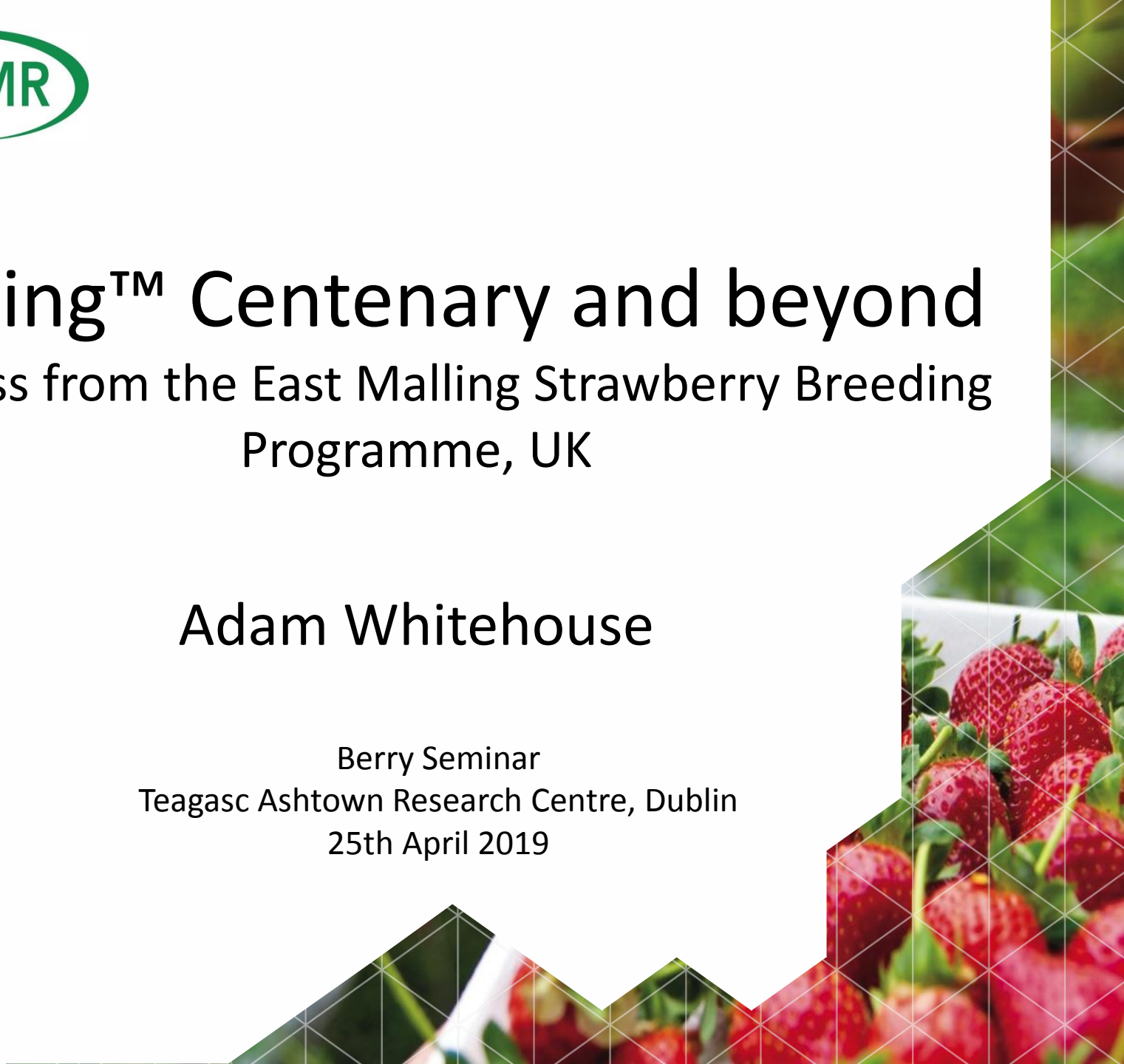
Malling™ Centenary and beyond

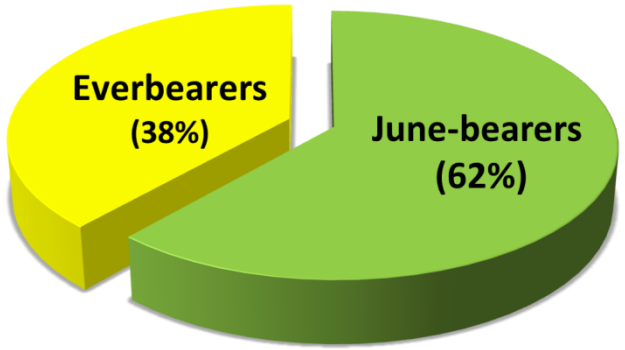
Progress from the East Malling Strawberry Breeding Programme, UK

Adam Whitehouse

Berry Seminar
Teagasc Ashtown Research Centre, Dublin
25th April 2019



Strawberry Breeding at East Malling



13000 seedlings per annum

- Pandora (1988)
- Pegasus (1990)
- Calypso (1991)
- Tango (1994)
- Eros (1994)
- Marshmello (1995)
- Emily (1995)
- Bolero (1996)
- Laura (1996)
- Florence (1997)
- Sophie (1997)
- Perfection (1998)[1]
- Rosie (1999)
- Alice (2000)
- Flamenco (2002)
- Mae (2003)
- Malling™ Pearl (2005)
- Malling™ Opal (2005)
- Judibell (2005)
- Delia (2005)
- Amelia (2007)
- Sallybright (2007)
- Cassandra (2007)[2]
- Viktoriana (2008)[2]
- Sasha (2009)
- Lucy (2009)
- Elegance (2009)
- Fenella (2009)
- Finesse (2009)
- Cupid (2010)
- Irresistible (2010)[1]
- Sweetheart (2010)
- Vibrant (2011)
- Mayflower (2012)[2]
- Serenity (2012)
- Buddy (2012)
- Strawbino (2013)[1]
- Malling™ Centenary (2013)
- Malling™ Star (2014)
- Malling™ Beauty (2014)
- Malling™ Glow (2014)
- Malling™ Silk (2014)
- Malling™ Sunrise (2014)
- Malling™ Allure (2018)
- Malling™ Champion (2018)

[1]Amateur varieties,[2]Exclusive varieties

Plant Science into Practice

Partners

SOLO BERRY

NIAB EMR

MACK

BerryWorld VARIETIES

AHDB AGRICULTURE & HORTICULTURE DEVELOPMENT BOARD

dps

Berry Gardens

FFPO Ltd

the Greenery

MEIOSIS

USA

EUROPE

Plant Science into Practice

Scale & Scope

1 Crosses

2 Selecting

4 Preliminary Trials

5 Resistance screening

6 Knowledge Transfer

Growers Trials

Propagation

8 Commercialisation

‘cross to cultivar’

8 years

Plant Science into Practice

Research Projects

Crosses

Selecting

Trialling

Resistance screening

Knowledge Transfer

Growers Trials

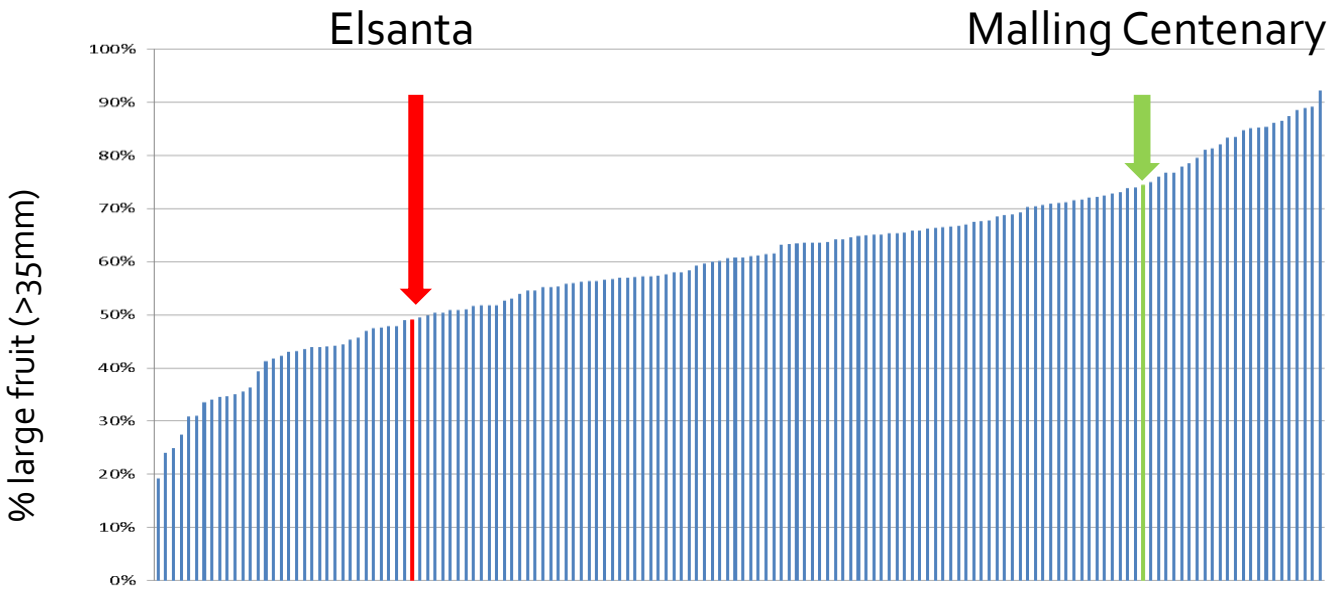
Propagation

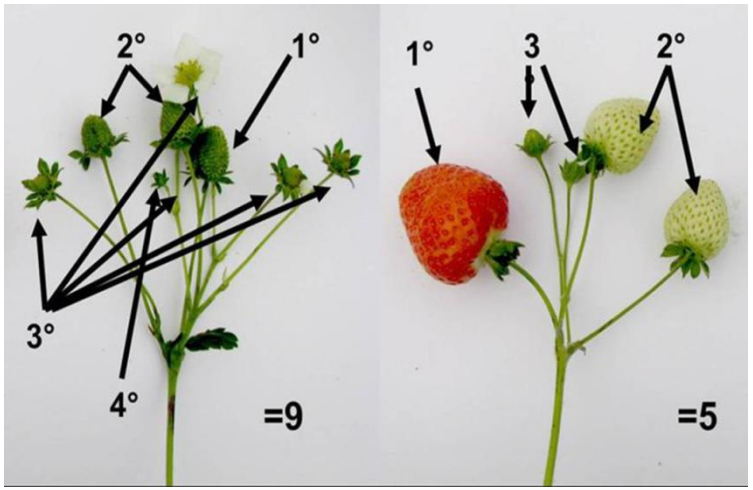
Commercialisation

- **SF135** Genetics of resistance to Verticillium Wilt in Strawberry
- **CP 094** PhD studentship
  Genetic mapping and phenotyping of fruit quality and disease resistance traits in octoploid strawberry (*Fragaria* × *ananassa*)
- **CP 163** PhD studentship
  Next generation berries -implementing genome wide selection approaches
- **101630** Developing robustness to biotic stress in fruit crop
- **100875** Development of molecular markers for resistance to strawberry powdery mildew
- **BB/N006682/2** OctoSEQ- Sequencing the octoploid strawberry
- **BB/K017071/1-2** BBSRC IDRIS Improved disease resistance in strawberries
- **BBSRC** A genetic system to study resistance to the soil-borne pathogen Verticillium dahliae in strawberry

Plant Science into Practice

Breeding Target: Fruit Size





Plant Science into Practice

Genetic improvement of strawberry for sustainable production in the UK
Project HH3201SSF

defra
Department for Environment Food and Rural Affairs

Breeding Target: Disease Resistance

BBSRC bioscience for the future

Improved disease resistance in strawberry (IDRIS) 2013-18. Value £1.1million

Emily

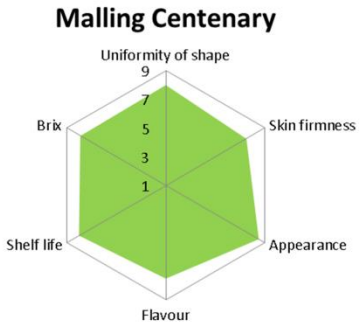
x

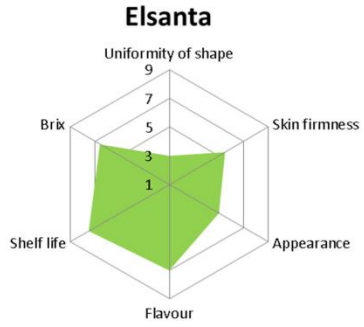
181 progeny

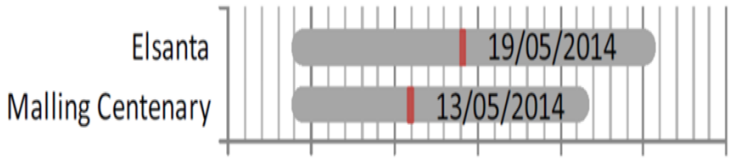
Fenella

Sample Name	Actual Crown Rot	Predicted Crown Rot
1	4.4	3.66
2	5.79	5.73
3	3.95	3.24
4	3.2	4.15
5	5.27	6.23
6	4.73	5.71
7	4.2	3.24
8	6.11	5.65
EM2464	3.05	N/A
9	N/A	3.55
10	N/A	3.24
11	N/A	3.71
12	N/A	3.24
13	N/A	3.73
14	N/A	3.13
15	N/A	3.73
16	N/A	2.08
EMR564	2.28	3.66
EMR639	1.79	2.08
17	4.00	3.24
18	4.00	3.66
19	N/A	3.66
EMR704	2.95	3.24

Malling™ Centenary







Plant Science into Practice

Picking efficiency

30% saving

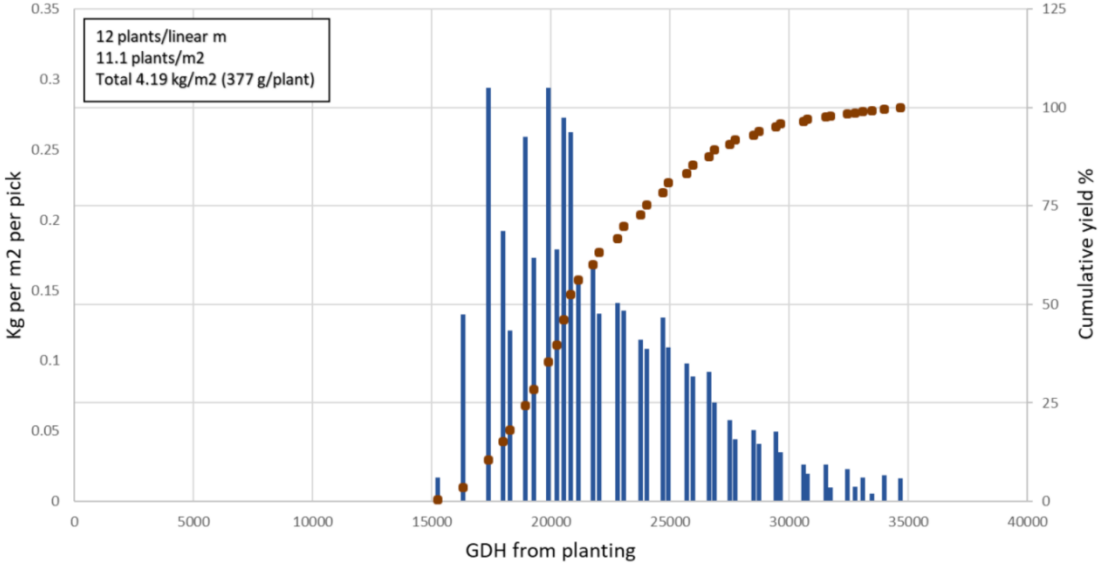
	Class 1 Yield (t/ha)	Waste	Picking cost (€/kg)
Elsanta	27.4	15%	0.64
M Centenary	**27.1**	**<1%**	**0.49**

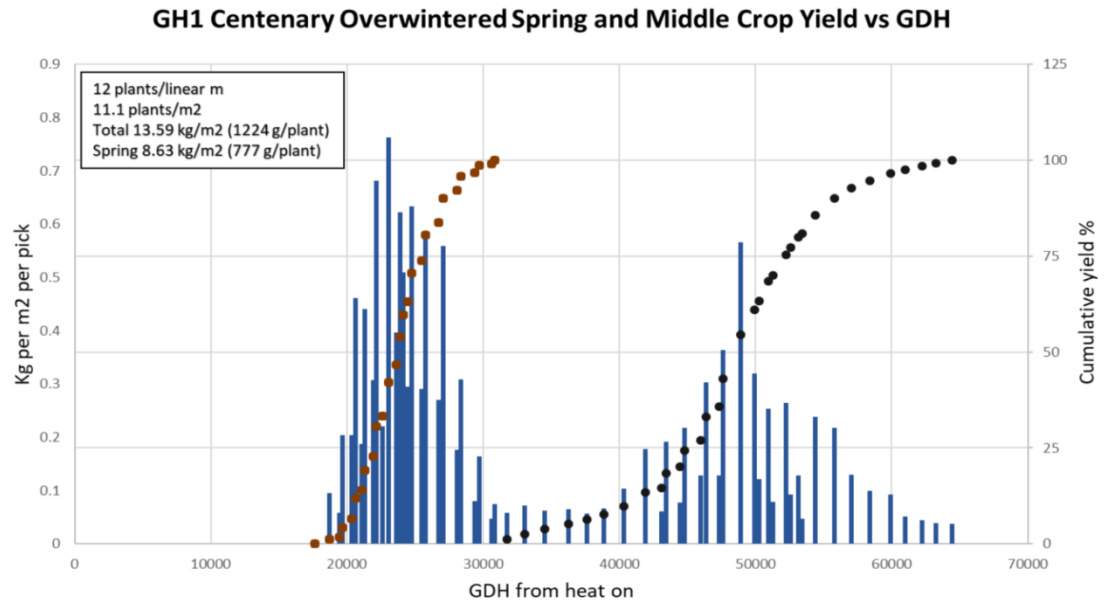
1.8x faster

	2016 (kgs/hr)	w/c 23 May 16 (kgs/hr)	Fastest 3 pickers (kgs/hr)
Vibrant	8.9	9.9	16.0
M Centenary	**15.9**	**18.9**	**27.9**

Source: BerryGardens Commercial Grower site, Cambs, United Kingdom. 2016

Glasshouse production





Source: Delphy Production Guide Malling Centenary, 2018.
Data courtesy of Haygrove, UK

Grower recommendations

- **Plant establishment**
  - Be wary of rapid, strong growth as roots system weaker and less fibrous
  - Summer planting: problems with tip and calyx burn, boost root pressure
  - Remove pre-flower (flowers expressed within 5000 GDH of planting)
  - Avoid overhead sprinkling

- **Plant management**
  - High crown density good, avoid crown thinning (if is needed then do immediately after harvest)
  - BUT botrytis risk ↑, so remove short leaves around crowns and pull trusses & beware moisture trapped in more upright flowers
  - Long trusses, truss tape moved up and out compared to Elsanta

Grower recommendations

- **Chill requirement & manipulation**
  - High, similar to Sonata, overwintered glass may require night-break lighting to get stretch
  - Partly chilled (600-800) + night break lighting (30-40 nights) can achieve useful, high-quality summer crop with little gap in picking

- **Nutrition**
  - To avoid tip burn, high calcium starter feed
  - Potassium demand during early fruiting stage , but needs to be reduced around 65% pick to avoid calyx burn on developing crop
  - Avoid starving plants that are to be overwintered , can lose vigour and go into premature flower induction

Grower recommendations

Crop Protection

Crown rot (*Phytophthora cactorum*) susceptible

- Plant quality is key – check propagation, inspect in production fields
- Promptly remove any collapsing plants
- Use fresh substrate
- Avoid overhead irrigation
- Apply fungicides at plant establishment, also try Potassium Phosphite
- Avoid operations to cause any crown damage
- Avoid overwatering

....and beyond

Short-day	V Early	Early	Mid	Mid-late	Late
Standard	Flair	Clery/Lusa	M Cent	Sonata	Faith
2019/20		EM2464 (LS) EM2541 EM2544	EM2248	EM2494	M Allure EM2434 EM2588 EM2622
2020/21	EM2547 (LS)		EM2628 EM2696 EM2721	EM2591 EM2723	EM2617 EM2656 EM2674

Everbearer	Early	Mid
Standard	M Champion	Murano
2019	EMR704 (LS)	EMR693 (LS) EMR773 EMR794 EMR797
2020	EMR721 (LS) EMR727 EMR796 (LS)	EMR745 EMR805

Malling™ Allure

- Late season June-bearer
- High % Class 1 (>90%)
- Large fruit size (>65% >35mm)
- Good yield potential (c1kg/plant)
- Excellent fruit quality
- Excellent display
- Moderate plant vigour
- “Late Malling Centenary”

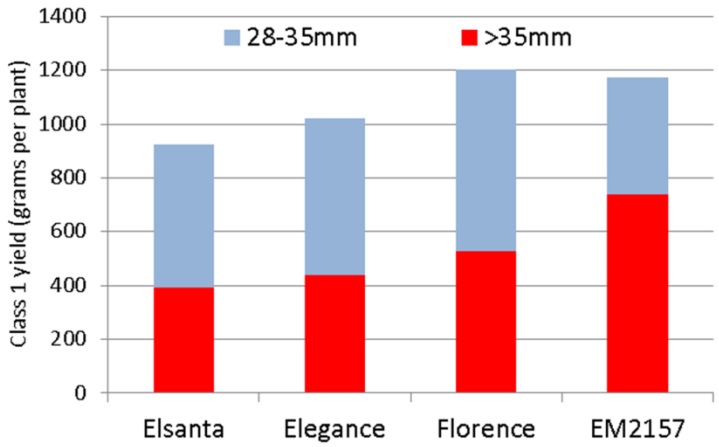
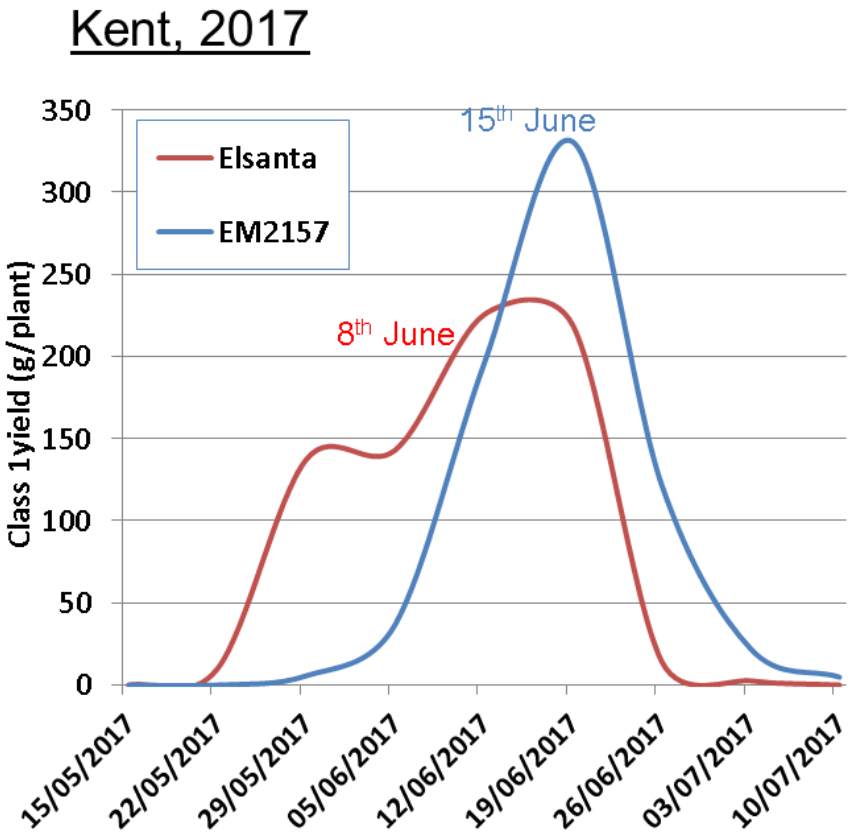
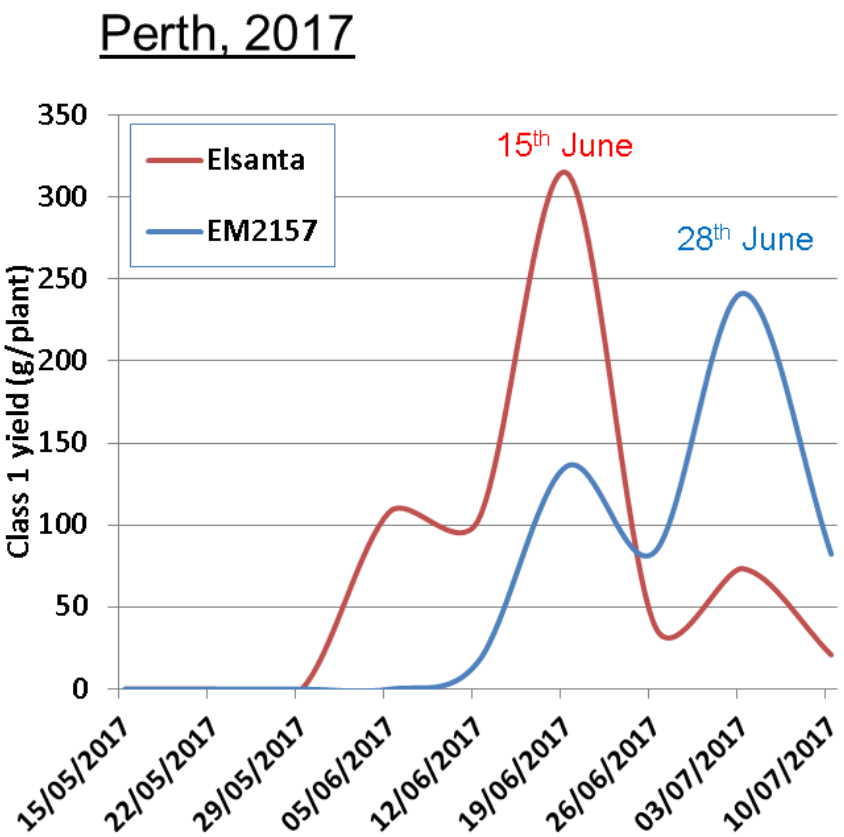


Figure 1. Class 1 yields and fruit size, NIAB-EMR trial 2016. Misted tips, tunnelled soil production.

Malling™ Allure

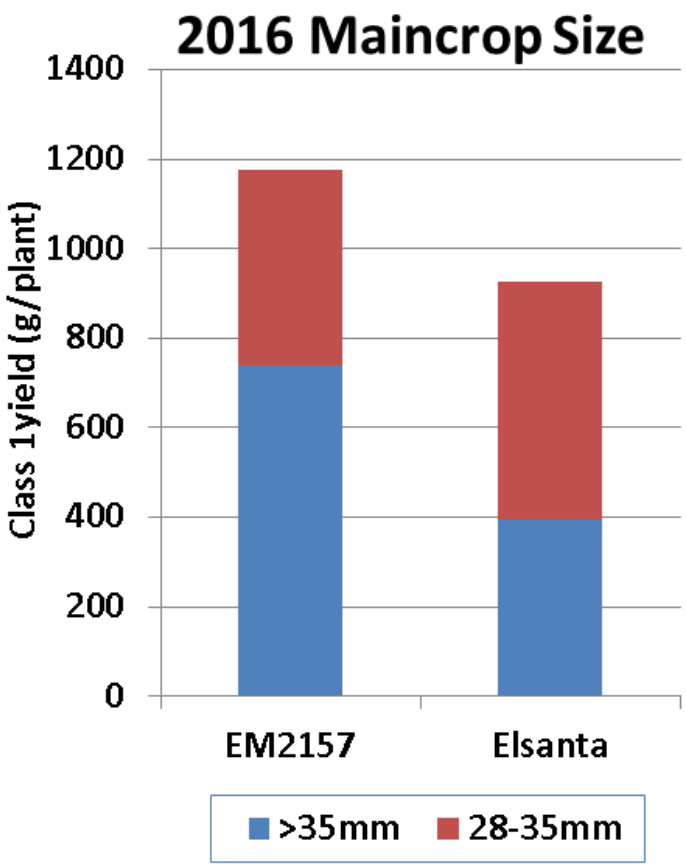




Source: 2017 Berry Gardens trial site data

Malling™ Allure

Malling™ Allure



Sonata

Plant Science into Practice

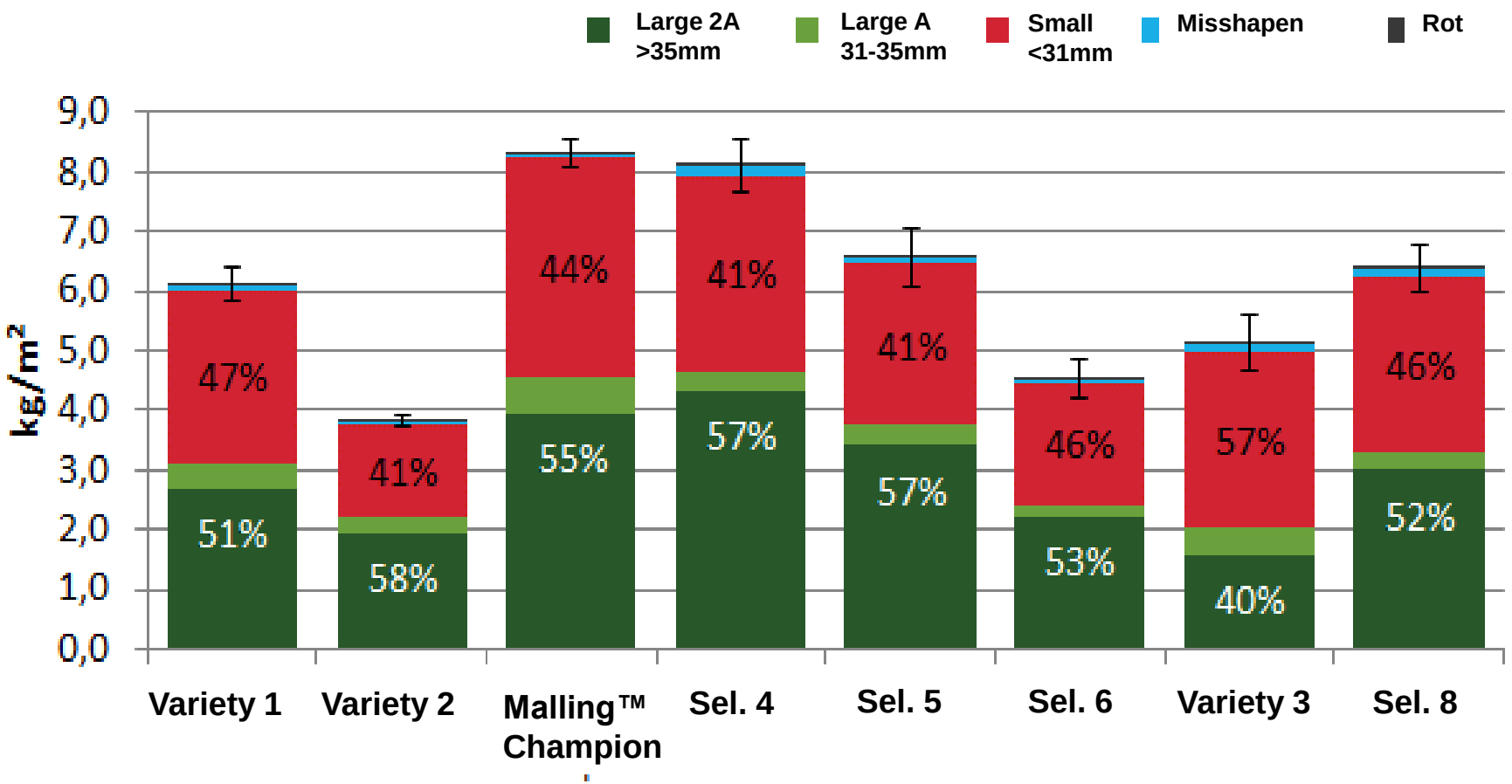
Malling™ Allure

Plant Science into Practice

Malling™ Champion

- Early everbearer
- High % Class 1 (>85%)
- Good fruit size
  (>60% >35mm EMSBC trials)
- Good yield potential (c1kg/plant)
- Excellent shelf life, firm flesh, strong skin, maintains colour
- Juicy texture
- Compact plants
- Strong, long trusses
- Excellent disease resistance

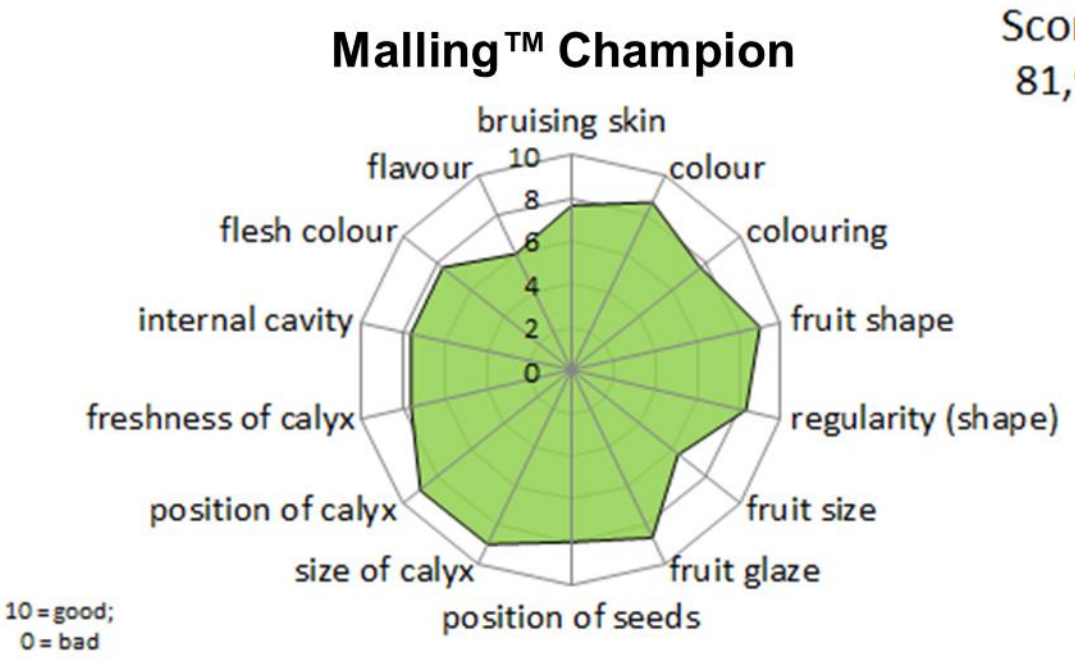
Malling™ Champion



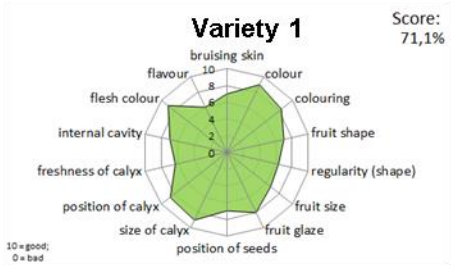
Plant Science into Practice

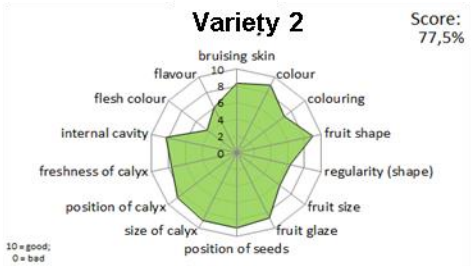
PROEFCENTRUM HOOGSTRATEN

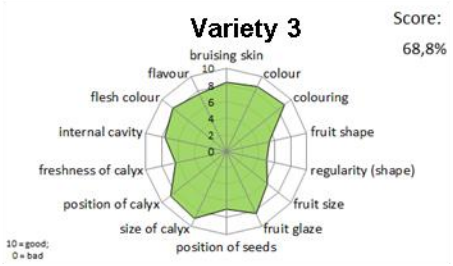
Malling™ Champion



- 1st, overall assessment
- 1st, firmness
- 2nd, shelf life
- 2nd, transport tests







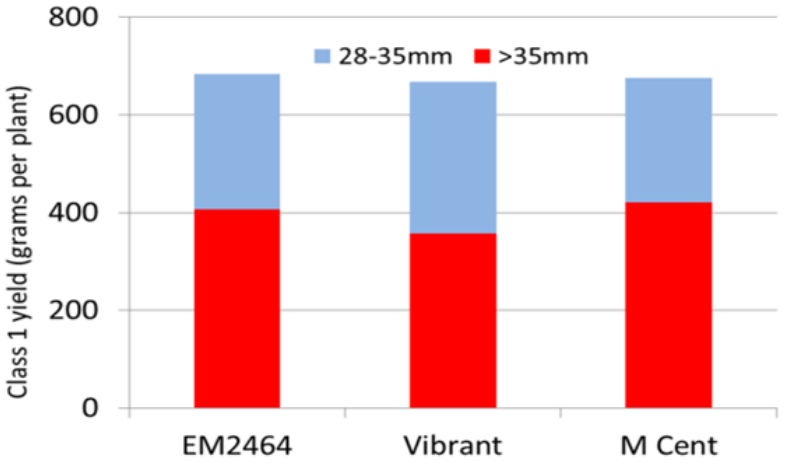
Plant Science into Practice

PROEFCENTRUM HOOGSTRATEN

EM2464

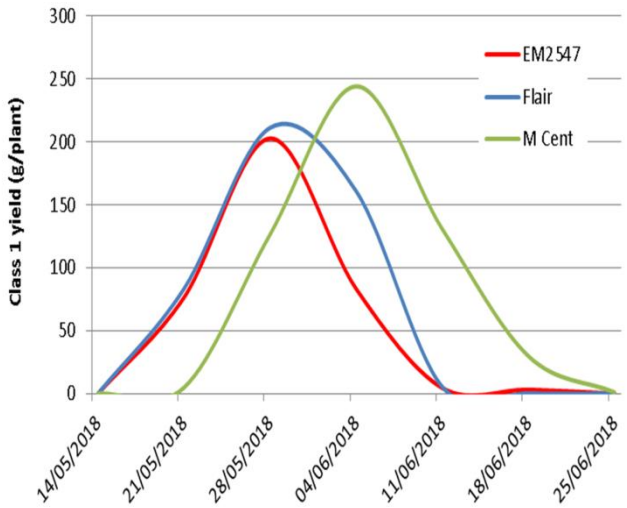
- Early –mid season June-bearer
- High % Class 1 (96%)
- Good fruit size (>60% >35mm)
- Yield comparable to M Centenary
- Excellent shelf life
- Good plant habit & fruit display
- **Resistance to crown rot**
- Commercialisation in 2019

	Class 1 yield (g/plant)	% large (>35 mm)	% Class 1	50% HD
EM2464	**683**	**60**	**96**	**16-Jun**
Vibrant	668	54	94	20-Jun
M Cent	676	63	92	20-Jun



EM2547

- Very early season June-bearer
- High % Class 1 (88%)
- Large fruit size (>88% >35mm)
- Excellent fruit quality (frim)
- High brix (avg. 9.1°)
- Growers' trials 2020/21



High yielding new selections

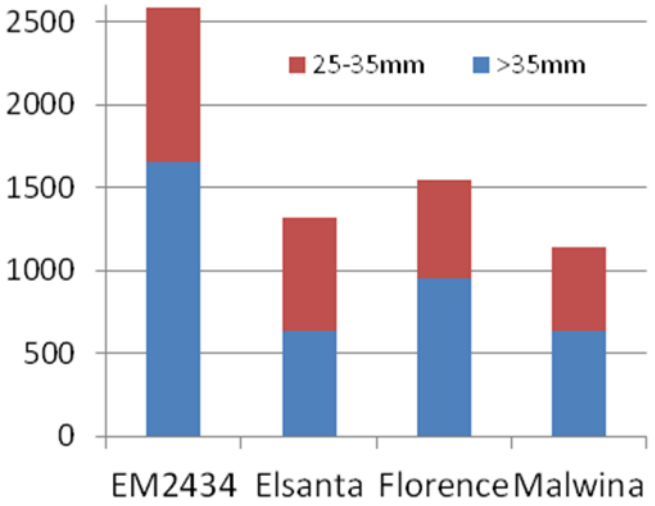
EM2434

Short-day

2.5kg/plant (2016)

78% >35mm

Mean brix 9.4º



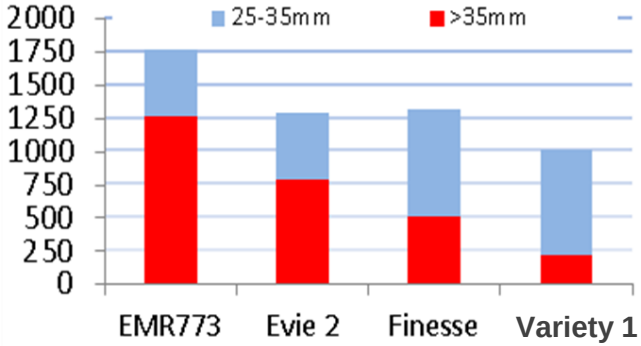
EMR773

Everbearer

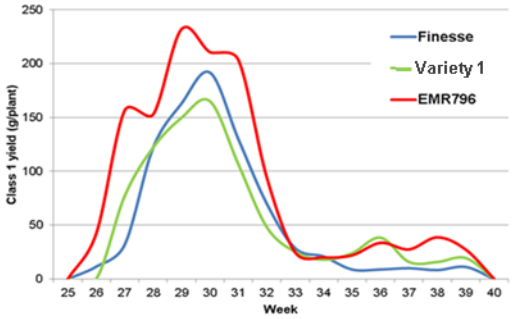
1.7kg/plant (2017)

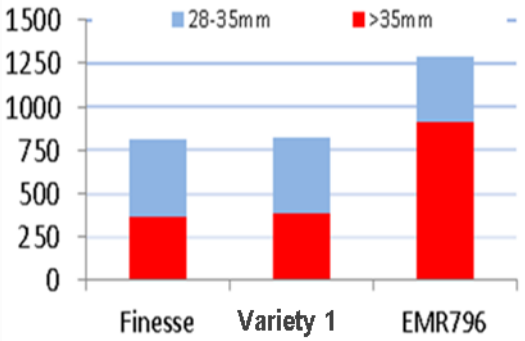
81% >35mm!

Mean brix 8.1º



Everbearer EMR796



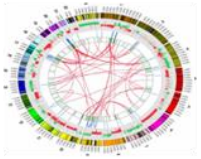


Plant Science into Practice

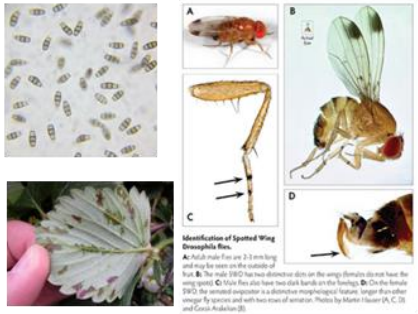
Future Developments

Breeding efficiency

New Molecular Genetic Tools

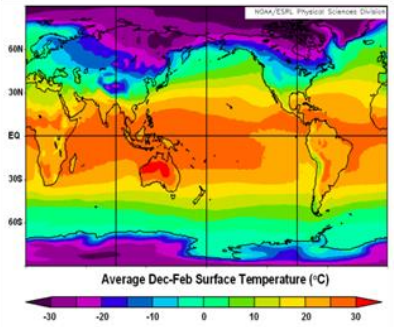


New Territories



New pest & diseases

Land use, population ↑ growing systems



Environmental Requirements

Labour requirements/ Automation


MEIOSIS
NIAB EMR
www.meiosis.co.uk