Insecticides

NPARR, 8(2), 2017-321 Methylamine-modified graphene-based solid phase extraction combined with UPLC-MS/MS for the analysis of neonicotinoid insecticides in sunflower seeds

In this paper, methylamine modified graphene (CH$_3$NH$_2$-G) was synthesized and used as solid-phase extraction (SPE) sorbent to cleanup the acetonitrile extract of sunflower seeds for the determination of neonicotinoid insecticides by UPLC-MS/MS. The effects of the type of extraction solvent, pH, the amount of CH$_3$NH$_2$-G sorbent as well as the type and volume of eluent on the extraction efficiency were evaluated. Good linearity was obtained for the analytes with coefficient of determination ($R^2$) in the range of 0.9986–0.9998. LOD (S/N=3) and LOQ (S/N=10) were below 6 and 20 ng kg$^{-1}$, respectively. Method recoveries were between 74.3% and 119.1%. Relative standard deviations (RSD) for eight replicate determinations were in the range of 1.7–2.9%. The proposed method has been applied to the analysis of 3 kinds of sunflower seed samples from local market [Shi, Z., Zhang, S., Huai, Q., Xu, D. and Zhang, H* (College of Chemistry and Environmental Science, Hebei University, Baoding, China) Talanta, 2017, 162, 300-308].

NPARR, 8(2), 2017-322 Effects of insecticides used against the European corn borer on thrips abundance on maize

The effect of a single chemical treatment against Ostrinia nubilalis (Hbn.) on thrips abundance on maize in south-eastern Poland was evaluated. Two insecticides: Karate Zeon 050 CS, containing lambda-cyhalothrin, and Proteus 110 OD, containing thiacloprid with deltamethrin, were tested. Maize was sprayed in the second ten days of July, during the abundant occurrence of O. nubilalis larvae, which coincided with the population peak of thrips on plants. The tested active substances showed high effectiveness against thrips, but a better effect, reflected in a decrease in thrips abundance, was found for the mixture of thiacloprid with deltamethrin. The tested insecticides significantly reduced the population of thrips for up to 14 days after treatment [Bereś P.K*., Kucharzyk H. and Górski D (Regional Experimental Station, Institute of Plant Protection – National Research Institute, Rzeszów, Poland) Plant Protection Science, 2017, 53(1), 44–49].

NPARR, 8(2), 2017-323 Toxicity of insecticides to Chrysodeixis includens and their direct and indirect effects on the predator Blaptostethus pallescens

The soybean looper Chrysodeixis includens (Lepidoptera: Noctuidae) is a pest of the soybean, and increasing populations have been observed on several crops in Brazil. Control of this pest is accomplished using insecticides, particularly with new products recently launched in the market. The effectiveness of these insecticides against C. includens and their impact on natural enemies need further study. Therefore, this study aimed to determine the toxicity of nine insecticides for C. includens and their effects on the Blaptostethus pallescens. Toxicity was increased via the addition of an insecticide synergist, and behavioural changes in Blaptostethus pallescens, an anthocorid predator of C. includens, were assessed. Except for acephate, all other insecticides showed high toxicity to C. includens (mortality >80%). The estimated lethal time (LT$_{50}$) for C. includens was shorter for methomyl, cartap and spinosad than others six insecticides tested in this work. Chlorantraniliprole, chlorfenapyr, deltamethrin, flubendiamide, indoxacarb and spinosad showed selectivity for the predator B. pallescens and exhibited a lower toxicity to the predator than to C. includens. The detoxifying enzymes monooxygenase and glutathione S-transferase may be involved in the selectivity mechanisms of these insecticides for the predator based on the results obtained with the synergized insecticides. Only the insecticides cartap,
In the study, indoxacarb and spinosad changed the behaviour of the predator *B. pallescens*. These three insecticides are repellent, and the predator avoids them. However, the predator tended to remain on the surface treated with flubendiamide longer. Our results suggest that the insecticides chlorfenapyr, chlorantraniliprole, flubendiamide, spinosad and indoxacarb are the most promising compounds for use against *C. includens*. These compounds also preserve populations of *B. pallescens* and allow more sustainable integrated pest management programmes.

**References**


NPARR, 8(2), 2017-325 Selectivity of insecticides used in peach farming to larvae of *Chrysoperla externa* (Neuroptera: Chrysopidae) in semi-field conditions

The selectivity of five insecticides, regularly used in peach farming, was assessed for larvae of the predator *Chrysoperla externa* (Hagen) (Neuroptera: Chrysopidae) by means of bioassay in semi-field conditions. The bioassay was based on the counting of captured larvae after release in peach trees treated with the insecticides (% of active ingredient in spray liquid): deltamethrin (0.001), fenthion (0.050), phosmet (0.100), lufenuron (0.005) and malathion (0.200). Bait-cards with eggs of *Anagasta kuehniella* (Zeller) (Lepidoptera: Pyralidae) were used to capture larvae from treated plants; five of them were fixed in plant canopy and five others left on the soil around stem. A protective barrier made up of galvanized steel sheet was used for each plant to avoid loss of larvae. The number of larvae feeding on the bait-cards was measured for four days. According to the number of captured larvae, each insecticide effect was estimated and classified into toxicity categories as stated by the International Organization for Biological and Integratec Control of Noxious Animals and Plants (IOBC). Based on observations, the insect growth regulator lufenuron was harmless, while the neurotoxins deltamethrin and malathion were slightly harmful; and lastly, fenthion and phosmet were moderately harmful to *C. externa* larvae in semi-field conditions. Thus, lufenuron should be recommended for integrated pest management, since it would preserve this predator species in peach orchards.

**References**

Castilhos, R.V.*, Grützmacher, A.D., das Neves, M.B., de Moraes, Í.L. and...

NPARR, 8(2), 2017-326 Mating behaviour and reproductive output in insecticide-resistant and -susceptible strains of the maize weevil (*Sitophilus zeamais*)

Insecticide resistance is a broadly recognised and well-studied management problem resulting from intensive insecticide use, which also provides useful evolutionary models of newly adapted phenotypes to changing environments. Two common assumptions in such models are the existence of fitness costs associated with insecticide resistance, which will place the resistant individuals at a disadvantage in insecticide-free environments, and the prevalence of random mating among insecticide-resistant and -susceptible individuals. However, cases of insecticide resistance lacking apparent fitness disadvantages do exist impacting the evolution and management of insecticide resistance. Assortative mating, although rarely considered, may also favour the evolution and spread of insecticide resistance. Thus, the possible existence of both conditions in the maize weevil (*Sitophilus zeamais*), a key pest of stored cereals, led to the assessment of the mating behaviour and reproductive fitness of insecticide-resistant and -susceptible weevil strains and their reciprocal crosses. The patterns of female and male mating choice also were assessed. Although mating behaviour within and between weevil strains was similar without mate choice, mating within the resistant strain led to higher reproductive output than within the susceptible strain; inter-strain matings led to even higher fertility. Thus, no apparent fitness cost associated with resistance seems to exist in these weevils, favouring the evolution of this phenotype that is further aided by the higher fertility of inter-strain matings. Mate choice reduced latency to mate and no inter-strain preference was detected, but female weevils were consistent in their mate selection between 1st and 2nd matings indicating existence of female mating preference among maize weevils. Therefore, if female mate selection comes to favour trait(s) associated with insecticide resistance, higher reproductive fitness will be the outcome of such matings favouring the evolution and spread of insecticide resistance among maize weevil populations reverting into a management concern [Guedes, N.M.P., Guedes, R.N.C*., Campbell, J.F. and Throne, J.E (Departamento de Entomologia Universidade Federal de Viçosa Viçosa Brazil) Annals of Applied Biology, 2017].

NPARR, 8(2), 2017-327 Croatian diatomites and their possible application as a natural insecticide

In recent decades, there has been an increase in the use of diatomaceous earth (DE) as a natural insecticide because of its low mammalian toxicity, worker safety, low risk of food residues and the occurrence of resistant insect populations associated with the use of chemical insecticides. Therefore there is potential for research into known but previously undescribed Croatian mid-Miocene marine diatomites from the perspective of their potential as proper DE that could be mixed with plant extracts as a new formulation for grain storage protection. The marine diatomites belong to the Paratethyan near shore environment, deposited in the upwelling zone during a mid-Miocene temperate climate. Palaeontological, mineral and geochemical analyses were done on ten promising marly sediments from 26 outcrops and one borehole from the North Croatian Basin. The most important ingredient of diatomaceous sediments is silica (biogenic opal-A and SiO2 bound in other silicate minerals including quartz, clay minerals, micas, etc.). The amorphous silica content of the tested *Croatian diatomites* is relatively low (< 70%) in comparison with the
DE MN-51 standard (medium to high efficient DE) (73.6%), nevertheless they show in some part even slightly better efficacy against insects. It seems that the enhanced content of smectite in diatomaceous sediments also influences increased absorption of DE. Based on palaeontological results, the most efficient diatomites from the Podsusedsko Dolje and Markuševec (Medvednica Mt.) consist of the mid-sized planktonic Coscinodiscus group of species where *Thalassionema nitzschioides* dominate and is positively correlated with their absorption. The usage of Boström's standard formula for getting opal-A from geochemical data was abandoned because of negative results and the modified Murdmaas’ formula for hemipelagic sediments was applied. Preliminary results on the aforementioned diatomite (as inert dusts) show good efficacy against tested insects *Sitophilus oryza* [Galović, I*., Halamić, J., Grizelj, A., Rozman, V., Liška, A., Korunić, Z., Lucić, P. and Baličević, R. (Croatian Geological Survey, Department of Geology, Sachsova 2, Zagreb, Croatia) *Geologia Croatica*, 2017, 70(1), 27-39].

**NPARR, 8(2), 2017-328**  
Endosulfan inducing apoptosis and necroptosis through activation RIPK signaling pathway in human umbilical vascular endothelial cells

Endosulfan, an organochlorine pesticide, was found in human blood, and its possible cardiovascular toxicity has been suggested. However, the mechanism about endothelial cell injuries induced by endosulfan has remained unknown. In the present study, human umbilical vein endothelial cells (HUVECs) were chosen to explore the toxicity mechanism and were treated with 0, 1, 6, and 12 μg/mL−1 endosulfan for 24 h, respectively. The results showed that exposure to endosulfan could inhibit the cell viability, increase the release of lactate dehydrogenase (LDH), damage the ultrastructure, and lead to apoptosis and necroptosis in HUVECs. Furthermore, endosulfan upregulated the expressions of receptor-interacting protein kinase 1 (RIPK1), receptor-interacting protein kinase 3 (RIPK3), mixed lineage kinase domain-like (MLKL), caspase 8, and caspase 3, which means the activation of RIPK1 pathways. In addition, endosulfan promoted the increases of ROS, IL-1α, and IL-33 levels while antioxidant N-acetyl-l-cysteine (NAC) effectively attenuated the cytotoxicity from endosulfan. Taken together, these results have demonstrated that endosulfan induces the apoptosis and necroptosis of HUVECs, where the RIPK pathway plays a pro-necrotic role and NAC plays an anti-necrotic role. Our results may contribute to understanding cellular mechanisms for endosulfan-induced cardiovascular toxicity [Zhang, L., Wei, J., Ren, L., Zhang, J., Yang, M., Jing, L., Wang, J., Sun, Z. and Zhou, X* (Department of Toxicology and Hygienic Chemistry, School of Public Health, Capital Medical University, Beijing, China) *Environmental Science and Pollution Research*, 2017, 24(1), 215-225].
oil displayed fumigant toxicity against booklice, with a median lethal concentration (LC$_{50}$) of 507.35 µg/L while the isolated constituents, borneol and 4-terpineol, had LC$_{50}$ values of 2.20 mg/L and 335.24 µg/L against booklice, respectively. The essential oil also exhibited contact toxicity against L. bostrychophila with an LC$_{50}$ value of 210.73 µg/cm$^2$. Borneol, caryophyllene oxide, β-cedrene, and 4-terpineol showed acute toxicity against booklice with LC$_{50}$ of 98.04, 84.62, 458.79 and 211.35 µg/cm$^2$, respectively. Conclusion: The results suggest that the essential oil and its isolates possess potential for cultivation into natural insecticides or fumigants, for control of insects in stored grains [Li, H.Y., Chen, X.B., Liu, Q.Z. and Liu, Z.L* (Department of Entomology, China Agricultural University, 2 Yuanmingyuan West Road, Haidian District, Beijing, China) Tropical Journal of Pharmaceutical Research, 2017, 16(1), 171-177].

NPARR, 8(2), 2017-330 Beauveria bassiana (Clavicipitaceae): a potent fungal agent for controlling mosquito vectors of Anopheles stephensi, Culex quinquefasciatus and Aedes aegypti (Diptera: Culicidae)

Mosquitoes are the carriers of severe and well-known illnesses such as malaria, arboviral encephalitis, dengue, chikungunya and yellow fever, which cause significant morbidity and mortality in humans and domestic animals around the world. Entomopathogenic fungal metabolites act as a mosquito control agent and are potential alternatives to chemical control because they can be innovative and more selective than chemical insecticides. The main aim of the present study was to perform experiments on the larvicidal and pupicidal effects of the entomopathogenic fungus Beauveria bassiana (isolated from infected grasshopper) against the first to fourth instar larvae of Anopheles stephensi, Cx. quinquefasciatus and Aedes aegypti. The larval and pupal mortality were observed after 24 h of exposure. The efficacy of an ethyl acetate mycelium extract at all the tested concentrations (50, 100, 150, 200, 250 and 300 µg mL$^{-1}$) exhibited better activity against the 1$^{st}$ to 4$^{th}$ instar larvae of An. stephensi (LC$_{50}$ = 42.82, 39.45, 25.72, and 32.66; LC$_{90}$ = 254.67, 367.11, 182.27, and 199.20 µg mL$^{-1}$), Cx. quinquefasciatus (LC$_{50}$ = 72.38, 68.11, 27.06, and 35.495; LC$_{90}$ = 481.68, 254.69, 129.83, and 146.24 µg mL$^{-1}$) and Ae. aegypti (LC$_{50}$ = 62.50, 52.89, 58.60, and 47.12; LC$_{90}$ = 314.82, 236.18, 247.53, and 278.52 µg mL$^{-1}$), respectively. The pupicidal activity of the fungal mycelium extracts was tested against An. stephensi, Cx. quinquefasciatus and Ae. Aegypti, where the ethyl acetate extracts had different LC$_{50}$ values (LC$_{50}$ = 40.66, 54.06, 44.26, and LC$_{90}$ = 184.02, 225.61, and 263.02 µg mL$^{-1}$). Based on Fourier transform infrared spectroscopy (FTIR) analysis and gas chromatography-mass spectrometry (GC-MS) analyses, the ethyl acetate mycelium extract contained six major chemical compounds identified as 9,12-octadecadienoic acid (ZZ)- (63.16%), n-hexadecanoic acid (21.28%), octadecanoic acid, phenyl methyl ester (10.45%), dehydroegosterol 3,5-dinitrobenzoate (1.86%), squalene (1.66%) and bis[3-(3,5-di-tert-butyl-4-hydroxyphenyl)propyl] maleate (1.56%). The n-hexadecanoic acid standard was found to be better larvicidal against An. stephensi, Cx. quinquefasciatus, followed by Ae. aegypti. The HPLC analysis of the ethyl acetate mycelium extract was compared with that of the n-hexadecanoic acid standard and it was found to show a similar chromatographic peak (at a retention time of 3.383 and 3.378 min). The outcome of the present study identifies the bioactive compounds obtained from B. bassiana that can be used as effective and alternate larvicidal and pupicidal agents against the An. stephensi Cx. quinquefasciatus and Ae. aegypti mosquito vectors [Ragavendran, C., Dubey, N.K. and Natarajan, D* (Natural Drug Research Laboratory, Department of Biotechnology, School of Biosciences, Periyar University, Salem,Tamil Nadu, India) RSC Advances, 2017, 7(7), 3838-3851].
Fungicide and insecticide residues in rice grains

The objective of this study was to analyse residues of fungicides and insecticides in rice grains that were subjected to different forms of processing. Field work was conducted during three crop seasons, and fungicides and insecticides were applied at different crop growth stages on the aerial portion of the rice plants. Azoxystrobin, difenoconazole, propiconazole, tebuconazole, and trifloxystrobin fungicides were sprayed only once at the R2 growth stage or twice at the R2 and R4 growth stages; cypermethrin, lambda-cyhalothrin, permethrin, and thiamethoxam insecticides were sprayed at the R2 growth stage; and permethrin was sprayed at 5-day intervals from the R4 growth stage up to one day prior to harvest. Pesticide residues were analysed in uncooked, cooked, parboiled, polished and brown rice grains as well as rice hulls during the three crop seasons, for a total of 1,458 samples. The samples were analysed by gas chromatography with electron capture detection (GC-ECD) using modified QuEChERS as the extraction method. No fungicide or insecticide residues were detected in rice grain samples; however, azoxystrobin and cypermethrin residues were detected in rice hull samples [Teló, G.M*., Marchesan, E., Zanella, R., Peixoto, S.C., Prestes, O.D. and de Oliveira, M.L* (Grupo de Pesquisa em Arroz Irrigado, Departamento de Fitotecnia, Universidade Federal de Santa Maria, Santa Maria, Rio Grande do Sul, Brazil) Acta Scientiarum - Agronomy, 2017, 39(1), 9-15].

Effects of bund crops and insecticide treatments on arthropod diversity and herbivore regulation in tropical rice fields

Ecological engineering using vegetable or flower strips is promoted as a potential pest management strategy in irrigated rice. Farmers in the Philippines often plant rice levees (bunds) with vegetables, particularly string beans (Vigna unguiculata [L.] Walpers) to supplement income, but without considering the potential for pest management. This study examines the effects of planted bunds on rice herbivores and their natural enemies. We compared arthropods in (a) rice fields that had string beans planted on bunds, (b) fields without string beans and without any insecticide applications and (c) fields without string beans but with insecticide treatments (standard practice). Rice yield was similar across all treatments; however, the vegetation strips produced an extra 3.6 kg of fresh string bean pods per metre of bund. There were no apparent increases in major natural enemy groups in fields with string beans compared to fields with conventional bunds. Fields with insecticide treatments had higher damage from leaffolders (Lepidoptera: Pyralidae). The sprayed fields also had lower parasitism of planthopper eggs and fewer predatory dragonflies and damselflies (Odonata). Furthermore, the mortality of planthopper (Delphacidae: Hemiptera) and stemborer (Pyralidae) eggs by parasitoids and predators was density dependent only in the unsprayed fields (with and without string beans). Our results demonstrate that planting string beans on rice bunds improves the productivity of rice farms, but our ecological engineering system did not appreciably affect natural enemy or herbivore abundance; however, chemical insecticides adversely affected pest regulatory ecosystem functions leading to higher pest damage [Horgan, F.G*, Ramal, A.F., Villegas, J.M., Jamoralín, A., Bernal, C.C., Perez, M.O., Pasang, J.M., Naredo, A.I. and Almazán, M.L.P (Centre for Compassionate Conservation University of Technology Sydney Sydney, NSW Australia) Journal of Applied Entomology, 2017, doi: 10.1111/jen.12383].

Mode of action of the natural insecticide, decaleside involves sodium pump inhibition

Decalesides are a new class of natural insecticides which are toxic to insects by contact via the tarsal gustatory chemosensilla. The
symptoms of their toxicity to insects and the rapid knockdown effect suggest neurotoxic action, but the precise mode of action and the molecular targets for decaleside action are not known. We have presented experimental evidence for the involvement of sodium pump inhibition in the insecticidal action of decaleside in the cockroach and housefly. The knockdown effect of decaleside is concomitant with the in vivo inhibition of Na\(^+\), K\(^+\)-ATPase in the head and thorax. The lack of insecticidal action by experimental ablation of tarsi or blocking the tarsal sites with paraffin correlated with lack of inhibition of Na\(^+\)-K\(^+\)-ATPase in vivo. Maltotriose, a trisaccharide, partially rescued the toxic action of decaleside as well as inhibition of the enzyme, suggesting the possible involvement of gustatory sugar receptors. In vitro studies with crude insect enzyme preparation and purified porcine Na\(^+\), K\(^+\)-ATPase showed that decaleside competitively inhibited the enzyme involving the ATP binding site. Our study shows that the insecticidal action of decaleside via the tarsal gustatory sites is causally linked to the inhibition of sodium pump which represents a unique mode of action. The precise target(s) for decaleside in the tarsal chemosensilla and the pathway linked to inhibition of sodium pump and the insecticidal action remain to be understood [Rajashekar, Y. and Shivanandappa, T* (Department of Food Protectants and Infestation Control, CSIR-Central Food Technological Research Institute, Mysore, Karnataka, India) PLoS ONE, 2017, 12(1), e0170836].

NPARR, 8(2), 2017-334 Evaluation of the efficacy of insecticidal coatings based on teflutilrin and chlorpyrifos against Rhynchophorus ferrugineus

Background: The date palm (Phoenix dactylifera L.), an important economic resource for many nations worldwide, has recently been threatened by the presence of different insect pests, like the red palm weevil (RPW) Rhynchophorus ferrugineus. Results: Two products, glue (polyvinyl acetate) and oil (raw linseed oil) were used as coatings and applied together with a repellent and two insecticides (teflutrin and chlorpyrifos) at different dosages on two species of palm (P. dactylifera and P. canariensis). Phytotoxic effects of the treatments were evaluated in a greenhouse on 260 potted palms (130 P. dactylifera and 130 P. canariensis) and no negative effects were observed. Afterwards, a trial lasting 400 days was carried out in a nursery located in Sicily (south Italy), treating 572 potted palm trees (286 P. dactylifera and 286 P. canariensis) with an average diameter at the base of 18-20 cm. After 400 days, 48% of the untreated palms were infested, while only 3% of date palms and 7% of Canary palms treated with insecticide at lower dosages were infested. Conclusions: The application of an insecticide-based coating is a good strategy to control and prevent the red palm weevil infestation, in particular on date palms [Pugliese, M*., Rettori, A.A., Martinis, R., Al-Rohily, K., Velate, S., Moideen, M.A. and Al-Maashi, A (AgriNewTech srl and University of Torino Turin Italy) Pest Management Science, 2017, doi: 10.1002/ps.4527].

NPARR, 8(2), 2017-335 Toxicity of butene-fipronil, in comparison with seven other insecticides, in Leptinotarsa decemlineata and Drosophila melanogaster

The speed of toxic action of an insecticide is an indicator for control efficacy and has considerable practical importance. For agricultural pest control, fast-acting is an important feature for an insecticide to consistently reduce the amount of feeding damage. Butene-fipronil is a novel compound obtained via the structural modification of fipronil. However, information about the toxicity and speed of toxic action is still limited. In the present paper, we compared the toxic feature of butene-fipronil with seven other insecticides, of which imidacloprid and abamectin are slow-acting insecticides, and acephate, endosulfan, methomyl, α-cypermethrin and spinosad are fast-acting insecticides. We found that the contact
and stomach toxicities of butene-fipronil were among the highest ever estimated to *Leptinotarsa decemlineata* and *Drosophila melanogaster*. The speed of toxic action of butene-fipronil was determined using median lethal time (LT50) at a dose (concentration) equivalent to LD50 values. For *L. decemlineata*, the values for butene-fipronil, imidacloprid, abamectin, acephate, endosulfan, methomyl, cypermethrin and spinosad were calculated to be 39.9, 36.5, 37.5, 20.2, 22.4, 23.8, 16.4 and 23.1 h, respectively. Those for *D. melanogaster* were 29.8, 31.5, 29.4, 14.0, 20.3, 18.1, 13.5, and 20.1 h, respectively. ANOVA analysis showed that butene-fipronil, imidacloprid, abamectin had similar LT50 values, whereas acephate, endosulfan, methomyl, spinosad and cypermethrin had comparable LT50 values. Thus, butene-fipronil belongs to slow-acting insecticides. Our results provide more empirical information for butene-fipronil potential application [Arain, M.S*., Wan, P.-J., Shakeel, M., Farooq, M., Hu, X.-X., Shah, S.A.H., Elzaki, M.E.A. and Li, G.-Q (Education Ministry Key Laboratory of Integrated Management of Crop Diseases and Pests, College of Plant Protection, Nanjing Agricultural University, Nanjing, China) Phytoparasitica, 2017, 45(1), 103-111].

**NPARR, 8(2), 2017-336 Insecticidal activity of plant-derived extracts against different economically important pest insects**

With the aim of selecting potential botanical insecticides, seven plant extracts (*Daphne mucronata* (Family: Thymelaeaceae), *Tagetes minuta* (Asteraceae), *Calotropis procera* (Apocynaceae), *Boeninghausenia albiflora* (Rutaceae), *Eucalyptus sideroxylon* (Myrtaceae), *Cinnamomum camphora* (Lauraceae) and *Isodon rugosus* (Lamiaceae)) were screened for their toxic effects against four important agricultural pest insects, each representing a separate insect order; pea aphids of *Acrithosiphon pisum* (Hemiptera), fruit flies of *Drosophila melanogaster* (Diptera), red flour beetles of *Tribolium castaneum* (Coleoptera), and armyworms of *Spodoptera exigua* (Lepidoptera). Aphids were the most susceptible insect with 100% mortality observed after 24 h for all the plant extracts tested. Further bioassays with lower concentrations of the plant extracts against aphids, revealed the extracts from *I. rugosus* (LC50 36 ppm and LC90 102 ppm) and *D. mucronata* (LC50 126 ppm and LC90 198 ppm) to be the most toxic to aphids. These most active plant extracts were further fractionated into different solvent fractions on polarity basis and their insecticidal activity evaluated. While all the fractions showed considerable mortality in aphids, the most active was the butanol fraction from *I. rugosus* with an LC50 of 18 ppm and LC90 of 48 ppm. Considering that high mortality was observed in aphids within 24 h of exposure to a very low concentration of the butanol fraction from *I. rugosus*, we believe this could be exploited and further developed as a potential plant-based insecticide against sucking insect pests, such as aphids [Khan, S., Taning, C.N.T., Bonneure, E., Mangelinckx, S., Smagghe, G. and Shah, M.M* (Biotechnology Program, Department of Environmental Sciences, COMSATS Institute of Information Technology, University Road, Abbottabad, Pakistan) Phytoparasitica, 2017, 45(1), 113-124].

**NPARR, 8(2), 2017-337 Insecticidal activity of sesquiterpene lactones and monoterpenoid from the fruits of *Carpesium abrotanoides***

The isolation of secondary metabolites produced by plants can lead to the discovery of new insecticidal agents. The aim of this study was to identify secondary metabolites from the fruits of *Carpesium abrotanoides*, a well-known medicinal and poisonous plant belonging to the family Asteraceae, with the potential to act as natural insecticides. Two new sesquiterpene lactones 9β-hydroxy-1βH, 11αH-guaia-4,10(14)-dien-12,8α-olide (1) and 9β-hydroxy-1βH, 11βH-guaia-4,10(14)-dien-12,8α-olide (2) along with four known sesquiterpene lactones (3-6) and one monoterpenoid (7) have been isolated. The structures of these compounds were established...
on the basis of 1D and 2D NMR data and HRESIMS data interpretation. To characterize their insecticidal activities, bioassays were conducted using two insect pest species of agricultural importance. Compounds 1–7 showed antifeedant effects to 3rd instar larvae of *Plutella xylostella* (Lepidoptera: Plutellidae) in a concentration-dependant manner with EC$_{50}$ of 19.84, 42.82, 97.94, 96.90, 39.94, 37.35 and 43.99 mg/L, respectively. Moreover, all of these compounds display stomach-contact combination toxicity toward 4th instar larvae of *Bradysia odoriphaga* Yang and Zhang (Diptera: Sciaridae) (LD$_{50}$ = 18.71, 80.29, 230.65, 319.67, 31.18, 40.87 and 68.47 mg/L, respectively). In general, this is the first report of insecticidal activities of secondary metabolites isolated from *C. abrotanoides*. Moreover, compound 1 showed the best insecticidal activity in the test, demonstrating its potential to be used as a natural insecticide [Wu, H.-B., Wu, H.-B., Wang, W.-S*, Liu, T.-T., Qi, M.-G., Feng, J.-C., Li, X.-Y. and Liu, Y (College of Life and Environmental Sciences, Minzu University of China, Beijing, China) Industrial Crops and Products, 2016, 92, 77-83].

**NPARR**, 8(2), 2017-338 *A comparison of the effectiveness of insecticides in constant and variable thermal conditions*

The effectiveness of insecticides differs with changes in temperature, but insecticide toxicities are determined at constant temperatures. Constant thermal conditions do not occur in the field, where insects can change their behaviors to achieve a preferred temperature. The aim of this study was to assess whether the choice of ambient temperature affects the mortality rate of intoxicated firebugs and Colorado potato beetles. The insects’ mortality following insecticide exposure was monitored at constant temperatures (15, 25, and 35 $^\circ$C) as well as in a thermal gradient system, where the insects could freely select their preferred ambient temperature. Firebugs treated with oxadiazine showed 58% higher mortality when held at a constant temperature post-treatment compared to mortality levels seen when able to choose a preferred temperature in a thermal gradient. Similar results were seen in Colorado potato beetles treated with oxadiazine (15%–33% higher mortality in constant vs. preferred temperature) or organophosphate (36% higher mortality in constant vs. preferred temperature). The insects’ ability to mitigate the impacts of pesticide exposure by selecting more beneficial thermal conditions is an important consideration for pest management. Therefore, the application rates of insecticides used under field conditions should be additionally analyzed to take this factor into account [Maliszewska, J* and Tęgowska, E (Department of Animal Toxicology, Faculty of Biology and Environment Protection, Nicolaus Copernicus University, Toruń, Poland) International Journal of Pest Management, 2016, dx.doi.org/10.1080/09670874.2016.1267818].

**NPARR**, 8(2), 2017-339 *Larvicidal and insecticidal effect of Cinnamomum zeylanicum oil (pure and nanostructured) against mealworm (Alphitobius diaperinus) and its possible environmental effects*

The aim of this study was to evaluate the *in vitro* susceptibility of larva and adult forms of *Alphitobius diaperinus* treated with cinnamon (*Cinnamomum zeylanicum*) essential oil on its free form, nanoemulsion (NE), and nanocapsule (NC), as well as the effect of these treatments on the edaphic fauna using springtails of *Folsomia candida* (ISO) as a model. The tests with larvae and adults were performed using 1, 5, and 10% of the cinnamon essential oil, and 0.5, 1, and 5% of NE and NC containing 5% of cinnamon essential oil. To validate the test, three controls were used: only oil diluent (Triton), blank nanoemulsion (without oil) and blank nanocapsule (without oil). Cinnamon essential oil at 5 and 10% caused mortality in larva and adult forms of *A. diaperinus*. The NE (1%) and NC (5%) caused mortality in both phases of *A. diaperinus* life cycle. After these promising findings, more
studies were conducted to verify the ecotoxicological effect of the cinnamon oil. For this, a Tropical Artificial Soil (TAS) was used with different doses of cinnamon oil, NE and NC, using springtails of *F. candida*. The use of cinnamon oil, even in very low concentrations (25 mg kg$^{-1}$), on its original form significantly affected springtails survival and reproduction. However, the nanostructuring process seemed to minimize this toxic effect without affecting its insecticidal action. In summary, the pure oil and NE containing cinnamon oil showed effect against *A. diaperinus*, and may be considered an alternative to control this infestation [Volpato, A., Baretta, D., Zortéa, T., Campigotto, G., Galli, G.M., Glombowsky, P., Santos, R.C.V., Quatrin, P.M., Ourique, A.F., Baldissera, M.D., Stefani, L.M. and Da Silva, A.S* (Department of Animal Science, Universidade do Estado de Santa Catarina (UDESC), Chapecó, SC, Brazil) *Journal of Asia-Pacific Entomology*, 2016, 19(4), 1159-1165].