GM food labelling: The science, sense and stewardship of it

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Food labelling in India

❖Food Safety and Standards (Packaging and labelling) Regulations,2011

1. The name of Food
2. List of Ingredients,
3. Nutritional Information,
4. Declaration regarding Veg or non-veg,
5. Declaration regarding Food Additives,
6. Name and complete address of the manufacturer or packer
7. Net Quantity,
8. Code No,/Lot No./Batch No.,
9. Date of manufacture or packing,
10 Best Before and Use By Date,
11. Country of Origin for imported food and
12. Instructions for use

GM food labelling is now mandatory in India

भारत का राजपत्र
The Gazette of India

G.S.R 427(E)- In exercise of the powers conferred by sub-section (1) read with clause (j) and (q) of sub-section (2) of section 52 of **the Legal Metrology Act, 2009** (1 of 2010), the Central Government hereby makes the following rules further to amend the **Legal Metrology (Packaged Commodities) Rules, 2011**, namely:-

1. (1) These rules may be called the Legal Metrology (Packaged Commodities) Amendment Rules, 2012

(ii) After sub-rule (6), the following sub-rule shall be inserted, with effect from 1st day of January, 2013, namely:-

'(7) **Every package containing the genetically modified food shall bear at the top of its principal display panel the words "GM".**

GM food labelling status across world



Labelling mandatory in 36 +1 (EU) countries

CFS, 2015

Position of Codex on GM Food labelling

"At the moment, there are no internationally-agreed recommendations on the food labelling of GM foods. Governments are therefore applying their own regulations"

Codex "Guideline for the conduct of food safety assessment of foods derived from recombinant-DNA plants" (CAC/GL 45-2003, annex III adopted in 2008)

India has been a strong supporter of mandatory labelling of GM foods in Codex discussions

Evaluation of GMO labelling policies.

Policy option	Small market for GMO-free	Large market for GMO-free
Labeling ban	Inefficient	Inefficient
Voluntary labeling	Works well, but needs some enforcement mechanism to minimize false claims	May work if the right enforcement mechanisms are in place
Mandatory labeling	Works, but imposes costs on all for the benefit of a few	Works and is no different from voluntary labeling if the market is large

Huffman and McClusky, 2014

Considerations for GMO labelling

- Right to know and consumer autonomy
- Costs
- Stigmatization
- Feasibility
- Impact on food security and innovation

Based on Oh and Ezezika, 2014

GM crops are now grown widely across the world



Isaaa, 2014

GM crops are grown in 28 countries and imported by several other countries.

GM crops in India

India has allowed use of only two **food products** derived from GM material, i.e

1. **imported GM soybean oil** (crude de-gummed/ refined form) derived from Roundup Ready Soybean for the purpose of consumption after refining
2. **domestically produced cottonseed oil.**

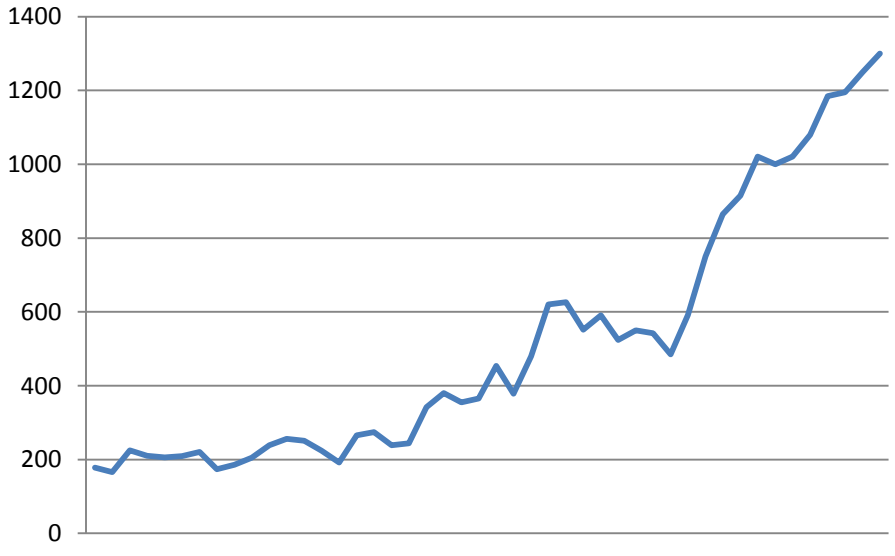
Indian imports

Commodity	HS Code	Quantity imported in 2014-15 (in thousand MT)	Value of imports (Rs lakhs)
SOYA BEANS, WHETHER OR NOT BROKEN	1201	6,312	2,343
SOYA BEAN OIL AND ITS FRACTNS W/N REFIND BUT NOT CHEMICALLY MODIFIED	**1507**	**2,317,179**	**1,291,093**
SOYA SAUCE	210310	145	240
SOYA MILK DRINKS W/N SWEETNDOR FLAVRD	22029010	438	297
ISOLATED SOYA PROTEIN	35040091	4,498	10,734
MAIZE (CORN)	1005	6,028	2,856
STARCH OF MAIZE (CORN)	110812	1,694	1,598
		DGFT, 2015	

Cottonseed oil in India

Oil	Production (1000 MT)
Rapeseed and musturd	2450
Cottonseed oil	**1350**
Soybean	1330
Groundnut	1150
Sunflower	163

India's cotton seed oil food use domestic consumption (1969-2014)



Source: USDA

Does the food made in cotton seed oil or imported soybean oil needs to be labelled as 'GM'?

Every package <u>containing</u> the genetically modified food shall bear at the top of its principal display panel the words "GM".

Containing vs ***derived from***

Foods produced with GM technology (e.g. cheese produced with GM enzymes) and products such as meat, milk and eggs from animals fed on GM animal feed do not have to be labelled

GM content in soybean oil

……Test Reports received from CFTRI indicate

(a) **<u>DNA was absent in Refined Soybean oil</u>** and Crude Oil LL Soybean for all events (LL event AA547-127, LL event A2704-12, RR event (BtRR2Y) and event BPS-CV127-9); and

(b) **No protein was detected** by amino acid analysis for all Soybean events mentioned above.

The Committee also noted that the tests have been conducted at a detection level of 0.01 %.

…….decided to approve the import of Refined Soybean Oil derived from transgenic Soybean

GEAC. 121ST MEETING, 18.07.2014

In the refined oil from genetically modified soybean and maize, DNA could not be detected nor PCR amplified following different DNA extraction methods(Laboratory of government chemists, UK, 1998)

Food addititives derived GM soybean

Soy ingredient	Use	Processing and testing for GM content	Labelling (EU)	Labelling (India)
Oils and fats	**Margarine, vegetable oils, mayonaise, and many other fat products**	Soy oil must be refined in order to get rid of solvent residues and other unwanted substances. This process involves heating oil to 120°C in a vacuum, which destroys DNA and protein to such an extent that it becomes impossible to tell if it was made from GM soybeans.	Yes	No
Lecithin and other emulsifiers	**Chocolate, desserts, baked goods, and other processed foods**	Lecithins are naturally found in soy oil. If lecithin is extracted from refined soy oil, GM content cannot be detected. If lecithin comes from soy oil that has not been refined, it may be possible to identify traces of GM soy.	Yes	No/Yes
Tocopherol / Vitamin E	**Prevents oxidation in many fatty foods; used in vitamin fortified products**	Vitamin E is produced as a by-product of plant oils. For detecting GM content, the situation is the same as lecithin.	Yes	No/Yes

Food addititives derived GM soybean

Soy protein additives, soy isolate	**Prepared foods (soups, sauces), meat substitutes, diet foods, imitation milk products, e.g. non-dairy creamer**	Made from roasted, de-oiled soy flakes. Although GM content can still be detected, the final product usually undergoes more processing, which destroys traces of GM content.	Yes	No/Yes
Soy meal, semolina flour	**Bread, snacks, pasta**	Similar to soy protein additives; baking often destroys traces of GM content.	Yes	No/Yes
Hydrolysed soy protein	**Soy sauce, seasonings**	The protein is chemically changed by acids or enzymes. This usually destroys DNA.	Yes	No/Yes
Products from whole soybeans	**Tofu, soy drinks, miso, soy flour**	GM traces can be detected in products made from whole soybeans.	Yes	No/Yes
Feed for poultry, swine, beef, and aquaculture	**Indirectly for animal products like meat, eggs, and milk**	Generally speaking, plant genetic information is not detectable in animals, regardless if they were fed GM feed.	Yes, (resulting animal products: No)	No

Food ingredients and additives produced by the saccharification of starch, which may be derived from GM maize

- **Gucose syrup:** Used in sweets, baked goods, and soft drinks
- **Dextrose (glucose):** Sold pure or used in sweets and energy foods
- **Fructose:** Sweetener for diabetics
- **Dextrin:** Filler and thickener in sweets, convenience products; carrier substance for flavours and vitamins
- **Maltose (maltitol):** Sweetener in sugar-free or low-sugar products



❖It is impossible to tell by examining starch derived sugar products if the source material was genetically modified or if the enzymes used were produced with the help of genetically modified microorganisms

❖Enzymes do not need to be declared or listed, regardless of the way they were produced.

Additives, Vitamins, Amino Acids, Enzymes produced from GM micro-organisms

❖**Vitamin B2 (colouring, rivoflavin E 101), vitamin C (preservative, ascorbic acid E 300);**

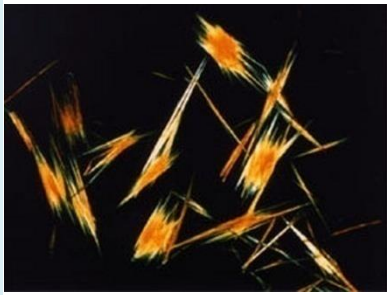
❖**Thickener, xanthan (E 415), acidity regulator**, **citric acid** (E 330);

❖**Preservative, natamycin (E 235), nisin (E 234), lysozyme (E 1105);**

❖Various amino acids used to improve the quality of animal feed - also used in some foods, e.g. the flavour enhancer glutamate (E621),

❖the sweetener **aspartame (E 951)** or the flour treating agent **cysteine (E 921);**

❖Numerous **enzymes used in cheeses**, bread and baked goods, alcoholic beverages, and juice, as well as in the production of glucose syrup (corn syrup), glucose, and other starch products





GMOs in dairy food products

❖It is estimated that 80 to 90 percent of cheese produced in the US and UK is made with chymosin produced by genetically modified microorganisms.



❖Beta-carotene colouring (E 160a); used as a yellow dye in butter during the winter - also used in some dairy desserts and yogurt.

❖Riboflavin colouring (E 101: Vitamin B2); used in cheeses and cream products

❖Preservatives: Natamycin (E 235), Nisin (E 234), Lysozyme (E 1105); approved for use in cheeses

❖Dairy desserts, creams, and puddings sometimes contain emulsifiers and thickeners made from GM soybeans or GM maize.

GM Labelling and organic food

National Programme for Organic Production (NPOP Regulations)
Foreign Trade (**Development** and Regulation) **Act**, 1992

- *Genetically engineered organisms or* ***products thereof*** are banned in organic farming
- Genetically engineered vaccines are prohibited
- Organic products shall not be labelled as GE (genetic engineering) or GM (genetic modification) free
- Additives or processing aids produced by means of genetic engineering prohibited

Major Considerations when Testing for GMOs?

❖Food companies would require to establish GM testing labs in their R&D/ QC departments in times to come, if not established already

❖GMO testing would be a routine practice in food industry (export/domestic)

❖Why is the product being tested for GMOs?

❖What level of information is being sought by the test?

❖Is this a raw commodity, an intermediate material or a highly processed product?

❖Is the product homogeneous?

Common terms in GMO detection

- CONSTRUCT
- EVENT
- EXPRESSION
- TRAIT
- LINE

SCREENING

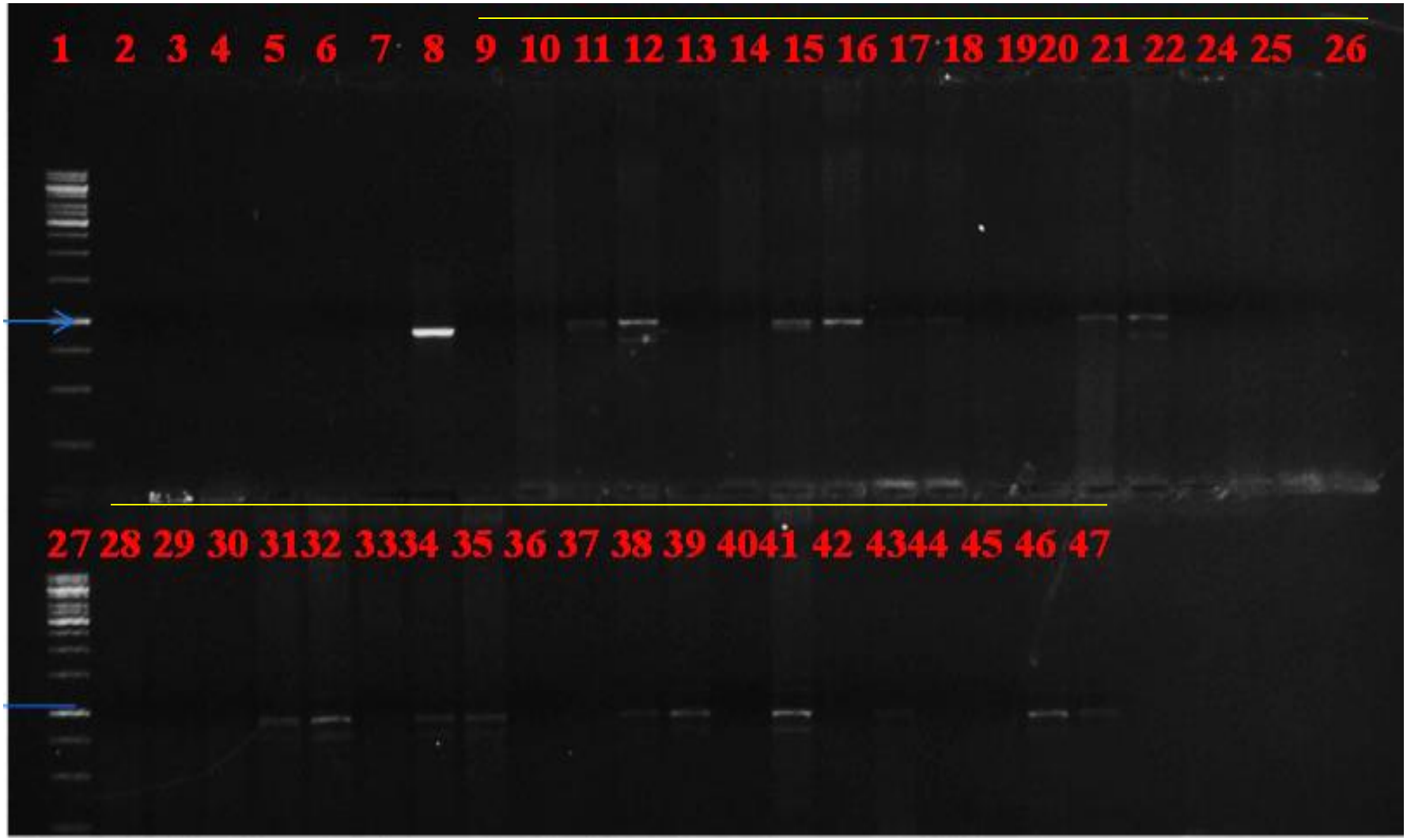
- Trait specific
- Construct specific
- Event specific
- Quantitative
- Qualitative

- Limit of Detection (LOD)

Methods of GMO detection

- ELISA
- Lateral flow strips
- PCR based methods
- Loop-mediated isothermal amplification (LAMP)
- RNA based
- Northen
- Southern

Detection of *cry* 1Ab Bt maize using PCR

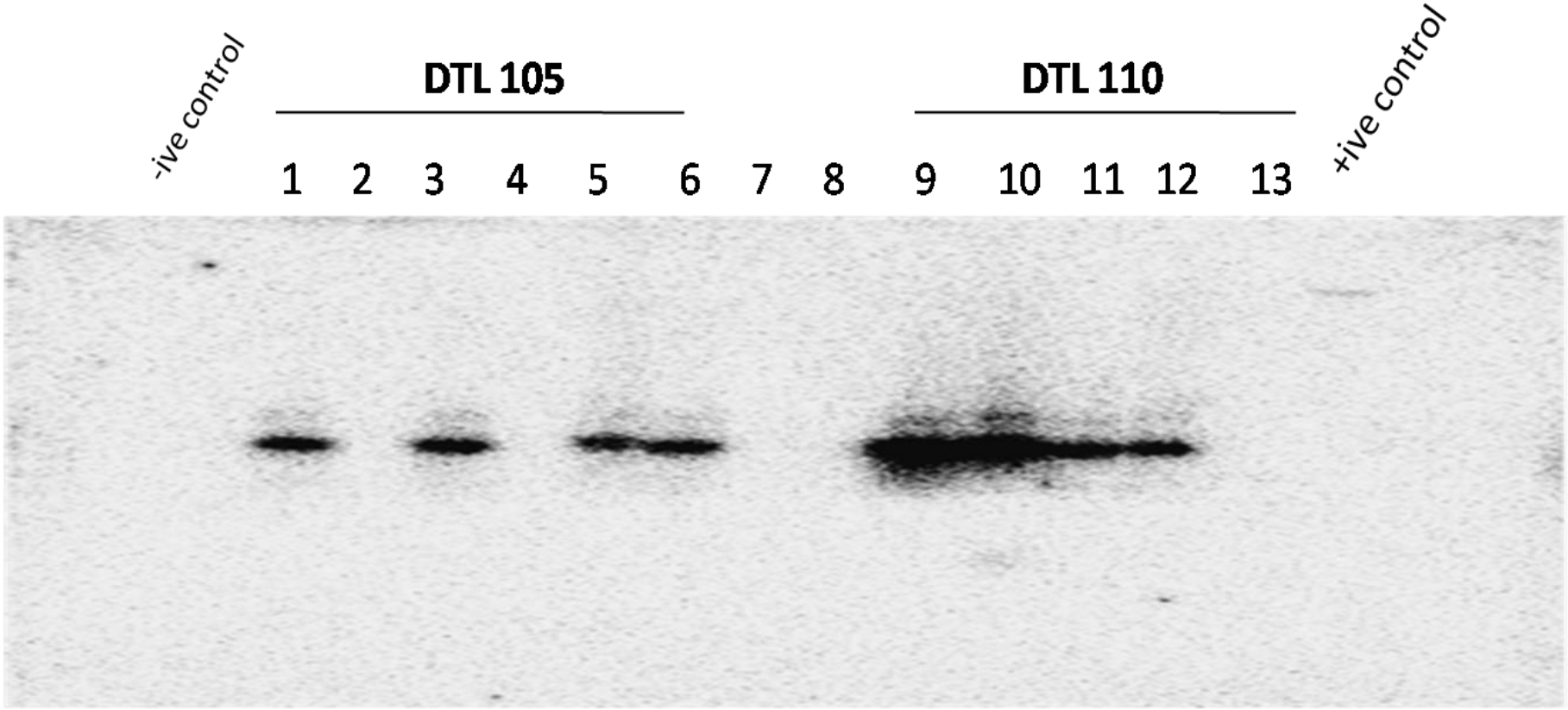


*cry*1Ab F- **atgcatcccgtacaactgcctcag**
cry1Ab R- **cgcatgtttgactttctcggacaa**

1&27 -1 kb ladder.
2-NTC,
3-7- non transformed regenerated plants.

8- +ve control pBT1291
10-26 & 28- 47 transformed samples

Southern blot for detection of T_1 stage GM maize events Event DTL 105 and Event DTL 110 (using radio labelled cry1Ab probe)

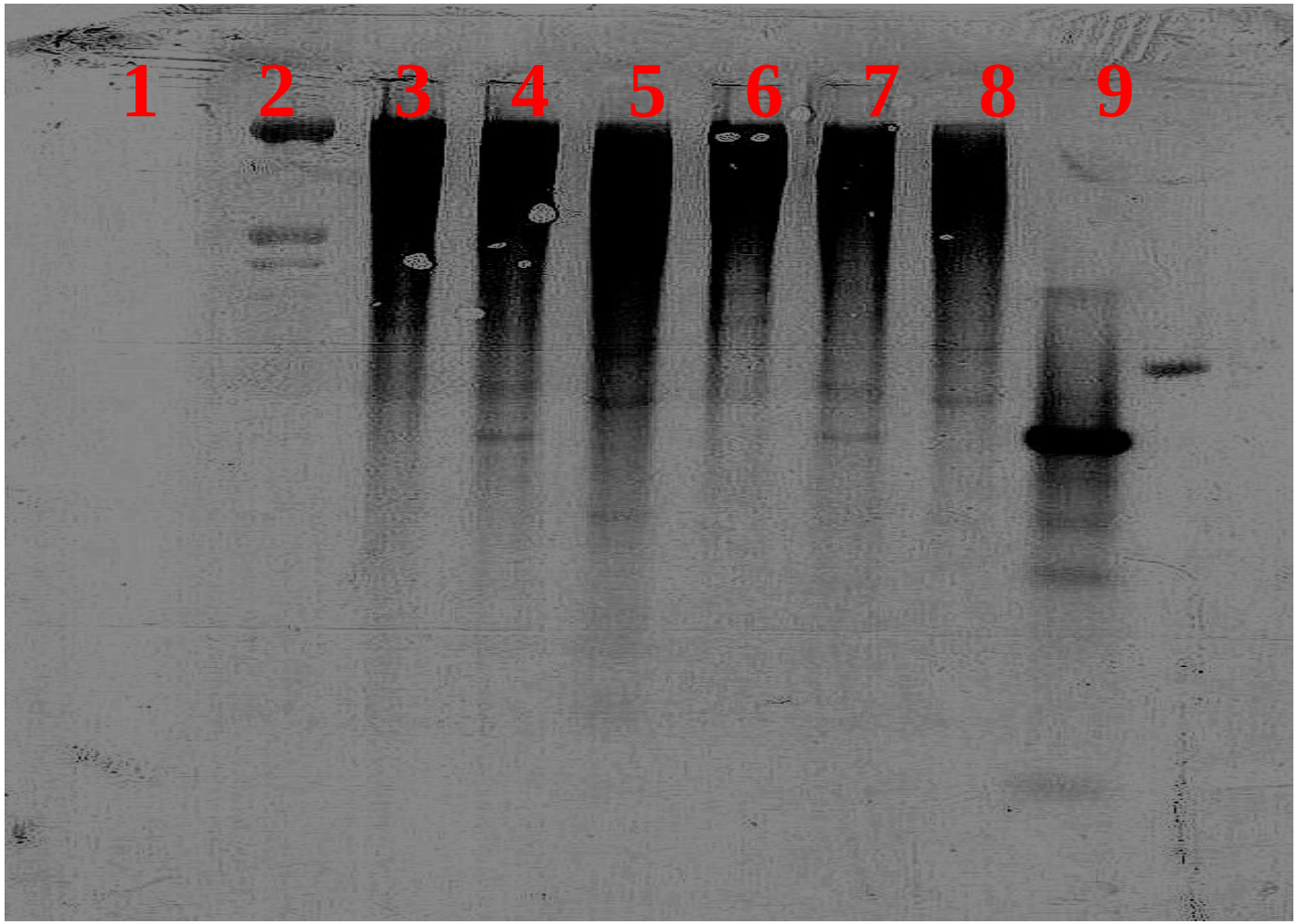


Digested with Xba I

-ve control-non transformed CM300
+ve control-pBT1291 plasmid

Southern blot for detection of T1 stage GM maize event Event# It2 using DIG labelled cry 1Ab probe

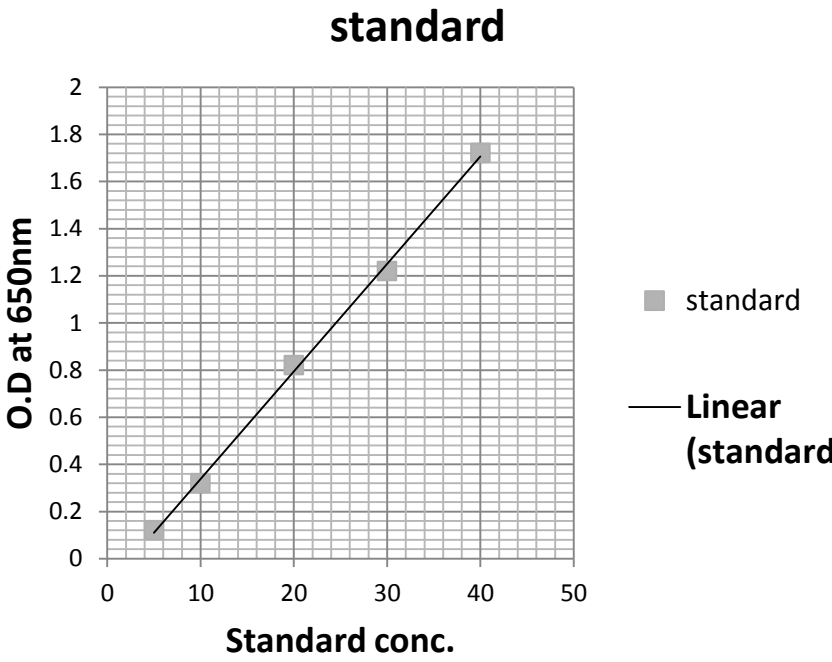
Lane 1= -C
Lane2=+C
Lane 3-9= iT-2 progenies
3=iT2-20,
4-iT2-35,
5-iT2-36,
6-iT2-38,
7-iT2-43,
8-iT2-46,
9-iT-78

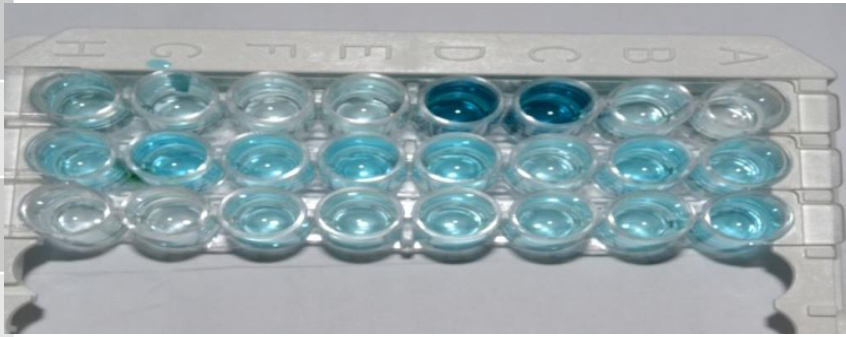


Digested with Hind III

ELISA based detection of Bt expression in selected plants of GM maize event DTL 105

S. No.	Event T5 plants	ng/mg of TSP
1	DTL 105-1	40
2	DTL 105-2	35
3	DTL 105-3	30
4	DTL 105-4	0
5	DTL 105-5	20
6	DTL 105-6	15
7	DTL 105-7	5
8	DTL 105-9	0
9	DTL 105-10	10
10	DTL 105-11	0





Conclusion

- GM labelling is a global reality before the food industry
- Labelling of packaged food ***containing*** the GM food is mandatory in India
- A number of food products may contain materials ***derived*** from GMOs. These need not be labelled
- **Organic food** industry is prohibited to use even materials ***derived*** from GMOs
- **GM testing** would be routinely required in food industry in times to come to meet regulatory requirements, both domestically as well as in export markets
- Industry needs to develop **expertise in GM testing** methods
- **Policy advocacy** for greater clarity and standards in GM labelling norms is required


Thanks!