Grape-insect toxicology

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The effects of natural and synthetic materials on two insect pests of grapes, cutworms (Lepidoptera: Noctuidae) and leafhoppers (Hemiptera: Cicadellidae), are discussed. In all of these studies assessing the effects of toxicants, the importance of dose response was stressed (Paracelsus: "The dose makes the poison"). In the first set of studies, insecticides were tested for efficacy on fourth-instar larvae of three species of cutworms that have become serious pests in British Columbia vineyards: *Abagrotis orbis*, A. *nefascia*, and *A. reedi*. There was considerable variation in response to these insecticides (chlorantraniliprole [rynaxypyr], permethrin, methoxyfenozide, spinetoram, spinosad, malathion, carbaryl, and *Bacillus thuringiensis*), both within and among the three species. Significant differences in tolerance among the species to currently registered active ingredients chlorantraniliprole and permethrin illustrates the importance of correct identification of the species complex present in different locations. The second set of experiments examined the effects of essential oils on the Virginia creeper leafhopper, *Erythroneura ziczac*. These studies are an example of experiments that assess behavioral responses, not mortality, resulting from exposure to toxicants. In this case, repellency was measured using leaf-disc choice tests on third-instar nymphs. Of the 11 oils tested, four repelled leafhopper nymphs (paraffin oil, canola oil, mustard seed oil, and lemon oil), whereas tea tree oil and citronella oil repelled nymphs at high concentrations but attracted them at low concentrations. Five materials had no significant effect (eucalyptus oil, peppermint oil, rice bran oil, cedarwood oil, and garlic juice). Essential oils may be useful in reducing leafhopper feeding if appropriate formulations can be developed and effective usage patterns determined.

Presentation Abstracts

Entomological Society of British Columbia Annual General Meeting, Pacific Agri-Food Research Station, Summerland, B.C., Oct. 11-12, 2012

Current insect pest issues in the Southern Interior of British Columbia

Susanna Acheampong, *BC Ministry of Agriculture, Kelowna, BC*

Insect pests of concern in 2012 on stone fruit and vegetable crops and their management will be discussed. Pest species include San Jose scale, *Quadraspidiotus perniciosus*; apple leaf curling midge, *Dasineura mali*; woolly apple aphid, *Eriosoma lanigerum*; onion maggot, *Delia Antigua*; and, garlic bulb mites.

***Micromus variegatus*: a new biological control agent for aphids on greenhouse peppers**

Rob McGregor, and Jordan Bannerman, *Douglas College, New Westminster, BC*

Brown lacewings (Neuroptera: Hemerobiidae) have rarely been used in augmentative biological control programs. Hemerobiids feed voraciously on aphids in both the larval and adult stages, and often display low developmental temperature thresholds. Both of these characteristics confer advantages regarding the use of brown lacewings for biological control. Here, we present results of a greenhouse cage experiment where the brown lacewing, *Micromus variegatus*, was released alone and simultaneously with the parasitoid, *Aphidius matricariae*, for management of the green peach aphid, *Myzus persicae*.

Thrips (Thysanoptera: Thripidae): From the greenhouse to the lab, a new pest on lavender, *Lavendula pinnata*, and in coriander, *Coriandrum sativa*, tissue culture

Lauren Erland, Naomi DeLury, and Soheil Mahmoud, *Agriculture & Agri-Food Canada, Summerland BC*

Thrips are a common phytophagous pest with a significant economic impact. Adults and nymphs were found on lavender, a plant

thought to have few or no insect pests, and on coriander in tissue culture. To our knowledge, this is the first report of thrips on *L. pinnata* and of a sterile population of a greenhouse pest in tissue culture.

The confusing transition into adulthood: age–size conflict in insect metamorphosis

Amber Gigi Hoi, Simon P. Zappia, and Bernard D. Roitberg, *Simon Fraser University, Burnaby, BC*

Holometabolous insects often face a trade-off: spending more time as larvae growing for bigger adult size, higher fecundity, but delaying reproduction. We studied such time allocation in larvae under deprived conditions and during a nutrient influx. A waiting tactic was observed and the complex trade-offs involved are discussed.

Cool climate and climbing cutworm: Biological control of a grape pest

T. Scott Johnson, Tom Lowery, Joan Cossentine, and Jenny Cory, *Simon Fraser University, Burnaby, BC and Agriculture & Agri-Food Canada, Summerland, BC*

Abagrotis orbis is a climbing cutworm pest in the vineyards of the Okanagan. Much of their active feeding periods occur under cooler temperatures. We evaluated their susceptibility to several entomopathogenic fungi and nematodes across three temperatures. The larvae were susceptible to entomopathogenic fungi and nematodes with the highest mortality rates occurring at higher temperatures, although mortality occurred at lower temperatures.

Spotted Wing Drosophila in fruit crops of interior valleys of British Columbia, 2009 – 2012

Howard Thistlewood, Susanna Acheampong, Charlotte Leaming, Molly Thurston, Brigitte Rozema, Duane Holder, and Gayle Krahn, *Agriculture and Agri-Food Canada, Summerland, BC*

A vinegar fly, Spotted Wing Drosophila, *Drosophila suzukii*, was first detected in the British Columbia interior in September 2009, and damaged crops in 2010. We report on its abundance and distribution in traps and plant hosts, on a parasitoid, and other efforts to understand the ecology of this invasive insect.

Effects of thermal stress on survival and development time of *Aphidius matricariae*, a biological control agent of *Myzus persicae*

Christina Hodson, *Simon Fraser University, Burnaby, BC*

We evaluated thermal-tolerance limits of the aphid parasitoid, *Aphidius matricariae*. Heat stress was applied to juvenile parasitoids, and effects on survival and development time were assessed. The results have implications for the effectiveness of *A. matricariae* as a biological control agent during heat waves.

Are fungi and parasitoids compatible for controlling aphids in greenhouses?

Jasmine Norouzi, *Agriculture & Agri-Food Canada, Agassiz, BC*

Beauveria bassiana (strain GHA) in the commercialized form, BotaniGard, affected survival and longevity of a parasitoid, *Aphidius matricariae* attacking *Myzus persicae* on pepper plants, *Capsicum annuum*. The results suggest that the fungus interferes sufficiently with the parasitoids and that it does not have a positive effect on controlling aphids.

Turning up the heat on predation: Temperature fluctuations decrease pest suppression

F. W. Simon, A. M. Chubaty, and B. D. Roitberg, *Simon Fraser University, Burnaby, BC*

Insect activity is temperature mediated, however little work has explored how temperature fluctuations can influence pest suppression. We investigated this phenomenon with a Lokta–Volterra predator–prey model with daily temperature fluctuations. We found that increased amplitude of temperature fluctuations caused large boom–bust cycles, which lead to more severe pest outbreaks.

Visual and olfactory cues used by the apple clearwing moth to locate showy milkweed flowers

Chelsea Eby, *Simon Fraser University, Burnaby, BC*

In British Columbia, adult *Synanthedon myopaeformis* commonly feed on showy milkweed flowers. Vision was examined using ERGs and spectral reflectance. Olfaction was examined using GC-EAD and proboscis-extension assays. A single milkweed floral

semiochemical was shown to be highly attractive in field-trapping assays, whereas visual cues were less important.

Anagrus (Hymenoptera: Mymaridae) parasitoids of leafhopper eggs on grapevines

Tom Lowery, *Agriculture & Agri-Food Canada, Summerland, BC*

There are at least 10 known instances of *Anagrus* (Hymenoptera: Mymaridae) egg parasites successfully imported for the control of leafhopper pests in various countries. In British Columbia, they are important for the control of Virginia creeper leafhopper, *Erythroneura ziczac*, and western grape leafhopper, *E. elegantula*, with parasitism rates in certain locations near riparian areas reaching nearly 100% late in the season. Our research has shown that their activity is limited by a lack of suitable overwintering hosts and that they are sensitive to chemical sprays. Until recently the taxonomy and host relationships of *Anagrus* species utilizing eggs of leafhoppers on grapes was poorly studied. A single species, *Anagrus epos*, was thought to parasitize both *E. ziczac* and *E. elegantula*, but it is now understood that one species *A. daanei* uses eggs of the former, and a different species, *A. erythroneurae*, parasitizes the latter. A survey is currently being conducted to determine if a third species, *A. tretiakovae*, which parasitizes eggs of both species, has arrived in British Columbia from Washington State, or if it can be imported from its native range in eastern North America.

Eocene fossil insect beta diversity, climate, and topography across southern British Columbia and northern Washington

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Just over four decades ago, Janzen hypothesized a relationship between dispersal, topography, climate, and latitude. He proposed that whereas warm valleys and cool mountain passes in seasonal temperate latitudes have a temperature overlap at least part of the year that facilitates dispersal of organisms between valleys, the same elevation difference in the equable tropics share no common temperatures over a year, constituting a physiological dispersal barrier between valleys. This would result in higher overturn of species—increased beta diversity—across tropical montane landscapes. The early Eocene Okanagan Highlands fossil sites of southern BC and northern Washington present a unique opportunity to test this notion independent of latitude. We sampled insect fossils across this 1000-km montane transect of cool mean annual temperatures, yet low temperature seasonality as in the modern tropics. We found that beta diversity was indeed high, supporting Janzen's notion that temperature seasonality is key to montane beta diversity, as well as that global biodiversity was higher in the Eocene than it is today.