



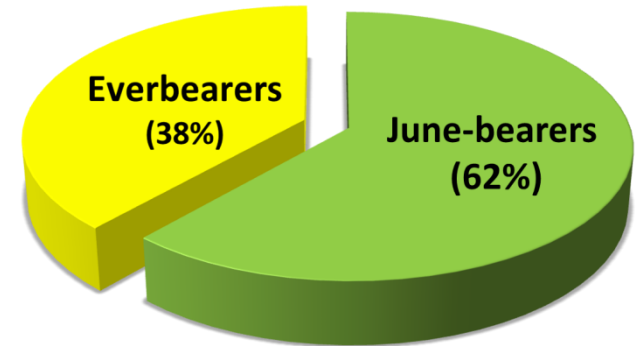
Malling™ Centenary and beyond

Progress from the East Malling Strawberry Breeding Programme, UK

Adam Whitehouse

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





13000 seedlings per annum

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



¹Amateur varieties, ²Exclusive varieties



USA

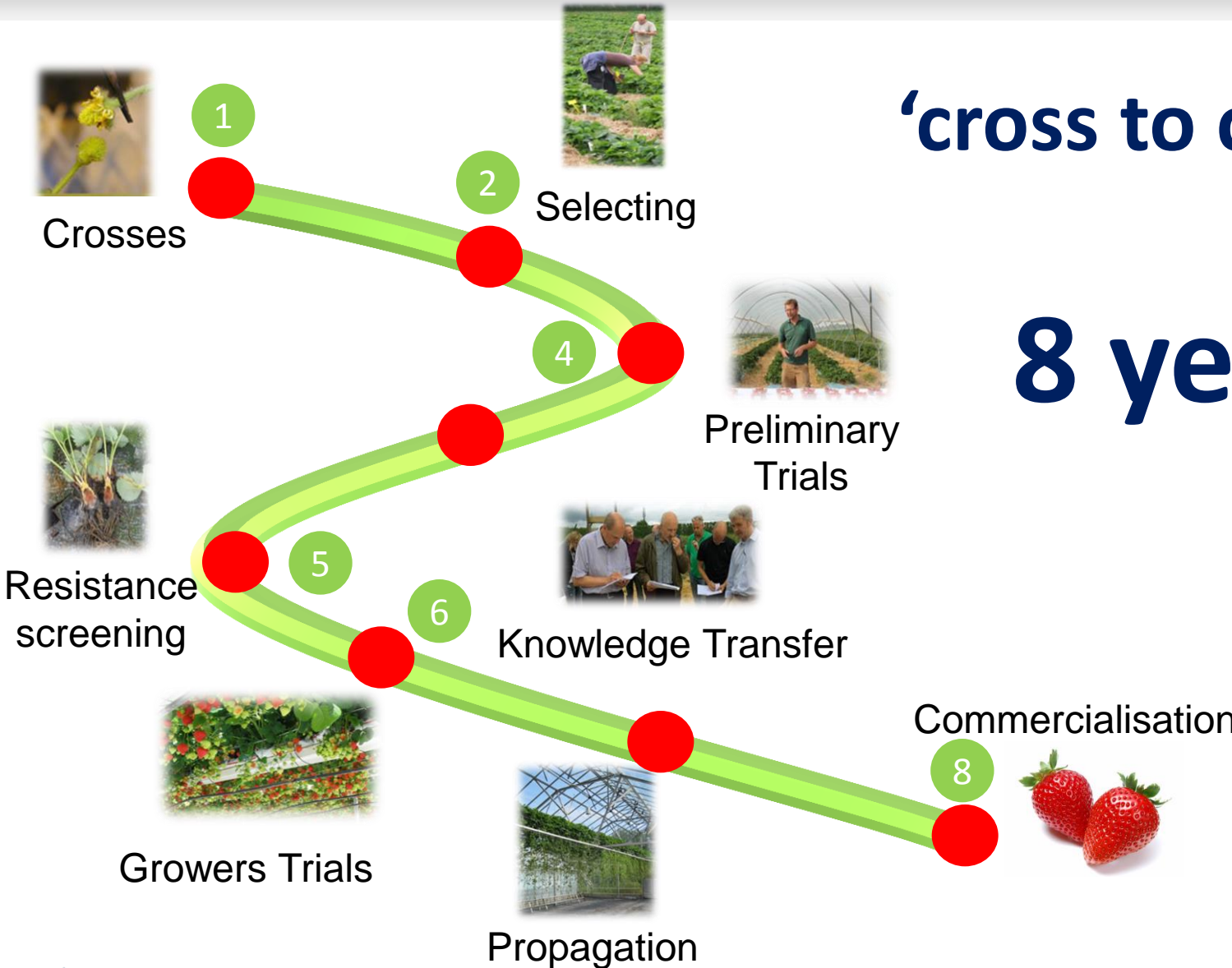


EUROPE



'cross to cultivar'

8 years





Crosses



Selecting



Innovate UK



AHDB SF135 Genetics of resistance to Verticillium Wilt in Strawberry

AHDB CP 094 PhD studentship
Genetic mapping and phenotyping of fruit quality and disease resistance traits in octoploid strawberry (*Fragaria × ananassa*)

AHDB CP 163 PhD studentship
Next generation berries -implementing genome wide selection approaches

Innovate UK 101630 Developing robustness to biotic stress in fruit crop

Innovate UK 100875 Development of molecular markers for resistance to strawberry powdery mildew

BBSRC AHDB BB/N006682/2 OctoSEQ- Sequencing the octoploid strawberry

BBSRC AHDB BB/K017071/1-2 BBSRC IDRIS Improved disease resistance in strawberries

BBSRC BBSRC A genetic system to study resistance to the soil-borne pathogen *Verticillium dahliae* in strawberry



Trialling



Resistance screening



Knowledge Transfer



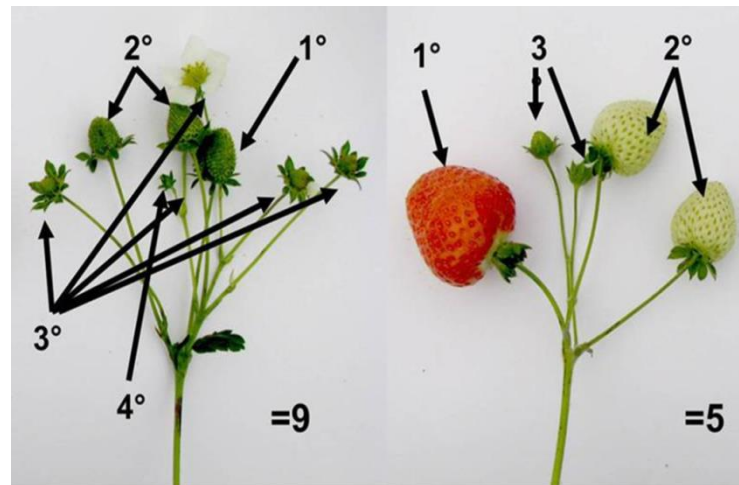
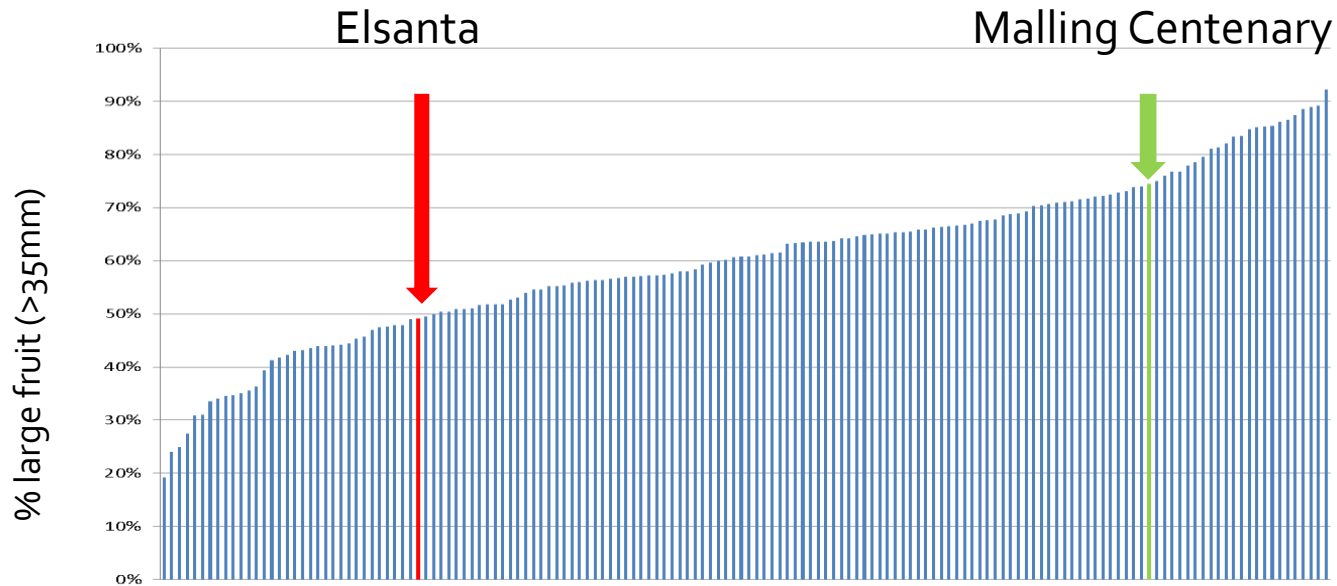
Growers Trials



Propagation

Commercialisation



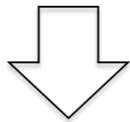


Improved disease resistance in strawberry (IDRIS) 2013-18. Value £1.1million



Emily

x



181 progeny

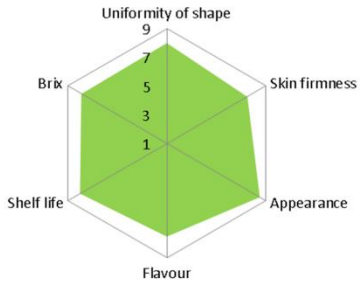


Fenella

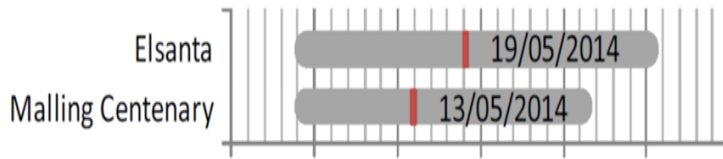
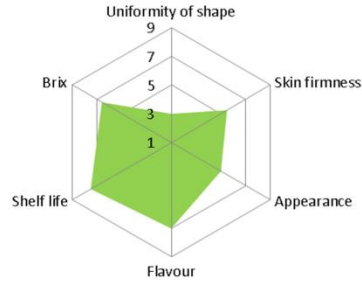


Sample Name	Actual Crown Rot	Predicted Crown Rot
1	4.4	3.66
2	5.79	5.73
3	3.95	3.24
4	3.2	4.15
5	5.27	6.23
6	4.73	5.71
7	4.2	3.24
8	6.11	5.65
EM2464	3.05	N/A
9	N/A	3.55
10	N/A	3.24
11	N/A	3.71
12	N/A	3.24
13	N/A	3.73
14	N/A	3.13
15	N/A	3.73
16	N/A	2.08
EMR564	2.28	3.66
EMR639	1.79	2.08
17	4.00	3.24
18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

Malling Centenary



Elsanta



30% saving

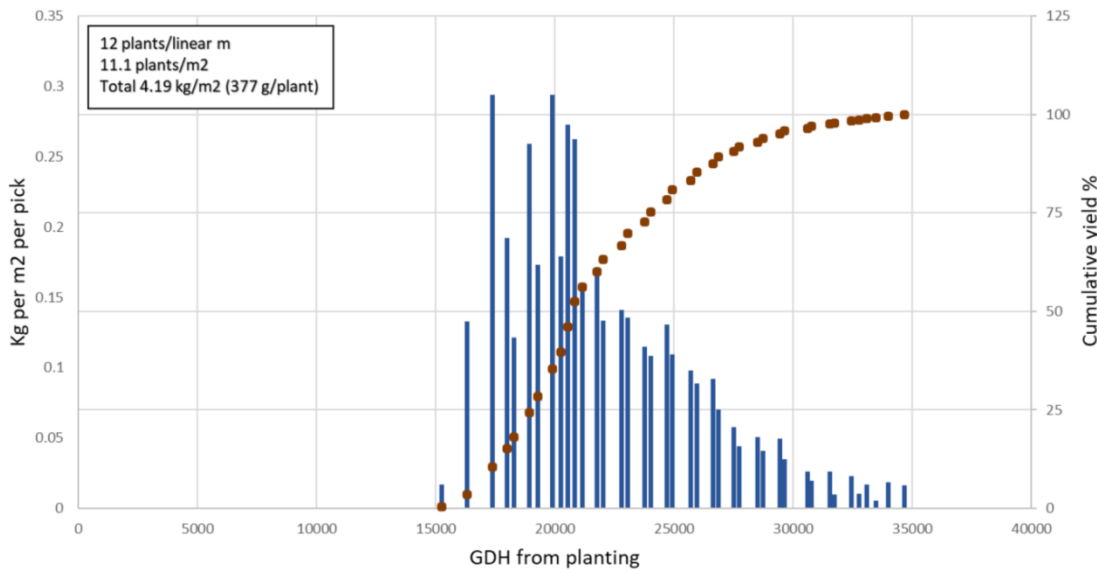
	Class 1 Yield (t/ha)	Waste	Picking cost (€/kg)
Elsanta	27.4	15%	0.64
M Centenary	27.1	<1%	0.49

1.8x faster

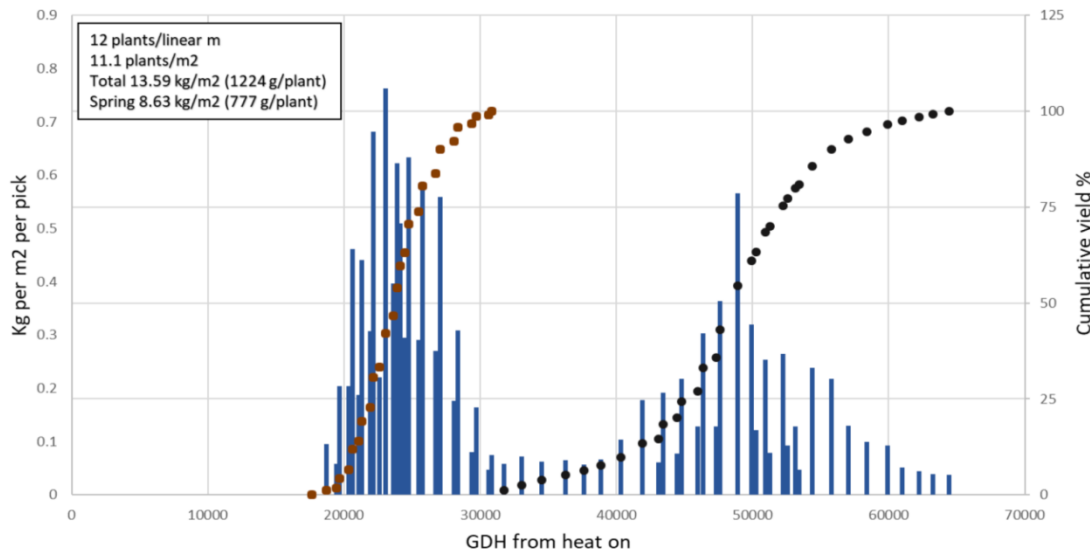
	2016 (kgs/hr)	w/c 23 May 16 (kgs/hr)	Fastest 3 pickers (kgs/hr)
Vibrant	8.9	9.9	16.0
M Centenary	15.9	18.9	27.9

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

GH1 Centenary Autumn Crop Yield vs GDH



GH1 Centenary Overwintered Spring and Middle Crop Yield vs GDH



- **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

- **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

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

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		

- 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”

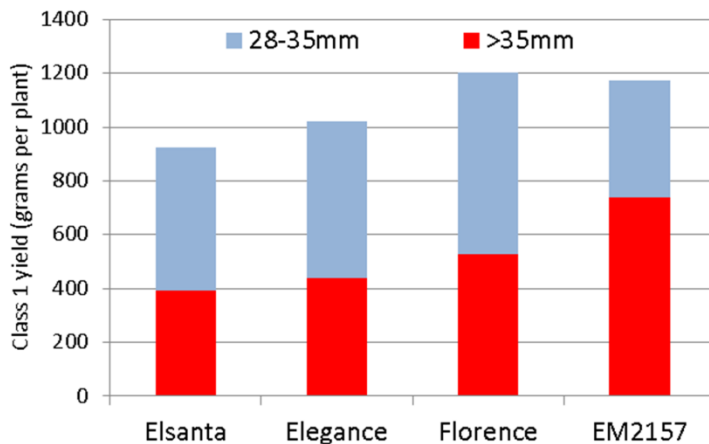
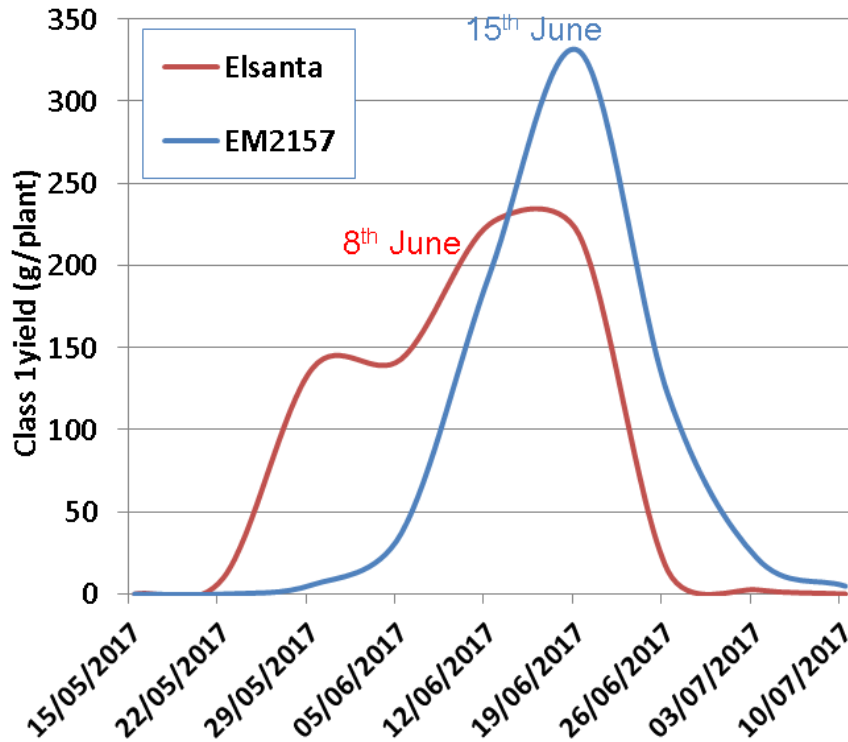


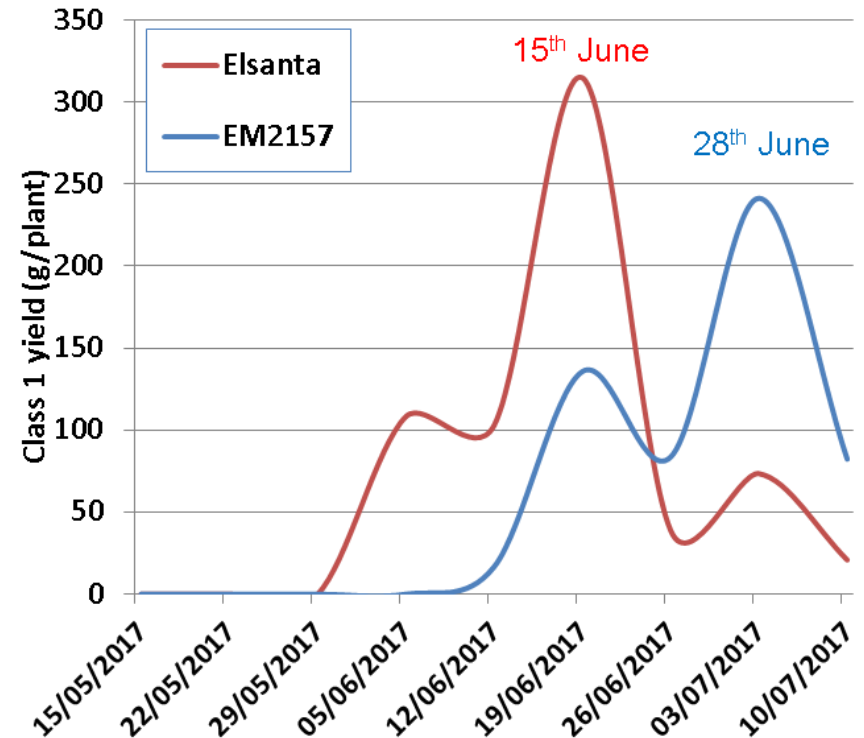
Figure 1. Class 1 yields and fruit size, NIAB-EMR trial 2016. Misted tips, tunnelled soil production.



Kent, 2017



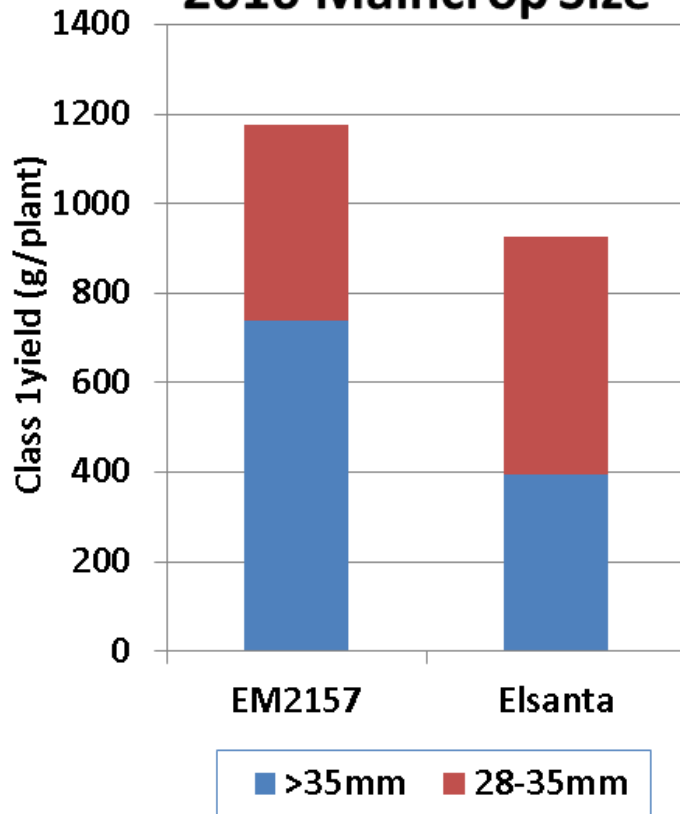
Perth, 2017



Source: 2017 Berry Gardens trial site data

Malling™ Allure

2016 Maincrop Size



Sonata



Malling™ Centenary

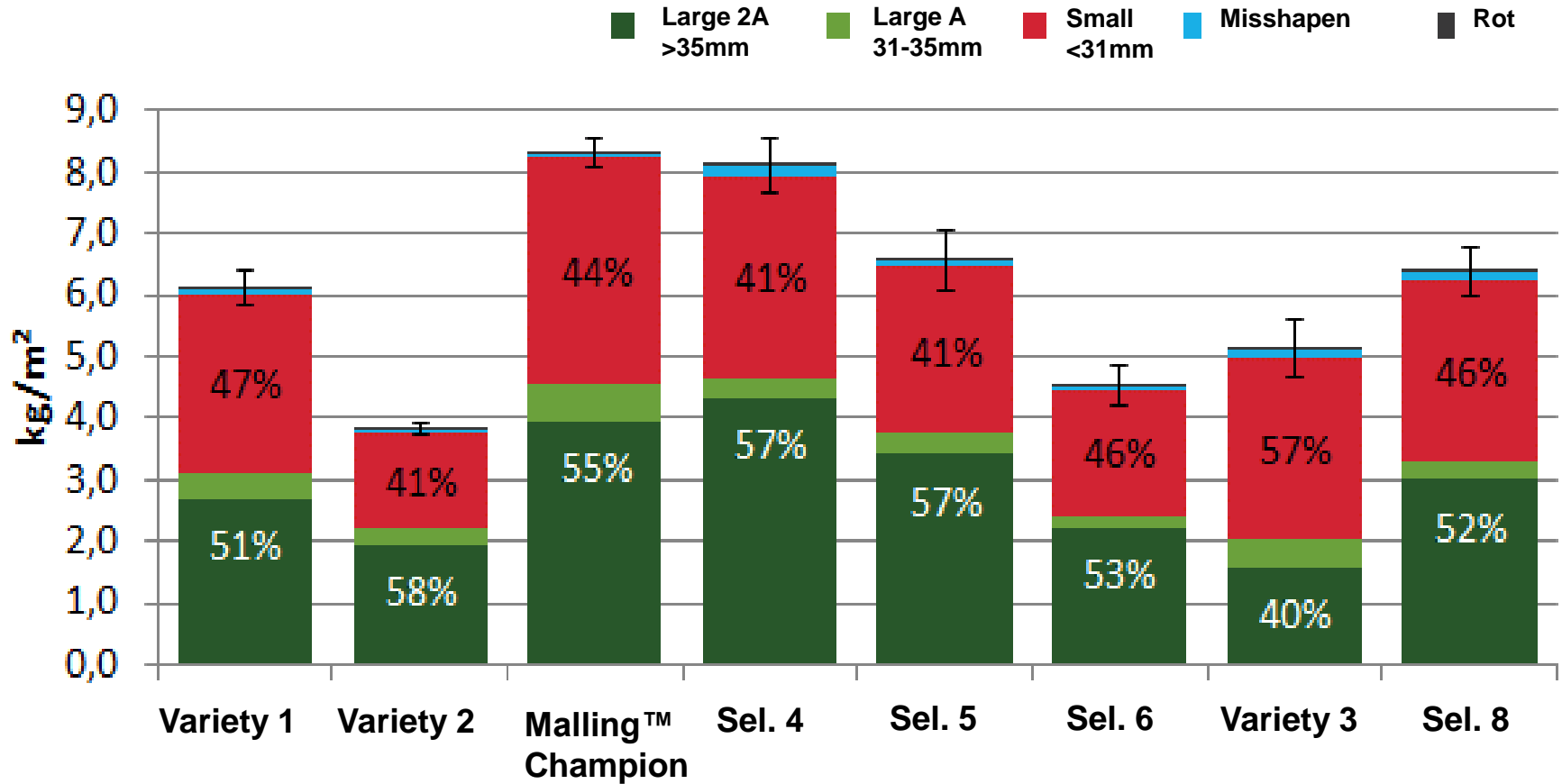


Malling™ Allure



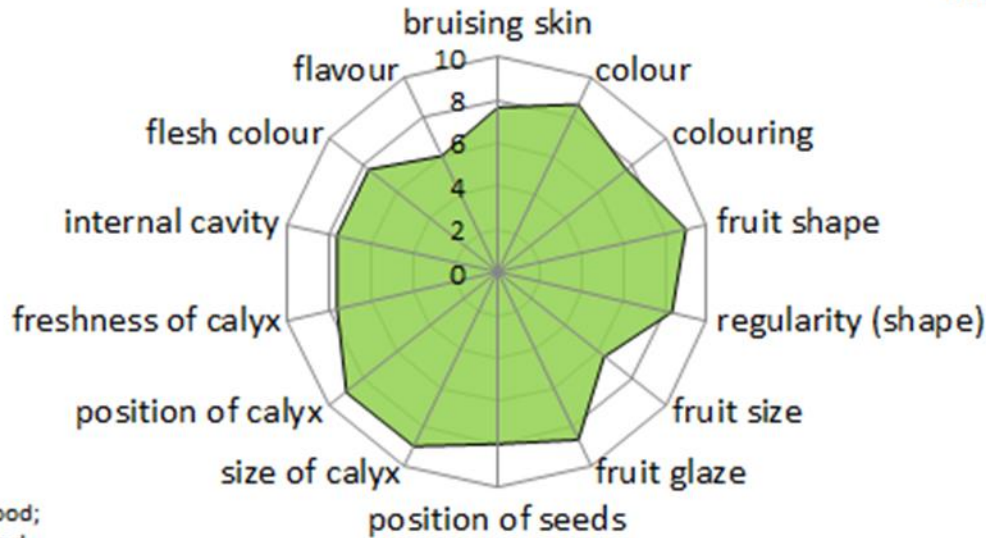
- Early everbearer
- High % Class 1 (>85%)
- Good fruit size (>60% >35mm EMSBC trials)
- Good yield potential (c1kg/plant)
- Excellent shelf life, firm flesh, strong skin, maintains colour
- Juicy texture
- Compact plants
- Strong, long trusses
- Excellent disease resistance





Malling™ Champion

Score:
81,9%



10 = good;
0 = bad

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

Variety 1

Score:
71,1%



10 = good;
0 = bad

Variety 2

Score:
77,5%



10 = good;
0 = bad

Variety 3

Score:
68,8%

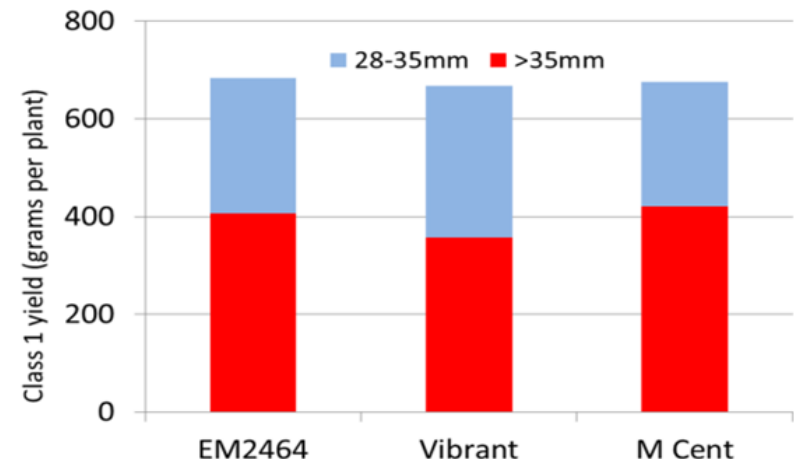


10 = good;
0 = bad

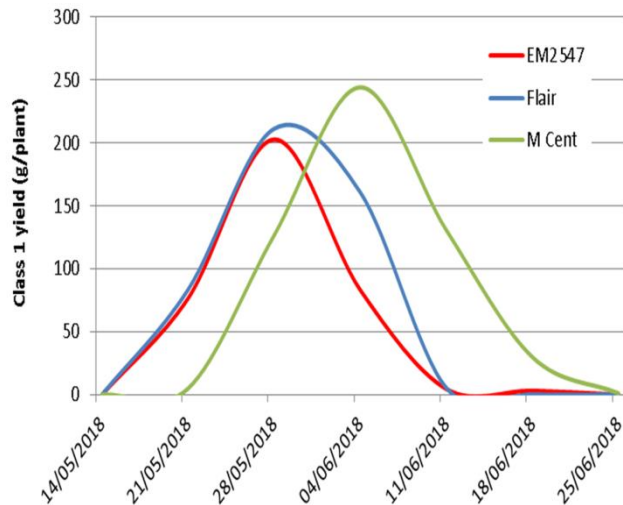
- Early –mid season June-bearer
- High % Class 1 (96%)
- Good fruit size (>60% >35mm)
- Yield comparable to M Centenary
- Excellent shelf life
- Good plant habit & fruit display
- **Resistance to crown rot**
- Commercialisation in 2019



	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



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



High yielding new selections



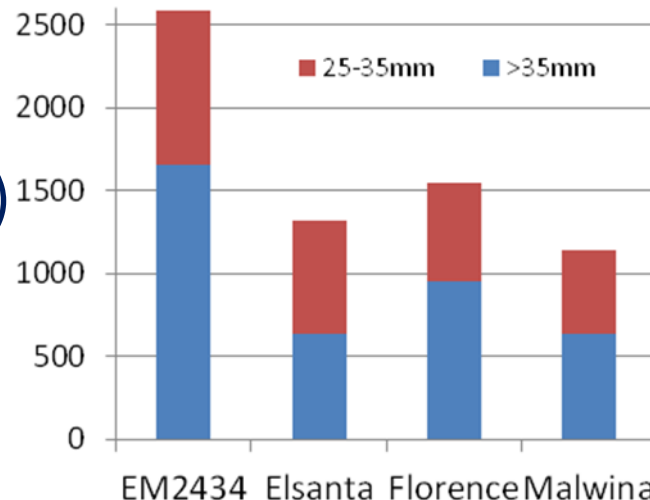
EM2434

Short-day

2.5kg/plant (2016)

78% >35mm

Mean brix 9.4°



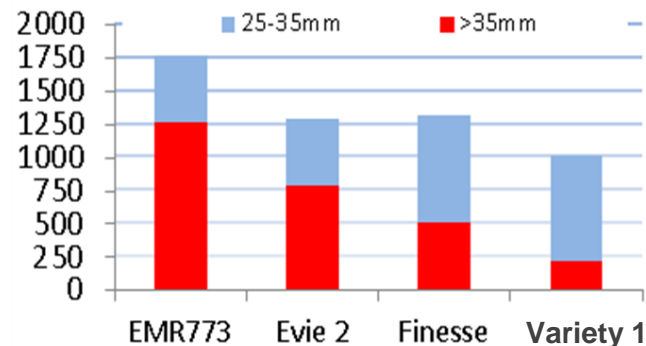
EMR773

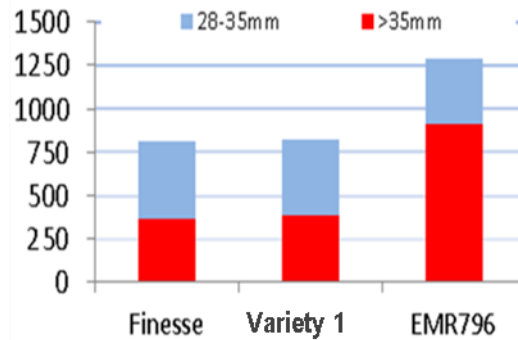
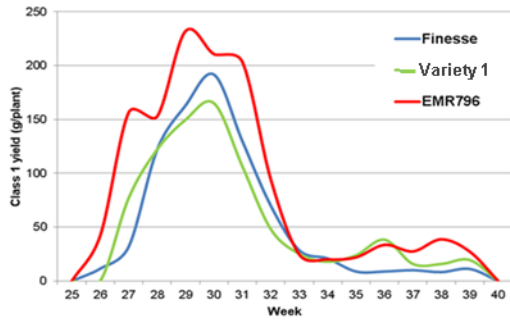
Everbearer

1.7kg/plant (2017)

81% >35mm!

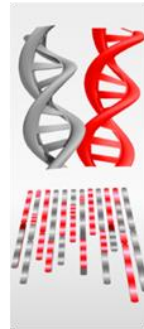
Mean brix 8.1°



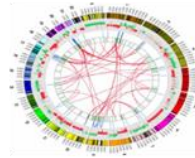




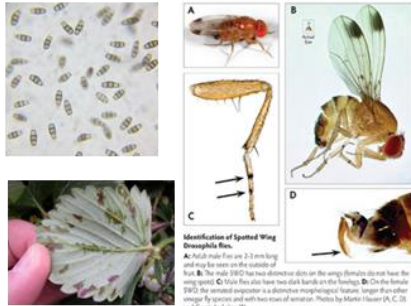
Breeding efficiency



New Molecular Genetic Tools



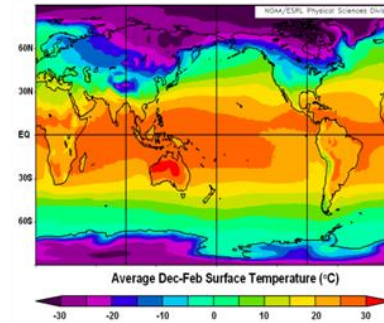
New Territories



New pest & diseases



Land use, population ↑ growing systems



Environmental Requirements



Labour requirements/ Automation



www.meiosis.co.uk