Fruit and Shoot Borer-Resistant Eggplant

- Fact Sheet -

A consortium of public and private sector institutions have joined forces to develop a bioengineered solution to eggplant's most persistent constraint to production: the eggplant fruit and shoot borer. The goal of this project is to deliver high-quality eggplant seeds to resource-limited farmers at affordable prices in India, Bangladesh and the Philippines.

Introduction

Eggplant, known as brinjal in India, is a popular year-round vegetable crop grown in the subtropics and tropics. The crop is mainly cultivated on small family farms and is an important source of nutrition and cash income for many resource-poor farmers. It supplies 25 calories per serving and has virtually no fat. Its "meaty" texture makes eggplant a staple in vegetarian diets.

In India, eggplant is cultivated on 512,800 hectares and 8,450,200 metric tons were produced in 2007 (FAOSTAT, 2007). The main growing areas are in the states of Andhra Pradesh, Bihar, Karnataka, Maharashtra, Orissa, Tamil Nadu, Uttar Pradesh, and West Bengal.

In Bangladesh, eggplant crops cover 57,745 hectares with a production of 339,795 metric tons (BBS, 2007). Eggplant constitutes about 25% of the total vegetable area of the country. The main growing districts are:

Bogra, Chittagong, Comilla, Dhaka, Dinajpur, Faridpur, Jamalpur, Jessore, Khagrachari, Khulna, Mymensingh, Rangamati, Rangpur, Rajshahi, Sylhet, and Tangail (BBS, 2007).

In the Philippines, it is estimated that over 21,000 hectares are devoted to eggplant production and that their annual production of more than 198,000 metric tons is valued at US $ 32 million (FAOSTAT, 2007). Eggplant accounts for 28% of the country's total volume of vegetable production. The major growing areas are at the low elevation areas of Cagayan Valley, the Ilocos Region, Central Luzon, Southern Tagalog, Central Visayas, and Western Visayas.

The Eggplant Fruit and Shoot Borer (FSB)

The eggplant fruit and shoot borer (FSB) is the most destructive insect pest for eggplant in South and South East Asia. The FSB is a small larva that bores inside shoots, resulting in the withering of the shoots. It also bores into and feeds on young and maturing fruit, making the fruit inedible and unfit for market. Damage from the FSB starts at the nursery stage and continues until harvest.

An FSB larva that has bored into the shoot of an eggplant, thus causing the plant to whither.

An FSB larva that has bored into an eggplant fruit, causing considerable damage and rendering it unfit for market.

What is genetic engineering?

Genetic engineering is the introduction of a specific gene into the DNA of a plant to obtain a desired trait. The gene introduced may come from another plant species or from other organisms. While traditional plant breeding involves crossing related plants, biotechnology is a new tool that allows breeders to be more precise.

The goals of genetic engineering are the same as with traditional breeding. Scientists may aim to improve crop performance in the field by conferring pest and disease resistance, herbicide resistance, or tolerance to environmental stresses (such as drought or flooding). They may also aim to develop products with enhanced value, such as improved post-harvest life, nutritional value, or other health benefits.

Why genetically engineer fruit and shoot borer resistance into eggplant?

Farmers currently use labor-intensive practices to control the FSB – the prompt manual removal of wilted shoots, the trapping of male moths using pheromones to prevent mating, and the use of nylon netting to protect the plants. These efforts are usually insufficient so farmers also rely heavily on insecticide sprays to control the FSB. However, the FSB is only vulnerable to sprays for a few hours before it bores into the plant, forcing farmers to spray insecticides as often as every 2-3 days (AVRDC, 2001). Intensive use of insecticides poses a serious threat to human health and the environment. Heavy use of pesticide sprays also adds to the cost of production.

What is FSBR-eggplant?

Fruit and shoot borer resistant (FSBR) eggplant is known as Bt brinjal in India. It is a plant that is genetically engineered to contain its own FSB resistance mechanism: the Bt gene, Cry1Ac. Bt is short for *bacillus thuringiensis*, or *B. thuringiensis*.

In the last few years, several crops have been genetically engineered to produce their own Bt proteins, making them resistant to specific groups of insects. Bt is a soil bacterium that contains a protein that is toxic to a narrow range of insects, but is not harmful to animals or humans.

Why would farmers choose FSBR eggplant over other varieties?

ABSPII has conducted a detailed socio-economic impact study to estimate the costs and benefits of introducing FSBR eggplant (Ramasamy 2008, Norton 2009). Scientists and economists in the ABSPII consortium anticipate the following benefits to farmers:

- When used in conjunction with good farming practices, FSBR eggplant crops will produce more undamaged fruit than non-bioengineered eggplant crops. Higher yields will lead to increased income for farmers.
- As the FSBR-eggplant will require fewer insecticidal sprays, farmer and farm worker exposure to insecticides will be minimized.
- The pricing of varieties distributed through the public system will be based on a cost-recovery model in order to bring high quality seeds to economically weaker farming communities.
- For hybrids and for varieties, farmers will be able to continue their present practices of acquiring and using seeds.

Is FSBR-eggplant safe to eat?

The experience of millions of consumers of Bt products for over ten years and the use of Bt as an insecticide for more than 60 years indicates an excellent track record of safety to humans and the environment. Scientists have conducted rigorous tests to ensure that FSBR-eggplant is safe for human consumption. Moreover, the reduced use of chemicals will mean that less pesticide residue will remain on the fruit when it is brought to market.

- Nutritional content: FSBR-eggplant is compositionally identical to normal eggplant except for the additional Bt protein. It therefore has the same nutritional value as non-FSBR-eggplant.
- Toxicity: FSBR-eggplant has been tested on a number of different animal groups and no toxicity has been detected.
- Allergenicity: The FSBR-eggplant has been tested to make certain that it contains no new allergenic compounds and has been found to be non-allergenic.

Are there potential impacts on biodiversity?

Eggplant originated in South Asia and wild species may be present near cultivated eggplant. Researchers have studied eggplant have conducted tests to see how likely FSBR-eggplant is to cross with other eggplant or wild species. No problems have been detected. It is very unlikely that FSBR-eggplant would pollinate and reproduce with non-bioengineered eggplant.

Are there potential impacts on the environment?

Because FSBR-eggplant will reduce the need for insecticides, use of the new variety could lead to lower levels of insecticide residues in the soil and groundwater (Shelton et al 2002). This would offer an important environmental improvement.

Are there potential impacts on non-target insects or other animals?

Most insecticide sprays kill more than just the target pest and can even kill beneficial insects and animals. Evidence from Bt crops grown in other countries has shown a greater biodiversity of insects when such spraying is reduced. FSBR-eggplant targets only the fruit and shoot borer and other lepidopteron pests. It does not affect non-target or beneficial insects.

What testing has been done for FSBR-eggplant?

Scientists conducted a series of tests as per international best practices and in compliance with national regulatory requirements to assess the safety of FSBR-eggplant to human health, animals and the environment. The following studies have been done in India and are also being conducted in Bangladesh and the Philippines.

- Gene equivalency trials: to determine that the finished plant is as genetically similar as possible to the original “parent” eggplant.
- Efficacy studies: to determine how effective the FSB resistance is under field conditions and how well the resistance is maintained over time and across regions.
- Pollen flow studies: to determine how much the FSBR-eggplant crosses with other eggplants in a field situation and to determine how far FSBR-eggplant fields should be from other eggplant fields.
- Yield trials & agronomic performance studies: to ensure that the bioengineered varieties are equivalent or better than existing varieties in terms of total production.
- Effect on beneficial insects: to determine what affect the bioengineered plant will have on the non-target insect population in the long term.
- Toxicity studies: to determine whether FSBR-eggplant is toxic or could cause irritation to humans.
- Feeding studies: to determine whether there are deleterious effects on non-target organisms.

Project Partners

The Maharashtra Hybrid Seeds Company Limited (MAHYCO) has developed a bioengineered hybrid eggplant which is highly resistant to the fruit and shoot borer. With the help of ABSPII, MAHYCO has sub-licensed this technology free of charge to:

- Tamil Nadu Agricultural University (TNAU)
- The University of Agricultural Sciences, Dharwad
- The Indian Institute of Vegetable Research, Varanasi (IIVR)
- The Bangladesh Agricultural Research Institute (BARI)
- The University of the Philippines, Los Baños (UPLB)

These public-sector partners have bred varieties of bioengineered eggplant that would be made available through existing university extension systems on a cost-recovery basis.

What is ABSPII?

ABSPII is a USAID-funded consortium that supports scientists, regulators, extension workers, farmers and the general public in developing countries to make informed decisions about agricultural biotechnology. Where demand exists, ABSPII focuses on the safe and effective development and commercialization of bio-engineered crops as a complement to traditional agricultural approaches. The project helps boost food security, economic growth, nutrition and environmental quality in East and West Africa, Indonesia, India, Bangladesh and the Philippines.

References, Resources & Websites

ABSPII South Asia website (www.absp2.net)

ABSPII Southeast Asia website (http://www.isaaa.org/Programs/supportprojects/abspii/default.asp)

AVRDC, The World Vegetable Center, www.avrdc.org (particularly http://www.avrdc.org/LC/eggplant/borer.html)

Bureau of Agricultural Statistics (BAS), Philippines.

Bangladesh Bureau of Statistics (BBS).

Faostat (http://apps.fao.org/)

Integrated Pest Management Collaborative Research Support Program (IPM CRSP) http://www.ag.vt.edu/ipmcrsp/index.asp

International Service for the Acquisition of Agri-biotech Applications (ISAAA) www.ISAAA.org

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