OUTCOME SUMMARY OF PROJECT BSA 08-001

BSA 08-001: Studies on the effects of Bt maize on selected arthropods, amphibians and annelids

Project Leader: Prof. Johnnie van den Berg

Research Institution: North West University

Duration: 2 years

Summary of project

The effect of Bt maize on non-target organisms is not well understood and prior to this study, no research has been conducted in South Africa other than field monitoring of species diversity and abundance. The main aims of the project were to study the effects of Bt maize on non-target organisms, to investigate gene-flow between target pest populations and lastly to develop research capacity. Below you will find the main results of the research project, how it advanced our current knowledge and understanding of relevant biosafety issues and the how the outcomes of the project will impact on current biosafety policy and management practices.

PROJECT OUTCOMES

AIM 1: The effects of Bt maize on non-target organisms

Investigating the presence of lacewing predators in Bt maize fields and the impact of the consumption of the Bt protein on these predators showed that lacewing predator numbers were orders of magnitude higher in Bt maize fields than in the wild and seemingly not adversely affected. Research showed that no or low risk exists of adverse effects caused by exposure of lacewing predators to prey that feed on Bt maize and the development of resistant target pests does not adversely affect lacewing biology. On the effects of Bt maize on earthworms, research showed that no or low risk exists of adverse effects caused by exposure to Bt maize. Interestingly, termites showed no preference for Bt or non Bt maize leaves and the food removal rate was not affected. Studying the effects of Bt maize on tadpole development was inconclusive and warrants further research which is needed for the risk assessment of GMOs. Investigating the question whether the gut-microbes play a role in the resistance to Bt toxin led to protocol development and generation of baseline data on the biodiversity of and possible role of bacteria in resistance development. This resulted in a better understanding of factors that could play a role in insect resistance development.

AIM 2: Investigate gene-flow between target pest populations

DNA analyses was conducted to determine the level of relatedness and gene-flow between populations of the maize stem borer and to study the dominance or recessiveness of resistance in target pests. A laboratory experiment using crosses between resistant and susceptible populations showed that R was

dominant, information that will influence biosafety issues such as resistant management in the future and contribute significantly to biosafety policy issues both locally and internationally. Furthermore, this information will result in improved risk assessment before GM crop releases and management when pest populations develop resistance. Investigating gene-flow between target pest populations also led to protocol development for sampling. Collectively, this information leads to a better understanding of migration patterns of target pests and the rapid spread of resistance in South Africa.

AIM 3: Research Capacity Development

Funding for this project resulted in the completion of five degrees in total (2 BSc Honours degrees and 3 MSc degrees).

CONFERENCE PRESENTATIONS

Conference Name	**Title of Presentation**
16th Entomological Congress of the Entomological Society of southern Africa, Stellenbosch (South Africa) **5-7 July 2009**	Brink, D.E., Coetsee, M., Van den Berg, J. & Bezuidenhout, C.C. 2009. Mid-gut bacterial fauna in Bt-resistant and Bt-susceptible populations of the maize stem borer, *Busseola fusca* (Lepidoptera: Noctuidae) ***(Oral presentation)***
	Van den Berg, J., Kruger, M. & Van Rensburg, J.B.J. 2009. Perspective on the development of stem borer resistance to Bt maize and the refuge compliance in South Africa ***(Oral presentation)***
11th International Symposium on the Biosafety of Genetically Modified Organisms (ISBGMO), Buenos Aires (Argentina) **15 – 20 November 2010**	Keulder, R. & Van den berg, J. 2010. Effect of Cry 1Ab protein from Bt maize (MON810) on the biology of *Chrysoperla pudica* (Neuroptera: Chrysopidae) ***(Poster)***
Herpetological Association of Africa. **January 2011, Stellenbosch (South Africa)**	Zaayman, J.L., Van den Berg, J. & du Preez, L . 2011. Protocol development to test the effect of Bt-toxins on the development and length of *Xenopus laevis* tadpoles ***(Oral presentation)***

17th Entomological Congress of the Entomological Society of South Africa, Bloemfontein (South Africa)

3 - 6 July 2011

Kruger, M., Van Rensburg, J.B.J. & Van den Berg, J. 2011. Fitness and fitness costs associated with evolution of resistance by *Busseola fusca* to Bt maize ***(Oral presentation)***

Van den Berg, J. 2011. Will genetically modified (GM) crops solve pest problems in Africa and what are the potential ecological costs? ***(Oral presentation)***

Van den Berg, J., Kruger, M. & Erasmus, A. 2011. A review of studies on target- and non-target effects of Bt maize in South Africa

(Oral presentation)

PEER REVIEW PUBLICATIONS

1. Campagne P, Kruger M, Pasquet R, Le Ru B, Van den Berg J (2013) Dominant Inheritance of Field-Evolved Resistance to *Bt* Corn in *Busseola fusca*. PLoS ONE 8(7): e69675.

2. Keulder R, and Van den Berg J (2013) Patterns of lacewing (Neuroptera: *Chrysopidae*) flight activity, flight height and spatial distribution of eggs on maize plants. *African Entomology* 21 (1), 95-102

3. van der Merwe F, Bezuidenhout C, van den Berg J, Maboeta M (2012) Effects of Cry1Ab Transgenic Maize on Lifecycle and Biomarker Responses of the Earthworm, *Eisenia Andrei*. Sensors (Basel) December; 12(12): 17155–17167.