Preparing for GM sugarcane in South Africa: pre-commercial biosafety aspects to consider

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International GM sugarcane landscape

USA

- GM sugarcane field trials and regulatory dossier (mosaic virus and herbicide tolerance)
- GM sugarbeet deregulated i.e. sugar derived from GM plants on world market

Brazil*

- CTC – commercial approval for insect resistance and herbicide tolerance (2017)
- CTC - field trials – 2nd generation ethanol, weed and insect control

South Africa

- SASRI - GM field trials
- Licence from Arcadia Biosciences, USA – N use efficiency
- Bt cane – insect tolerance - start development

Argentina

research

India

research

China

research

Japan

research

Indonesia*

- Drought tolerant sugarcane passed through biosafety committee (2013). Sugar - local market
- Research

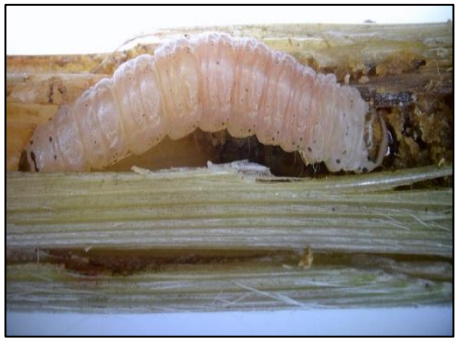
Australia

- SRA - GM field trials
- Syngenta 'Sugarbooster' (isomaltulose)
- UQ – research on sucrose enhancement

The problem

- Lepidopteran borers ~ R1 billion loss in revenue.
- SA biosecurity risk = *Chilo sacchariphagus* in Mozambique.

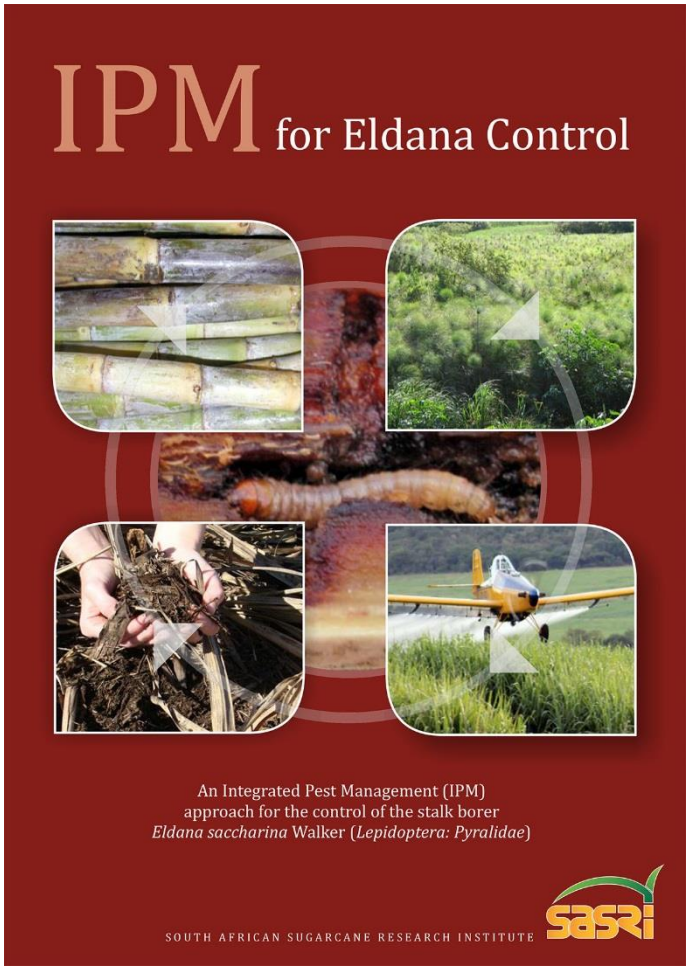
Eldana saccharina



Sesamia calamistis

Chilo sacchariphagus

The approach

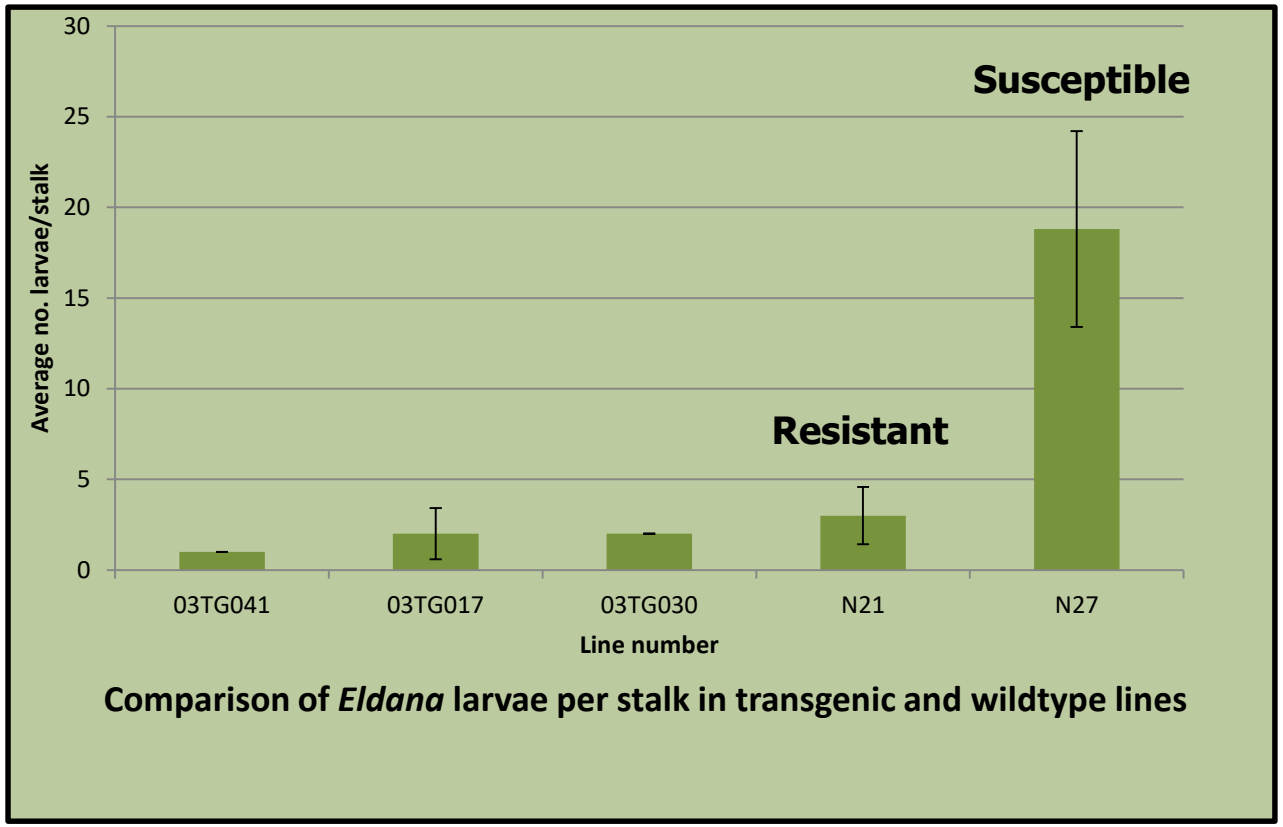


Integrated Pest Management:

- breeding
- insecticides
- soil health
- agro-ecosystem
- sugarcane genetically modified to produce lepidopteran-specific protein from bacterium *Bacillus thuringiensis* (Bt).

Proof of Concept

Pot-based bioassay in shade-house facility



Comparison of *Eldana* larvae per stalk in transgenic and wildtype lines

The timeframe

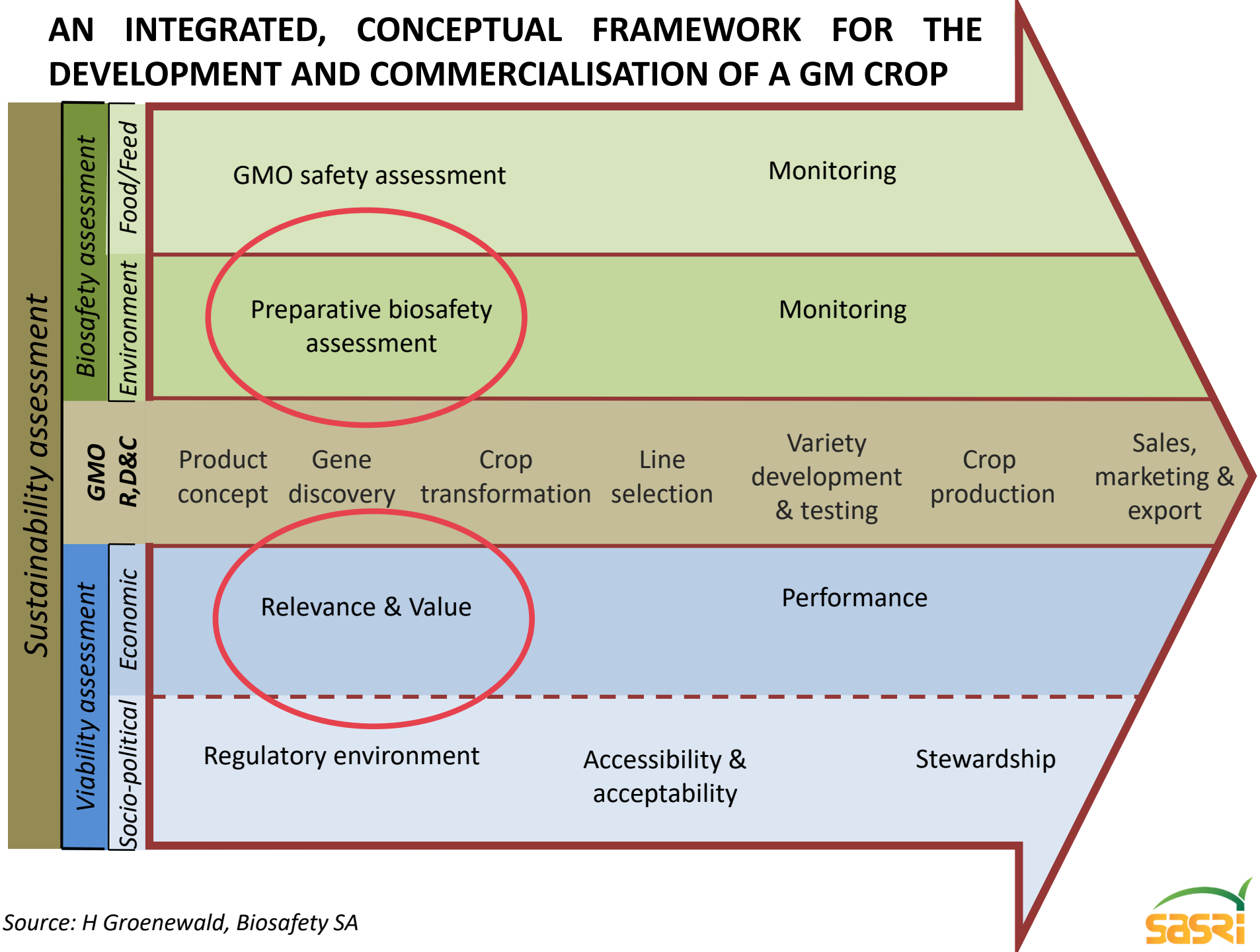
Year 1

- Intellectual Property audit
- Perform genetic transformations
- Select promising lines
- Conduct field trials to check agronomic and yield characteristics
- Submit regulatory dossier to GM Registrar (DAFF)
- Obtain permit for commercial cultivation
- Bulk up the GM plant via NovaCane® and large-scale nurseries
- Deploy to the industry
- Use GM line as a parent in new crosses

Year 16




AN INTEGRATED, CONCEPTUAL FRAMEWORK FOR THE DEVELOPMENT AND COMMERCIALISATION OF A GM CROP



Source: H Groenewald, Biosafety SA

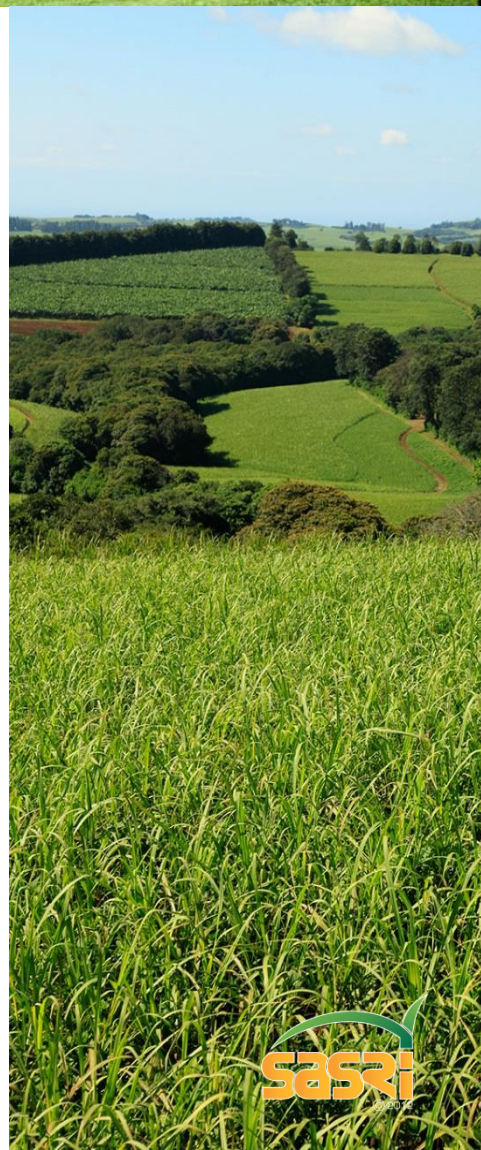
Pre-commercialisation aspects

Project	Who?
1. Ex ante socio-economic study	Marnus Gouse, Bureau for Food and Agricultural Policy, University of Pretoria Stuart Ferrer University of Kwa-Zulu Natal
2. Bt bioassays on *Eldana saccharina, Sesamia calamistis, Chilo partellus*	Johnnie van den Berg, University of the North West and Agricultural Research Council
3. Likelihood of gene flow with wild relatives of sugarcane	Stefan Siebert, University of the North West
4. Refugia modeling for Bt sugarcane	Linke Potgieter, University of Stellenbosch

Pre-commercialisation aspects

1. Ex ante socio-economic study

- Potential farm level impacts
- Economic impacts at sector/macro level
- Potential co-existence, supply chain and export market impacts
- Consumer impacts – GMO and ‘Health Tax’



Pre-commercialisation aspects

2. Bt bioassays on lepidopteran sugarcane pests

- Cry1Ab - emergence of resistance in Bt maize by *Busseola fusca*
- Important to have a high dose of Bt protein

- base-line susceptibility of eldana, chilo and sesamia to Cry1Ab
- diet- and plant-based bioassays
- other Cry proteins

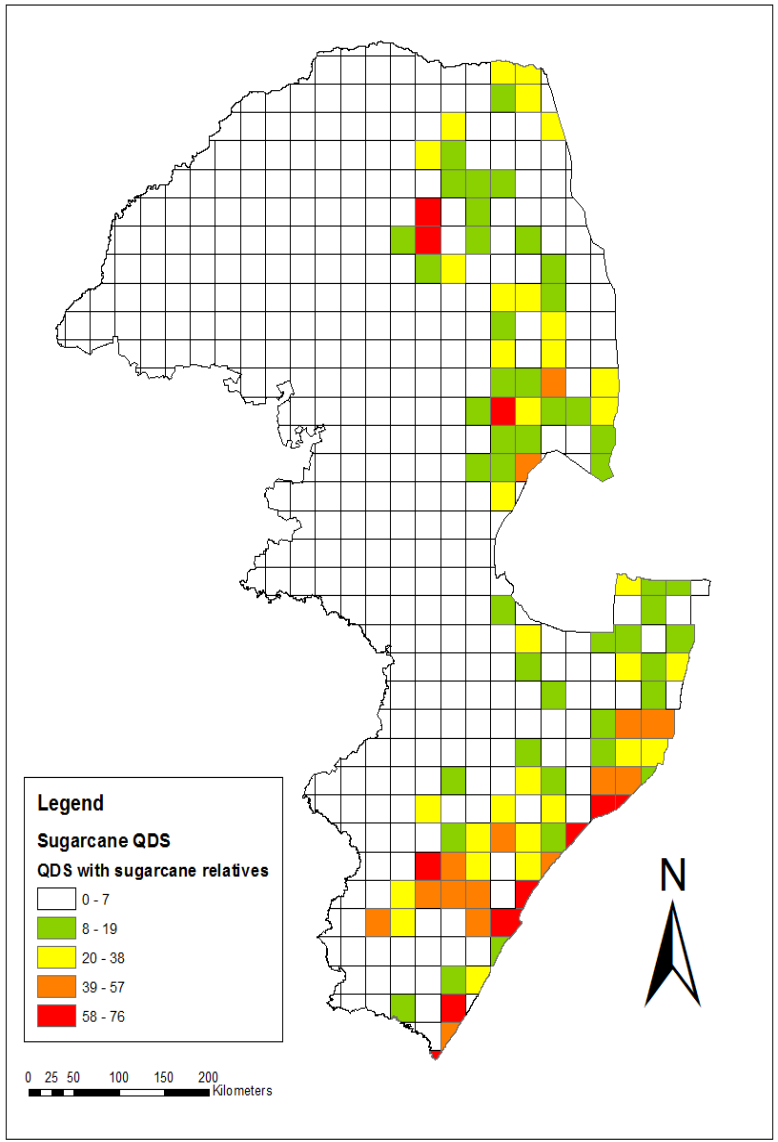
Pre-commercialisation aspects

3. Assessing the likelihood of gene flow

- Identification of indigenous wild relatives

- Spatial distribution and overlap with cultivated sugarcane

- Field assessment of pollen viability



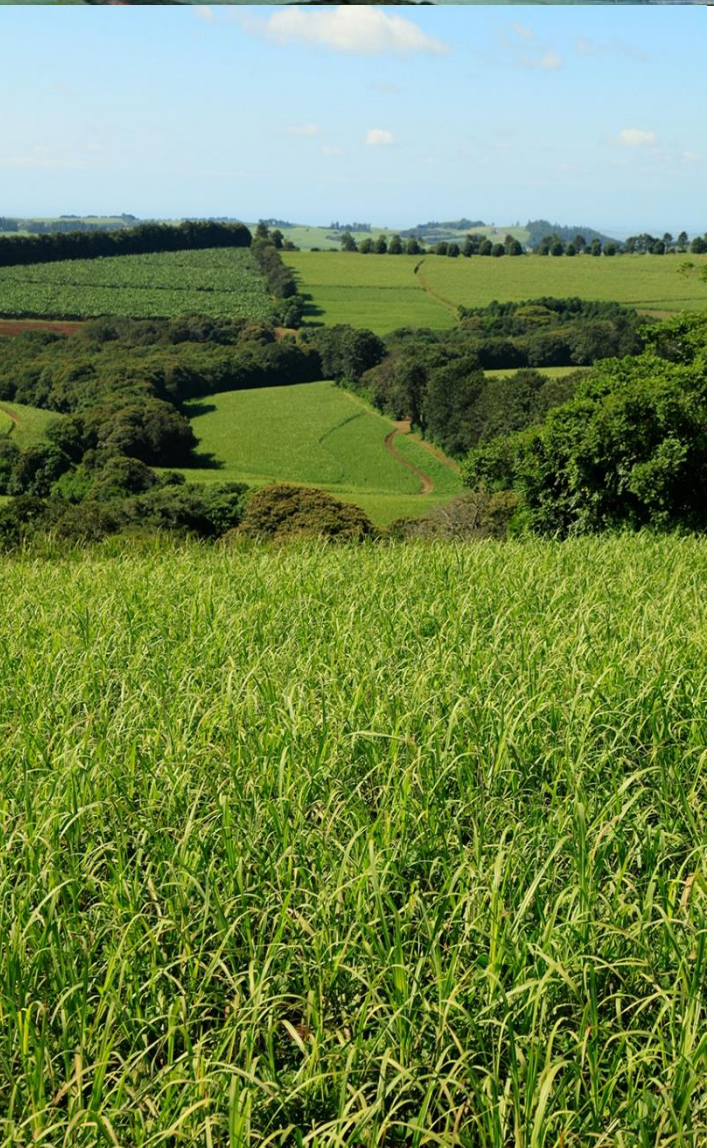
Pre-commercialisation aspects

4. Refugia modeling for Bt sugarcane

- Eldana population dynamics researched
- Developed model of movement and mating
- Predict impact of differently designed refuge areas on resistance evolution
- Recommend an optimal design for refuge areas in Bt sugarcane

Butterfield MK (2002). Genetic models to assess the development of counter-resistance in insect pests exposed to Bt-sugarcane, Proceedings of the South African Sugarcane Technologists Association, 76: 329-335
Van Vuuren et al. (2014). Prerequisites for the design of an agent-based model for simulating the population dynamics of Eldana saccharina Walker, Proceedings of the 2014 ORSSA annual conference, pp.62-70

Funding acknowledgement



Technology Innovation Agency (Department of Science and Technology) administered by Biosafety SA

South African Sugarcane Research Institute


It’s a long and winding road…