Successful Commercialization of Insect-Resistant Eggplant by a Public–Private Partnership: Reaching and Benefiting Resource-Poor Farmers

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ABSTRACT

This chapter looks at the results of a unique public–private partnership instituted to provide resource-constrained farmers in the developing world with access to proprietary agri-biotechnologies. Eggplant, a widely consumed vegetable crop in the tropics, is commonly infested by the eggplant fruit and shoot borer (EFSB), which devastates both plants in the field during development and eggplant fruits after harvesting. The chapter considers the application of insect-resistance technology (based on the Cry1Ac protein from Bacillus thuringiensis) in eggplant, focusing on its sublicensing from a private company to a partnership of public institutes and agricultural universities in Bangladesh, India, and the Philippines.

1. INTRODUCTION

Eggplant (*Solanum melanogena*) is an important vegetable crop widely cultivated and consumed in the subtropical and tropical regions of Asia and Africa. It grows in a wide range of climatic conditions and is a staple of human consumption. About 510,000 hectares of arable land in India and 20,000 hectares in the Philippines are devoted to cultivating eggplant.

A long-duration crop, eggplant is grown using either hybrid varieties or open-pollinated varieties (OPVs, for which seeds can be saved and used later). Although much preventive care is taken, eggplant is commonly attacked by more than a dozen insect-pest species. Among these species, the eggplant fruit and shoot borer (*Leucinodes orbonalis*), or EFSB, is the most widespread and devastating in South and Southeast Asia, with infestation inflicting about a 70% crop loss.[1] EFSB larvae feed inside the eggplant shoot and fruits, retarding the vegetative growth of the plant and decreasing the marketability and edibility of the fruit.

Many attempts to crossbreed eggplant varieties with EFSB-resistant wild varieties have been unsuccessful. So farmers have had to rely heavily on chemical pesticides to control EFSB. According to a study conducted on pest control for eggplant in South Asia, farmers spend about US$400 per hectare on pesticides, two-thirds of which are used to control ESFB.[2] In addition, EFSB populations have gradually become resistant to certain chemicals, so farmers have resorted to using other chemicals, some of which are more hazardous to human health and to the environment, as well as illegal, to control the insect.

2. THE TECHNOLOGY

MAHYCO, a private Indian company, was the first in India to develop a hybrid eggplant containing a gene that provides resistance to EFSB. The gene it used (*cry1Ac* which produces the corresponding protein called Cry1Ac[3]) is obtained from *Bacillus*

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thuringiensis (Bt). Bt is a spore-forming bacterium that produces crystal proteins (called Cry proteins) that are toxic to many species of insects, including EFSB. Bt action is very specific. To become lethal, the Bt protein has to be ingested; the Bt toxin is activated in the high pH environment of the insect gut. The activated protein perforates the lining of the gut, which causes the death of the insect within a of couple days.

A main advantage of this technology is that it reduces the use of chemical pest control, thereby making the technology environmentally harmless. Through its safety tests, the U.S. Environmental Protection Agency has found no human health hazards related to Bt use. The agency has exempted Bt from its standards for food-residue tolerances and groundwater concentration, from endangered species labeling, and from special review requirements, indicating that cultivation of crops using Bt is safe for resource-constrained farmers in the developing world.

3. THE LICENSING ARRANGEMENT

MAHYCO is the first Indian company to have received the rights under license for the use of the Bt *cry1Ac* gene technology for insect-pest management from Monsanto Company. This licensed *cry*-gene technology was used by MAHYCO to develop and generate hybrid eggplant events. Under the aegis of the Agricultural Biotechnology Support Project II (ABSP II), funded by the U.S. Agency for International Development, Sathguru Management Consultants Pvt. Ltd. partnered with MAHYCO. The *cry*-gene technology was licensed then to several public institutes in South and Southeast Asia that were participating in a public–private consortium created to develop EFSB-resistant OPV eggplant that would improve the conditions of resource-constrained farmers in developing countries. The ABSP II played a pivotal role in this venture by funding all the consortium partners for their R&D roles in developing the EFSB-resistant eggplant.

The technology was sublicensed by MAHYCO on a royalty-free basis to public research institutes in India (the Indian Institute of Vegetable Research, Tamil Nadu Agricultural University, and the University of Agricultural Sciences, Dharwad), in Bangladesh (the Bangladesh Agricultural Research Institute), and in the Philippines (the University of Philippines, Los Banos). MAHYCO also sublicensed this technology to East West Seeds, a private corporation in Bangladesh, on commercial royalty-bearing terms. To safeguard the licensor's interests, specific strategies for the stewardship and monitoring of the technology by the licensees were addressed and formulated early in the sublicensing process.

4. TRANSGENIC EGGPLANT

Most eggplant farmers in India grow OPVs. The area planted with hybrid varieties is less than 30% of the total area. Growers that plant these hybrid varieties also tend to use more purchased inputs and have higher yields compared to growers who plant OPVs.[4] The main reason that the cultivation of OPVs is more widespread is that OPV seeds can be saved and replanted in future growing seasons. As a result, OPV seeds are much more available and affordable. The market price of hybrid seeds is five to ten times the market price of OPV seeds.

The first transgenic Bt hybrids developed by MAHYCO are slated to be commercially released in India by the end of the 2006–2007 season,[5] after the fulfillment of all regulatory requirements. The transgenic Bt OPVs under development by the public–private partnership are expected to be commercialized about six months later. Because of the existing price differential between conventional OPVs and hybrids, and because of the zero premium being charged for the Bt trait in the OPVs, it is still expected that most of the existing growers of hybrid eggplant will adopt the Bt hybrids rather than the Bt OPV, even though the Bt OPVs would be priced much lower than the Bt hybrids. This is primarily due to production and yield differences between the two systems. Farmers growing OPV eggplant are most likely to adopt the Bt OPV because of the cost factor. Growers of both types of eggplant can be expected to shift to the corresponding Bt versions because of the expected savings in pesticide expenses.[6]

The public–private partnership also addresses distribution issues: the participating public institutions will be able to deliver high-quality Bt eggplant seeds that are resistant to EFSB through their own public distribution systems on a cost basis (in other words, without adding profit margins).

Most resource-constrained farmers in the developing world cultivate OPVs because of the lower costs involved. By recognizing these agricultural practices, and by providing the public sector with access to Bt technology for use in OPVs, via a unique public–private partnership, MAHYCO both commercializes its Bt hybrid eggplant (sold on a for-profit basis) and through its donation addresses the need to improve crops of vital importance to poor farmers. ■

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