THURSDAY

Christine T. Griffin - National University of Ireland Maynooth, Maynooth, Co. Kildare, Ireland; ***Aoife B. Dillon*** - Coillte, Cork, Ireland; ***Darragh Ennis*** - National University of Ireland Maynooth, Maynooth, Co. Kildare, Ireland; ***Khalil M. Alameen*** - National University of Ireland Maynooth, Maynooth, Co. Kildare, Ireland; ***Aileen Foster*** - National University of Ireland Maynooth, Maynooth, Co. Kildare, Ireland; ***Chris D. Harvey*** - National University of Ireland Maynooth, Maynooth, Co. Kildare, Ireland
Address for correspondence: christine.griffin@nuim.ie

The large pine weevil *Hylobius abietis* is the most serious pest of reforestation in northern Europe, with a life cycle similar to that of *H. congener* in north America. Weevil larvae feed under the bark of stumps of recently felled conifers. When adult weevils emerge they feed on the bark of newly planted tree seedlings; 100% mortality of unprotected trees is not uncommon. The strategy of targetting pine weevil larvae and pupae within the stumps has potential to reduce weevil populations. In small scale field trials *Heterorhabditis downesi* was the most successful nematode species tested, reducing the emergence of adult weevils by up to 85% compared to untreated controls. *Steinernema carpocapsae* performed surprisingly well, given its reputation as an ambush forager: it parasitised weevils that were located inside tree roots up to 50 cm below soil level, and reduced emergence of adult weevils by up to 64%. Laboratory experiments indicate that host-finding by *S. carpocapsae* may be facilitated by roots as routeways through the soil, especially when there are weevil larvae feeding on them. Large scale trials of nematodes against pine weevil are underway in commercial forests in Ireland, with approximately 370 hectares treated to date. No adverse effects of nematodes on numbers or diversity of non-target beetles, either wood-associated or not, were detected by comparing trap catches from nematode-treated and untreated stumps. Special attention was paid to the non-target *Rhagium bifasciatum*, a common longhorn beetle which is important in wood decomposition. Although all stages of this beetle are susceptible, they escape nematode attack by spatial and temporal separation from the nematodes. At the time of nematode application to sites, *R. bifasciatum* is present only in debris logs which are at an advanced stage of decay, while nematodes are applied only around tree stumps where persistence is limited.

Contributed Paper - Thursday, 16:30 166

Field efficacy of *Beauveria bassiana* on the *Vespula germanica* wasp nests.

Loreto Merino - NIA Quilamapu, Chillán, Bio Bio, Chile; ***Andrés France*** - NIA Quilamapu, Chillán, Bio Bio, Chile; ***Marcos Gerding*** - NIA Quilamapu, Chillán, Bio Bio, Chile; ***Ricardo Ceballos*** - NIA Quilamapu, Chillán, Bio Bio, Chile
Address for correspondence: lmerino@inia.cl

After an extensive survey along Chile and selection process in the lab, the isolate DW B941 of *Beauveria bassiana* was selected for field experiments against *V. germanica* nest control. The first evaluation was accomplished on nest collected from the field and reduced to a population of 100 larvae, 25 workers and 1 queen, and confined into wood boxes. The wasp colonies were feeding with liquid baits containing 1 x 10^8 conidia mL^{-1} of *B. bassiana*. The mortality of larvae and workers were evaluated daily. The second experiment was similar but achieved in three fields on wild nests. The bait was changed every 5 days and the insect traffic was evaluated weekly. After 5 weeks the nests were removed from the soil and the adults, larvae and pupae were counted. The results indicate that isolate DW B941 produced a 50% of larvae and workers mortality after 12 and 17 days, respectively. After 23 days 100% of workers were dead. Those values were different (p= 0.012) to the control. On wild nest the insect traffic decreased from 66 to 99% when they were fed with *B. bassiana* baits. After dissecting the nests, the treated ones showed a reduction of 51 and 71% of eggs and larvae, respectively. Furthermore, 76% of the remaining larvae were colonized by *B. bassiana,* instead any eggs was affected by the fungus.

Contributed Paper - Thursday, 16:45 167

Persistence and efficacy of entomopathogens in potting media.

Anne Nielsen - University of California at Davis, Davis, CA, USA; ***Kenneth Spence*** - University of California at Davis, Davis, CA, USA; ***Denny Bruck*** - USDA-ARS, Corvallis, OR, USA; ***Edwin Lewis*** - University of California at Davis, Davis, CA, USA
Address for correspondence: alnielsen@ucdavis.edu

Greenhouse nursery production represents a large and growing industry. In recent years there has been a shift both toward the use of soilless media (i.e. potting media) and integrated pest management. Application of entomopathogens such as nematodes, fungi, and bacteria against soil-dwelling insect pests is a sustainable alternative to insecticide centered control programs, but soilless media are designed to provide a plant pathogen free growing environment. The potential impact of soilless media on the efficacy of entomopathogens is often overlooked. We measured the effect of soilless media and watering regime on entomopathogen persistence under greenhouse conditions. The entomopathogens *Steinernema riobrave*, *Heterorhabditis bacteriophora*, and *Metarhizium anisopliae* were evaluated in three potting media; peat:sand mix, redwood bark mix and redwood sawdust mix. Aqueous soil drench and cadaver application methods were compared for *S. riobrave* and *H. bacteriophora*. *M. anisopliae* was applied as a soil drench. Survivorship decreased over the 4 week sampling period, independent of potting media or pathogen, although *M. anisopliae* had the longest persistence of all pathogens. The relationship between watering regime and persistence in media types was unclear. The persistence of entomopathogenic nematodes varied significantly among media types, but the best media type for each species and application method varied. The sawdust mix had the shortest persistence of all media tested and was not evaluated for efficacy. Efficacy of each pathogen was evaluated against *Otiorhynchus sulcatus* larvae in the best media from the persistence study (for each pathogen) 3 DAT and 10 DAT.

Contributed Paper - Thursday, 17:00 168

Field efficacy of a baculovirus isolate that doesn't cause the liquefaction of *Spodoptera frugiperda* dead larvae.

Fernando Valicente - Embrapa, Sete Lagoas, MG, Brazil; ***Corina Macedo*** - Student, Sete Lagoas, MG, Brazil; ***José Wolff*** - Universidade Presbiteriana Mackenzie, São Paulo, SP, Brazil; ***Edmar Tuelher*** - Student-Embrapa, Sete Lagoas, MG, Brazil; Carlos Paiva - Student-Embrapa, Sete Lagoas, MG, Brazil; ***Alan Costa*** - Student- Embrapa
Address for correspondence: valicent@cnpms.embrapa.br

The Spodoptera frugiperda nucleopolyhedrovirus (SfMNPV) has shown potential to be used in Brazil as a biopesticide. However, the liquefaction of the integument (isolate 19) makes large-scale production laborious and expensive, because all larvae must be frozen before being harvested for polyhedra extraction. One dead larva was found with the integument not disrupted (isolate 6) and was multiplied during 5 generations in laboratory. Detection and sequencing of chitinase and cathepsin genes were performed as well as LC_{50}, LT_{50} and field experiment using a wettable

THURSDAY

powder formulation. The new Brazilian isolate 6 of S. frugiperda that doesn't disrupt the integument was confirmed to harbour cathepsin and chitinase genes. Restriction fragment analysis with BamHI and HindIII did not show differences between isolate 19 and 6. PCR amplification of the regions encompassing the chitinase and the cathepsin genes produced an amplicon whose size was the same for the two isolates. Alignment of the sequence (isolate 6) obtained with the sequence of isolate 19 revealed a deletion of one base located within the chitinase gene. The framesift caused by this deletion resulted in appearance of a stop codon 15 base pairs downstream the mutation. LC 50 was similar to both isolates (2.6x10 5 and 3.6x105 PIB/mL to isolate 6 and 19, respectively) but LT_{50} was around three days longer to isolate 6 than 19 on those concentrations equivalent to LC_{50} and LC_{95}. Field experiments using $1x10^7$ PIBs/mL showed mortality up to 90% when larvae were collected 24 and 48 hours after the bioinsecticide was sprayed. Mortality caused by baculovirus plus parasitoids was above 90% when a concentration of $1x10^6$ and $1x10^7$ PIB/mL of both isolates were used Using isolate 6, the larval equivalent/ha could be lowered to around 80 to 120 larvae/ha, which is equivalent to 10.75 and 13.86 g of dead larvae/ha, respectively.

Contributed Paper - Thursday, 17:15 169

Successful introduction of Green Muscle® into Madagascar for the control of the migratory locust *Locusta migratoria* Capito.

Jocelyn J.H. Rajaonarison - FOFIFA, Antananarivo, Madagascar; ***Nguya Kalemba Maniania*** - International Centre of Insect Physiology and Ecology (icipe), Nairobi, Kenya; ***Rahalivavololona Njaka*** - FOFIFA, Antananarivo, Madagascar; ***Saholy Ramiliarijaona*** - FOFIFA, Antananarivo, Madagascar
Address for correspondence: nmaniania@icipe.org

The Malagasy migratory locust, *Locusta migratoria capito*, is a major threat to food production in Madagascar. Crop losses can be as high as 100% in some areas during severe outbreaks. The current control method based on the use of synthetic insecticides in plague or outbreak situations is costly, pollutes the environment and threatens Malagasy highly valued rich biodiversity. The use of *Metarhizium anisopliae* var. *acridum* is one of the alternatives being explored. Since Green Muscle® developed for the control of *Schistocerca gregaria* is now commercially available; steps were taken for its introduction into Madagascar. The steps included efficacy against *L. migratoria* in the laboratory and its effect on non-target organisms. Green Muscle® was virulent against *L. migratoria* nymphs and did not show negative effects on *Apis mellifica, Bombyx mori, Papillio demodecus* and *Antherina suraka*, and was therefore allowed into Madagascar for further studies. In field trials conducted in 2008 and 2009 in Tuléar Province, 5 and 16 ha, respectively, were treated with an ULV formulation of Green Muscled® at a rate of 100g conidia in 2000 mL of oil-kerosene/ha. Field populations of the locust were reduced to 70 and 80% 6 days after treatment during 2008 and 2009, respectively, while 100% reduction was achieved after 9 days post-treatment. Insects collected from treated plots at different interval times and placed in outdoor cages, all succumbed to fungal infection. Mortality of 100% was also observed after 25 days among nymphs that were exposed to treated grass collected 6 days post-treatment. These results confirm the potential of Green Muscle® as biopesticide for control of both *S. gregaria* and *L. migratoria*.

Contributed Paper - Thursday, 17:30 170

Beauveria bassiana UV resistance in the laboratory and its virulence against the coffee berry borer in the field.

Sandra Valdes - Cenicafé. National Centre of Coffee Research., Chinchina., Caldas, Colombia; ***Carmenza E Gongora*** - Cenicafe. National Centre of Cofee Research., Chinchina., Caldas., Colombia.
Address for correspondence: carmenza.gongora@cafedecolombia.com

The entomopathogenic fungus *Beauveria bassiana* displays a great potential as biological controller of insects. Nevertheless, the effectiveness of this microorganism depends to a large extent on its persistence under field conditions, which is affected by the solar radiation, particularly by UV-A and UV-B wavelengths. In studies under laboratory and field conditions it has been found that the highest coffee berry borer (CBB) mortality in laboratory conditions (100 %) is caused by a mixture of strains (Bb 9001, Bb9024 and Bb9119), that individually are low virulent strains, compared with the strain Bb 9205 considered a high virulence strain (88% mortality). However, under field conditions a good performance on CBB was exhibited by both, the mixture (67%) as well as the Bb 9205 (60%). In order to know the possible causes for this behavior, an evaluation of UV light resistance of the strains was done. Three ARSEF strains were tested (Bb718, Bb1053 and Bb2997), in addition to the individual low virulence strains (Bb 9001, Bb9024 and Bb9119), the mixture of these three, and the high virulence strain Bb 9205. All the strains were exposed to UV-A radiation, followed by UV-B and visible light by 15 min. periods. A higher percentage of resistance to UV light was found in the strain Bb 9205 compared to the mixture of low virulence strains, which is perhaps favoring the Bb 9205 strain under field conditions. On the other hand, the mixture showed a high potential because a lower concentration of spores is required to cause the highest mortality. A good formulation of this mixture will improve its field UV resistance and also virulence. This work has been co-financed by the Ministry of Agriculture and Rural Development of Colombia.

Contributed Paper - Thursday, 17:45 171

Biological control of Asian corn borer using *Wolbachia* infected line of *Trichogramma dendrolimi* and its evaluation.

Bin Cong - Laboratory for Biological Control, Shenyang Agricultural University, Shenyang, Liaoning, China ; ***Xihua Wang*** - Laboratory for Biological Control, Shenyang Agricultural University, Shenyang, Liaoning, China ; ***Haiyan Zhang*** - Laboratory for Biological Control, Shenyang Agricultural University, Shenyang, Liaoning, China ; ***Haitao Qian*** - Laboratory for Biological Control, Shenyang Agricultural University, Shenyang, Liaoning, China ; ***Hui Dong*** - Laboratory for Biological Control, Shenyang Agricultural University, Shenyang, Liaoning, China
Address for correspondence: bin1956@163.com

One new line was created by mean of horizontal transmission of a symbiont, *Wolbachia* from the donate wasp of *Trichogramma embryophagum* to the receptor wasp of *T. dendrolimi*. The reproduction pattern of *T. dendrolimi* was converted from arrhenotoky to thelytoky. A series trial was carried out to test the possibility to apply the new line in commercial mass-rearing and biological control. The comparison of the fecundity, developmental duration, Genetic stability, survival rate and dispersion, bionomics and ecological effects between the thelytokous line and the non-thelytokous line was conducted. The result showed that the tested trait was most similar; no significant difference was observed. A field release trial compared for two lines in 2007 and 2008, respectively, no significant difference was observed, again. These results imply that the thelytokous *T. dendrolimi* is a good prospect for the biological control of the asian corn borer (*Ostrinia furnacalis*) in northern China, where the *T.dendrolimi* had been released consistently on a large scale for over thirty years. The cost of mass rearing *Trichogramma* will be reduce by 20-30 percent if no male thelytoky line in used.