FLANDERS FOOD AGF

Melle | 5 december 2017

Kürt Demeulemeester, Kristof Werbrouck, Melvin Berten, Gino Viaene

Kurt Cornelissen, Jenny Heuvick, Bart De Vriese, Henri Welvaert, Pascal Dupont

PCA

inagro

RESEARCH & ADVICE IN AGRICULTURE & HORTICULTURE

Outline

1. Motivation for the project
2. Trial set up
3. Trial protocol
4. Most important results
5. Comments and conclusions
6. General conclusions

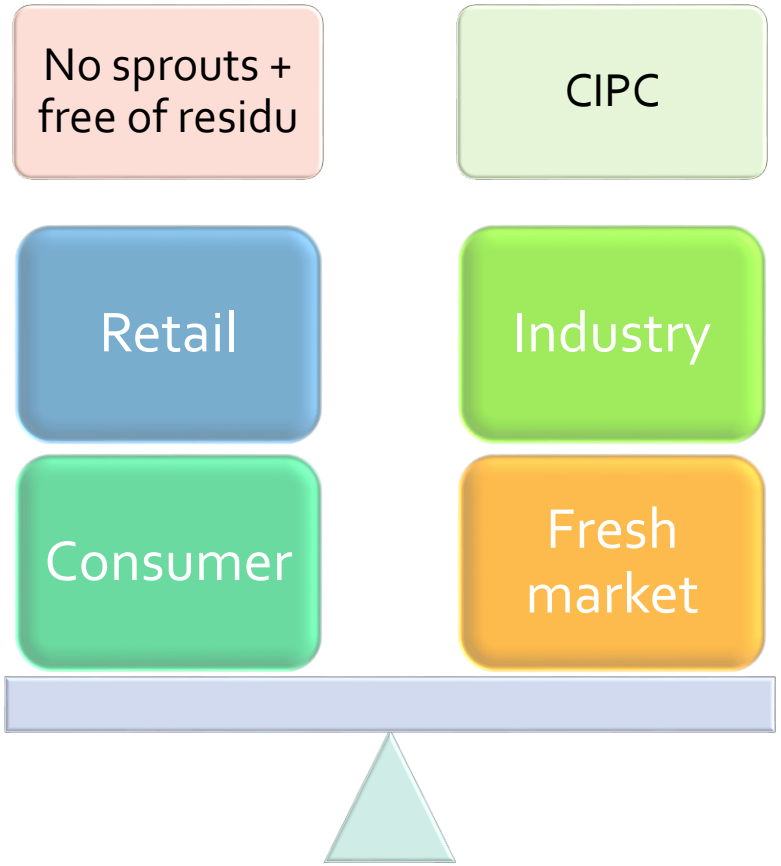
1. MOTIVATION FOR THE PROJECT

Motivation

- Processing & trade : export
- Demand for produce without residue
- Pressure from retail & consumer organisations

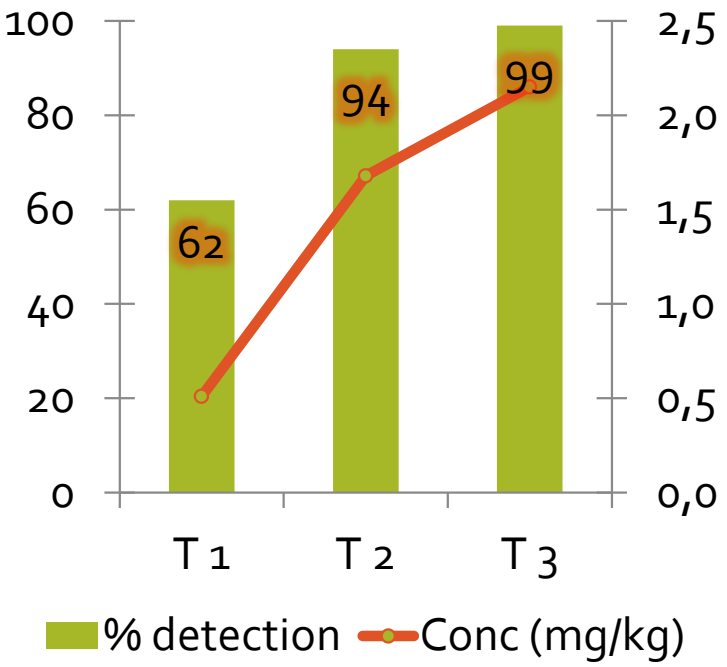
=> Pressure on export position

Sprout control

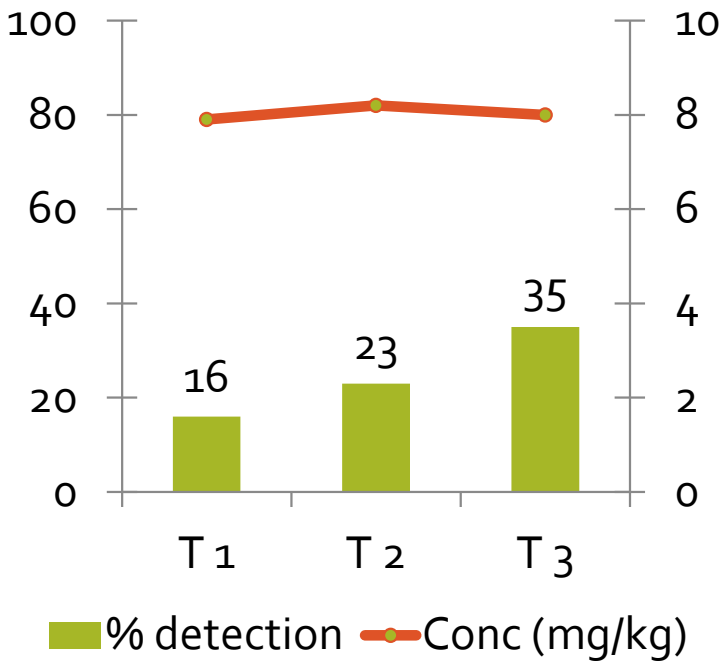


Survey fresh market France

CIPC



MH



Plan de surveillance Qualité Sanitaire Pdt – campagnes 2009-2011
Paris, 30 janvier 2013


2. TRIAL SET UP

TRIAL SET-UP: type 1

Beitem (Inagro)

- 6 stores
- 4 boxes (750 kg) per store
- Ambient air ventilation/cooling
- Sprout control: electrofog / restrain generator
- 7 varieties per box

Scheme type 1 (3,5 ton) – 6 stores

Products

	Name	Active ingredient
1	Gro-Stop Electro	chloorpropham (636 g/l)
2	Biox-M	spearmint oil 100 %
3	Restrain	ethylene 96%
4	PM-1	experimental compound
5	1,4 Sight	1,4-dimethylnaphthalene (987,6 g/l)
6	PM-2	3-decen-2-one (784 g/l)

6,5 ° C

Application

Product	Temperature (°C)
PM-1	180
PM-2	175
1,4 Sight	250
Biox-M	180
Gro-Stop Electro	235

Applications – dose & timing 2016-2017

	Number of applications	Total applied (product per ton potatoes)
1 PM-1	10	1000 ml
2 PM-2	3	300 ml
3 1,4Sight	5	100 ml
4 Restrain	continuous	10 ppm
5 Biox-M	8	300 ml
6 Gro-Stop Electro	4	56,6 ml

PM-2; 1,4 Sight & Biox-M:

less applications then 2015-2016 !

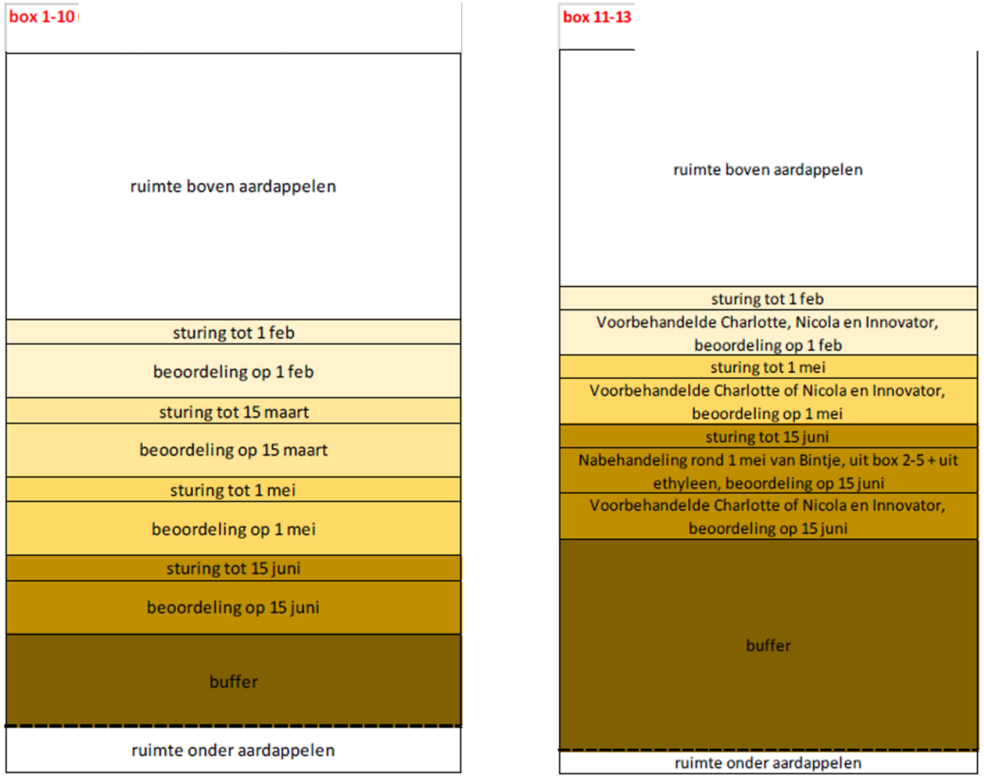
	16 nov	23 nov	14 dec	21 dec	4 jan	11 jan	17 jan	25 jan	8 feb	15 feb	8 mrt	20 mrt	21 mrt	29 mrt	19 apr	3 mei	10 mei	18 mei	30 mei	Total
1 PM-1		100	100		100			100		100	100			100	100		100		100	1000
2 PM-2				100						100						100				300
3 1,4Sight	20		20							20			20				20			100
4 Restrain	10																			10
5 Biox-M			90				30		30		30			30	30		30		30	300
6 Gro-Stop Electro	18,8					12,6					12,6					13				56,6

Approach @ PCA

- 13 boxes in 1 cold storage
- 640 kg / box
- No replicates
- Grid floor – positive ventilation
- Sprout control: Potatofog
- 4 varieties / box
- 30-35 tubers / bag (5-10 kg)

Filling the boxes

Figuur: Schematische voorstelling vulling boxen



Scheme type 2 (640 kg) – 13 boxes

High dormancy

1. Gro-Stop Electro
2. Biox-M
3. PM-1
4. 1,4 Sight
5. PM-2

Low dormancy

6. Gro-Stop Electro
7. Biox-M
8. PM-1
9. 1,4 Sight
10. PM-2

Combined applications

11. 2nd treatment : Biox-M
12. 2nd treatment : PM-2
13. 2nd treatment : 1,4 Sight

6,5 °C

Varieties

Processing

Bintje (MH)

Fontane

Markies (MH)

Innovator

Fresh market

Charlotte

Nicola MH

Hansa

Double

Challenger

MH = maleic-hydrazide

3. TRIAL PROTOCOLS

Trial protocols Inagro & PCA

Differences in 2016-2017

Follow up of commercial scale storage facilities

Assessments

Effectiveness

- Sprouting – biweekly (timing applications)
- Shelf-life (fresh-market varieties)
  - Timing
    - 1 February
    - 15 March
    - 1 May
    - 15 June
  - Washing
  - Store 2 weeks @ 15°C

Other parameters

- Fry colour (0-6)
- Cooking quality
- Silver scurf
- Black dot
- Internal sprouting
- Weight loss (season 2)

Sprouting – scale

Sprouting index (1-6)

1. No sprouts
2. White point
3. Biggest sprout < 2 mm
4. Biggest sprout 2 – 5 mm
5. Biggest sprout 5 – 10 mm
6. Biggest sprout > 10 mm

Only biggest sprout assessed
(white and brown apart)

25 tubers per assessment

Index = average 25 tubers

Differences season 1 & 2

- 2016-2017 All varieties harvested end of October, arriving in the same week
- 2015-2016 Sep 10 – Oct 27 – pre-conditioning
- Weight loss during storage to be assessed
  - May 1 & June 15 @ PCA
  - 4 times @ Inagro

Open box day

- @ PCA
- June 23, 2017

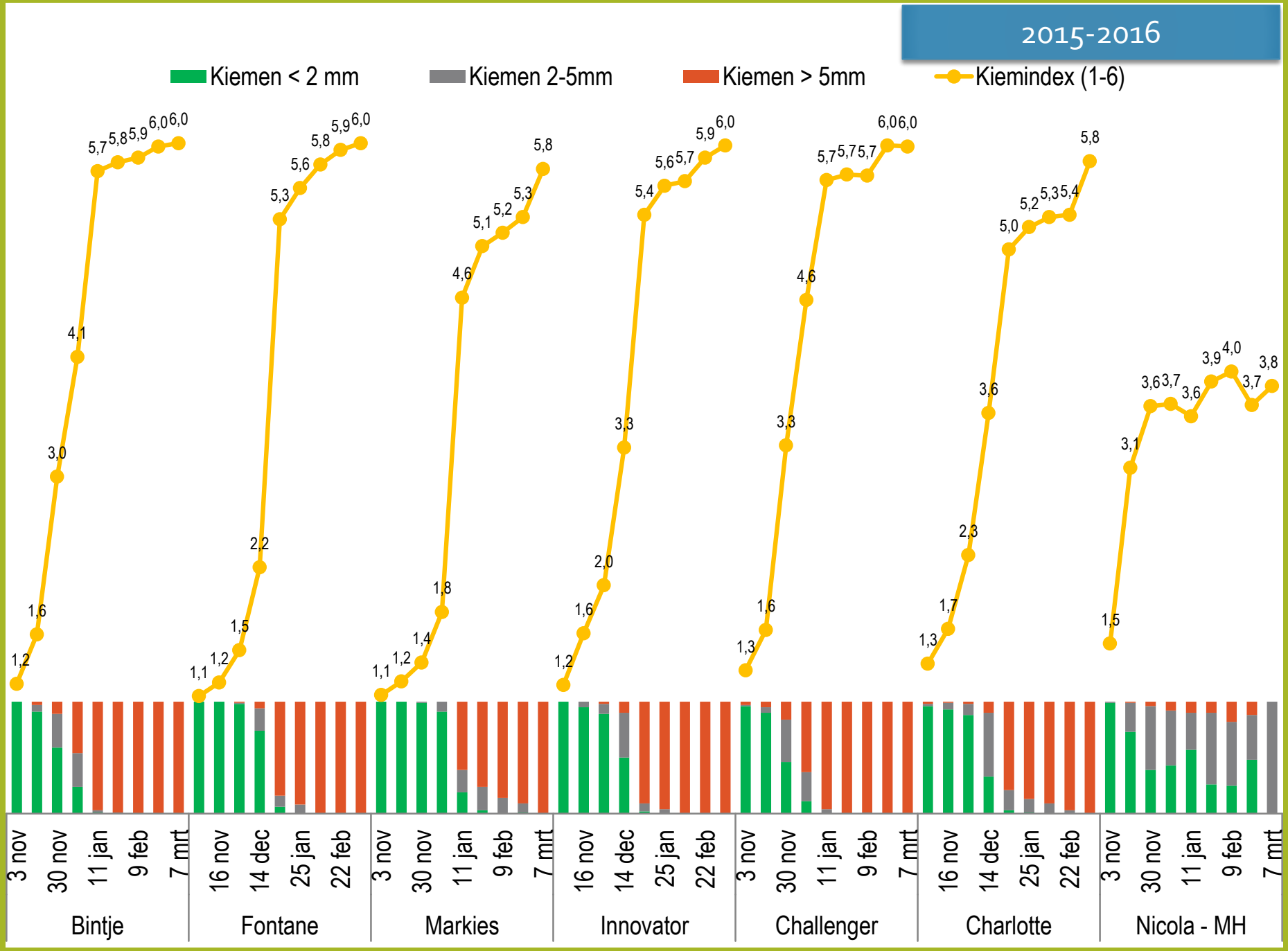
4. RESULTS – SYNTHESIS

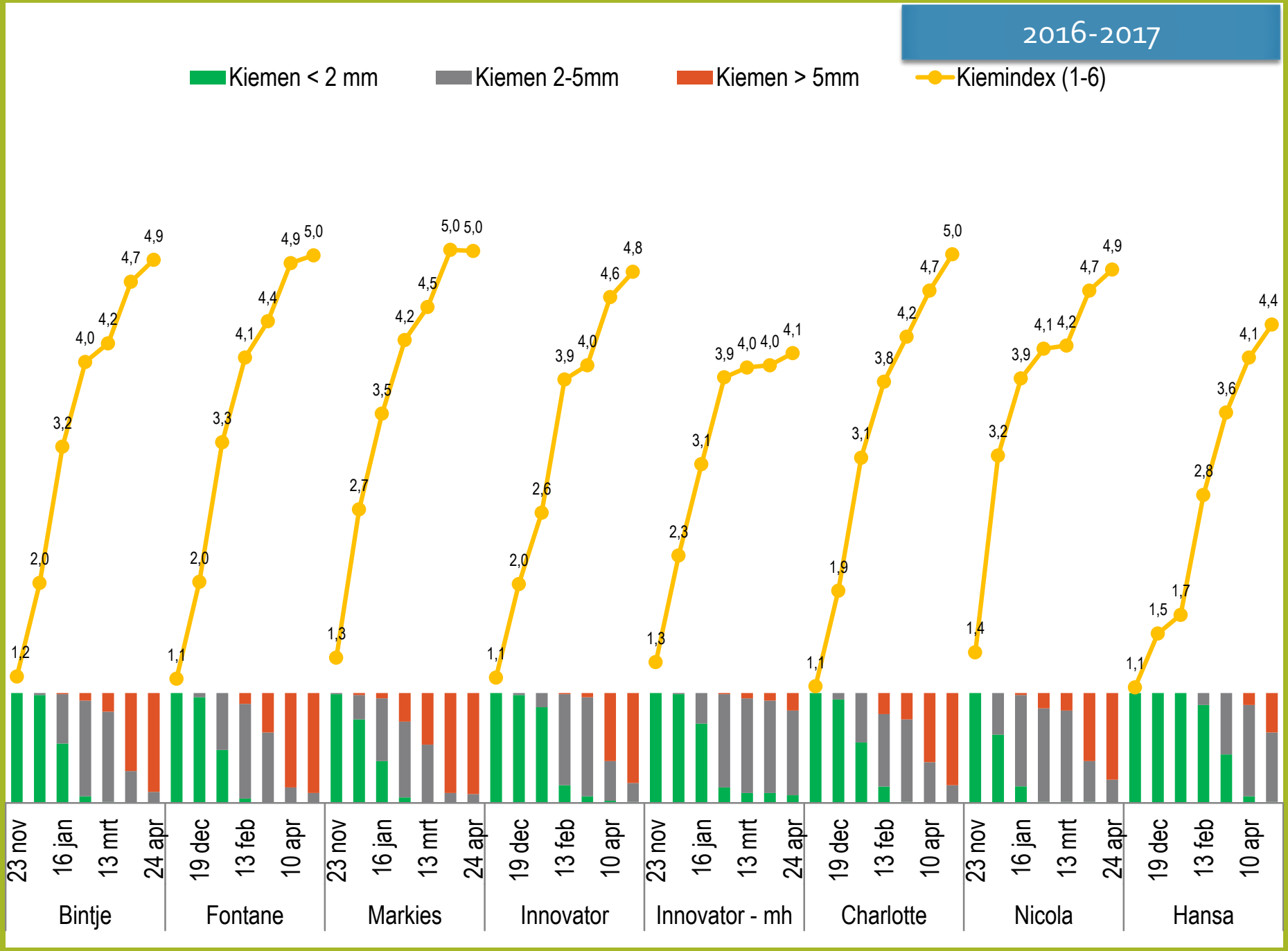
Relevant results for seasons
2015-2016 & 2016-2017

Untreated control

- Stored @ 8°C

- 2015-2016
  - 7 varieties – only Nicola with MH
  - Sproutindex 5 from mid-December on
  - Sproutindex 6 from end of February
- 2016-2017
  - 7 varieties – only Innovator with MH
  - Sproutindex 4 from mid- February on
  - Sproutindex 5 from end of April


2015-2016
Kiemen < 2 mm
Kiemen 2-5mm
Kiemen > 5mm
Kiemindex (1-6)
1,2 1,6 3,0 4,1 5,7 5,8 5,9 6,0 6,0
1,1 1,2 1,5 2,2 5,3 5,6 5,8 5,9 6,0
1,1 1,2 1,4 1,8 4,6 5,1 5,2 5,3 5,8
1,2 1,6 2,0 3,3 5,4 5,6 5,7 5,9 6,0
1,3 1,6 3,3 4,6 5,7 5,7 5,7 6,0 6,0
1,3 1,7 2,3 3,6 5,0 5,2 5,3 5,4 5,8
1,5 3,1 3,6 3,7 3,6 3,9 4,0 3,7 3,8
3 nov
30 nov
11 jan
9 feb
7 mrt
16 nov
14 dec
25 jan
22 feb
Bintje
Fontane
Markies
Innovator
Challenger
Charlotte
Nicola - MH


2016-2017
Kiemen < 2 mm
Kiemen 2-5mm
Kiemen > 5mm
Kiemindex (1-6)
1,2 2,0 3,2 4,0 4,2 4,7 4,9
1,1 2,0 3,3 4,1 4,4 4,9 5,0
1,3 2,7 3,5 4,2 4,5 5,0 5,0
1,1 2,0 2,6 3,9 4,0 4,6 4,8
1,3 2,3 3,1 3,9 4,0 4,0 4,1
1,1 1,9 3,1 3,8 4,2 4,7 5,0
1,4 3,2 3,9 4,1 4,2 4,7 4,9
1,1 1,5 1,7 2,8 3,6 4,1 4,4
23 nov
16 jan
13 mrt
24 apr
19 dec
13 feb
10 apr
Bintje
Fontane
Markies
Innovator
Innovator - mh
Charlotte
Nicola
Hansa

Untreated – 22 February 2016

Bintje (5,88)

Challenger (5,88)

Charlotte (5,00)

Fontane (5,80)

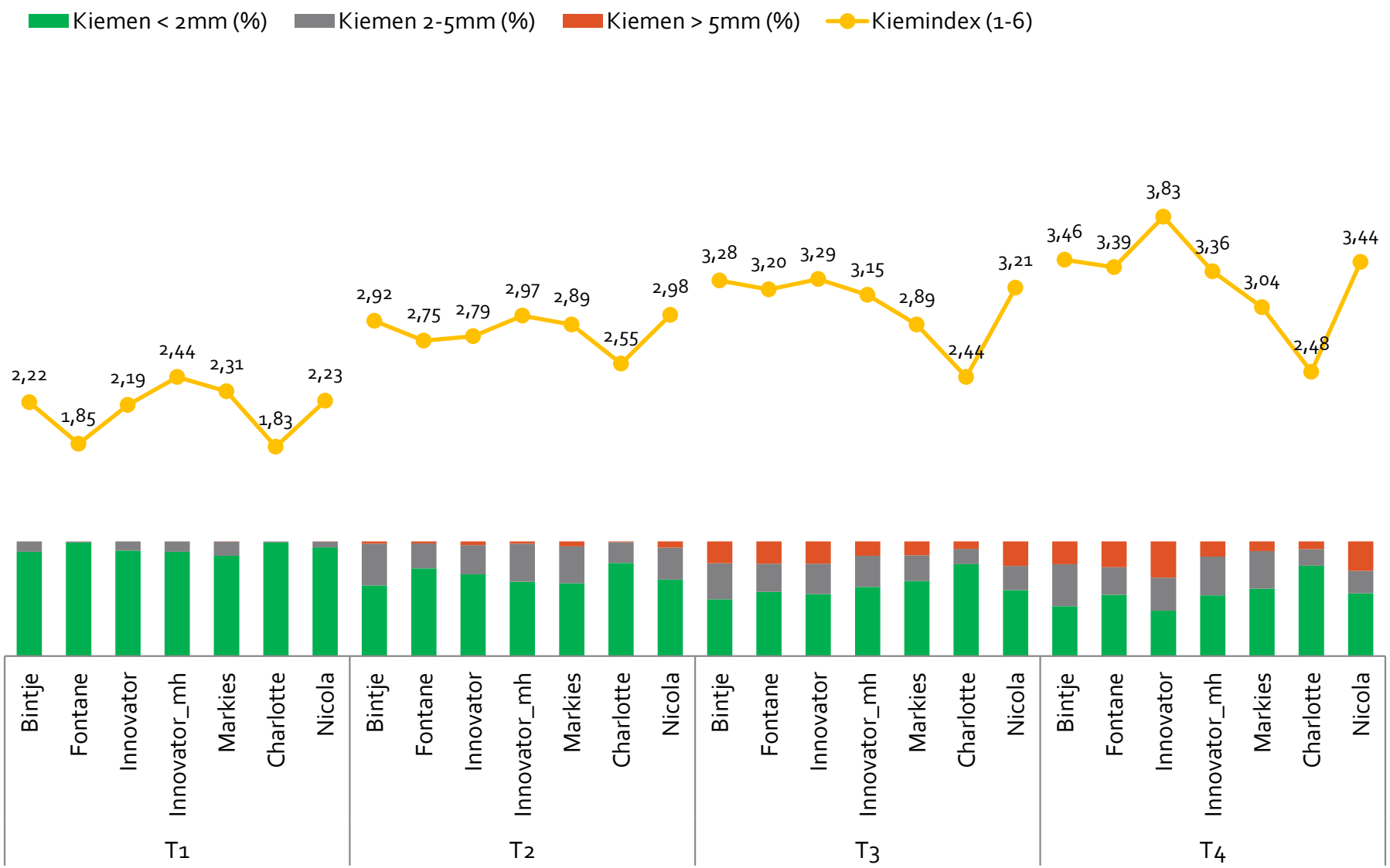
Innovator (6,00)

Nicola (3,57)

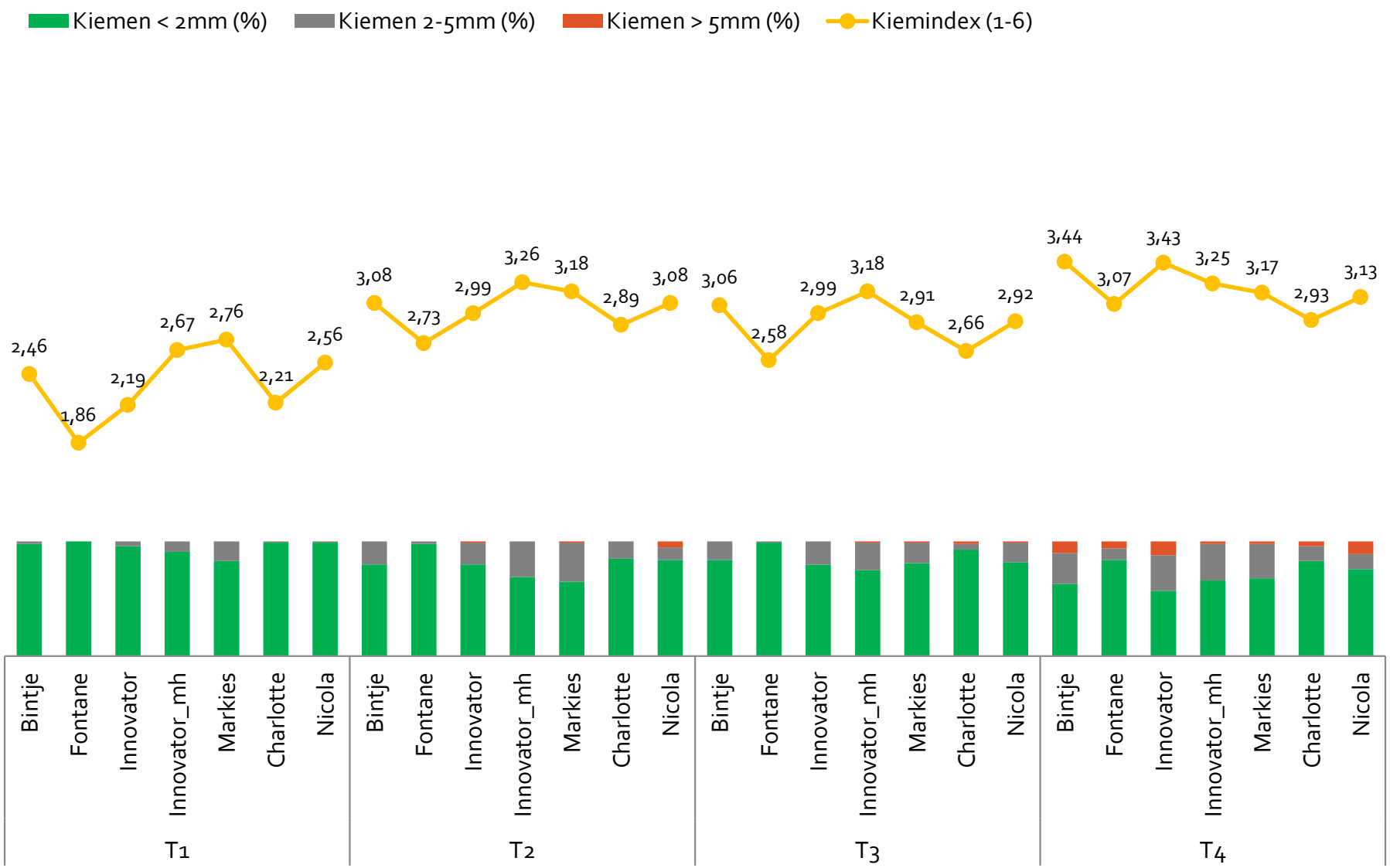
SPROUT-INDEX 2016-2017

At unloading (4 replicates)

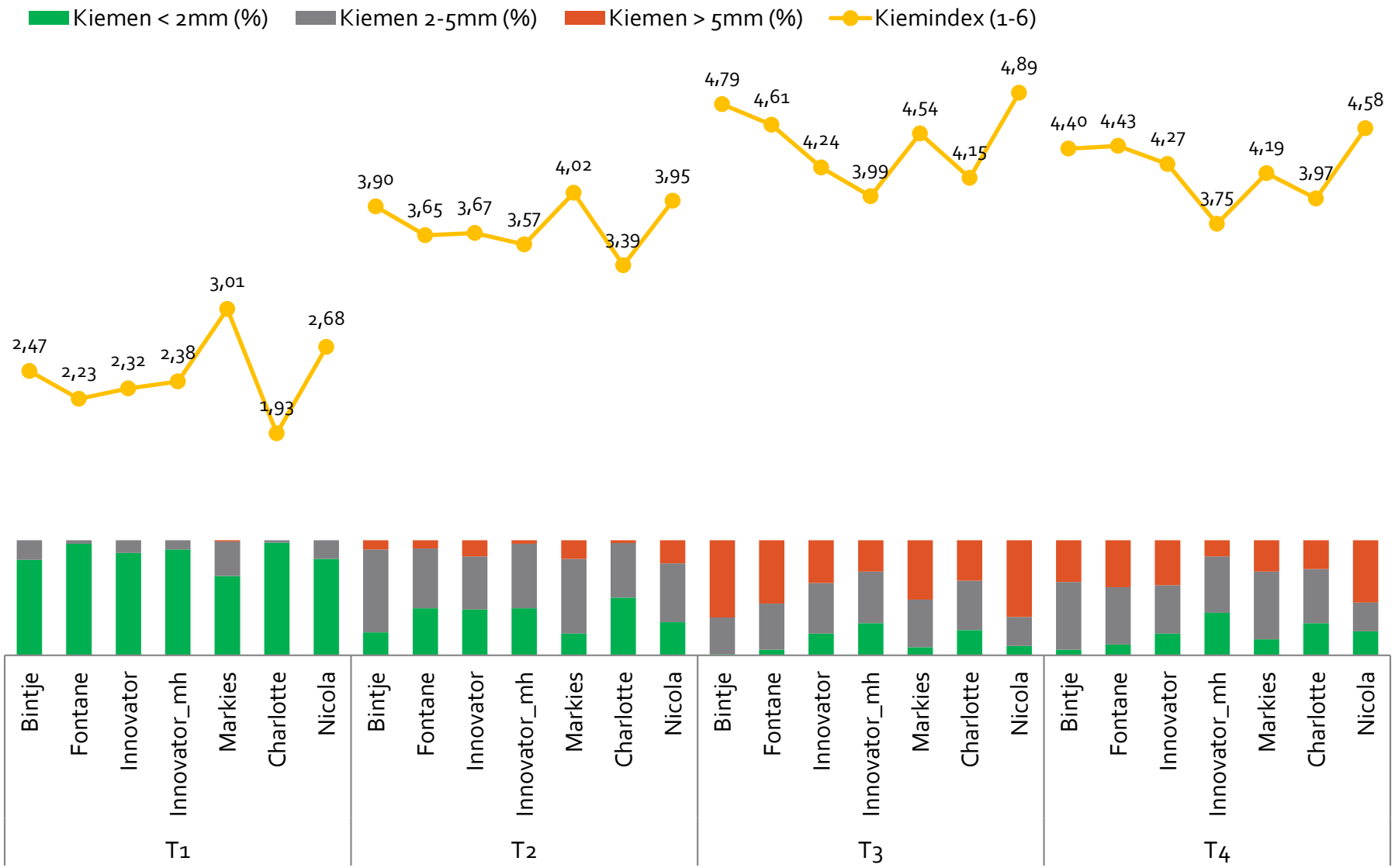
(Alle)


Kiemen < 2mm (%)
Kiemen 2-5mm (%)
Kiemen > 5mm (%)
Kiemindex (1-6)
2,22
1,85
2,19
2,44
2,31
1,83
2,23
2,92
2,75
2,79
2,97
2,89
2,55
2,98
3,28
3,20
3,29
3,15
2,89
2,44
3,21
3,46
3,39
3,83
3,36
3,04
2,48
3,44
Bintje
Fontane
Innovator
Innovator_mh
Markies
Charlotte
Nicola
T1
T2
T3
T4

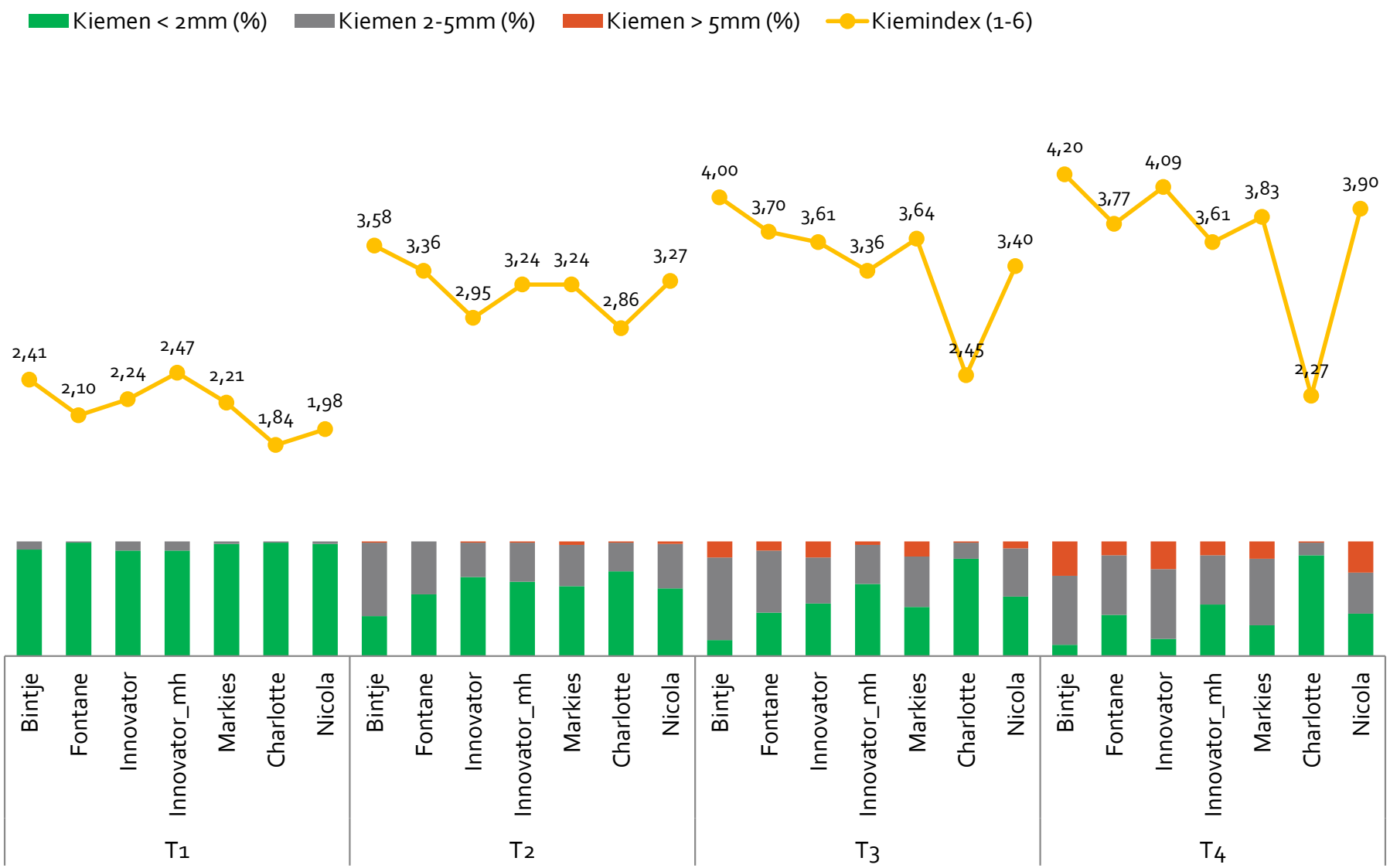
Gro-Stop


Kiemen < 2mm (%)
Kiemen 2-5mm (%)
Kiemen > 5mm (%)
Kiemindex (1-6)
2,46
1,86
2,19
2,67
2,76
2,21
2,56
3,08
2,73
2,99
3,26
3,18
2,89
3,08
3,06
2,58
2,99
3,18
2,91
2,66
2,92
3,44
3,07
3,43
3,25
3,17
2,93
3,13
Bintje
Fontane
Innovator
Innovator_mh
Markies
Charlotte
Nicola
T1
T2
T3
T4

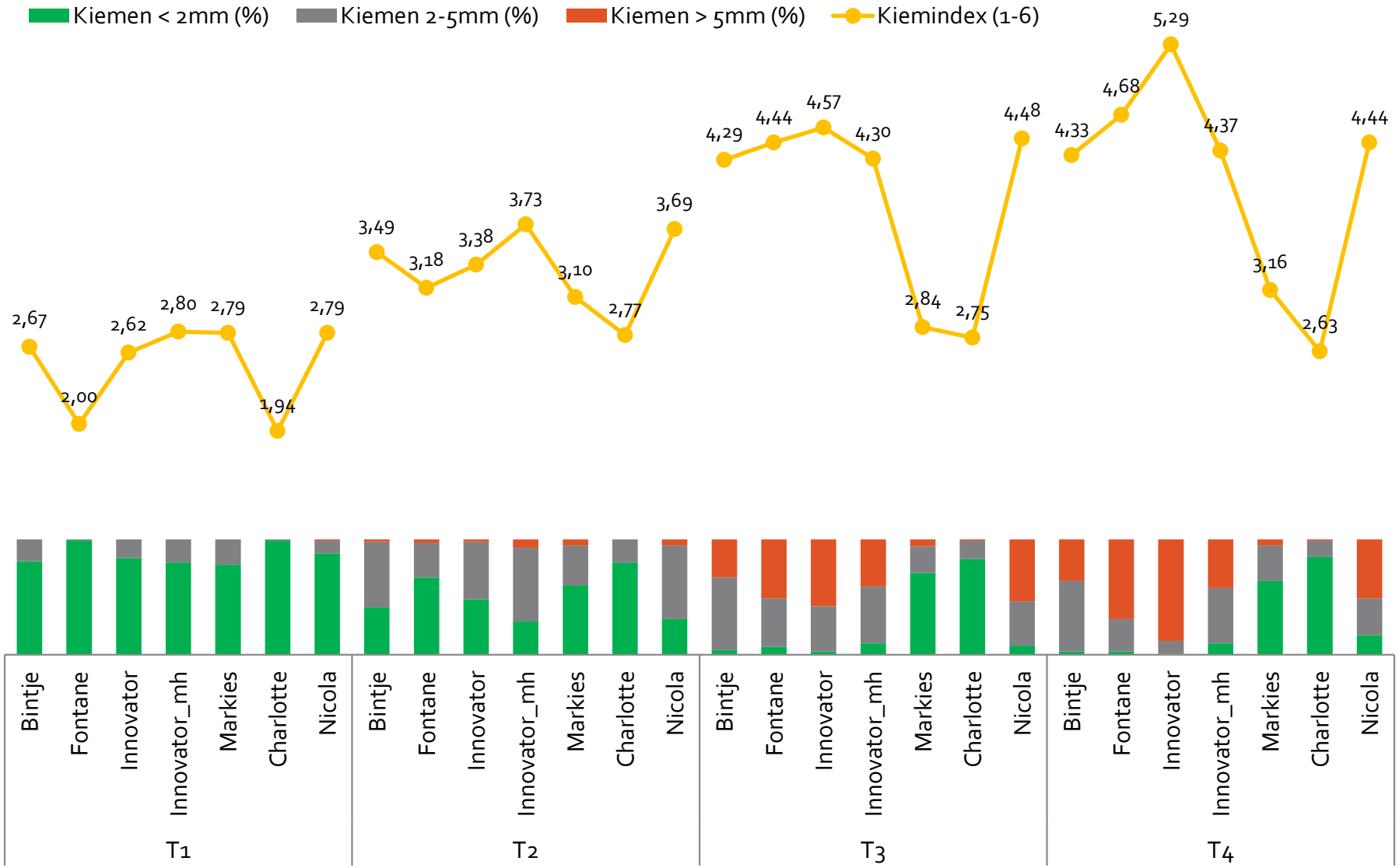
PM-1


Kiemen < 2mm (%)
Kiemen 2-5mm (%)
Kiemen > 5mm (%)
Kiemindex (1-6)
2,47
2,23
2,32
2,38
3,01
1,93
2,68
3,90
3,65
3,67
3,57
4,02
3,39
3,95
4,79
4,61
4,24
3,99
4,54
4,15
4,89
4,40
4,43
4,27
3,75
4,19
3,97
4,58
Bintje
Fontane
Innovator
Innovator_mh
Markies
Charlotte
Nicola
T1
T2
T3
T4

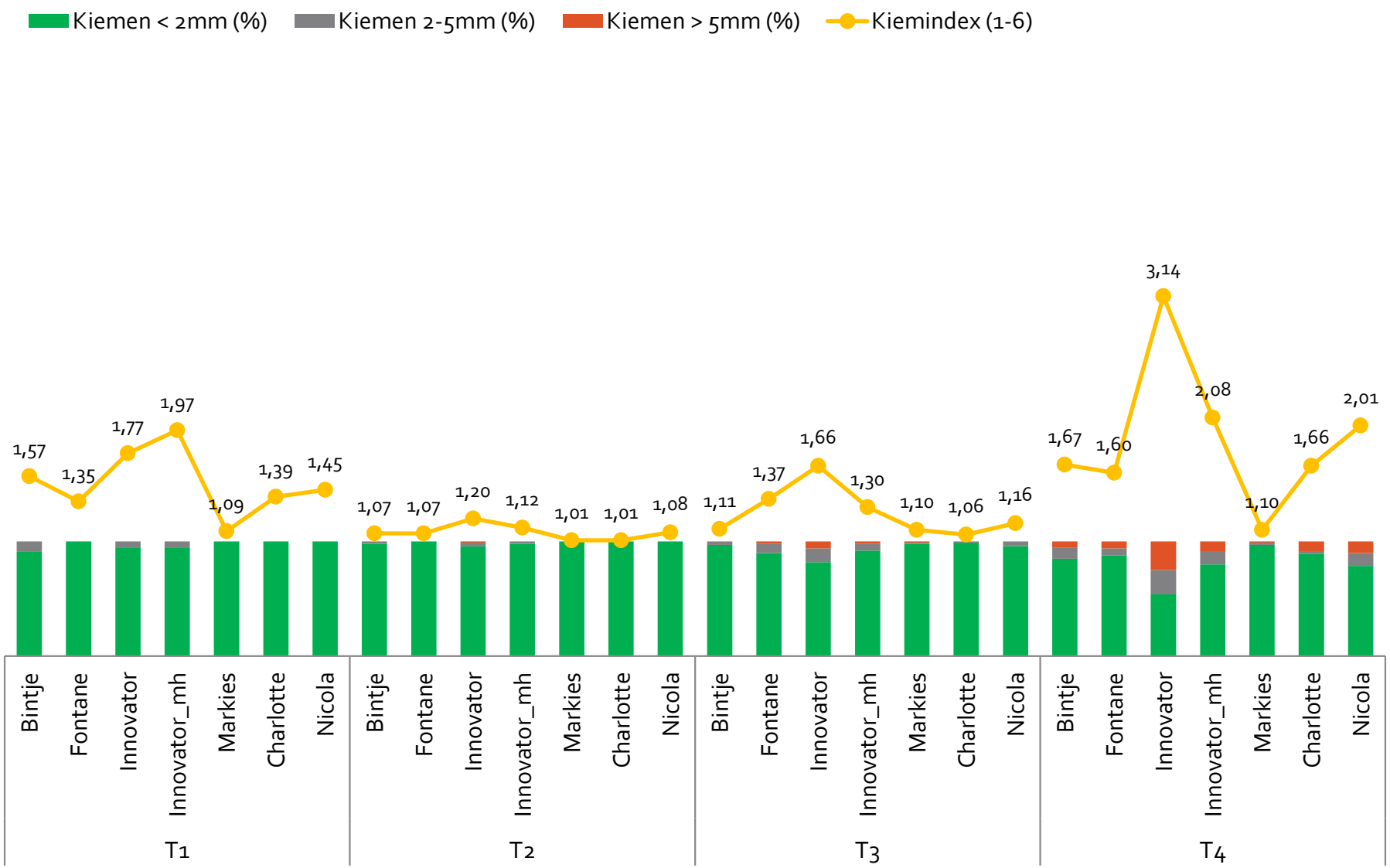
Biox-M


Kiemen < 2mm (%)
Kiemen 2-5mm (%)
Kiemen > 5mm (%)
Kiemindex (1-6)
2,41
2,10
2,24
2,47
2,21
1,84
1,98
3,58
3,36
2,95
3,24
3,24
2,86
3,27
4,00
3,70
3,61
3,36
3,64
2,45
3,40
4,20
3,77
4,09
3,61
3,83
2,27
3,90
Bintje
Fontane
Innovator
Innovator_mh
Markies
Charlotte
Nicola
T1
T2
T3
T4

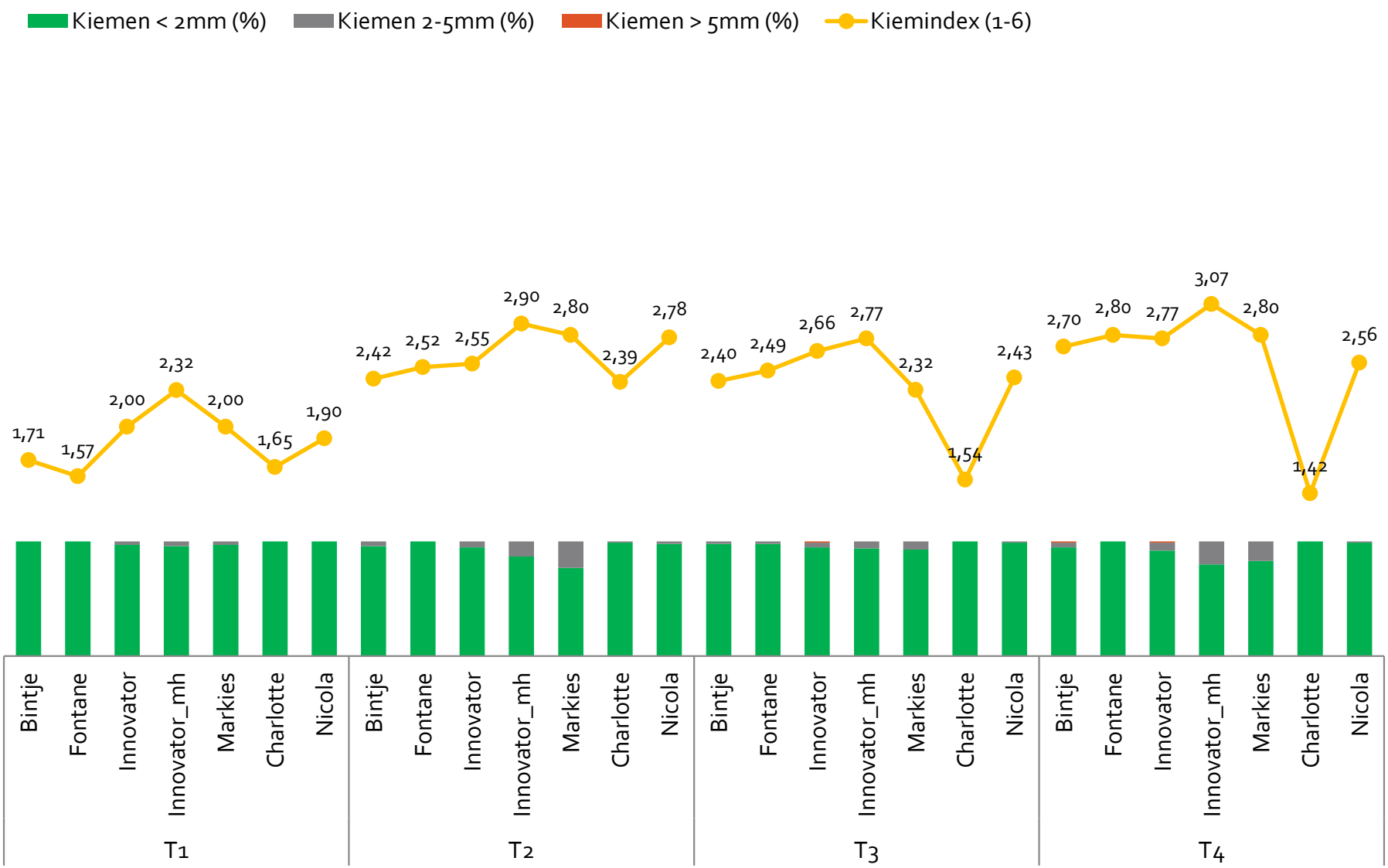
Restrain


Kiemen < 2mm (%)
Kiemen 2-5mm (%)
Kiemen > 5mm (%)
Kiemindex (1-6)
2,67
2,00
2,62
2,80
2,79
1,94
2,79
3,49
3,18
3,38
3,73
3,10
2,77
3,69
4,29
4,44
4,57
4,30
2,84
2,75
4,48
4,33
4,68
5,29
4,37
3,16
2,63
4,44
Bintje
Fontane
Innovator
Innovator_mh
Markies
Charlotte
Nicola
T1
T2
T3
T4

PM-2


Kiemen < 2mm (%)
Kiemen 2-5mm (%)
Kiemen > 5mm (%)
Kiemindex (1-6)
1,57
1,35
1,77
1,97
1,09
1,39
1,45
1,07
1,07
1,20
1,12
1,01
1,01
1,08
1,11
1,37
1,66
1,30
1,10
1,06
1,16
1,67
1,60
3,14
2,08
1,10
1,66
2,01
Bintje
Fontane
Innovator
Innovator_mh
Markies
Charlotte
Nicola
T1
T2
T3
T4

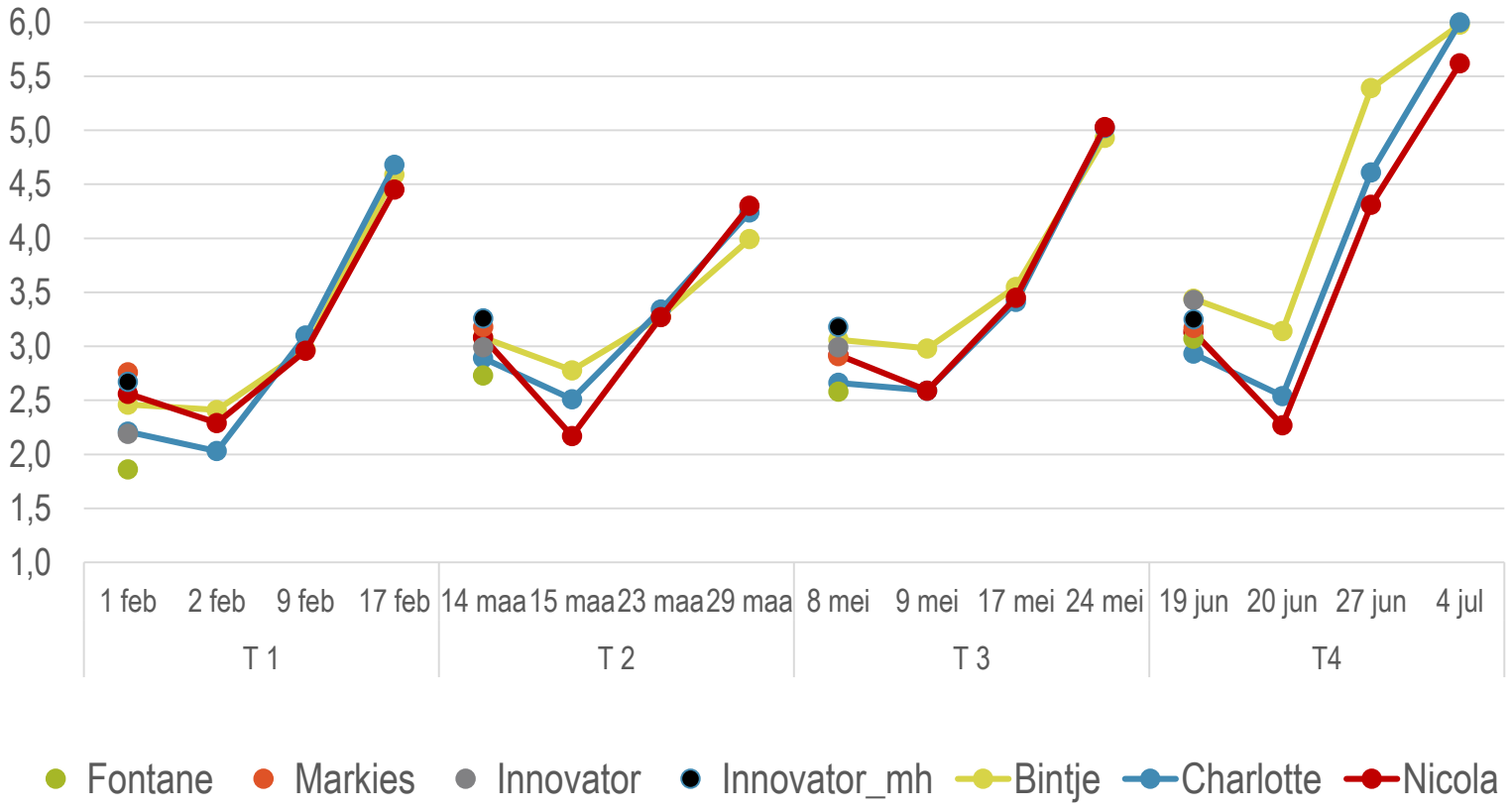
1,4 Sight


Kiemen < 2mm (%)
Kiemen 2-5mm (%)
Kiemen > 5mm (%)
Kiemindex (1-6)
1,71
1,57
2,00
2,32
2,00
1,65
1,90
2,42
2,52
2,55
2,90
2,80
2,39
2,78
2,40
2,49
2,66
2,77
2,32
1,54
2,43
2,70
2,80
2,77
3,07
2,80
1,42
2,56
Bintje
Fontane
Innovator
Innovator_mh
Markies
Charlotte
Nicola
T1
T2
T3
T4

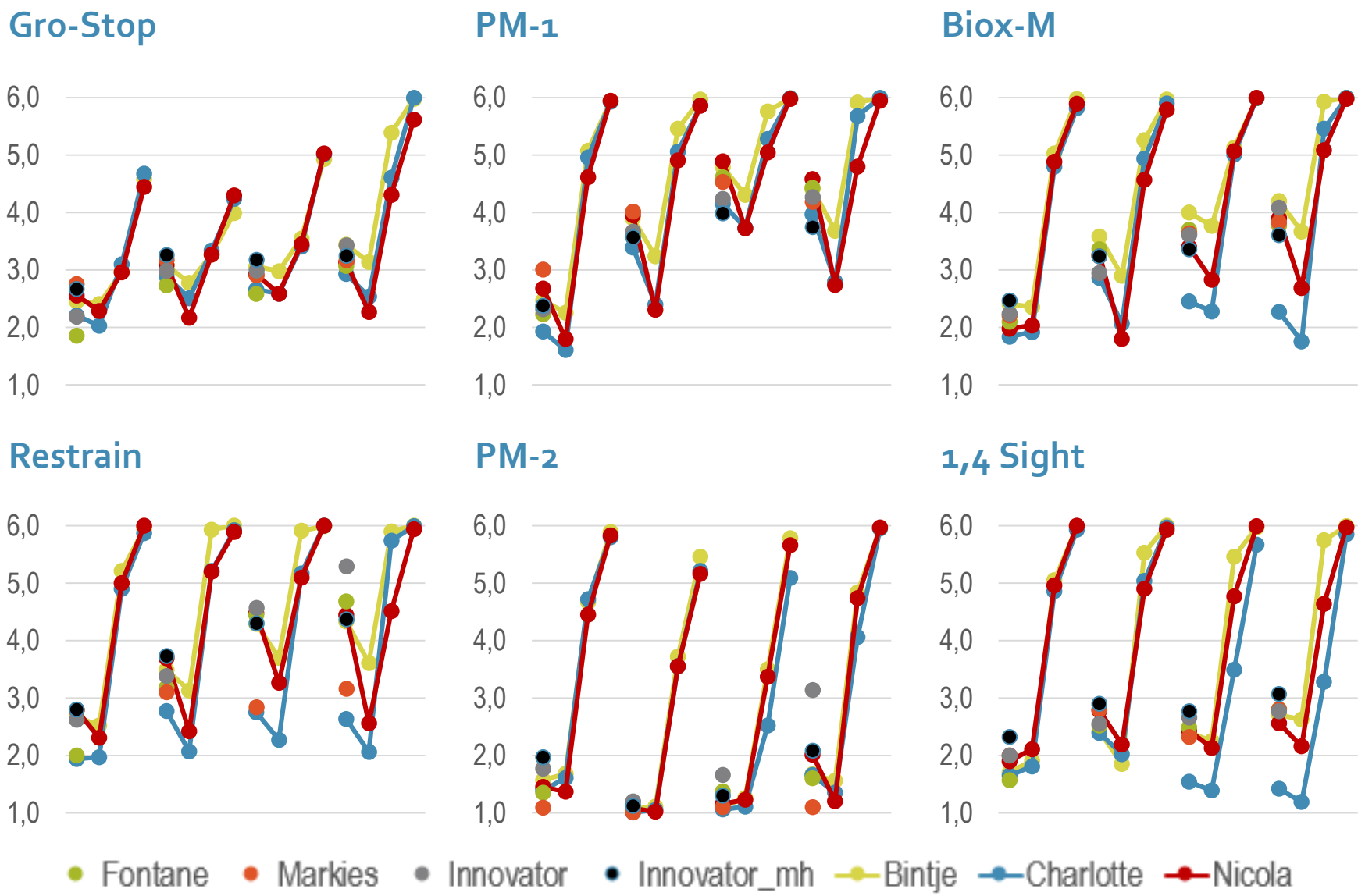
SPROUT-INDEX 2016-2017

Shelf-life (4 replicates)

Gro-Stop


6,0
5,5
5,0
4,5
4,0
3,5
3,0
2,5
2,0
1,5
1,0
1 feb
2 feb
9 feb
17 feb
14 maa
15 maa
23 maa
29 maa
8 mei
9 mei
17 mei
24 mei
19 jun
20 jun
27 jun
4 jul
T 1
T 2
T 3
T4
Fontane
Markies
Innovator
Innovator_mh
Bintje
Charlotte
Nicola

Sprout index (1-6) @ unloading + shelf-life



QUALITY ASSESSMENTS

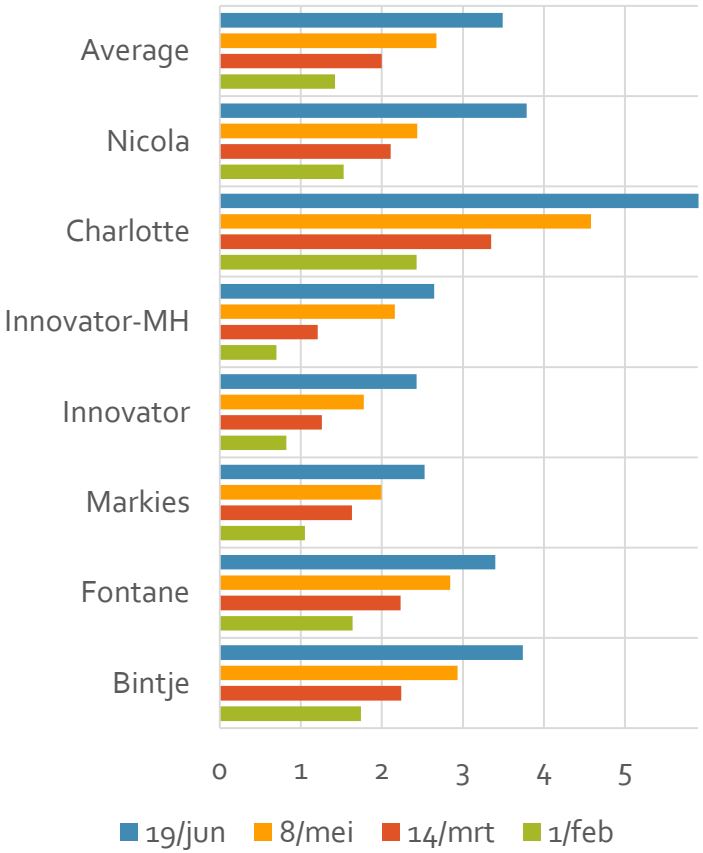
Weight loss | Firmness tubers | Fry colour | Taste

Internal sprouting |Silver scurf | Black dot

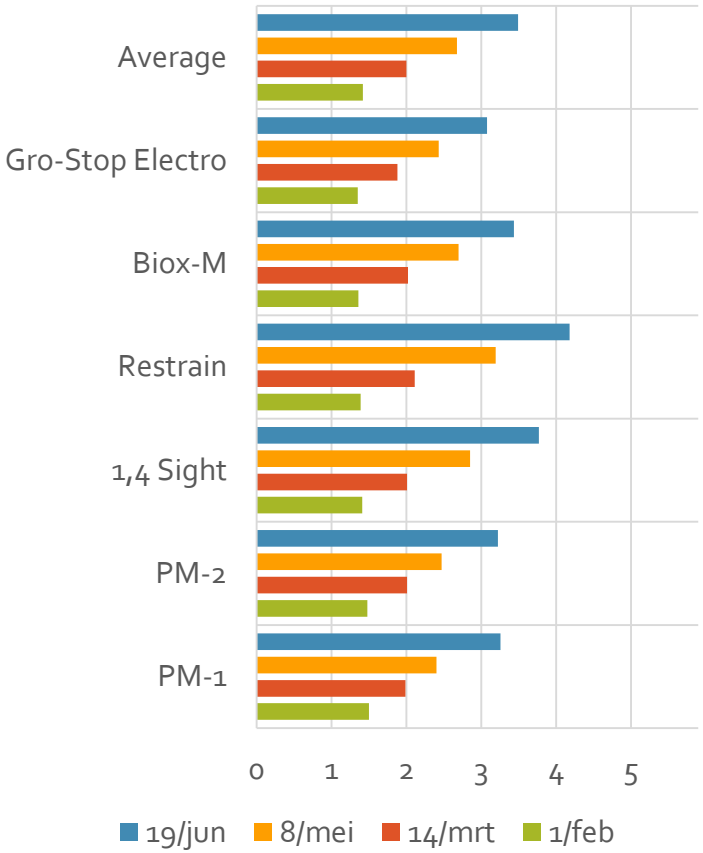
(4 replicates)

Weight loss (%)

By variety

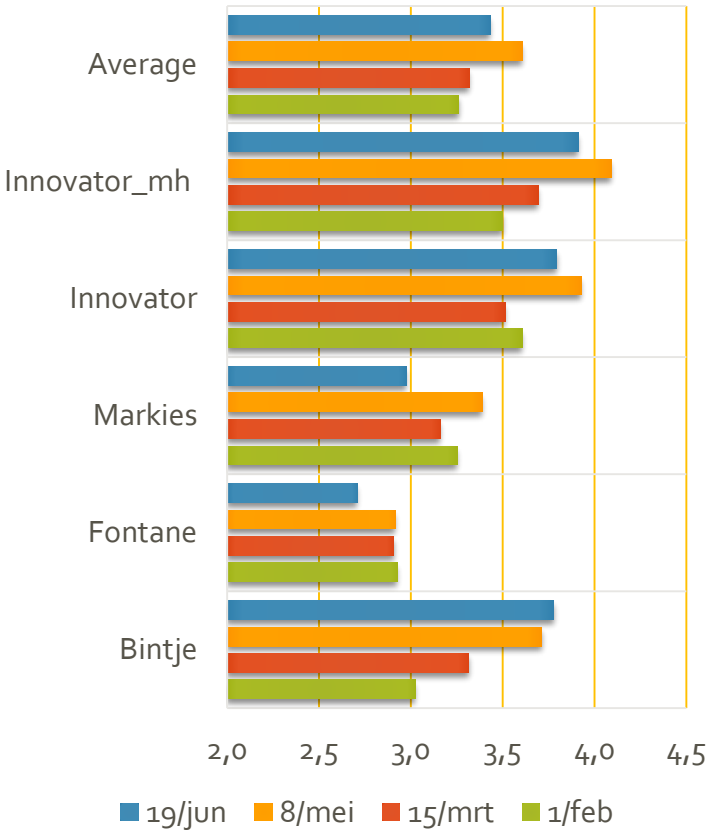


By treatment

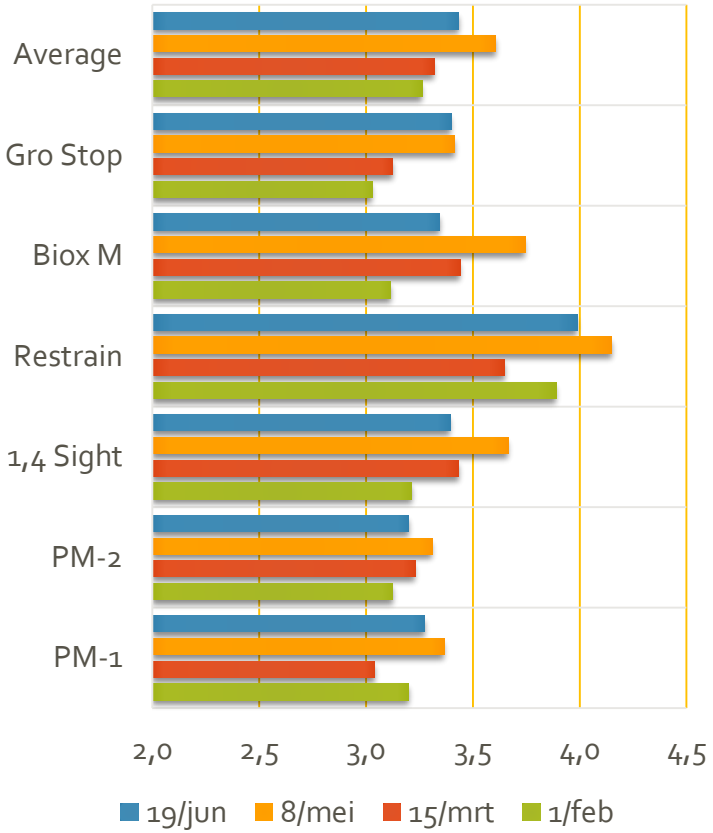


Fry colour (0-6)

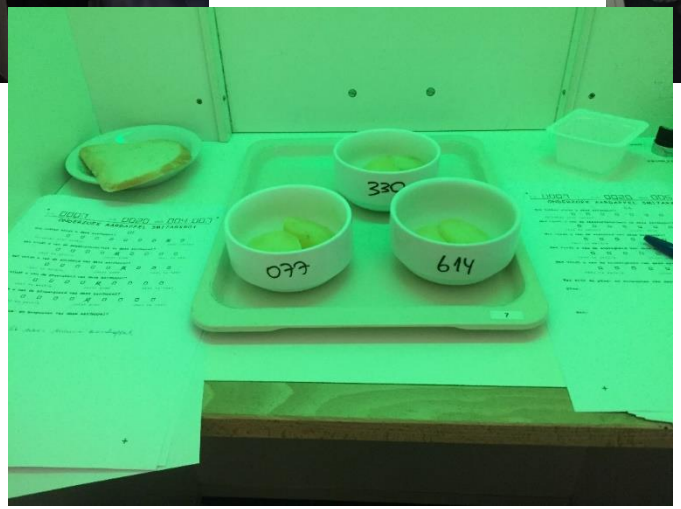
Variety



Regime



Taste demo (1)



Taste demo (2)

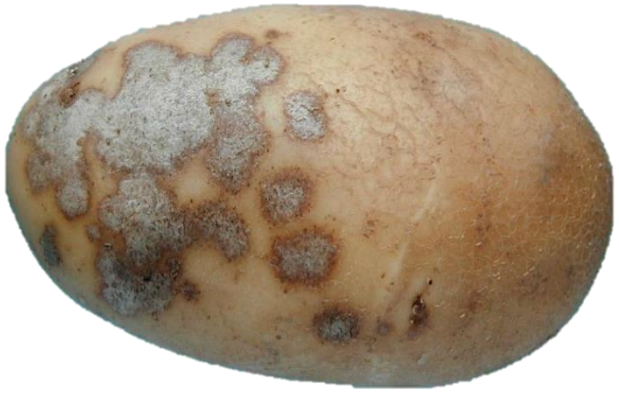
- Demonstrative taste trial : consumer acceptance (not a taint test)
- Scores for taste intensity, sweetness, firmness & texture ('bloemigheid')
- 6 objects : CIPC, BIOX-M, Restrain, 1,4SIGHT & 2 experimental products (PM1 en PM2)
- Potatoes peeled & steamed
- Number of panelists (n=21) is small for statistiscally significant differences

Taste demo : conclusions

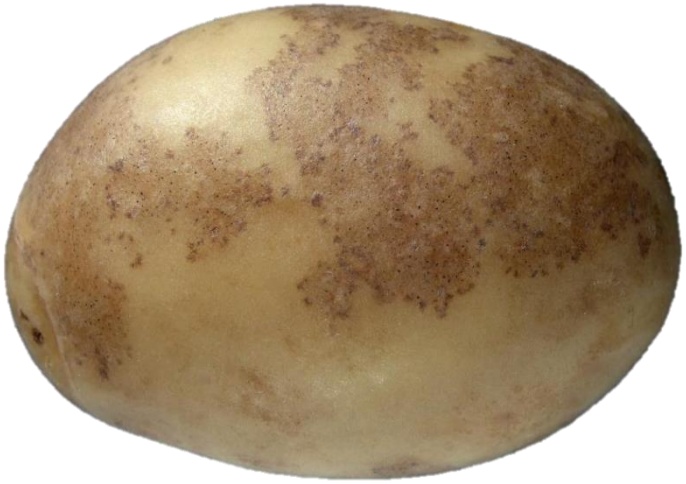
- No differences found in taste acceptance and texture
- Potatoes treated with Restrain are sweeter compared to those treated with CIPC
- Potatoes treated with CIPC or PM2 are firmer compared to those treated with BIOX-M (after cooking)
- Some comments were made regarding a taint, mainly for the potatoes treated with BIOX-M or PM1
- Given the limited number of panelists (n=21) a more elaborate trial (taint or consumer acceptance) would need to confirm the results

Blemish diseases

Silver scurf

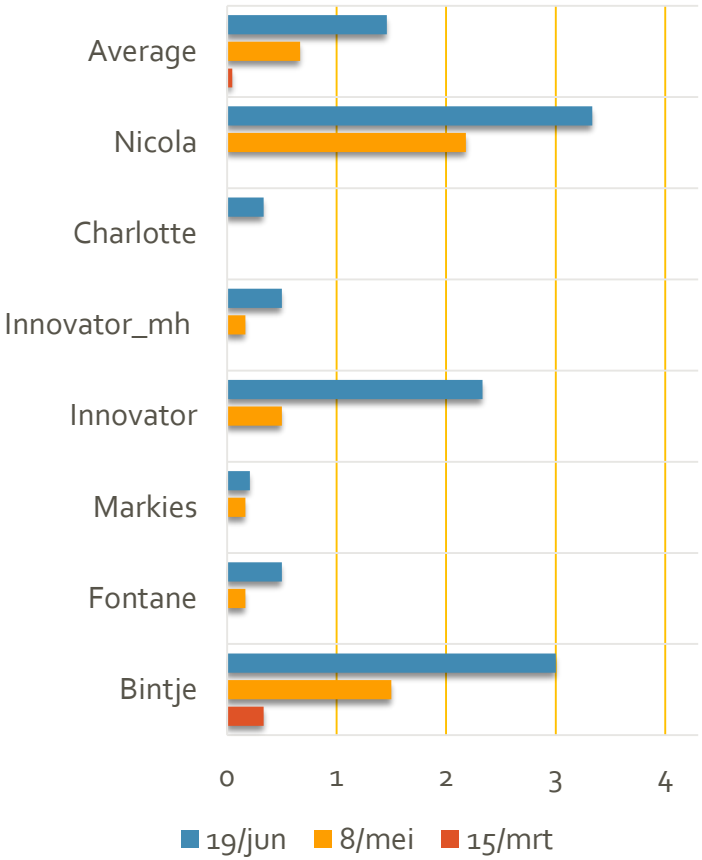


Black dot

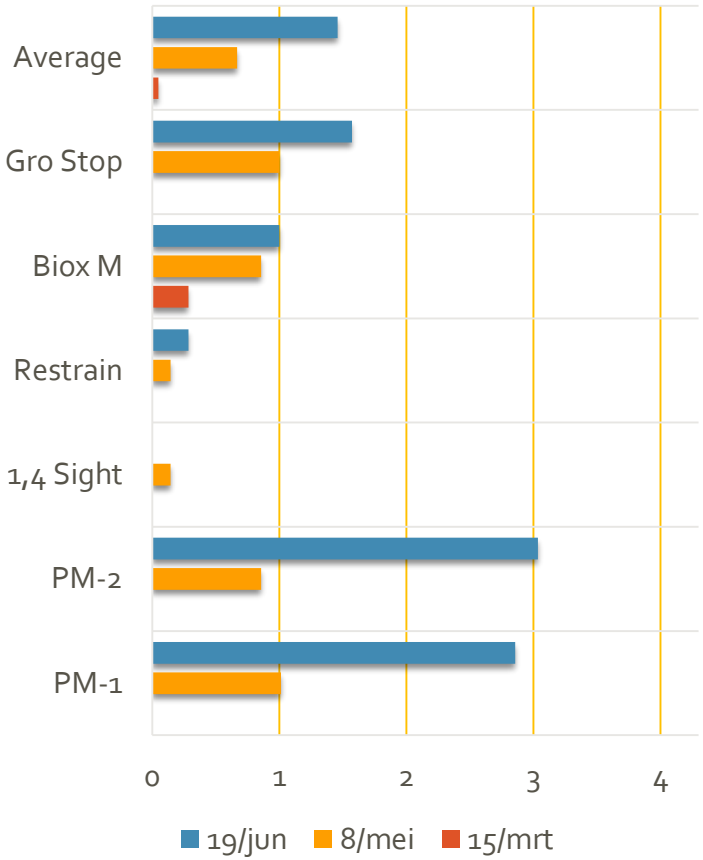


Internal sprouting (%)

Variety



Regime



Trial Inagro @ Sint-Truiden (Pomuni)

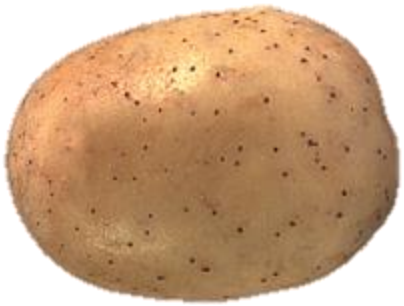
1,4 Sight *vs*. CIPC in box-stores

2015-2016

Set-up

Location

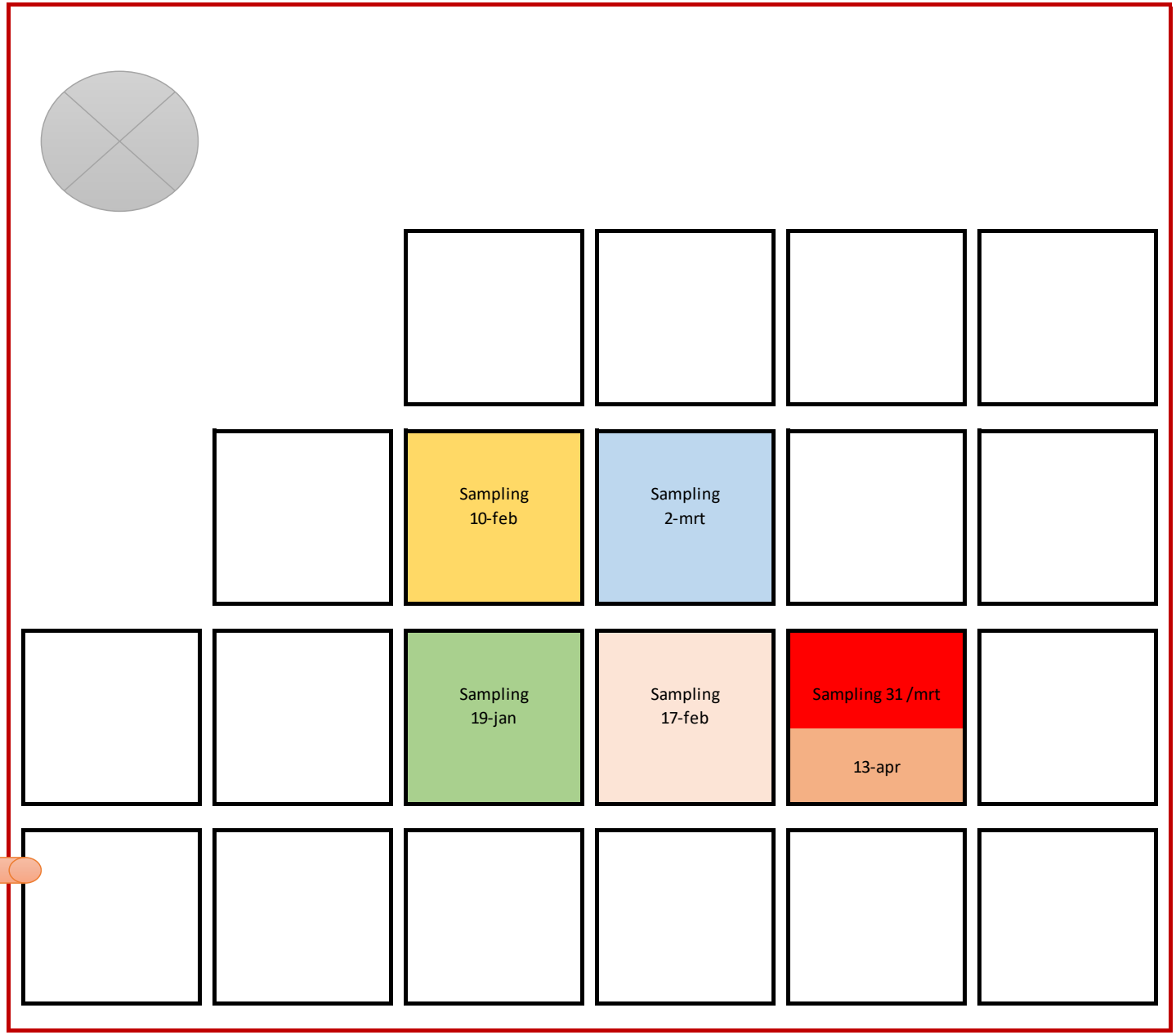
- cv. Melody
- Stored in wooden boxes
- 2 identical cels of 355 tonnes
- Harvested & stored on the same day
- Hot fogging



Protocol

- Samples for shelf-life
  - 10 to 14 d before fogging
  - +7, +14 and +28 d after fogging
- Assessment:
  - Sprouting before washing
  - Store at 10°C and 18°C
  - Sprouting after
    - +7 d
    - +14 d
    - +21 d
    - +28 d

Zij-aanzicht **Lateral view**



Set-up & residue monitoring

Fogging	Store A	Store B
13 Nov	Neonet*	Neonet
16 Dec	Neonet	1,4 Sight
3 Feb	Neonet	1,4 Sight
17 Mar	Neonet	1,4 Sight

Dose: 20 ml product/ton

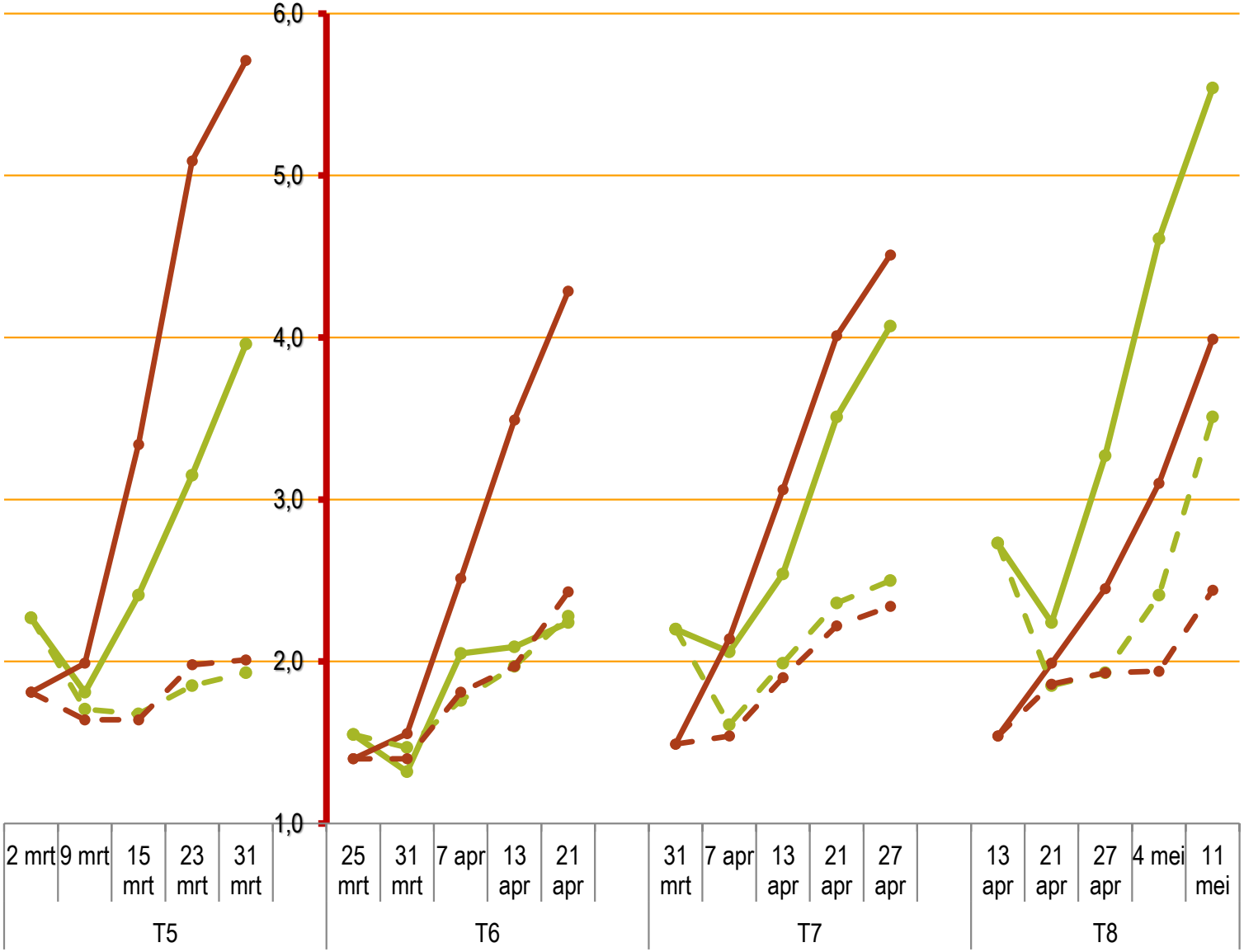
Residue CIPC	Store A	Store B
19 Jan	1,5	2,1
10 Feb	2,1	1,1
16 March	2,7	0,41
30 March	6,5	0,55
30-03 (washed)	4,9	0,45

Residue CIPC (ppm)

* Neonet: 300 g/l chloorpropham

Evolution sprouting index

Fogging: March 17



Conclusions "Sint-Truiden"

- Valuable set-up
- One variety = ideal to steer fogging
- Neonet *vs*. 1,4 Sight
  - Sprout control at unloading: 1,4 Sight better then Neonet
  - Shelf-life
    - 18°C — Neonet > 1,4 Sight
    - 10°C — Neonet = 1,4 Sight
    - Early & mid season — Neonet > 1,4 Sight
    - End of season — 1,4 Sight > Neonet

Trial Inagro @ Thorembais (Pomuni)

1,4 Sight vs. CIPC

2016-2017

Trial setup

Location

- Wooden boxes
- 2 stores 900 tonnes each
- Different varieties
- Fogging by external society
- Varieties Challenger & Noblesse

Protocol assessment

- Sprouting before washing
- Shelflife at 10°C and 18°C
- Sprouting after
  - +7 d
  - +14 d
  - +21 d
  - +28 d

Fogging & residu

Date	Box A	Box B
14 nov	Growstop Fog 300g/l	
22 nov		1,4 Sight
10 jan		1,4 Sight
16 jan	Growstop Fog 300g/l	

Dose: 20 ml/tonne

Residue MH	Challenger	Noblesse
4 jan	0,0	0,0

Residue CIPC	Challenger	Noblesse
4 jan	0,13	3,20
25 jan	0,65	5,90

Residue 1,4 DMN - Challenger

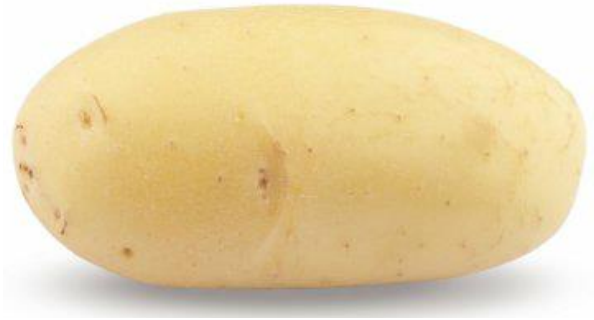
Date	Washed?	Peeled	Residu (ppm)
25 jan	No	No	-
28 jan (+ 3d)	Yes	No	0,76
1 feb (+ 7d)	Yes	No	0,51
23 feb (+ 28d)	Yes	No	0,23
23 feb (+ 28d)	Yes	Yes	0,041

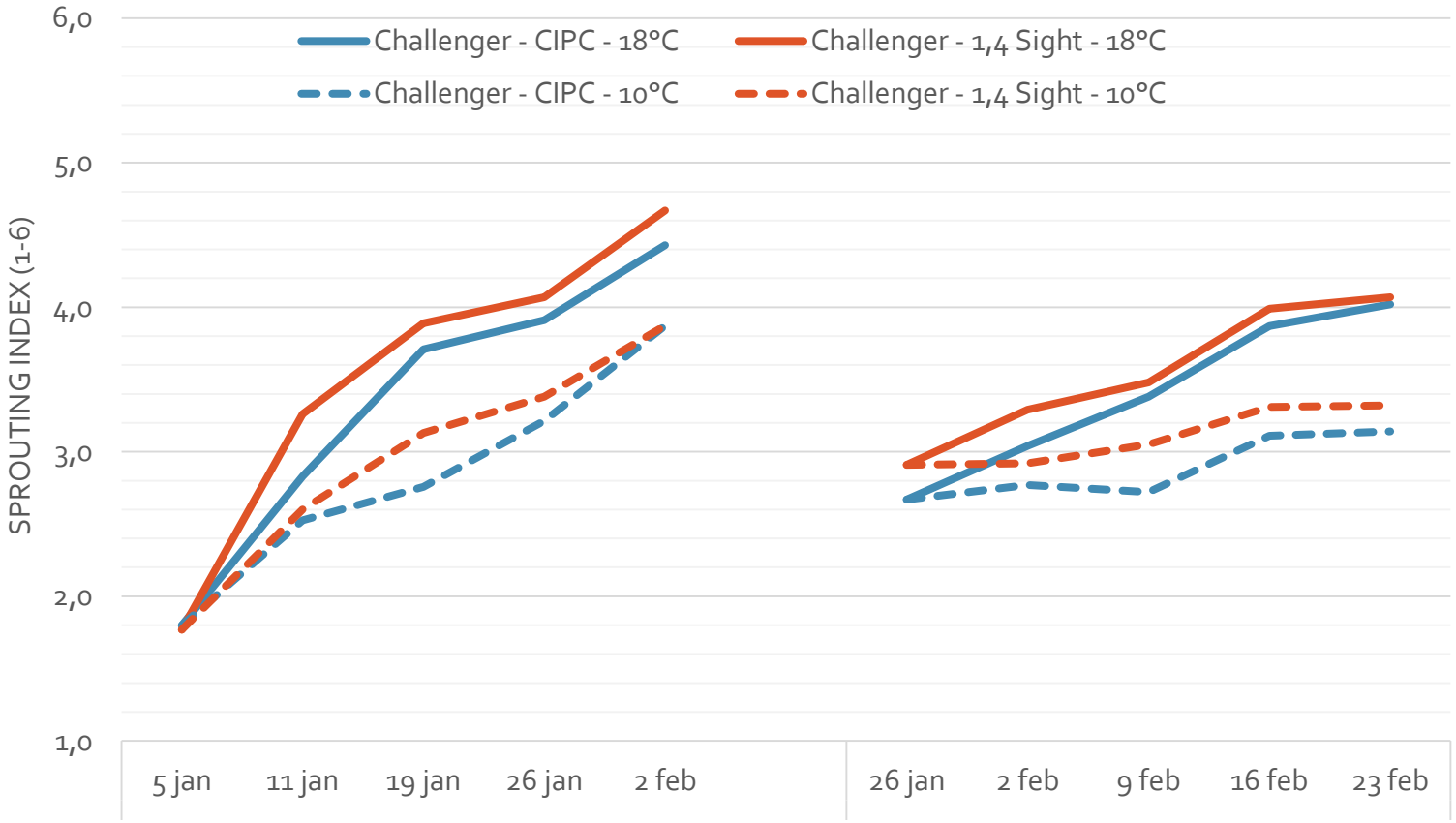
Analyses by Eurofins on 12 tubers (GC-MSMS)

Interval application – sampling

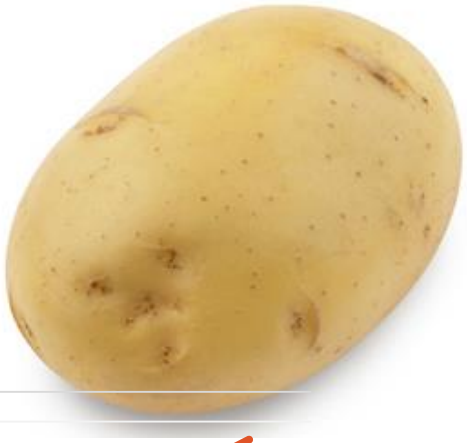
Dagen na laatste toepassing	Shelf-life 1					Shelf-life 2				
	5 jan	11 jan	19 jan	26 jan	2 feb	26 jan	2 feb	9 feb	16 feb	23 feb
Cel		*6*	*14*	*21*	*28*		*7*	*14*	*21*	*28*
CIPC	52	58	66	73	80	10	17	24	31	38
1,4 Sight	44	50	58	65	72	16	23	30	37	44
Gemiddeld	48	54	62	69	76	13	20	27	34	41

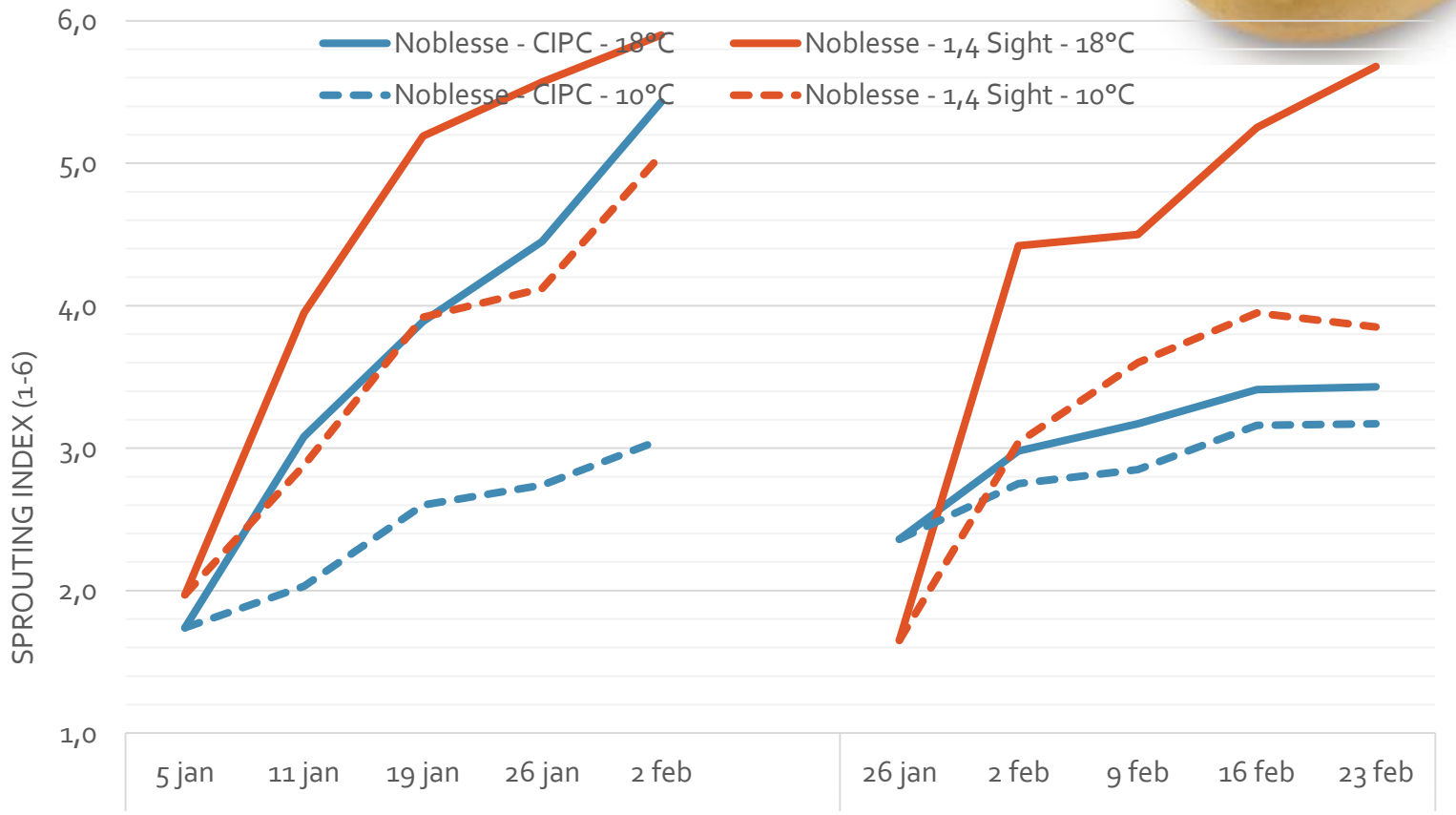
Challenger - sprouting





Noblesse- sprouting





Conclusions "Thorembais"

- Valuable set-up
- CIPC residue heterogeneous
- Influence of variety & residue level
- Neonet *vs*. 1,4 Sight
  - Sprout control at unloading: 1,4 Sight ~ Neonet
  - Shelf-life
    - 18°C Neonet > 1,4 Sight
    - 10°C Neonet > 1,4 Sight

Trial Inagro @ Leuze-en-Hainaut (Lutosa)

Restrain *vs*. CIPC

2016-2017

Setup

Location

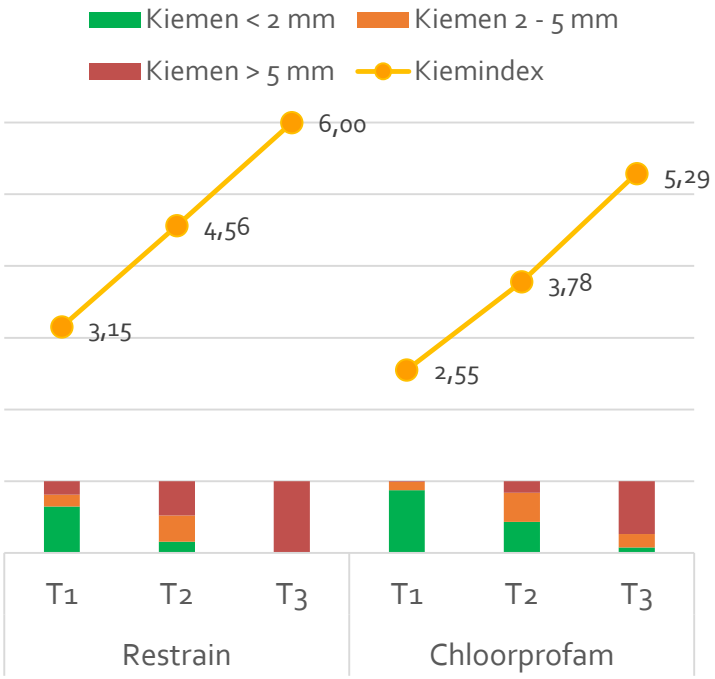
- cv. Bintje – 3 lots
- Bulk store (> 5000 tonnes)
- Collecting + installing samples on October 25th
- Installation Restrain Generator on December 2nd

Assessment

- When?
  - 13 December
  - 7 February
  - 25 April
- What?
  - Sprouting
  - Fry colour

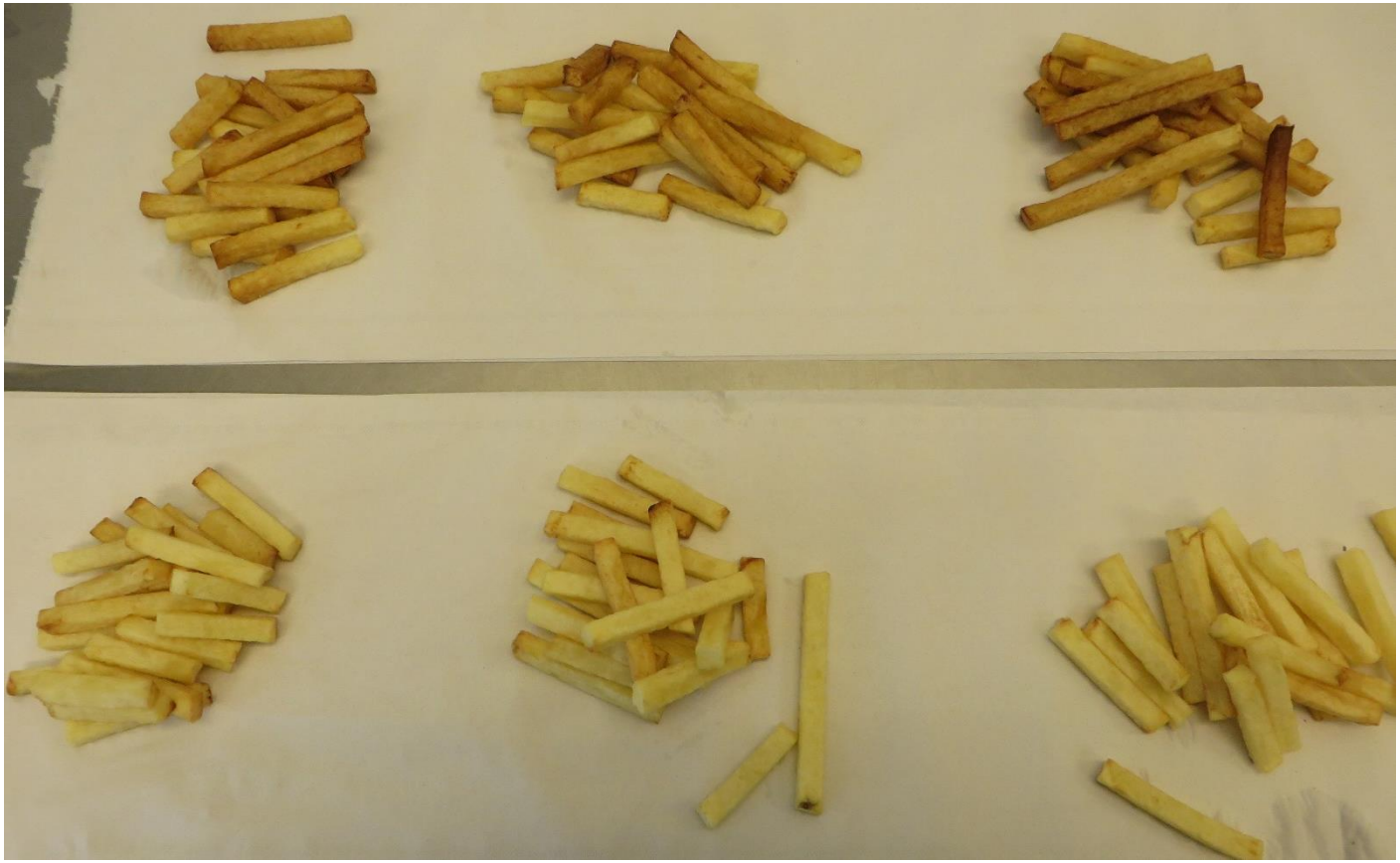
Results results (average of 3 lots)

Sprouting index (1-6)



Fry colour (0-6)

Fry colour (25th April)



Restrain

CIPC

Lot n°1 Lot n°2 Lot n°3

Conclusions “Leuze”

- Set-up:
  - Limited effect of liquid CIPC on non-treated tubers
  - Ethanol consumption rises when “open” store

- Long term storage Bintje x Restrain: fry colour degrades

5. CONCLUSIONS

Products & varieties

Conclusions products

Gro-Stop Electro

- Sprout suppression good (@ authorized dose)
- Minor influence variety x MH
- Internal sprouting moderate
- Shelf-life good

PM-1

- Sprout control moderate
- Better when combined with MH
- 10 applications (9 on label?)
- Internal sprouting
- Shelf-life: poor control

Biox-M

- Sprout control moderate @ reduced dose/scheme)
- Some varietes OK (Charlotte)
- Shelf-life poor control
- Internal sprouting moderate

Restrain

- Sprout control moderate (good on Markies & Charlotte)
- Shelf-life poor
- ± no internal sprouting
- Limited impact on fry colour for Fontane & Innovator

PM-2

- Excellent sprout control (>> CIPC)
- Interval after treatment influence on shelf-life
- Internal sprouting
- Shelf-life 7d ok; 14d not ok

1,4 Sight

- Sprout control good (> CIPC)
- Shelf-life 7d ok; 14d not ok (big interval after applications)
- ± no internal sprouting
- Hard to manage with multiple varieties

Conclusions varieties (1)

Bintje

- Sprout suppression ok with PM-2; 1,4 Sight – moderate with GroStop
- Internal sprouting
- Fry colour poor with Restrain
- Shelf-life moderate (7d ok)

Fontane

- Sprout suppression ok with PM-2; 1,4 Sight and GroStop; moderate with Biox-M
- Fry colour good with all products
- Internal sprouting limited

Markies

- Sprout suppression perfect with PM-2; good 1,4 Sight, Restrain & Gro-Stop; moderate for Biox-M and PM-1
- Internal sprouting ± nihil
- Fry colour moderate with Restrain

Innovator

- Sprout control moderate from May on
- Internal sprouting
- Soft tubers

Charlotte

- Sprout control excellent with PM-2; moderate with PM-1
- Silver scurf !! (lot *vs*. **variety**?)
- Shelf-life moderate (7d ok)
- Limited internal sprouting
- Weightloss rather high

Nicola

- Sprout suppression good with PM-2; 1,4 Sight & Gro-Stop
- Shelf-life moderate – up to 7d
- Moderate internal sprouting

Conclusions varieties (2)

Nicola – MH (2015-2016)	Innovator_MH (2016-2017)	Hansa
• Sprout suppression very good: MH !! – ALL products • Shelf-life very good – up to 2w (MH) • No internal sprouting • 19 ppm MH	• Poor effect of MH on sprouting • Limited internal sprouting • Fry colour moderate – all products equal • 10 ppm MH	• Best sprout suppresion for all products • No internal sprouting • Processing quality good

6. GENERAL CONCLUSIONS & COMMENTS

CIPC-renewal

- CIPC Task Force

CERTIS Arysta LifeScience UPL

- Consumer risk assessment
  - EFSA uses conservative method

    Unrealistic estimate of consumption

    (raw + unwashed + unpeeled)

    (huge consumption per day by toddlers)

  ➔ ARFd too high?
  - Chronic toxicity no problem
  - EU-method ≠ US-method
- Decision EU-commission expected Dec. '17 – Feb. '18

Conclusions trials (1)

- Influence of season / potatoes

- Influence of temperature
  - Tuber temperature at start – cooling down period
  - Stable temperature

- Cold vs. hot fogging
  - Not tested in the same set-up
  - No fytotox encountered

Conclusions trials (2)

- CIPC can be replaced for long time storage

- Shelf-life
  - Alternatives can hold for 7 days @ 15°C without MH
  - Influence of interval between application and unloading

- Quality not effected by product, except some minor…
  - Internal sprouting (suppressant *vs.* inhibitor)
  - Fry colour (function of variety x product)

Acknowledgments

Partners

FLANDERS' FOOD

inagro
RESEARCH & ADVICE IN AGRICULTURE & HORTICULTURE

PCA

Funding

IWT

belgapom

Arysta LifeScience

BASF
We create chemistry

CERTIS

RESTRAIN
Company Ltd.

technologie pour l'agriculture
XEDA

Questions?