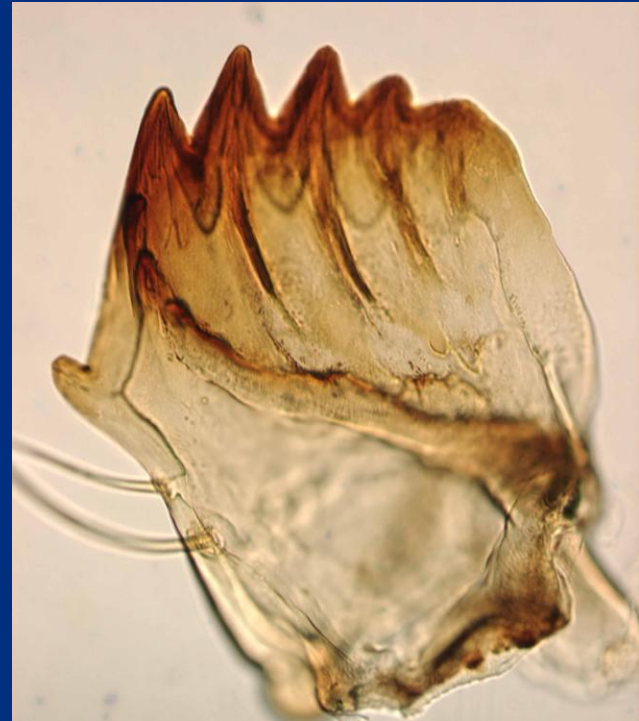
Duponchelia fovealis (Crambidae)

- SV pinacula of meso and metathorax notched anteriorly
- Anal shield lacks pigmented patches (present in *Nomophila nearctica*)
- Found in greenhouses in Canada but eradicated
- See Tremattera (1990), CFIA (2005)



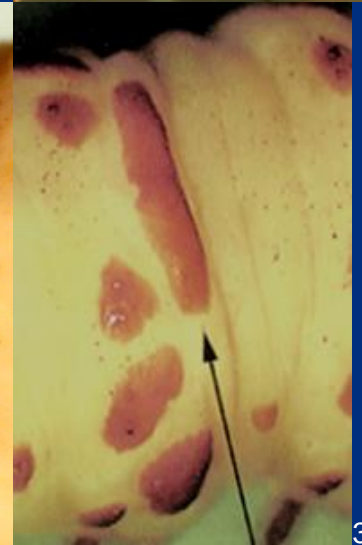
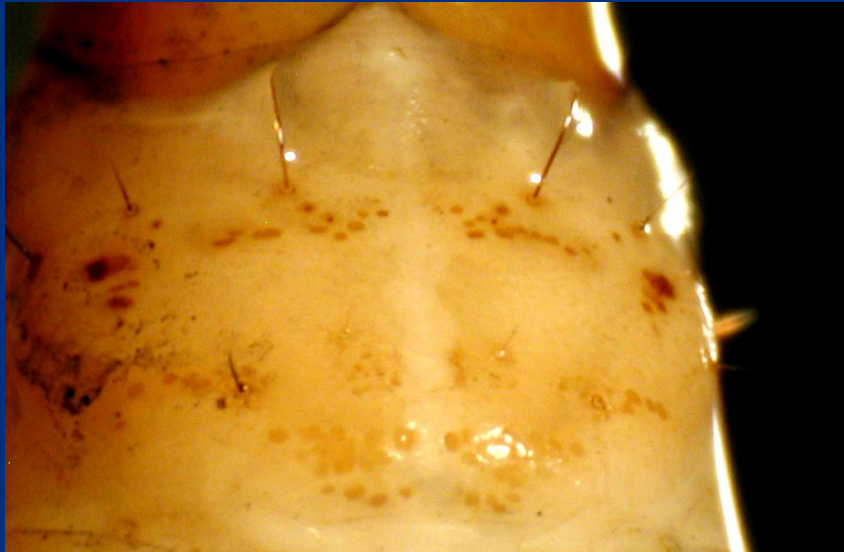
Diaphania indica (Crambidae)

- Mandible with an outer tooth and three small inner teeth
- Identical as larva to *D. hyalinata* except with wider host range
- *D. hyalinata* outbreaks on strange hosts will be a clue
- Reared from *Mormidica*. Intercepted from Jamaica and prob. established in at least extreme S. Florida
- See Heppner (2005): Texas and Florida on cucurbits



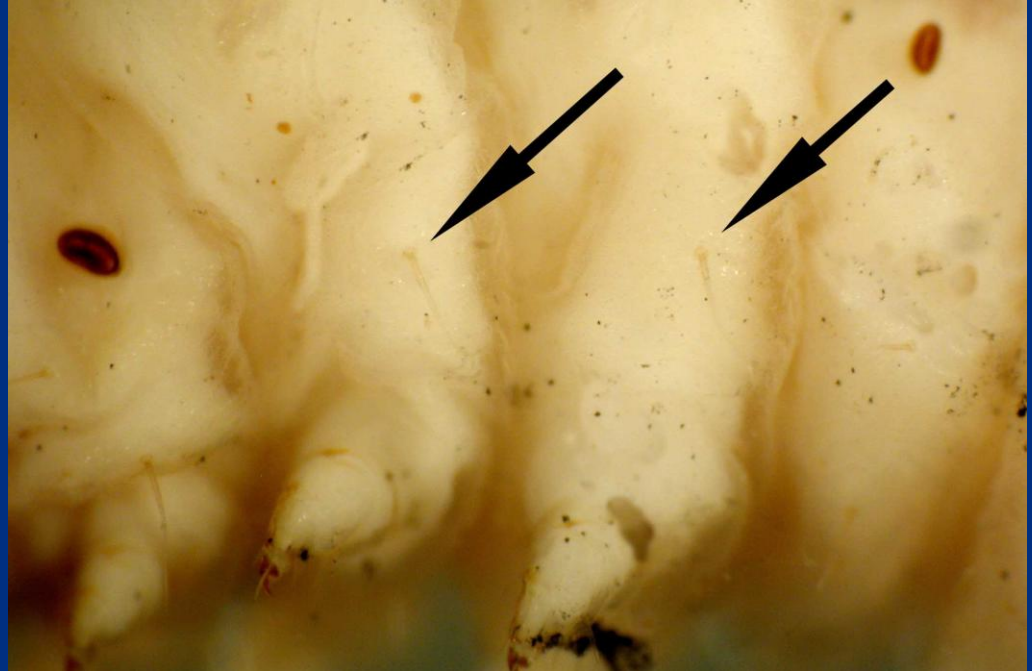
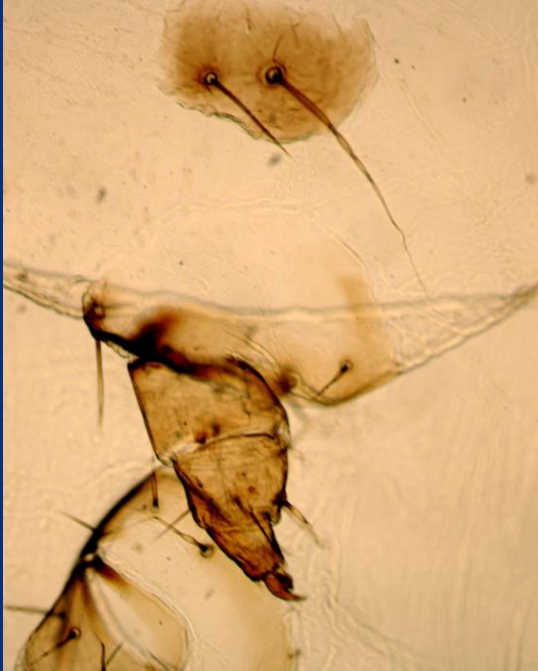
Chilo spp. (Crambidae)

- Prothoracic shield with tonofibrillary platelets weakly circle the margins; anal shield irregularly marked throughout. Metathoracic “bar” not divided.
- Confused with *Diatraea*, *C. plejadellus* (sod webworms ?)
- Confirmed Old World origins: borer in rice, corn, sorghum- not a sod webworm
- See Bleszynski (1970), Mutuura (1980), PNKTO 96, 97



Eoreuma loftini (Crambidae)

- Meso and metathorax with SV group unisetose (look above the legs)
- Similar to Diatraea which has a bisetose SV group
- Mexico on sugarcane
- See Passoa (1985)



Cryptoblabe gnidiella (Pyralidae)

- Prespiracular group and spiracle fused to prothoracic shield in late instars
- Dry and damaged fruits from the Caribbean
- See Neunzig (1986), Solis (1999)



Cactoblastis cactorum (Pyralidae)

- **Key to Florida Phycitine Larvae Eating Opuntia (Solis et al. 2004)**

- 1. Orange-red larva with conspicuous dark spots forming transverse bands

Cactoblastis cactorum

- 1'. Dirty-white to bluish-purple not forming transverse bands 2

- 2. Small dark spots (older larvae purplish) *Melitara prodenialis*

- 2'. Without spots 3

- 3. Dirty white; gregarious *Rumatha glaucatella*

- 3' White to dark gray color; larvae solitary *Ozamia lucidalis*

- Related species of *Cactoblastis* in Peru and Argentina (Mann 1969). Published record for *C. cactorum* in Arizona was false (Lep. News). See Floyd (2005)



Lymantria dispar (Lymantriidae)

Gypsy moth (European strain)

- Dorsal glands on A6 and A7; no dorsal tufts like *Orygia*, *Dasychira* or browntail moth; no large white square dorsal patches like satin moth
- Has thick vertical head stripes and lateral prothoracic projecting verrucae
- See Pogue and Schaeffer (in press)
- Wallner method to tell strains apart by color pending evaluation



Dendrolimus spp. (Lasiocampidae)

- Two thoracic transverse steel blue setal bands, may be retracted
- These bands absent in *Gloveria* and other SW USA lasiocampids of similar size; bands are red in *Phyllodesma*. One black band in *Tolyte*.
- See Baranchikov et al. (1997), USDA 1967



Spodoptera littoralis (Noctuidae)

- Genus Spodoptera: adfrontal areas outlined in white, mesothorax or A1 with a lateral dark spot (except frugiperda), thorax with a single SD tonofibrillary platelet
- Most littoralis: mesothorax and metathorax with pair of subdorsal white spots; dorsal triangular markings present only on A1 and A8, or just A8; subdorsal area darker than dorsal area, no thick subdorsal orange or yellow line
- Can be confused with eridania (also has large A1 triangles)
- See Passoa in Wagner (in final draft)



S. littoralis color forms



Autographa gamma, *Cornutiplusia circumflexa* (Noctuidae)

- Pinacula surrounded by black spicules, especially SV and V setae
- Almost identical to *A. californica* of the western USA and *C. circumflexa* of Europe, very similar to *Rachiplusia* of Latin America. Differences will be in the mandible and head markings (under study)
- For now, use Poole and LaFontaine (1991). Mexican Plusiinae are not a threat to the USA



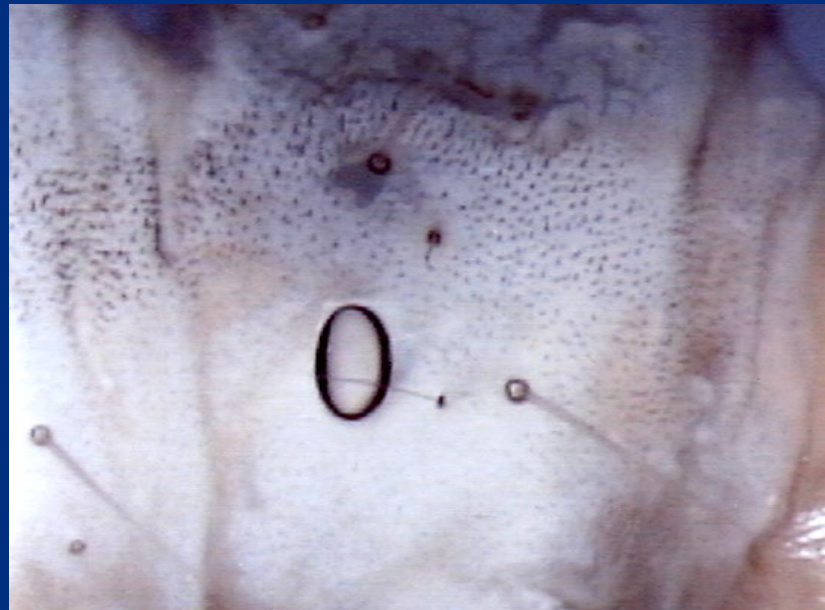
Mamestra brassicae (Noctuidae)

- Mandible with a large retinaculum, both SD setae with tonofibrillary platelets on meso and metathorax, young larvae green, mature larvae dark with a black patch around the spiracles and a light transverse band on A8
- Easily confused with many USA and exotic genera. Need to confirm Old World origin. Many noctuids have a similar coloration or mandible. Traditional pathway is Netherlands on Delphinium (cut flowers)
- Try Beck (1999-2000)



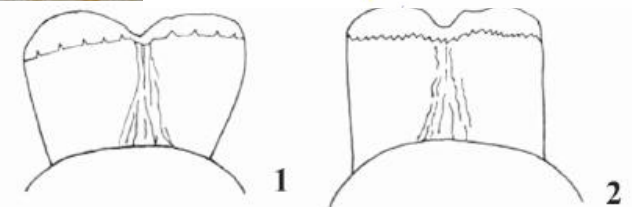
Helicoverpa armigera (Noctuidae)

- Heliothinae have L setae in a horizontal line in late instars and spiny skin
- See Passoa (2007 version) guide to the subfamily using host/origin



Copitarsia sp. (Noctuidae)

- Spinneret usually with medial depression, third segment of labial palpi shorter than first, thorax with 2 SD tonofibrillary platelets
- Green when young, variable when older. Looks like *S. exigua* (has dark T2 lateral spot) or *M. brassicae* (Old World only). Some Bugwood photos are wrong.
- The pupa is the most distinctive stage (covered with “extra” spines)
- New World only (Mexico, northern S. America, Chile)
- Lots of PRA’s on web



Chrysodeixis chalcites (Noctuidae)

- Prolegs of A3 and A4 vestigial, crochets biordinal
- Key in LaFontaine and Poole (1991). Need origin to identify
- From Hawaii = *C. eriosoma*
- From New World = *Pseudoplusia includens*
- From Old World = *Chrysodeixis* (*chalcites* or *eriosoma* depending on locality)
- Eradicated from Ohio greenhouses (Passoa and Gilligan 1995)



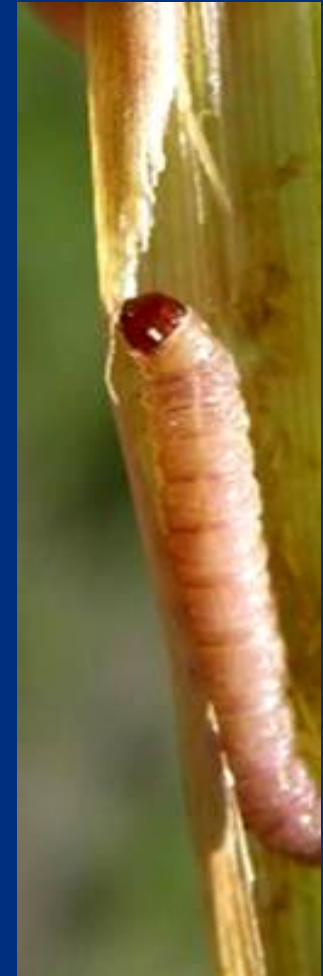
Metaponpneumata rogenhoferi (Noctuidae)

- Spiracles surrounded by black spots that fuse in dark form
- Honduras and SW USA on corn or sorghum
- See Cordero et al. (2000)



Sesamia spp. Busseola spp.

- Single L seta on prespiracular pinaculum
- Corn, sorghum, and strangely chestnuts from Europe
- try key in Meijerman and Ulenberg (1996) (you will need a goniometer)



Noctua pronuba (Noctuidae)

- Skin smooth, mandible with inner tooth, posterior of abdomen pale, subdorsal stripe thick
- “Winter cutworm” in north, agricultural damage in south undocumented
- See Passoa and Hollingsworth (1996), LaFontaine (1998), Wagner (2005)



Photo Credits

- In general, photomicrographs and larva on green plants or gray cards were mine. I thank the following for the others:
- Identifiers (J. Bruschi, Miami entomologists for adult photos)
- Web (Bugwood, various Dept. Agr., Universities, etc.)
- PPQ (New Pest Guidelines, OTIS lab)
- Misc (N. Ianni, J. Castner,)
- CAPS (E. Day, D. Bean, J. Brambila, M. J. van der Straten)
- Details and hi resolution tiffs of my photos available upon request

Acknowledgements

- Don Christopher, formerly of PDC for this template
- Support by Joe Cavey for the specialist concept
- Amanda Hodges and crew for this workshop
- All the diagnostic labs and PPQ identifiers who actually find things

LAB TOPICS

- Slide preparation of larvae
- Genitalia slide preparation
- “Valve ripping”
- Clean sticky trap samples

**Anyone welcome in lab for training no matter what
the school's football (or basketball) record is
against OSU**

