

Bt (*Bacillus thuringiensis*) Potato Project in South Africa

Project Background

The cultivated potato, (*Solanum tuberosum* subsp. *tuberosum* L.) is one of the world's major food crops following rice, wheat and maize in importance. The potato tuber moth (*Phthorimaea operculella* Zeller) is a primary problem facing potato farmers in developing countries. Currently, the only available means to control the potato tuber moth (PTM) and avoid major crop losses is the use of chemical pesticides. Michigan State University (MSU), funded by the U.S. Agency for International Development (USAID) through its Agricultural Biotechnology Support Project (ABSP), initiated biotechnology research on the development of PTM resistant varieties in 1992. A *Bacillus thuringiensis* (Bt)-cry1Ia1 gene, was obtained from ICI Seeds (now Syngenta seed company) and successfully introduced into the potato variety Spunta. Transgenic lines were shown to have a high level of resistance to tuber moth.



Two Spunta lines with commercial potential have been identified through collaborative research between MSU and research institutions in Egypt and South Africa. In 2003, MSU and its South African partner, Roodeplaat Vegetable and Ornamental Plant Institute (VOPI) started to collect the necessary data for commercial approval in South Africa with the aim of distributing the best line to potato farmers. Bt potato lines have been tested for multiple seasons, and have been found to be efficacious in the field and in storage. The South African government is supportive of biotechnology applications and has since 1997 deregulated Bt cotton, Bt maize and herbicide tolerant soybean. The benefits of the Bt potato to the farmer and end-users will be reduced input costs (less insecticides used), increased marketable yield, improved quality, reduced post-harvest losses, reduced human exposure to pesticides, and less pesticide residues on potato tubers.

The commercialization process of Bt potatoes in South Africa includes six components: Product Development, Regulatory File Development, Obtaining Freedom to Operate and Establishing Licensing Relationships, Marketing and Technology Delivery, Documentations of Socio-Economic Benefits, and Public communication.

Project Development

Activities included under this component involve contained on-station field trials, contained on-farm field trials, multi-location field trials, variety development and registration, seed certification, conventional breeding, and transformation of local South African varieties with the cry1Ia1 gene.



Since 1994 agronomic trials have been conducted in Michigan. All the Bt-transgenic lines developed with some potato tuber moth efficacy were evaluated for at least one year. The lines Spunta-G2 and Spunta-G3 were most intensely evaluated and had the best tuber moth resistance and agronomic characteristics. The first field trial of Spunta-G2 and Spunta-G3 was conducted at ARC-VOPI, Pretoria in 2001. Since 2001 field trials have been undertaken at 5 locations in South Africa. All field and storage trials showed excellent

results in terms of PTM control, and have generated interest among both small scale and commercial farmers for growing the Bt variety.

In addition, three important cultivars in South Africa have been selected for genetic transformation. Mnandi is a late blight resistant cultivar that is primarily grown by the small farmers in the KwaZulu-Natal and Eastern Cape. The other two cultivars targeted are BP-1 and Darius, important table stock cultivars grown by the commercial sector. Potato tuber moth control in these three cultivars, in addition to Spunta, will maximize the Bt-potato's impact in South Africa.

During the four-year period contemplated for this project, product development and commercialization is likely to be completed in South Africa. It is anticipated that the work in South Africa will provide the template for work in other developing countries and that some of the data gathered for South Africa (product performance, product quality) will be applicable to variety development in other countries.

Regulatory File Development



Before the Bt Spunta can be commercialized, regulatory approval of the product must be granted by the South African authorities. In support of this application for commercial release a regulatory dossier is being compiled to document the food and environmental safety of this product. Data is currently being collected in a collaborative effort

between laboratories in South Africa, coordinated through the ARC-VOPI, and Michigan State University. Efforts are focused on the Spunta-G2 line and the data collection includes molecular characterization of Spunta-G2, allergenicity and toxicity assessments, evaluation of outcrossing and weediness potential, and the effect of Spunta-G2 on non-target insects.

Obtaining Freedom to Operate (FTO) and Establishing Licensing Relationships

The MSU Bt potato team will work with the [MSU-Office of Intellectual Property](#) (OIP) and other appropriate parties in partner countries to ensure that the rights of all owners of intellectual property involved in this project are respected

Marketing and Technology Delivery

Preliminary investigations in South Africa have led to the conclusion that the most effective mechanism for distributing the Bt potato product to the primary target population will be through commercial seed potato growers. Commercial seed potato producers in South Africa, who have established markets serving commercial and resource-poor farmers, supply quality potato seed to all farmers. These companies will be engaged and relationships will be established. Furthermore, Potato Certification Services of South Africa has expressed their willingness to provide guidance in incorporating Bt potatoes into the standard certification scheme.

Documentation of Socio-Economic Benefits

An *ex ante* economic analysis was undertaken in 2001 to determine the potential impacts of the adoption of a PTM resistant transgenic potato in Egypt and South Africa. The study determined that the economic benefits of PTM resistance would be significant and many times the initial cost required to introduce a transgenic crop with this trait to market. This study provided a good start to the assessment of socio-economic benefits, but follow-up studies will be



necessary, not only to update and clarify some of the results of the completed study, but also to address more directly the requirements for documentation of socioeconomic benefit that are a required part of the regulatory submission for commercialization in South Africa.

In order to address the requirements for the Regulatory dossier, a South African Project team was assembled to conduct a preliminary socio-economic survey and assessment of the potential social impact of introducing Bt Potato as a commercial crop amongst all farmers in South Africa. This will include smallholder commercial farmers, subsistence farmers, large scale commercial farmers and seed producers. A set of questions relating to how the introduced Bt Potato will affect all four categories of farmers, economically and socially, will be answered by this study. This will be achieved through a socio-economic survey done amongst all potato farmers in South Africa. In small and emerging farmer communities it may be required to hold Rapid Rural Appraisal workshops to answer the questions.

Public Communication



Communication with all stakeholders is essential during the project to minimize opposition to the potatoes caused by poor information and poor transparency. A communication strategy was developed at the onset of the project with the aim to provide regular, accurate information on Bt Potatoes to identified target groups, in order to achieve product acceptance. This strategy was recently revised during a Communication Workshop held in South Africa and attended by various stakeholders. Stakeholders reassessed the target groups that need to receive information, the best spokespeople for each target group, and the medium that would best reach each group.

Project Management, Organization and Partnerships

The Management Entity (ME) for the Bt Potato project includes MSU's Institute for International Agriculture and the International Potato Center (CIP). CIP has a long history of presence in Africa and a good understanding of the regional needs and priorities. CIP is committed towards making the benefits of biotechnology available to resource-poor farmers by supporting the R & D of the project and in particular looking at the impacts it will have on resource-poor farmers.

The ME is supported by a team of Component Coordinators comprised of experts in Product Development, Regulatory Package development, Licensing of technology as well as Public Communication. In addition, a Principal Investigator (PI) in South Africa will coordinate and manage in-country activities of all the project components.

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