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Importance and Prospect of Bt Brinjal As a Safe Food

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Importance and prospect of Bt brinjal as a Safe Food

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ABSTRACT

Brinjal, also known as eggplant, is third most important vegetable in Bangladesh in terms of both yield and area cultivated. However, the yield of brinjal could be much higher but it is decreased by the brinjal shoot and fruit borer (BSFB), which is the most destructive insect pest in South and South East Asia. It was found that, 2-5% shoot and 17-50% fruit infestation caused by BSFB. Farmer uses a lot of pesticide for controlling the brinjal shoot and fruit borer. Genetically modified brinjal (Bt brinjal) has the potential to bump up agricultural productivity in Bangladesh. It was found that Bt brinjal reduced insecticide use against FSB 77.2% and it gives 33% more yield. Bt brinjal can reduces pesticide cost of farmers from 25-80 %. It summarizes the results of recent research undertaken in Bangladesh on the environmental safety of Bt brinjal and safe food. Therefore, Bt brinjal could make a significant contribution to safe food production. Environmentally safe agriculture will be ensured by Bt brinjal.

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INTRODUCTION

Brinjal or eggplant (*Solanum melongena* L.) is an important solanaceous crop grown in Bangladesh. It is one of the major vegetables and its production ranks third among all vegetables in the world. Brinjal is a versatile and economically important vegetable among small-scale farmers and low income consumers of the entire universe (FAO, 2000). Nutritionally brinjal offer substantial amounts of some vitamins and minerals (Nonnecke, 1989). Low in calories and high in nutrition, the vegetable has very high water content and is a very good source of fiber, calcium, phosphorus, folate, and vitamins B and C. It is also used in ayurvedic medicine for curing diabetes, hypertension and obesity (ISAAA,2009). It is a perennial but grown commercially as an annual crop. Although Bangladesh produced huge amount of brinjal it is only a fraction of the world's production. In Bangladesh, over 1, 24,526 acres of total cultivable land is devoted to brinjal cultivation (BBS, 2016).

The crop is mainly cultivated on small family farms and is an important source of cash income for many resource-poor farmers .Yet, the growth and production of brinjal is affected – due to a dozen of insect pest species. *Leucinodes orbonalis* Guenee is considered to be the most serious pest of brinjal and it has become a very serious production constraint in all brinjal growing countries (Alam *et al*., 2003).To address this problem, many eggplant farmers in major eggplant producing areas in the Philippines and Bangladesh spray chemical insecticides every other day, or up to 80 times per growing season (Tacio,2013).For brinjal production, farmers spray insecticides at 2-3 days intervals (in one season 80-160 times) which are most harmful for public health and environment. The excessive use of insecticides creates adverse effect on human health and environment.. It was not possible to develop variety resistant to brinjal shoot and fruit borer by conventional breeding.(http:// bteggplant.cornell.edu).

Bt brinjal is a genetically modified brinjal, carrying an additional gene that provides an in-built insect protection against fruit and shoot borer (FSB). The development of Bt brinjal involves the introduction of the so-called cry1Ac gene, expressing insecticidal protein to confer resistance against FSB. The cry1Ac gene is sourced from environment friendly and ubiquitous soil bacterium called Bacillus thuringiensis (Bt) (Choudhary and Gaur,2009) .

Safe food is a food which maintains food safety regulation. Food safety is a scientific discipline describing handling, preparation, and storage of food in ways that prevent food-borne illness. In this way food safety often overlaps with food defense to prevent harm to consumers. The tracks within this line of thought are safety between industry and the market and then between the market and the consumer. Food should be free from hazard materials like pesticide residue (https://en.wikipedia.org).

Bangladesh Agricultural Research Institute (BARI) is involved in research to improve the production and quality of Bt brinjal .Already they released four variety of Bt brinjal .The varieties are BARI Bt Begun-1 (Uttara), BARI Bt Begun- 2 (Kajla), BARI Bt Begun-3 (Nayantara) and BARI Bt Begun-4 (ISD006).Further researches are carried on Bt brinjal development in Bangladesh Agricultural Research Institute (BARI).

Thus, considering the above I have fixed the following two objectives in this review.

Objectives:

1. To learn about the importance of brinjal in Bangladesh.
2. To know the prospect of Bt brinjal in Bangladesh.

CHAPTER-2

MATERIALS AND METHODS

This seminar paper is exclusively a review paper so all of the information has been collected from the secondary sources. During preparation of this paper, key information from various relevant books, journals, proceedings, reports, publications, internet browsing etc were collected. Findings related to my topic have been reviewed with the help of the library facilities of Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU). Valuable suggestion and information were got from my course instructors, my major professor and other resource personnel. After collecting all the available information, this seminar manuscript was compiled and prepared.

CHAPTER-3

REVIEW OF FINDINGS

Brinjal production in Bangladesh

Eggplant is a staple food in Bangladesh, India and other countries in South and Southeast Asia where it is called brinjal .In Bangladesh, it is the third most important vegetable in terms of production and grown on about 50,000 hectares across the country (Choudhary *et al*.,2014). Hence, eggplant is an important source of income to many Asian farmers. In Bangladesh, brinjal cultivation rate are increasing day by day. In figure 1, shows that the cultivation area for brinjal production is 124 thousand acre and annual production is 475 thousand ton in 2015-16 (BBS,2016).

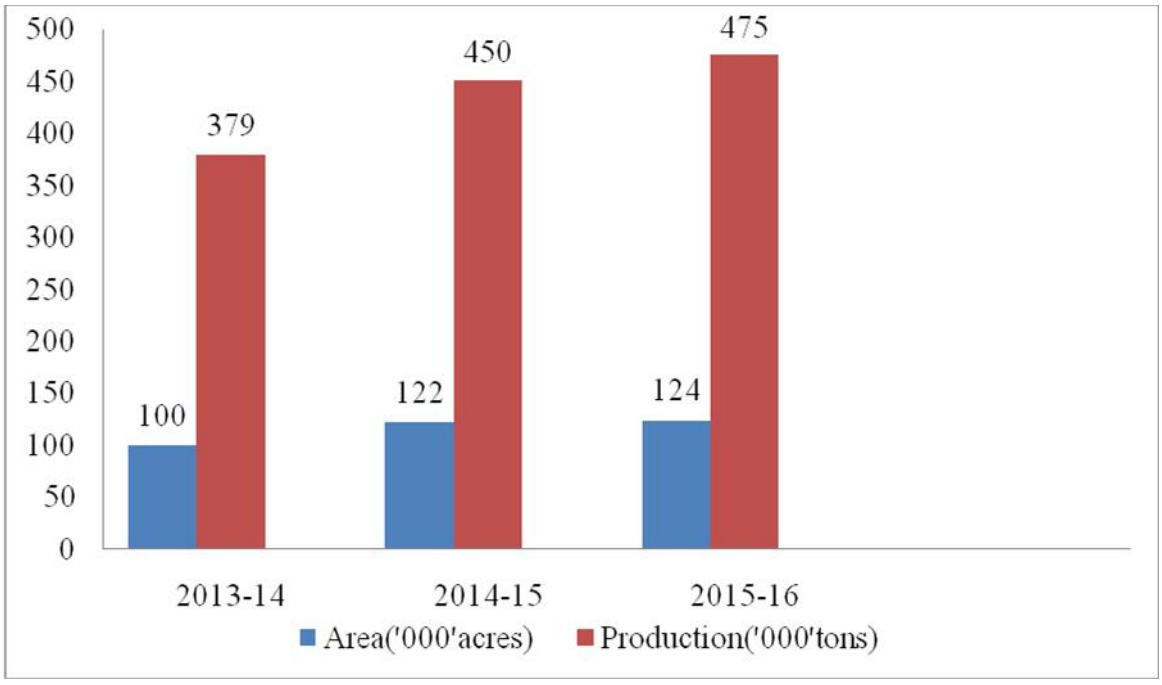

Figure 1: Area and Production of Brinjal cultivation in Bangladesh.

Source :(BBS, 2016)

Nutritional Characteristics of brinjal

Brinjal consists of almost 95 percent of water and is superior in terms of fiber, folic acid etc. It has very small amount of fat and supplies 25 calories per serving. It contains good amounts of many essential B-complex groups of vitamins such as vitamin B5, vitamin B6, vitamin B1 & B3. These vitamins are essential in the sense that body requires them from external sources to replenish and required for fat, protein and carbohydrate metabolism. Further, this vegetable is also an excellent source of minerals like manganese, copper, iron and potassium. The antioxidant enzyme, superoxide dismutase utilizes manganese as a co-factor. Potassium is an important intracellular electrolyte that helps counter pressing (hypertension) effects of sodium.(Detailed information are given table 1) (Choudhary and Gaur ,2009)

Table1.Nutritional Composition of Brinjal(All values are per 100 gm of edible portion)

Nutrients	**Value**	**Nutrients**	**Value**
Moisture	92.70%	Calcium	18.0 mg
Energy	24 Kcal	Magnesium	16.0 mg
Fiber	1.3 gm	Phosphorus	47.0 mg
Fat	0.3 gm	Iron	0.9 mg
Protein	1.4 gm	Sodium	3.0 mg
Carbohydrates	4.00%	Copper	0.17 mg
Vitamin A	6.4 mg	Potassium	2.0 mg
Vitamin B	0.15 mg	Sulphur	44.0 mg
Vitamin C	12.0 mg	Chlorine	52.0 mg
Oxalic acid	18.0 mg	ß-carotene	0.74 µg

Source: (Choudhary and Gaur ,2009) and(Chadha and Kalloo ,1993)

Main problem of brinjal production

The main problem with growing brinjal is that the yield of brinjal is decimated by a dozen of insect pest species, among which the most serious and vicious one is the brinjal shoot and fruit borer (FSB).Brinjal farmers suffer significant yield losses at 51-73% annually due to the Eggplant Fruit and Shoot Borer (FSB) (SEARCA BIC, 2010).Female moths deposit eggs mostly on eggplant leaves. When the eggs hatch and turn into larvae (Figure 2).

Adult moth and larvae of BSFB .

Plant Death Caused by FSB larvae .

Fruit damage caused by FSB larvae.

Figure 2: Adult moth and larvae of BSFB, Plant death and fruit damage of Brinjal Caused by FSB Larva.

Source: (ISAAA, 2015), (Agricultural Biotechnology Support Project II (ABSPII), 2005)

These small larvae bores inside shoots and bores into petioles and midribs of large leaves and tender shoots, causing shoot tips to wilt. Later on, they also bore into flower buds and fruits (Figures 2). Attributable to its infestation, it affects the quality and quantity of fruits (Mall *et al.*, 1992). Affected fruits are difficult to sell on the market (unless the price is discounted heavily) and contain significantly less vitamin C (Abrol and Singh, 2003 and Ghosh *et al*.,2003). Table 2 and 3 shows that, Shoot and Fruit infestation caused by brinjal shoot and fruit borer of Six brinjal varieties/lines at different days after transplantation (DAT).

Table 2.Shoot infestation caused by brinjal shoot and fruit borer

Varieties/Lines	**Shoot infestation caused by BSFB (%**				
	60 DAT	**80 DAT**	**100 DAT**	**120 DAT**	**Mean**
Bijoy	4.54	5.30	5.77	4.65	5.04
Islampuri BADC	2.12	3.68	5.53	4.10	3.96
Kajla	3.42	2.70	3.55	2.92	3.09
Nayantara	2.00	3.74	4.67	3.49	3.50
Singnath	2.93	2.51	3.41	1.83	2.76
Uttara	2.51	3.08	3.79	2.59	2.99

Source: (Ahmad *et al*.,2008)

Table 3: Fruit infestation caused by brinjal Shoot and fruit borer

Varieties/Lines	**Fruit infestation caused by BSFB (%)**				
	60 DAT	**80 DAT**	**100 DAT**	**120 DAT**	**Mean**
Bijoy	26.04	33.44	56.14	44.04	40.97
Islampuri BADC	13.69	32.37	43.66	43.29	35.50
Kajla	11.24	18.15	32.24	30.44	24.09
Nayantara	10.11	19.91	31.43	37.32	25.53
Singnath	5.41	21.06	33.69	33.33	24.23
Uttara	17.23	23.13	32.94	38.18	29.24

Source: (Ahmad *et al*.,2008)

In table 4 shows that, the mean fruit yield obtained was 24.63 ton ha-1 in treated plots and 12.69 ton ha-1 in untreated plots .The per cent increase in yield over untreated control and avoidable loss were 94.07 and 48.47 Per cent, respectively. If the losses due to *L. orbonalis* could be avoided by pest control measures, the production can be appreciably increased.

Table 4. Assessment of crop losses due to shoot and fruit borer, *Leucinodes orbonalis (L.)* Guen. to brinjal crop in Kharif, 2015

Treatment	Yield (ton ha-1)	Increase in yield over untreated control (%)	Avoidable loss (%
Treated	24.63	94.07	48.55
Untreated control	12.69		
Increase in yield	11.94		

Source: (Modified from Prasad *et al.*, 2017)

To control this insect pest, farmers all over the world use large quantities of chemical insecticides singly or in combination to get blemish free fruits. In the district of Jessore, farmers spray pesticides 140 times during a cropping season of 180-200 days. As a result farmers suffer numerous health problems (including skin and eye irritation and faintness), resulting from direct exposure to pesticide during handling and spraying (Rahman,2000 and Wilson,2001). In Bangladesh, almost all farmers experienced sickness related to pesticide application (e.g. physical weakness or eye infection or dizziness) and 3 percent were hospitalized due to complications related to pesticide use (Alam *et al.,* 2003). In India, 43 percent of brinjal farmers suffered from health hazards due to various complexities related to pesticide application (Kolady and Lesser,2005). Despite some progress in improving the productivity of brinjal in Bangladesh through new vegetable techniques, recent experiments have shown that the productivity of brinjal could be more than tripled in both Bangladesh and India by growing genetically modified brinjal (Bt brinjal). Detailed socioeconomic studies were conducted along with large scale trials of Bt brinjal(Crawford *et al.*,2003 and Quasem,2003) indicated the potential of Bt brinjal to increase farmers' welfare through insecticide reductions and an increase in marketable yields of brinjal fruits

Bt brinjal: Process of Bt development

Bt brinjal is a genetically modified brinjal, carrying an additional gene that provides an in-built insect protection against fruit and shoot borer (FSB). It has been developed by the Maharashtra Hybrid Seed Company Ltd. (Mahyco), a leading Indian seed company, by inserting a gene cry1Ac from a soil bacterium called *Bacillus thuringiensis* through the *Agrobacterium* t*umefacie*rs mediated method. Bt brinjal contains three genes, namely:

1. The cry1Ac gene, which encodes an insecticidal protein Cry1Ac, is derived from a common soil bacterium *Bacillus thuringiensis* (Bt) subsp. *Kurstaki* to produce the insecticidal protein. Thecry1Ac gene is driven by a viral promoter, the cauliflower mosaic virus (CaMV) 35S promoter.
2. The nptII gene for an antibiotic resistance marker, neomycin phosphotransferase-II, and
3. The aad gene for another marker O-aminoglycoside adenyl transferase.

The expression of the cry1Ac genes provides an effective built-in control in brinjal crop against FSB and thus reduces pests-linked damages and protects the environment from adverse effects of pesticides. This is also expected to bring down the cultivation cost of brinjal, as the cost of chemical pesticides to brinjal cultivation is substantial. The cry1AC protein produced in Bt brinjal is similar in structure and function to that found in nature and in commercial B.t.k. microbial formulations (Kumar *et al*.,2011).

Action of *Bacillus thuringiensis var Kurstaki* on caterpillar

Bt has to be eaten to cause mortality. The *Bt* toxin dissolve in the high pH insect gut and become active. Figure 3 shows the mode of action of Bt on caterpillar.

1. Caterpillar consumes foliage treated with Bt (spores and crystalline toxin).
2. Within minutes, the toxin blinds to specific receptors in the gut wall and the caterpillars stop feeding.
3. Within hours, the gut wall breaks down, allowing spores and normal gut bacteria to enter the body cavity; the toxin dissolves.
4. In 1-2 days, the caterpillar dies from septicemia as spores and gut bacteria proliferate in its blood.

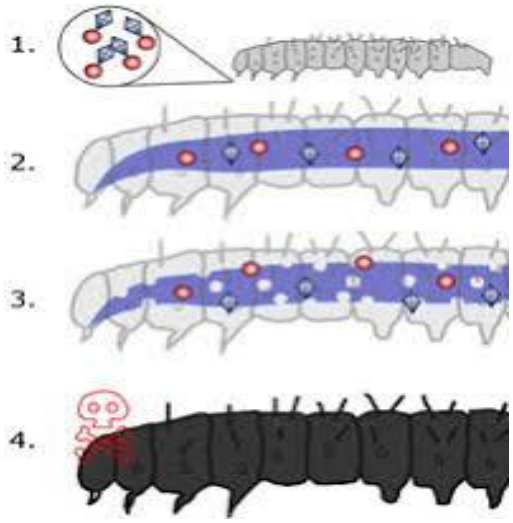

Figure 3: Action of *Bacillus thuringiensis* var. *Kurstaki* on caterpillar.

Source: http://www.bt.ucsd.edu/how_bt_work.html

Bt action is very specific. Different strains of *Bt* are specific to different receptors in insect gut wall. *Bt* toxicity depends on recognizing receptors, damage to the gut by the toxin occurs upon binding to a receptor. Each insect species possesses different types of receptors that will match only certain toxin proteins, like a lock to a key.

Fate of Bt protein in FSB, Non- target pest and humans

Bt eggplant expresses Bt gene, enabling it to produce the same protein that makes it resistant to FSB. When Bt protein is ingested by FSB larva, it is made soluble by the presence of enzyme and alkaline condition (pH9.5) of the gut. It then binds into another protein (receptor) present in the midgut resulting to an active toxin. The Bt toxin then punctures the gut leaving the insect unable to eat. The insect dies within a few days(Tacio,2013) .The Bt protein only affects FSB and does not affect humans, farm animals, and other non target organisms because these organisms do not have the required gut conditions (pH and required receptor) to activate the toxin (Figure 4). (https://www.isaaa.org)

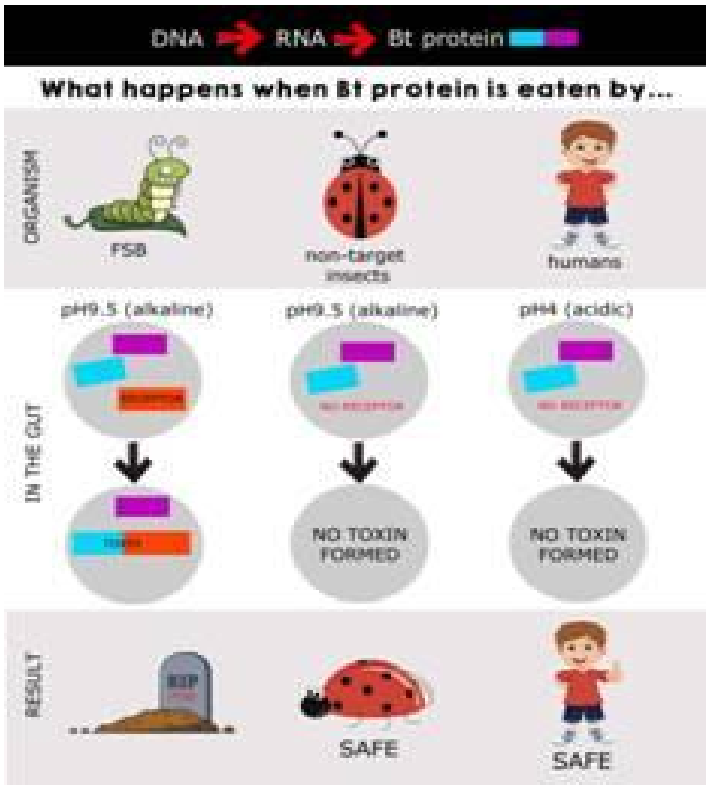

Figure 4: Fate of Bt protein in FSB, non-target organisms, and humans.

Source: https://www.isaaa.org

Variety released by BARI

BARI released four Bt brinjal varieties [BARI Bt Begun-1 (Uttara), BARI Bt Begun-2 (Kazla), BARI Bt Begun-3 (Nayantara), and BARI Bt Begun-4 (ISD 006)] on 30 October, 2013 following the exiting rules of the country (http:// bteggplant.cornell.edu).

Figure 5: Four varieties released by BARI .

Source: https://bteggplant.cornell.edu

Commercialization of Bt brinjal varieties in Bangladesh

On 22-01-2014, Bt brinjal seedlings were distributed among 20 farmers of Gazipur, Pabna, Rangpur and Jamalpur districts. The farmers successfully cultivated the distributed seedlings and sold the produce in the market. Based on experimental data, Bt brinjal can increase yield by at least 30% and reduce the number and cost of insecticide applications by 71-90% (Choudhary *et al*.,2014) In 2015, approximately 250 farmers planted Bt brinjal on 25 meters of land (James.2015).In the year (2014-2015), Bt brinjal demonstrations plots were established in 108 farmers' field across 19 districts in the country. Shoot and fruit borer infestation was not observed anywhere. Due to no infestation of the insect, production is more (on an average 25-39 ton per hectare) and farmers are benefited by selling the produce in the market. From the results, it is observed that the performance of Bt brinjal was better than non Bt brinjal in all districts. Table 5 shows that while the infestations by the insect in shoots and fruits in Bt brinjal were only 0.00-0.05 per cent and 0.04-0.88 per cent respectively, the infestations in non-Bt brinjals were 30.00-40.00 percent and 48.00-57.00 per cent, respectively.

Table 5.Percentage of insect attack on Bt and Non Bt brinjal

Type of brinjal	**Insect attack on shoot**	**Insect attack on fruit**
Bt brinjal	0.00-0.05 per cent	0.04-0.88 per cent
Non Bt brinjal	30.00-40.00 percent	48.00-57.00 per cent

Source: http://bteggplant.cornell.edu

Reduction in Application of Insecticide

The performance of Bt hybrids over non-Bt and popular hybrids of brinjal was examined in terms of reduction in insecticide-use (Table 6) using data from large-scale field trials conducted by the Indian Institute of Vegetable Research (IIVR), a premier research institute under the Indian Council of Agricultural Research. These trials were conducted at8 locations for 7 hybrid varieties of brinjal containing Bt gene, non-Bt hybrids and most popular hybrids during2007-08 and 2008-09 to assess their marketable fruit yields. The data on reduction in insecticide-use were taken from the trials conducted by the All India Vegetable Improvement Project (AICVIP)

during 2004-05 and 2005-06. The analysis revealed that use of Bt technology had resulted in a significant reduction in insecticide-use.

Overall, the quantities of insecticides used against FSB were reduced by 77.2 per cent, which amounted to 41.8 per cent reduction in the total insecticide-use in brinjal (Table 6).

Table 6. Reduction in insecticide use due to Bt brinjal hybrids

Year	**Reduction in insecticide use* (%)**	
	Against FSB	**Against all insect-pests**
2007-08	80.0	40.4
2008-09	74.5	43.2
Average	77.2	41.8

Note: *relates to the years 2004-05 and 2005-06

Source:(IIVR ,2009 and AICVIP/ ICAR ,2007)

Yield increased due to Bt brinjal Cultivation

A large number of field trials and studies were conducted from 2004 to 2008 to ascertain the agronomic benefits of Bt brinjal hybrids vis-à-vis non-Bt counterparts in different agro-climatic zones. These studies were undertaken by two organizations, Mahyco and All India Coordinated Vegetable Improvement Program (AICVIP) of the Indian Council of Agricultural Research (ICAR). All 7 Bt brinjal hybrids tested at 11 locations out-yielded their non-Bt counterparts and national best check. It was noted that the marketable yield of Bt brinjal hybrids was substantially higher in locations where the pest infestation was comparatively high, which suggests that Bt technology was effective in controlling FSB. The mean marketable yield of 7 Bt brinjal hybrids was 32.93 tons per hectare compared to 26.28 tons per hectare of non-Bt counterparts and 25.15 tons per hectare of national best check. The mean marketable yield increased by 25% and 31% compared to non-Bt counterparts and national best check respectively as highlighted in Table 7.

Table 7. Summarized results of first year large-scale field trials (LSTs) with Bt brinjal hybrids conducted by IIVR/ICAR, 2007 to 2008

Field Trials	Mean marketable yield (tons/ha			Increase in marketable yield over	
	Bt brinjal hybrids	Non-Bt counterparts	National best check (Pusa Hybrid-6)	Non-Bt counterparts	National best check (Pusa Hybrid-6)
2007-08	32.93	26.28	25.15	25%	31%

Source: (IIVR, 2008)

Table 8, gives the results of the multi-location research trials of Bt brinjal hybrids conducted by Mahyco from 2004-05 to 2005-06.

Table 8. Summarized results of multi-location research trials with Bt brinjal hybrids conducted by Mahyco, 2004 to 2006

Field Trials	Increase in fruit yield over			
	Non-Bt counterparts		Popular hybrids	
	Yield Increase (tons/ha)	%	Yield Increase (tons/ha)	%
2004-05	29.4	117	28.4	120
2005-06	–	7	–	110
Average	–	100	–	116

Source :(Mahyco , 2008b) (Krishna and Qaim , 2007b, 2008)

Difference between Bt and non-Bt brinjal

In figure 6 shows that Bt brinjal was fresh looking, free from any spot and suitable for marketing and non-Bt brinjal was not suitable for consumption and it losses it's marketing quality.

Figure 6: Non-Bt Brinjal and Bt Brinjal.

Source: UPLB IPB Bt Eggplant Project, 2014 (http://www.searca.org)

Economic benefits of Bt brinjal cultivation

Farmers were benefited at multiple levels; they could save on quantity of insecticide used (Table 9), which directly affected savings in cost on insecticides and on labor in spraying of insecticides. A considerable increase observed in yield was due to low damage from FSB, which led to higher production and increase in income per unit area.

Table 9. Potential economic benefits of Bt brinjal cultivation to farmers and consumers under different adoption scenarios at all-India level

Particulars	Scenarios: Adoption level		
	I: Low (up to 15%)	**II: Medium (up to 30%)**	**III: High (up to 60%)**
Benefits to farmers			
• Increase in production ('000 tons)	29.70	59.40	118.80
• Saving from insecticides for FSB (in crore 'taka')	61.05	122.10	244.19
• Increase in net returns (in crore 'taka')	812.86	1625.73	3251.45
• Increase in net returns (taka/ha)	14386.70	28773.40	57548.10
Benefits to consumers			
• Likely reduction in brinjal price (%)	3.00	7.00	15.00

Source: (Modified from Kumar *et al*., 2010)

Corresponding to the assumed adoption levels of Bt hybrids, brinjal output to the tune of 30 thousand tons to 119 thousand tons can be added to total production from the existing area under brinjal (Table 10).

Table 10. Summary data used for simulation of economic gains from Bt-brinjal hybrids

Particulars	Region/ all-India				
	Eastern	**Western**	**Northern**	**Southern**	**All-India**
Production (thousand tons)	7036	1869	482	990	10377
Maximum yield gain (%)	33	33	33	33	33
Reduction in cost (%)	17	17	17	17	17
Price elasticity of demand	-0.515	-0.515	-0.515	-0.515	-0.515
Price elasticity of supply	1.0	1.0	1.0	1.0	1.0

Source :(Kumar *et al.*, 2011)

Impact and safety of Bt brinjal

The average shoot damage as well as the fruit infestation in Bt hybrids was far lower than that in non-Bt brinjal (Meherunnahar and Poul,2009).In addition to growth and pest studies, a variety of safety studies were conducted for Bt brinjal at BARI in order to comply with the Bangladeshi regulatory process. Data from such studies demonstrate that the protein which is inserted into genes causes no adverse effects on humans, wild and domesticated animals, birds, fishes and non-target insects, including beneficial insect. The safety of Bt proteins is attributed to the mode of action, specificity and digestibility. Scientists continued to conduct rigorous tests to ensure that Bt brinjal is safe for human consumptions or not. It was found that Bt brinjal is substantially equivalent to food and feed from non-Bt brinjal (Choudhary and Gaur,2009). The safety of Bt brinjal was also tested in various feeding studies (including among others chicken, cow and fish) and no toxicity was detected and no new allergenic compounds were found due to feeding Bt brinjal. Finally, Bt brinjal were used to determine whether the Bt protein was present in cooked fruits. The Bt protein was undetectable in cooked fruits. Table 11 shows that, Bt protein had been

tested after cooking by using ELISA (Enzyme-linked Immunusorbent Assay) (Choudhary and Gaur, 2009).

Table 11.Detection of protein after cooking by ELISA

Entry	Method of cooking	First time-point of sampling	No. of replications	ELISA result
Bt brinjal	Uncooked	-	3	Positive
	Roasted	5 min	3	Negative
	Steamed	1 min	3	Negative
	Shallow-fried	1 min	3	Negative
	Deep-fried	1 min	3	Negative
Non-Bt brinjal	Uncooked	-	3	Negative
	Roasted	5 min	3	Negative
	Steamed	1 min	3	Negative
	Shallow-fried	1 min	3	Negative
	Deep-fried	1 min	3	Negative

Source: (Mahyco,2006)

This study indicates that the Cry1Ac protein in Bt brinjal fruits is rapidly degraded upon cooking. Based on these results, a series of consultations and focus group discussions with scientific, agricultural, and regulatory experts were conducted in Bangladesh in July 2007, focusing on the potential effects of biotechnology improvements to resist biotic and abiotic stresses. The status of research, agricultural constraints, the potential of biotechnology, and other issues related to regulatory approval and consumer acceptance of transgenic crops were discussed with relevant experts (Meherunnahar and Poul,2009).

CHAPTER-4

CONCLUSION

From Bangladesh aspects Bt brinjal has great prospect for farmers to get better yield. Based on the studies undertaken so far in India and Bangladesh, Bt brinjal can be considered to be safe to the environment. Bt brinjal provides an effective means of control of lepidopteron insect pests specifically brinjal fruit and shoot borer and provides economic benefits to farmers.

- Bt brinjal controls target insect pests without adversely impacting beneficial insects and other non-target organisms.
- It can reduce insecticide use against FSB 77.2% and against all insect 40.4%.
- It can gives maximum 33% yield than non Bt brinjal.
- With growing Bt brinjal, it is possible to reduce the costs of small and marginal farmers by 25-80 percent, largely due to the reduction in pesticides spray.
- Bio-safety studies conducted till date show no significant differences between Bt and non-Bt brinjal

Bt brinjal is a environment friendly food and it can improve economic condition of brinjal farmers in Bangladesh.

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