SESSION 3

EXPLORING BIOLOGICAL CONTROL TO MANAGE NEW OR POTENTIAL INVASIVE ALIEN PESTS

BIOLOGY AND FEEDING EFFICIENCY OF INDIGENOUS PREDATORS OF COTTON MEALYBUG, PHENACOCCUS SOLENOPSIS TINSLEY (HOMOPTERA: PSEUDOCOCCIDAE)

M. Ahmad, A. Ghaffar, & M. Rafiq

Central Cotton Research Institute, Old Shujabad Road, P.O. Box 572, Multan, Pakistan

Cotton mealybug has become a serious pest for the last few years in the cotton belt of Punjab, Pakistan. The role of beneficial insects, especially predatory insects can help to limit its spread from alternate host plants to major economic crops like cotton, etc. The biologies of four predatory coccinellid beetles, Brumoides suturalis (Fab.), Coccinella septempunctata L., Menochilus sexmaculatus (Fab.), and Scymnus nubilus Mulsant (Coleoptera: Coccinellidae), and Chrysoperla carnea (Stevens) (Neuroptera: Chrysopidae) were studied under controlled laboratory conditions. Menochilus sexmaculatus and B. suturalis showed the shortest mean life duration (~20 days) followed by S. nubilus (22.2 days), C. septempunctata (25.6 days). C. carnea, on the other hand, took the longest to complete its life cycle (28.3 days). Larval development ranged from 12.2 to 15.3 days, with the highest feeding efficiency by C. septempunctata (153 mealybug nymphs consumed) amongst coccinelid beetles. Chrysoperla carnea larvae proved to be efficient feeders of the first instar nymphs of mealybug consuming 14.1 per day (216 in total). Incorporation of C. carnea with indigenous coccinellid beetles having both larval and adult predatory stages can help in better management of cotton mealybug, a noxious insect pest of more than 150 host plants.

ENTOMOPHAGOUS FUNGI ASSOCIATED WITH INSECT PESTS IN CASHEW ORCHARDS OF TAMIL NADU, INDIA

V. Ambethgar¹ & P.S. Bhat²

¹All India Coordinated Research Project on Cashew, Tamil Nadu Agricultural University, Regional Research Station, Vridhachalam-606 001, Tamil Nadu, India, drva_1965@yahoo.co.in; ²National Research Centre for Cashew, ICAR, Puttur-574 202, Karnataka, India, pshivarama@yahoo.co.in

A 10 year field survey of cashew orchards in Tamil Nadu (India) from 1998-2007 identified 12 genera of entomophagous fungi from 22 species of insects representing six orders. The fungal genera identified in order of occurrence include seven Hyphomycetes: Beauveria, Metarhizium, Paecilomyces, Nomuraea, Verticillium, Aspergillus and Fusarium, and five Zygomycetes: Conidiobolus, Entomophthora, Pandora, Neozygites, Mucor and Rhizopus. Of 46 species of cashew insects prevalent, 22 were positively infected with one or more species of fungi, with 16.6-43.3% mycoses under natural conditions. The cashew stem and root

borer, *Plocaederus ferrugineus* Linn. (Coleoptera: Cerambycidae), the termite, *Odontotermes obesus* (Rambur) (Isoptera: Termitidae), leaf folder, *Sylepta aurantiaca* Fisch (Lepidoptera: Pyralidae), mirid bug, *Helopeltis antonii* Signoret (Hemiptera: Miridae), aphid, *Toxoptera odinae* van der Hoot (Hemiptera: Aphidae) and flower thrips, *Scirtothrips dorsalis* Hood (Thysanoptera: Thripidae) were used for assessing pathogenicity of fungi. Among the fungi, *Beauveria bassiana* (Bals.) Vuill. was highly pathogenic to all the test insects causing 76.6-100% mortality under laboratory conditions. While, *Metarhizium anisopliae* (Metsch) Sorokin, *Paecilomyces farinosus* (Holm ex S F Grey) Brown and Smith and *Verticillium lecanii* (Zimmerman) Veigas inflicted 53.3-96.6% mortality to one or more species of Coleoptera, Lepidoptera, Hemiptera and Isoptera. However, the five fungal Zygomycetes genera were host specific mainly confined to thrips/aphids/mealy bugs and caused mortality below 30.0% under pathogenicity tests. The Zygomycetous *Conidiobolus obscures* (Hall & Dunn) Remaudiere & Kellerr, *Neozygites fresenii* (Nowakowski) Remaudiere & Kellerr and *Pandora neoaphidis* (Remaudiere & Hennebert) Humber have not previously been reported from cashew insects.

**RELATIVE VIRULENCE OF ENTOMOPATHOGENIC HYPHOMYCETES FOR BIOLOGICAL CONTROL OF CASHEW MIRID BUG, *HELOPELTIS ANTONII* SIGNORET (HETEROPTERA: MIRIDAE)**

V. Ambethgar¹ & P.S. Bhat²

¹All India Coordinated Research Project on Cashew, Tamil Nadu Agricultural University, Regional Research Station, Vridhachalam-606 001,Tamil Nadu, India, drva_1965@yahoo.co.in; ²National Research Centre for Cashew, ICAR, Puttur-574 202, Karnataka, India, pshivarama@yahoo.co.in

Twenty isolates of entomopathogenic fungi (Hyphomycetes) including 10 *Beauveria bassiana* (Bals.) Vuill., six *Metarhizium anisopliae* (Metsch) Sorokin and four *Paecilomyces farinosus* (Holm ex S.F. Grey) Brown & Smith derived from a range of insect species were evaluated *in vitro* against the mirid bug, *Helopeltis antonii* Signoret (Heteroptera: Miridae), a serious sucking pest of cashew. The bioassay had two major components: the initial single dose (1x10⁷ conidia/ml) time mortality assays followed by multiple-dose (1x10⁵ to 1x10⁹ conidia/ml) assays each replicated four times. Conidial suspensions of respective isolates prepared in 0.05% Tween 80® were sprayed topically after release of 20 third instar nymphs per replication in mylar-film cages each containing four cashew grafts previously dipped in the respective fungal suspension. Assessment of infection was made every 24 h from 4 to12 days post treatment. All the isolates tested were capable of infecting *H. antonii*, but their virulence determined by LT₅₀ and LC₅₀ varied. In single-dose (1x10⁷ conidia/ml) screening assay, five isolates including three *B. bassiana*: *BbHa* VRI 0102, *BbFv* VRI 0201 and *BbSl* TIR 1201; and two *M. anisopliae*: *MaFv* VRI 0202 and *MaPf* VRI 0198 isolates were superior to all other isolates with mirid bug derived *B. bassiana*: *BbHa* VRI 0102 inflicted quickest LT₅₀ in 5.9 days. In multiple-dose assays, the mirid bug- derived *B. bassiana* isolate, *BbHa* VRI 0102 inflicted the greatest mortality at a concentration lower than the standard dose of 1 x10⁷ conidia/ml. Based on the time-
INTEGRATION OF THE PARASITOID DIAERETIELLA RAPAE (MCINTOSH) (HYMENOPTERA: APHIDIIDAE) AND CERTAIN INSECTICIDES TO CONTROL THE CABBAGE APHID BREVICORYNE BRASSICAE L. (HOMOPTERA: APHIDIDAE)

M.A. Ateyyat¹, T.M. Al Antary², & B.M. Abussamin²

¹Ash-Shoubak University College, Al-Balqa’ applied University, Al-Salt 19117, Jordan, ateyyat@bau.edu.jo; ²Plant Protection Department, Faculty of Agriculture, University of Jordan, Amman, Jordan

This study was an attempt to search for insecticides that are of high degree of toxicity to the cabbage aphid, Brevicoryne brassicae L. (Hemiptera: Aphidae) and of low toxicity to its aphidiine parasitoid wasp, Diaeretiella rapae McIntosh (Hymenoptera: Braconidae), as part of an integrated pest management program. Six insecticides that are used in Jordan for cruciferous crop protection were evaluated. These insecticides are: Actara® (thiamethoxam, Neonicotinoide), Calypso® (thiacloprid, Neonicotinoide), Actellic® (pirimiphos-methyl, Organophosphate), Malathion® (malathion, Organophosphate), Pirimor® (pirimicarb, Carbamate), and Cypermethrin® (cypermethrin, Pyrethroide). There were large differences between the LC90s of the insecticides on the cabbage aphid and the recommended field rates of these insecticides. From the ratios of LC50s estimated for the aphid to those estimated for the parasitoid, the two insecticides Cypermethrin® and Pirimor® gave a ratio of less than one which means that they are more toxic to the aphid than to its parasitoid. Thus, they are good candidates to be used in integrated pest management programs (IPM) for the cabbage aphid.

NATURAL ENEMIES OF TOXOPTERA CITRICIDA (KIRKALDY) (HEMIPTERA: APHIDIDAE) AND OTHER CITRUS APHIDS IN SPAIN

A. Hermoso de Mendoza¹, A. Álvarez², J.M. Michelena³, P. González³, & M. Cambra¹

¹Institut Valencià d’Investigacions Agràries, Carretera de Nàquera Km 5, 46113 Montcada, València, Spain, ahermoso@ivia.es, mcambra@ivia.es; ²Laboratorio de Sanidad Vegetal, Consejería de Medio Rural y Pesca, c/ Lucas Rodríguez 4 bajo, 33011 Oviedo, Asturias, Spain, almualal@yahoo.es; ³Institut Cavanilles de Biodiversitat i Biologia Evolutiva, Universitat de València, Apartat 2085, 46071 València, Spain, michelen@uv.es, pilar.gonzalez@uv.es

The aphid Toxoptera citricida (Kirkaldy) (Hemiptera: Aphidae), the most efficient vector of Citrus tristeza virus (CTV) (Closteroviridae) in the world, is present on citrus along the Atlantic coast in the northwest quadrant of the Iberian Peninsula, but it is absent from the main Spanish citrus areas in eastern and southern Spain. Toxoptera citricida is attacked in northern Spain by 18 species of natural enemies, most of them present in eastern Spain on other citrus aphids. In northern Spain, the main natural enemies of T. citricida are Syrphidae, Coccinellidae and Aphidiinae, and CTV spread.
has not been detected. In eastern Spain, the main natural enemies of citrus aphids, \textit{Aphis spiraecola} Patch and \textit{A. gossypii} Glover (Hemiptera: Aphidae), are Cecidomyiidae and Coccinellidae.

**STUDY OF THE PARASITOIDS OF LIRIOMYZA TRIFOLII (DIPTERA: AGROMYZIDAE) IN SHIRAZ, IRAN**

A.F. Dousti\(^1\), K. Kamali\(^2\), & H. Ostovan\(^3\)

\(^1\)Department of Entomology, Islamic Azad University, Jahrom branch, Fars, Iran, fdousti@yahoo.com; \(^2\)Head of Entomology Department, Islamic Azad University, Fars Science and Research Branch, Marvdasht, Iran, Ostovan2001@yahoo.com; \(^3\) Department of Entomology, College of Agriculture, Tarbiat Moaress university, Tehran, Iran, kamali_k@modares.sc.ir

A survey was conducted to identify parasitoids of vegetable leafminer \textit{Liriomyza trifolii} (Burgess, 1880) (Diptera: Agromyzidae) in Shiraz region during April 2004 – September 2005. A total of 13 eulophid species (Hymenoptera: Eulophidae) were recognized. Four species which are marked with a (*), are new records from Iran.  
1. \textit{Baryscapus impeditus} Nees*
2. \textit{Baryscapus} sp.
3. \textit{Closterocerus formosus} Westwood
4. \textit{Closterocerus} sp.
5. \textit{Diaulinopsis arenaria} Erdos*
6. \textit{Chryssocharis} sp.
7. \textit{Diglyphus crassinervis} Erdos
8. \textit{Diglyphus isaea} Walker
9. \textit{Diglyphus pulchripes} Crawford*
10. \textit{Hemiptarsenus zilahisebessi} Erdos
11. \textit{Ratzeburgiola cristatus} Ratzeburg*
12. \textit{Pnigalio} sp.
13. \textit{Pediobius} sp.

The Bulgarian specialist, Dr. Boyadzhiv, confirmed the parasitoids identifications. All of the specimens were deposited in the insect collection of the Jahrom Azad University.

**AN APPROACH TO BIOLOGICAL CONTROL OF ZOPHIUMA LOBULATA GHAURI (HOMOPTERA: LOPHOPIDAE) USING MYMARID AND ENCYRTID EGG PARASITOIDS**

C.W. Gitau\(^1\), G.M. Gurr\(^1\), C.F. Dewhurst\(^2\), M.J. Fletcher\(^3\), & A. Mitchell\(^4\)

\(^1\)Department of Agriculture and Wine Sciences, Charles Sturt University, P.O. Box 883, Orange, New South Wales 2800, Australia, cgitau@csu.edu.au & ggurr@csu.edu.au; \(^2\) Department of Entomology, Papua New Guinea Oil Palm Research Association Inc., P.O. Box 97, Kimbe, West New Britain, Papua New Guinea, charles.dewhurst@pngprra.org.pg; \(^3\) NSW Department of Primary Industries, Orange Agricultural Institute, Forest Road, Orange New South Wales 2800, Australia, murray.fletcher@dpi.nsw.gov.au; \(^4\) NSW Department of Primary Industries, Wagga Wagga Agricultural Institute, Pine Gully Road, Wagga Wagga, New South Wales 2650, Australia,
The plant hopper *Zophiuma lobulata* Ghauri (Hemiptera: Lophopidae) has been implicated to Finschhafen disorder of coconut and oil palms in Papua New Guinea. The biology and the pest status of *Z. lobulata* are largely unknown. Previous reports suggest that the disorder is prevalent when and where the plant hopper is present and is continuously feeding on the palms. The control of the disorder is therefore dependent on the management of *Z. lobulata* populations. Egg masses of *Z. lobulata* collected from coconut and oil palms in two seasons during 2007 and 2008 yielded parasitoids belonging to the families Mymaridae and Encyrtidae. This poster will draw attention to the importance of these egg parasitoids in the control of *Z. lobulata* in Papua New Guinea.

**BIOPESTICIDES: AN IDEAL COMPONENT OF IPM IN CHILI UNDER IRRIGATED ECOSYSTEM**

A.C. Hosamani, K.A. Kulkarni, & B.V. Patil

Regional Agricultural Research Station, Raichur 584 102 Karnataka, India, aren23@gmail.com

Chili, *Capsicum annuum* L. (Solanaceae), commonly known as red pepper is an important and indispensable condiment as well as vegetable grown in many parts of the world. To combat the insect and mite pest outbreaks, farmers are solely dependent on pesticides. In Northern Karnataka, farmers apply nearly 18-26 rounds of chemical sprays of different combinations of pesticides under irrigated ecosystems (Anon. 2006). Three modules viz., Biointensive module, Adoptable module and Farmers practice were tested during 2004-2005 and 2005-2006 kharif season. The Biointensive module included neem-based insecticides and biopesticides like HaNPV and SINPV as major components, the Adoptable module used the combination of effective new molecules with biopesticides, and the Farmers practice was based solely on chemical insecticides. The pooled data indicated that the Adoptable module recorded fewest thrips, *Scirtothrips dorsalis* Hood (Thysanoptera: Thripidae), mites, *Polyphagotarsonemus latus* Banks (Acari: Tarsonemidae), and fruit borer, *Helicoverpa armigera* Hub. (Lepidoptera: Noctuidae), populations, followed by the Farmers practice and the Biointensive module. Use of HaNPV and SINPV was found to be an effective component in the Adoptable and Biointensive modules which recorded the minimum larval populations. The Adoptable module recorded maximum dry chili yield of 16.08q/ha which was superior to the Farmers practice (15.00q/ha) and the Biointensive module (11.12q/ha). The Biointensive module recorded maximum predator populations and it was on par with the Adoptable module while the Farmers practice recorded very low predator populations.
Rhynchophorus ferrugineus (Olivier) (Coleoptera: Curculionidae) is an important pest of palms native to South East Asia. This species has recently colonized the Mediterranean Basin where it is a serious problem, especially on ornamental Phoenix canariensis hort. ex. Chabaud (Arecacea) palms. This weevil is a concealed tissue borer which can spend all of its life stages inside the palm. Adults often remain within the host until the apical growing area of the palm has been destroyed, killing the palm. The methods currently used to control R. ferrugineus are chemical, with frequent applications over a long period of time. Nevertheless, efficacies are not high and there are deep concerns about the environmental impact of these treatments, especially in public areas where ornamental palms are grown. Investigations on the use of natural enemies of this weevil are underway. On the one hand, exotic parasitoids from Rhynchophorus palmarum (L.) (Coleoptera: Curculionidae) from Ecuador have been identified and are currently under quarantine confinement, on the other, a native strain of the entomopathogenic fungus Beauveria bassiana (Balsamo) Vuillemin (Hyphomycetes) has been found in field-collected adults. This strain has shown a high virulence against all instars of the weevil in laboratory bioassays. Furthermore, a commercial formulation containing an indigenous strain of Steinernema carpocapsae Weiser (Rhabditida: Steinernematidae) has shown efficacies around 80 % in curative semi-field assays, and up to 98 % in preventative assays.
and the Bay of Plenty, and south to at least Hawke’s Bay. High populations are causing sooty mould problems and a possible reduction in fruit colour, as well as tree health issues. Conversely, in its native Australia, ACWF is only a minor, occasional pest on citrus, where it is assumed to be kept under control by its natural enemies. Two orchards in each of Kerikeri, Auckland and Gisborne areas with high populations of ACWF were selected and natural enemies on ACWF-infested leaf samples and yellow sticky traps were surveyed weekly or fortnightly from October 2007 to April 2008 to determine if effective natural enemies of ACWF were present. No parasitoids emerged from ACWF on leaf samples. Whitefly parasitoids generally belong to one of three hymenopterous families: Aphelinidae, Platygasteridae or Eulophidae. Of the 27 parasitoid species trapped, seven were in the Platygasteridae family and one in the Eulophidae family. Given the known host range of some of these species, and the absence of parasitized ACWF on leaf samples, none were likely to be attacking ACWF. Eight species of coccinellid ladybirds were trapped. No ladybird larvae or eggs were found on leaves and only adult Halmus chalybeus (Boisduval) (Coleoptera: Coccinellidae) were seen predating on ACWF, suggesting that ladybirds were having little impact on ACWF populations. Larvae of the lacewing Micromus tasmaniae (Walker) (Neuroptera: Hemerobiidae) were also observed predating on ACWF and various species of predatory mites were associated with ACWF. Three species of Staphylinids were trapped, however none were seen consuming ACWF. None of the natural enemies collected in this survey appeared to have any impact on the high ACWF populations observed in these orchards.

FEMALE DIAERETIELLA RAPAE RECEIVE MORE REPRODUCTIVE FITNESS GAIN BY PARASITISING OLDER BREVICORNYNE BRASSICAE NYMPHS

R. Kant ¹, Q. Wang ¹, & W.R.M. Sandanayaka ²

¹Institute of Natural Resources, Massey University, Palmerston North, New Zealand, Email R.Kant@massey.ac.nz; ²HortResearch, Mt. Albert, Auckland, New Zealand

The reproductive fitness of parasitoids is closely associated with host quality. Understanding the oviposition strategy of parasitoids can help in improving their efficiency. To test the oviposition strategy and fitness of Diaeretiella rapae (McIntosh) (Hymenoptera: Braconidae), the females were given a choice of four different age groups (7, 5, 3 and 1 day old) of nymphs of the cabbage aphid, Brevicoryne brassicae (L.) (Hemiptera: Aphidae). Ten hosts of each age group were offered daily to a mated and honey fed female until her death. The female appeared to show a stronger preference for the 7-day-old hosts for oviposition over younger hosts but was not able to discriminate between 1-day- and 3-day-old hosts. The development of female offspring was quicker in older hosts than in younger hosts. Males developed quicker than females in older hosts but their developmental time was not different in younger hosts. The proportion of females that emerged from older hosts was 73% which was significantly higher than those that emerged from younger ones. The body size of male and female offspring was positively correlated to the size of hosts in which they developed. Females that emerged from older hosts also lived for a significantly longer time, 4.6 ±0.2 days, than those that emerged from younger ones. Results showed that the reproductive efficiency of D. rapae could be improved
by using older nymphs during mass production of the parasitoids in a biological control programme for B. brassicae.

THE ROLE OF ANAGYRUS LOECKI (HYMENOPTERA: ENCYRTIDAE) IN SUPPRESSING PARACOCCUS MARGINATUS (HEMIPTERA: PSEUDOCOCCIDAE) IN COMMERCIAL PAPAYA FARMS IN HAWAII

L.V. Kaufman¹ & M.G. Wright²

Department of Plant and Environmental Protection Sciences, University of Hawai‘i at Mānoa, 3050 Maile Way, Room 310, Hawaii 96822, U.S.A., ¹leyla@hawaii.edu, ²markwrig@hawaii.edu

The papaya mealybug (PM), Paracoccus marginatus Williams and Granada de Willink (Hemiptera: Pseudococcidae), was first detected in Hawaii in 2004. This polyphagous species attacks many tropical crops and ornamentals. Current methods of control of PM in commercial papaya farms in Hawaii rely on the use of pesticides. The objectives of this study are to determine the density of PM in different papaya farms and to determine the effectiveness of the adventive parasitoid Anagyrus loecki Noyes (Hymenoptera: Encyrtidae) in controlling PM in commercial papaya fields using emergence data. This paper will also compare parasitism rates of PM in commercial organic and non-organic papaya farms as well as present notes on the role of the adventive hyperparasitoid Aprostocetus minutus Howarth (Hymenoptera: Eulophidae) on the performance of A. loecki.

EXPLORING USE OF IRRADIATED HOSTS FOR REARING FRUIT FLY PARASITOIDS: A NOVEL APPROACH FOR INVASIVE TEPHRITID MANAGEMENT

O.L. Kvedaras¹, A.R. Harris², C.F. Pratt², A.J. Jessup³, C. Banos⁴, & G.M. Gurr⁵

¹EH Graham Centre for Agricultural Innovation, NSW Department of Primary Industries, Wagga Wagga Agricultural Institute, Wagga Wagga, New South Wales, Australia, olivia.kvedaras@dpi.nsw.gov.au; ²Division of Biology, Imperial College London, Silwood Park, Ascot, Berkshire, SL5 7PY, United Kingdom, anna.harris03@imperial.ac.uk & corin.pratt07@imperial.ac.uk; ³Insect Pest Control Sub-programme, FAO/IAEA Agriculture and Biotechnology Laboratory, A-2444 Seibersdorf, Austria, a.jessup@iaea.org; ⁴Australian Nuclear Science and Technology Organisation, PMB 1 Menai, New South Wales, 2234, Australia, cbx@ansto.gov.au; ⁵EH Graham Centre for Agricultural Innovation, Charles Sturt University, Orange, New South Wales, Australia, GGurr@csu.edu.au

Fruit production in Australia is threatened by invasion of exotic fruit flies (Diptera: Tephritidae) as well as by a native species that has a limited distribution which is maintained by ongoing quarantine: the Queensland fruit fly (‘Qfly’), Bactrocera tryoni (Froggatt). Biological control would be a welcome technology to respond to fruit fly incursions and help prevent spread of Qfly within Australia. This paper presents results from a study exploring the scope for mass rearing parasitoid wasps on gamma irradiated, sterile host material. The practical advantage of such a rearing system is that flies and wasps would not need to be separated, thus reducing cost of production. Host larvae of different stadia were irradiated at 0, 4.7, 9.1, 15.9,
27.6, 47.0 and 79.9 Gy and later exposed to Diachasmimorpha kraussii (Fullaway) (Hymenoptera: Braconidae) adults. Eggs were also irradiated (since these are likely to be easier to transport and handle) and exposed to parasitoids after eclosion and culturing on artificial medium. Detailed results will be presented for wasp development and subsequent reproductive performance as well equivalent data for the Qfly developing from unparasitised hosts. Overall results suggest good scope to develop a protocol involving a carefully calibrated irradiation dose and host material of a specific developmental stage that will allow mass production of D. kraussii, yet produces no flies from any unparasitised hosts. Findings will be discussed in relation to the wider potential for this approach in managing invasive tephritids.

LIFE TABLES OF CACTOBLASTIS CACTORUM (BERG) (LEPIDOPTERA: PYRALIDAE) IN CULTIVATIONS OF PRICKLY PEAR CACTUS (OPUNTIA FICUS-INDICA) IN ARGENTINA

G.A. Logarzo¹, L. Varone¹, J.A. Briano¹, E. Lobos², D.G. Ruiz³, & S. Hight⁴.

¹USDA-ARS South American Biological Control Laboratory, Bolivar 1559 (1686) Hurlingham, Buenos Aires, Argentina, glogarzo@speedy.com.ar; ² Universidad Nacional de Santiago del Estero, Argentina; ³ Universidad Nacional de Córdoba, Argentina; ⁴ USDA-ARS-Center for Medical, Agricultural & Veterinary Entomology, Tallahassee, Florida, U.S.A.

The cactus moth, Cactoblastis cactorum Berg (Lepidoptera: Pyralidae) has become a serious threat to the diversity of native and cultivated Opuntia species in Mexico and the United States. These Cactaceae are important not only as crops, but also as factors in the maintenance of natural ecosystems. In August 2007, the South American Biological Control Laboratory (SABCL) started studies in Argentina to control this pest in North America. The moth mortality factors were identified by building life tables in managed and unmanaged cultivated fields of prickly pear cactus, Opuntia ficus-indica (L.) Mill. (Cactaceae) in Córdoba and Santiago del Estero provinces. In each field, more than 400 egg sticks were marked and monitored until the adult stage was reached in each of the 3 annual generations. Samples of the different stages were taken every 7-14 days. On average, the mortality of eggs, larvae, and pupae was 50%. Main mortality factors for eggs were rain and wind (11-29%) and ant predation (9-28%). For larvae and pupae, predation was the main mortality factor (46-50%). Parasitism was 2-6% for eggs (mainly by Trichogramma pretiosum Riley, and Trichogramma sp. (Hymenoptera: Trichogrammatidae)), 7-18% for larvae (mainly by Apanteles alexanderi Brethes (Hymenoptera: Bracnoidae)), and was negligible for pupae. In general, the sex ratio was 1:1. Although each generation showed an overall survivorship of only 1%, populations at both sites increased 6-7 fold from the initial values. Life table studies will be continued for one more year. Additionally, life table studies of C. cactorum will be carried out on native Opuntia at two new sites. Complementary studies on female moth oviposition preference and larval performance on native and exotic Opuntia species of Argentina are under appraisal.
INVESTIGATIONS INTO THE POTENTIAL BIOLOGICAL CONTROL OF THE INVASIVE SPECIES, AGRILUS PLANIPENNIS (COLEOPTERA: BUPRESTIDAE), IN NORTH AMERICA USING NATIVE PARASITOIDS

D.B. Lyons & G.C. Jones

Natural Resources Canada, Canadian Forest Service, 1219 Queen St. E., Sault Ste. Marie, Ontario Canada P6A 2E5, blyons@nrcan.gc.ca

The emerald ash borer, Agrilus planipennis Fairmaire (Coleoptera: Buprestidae), was first discovered in North America in 2002 in the vicinity of Detroit, Michigan. The species is native to eastern Asia and dendrochronological evidence suggests it was present in the Detroit area for about 10 years prior to its discovery. USDA-FS evaluated the impact of native parasitoids on A. planipennis populations in 2003. Observations from Michigan populations indicated that native parasitism rates were <1%. We describe survey results that we have undertaken to assess parasitism in populations of endemic Agrilus spp. and in A. planipennis. We describe an Ontario population of A. planipennis that had high numbers of two larval parasitoids. The most abundant parasitoid was Phasgonophora sulcata Westwood (Hymenoptera: Chalcididae) and the less abundant parasitoid was Balcha indica (Mani & Kaul) (Hymenoptera: Eupelmidae). The former species is the most common parasitoid encountered in native Agrilus populations. The second species, itself an alien, probably arrived in North America from Asia on some host other than EAB because it was first encountered in 1994 in Virginia. Both species were reported during the Michigan study. Subsequent trapping at this Ontario location using sticky bands suggested a parasitism rate of ~40% by P. sulcata. Preliminary information on the distribution, ecology and phenology of these parasitoids are presented. These parasitoids are being evaluated for their potential for augmentative and/or inundative control of the borer.

PRELETHAL EFFECT OF ENTOMOPATHOGENOUS FUNGUS BEAUVERIA BASSIANA (BALS.) VUILL. OVER EUROPEAN PAPER WASP POLISTES DOMINULUS (HYMENOPTERA: VESPIDAE)

L. Merino¹, M. Gerding¹, & A. France¹

¹ Instituto de Investigaciones Agropecuarias, Centro Regional de Investigaciones Quillamapu, Casilla 426, Chillán, Chile, lmerino@inia.cl

The prelethal effect of an infection is an aspect of entomopathogenic fungi efficacy that does not include insect mortality but affects or decreases various aspects of a host’s biology. The objective of this research was to evaluate prelethal effect of Qu-B933 isolates of Beauveria bassiana (Balsamo) Vuillemin (Hyphomycetes) over Polistes dominula (Christ) (Hymenoptera: Vespidae) wasps. A matrix was built to establish activities and distribution of time on healthy wasp colonies, comparing with wasps belonging to colonies receiving a liquid bait with a dose of $10^8$ espores mL$^{-1}$ using The Observer™ software and grouping activities in active and inactive times. The test results showed significant decreases ($P=0.05$) in
total active time of inoculated wasps, reaching a 79.89% decrease at day 11 of test. The isolate application caused: a progressive reduction in activities such as drinking, washing, nest expansion, larva feeding, flying, walking, and interaction with other individuals; increased inactive time in inoculated wasps, finally causing insect death from the 10th day; and collapse of inoculated colonies due to a lack of defense work, cleaning and nest maintenance.

CONSERVING AND USING ENTOMOPATHOGENIC FUNGI AND NEMATODES WITHIN CHILE

L. Merino1, A. France1, M. Gerding1, D. Moore2, & S. Edgington2

1 Instituto de Investigaciones Agropecuarias, Centro Regional de Investigaciones Quilamapu, Casilla 426, Chillán, Chile. lmerino@inia.cl; 2 CABI UK Centre (Ascot) Silwood Park Buckhurst Road Ascot Berks SL5 7TA United Kingdom

The Insect Pathology Program at INIA Quilamapu (Chile) is working in collaboration with CABI (UK) on a Darwin Initiative (DEFRA-UK) to conserve and use entomopathogenic microorganisms in Chile. The aim is to collect entomopathogenic fungi and nematodes from some of the major ecological habitats in Chile. Seven survey transects have been chosen: 1. Latitude 20°, with sections of Altiplano and on the periphery of the Atacama desert; 2. Latitude 30°, desert with remnants of ancient tropical forests; 3. Latitude 33°, an area of Mediterranean vegetation; 4. Latitude 37°, a transitional zone from dryland into wetland; 5. Latitude 46°, heavy rainfall, relatively cold, with humid forests and areas of pampas, 6. Latitude 52°, Tierra del fuego, with near Antarctic conditions and flora and fauna adapted to low temperatures. The transects have been surveyed, revealing 457 isolates of entomopathogenic fungi, predominately *Metarhizium* and *Beauveria* spp. (Hyphomycetes) and 99 isolates of nematode, *Heterorhabditis* (Rhabditida: Heterorhabditidae) and *Steinernema* spp. (Rhabditida: Steinernematidae). The isolates will be placed into the Genetic Resource Collection at INIA, significantly enhancing the bank of indigenous germplasm already present. It is likely that indigenous isolates will show stronger adaptations to conditions in Chile compared to exotic isolates and could be important pest control options.

EFFECTIVENESS OF ASECODES HISPINARUM AS AN INTRODUCED CONTROL AGENT OF THE INVASIVE PEST, THE COCONUT HISPINE BEETLE IN VIETNAM

K. Takasu1, K. Konishi2, V.T. Tran3, & S. Nakamura4

1 Faculty of Agriculture, Kyushu University, Fukuoka, Japan; 2 National Agricultural Research Center for the Hokkaido Region, Sapporo, Japan; 3 Faculty of Agronomy, Nong Lam University, Ho Chi Minh, Vietnam; 4 Japan International Research Center for Agricultural Sciences, 1-1 Ohwashi Tsukuba 305-8686. Japan, s.nakamura@affrc.go.jp
The coconut hispine beetle, *Brontispa longissima* Gestro (Coleoptera: Chrysomelidae) is one of the most serious pests of coconut palms in Southeast Asia. The beetle is believed to be native to Indonesia and Papua New Guinea, and recently it was accidentally introduced into continental Southeast Asian countries. In Vietnam, *B. longissima* was found in the Mekong Delta region (Southern Vietnam) in 1999 and then spread to the central region. Almost all the coconut trees in the southern and central parts of Vietnam were heavily infested with this beetle by 2003. The larval parasitoid *Asecodes hispinarum* Boucek (Hymenoptera: Eulophidae) was introduced from Western Samoa in 2003 with the support of FAO, and was released to those areas of Vietnam. The beetle was no longer abundant in the southern part of the country in 2007; 10-40% of trees were still infested with the beetle, but only less than 20% of leaves in the infested trees were damaged. This result suggests that the introduced larval parasitoid succeeded in controlling the beetle. On the contrary, in the central part of Vietnam such as Phu Yen and Khanh Hoa provinces, there were still many trees with heavy infestations found, although the parasitoid had been released. We discuss factors responsible for the difference in effectiveness of biological control between the two regions in Vietnam.

**ARTIFICIAL DIET OF THE COCONUT HISPINE BEETLE *BRONTISPA LONGISSIMA* FOR REARING ITS PARASITOID *ASECODES HISPINARUM***

R.T. Ichiki, D.T. Dang, S. Takano, & S. Nakamura

*Japan International Research Center for Agricultural Sciences, 1-1 Ohwashi, Tsukuba, 305-8686, Japan. s.nakamura@affrc.go.jp*

The coconut hispine beetle, *Brontispa longissima* Gestro (Coleoptera: Chrysomelidae) is one of the most serious pests of coconut, *Cocos nucifera* L. (Arecaceae) and several ornamental palms in Southeast Asia. The pest is believed to be native to Indonesia and Papua New Guinea, and recently it was accidentally introduced into continental Southeast Asian countries. The endoparasitoid *Asecodes hispinarum* Boucek (Hymenoptera: Eulophidae) specifically attacks larvae of *B. longissima* and could potentially be used as a biological control agent. To keep colonies of the wasp and the beetle in the laboratory, it is necessary to provide coconut fronds for the beetle, which are important parts for healthy growth of the trees and are relatively expensive even in Southeast Asia as well. We developed an artificial diet for *B. longissima* for a convenient rearing technique, which can maintain this beetle during the developmental stage from hatching to adult emergence with 41% survival. Females of *A. hispinarum* actively oviposited in 4th instar larvae of beetles reared on the diet. Of the oviposited hosts, 75% were mummified and 42% produced adult wasps.
POPULATION DYNAMICS AND ON-FARM FRUIT FLY INTEGRATED PEST MANAGEMENT IN MANGO ORCHARDS IN THE NATURAL AREA OF NIAYES IN SENEGAL

M. Ndiaye¹, E. O. Dieng¹, & G. Delhove²

¹National Plant Protection Service, Km 15, Route de Rufisque, Box 20054 Thiaroye, Dakar, Republic of Senegal, mbaye52@hotmail.com, elhadjidien@yahoo.fr; ²PIP/COLEACP, Rue du Trône, 98 1050 Bruxelles, Gilles.Delhove@coleacp.org

The trend of the population of fruit flies follows the dynamic of the rains. This tendency is more perceptible in Bactrocera invadens Drew, Tsuruta & White than in Ceratitis cosyra (Walker) (Diptera: Tephritidae). From 350 individuals captured per trap, B. invadens seemed to disrupt the presence of C. cosyra and the other related fruit fly species. Such behavior is probably due to an interspecific competition and could be the fact that C. cosyra dominated emergences from the incubated fruits of alternate host plants up to 87% even though B. invadens was observed. Integrated pest management (IPM) package was tested which included: (1) male annihilation using wood blocks soaked in insecticide (malathion 500 EC) and lure (methyl eugenol and terpinyl acetate); (2) two protein hydrolysate bait applications (Success Appat at 1 L/ha); and (3) sanitation (weeding and destroying of the collected fallen fruits by the following practices: using black plastic bags, burying in holes, burning on the ground surface and incinerating with a barrel transformed into incinerator). The aim was to control fruit flies in mango orchards. Results showed a control as an inferred improvement in fruit fly infestations in the treated plot up to 83% compared to the untreated. From the above the method to destroy collected fruits using a reinforced black plastic bag would be recommended for popular use. When we compare methyl eugenol to the home-made baits of grinded nutmeg and NET, a beauty cream, we found that methyl eugenol attracted B. invadens significantly. Methyl eugenol's half life is also significantly longer (5 weeks) than the ground nutmeg (less than 1 week) (P=0.0109; t=9.4935; df=2). No capture was recorded in the NET based trap. In case of lack of methyl eugenol, the ground nutmeg might be recommended as an alternative product to renew every week.

NATIVE TRICHOGRAMMA PARASITISM OF THE NEWLY INTRODUCED LIGHT BROWN APPLE MOTH IN CALIFORNIA, USA

W.J. Roltsch¹ & N.T. Carruthers²

¹California Department of Food and Agriculture, Biological Control Program, 3288 Meadowview Rd., Sacramento, California, U.S.A., wroltsch@cdfa.ca.gov; ²USDA-APHIS-CPHST, Western Regional Research Center, 800 Buchanan St., Albany, California, U.S.A., ntc@pw.usda.gov

Native to Australia, the light brown apple moth, Epiphyas postvittana (Walker) (Lepidoptera: Tortricidae) is presently established in several coastal areas of California, USA. The present study investigates the impact of native Trichogramma species (Hymenoptera: Trichogrammatidae) upon LBAM in California. Objectives of the ongoing project include the identification of Trichogramma species responsible
for parasitism, seasonality of parasitism, and the variability of parasitism in the field across a range of LBAM host plants.

POTENTIAL USE OF NATIVE ISOLATES OF ENTOMOPATHOGENIC FUNGUS FOR OBSCURE MEALY BUG (PSEUDOCOCCUS VIBURNI (MASKELL)) CONTROL

A. Salazar¹, M. Gerding¹, R. Ceballos¹, & A. Pereira²

¹Instituto de Investigaciones Agropecuarias (INIA), Quilamapu, Chillán, Chile; ²Universidad de Concepción, Facultad de Agronomía, Chillán, Chile, asalazar@inia.cl

The obscure mealy bug is an important plant pest for Chilean fruit production due to cosmetic fruit damage and its quarantine importance for export markets. At laboratory were tested 100 isolates of native entomopathogenic fungi, Metarhizium anisopliae (Metschnikoff) Sorokin and Beauveria bassiana (Balsamo) Vuillemin (Hyphomycetes), on third instar mealybugs. Every two days during 31 days, the mortality and sporulation were evaluated. The selected isolate was sprayed on all developmental stages of the mealybug, to obtain the instars susceptibility and LC₅₀. This isolate was also mass cultured and sprayed in preliminary field trials. Significant differences were detected among the 100 isolates (P<0.05), the Qu M984 isolate showed the best potential control of mealybugs (85% mortality and 80% sporulation). The second instars showed the greatest susceptibility to the fungi with LC₅₀ 1X10⁴ /ml. The field trials (dose of 1X10¹² /hectare) showed a mealybug population decrease of 70% as compared with the control. Therefore, the future emphasis will be to increase dose concentrations. Entomopathogenic fungi have an important potential for control of obscure mealybugs in commercial fruit production.

CHARACTERIZATION AND EVALUATION OF AN INDIGENOUS GRANULOVIRUS OF PIERIS BRASSICAЕ L. IN THE NORTH-WESTERN HIMALAYAS

P. Sood, K. Bhandari, P.K. Mehta, A. Choudhary, & C.S. Prabhakar

Department of Entomology, CSK HP Agriculture University, Palampur 176062, India, pankajplp@rediffmail.com

Cole crops are important cash crops in Himachal Pradesh situated in north-western Himalaya between 30°22' to 33°12' N latitude and 75°45' to 79°04' E longitude. Amongst a number of insect pests, cabbage butterfly, Pieris brassicae L. (Lepidoptera: Pieridae) is the major constraint in their successful cultivation, making insecticidal application mandatory. The increased consumer awareness has made it obligatory to reduce the pesticide usage in vegetables, which however requires the alternative pest management strategies. A granulovirus of P. brassicae isolated from the high temperate region (Sangla: altitude 2580 mt.) was characterized and evaluated for its effective field usage against the pest. Partial nucleotide sequencing using a granulin specific marker revealed 365 bp sequence of PbGV and was analyzed using the clustalW programme. Local isolate had maximum homology
(76%) with *Phtorimaea operculella* granulovirus followed by *Choristoneura occidentalis* granulovirus (75%), whereas, minimum homology (39%) was observed with *P. rapae* granulin gene. Laboratory evaluation of PbGV alone and in combination with 5% solvent extracts of botanicals (*Artemisia brevifolia*, neem seed kernel and *Eupatorium adenophorum*) revealed the synergistic effect of botanicals. The lowest LC$_{50}$ values were recorded for PbGV+neem seed kernel extracts i.e. 2.16X10$^7$, 7.12X10$^6$ and 1.15X10$^6$ OBs/ml, respectively for aqueous, methanolic and petroleum ether extracts against IV instar larvae. Field studies revealed that PbGV @ 500 LE/ha was effective in managing *P. brassicae*, however, when combined with Bt and NSKE, effective dosage was 250LE/ha. UV protectants and phagostimulants were also evaluated to improve PbGV persistence and pathogenicity.

NATIVE PARASITIC WASPS (HYMENOPTERA: BRACONIDAE): A NEW TOOL FOR FRUIT FLY (DIPTERA: TEPHRITIDAE) MANAGEMENT IN AUSTRALIA.

**J.E. Spinner$^1$, G.M. Gurr$^2$, A.J. Jessup$^3$, & O.L. Kvedaras$^4$**

$^1$CRC National Plant Biosecurity, EH Graham Centre for Agricultural Innovation (NSW Department of Primary Industries and Charles Sturt University), Boorooma Street, Locked Bag 588, Wagga Wagga New South Wales 2678, Australia, jspinner@csu.edu.au; $^2$EH Graham Centre for Agricultural Innovation (NSW Department of Primary Industries and Charles Sturt University), PO Box 883, Orange, New South Wales 2800, Australia, GGurr@csu.edu.au; $^3$Insect Pest Control Sub-programme, FAO/IAEA Agriculture and Biotechnology Laboratory, A-2444 Seibersdorf, Austria, a.jessup@iaea.org; $^4$EH Graham Centre for Agricultural Innovation, NSW Department of Primary Industries and Charles Sturt University, Wagga Wagga Agricultural Institute, NSW Department of Primary Industries, Private Mail Bag, Pine Gully Road, Wagga Wagga, New South Wales 2650, Australia, olivia.kvedaras@dpi.nsw.gov.au

Inundative releases of Australian parasitoid species have resulted in improved management of fruit flies (Tephritidae) in several regions of the world. Despite this, and the importance of fruit flies as pests, inundative releases of parasitoids are not yet used in Australia. This paper will present preliminary results on the development of such an approach for use in Australia. Initial work comprises field surveys of areas in inland New South Wales to determine the identity of fruit fly parasitoid species present and levels of parasitism. In Australia, a number of hymenopteran parasitoids are known to target Queensland fruit fly, *Bactrocera tryoni* (Froggatt) (Diptera: Tephritidae) including *Diachasmimorpha tryoni* (Cameron) and *D. kraussii* (Fullaway) and the introduced *Fopius arisanus* (Sonan) (Hymenoptera: Braconidae).The extent of *B. tryoni* sharing parasitoid species with other native fruit fly species including island fruit fly, *Dirioxia pornia* (Walker) and wild tobacco fruit fly, *B. cacuminata* (Hering) (Diptera: Tephritidae) will be reported. Small-scale, laboratory assessment of the ease of culturing each parasitoid species, along with overseas reports, will allow selection of the superior species for more detailed studies. Results will be discussed in relation to optimal rearing techniques and strategies for release frequency, rate, location, timing and pre-release feeding of parasitoids and potential incorporation into pest fruit fly management programs.
COMPOSITION OF PREDATORY FAUNA DURING THE PEAK PESTICIDAL APPLICATION SEASON IN COTTON CROP

F. Hafeez¹, W. Akram¹, & M. Tariq²

¹Department of Agri. Entomology, University of Agriculture, Faisalabad, Pakistan, faisalhafeez143@gmail.com, areeba14@yahoo.com; ²Division of Biology, Faculty of Natural Sciences, Imperial College, Silwood Park campus, Buckhurst Road, Ascot, Berkshire SL5 7PY, U.K., tariqrao1223@gmail.com

A detailed study on the composition of the predator fauna from potential growing areas of Punjab was carried out in 2004-2005. Five productive sites of cotton growing belt were examined from June to August with outbreaks of sucking and chewing insects of all stages, high temperature and repeated application of insecticides. The cotton varieties grown in the five selected localities generally included the high yielding resistant varieties with overall average yield of 35-40 monds / acre. The predator composition recorded after the start of pesticide spraying revealed that in all the selected sites Orius sp. (Hemiptera: Anthocoridae) is the dominant biocontrol agent with total catches of 216 individuals followed by Geocoris sp. (Hemiptera: Geocoridae) (209) and Chrysoperla sp. (Neuroptera: Chrysopidae) (157). The predatory potential of Chrysoperla sp. is quite conspicuous as most of the trapped individuals were seen on places heavily infested with soft bodied stages of both chewing and sucking insects: whiteflies, jassids, thrips and bollworms. Similar population trends were recorded at 15 day intervals during the entire collection season. The average temperature noted during the collection period ranged from 38.36 to 43.16°C.

UTILISING NATURAL ENEMIES ALREADY PRESENT IN NEW ZEALAND TO ENHANCE BIOLOGICAL CONTROL FOR GREENHOUSE CROPS

P.J. Workman

New Zealand Institute for Crop & Food Research Limited, Private Bag 921694, Auckland, New Zealand

Currently only a small number of biological control agents are available for use in New Zealand for greenhouse crops. Growers identified this as a major impediment to the uptake of biological control programmes. Additional biological control agents are required for new invasive species such as the tomato/potato psyllid, Bactericera cockerelli (Sulc) (Hemiptera: Psyllidae), western flower thrips, Franklinella occidentalis (Pergande), and intonsa flower thrips, Frankliniella intossa (Trybom) (Thysanoptera: Thripidae). More effective biological control agents are also required for the established greenhouse pest such as greenhouse whitefly, Trialeurodes vaporariorum (Westwood) (Hemiptera: Aleyrodidae), and onion thrips, Thrips tabaci Lindeman (Thysanoptera: Thripidae). Compliance with the regulations for importation of biological control agent from countries outside New Zealand is costly and takes a considerable amount of time. Many of the biological control agents used in other countries are generalist predators and it is unlikely that these could be imported into
New Zealand because of the threat they pose to the indigenous fauna. The difficulties of importing new organisms has led to a search in New Zealand for biological control agents for greenhouse crops. The southern ladybird, Cleobora mellyi Mulsant (Coleoptera: Coccinellidae), and a psyllid parasitoid, Tamarixia sp. (Hymenoptera: Eulophidae), have potential as psyllid biological control agents. Two new whitefly natural enemies have also been found, the parasitoid Eretmocerus eremicus Rose and Zolnerowich (Hymenoptera: Aphelinidae) and the predatory mirid Macrolophus pygmaeus Rmbur (Hemiptera: Miridae). Laboratory colonies of the predatory mite Amblydromalus limonicus (Garman & McGregor) (Acari: Phytoseiidae) have also been established. This mite has the potential to improve thrips control and give additional control of whitefly and psyllids.

BIOLOGICAL CONTROL OF THE INVASIVE LETTUCE APHID NASONOVIA RIBISNIGRI IN OUTDOOR LETTUCE BY INDIGENOUS PREDATORS IN NEW ZEALAND

P.J. Workman & G.P. Walker

New Zealand Institute for Crop & Food Research Limited, Private Bag 921694, Auckland, New Zealand

Lettuce aphid, Nasonovia ribisnigri Mosely (Hemiptera: Aphidae), was first detected in New Zealand on lettuce, Lactuca sativa L. (Asteraceae) in Christchurch in March 2002. Lettuce growers immediately found the new pest difficult to control using foliar insecticide applications because lettuce aphid prefers to feed and reproduce in the interior of the lettuce. Control options for the lettuce aphid, including foliar-applied insecticides, insecticide drenches, lettuce aphid-resistant cultivars and biological control, were investigated in 10 lettuce field trials in Pukekohe (South Auckland) quarterly from September 2002 to April 2005. Biological control agents, including the Australasian Tasmanian lacewing, Micromus tasmaniae Walker (Neuroptera: Hemerobiidae), and the native indigenous hoverfly, Melanostoma fasciatum Macquart (Diptera: Syrphidae), consistently gave effective control of lettuce aphid and other aphid species in the 3 spring trials (October–December). Although these predators failed to reduce the high lettuce aphid populations to acceptable levels in the summer trials (January–March), aphid numbers in the untreated controls were lower than in foliar-applied insecticide treatments at harvest. Only low numbers of lacewings and hoverfly larvae were found in autumn trials (April–June) and they were rarely found in the winter trials (July–September). These trials demonstrate the potential of indigenous biological control agents to contribute to the management of a new exotic pest.
RESEARCH ADVANCE OF *BACILLUS THURINGIENSIS* AGAINST PESTS AND PLANT DISEASES

Y. Ziniu, L. Jianhong, Z. Jibin, & S. Ming

State Key Laboratory of Agricultural Microbiology, National Engineering Research Center of Microbe Pesticides, Huazhong Agricultural University, Wuhan 430070, China

*Bacillus thuringiensis* Berliner (Bacillaceae) is well known as a high-effective bio-insecticidal bacterium. Few people realized about the character of *B. thuringiensis* for plant disease-control. During the last 20 years of development of *B. thuringiensis*, many new functions of were reported. In this paper, novel functions of *B. thuringiensis* to control phytopathogenic microorganisms are summarized. The first function is AHL lactonase, which can quench the quorum sensing signal molecular N-acyl homoserine lactones and in turn significantly silence *Pectobacterium carotovorum* (Jones) Waldee, emend. Gardan *et al.* (= *Erwinia carotovora* (Jones) Lehmann & Neumann) (Enterobacteriaceae) virulence and decrease the incidence of *P. carotovorum* infection. The second function is zwittermicin A, a linear aminopolyol antibiotic with high activity against the *Oomycetes* and their relatives, as well as the algal protists and certain Gram-negative bacteria. At the same time, zwittermicin A can greatly enhance the efficacy of *B. thuringiensis* insecticides. Finally, the potential of *B. thuringiensis* to control plant parasitic nematodes and some new progresses were introduced. Each function had some striking results and showed good promise for application. On the other hand, some results suggested that the control spectrum of *B. thuringiensis* can be widened and help to better understand the role of *B. thuringiensis* in the oil ecosystem.

EVALUATION OF ENTOMOPATHOGENIC FUNGI AS A BIOLOGICAL CONTROL AGENT OF *CAMERARIA OHRIDELLA*, AN INVASIVE PEST OF *AESCULUS HIPPOCASTANUM* IN EUROPE

R. Zemek¹, E. Prenerova², F. Weyda¹, & L. Volter¹

¹Institute of Entomology, Ceske Budejovice, Czech Republic, rosta@entu.cas.cz; ²Laboratory of Plant Protection Olesna, Bernartice u Milevska, Czech Republic, eva.prenerova@seznam.cz

We evaluated the potential for using entomopathogenic fungi to control the horse chestnut leaf-miner, *Cameraria ohridella* Deschka et Dimic (Lepidoptera, Gracillariidae). In the first step, the occurrence of entomopathogenic fungi in soil samples collected in the vicinity of horse chestnut trees heavily infested by *C. ohridella* was surveyed using the adapted *Galleria*-bait method. Totally, 45.3% of *Galleria* larvae (n=3840) were found infected with entomopathogenic fungi (Deuteromycetes). Dominant species found were *Isaria fumosorosea* syn. *Paecilomyces fumosoroseus* (Wize) Brown et Smith (77.6%) and *Beauveria bassiana* (Balsamo) Vuillemin (20.6%). *Isaria farinosa* (Holm ex S.F. Gray) Brown et Smith and *Metarhizium anisopliae* (Metschnikoff) Sorokin occurred rarely (1.7% and 0.1%, respectively). In addition, we discovered spontaneous infection of *C. ohridella* hibernating pupae by *I. fumosorosea* and *B. bassiana*. Both species were
successfully isolated from the host and cultivated on artificial medium. All isolated strains are deposited in the CCEFO (Culture Collection of Entomopathogenic Fungi Olesna) in the Czech Republic. The laboratory bioassays revealed a high insecticidal activity of *I. fumosorosea* blastospores and conidia on both *C. ohridella* pupae and eggs. Further research is currently on-going where we evaluate selected strains of *I. fumosorosea* in field trials. Ways of implementation of entomopathogenic fungi in the IPM of *C. ohridella* are discussed.