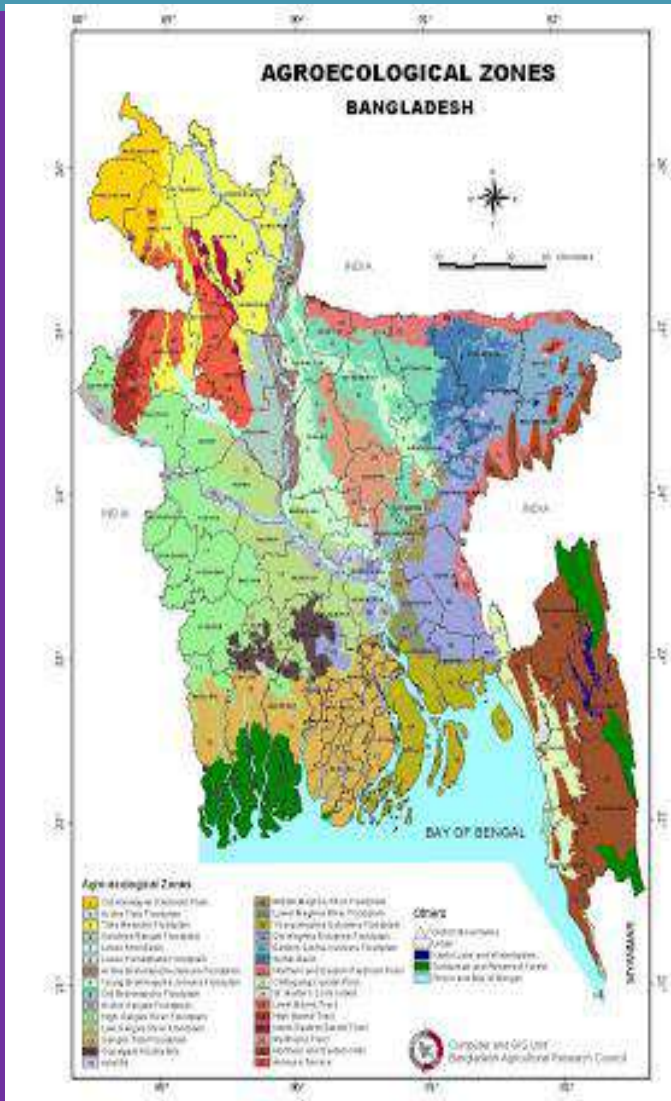


Bt Brinjal Research & Development in Bangladesh

Md. Jahangir Hossain, Ph.D.
Country Project Coordinator
FtF Biotech Partnership for Eggplant

IPB, UPLB, Los Banos,
Philippines
07 June 2018



Bangladesh

Area: 147,570 sq.km.

Population: 165 million

Bangladesh Agriculture –At a glance

Total area : 14.6 mil ha

Cultivable land : 8.56 mil ha

Cultivable fallow land : 0.2 mil ha

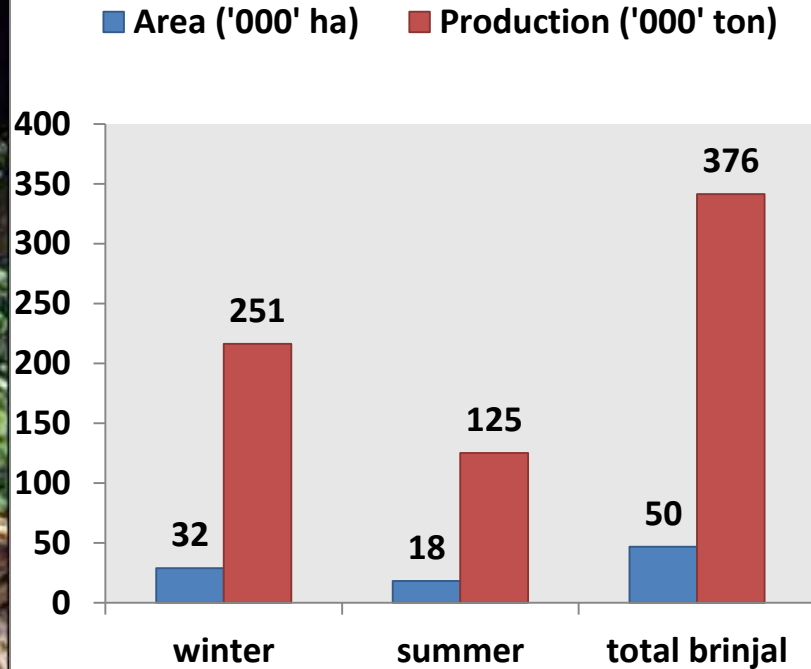
Cropping intensity : 192%

Total farm family : 15.18 million

Contribution in GDP : 14.75

Status of Vegetables in Bangladesh

Area	0.445 m ha
Production	3.00 m MT
Present consumption	55 g/day/person(BBS)
Recommendation	220g/day/person
Requirement (as per recommend)	11.24 m MT
Production to be increased (as per recommendation)	4 folds of the present production
No. of cultivated vegetable crops	> 90
Brinjal Position in terms of area & prodn	1 st



- Available round the year
- Around 15% share in winter vegetables production and 9% in summer
- Low average productivity 8.30 t/ha (BBS 2016)

Bt Brinjal Var. development pathways at BARI

Bt Eggplant Partners: India, Bangladesh, Philippines

Project Title: Agril. Biotech Support Project (ABSP)

Crops: Brinjal and Potato

2004 - 2005: USAID donated Cry1Ac gene. Event EE-1 developed by Mahyco. Backcrossing program initiated (BC1) for 9 local varieties of brinjal of Bangladesh at Mahyco.

2005 - 2006: Bangladesh Government imported **BC 1**, via MTA with Mahyco. BC2 developed at BARI.

2007: BC3 population were developed and Cry1Ac gene identified.

2008: BC3 (F2) generation yielded through self-pollination and MLT with BC3 F2 with five varieties

2009 – --BC3(F3), BC4

2010----BC3F4, BC5

Multi-location field trials conducted at 7 locations, Field day 200
Farmers attended.

2010 – 2011---BC3F5

–Confined field trials for 9 varieties were done in 7 locations

2011 – 2012--MLTs was repeated in the same 7 locations with all the 9
varieties as requested by Ministry of Agriculture

2012 – 2013--MLTs is being repeated in the same 7 locations with all the
9 varieties and **applied for releasing 4 varieties.**

2013-- Four varieties were released as 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.

2014--Honorable Agriculture Minister distributed Bt Eggplant seedlings among 20 farmers of four regions of Bangladesh on 22 Jan 2014, in a limited scale productions.

ABSP project closed, Bt brinjal program continued under FtF as “Feed the Future South Asia Eggplant Improvement Partnership”

2016---BARI applied for releasing more 3 Bt brinjal lines
NTCCB core committee approved 3 Bt brinjal as BARI
Bt brinjal 5, 6, 7. Proposal is waiting for NCB approval.



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Population advancement in Contained Greenhouse (BC₁- BC₃F₇) at BARI



Confined Field Trial of Bt brinjal at BARI





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9 Variety /lines included in the Bt Program



Singhnath



Uttara



Nayantara



Dohazari



Kazla



Chega



Khatkatia



Islampuri



ISD 006



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Ministry of Environment and Forest , Govt. of the peoples Republic of Bangladesh has Released 4 Bt Brinjal Varieties for Limited field production in the farmer field

Ref. No 22.00.0000.073.05.003.2012-271

dated: 30 October 2013



BARI Bt begun-1



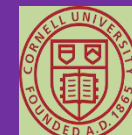
BARI Bt begun-2



BARI Bt begun-3



BARI Bt begun-4



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3 Bt brinjal lines waiting for registration



Dohazari

BARI Bt brinjal 5



Khatkatia

BARI Bt brinjal 6



Singhnath

BARI Bt brinjal 7

Bio-Safety issues

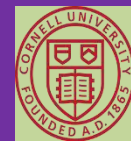
- Confined area
- Security guard for 24 hrs
- Maintained register for visitors
- Restricted entrance
- Buried of GM fruits
- Burning of plant parts
- FBC reporting to ministry (discontinued)



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Bt Brinjal Research



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Breeder seed production of Bt brinjal and quality assurance 2015-16

Variety	Area (ha)	Prodn (kg)	Seed quality	Remarks
BARI Bt Begun 1	0.41	140	Pure Seed-100, Inert Matter-0, Other seed-0, Germination-98, Moisture-7.9	
BARI Bt Begun 1	0.14	13.5	Pure Seed-100, Inert Matter-0, Other seed-0, Germination->90, Moisture-7.9	
BARI Bt Begun 2	0.55	112	Pure Seed-100, Inert Matter-0, Other seed-0, Germination-98, Moisture-8.0	
BARI Bt Begun 2	0.14	11	Pure Seed-100, Inert Matter-0, Other seed-0, Germination-93, Moisture-7.9	
BARI Bt Begun 2	0.28	2	Pure Seed-100, Inert Matter-0, Other seed-0, Germination-96, Moisture-7.9	
BARI Bt Begun 2	0.55	33	Pure Seed-100, Inert Matter-0, Other seed-0, Germination-96, Moisture-9.0	Wilt
BARI Bt Begun 3	0.41	32	Pure Seed-100, Inert Matter-0, Other seed-0, Germination-91, Moisture-8.0	

Contd.

Variety	Area (ha)	Prodn	Quality	Remarks
BARI Bt Begun 3	0.14	0	Plant damaged due to wilt disease	Severe wilt
BARI Bt Begun 3	0.14	20.5	Pure Seed-100, Inert Matter-0, Other seed-0, Germination-98, Moisture-7.9	
BARI Bt Begun 3	0.28	2.0	Pure Seed-100, Inert Matter-0, Other seed-0, Germination-81, Moisture-9.5	Wilt
BARI Bt Begun 3	0.41	30	Pure Seed-100, Inert Matter-0, Other seed-0, Germination-90, Moisture-8.5	
BARI Bt Begun 4	0.69	200	Pure Seed-100, Inert Matter-0, Other seed-0, Germination-98, Moisture-7.9	
BARI Bt Begun 4	0.41	39	Pure Seed-100, Inert Matter-0, Other seed-0, Germination-90, Moisture-9.0	
Total	4.55	661		

Breeder Seed Prodn. of Bt brinjal during 2016-17

Variety	Location	Area (sq. m)	Area (ha)	Production (kg)
BARI BtBrinjal1	RARS, Rangpur	7920	0.81	150
	ARS, Dinajpur	3960	0.40	84
BARI BtBrinjal2	RARS, Barisal	6600	0.67	200
	RARS, Jessore	2640	0.27	45
	OFRD, Pabna	2640	0.27	60
	HQ, Gazipur	5280	0.54	32
BARI BtBrinjal3	RARS, Jamalpur	6600	0.67	24
	ARS, Pahartali,	2640	0.27	18
	OFRD, Rangpur	5280	0.54	160
BARI BtBrinjal4	RARS, Pabna	6600	0.67	220
	OFRD, Bogra	5280	0.54	75
Total	11	55440	5.65	1068

Breeder Seed Prodn. of Bt brinjal during 2017-18

Variety	Location	Area (sq. m)	Area (ha)	Target of each var. (kg)	Actual Production (kg)
BARI Bt Brinjal-1	RARS, Barisal	1333	0.1333	15	20
BARI Bt Brinjal-2	RARS, Rangpur	1333	0.1333	15	21
BARI Bt Brinjal-3	Gazipur	1333	0.1333	15	18
Total	3	4000	0.40	45	59

Breeder Seed Production



Planting of seedling



Fruits ripening



Seed processing



Seed testing

Breeder seed production by the Project

Year	Bt Brinjal Project (kg)		Present stock (kg)
	Production	Distribution	Rest
2013-14	8.10	1.12	6.98
2014-15	90.0	6.40	83.60
2015-16	661.0	251	335
2016-17	1068.0	125	943
2017-18	59.0	-	59
Total	1886.1	383.52	1427.58

Bt Brinjal seed production by other project/agency

Year	GoB Project (kg) (breeder)			BADC (kg) (Foundation)			Total stock (kg)
	Prod.	Use	Rest	Prod.	Use	Rest	
2015-16	75	75	0				0
2016-17	475	10	465	284	235.4	48.6	513.6
2017-18	450	-	450	113	-	113.0	563.0
Total	1000	85	915	397	235.4	161.6	1076.6

Bt brinjal seed quality testing 2015-16 & 2016-17

Location	Variety	Sample size (no. of seed)	Moisture of seed (%)	Germination (%) Seed of 2015-16 (%)	Germination (%) Seed of 2016-17 (%)
Seed Tech Div	Bt Begun 4	25	5.98	-	24.25 (97%)
RARS Barisal	Bt Begun 2	25	4.98	22 (90%)	23.00 (92%)
ARS Dinajpur	Bt Begun 1	25	5.61	22 (90%)	23.25 (93%)
OFRD Rangpur	Bt Begun 1	25	5.88	22 (90%)	22.75 (91%)



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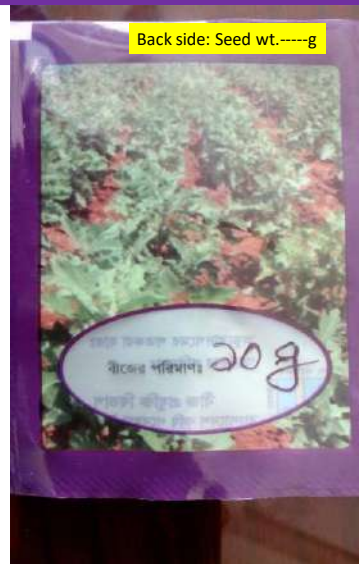
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Front side: BARI Bt Brinjal-4
Germination -----%
Moisture -----%

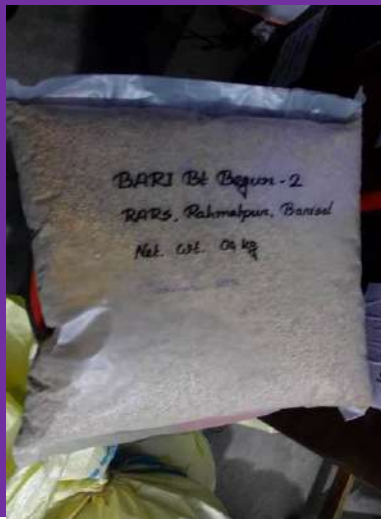


Back side: Seed wt. -----g



Seed processing

- Drying
- Quality testing
- Germination %
- Moisture %
- Storing in poly bag
- Distribution bag



Bt protein expression in Bt brinjal plants at different locations during 2016-17

Variety	Location	Plants tested for Bt gene	Positive result (No.)	Positive result (%)
BARI BtBrinjal1	RARS, Rangpur	3300	3293	99.78
	ARS, Dinajpur	2500	2500	100
BARI BtBrinjal 2	RARS, Barisal			
	RARS, Jessore	1220	1220	100
	OFRD, Pabna			
BARI BtBrinjal 3	RARS, Jamalpur	3560	3548	99.66
	ARS, Chittagong	2000	2000	100
	OFRD, Rangpur	200	200	100
BARI BtBrinjal4	RARS, Pabna	500	500	100
	OFRD, Bogra	1500	1500	100

The presence of *Cry1Ac* gene is determined by ELISA in Breeder seed crop of Bt brinjal 2 at Gazipur during 2016-17

Treatments	Range Absorbance	Mean Absorbance	Standard deviation	Standard error
Positive control	0.535-1.628	0.974	0.329	0.109
Negative control	0.021-0.238	0.145	0.0647	0.021
BARI Bt Brinjal 2	0.609-2.286	1.106	0.237	0.008
BARI begun-4 (Kazla) (Non-Bt)	0.062-0.0834	0.080	0.011	0.006



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Confirmation test for Cry 1 Ac gene in Bt brinjal varieties



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Result of the strip test for the presence of Bt gene in the Bt seed during 2017

Variety	Location	No. of plants tested	Positive result	Negative result	Presence of Bt gene in Btbrinjal plants
BARI BtBrinjal1	RARS, Rangpur	100	100	0	100%
	ARS, Dinajpur	100	100	0	100%
BARI BtBrinjal 2	RARS, Barisal	100	100	0	100%
	RARS, Jessore	100	100	0	100%
	OFRD, Pabna	100	100	0	100%
	Biotech., Gazipur	100	100	0	100%
BARI BtBrinjal 3	RARS, Jamalpur	100	100	0	100%
	RARS, Chittagong	100	100	0	100%
	ARS, Chittagong	100	100	0	100%
	OFRD, Rangpur	100	100	0	100%
BARI BtBrinjal 4	RARS, Ishurdi	100	100	0	100%
	OFRD, Bogra	100	100	0	100%



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Variety purification: Maintenance breeding





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MAINTENANCE OF Bt BRINJAL VARIETIES/LINES



**Seedling
(40-45 days)**



**Planting
(last Nov.-First Dec.)**



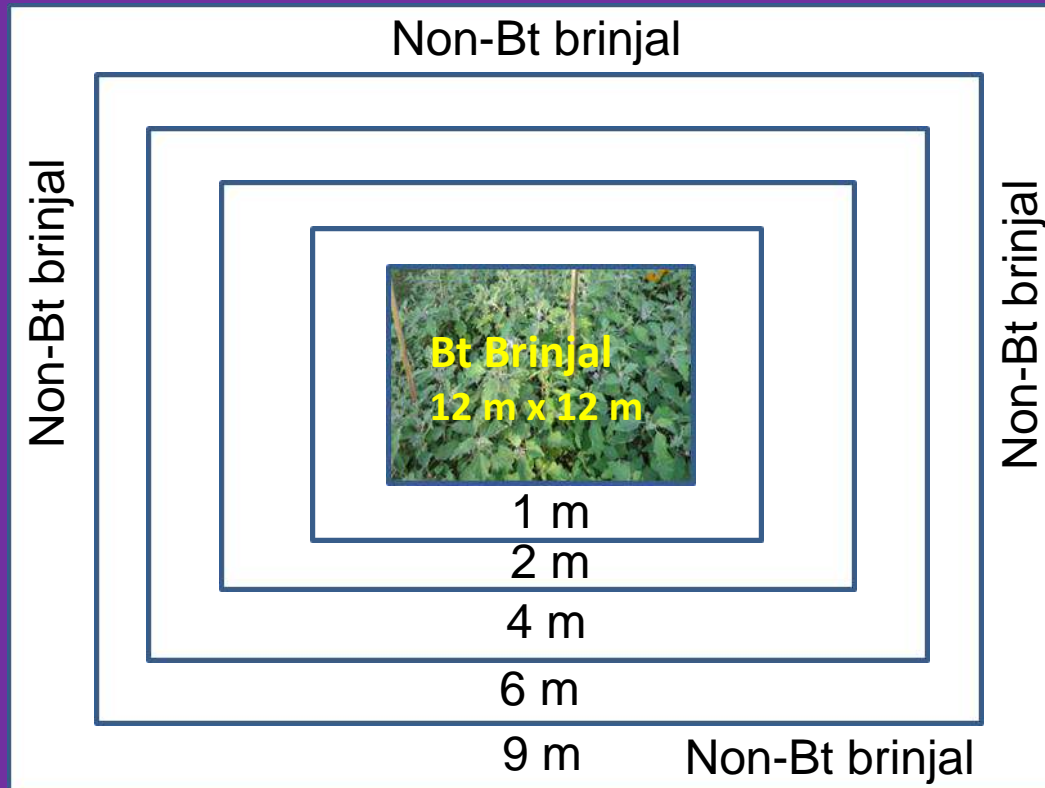
**Netting before
flowering**



**Discarding off
type plants**

MEASURING GENE FLOW IN THE CULTIVATION OF Bt BRINJAL

Objective : To estimate the frequency and distance of pollen dispersal from the Bt Brinjal Plant





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Pictorial view of Gene Flow Measurement



Seed from Non-Bt



Seedling



Strip test

Study of pollen movement of Bt brinjal into surrounding non-Bt brinjal line in 2016-17

Dist. from Bt (m)	North		South		East		West		Total	
	Plant tested (no.)	Cross pollination (%)	No. plants tested	Cross pollination (%)	Plants tested (no.)	Cross pollination (%)	Plants tested (no.)	Cross pollination (%)	Plant tested (no.)	No. and % cross pollination
1	100	8	100	17	100	10	100	21	400	56 (14)
2	100	5	100	11	100	6	100	12	400	34 (8.5)
4	100	3	100	1	100	2	100	8	400	14 (3.5)
6	100	4	100	3	100	0	100	2	400	9 (2.25)
9	100	5	100	3	100	1	100	1	400	10 (2.5)
18	100	0	100	2	100	1	100	4	400	7 (1.75)
Total	600	25	600	37	600	20	600	48	2400	130(5.4)

IRM issues

- Use refusa cent % farmers by BARI and spray insecticides for sucking pests
- No use of refusa at farmers field of DAE & also minimum spray for sucking pests, so crop partially damaged.
- BADC sale Bt brinjal seed to farmers by dealer, they have no idea to use refusa and minimum spraying of insecticides, crop partially damaged.
- Maintained isolation distance with local brinjal varieties, not always



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Promotional Activities

Honorable Minister for Agriculture
Begum Motia Chowdhury MP
distributing seedlings of Bt Brinjal among
the selected farmers

22 January 2014



Farmers Field Trials of Bt brinjal conducted by BARI

Parameters	2013-14	2014-15	2015-16	2016-17	2017-18
No. farmers	20	108	250	512	581
No. Variety	4	4	4	3	3
Training	Received	Received	Received	Received	Received
Leaflet supply	no	yes	yes	yes	Yes
District	4	19	25	36	30
Season	winter	winter	winter	Winter	winter
Seed distribution	Seedling	Seed+ Seedling	Seed+ Seedling	Seed+ Seedling	Seed+ Seedling
Seed sowing	Oct-Nov	Sept-Nov	Sept-Nov	Oct-Nov	Nov-Dec
Transplanting	Nov-Dec	Oct-Nov	Oct-Dec	Nov-Dec	Dec-Jan
Crop protection	Sprayed	Sprayed	Sprayed	Sprayed	Sprayed
Refugia crop by	Non-Bt set	Non-Bt set	Non-Bt set	Non-Bt set	Non-Bt set
Crop duration	150-180	150-180	150-180	150-180	150

Yield and economics of Bt Brinjal at farmers field

Parameters	Bt/Non-Bt	2013-14	2014-15	2015-16	2016-17
Av. Shoot infest. (%)	Bt crop	0	0-0.33	0-2.86	0-2.90
	NBt crop	86.32	21.54-65.0	14.21-68.92	2.7-90.0
Av. fruit infest. (%)	Bt crop	0	0-5.12	0-3.2	0-3.01
	NBt crop	100	32.8-78.0	10.9-80.0	4.80-67.25
Fruit yield (t/ha)	Bt crop	10-20	23.77	25.25	23.95
	NBt crop	7-11	14.97	13.11	12.89
Gross cost (tk/ha)	Bt crop	-	144049	129271	117035
	NBt crop	-	135360	124182	149747
Gross return (tk/ha)	Bt crop	-	296727	293348	313699
	NBt crop	-	154041	160981	174577
Net profit (tk./ha)	Bt crop	-	152679	165077	196664
	NBt crop	-	18681	36398	24830
% benefit over prodn cost	Bt crop	-	107	127	164
	NBt crop	-	21	31	24

Bt brinjal adoption at farmers field in Bangladesh

Year	Unit plot size (decimal)	No. of trials			Total
		BARI	DAE	BADC	
2013-14	33.0	20	0	0	20
2014-15	33.0	108	0	0	108
2015-16	10.0	250	0	0	250
2016-17	10.0/20.0	512	6000	0	6512
2017-18	16.5/20.0/10.0	581	7001	19430	27012
Total		1471	13001	19430	33902

Total brinjal farmer in the country 150,000. It is about 22.60%

BARI=Bangladesh Agricultural Research Institute
DAE=Department of Agriculture Extension
BADC=Bangladesh Agriculture Development Corporation

Bt brinjal adoption in acreage in Bangladesh

Year	Unit plot size (decimal)	Area covered by diff. agencies (acre)			Total (acres)
		BARI	DAE	BADC	
2013-14	33.0	6.66	0	0	6.66
2014-15	33.0	36.00	0	0	36.00
2015-16	10.0	25.00	0	0	25.00
2016-17	10.0/20.0	51.20	1200.00	0	1251.20
2017-18	16.5/20.0/10.0	95.86	1400.20	1943.00	3439.06
Total		194.07	2600.20	1943.00	4757.92

5.94% of the winter brinjal crop (80,000 acres)

BARI=Bangladesh Agricultural Research Institute

DAE=Department of Agriculture Extension

BADC=Bangladesh Agriculture Development Corporation

Bt brinjal research/activities for 2017-18

- IRM Experiment contd.
- Sucking pest experiment contd.
- Seed production: Bt brinjal 1, 2 and 3; 15 kg of each in 3 locations
- Seed quality test: Monthly (moisture % and Germination %)
- Gene flow experiment contd.
- Cry1AC gene presence confirm by ELISA
- Training on quantitative and qualitative gene test by ELISA for scientists
- Gene expression test: by strip method contd
- Training on Bt brinjal crop production of DAE officer
- Stewardship training and farmers field trials: 581 by OFRD, BARI
- Farmers field trial by DAE: 7001 in 30 districts
- Monitoring of Bt brinjal works by project management team



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Scientists Training



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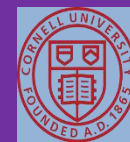
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Farmers' Training



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Dinajpur



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Bogra



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Mymensingh



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Field Day Bogra



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Project Management Team visiting Bt brinjal activities



Achievement/Success of Bt brinjal in Bangladesh

1. Variety release: 4 as Bt brinjal 1, 2, 3 and 4
2. Variety in pipeline: 3 as Bt brinjal 5, 6 and 7, waiting for release
3. Breeder Seed production: 2018.75 Kg. V1=480.8 kg, V2=547.5 kg, V3=327.0 kg and V4=663.45 kg
4. Seed distribution so far: about 1000 kg.
5. BARI scientists received training on Bt brinjal: 29
6. Local participants in workshop/training: 358
7. DAE Officer received training on Bt brinjal: 279
8. Bt brinjal adoption rate: 33,902 farmers (22.60%)
9. Area coverage: 4757.92 acre official record (5.94% of winter brinjal crop)

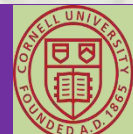
Hon'ble minister in support of Bt brinjal





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Barind Area



বিটি বেগুন
জাত: বারি বিটি বেগুন-৪



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On Farm Trial:

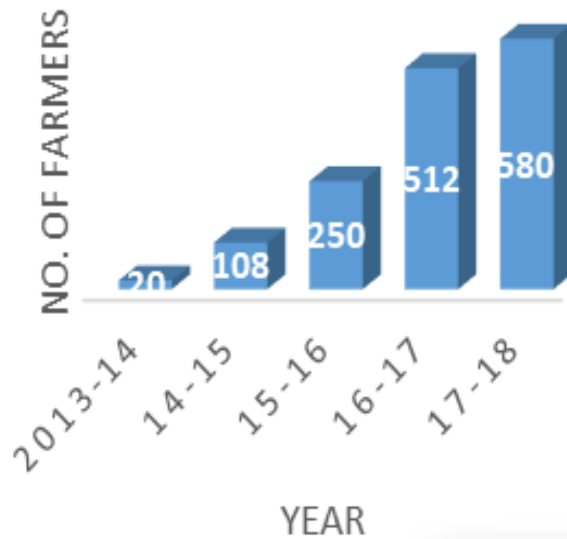
Farmers' Opinion

As the fruits of Bt brinjal varieties free from infestation, no sorting is required

Production cost becomes lower for no application of insecticides for BSFB

Higher gross margin obtained due to more fresh healthy fruits.

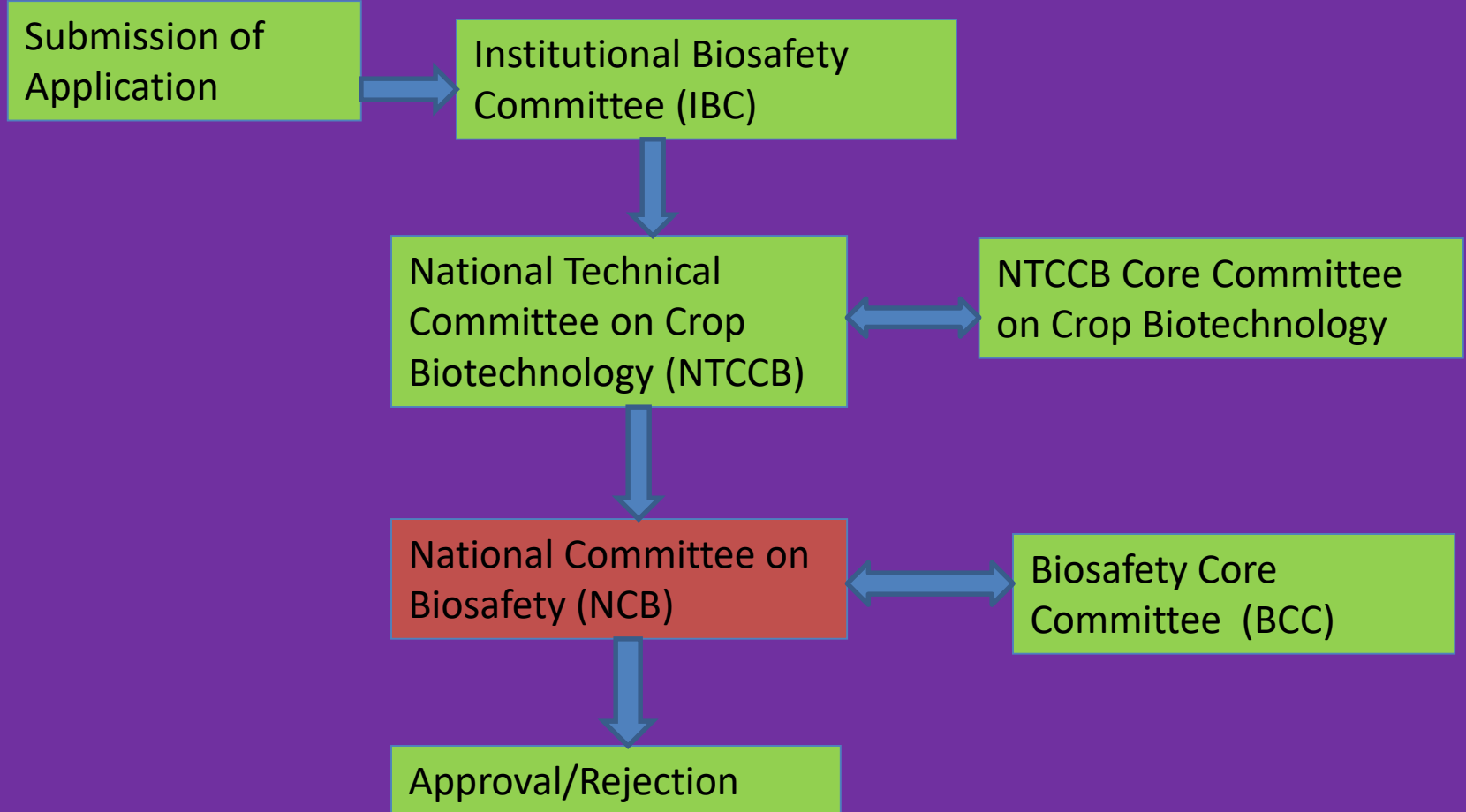
Farmers are interested to grow the varieties in the next season.



Challenges of Bt brinjal

- Seed Production: Presently it is done by BARI
- Private sector involvement: Biggest challenge, how to involve, need mechanism development
- Seed quality maintenance: Who will give the seed quality assurance?
- Centre of excellence: To ensure Bt brinjal seed quality, centre of excellence at BARI
- Stewardship of Bt brinjal seed: Traceability of Breeder seed and quality assurance of seed produced by other agencies/private company
- 2-gene variety development: 2-gene technology would be more strong and long lasting
- Farmers field trials monitoring: Need development of mechanism to monitor
- Biosafety compliance: At present, it is seldom followed, need improvement

Regulatory Process of GM crops in Bangladesh



US Charge the Affairs visited the Bt brinjal field





Thank you