Overview on GMO detection approaches

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Who uses detection methods and why?

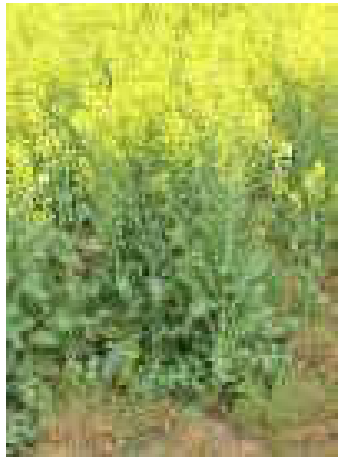
- GMO producers
  - To assure purity and segregation of products
  - To trace genetic modification in breeding
- Food & feed industry, seed companies
  - To assure purity and segregation of products
  - To assure compliance with legislation
- Competent (enforcement) authorities
  - Product control, compliance with legislation
  - To be able to retrieve specific products
    - E.g. if marketing permission withdrawn
- Laboratories
  - To provide analytical services to customers

Why to analyse GMOs?

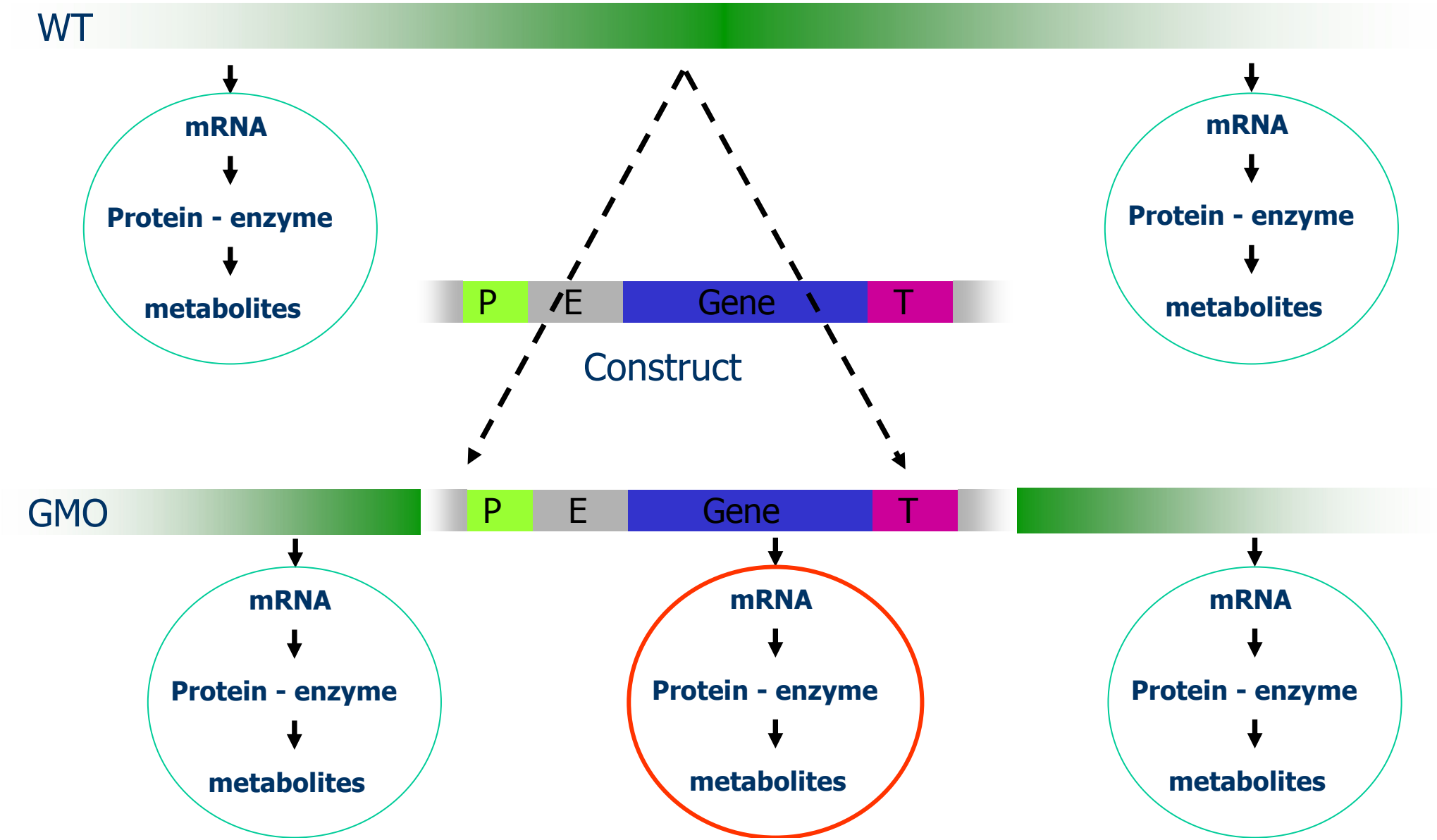
Contained use → **Deliberate release into the environment** → **Labelling and traceability**

Field experiments ↔ *Pre-market phase*

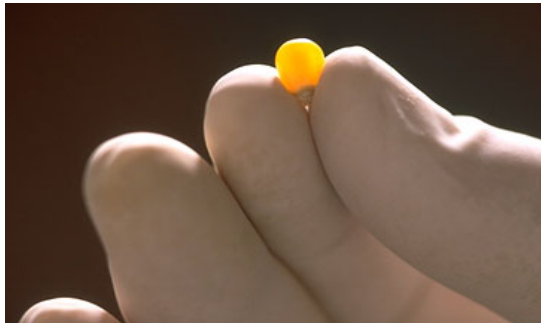
Marketing ↔ *Post-market phase*



How to Know if a Product is Genetically Modified ?



Which method to select ?



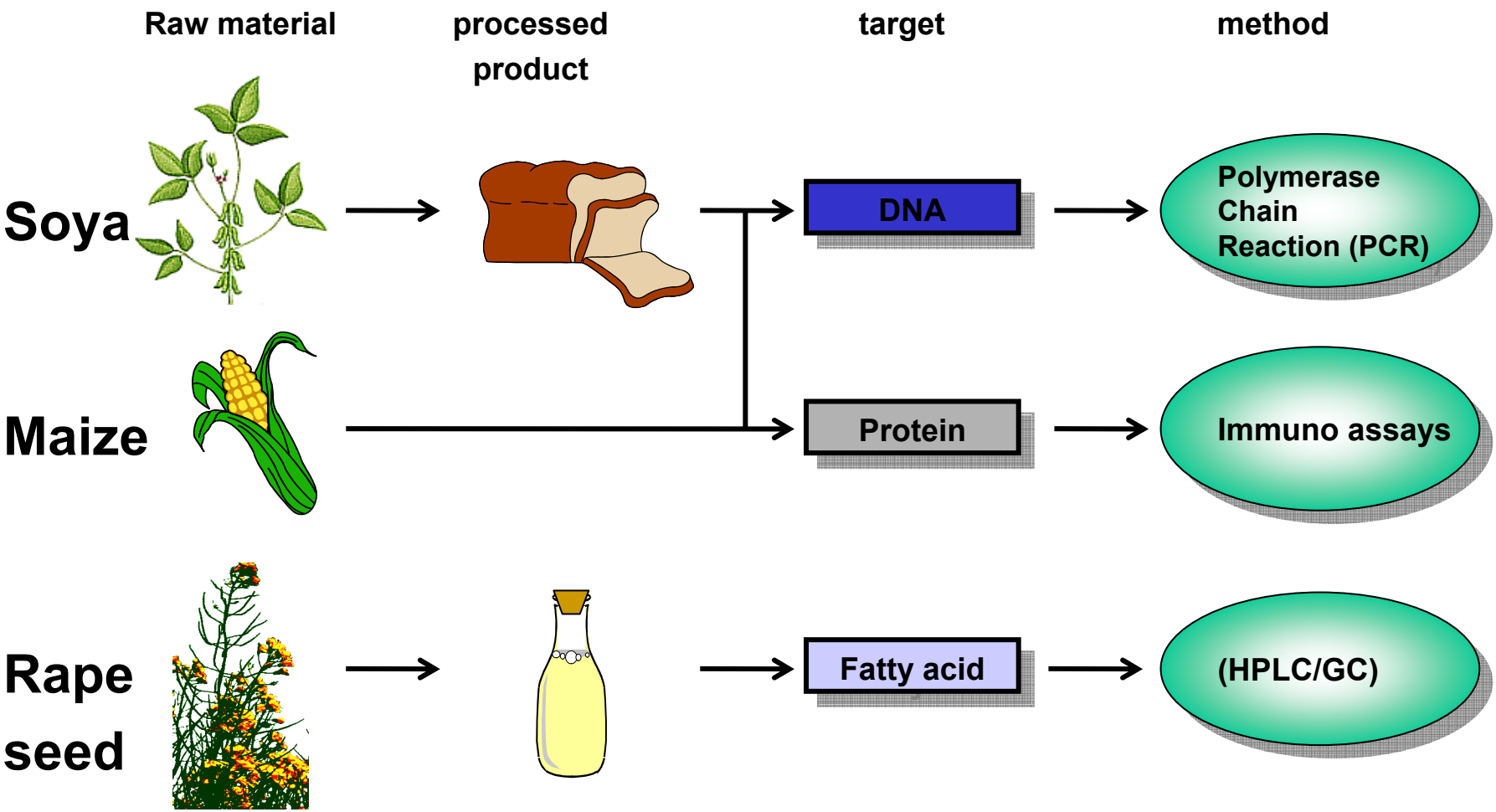
Methods of analysis

- **Biological**
  whole plant
- **Chemical**
  fatty acids
  fibre structure
  …
- **Bioanalytical**
  - **Protein**
  - **DNA**

Phenotypical

Genotypical

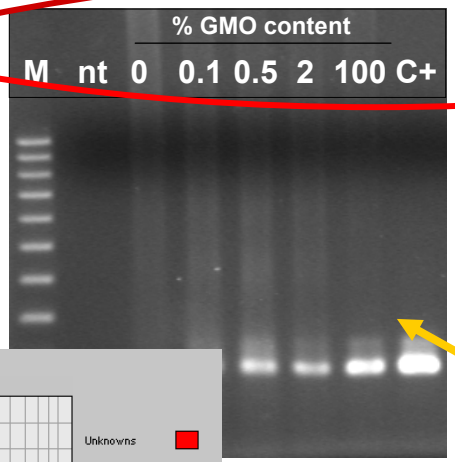
Detection strategies

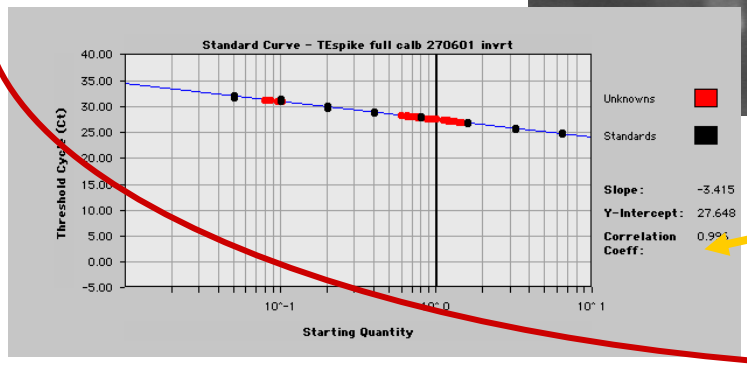


Steps in DNA based GMO analysis

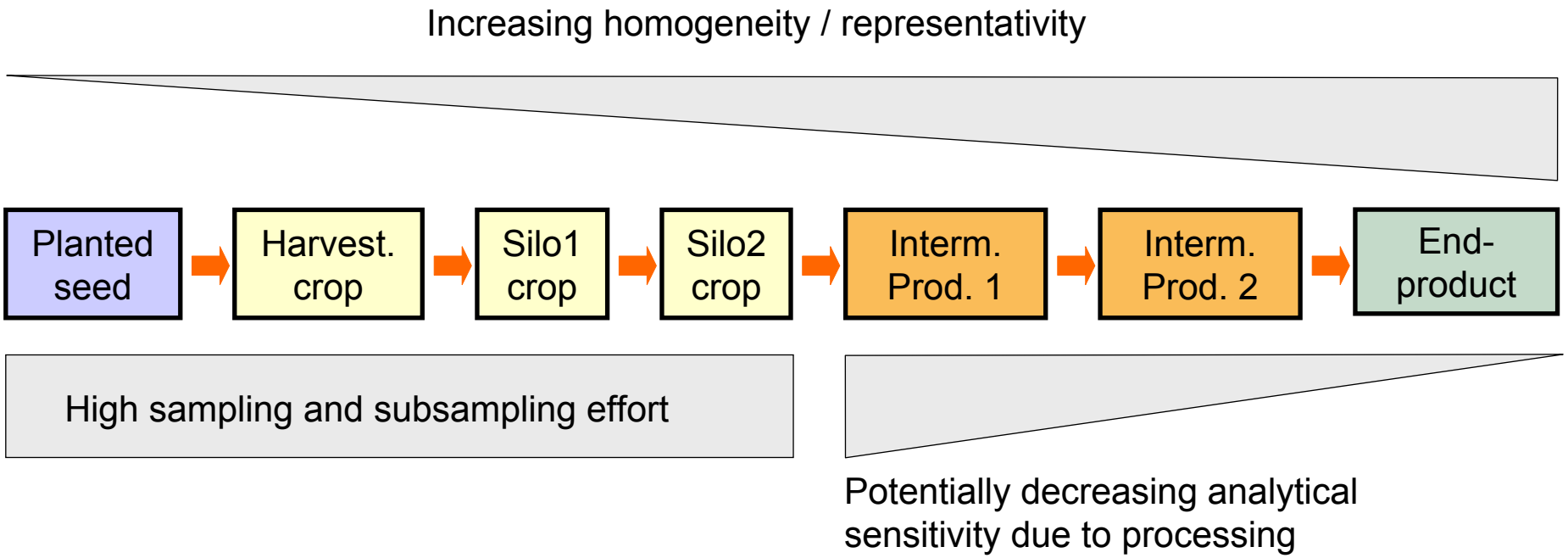
Sampling

Analytical





Experience along the production chain



Operation of GMO laboratories to comply with EU legislation

GMO detection

GMO ? Yes/No

Positive — **Negative**

GMO identification

Are they Authorised ? Yes/No

Yes — **No** — **Illegal**

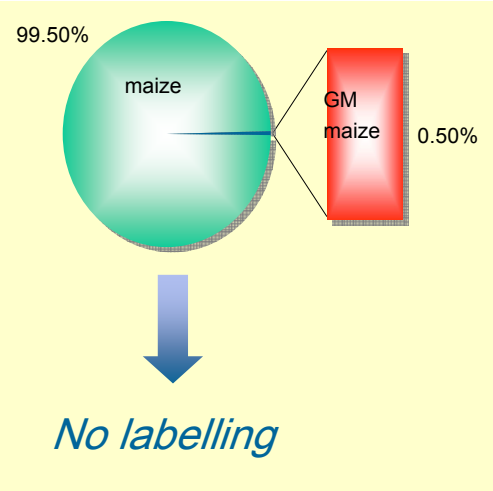
GMO quantification

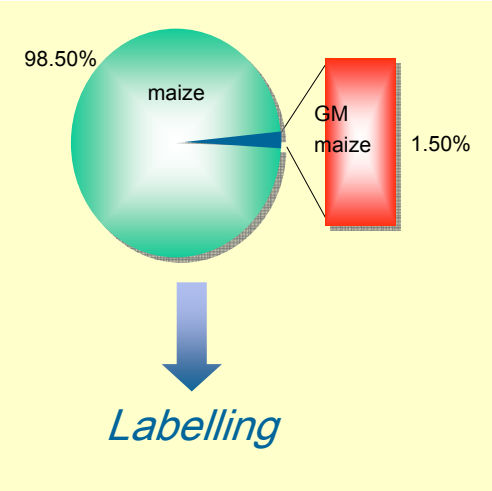
Must be Labelled ? Yes/No

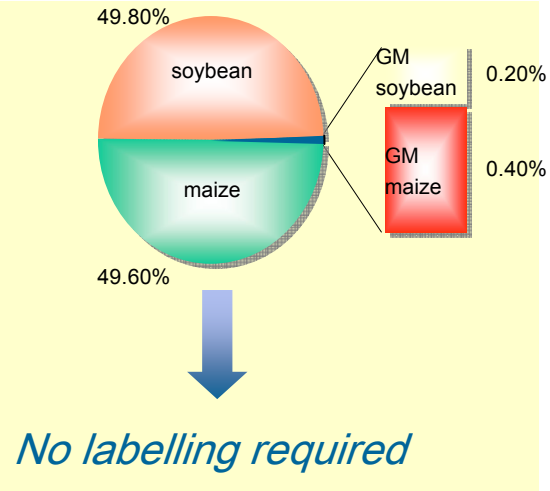
Assay individual ingredients

- **< threshold** — **No need for labelling**
- **> threshold** — **Labelling required**

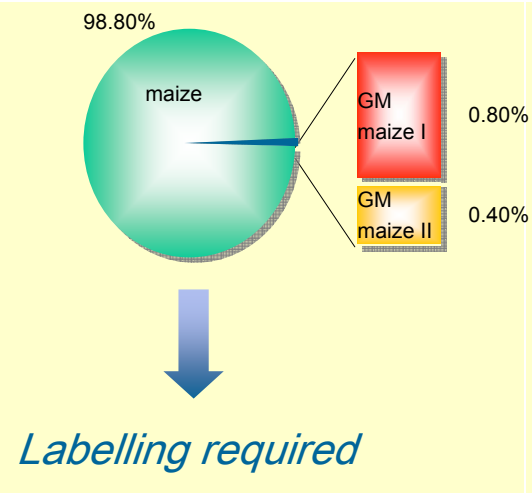
Quantification of GMOs and labelling

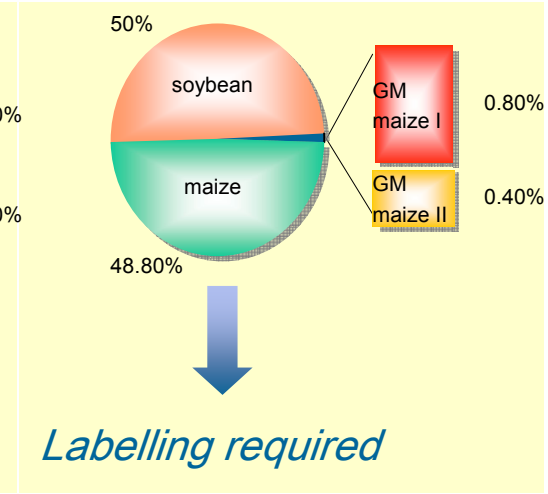






- maize
- soybean
- GM maize I
- GM maize II
- GM soybean





Ingredients

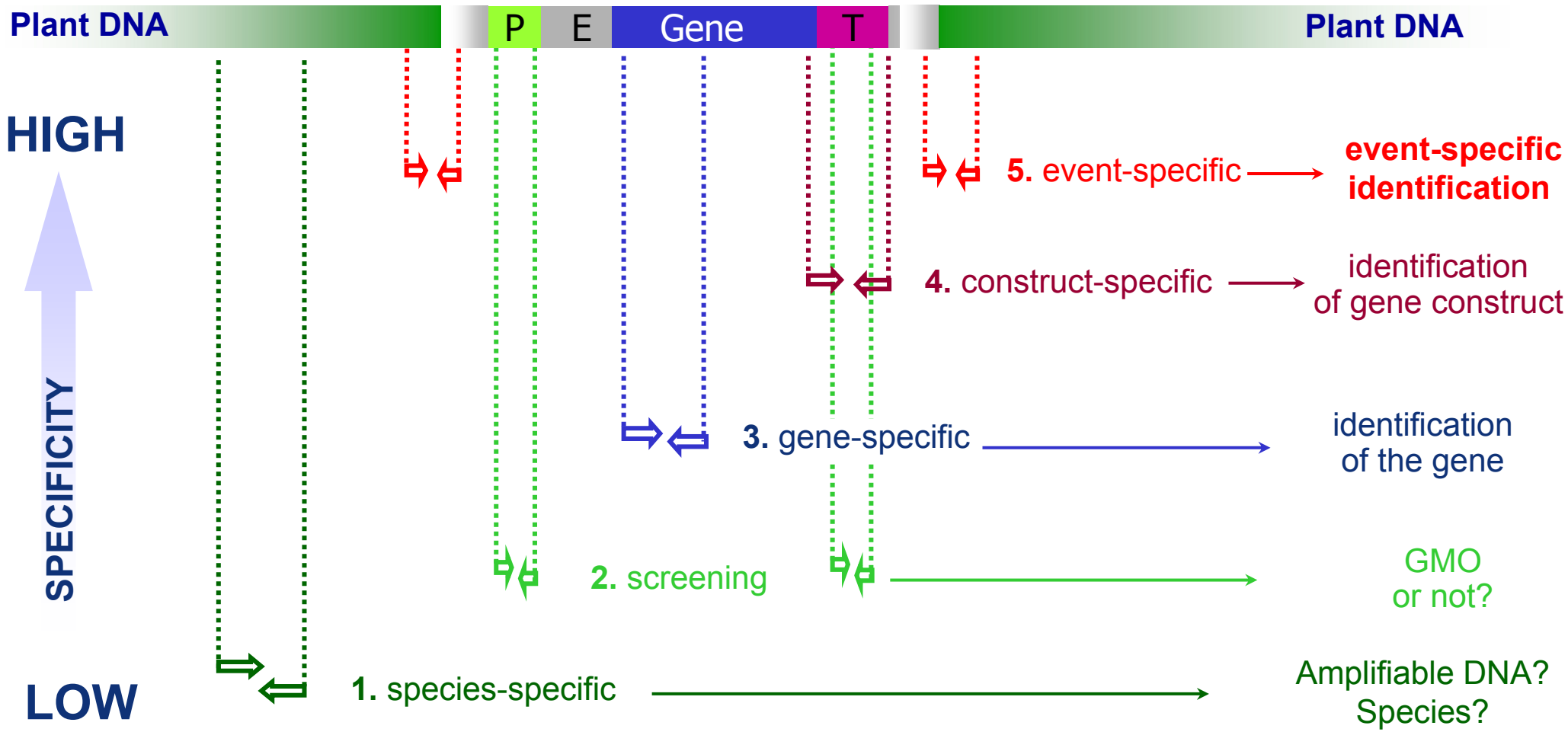
How much "maize" is present?

How much "GM-maize 1" is present?

How much "GM-maize 2" is present?

Make calculations

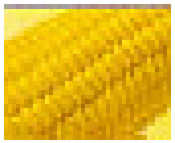
Detection strategies, which target to select?

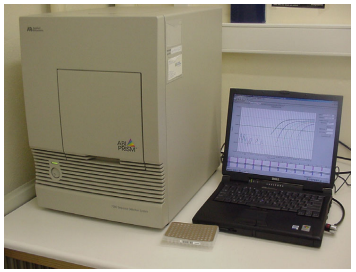


GMO quantification by RT-PCR

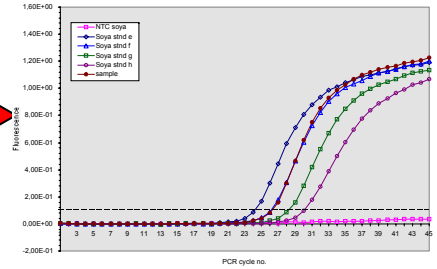
Wild type

GMO

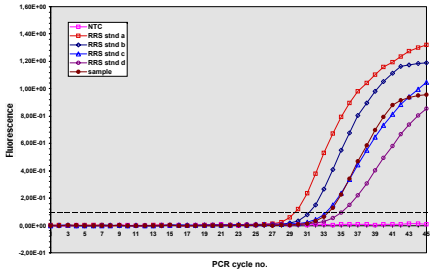


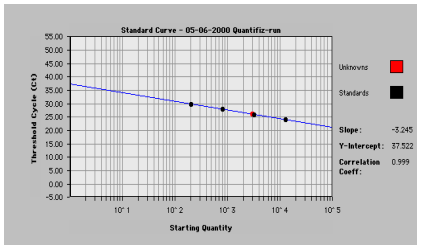


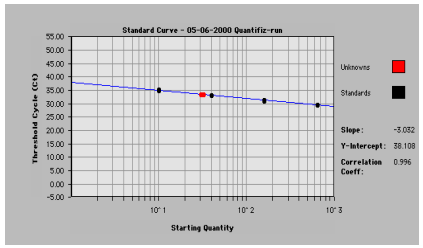
Target taxon specific



GM specific







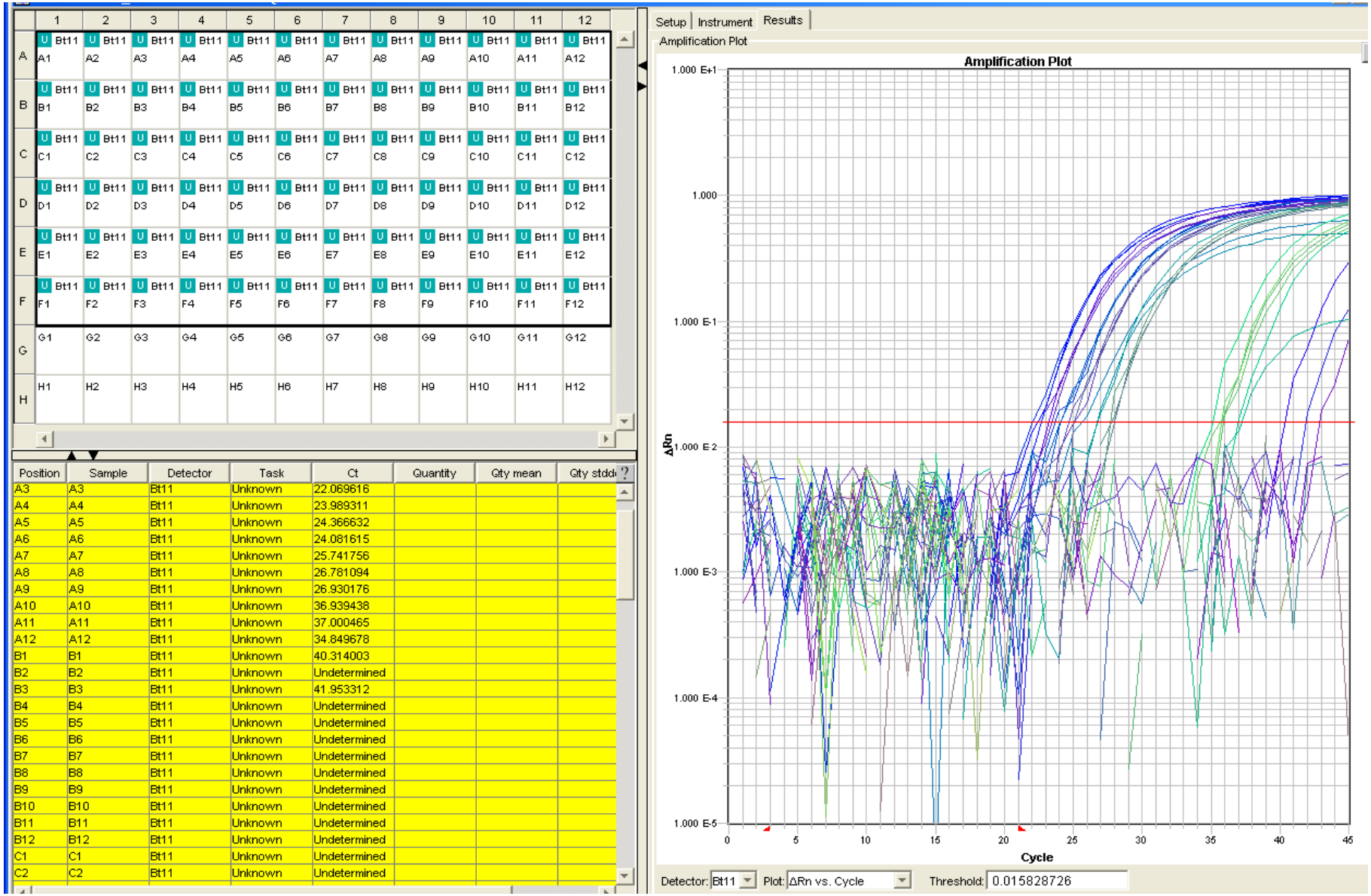
1.
Sample preparation, and DNA extraction

2.
DNA amplification in real-time PCR machine

$$\frac{\text{GM}}{\text{endogenous}} \times 100$$

3.
Interpretation of result

Qualitative PCR: endpoint RT-PCR detection

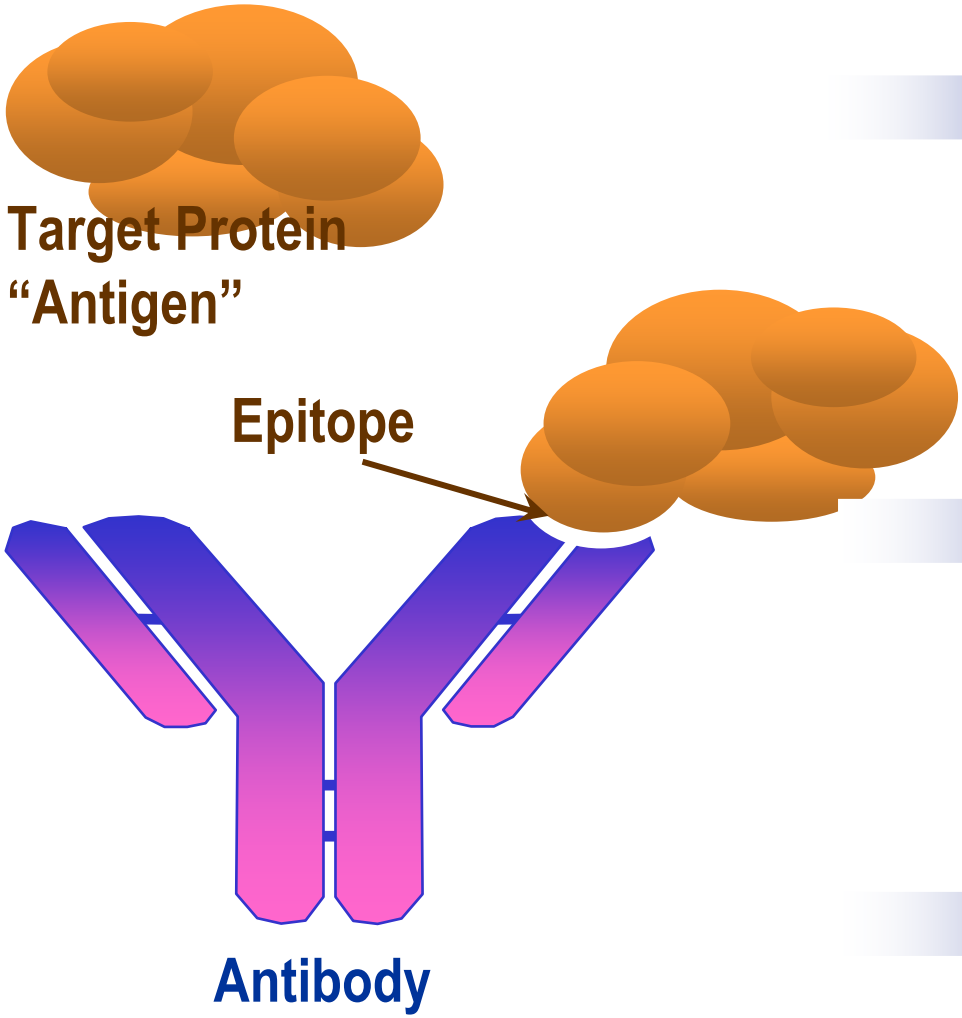


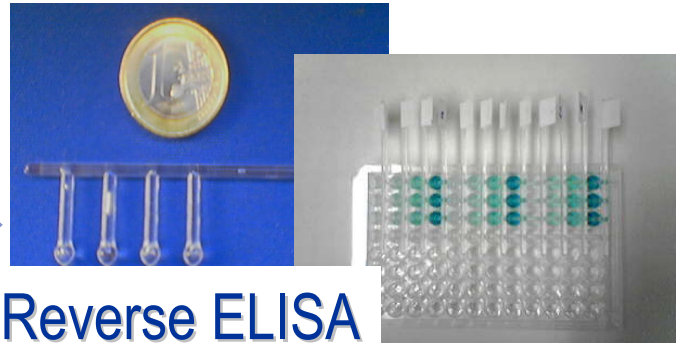
Position	Sample	Detector	Task	Ct	Quantity	Qty mean	Qty stdd
A3	A3	Bt11	Unknown	22.069616			
A4	A4	Bt11	Unknown	23.989311			
A5	A5	Bt11	Unknown	24.366632			
A6	A6	Bt11	Unknown	24.081615			
A7	A7	Bt11	Unknown	25.741756			
A8	A8	Bt11	Unknown	26.781094			
A9	A9	Bt11	Unknown	26.930176			
A10	A10	Bt11	Unknown	36.939438			
A11	A11	Bt11	Unknown	37.000465			
A12	A12	Bt11	Unknown	34.849678			
B1	B1	Bt11	Unknown	40.314003			
B2	B2	Bt11	Unknown	Undetermined			
B3	B3	Bt11	Unknown	41.953312			
B4	B4	Bt11	Unknown	Undetermined			
B5	B5	Bt11	Unknown	Undetermined			
B6	B6	Bt11	Unknown	Undetermined			
B7	B7	Bt11	Unknown	Undetermined			
B8	B8	Bt11	Unknown	Undetermined			
B9	B9	Bt11	Unknown	Undetermined			
B10	B10	Bt11	Unknown	Undetermined			
B11	B11	Bt11	Unknown	Undetermined			
B12	B12	Bt11	Unknown	Undetermined			
C1	C1	Bt11	Unknown	Undetermined			
C2	C2	Bt11	Unknown	Undetermined			

Pros and cons - DNA methods

- Genetic modifications = DNA modifications
- DNA stable and inheritable
- DNA traceable unit for all purposes
  - Matrix limitations may apply
- Sensitive, fit for identification and quantification
- Costs:
  - Efficient screening (multiple targets and GMOs)
  - Expensive identification and quantification
  - Equipment, reference material, skilled staff
- Limited coverage, although superior to protein
  - Can only detect what we have methods for!

GMO analysis by immuno assays





Pros and cons - protein methods

- Advantages/benefits:
  - Speed
  - Cost
  - Practicability and easy transferibility
  - Low risk of false positives (carry over)
  - Well established in the food industry
- Drawbacks:
  - Matrix limitations and sensitivity
  - Coverage low (methods only for few GMOs)
  - Low fitness for Qn analysis
  - Limited identification (no event identification except for ’unique’ traits)

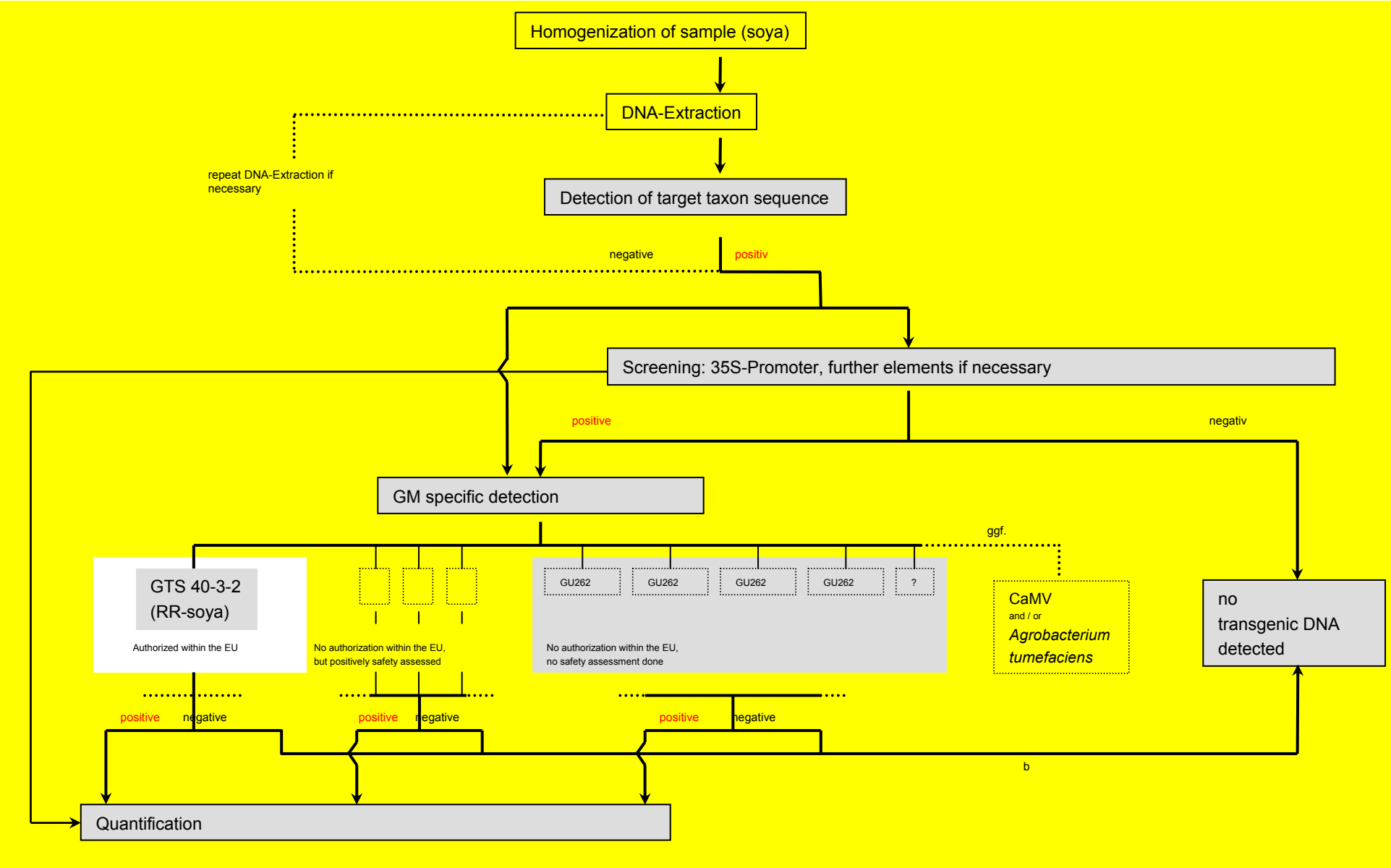
Present context

- Worldwide adoption and use of GMOs is rapidly increasing (acreage, countries);
- Constant rise in GMO complexity, number of traits and events;
- In the EU:
    - Mandatory labelling of GMOs and derived food/feed products (if above 0.9%) requires event-specific methods;
    - Post-market monitoring requirements;
    - GMO control based on combination of screening + event-specific detection methods;
    - Increasing number of GMOs under approval;
    - Asynchronous approval process complicates the analytical procedure.

↑ Higher number of methods to be applied for full product characterisation.

↑ Increased time and cost of analysis/sample.

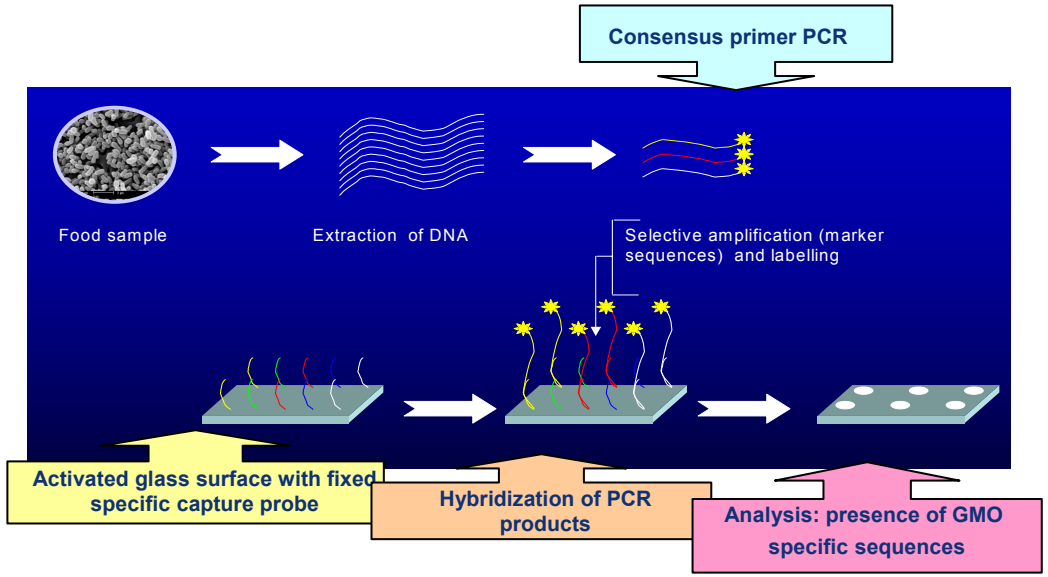
Analysis of soybean samples

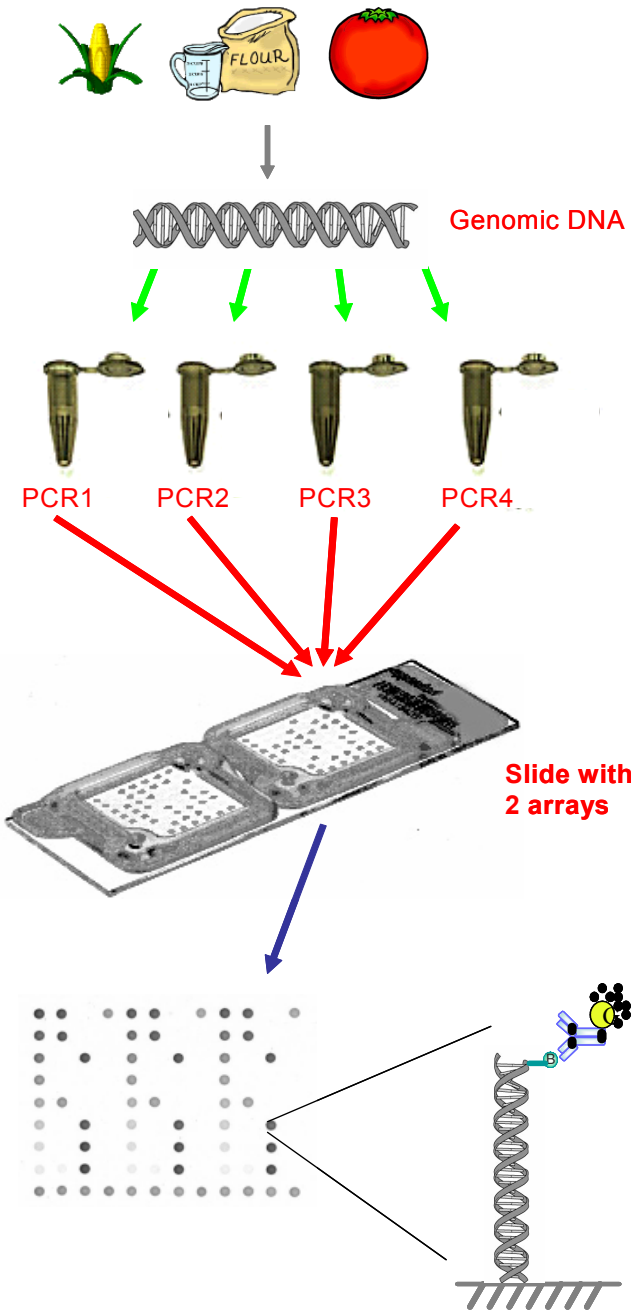


Konzept zur Analytik von gentechnisch veränderten Futtermitteln, 2005, M. Egert *et al.*

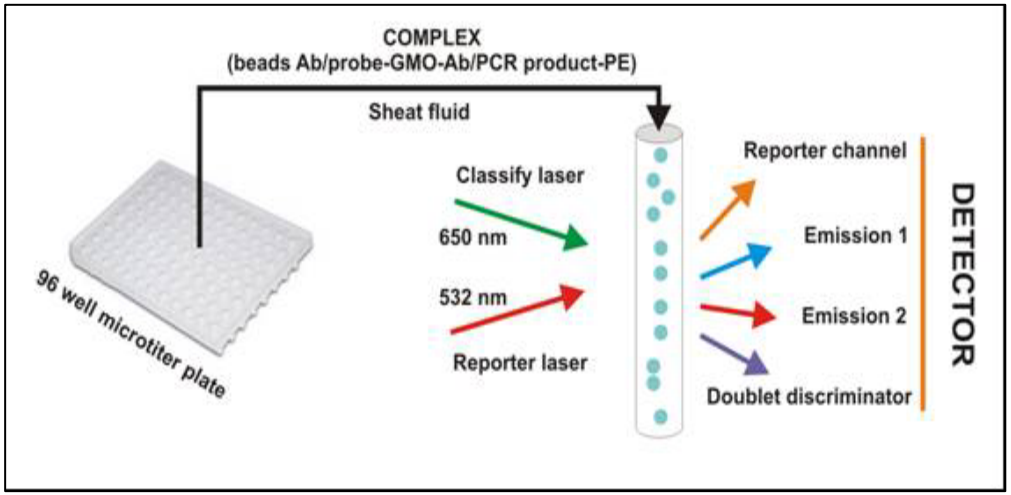
Next generation approaches for GMO analysis: Development and validation of high-throughput / multi-target detection methods

Multiplex DNA micro-array

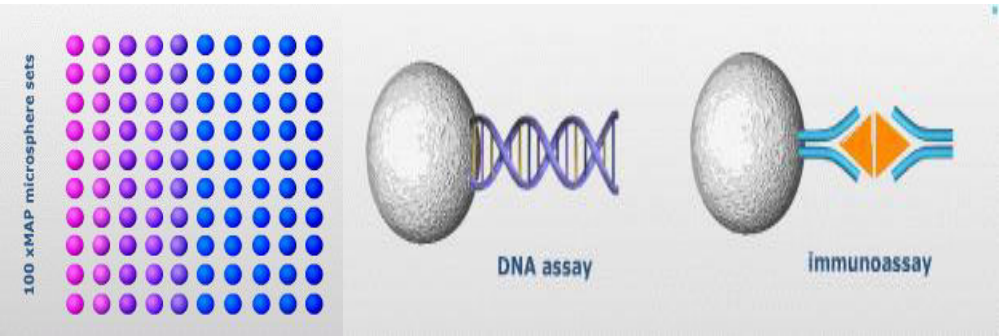




Next generation approaches for GMO analysis: Development and validation of high-throughput / multi-target detection methods



Micro-sphere based assays (xMAP/Luminex technology)



Within the present context….

The only way to foster appropriate testing and to guarantee proper GMO control in the EU is to facilitate the work of enforcement laboratories.

This can be achieved by developing and providing them tools able to overcome the difficulties of applying a complex analytical procedure, often exceeding laboratories' capabilities.

Next generation approaches for GMO analysis: Development and validation of high-throughput / multi-target detection methods

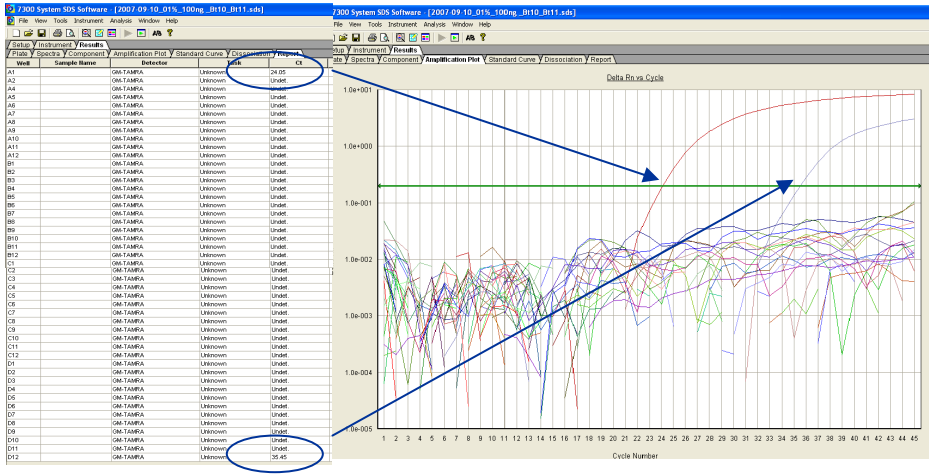
	1	2	3	4	5	6	7	8	9	10	11	12
A	HMG Maize Ref	SAH7 Cotton Ref	PLD Rice Ref	CruA Oilseed Ref	Lectin Soybean Ref	GS Sugarbeet Ref	UGPase Potato Ref	t11 Maize	NK603 Maize	GA21 Maize Monsanto	MON863 Maize	1507 Maize
B	T25 Maize	59122 Maize	H7-1 Sugar beet	MON810 Maize	281-24-236 Cotton	3006-210-23 Cotton	LLRICE62 Rice	T45 oilseed rape	EH92-527-1 Potato	Ms8 Oilseed rape	Rf3 Oilseed rape	GT73 (RT63) Rapeseed
C	LLCotton2 5 Cotton	MON 531 Cotton	A2704-12 Soybean	MIR604 Maize	Rf1 Rapeseed	Rf2 Rapeseed	Ms1 Rapeseed	Topas 19/2 Rapeseed	MON1445 Cotton	Bt176 Maize	MON15985 Cotton	40-3-2 Soybean
D	GA21 Maize Syngenta	MON88017 maize	LY038 Maize	3272 Maize	MON89788 soybean	MON89034 Maize	DP-356043 soybean	MON88913 cotton	Rice GM events P35S::bar	LLRice601 Rice	Bt63 Rice	Bt10 Maize
E	HMG Maize Ref	SAH7 Cotton Ref	PLD Rice Ref	CruA Oilseed Ref	Lectin Soybean Ref	GS Sugarbeet Ref	UGPase Potato Ref	t11 Maize	NK603 Maize	GA21 Maize Monsanto	MON863 Maize	1507 Maize
F	T25 Maize	59122 Maize	H7-1 Sugar beet	MON810 Maize	281-24-236 Cotton	3006-210-23 Cotton	LLRICE62 Rice	T45 oilseed rape	EH92-527-1 Potato	Ms8 Oilseed rape	Rf3 Oilseed rape	GT73 (RT63) Rapeseed
G	LLCotton2 5 Cotton	MON 531 Cotton	A2704-12 Soybean	MIR604 Maize	Rf1 Rapeseed	Rf2 Rapeseed	Ms1 Rapeseed	Topas 19/2 Rapeseed	MON1445 Cotton	Bt176 Maize	MON15985 Cotton	40-3-2 Soybean
H	GA21 Maize Syngenta	MON88017 maize	LY038 Maize	3272 Maize	MON89788 soybean	MON89034 Maize	DP-356043 soybean	MON88913 cotton	Rice GM events P35S::bar	LLRice601 Rice	Bt63 Rice	Bt10 Maize

Sample 1

Sample 2

Real-Time PCR based ready-to-use multi-target analytical system for the detection of EU authorised and unauthorised GM events

Targets: 7 plant species
39 GM events



Real-time PCR based ready-to-use multi-target analytical system for GMO analysis

Pre-spotted plates

- **source:** 48 real-time PCR methods validated by the CRL-GMFF

- **output:** unique system in which all methods work with a unique set of conditions without loosing specificity and overall performance

Dossier	Event			Probe	Reporter
1	Bt11 Maize		A	TAMRA	FAM
2	NK603 Maize		C	TAMRA	FAM
3	GA21 Maize		ACAGCAGGTGGGT	TAMRA	FAM
4	MON863 Maize		TCA	TAMRA	FAM
5	1507 Maize			TAMRA	FAM
6	T25 Maize			TAMRA	FAM
7	59122 Maize		A	TAMRA	FAM
8	H7-1 Sugar beet			TAMRA	FAM
9	MON810 Maize			TAMRA	FAM
10	281-24-236 Cotton		GAGACAA	TAMRA	FAM
11	3006-210-23 Cotton		CCCG	TAMRA	FAM
12	LLRICE62 Rice		CACCT	TAMRA	FAM
13	T45 oilseed rape			TAMRA	FAM
14	EH92-527-1 Potato			TAMRA	FAM
15	Ms8 Oilseed rape		TTC	TAMRA	FAM
16	Rf3 Oilseed rape			TAMRA	FAM
17	GT73 (RT63) Rapeseed		T	TAMRA	FAM
18	LLCotton25 Cotton		C	TAMRA	FAM
19	MON 531 Cotton			TAMRA	FAM
20	A2704-12 Soybean			TAMRA	FAM
21	MIR604 Maize		G	TAMRA	FAM
22	Rf1 Rapeseed		A	TAMRA	FAM
23	Rf2 Rapeseed		T	TAMRA	FAM
24	Ms1 Rapeseed		T	TAMRA	FAM
25	Topas 19/2 Rapeseed			TAMRA	FAM
26	MON1445 Cotton		TTT	TAMRA	FAM
27	Bt176 Maize			TAMRA	FAM
28	MON15985 Cotton		CTGAA	TAMRA	FAM
29	40-3-2 Soybean			MGB	FAM
30	GA21 Maize		T	TAMRA	FAM
31	MON88017		GGGT	TAMRA	FAM
32	LY038 Maize			TAMRA	FAM
33	3272 Maize			TAMRA	FAM
34	MON89788			TAMRA	FAM
35	MON89034 Maize			MGB	FAM
36	DP-356043 soybean		AGCAC	TAMRA	FAM
37	MON88913 cotton			MGB	FAM
38	Rice GM events P35S::bar			MGB	FAM
39	LLRice601 Rice		G	TAMRA	FAM
40	Bt63 Rice		CTCGAG	TAMRA	FAM
43	Bt10 Maize			MGB	FAM

Maize
Bt11
NK603
GA21
MON863
1507
T25
59122
MON810
MIR604
Bt176
MON88017
LY038
3272
MON89034
Bt10

Soybean
A2704-12
40-3-2
MON89788
DP-356043

Potato
EH92-527-1

Oilseed rape
T45
Ms8
Rf3
GT73
Rf1
Rf2
Ms1
Topas 19/2

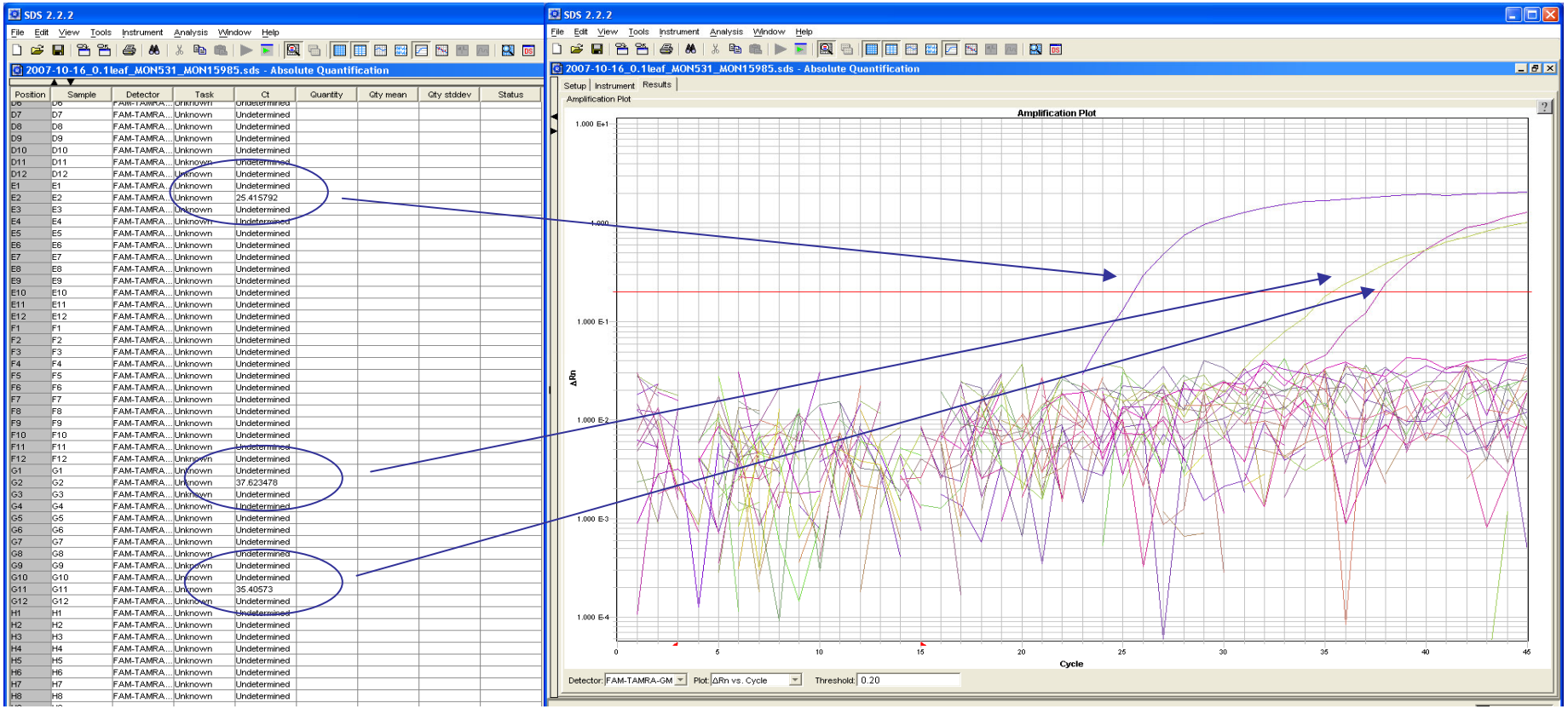
Rice
LLRICE62
LLRice601
Bt63 Rice

Sugar beet
H7-1 Sugar beet

Cotton
MON1445
MON88913
LLCotton25
MON 531
281-24-236
3006-210-23
MON15985

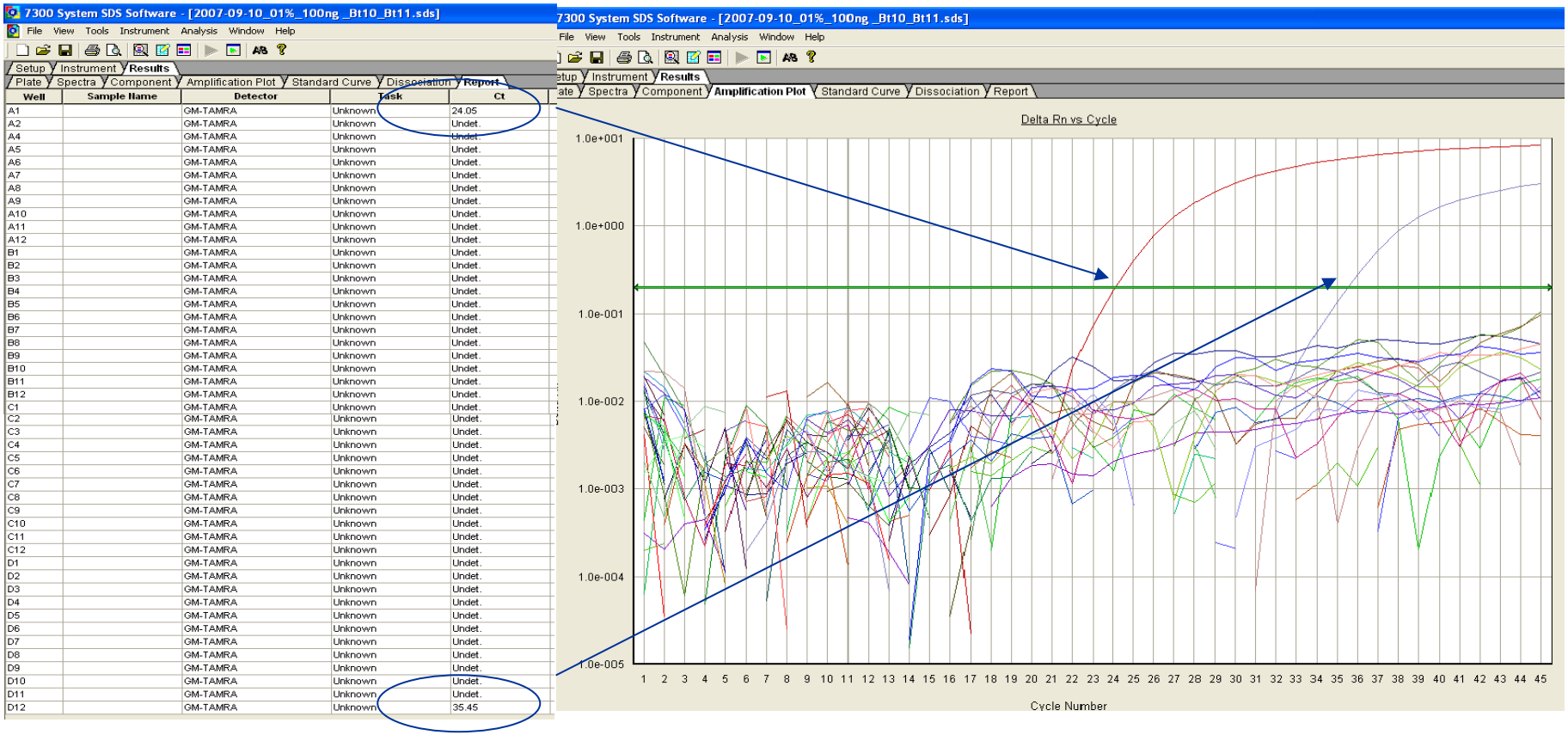
Detection of cotton event MON15985

E2 = SAH7 cotton reference gene method
G2 = MON531 event-specific method
G11 = MON15985 event-specific method



Detection of maize event Bt-10

A1 = maize reference gene method
D12 = Bt-10 event-specific method

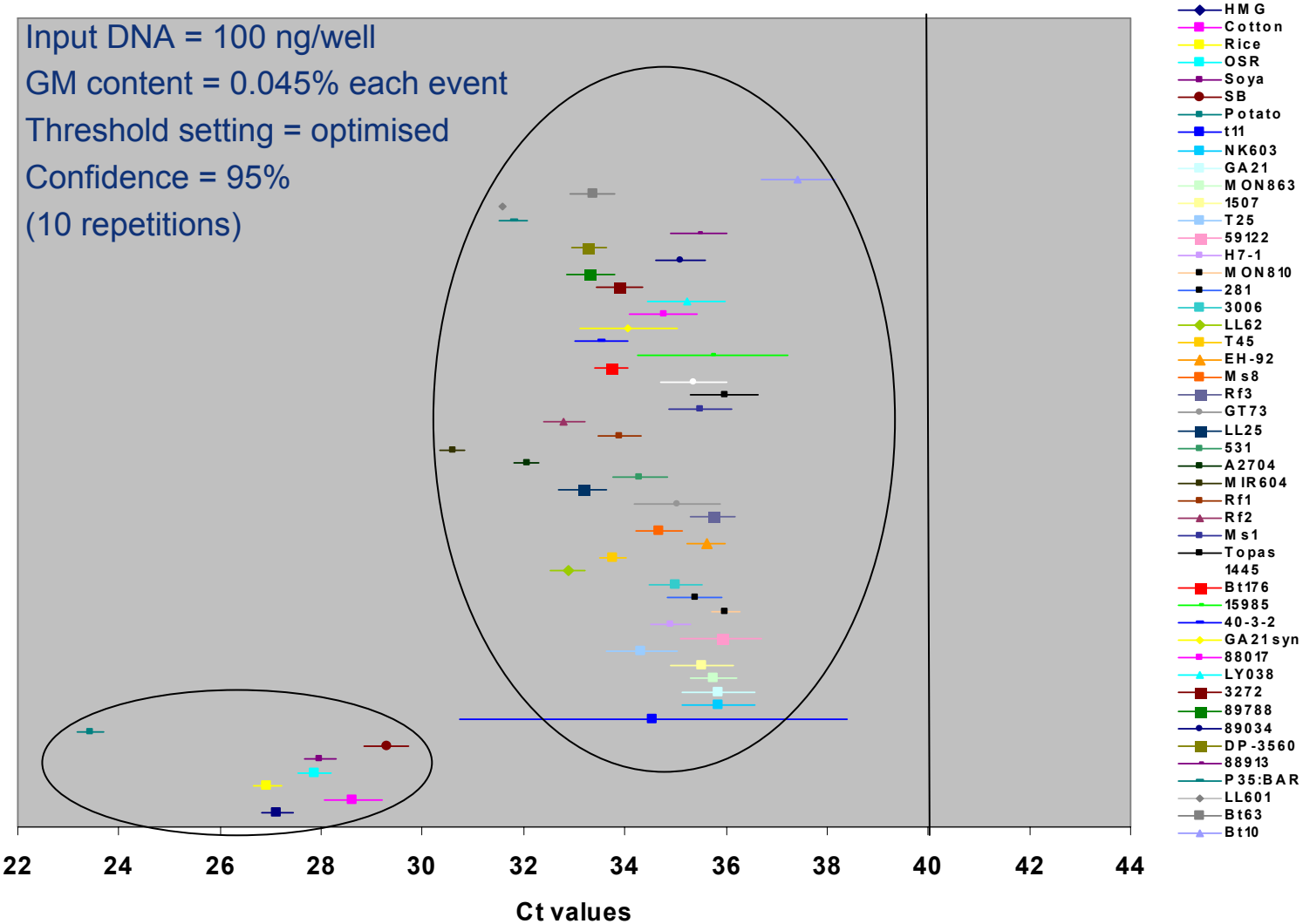


Well	Sample Name	Detector	Task	Ct
A1		GM-TAMRA	Unknown	24.05
A2		GM-TAMRA	Unknown	Undet.
A4		GM-TAMRA	Unknown	Undet.
A5		GM-TAMRA	Unknown	Undet.
A6		GM-TAMRA	Unknown	Undet.
A7		GM-TAMRA	Unknown	Undet.
A8		GM-TAMRA	Unknown	Undet.
A9		GM-TAMRA	Unknown	Undet.
A10		GM-TAMRA	Unknown	Undet.
A11		GM-TAMRA	Unknown	Undet.
A12		GM-TAMRA	Unknown	Undet.
B1		GM-TAMRA	Unknown	Undet.
B2		GM-TAMRA	Unknown	Undet.
B3		GM-TAMRA	Unknown	Undet.
B4		GM-TAMRA	Unknown	Undet.
B5		GM-TAMRA	Unknown	Undet.
B6		GM-TAMRA	Unknown	Undet.
B7		GM-TAMRA	Unknown	Undet.
B8		GM-TAMRA	Unknown	Undet.
B9		GM-TAMRA	Unknown	Undet.
B10		GM-TAMRA	Unknown	Undet.
B11		GM-TAMRA	Unknown	Undet.
B12		GM-TAMRA	Unknown	Undet.
C1		GM-TAMRA	Unknown	Undet.
C2		GM-TAMRA	Unknown	Undet.
C3		GM-TAMRA	Unknown	Undet.
C4		GM-TAMRA	Unknown	Undet.
C5		GM-TAMRA	Unknown	Undet.
C6		GM-TAMRA	Unknown	Undet.
C7		GM-TAMRA	Unknown	Undet.
C8		GM-TAMRA	Unknown	Undet.
C9		GM-TAMRA	Unknown	Undet.
C10		GM-TAMRA	Unknown	Undet.
C11		GM-TAMRA	Unknown	Undet.
C12		GM-TAMRA	Unknown	Undet.
D1		GM-TAMRA	Unknown	Undet.
D2		GM-TAMRA	Unknown	Undet.
D3		GM-TAMRA	Unknown	Undet.
D4		GM-TAMRA	Unknown	Undet.
D5		GM-TAMRA	Unknown	Undet.
D6		GM-TAMRA	Unknown	Undet.
D7		GM-TAMRA	Unknown	Undet.
D8		GM-TAMRA	Unknown	Undet.
D9		GM-TAMRA	Unknown	Undet.
D10		GM-TAMRA	Unknown	Undet.
D11		GM-TAMRA	Unknown	Undet.
D12		GM-TAMRA	Unknown	35.45

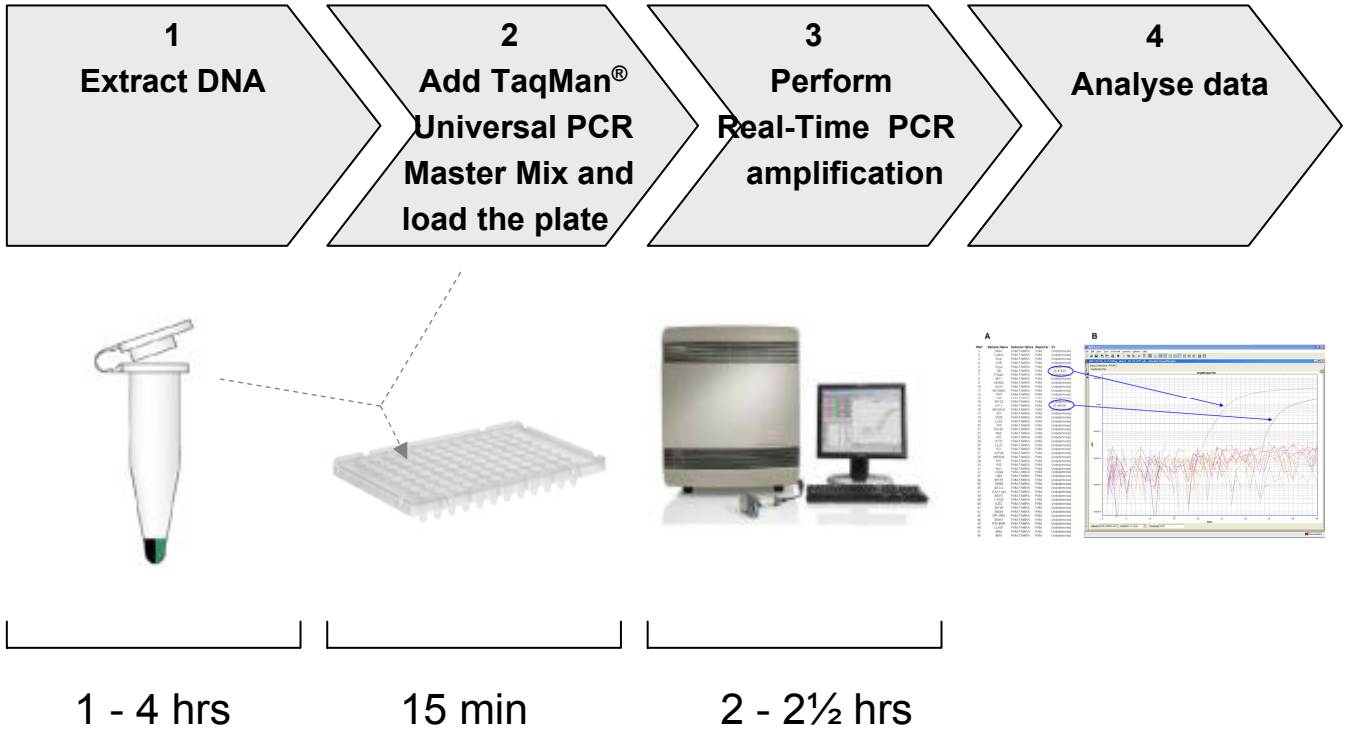
Performance of event-specific plates: specificity

Type of detection	Methods	SAMPLES																																						
		WILD TYPE							GM EVENTS																															
		Maize	Cotton	Rice	Rapeseed	Soybean	Sugar beet	Potato	Bt11 Maize	NK603 Maize	GA21Maize Monsanto	MON863 Maize	1507 Maize	T25 Maize	59122 Maize	H7-1 Sugar beet	MON810 Maize	281-24-236X3006-210-23 Cotton	LLRICE62 Rice	T45 Rapeseed	EH92-527-1 Potato	Ms8 Rapeseed	Rf3 Rapeseed	GT73 (RT63) Rapeseed	LLCotton25 Cotton	MON 531 Cotton	A2704-12 Soybean	MIR604 Maize	Rf1 Rapeseed	Rf2 Rapeseed	Ms1 Rapeseed	Topas 19/2 Rapeseed	MON 1445 Cotton	Bt176 Maize	MON 15985 Cotton	40-3-2 Soybean	GA21 Maize Syngenta	MON 88017 Maize	LY038 Maize	3272 Maize
Taxon specific	HMG Maize R	+							+	+	+	+	+	+	+		+											+						+			+	+	+	+
	SAH7 Cotton R		+															+							+	+							+		+					
	PLD Rice R			+															+																					
	CruA Rapeseed R				+															+		+	+	+					+	+	+	+								
	Lectin Soybean R					+																					+									+				
	GS Sugar beet R						+									+																								
	UGPase Potato R							+													+																			
Event specific	Bt11 Maize								+																															
	NK603 Maize									+																														
	GA21 Maize Method 1										+																										+			
	MON863 Maize											+																												
	1507 Maize												+																											
	T25 Maize													+																										
	59122 Maize														+																									
	H7-1 Sugar beet															+																								
	MON810 Maize																+																							
	281-24-236 Cotton																	+																						
	3006-210-23 Cotton																	+																						
	LLRICE62 Rice																		+																					
	T45 Rapeseed																			+																				
	EH92-527-1 Potato																				+																			
	Ms8 Rapeseed																					+																		
	Rf3 Rapeseed																						+																	
	GT73 Rapeseed																							+																
	LLCOTTON25 Cotton																								+															
	MON 531 Cotton																									+									+					
	A2704-12 Soybean																										+													
	MIR604 Maize																											+												
	Rf1 Rapeseed																												+											
	Rf2 Rapeseed																													+										
	Ms1 Rapeseed																														+									
	Topas 19/2 Rapeseed																															+								
	MON 1445 Cotton																																+							
	Bt176 Maize																																	+						
	MON 15985 Cotton																																		+					
	40-3-2 Soybean																																			+				
	GA21 Maize Method 2										+																										+			
	MON 88017 Maize																																					+		
	LY038 Maize																																						+	
	3272 Maize																																							+
	MON 89788 Soybean																																							
	MON 89034 Maize																																							
	DP-356043-5 Soybean																																							
	MON 88913 Cotton																																							
Construct specific	Rice P35S::bar																		+															+						
Event specific	LLRice601 Rice																																							
	Bt63 Rice																																							
	Bt10 Maize																																							

Performance of event-specific plates: sensitivity



Workflow and approximate timing for GMO analysis using the ready-to-use multi-target analytical system



Ready-to-use pre-spotted plate/strip systems in response to the different needs of GMO analysis:

Crop-specific formulation (for commodities testing)

Maize and soybean events detected

well	*RTi-PCR method*	*well*	*RTi-PCR method*
A1	HMG Maize Ref	B1	LY038
A2	HMG Maize Ref	B2	3272
A3	Bt11	B3	MON89034
A4	NK603	B4	98140
A5	GA21	B5	Lectin Soybean Ref
A6	MON863	B6	Lectin Soybean Ref
A7	DAS1507	B7	A2704-12
A8	T25	B8	40-3-2
A9	DAS59122	B9	MON89788
A10	MON810	B10	DP-356043
A11	MIR604	B11	DP-305423
A12	MON88017	B12	A5547-127

Plate layout

	1	2	3	4	5	6	7	8	9	10	11	12
A	HMG Maize Ref	HMG Maize Ref	Bt11 Maize	NK603 Maize	GA21 Maize	MON863 Maize	DAS1507 Maize	T25 Maize	DAS59122 Maize	MON810 Maize	MIR604 Maize	MON88017 Maize
B	LY038 Maize	3272 Maize	MON89034 Maize	98140 Maize	Lectin Soybean Ref	Lectin Soybean Ref	A2704-12 Soybean	40-3-2 Soybean	MON89788 Soybean	DP-356043 Soybean	DP-305423 Soybean	A5547-127 Soybean
C	HMG Maize Ref	HMG Maize Ref	Bt11 Maize	NK603 Maize	GA21 Maize	MON863 Maize	DAS1507 Maize	T25 Maize	DAS59122 Maize	MON810 Maize	MIR604 Maize	MON88017 Maize
D	LY038 Maize	3272 Maize	MON89034 Maize	98140 Maize	Lectin Soybean Ref	Lectin Soybean Ref	A2704-12 Soybean	40-3-2 Soybean	MON89788 Soybean	DP-356043 Soybean	DP-305423 Soybean	A5547-127 Soybean
E	HMG Maize Ref	HMG Maize Ref	Bt11 Maize	NK603 Maize	GA21 Maize	MON863 Maize	DAS1507 Maize	T25 Maize	DAS59122 Maize	MON810 Maize	MIR604 Maize	MON88017 Maize
F	LY038 Maize	3272 Maize	MON89034 Maize	98140 Maize	Lectin Soybean Ref	Lectin Soybean Ref	A2704-12 Soybean	40-3-2 Soybean	MON89788 Soybean	DP-356043 Soybean	DP-305423 Soybean	A5547-127 Soybean
G	HMG Maize Ref	HMG Maize Ref	Bt11 Maize	NK603 Maize	GA21 Maize	MON863 Maize	DAS1507 Maize	T25 Maize	DAS59122 Maize	MON810 Maize	MIR604 Maize	MON88017 Maize
H	LY038 Maize	3272 Maize	MON89034 Maize	98140 Maize	Lectin Soybean Ref	Lectin Soybean Ref	A2704-12 Soybean	40-3-2 Soybean	MON89788 Soybean	DP-356043 Soybean	DP-305423 Soybean	A5547-127 Soybean

Ready-to-use pre-spotted plate/strip systems in response to the different needs of GMO analysis:

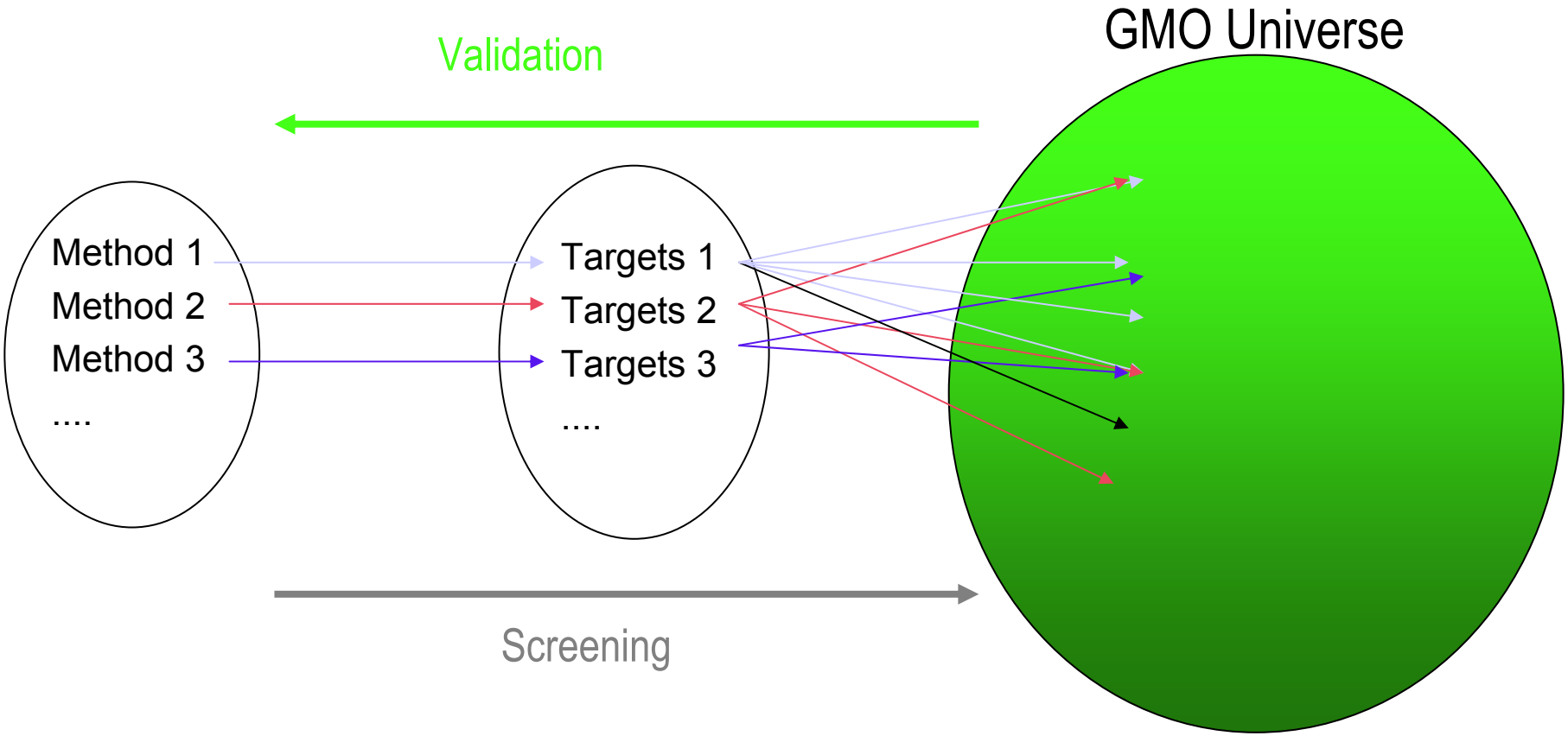
Screening formulation based on matrix approach

Requirements to apply screening in GMO analysis:

- defined **analyte** type (DNA)
- defined **GMO Universe (e.g. EU authorized GMO for food and feed use)**
- defined **targets** in the GMO of this Universe
- validated **methods** to demonstrate the presence of these targets

Matrix approach in GMO screening

Relationship between the "**GMO Universe**", the **targets** and the **methods**



Ready-to-use pre-spotted plate/strip systems in response to the different needs of GMO analysis:

Screening formulation based on matrix approach

What is a "GMO Matrix" (for screening purposes)

1) A description of the set of GMO in form of a (Excel) table

2) Each GMO is described as a combination of genetic elements which are the targets for the screening (such as the p35S, tNOS, CryIAb, ...)

3) A (mathematical) "matrix" form wherein the **relation** between targets and GMO is represented

- the (**molecular) targets** are listed as **columns**
- the **GMO** are represented as **rows**

Screening formulation based on pre-spotted plates and Matrix approach

The matrix representation facilitates to describe the relationships between the **"GMO Universe"**, the **targets** and the **methods** within a **screening set up**

Method 1 Method 2 Method 3

	Target 1	Target 2	Target 3	Target 4	Target 5	Target 6
GMO-1	+	-	-	-	-	-
GMO-2	+	+	+	+	-	-
GMO-3	-	+	+		+	+
GMO-4	-	-	-	-	-	-
GMO-5	-	-	-	+	-	-

+': present -': absent

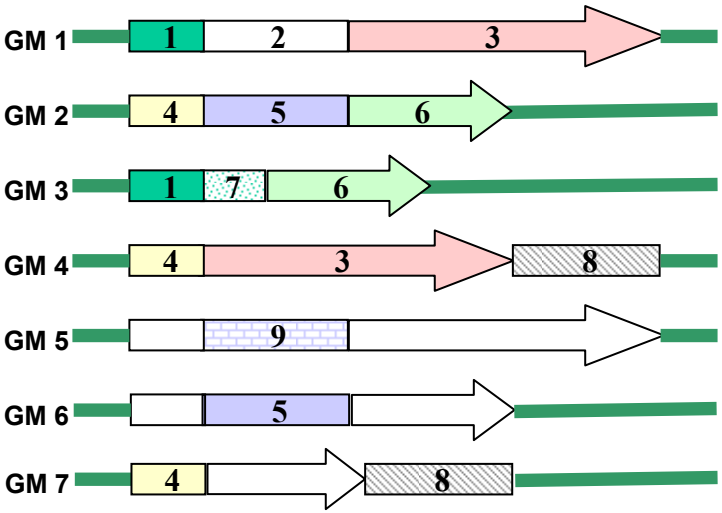
COSYPS: Combinatory SYBR® Green Q-PCR Screening

Semi-quantitative detection system using a set of SYBR® Green RT-PCR methods coupled to a software based application for data interpretation

X_{Prime}	PCR Test	Core element class	Primer Reference
3	RBCl	Plant	Debode (pers. Comm.), 2004
5	Lectin	Species (soya)	Terry and Harris, 2002
7	Alcohol dehydrogenase	Species (maize)	SBB/ISP
11	Cruciferine	Species (Oilseed rape)	SBB/ISP
13	CaMV p35S	Generic (promotor)	SBB/ISP
17	Agrobacterium T-NOS	Generic (terminator)	SBB/ISP
19	CP4-EPSPS	Trait (herbicide res.)	SBB/ISP
23	CryIAb	Trait (insect res.)	SBB/ISP
29	PAT/pat	Trait (herbicide res.)	SBB/ISP
31	PAT/bar	Trait (herbicide res.)	SBB/ISP

GMO	p35S	tNOS	CP4 EPSPS	PAT/pat	PAT/bar	Cry1Ab
GTS 40/3/2	X	X	X			
Bt 11	X	X		X		X
Bt 176	X				X	X
MON 810	X	X				X
GA 21		X				
T25	X			X		
NK 603	X	X	X			
MON 863	X	X				
TC1507	X			X		
DAS59122	X			X		
Bt10	X	X		X		X
GT73			X			
MS1/RF2/ MS1xRF2		X			X	
MS1/RF1/ MS1xRF1		X			X	
MS8/RF3/ MS8xRF3		X			X	
TOPAS 19/2	X			X		
T45	X			X		
Falcon GS 40/90	X			X		
MON 1445	X	X	X			
MON 531	X	X				**X**
LLRICE601	X				X	
Bt63		X				X
RUR H7-1			X			

Combination of screening methods targeting common GM elements



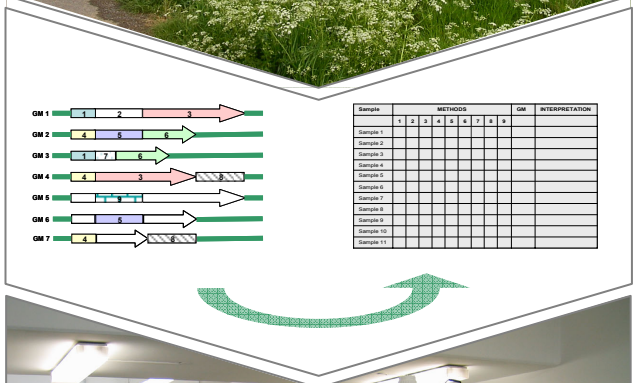
Sample	RESULTS (1 method = 1 element) METHOD n.									GM	Interpretation
	1	2	3	4	5	6	7	8	9		
Sample 1	+	+	+	-	-	-	-	-	-	+	GM 1
Sample 2	-	-	-	+	+	+	-	-	-	+	GM 2
Sample 3	+	-	-	-	-	+	+	-	-	+	GM 3
Sample 4	-	-	+	+	-	-	-	+	-	+	GM 4
Sample 5	-	-	-	-	-	-	-	-	+	+	GM 5
Sample 6	+	-	-	-	-	+	+	-	+	+	GM 3 + GM 5
Sample 7	-	-	-	-	+	-	-	-	-	+	GM 6
Sample 8	-	-	-	-	+	-	-	-	+	+	GM 5 + GM 6
Sample 9	-	-	-	-	-	-	-	-	-	-	NO GM
Sample 10	+	+	+	-	+	-	-	-	+	+	GM 1 + GM 5 + GM 6
Sample 11	+	+	+	-	+	-	-	+	-	+	GM 1 + GM 6 + ?

Decision Support Systems in GMO analysis using a matrix-based approach in combination with ready-to-use multi-target analytical system.

1) Sample definition,
2) Establishment of a GMO matrix and decision on optimal analysis strategy (screening & identification),
3) RTi-PCR amplification using ready-to-use pre-spotted plates, and
4) Combined interpretation of the analytical results.

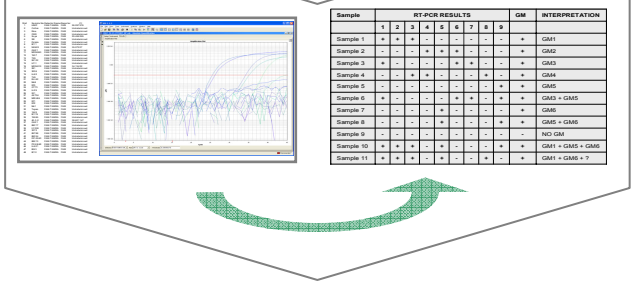
1.
Field or sample to be tested

2.
DSS - Level 1 Matrix approach



3.
DSS - Level 2 Application of analytical method(s)

4.
DSS - Level 3 Data analysis & interpretation



Future technological impact

The 'ready-to-use multi-target analytical system' based on pre-spotted plates has demonstrated a great potential for increasing harmonisation in GMO testing:

- –Tool to test all (several) many events at once (need to constant updating)
- –Unique tool/provider for all control laboratories;
- –Harmonised set of targets / methods;
- –Flexibility to be adapted according to needs;
- –Same tool if used by different laboratories → comparable results.

The combination of this system with the matrix-based screening approach, integrated into a Decision Support System allows to tackle the current complexity and will foster harmonisation GMO analysis

Thank you!

Gracias por su atenciòn!

Muito obrigada!