

Problems with the relatives?

Gene escape from genetically engineered (GE) *Bt* brinjal could create problem weeds in South and Southeast Asia

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Summary

Brinjal (also called eggplant or talong) is a popular vegetable in South and Southeast Asia. However, the cultivation of genetically engineered (GE, also called genetically modified, or GM) *Bt* brinjal poses risks to the environment and possibly to human health. The occurrence of wild, weedy and also cultivated relatives presents a likelihood that the GE *Bt* gene will spread to these relatives but, so far, this has largely been overlooked in the risk assessments for GE *Bt* brinjal.

Genetically engineered Bt brinjal and the implications for plant biodiversity – revisited, an independent study commissioned by Greenpeace International, finds that brinjal relatives do occur in the regions where cultivation of GE *Bt* brinjal is proposed, and that GE *Bt* brinjal may mate with these relatives to spread the GE *Bt* gene. Spread of the GE *Bt* gene would have considerable ecological implications, as well as implications for future crop contamination and farmers' rights. Importantly, spread of the GE *Bt* gene could result in brinjal becoming an aggressive and problematic weed. Greenpeace urges governments to employ the precautionary principle and not permit any authorisation of the outdoor cultivation of GE *Bt* brinjal, including field trials.

Introduction

The cultivation of GE *Bt* brinjal is proposed in some countries across Asia, including India where there is currently a moratorium on commercialisation¹, and the Philippines where field trials are ongoing. There are many concerns with GE brinjal², which has been engineered to be resistant to certain insect pests using *Bt* genes from the soil bacterium *Bacillus thuringiensis*. These concerns include food safety and possible effects on organisms other than the pest insect (ie non-target organisms), such as beneficial insects and butterflies.

One of the least known aspects of the GE *Bt* brinjal is its ability to cross with wild relatives or cultivated varieties. This is because there are no recent reviews in the scientific literature concerning species related to brinjal, and where they grow across Asia. This information is vital when addressing concerns regarding cultivation of GE *Bt* brinjal because insect-resistance gives a selective advantage to the plant, increasing its ability to survive and reproduce. If the GE *Bt* brinjal cross-pollinates wild, weedy or cultivated relatives, the result is a hybrid offspring, which may grow more aggressively and thus become a problem weed.

To assess this possibility, Greenpeace International commissioned an independent report to give an overview of current state of knowledge of brinjal, its wild and weedy relatives and the potential for gene flow (ie the transfer of genes, via pollination) from GE *Bt* brinjal to these relatives.

¹ Padma TV (2010). India says no – for now – to first GM vegetable. SciDevNet. www.scidev.net/en/south-asia/news/india-says-no-for-now-to-first-gm-vegetable.html

² See, for example, Seralini G (2009). Effects on health and environment of transgenic (or GM) *Bt* brinjal. www.criigen.org/SiteEn/images/stories/Dossiers/Divers/btbrinjal-ges_%200109.pdf

Summary of report: Brinjal and its wild and weedy relatives



Greenpeace summary of “Genetically engineered *Bt* brinjal and the implications for plant biodiversity – revisited” by Dr John Samuels³

Eggplant, brinjal or talong (*S. melongena* L.) is a popular vegetable throughout Asia. It has relatives that are cultivated both in Asia and Africa. Brinjal is a member of the spiny solanum group, which in Asia includes brinjal and its wild, cultivated and naturalised relatives.

The exact area in which the eggplant was first domesticated from its wild relative, the ‘centre of origin’, is not exactly known. However, the centres of diversity, where the greatest diversity of cultivated types or landraces occurs, includes the whole of South and Southeast Asia, from India to China, as well as the Philippines and Indonesia. For example, the National Plant Genetic Resources Laboratory of the Philippines holds records (or accessions) for around 500 local varieties.

It is in these centres of diversity that brinjal and its relatives have formed a complex and intricate mix of wild, weedy and cultivated relatives. The exact number of species is disputed, and which species can mate together (cross-pollinate, cross-breed or hybridise) is not precisely known. However, it is known that brinjal does cross-pollinate with at least 10 closely related species found in South and Southeast Asia.

Some brinjal relatives are weedy plants. Weedy plants often arise from the pollination of wild plants with cultivated ones, and can grow outside of cultivated areas, where they might form semi-wild populations, often called feral populations. Several of these brinjal relatives, and even brinjal itself, can grow in unexpected places, for example at the side of the road or among crops in small-scale cultivations and on the edges of villages.

Therefore, wild, weedy and cultivated relatives of brinjal exist in the regions where cultivation of GE *Bt* brinjal is proposed.

Gene flow from GE *Bt* brinjal to non-GE *Bt* brinjal and wild and weedy relatives

A number of gene flow studies on GE crops other than brinjal, such as rice and oil seed rape (canola), have shown that gene flow can occur from GE crops to their uncultivated, weedy or wild relatives. These studies also show that GE genes (or transgenes) can persist within, and spread through (or introgress), populations of wild and weedy relatives, especially if the genes are advantageous for the plant (eg, GE insect-resistant *Bt* genes). It might also be possible for weedy forms of GE *Bt* brinjal, or successful crosses between GE *Bt* brinjal and non-GE brinjal, to spread the *Bt* transgene in this way. As brinjal has wild and weedy relatives across South and Southeast Asia, gene flow from GE *Bt* brinjal to these relatives is expected to occur in these regions if GE *Bt* brinjal is either commercialised or tested in open field trials.

Implications of gene flow from GE *Bt* brinjal – increased weediness and impacts on genetic resources

Spreading of the *Bt* transgene into feral populations and to wild relatives has implications for ecology and agricultural biodiversity. The *Bt* transgene provides a plant with resistance to certain insect pests. This gives the plant a selective advantage that might encourage unnaturally aggressive growth. Coupled with the strong tendency for these brinjal relatives to sprout where not planted, such GE contaminated plants could become overbearing weeds. Thus, there is considerable potential for detrimental effects on ecological balance and biodiversity.

Traditional cultivars and landraces are considered valuable resources as they may contain traits in their genes (eg drought resistance) which may be needed in the future. However, these genetic resources will be compromised if contaminated by GE genes, such as genes from GE *Bt* brinjal. This raises the possibility of impacting upon the rights of farmers for the safe and sustainable use of indigenous agro-biodiversity.

There are serious implications of gene flow from GE *Bt* brinjal to wild and weedy relatives. These include the creation of problematic, insect-resistant weeds, and contamination of traditional cultivars and landraces, impinging on farmers’ rights.

Urgent need for studies on gene flow from GE *Bt* brinjal

Pollen studies have demonstrated that GE *Bt* brinjal and non-GE brinjal can cross, producing fruit with viable seed, and that GE *Bt* brinjal can cross with at least one wild species. However, further tests are needed to ascertain whether GE *Bt* and non-GE brinjal can cross with several other closely related species. Therefore, cross-pollination

³ Available from:
<http://www.greenpeace.org/international/Global/international/publications/agriculture/2012/GE-Bt-brinjal-revisited.pdf>

resulting in hybrids between GE *Bt* brinjal and at least some of its wild, weedy or cultivated relatives is likely if GE *Bt* brinjal is cultivated.

The report concludes that our knowledge of the diversity and taxonomy (classification) of the wild relatives of brinjal in South and Southeast Asia is incomplete. Updated knowledge is needed as a basic starting point in the understanding of the potential for GE genes to escape from GE *Bt* brinjal and persist in populations of brinjal and its close relatives. There is an urgent need for more detailed studies on hybridisation, gene flow, weediness and systematics of brinjal and its wild, weedy and cultivated relatives. The implications for plant biodiversity of the outdoor cultivation of GE *Bt* brinjal, including field trials and commercial growing, cannot be fully assessed in the absence of this knowledge of brinjal and its wild, weedy and cultivated relatives.

Greenpeace demands: No environmental releases of GE *Bt* brinjal

This independent report commissioned by Greenpeace International uncovers many gaps in our knowledge of the distribution of brinjal's wild and weedy relatives, and the relationships between them. There is a distinct likelihood that GE *Bt* brinjal will outcross and transmit genes to these wild and weedy relatives, which may then persist and spread (introgress) through the population. Because the *Bt* transgene confers resistance to certain insect pests, it gives a selective advantage to these relatives, which in some cases are already weeds. This could create new problem weeds.

There are additional concerns regarding the spread of the *Bt* transgene through wild, weedy and cultivated brinjal populations that are not covered in this report. These include the effects on non-target organisms – for example, beneficial insects – raising the risk of effects at the species population level. Food safety could also be compromised as the safety of GE crops is not known, and GE *Bt* brinjal is no exception. If the *Bt* transgene spreads through whole populations of cultivated varieties and landraces, there would be no GE-free choice.

There is insufficient evidence that non-GE brinjal will remain uncontaminated. Yet, the consequences of widespread contamination are potentially serious. Greenpeace urges governments to employ the precautionary principle and not permit any authorisation of the outdoor cultivation of GE *Bt* brinjal, including field trials.

For more information, contact:
enquiries@greenpeace.org

Greenpeace International
Ottho Heldringstraat 5
1066 AZ Amsterdam
The Netherlands
Tel: +31 20 7182000

greenpeace.org