

Progress

towards characterisation of pheromones of the two-spotted stink bug (*Bathycoelia distincta*)

Elisa Pal, Brett Hurley, Bernard Slippers and Gerda Fourie (Forestry and Agricultural Biotechnology Institute (FABI), University of Pretoria)

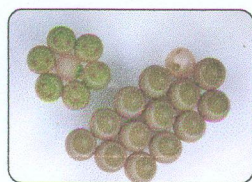
The native stink bug species *Bathycoelia distincta* (two-spotted stink bug) is the dominant stink bug in South African macadamia orchards (Schoeman 2009, 2013, 2018). It was first detected on macadamia during the spring of 1984 in the Limpopo province (Levubu) and has since become a serious pest for the macadamia industry. The seasonal occurrence (Schoeman 2009, 2013) and parameters that affect the distribution and dispersal behaviour (Schoeman 2014a) have been determined, and an Integrated Pest Management (IPM) strategy implemented (Schoeman 2014b). Nevertheless, fundamental information on the biology of *B. distincta*, required for efficient management of this pest, is still lacking. This includes characterising the semiochemicals of this insect.

The colony was established in November 2018 with egg patches collected from commercial orchards. The colony is maintained at the FABI Biological Control Centre of the University of Pretoria and more than ten generations have been obtained to

date. Under laboratory-controlled conditions ($25 \pm 2^\circ\text{C}$, $20 \pm 5\%$ relative humidity (RH), 16L:8D photoperiod) up to eight generations per year can be obtained. Similar to other *Hemiptera*, the development is hemimetabolous and consists of an egg, nymph and adult stage

A hemimetabolous insect does not have a pupal stage when developing into an adult.

Egg ready to hatch



Fresh egg

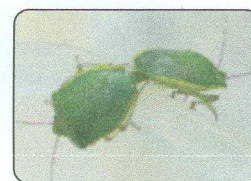
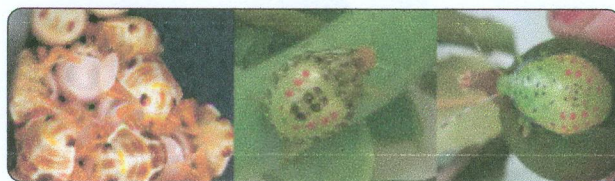


Figure 2. Lab-reared *B. distincta* population.

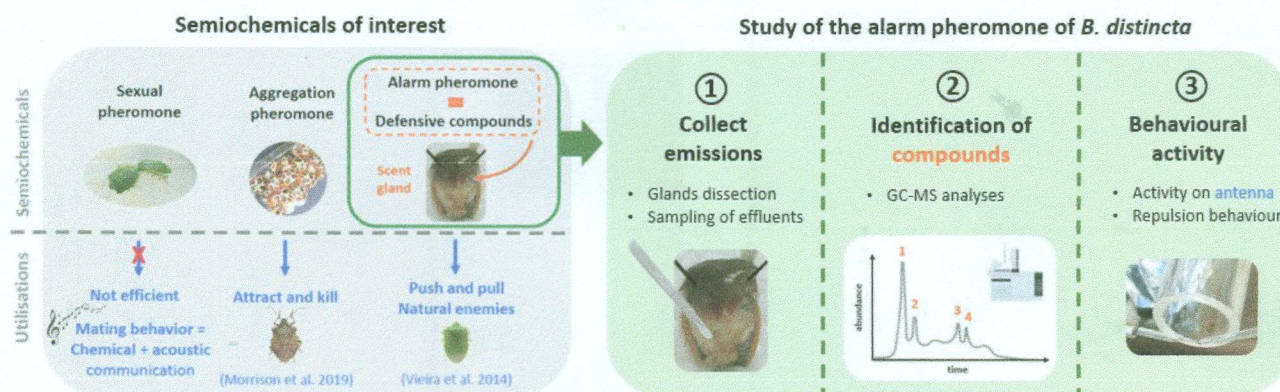


Figure 3. The identification and testing of alarm pheromones of the two-spotted stink bug.

Using semiocemicals to manage pests

The utilisation of semiocemicals for management is well-known, especially for lepidopteran pests, where sex pheromones are used for monitoring and/or mating disruption (Witzgall et al. 2010). Stink bugs, however, have complex mating behaviour, and trapping by means of a sex pheromone may not be useful. Pentatomids produce an alarm and aggregation pheromone and this can provide an alternative tactic for Integrated Pest Management. This strategy has been used for other stink bug species in various countries (Morrison 2019, Vieira 2014). Characterisation of *B. distincta* semiocemicals is therefore one of the main research focus areas of the Macadamia Protection Programme, based at the Forestry and Agricultural Biotechnology Institute (FABI), University of Pretoria.

Semiocemicals can be defined as chemical signal vehicles that carry information between organisms, for example pheromones.



In a recent study we characterised the alarm pheromone of *B. distincta* by analysing the gland contents of the species at different ages, and between male and female. In addition, we analysed the behavioural effect of each of the components present in their blends by electroantennography and a behavioural experiment. We extracted compounds by two methods, namely

directly by gland extractions and indirectly with live insects.

To investigate the pheromones and other biological characteristics of *B. distincta*, we needed to establish a lab-reared colony. Egg patches were collected from various commercial macadamia orchards and a *B. distincta* colony was established and maintained at FABI.

RESEARCHER
BIOGRAPHY

Dr Gerda Fourie



I was born and brought up in Mokopane, Limpopo Province, where I received my primary and secondary education. I graduated from the University of Pretoria with a BSc Microbiology and Plant Pathology and a BSc Honours Microbiology. I then worked at the Forestry and Agricultural Biotechnology Institute (FABI), University of Pretoria as a research assistant within the Banana Research Programme.

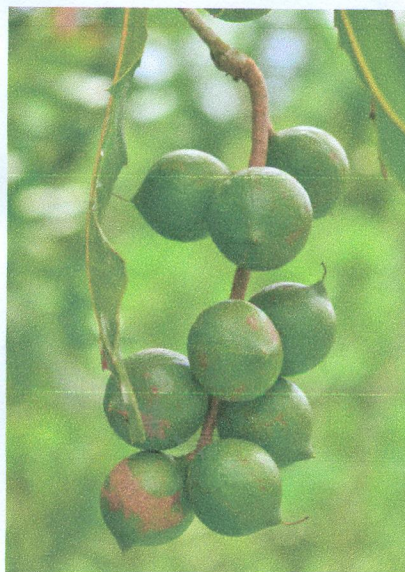
Working at this world-class research institute exposed me to the incredible research in the forestry and agricultural sectors and inspired me to do a PhD. In 2017, I was given the incredible opportunity to start a new chapter as the research leader of the FABI-Macadamia Protection Programme.

I really enjoy working with the macadamia industry and am passionate about the research being conducted in the programme. Our goal is to support the industry's knowledge regarding economically important pests and diseases to improve their management and the development of biological and natural control agents.

Our study revealed that the odour blend of males and females contained more than ten components of which four were shown to be main components. Similar compounds have also been characterised in other *Pentatomidae* species, which are promising in the view of management of this species. Future work will focus on determining the minimum blend of compounds that are essential and sufficient to elicit a response similar to the response elicited by live bugs, and we will then determine the optimal ratio and rate of components that are repellent under field conditions. Although much additional research is needed, these results have laid a foundation for the management of *B. distincta* in macadamia orchards with semiochemicals.

Acknowledgements

We acknowledge Macadamias South Africa NPC (SAMAC), the University of Pretoria (UP), the DSI-NRF Centre of Excellence in Plant Health Biotechnology (CPHB) and NRF Thuthuka for financial support. We also acknowledge Dr Elsje Joubert and numerous macadamia growers in the Levubu area for field visits and collection of egg patches. Finally, we acknowledge Dr Marc Bouwer for his contribution towards the establishment of a stink bug chemical ecology system at FABI. 🍷



References

- Morrison et al., 2019. Successful management of *Halyomorpha halys* (Hemiptera: Pentatomidae) in commercial apple orchards with an attract-and-kill strategy. *Pest Management Science* 75, 104-144.
- Rodrigues et al., 2014. Field evaluation of (E)-2-hexenal efficacy for behavioural manipulation of egg parasitoids in soybean. *Biocontrol* 59, 525-537.
- Schaefer and Panizzi, 2000. Heteroptera of economic importance. In C. W. Schaefer & A. R. Panizzi (Eds.).
- Schoeman, 2009. Key biotic components of the indigenous Tortricidae and Heteroptera complexes occurring on macadamia in South Africa (School of Environmental Sciences and Development North West University Potchefstroom Campus).
- Schoeman, 2013. Phytophagous stink bugs (Hemiptera: Pentatomidae; Coreidae) associated with macadamia in South Africa. *Open Journal of Animal Sciences*, 3, 179-183.
- Schoeman 2014a. Aspects affecting distribution and dispersal of the indigenous Heteroptera complex (Heteroptera: Pentatomidae & Coreidae) in South African macadamia orchards. *African Entomology*, 22, 191-196.
- Schoeman, 2014b. Stink bug IPM on macadamias in South Africa: Current status and the road ahead. *Trends in Entomology*, 10, 87-95.
- Schoeman, 2018. Relative seasonal occurrence of economically significant Heteropterans (Pentatomidae and Coreidae) on Macadamias in South Africa: Implications for Management. *African Entomology*, 26, 543-549.
- Witzgall, et al. 2010. Sex pheromones and their impact on pest management. *Journal of Chemical Ecology*, 36, 80-100.