

Strawberry Breeding at EMR

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*SSCR Soft Fruit Information Day
18th February 2016*

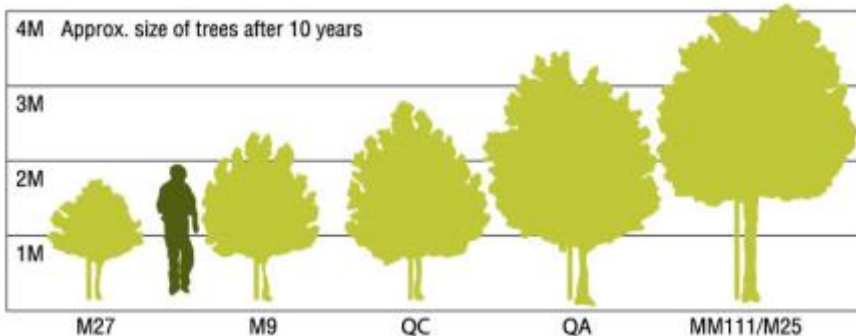
East Malling Research



East Malling Research



2016



Physiology

Pest & disease

Breeding



Strawberry breeding at East Malling



1983 (33 years)

300+ million plants sold

N. Europe, NE USA, S. Korea

43 varieties released



East Malling Varieties

1988-2015



- 🍓 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)

¹ Amateur varieties

² Exclusive varieties

East Malling Strawberry Breeding Club (EMSBC)



Formed
2008

2013-2023

£2.5 million

6 members
(10 shares)



East Malling Strawberry Breeding Club (EMSBC)



USA

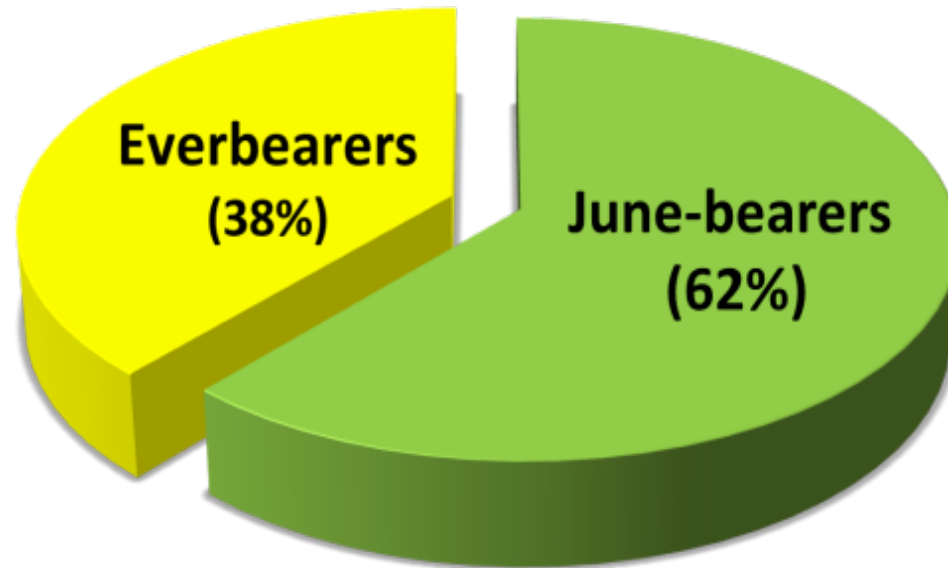


17 propagator
companies

EUROPE



Scale & scope



13,000 per annum

8 years



Breeding Process



Year	Process	Number
0	Breeding (150-200 crosses)	13,000
1	Select seedlings	120
2	Propagation from field	120
3	Trial selections –Stage 1	10
4	Trial selections –Stage 2	10
5	Micro-propagation	10
6	Offsite trials & resistance testing	10
7	Offsite trials & resistance testing	10
8	Identify new cultivar	1-2

Who and what are we breeding for?



Adaptation to growing systems

Yield

Fruit size

% Class 1

Shelf life

Fruit quality

PROPAGATOR

GROWER

RETAILER

CONSUMER

Runnering

Disease resistance

Environmental changes

Plant architecture

Fruiting season

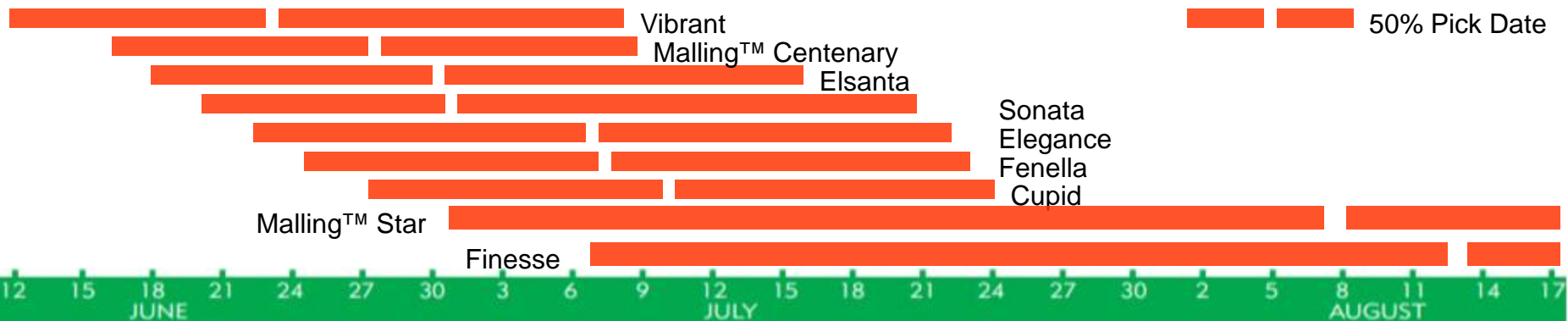
Extending the season



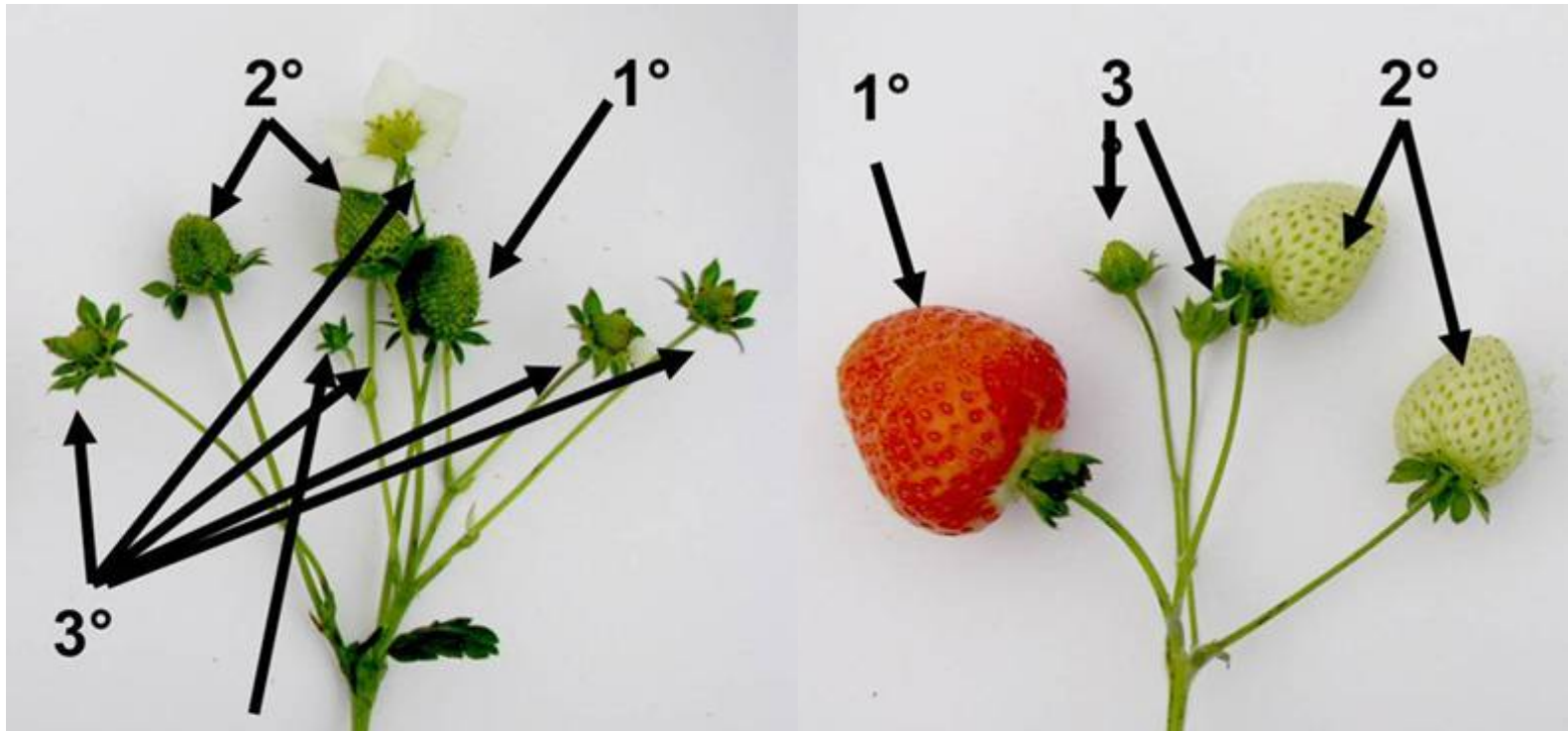
- 🍓 Early-late June bearers
- 🍓 High quality everbearers
- 🍓 Programmed cropping



picking periods for main season strawberries



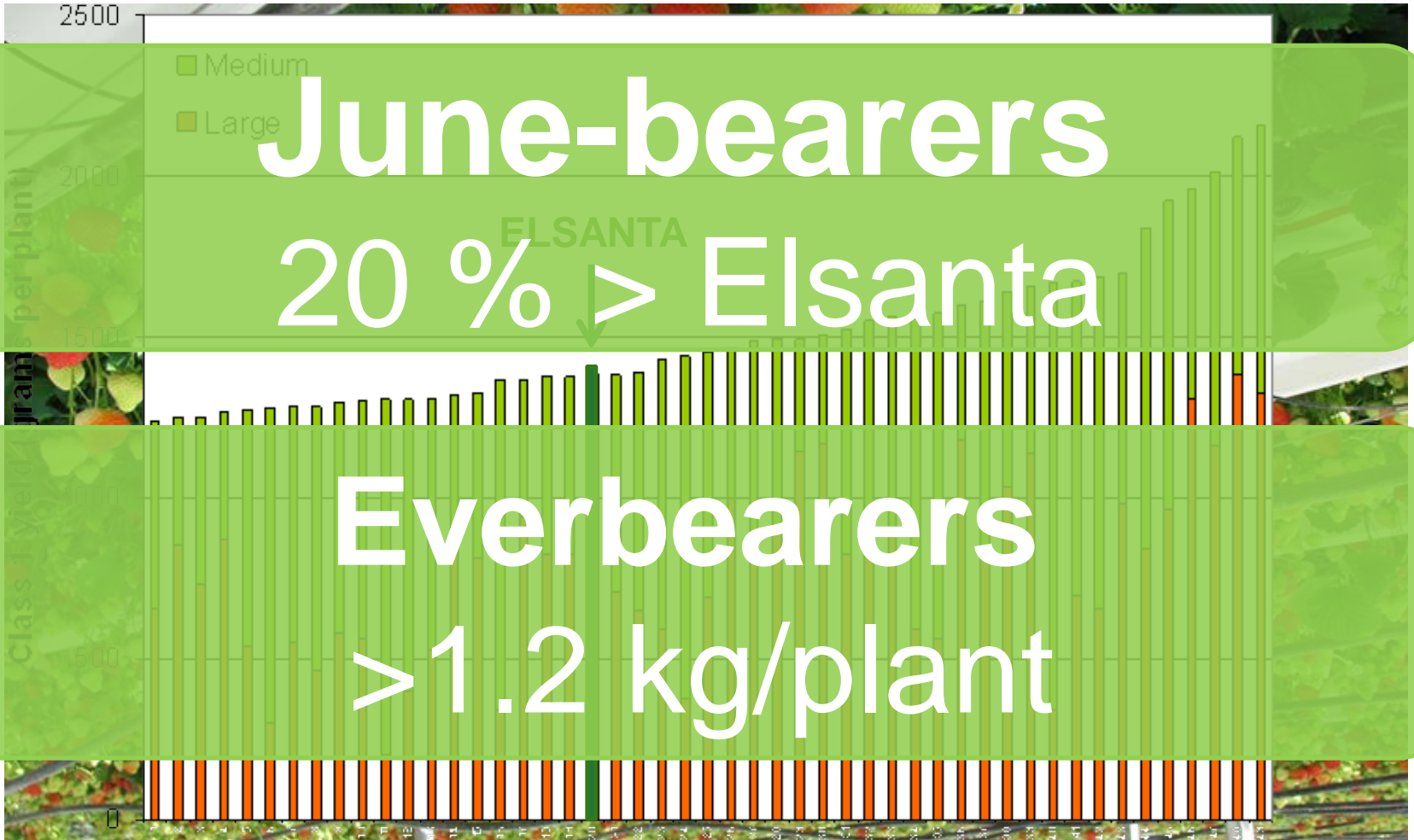
Fruit size



>60-65% large (>35mm)

=5

Increased yield



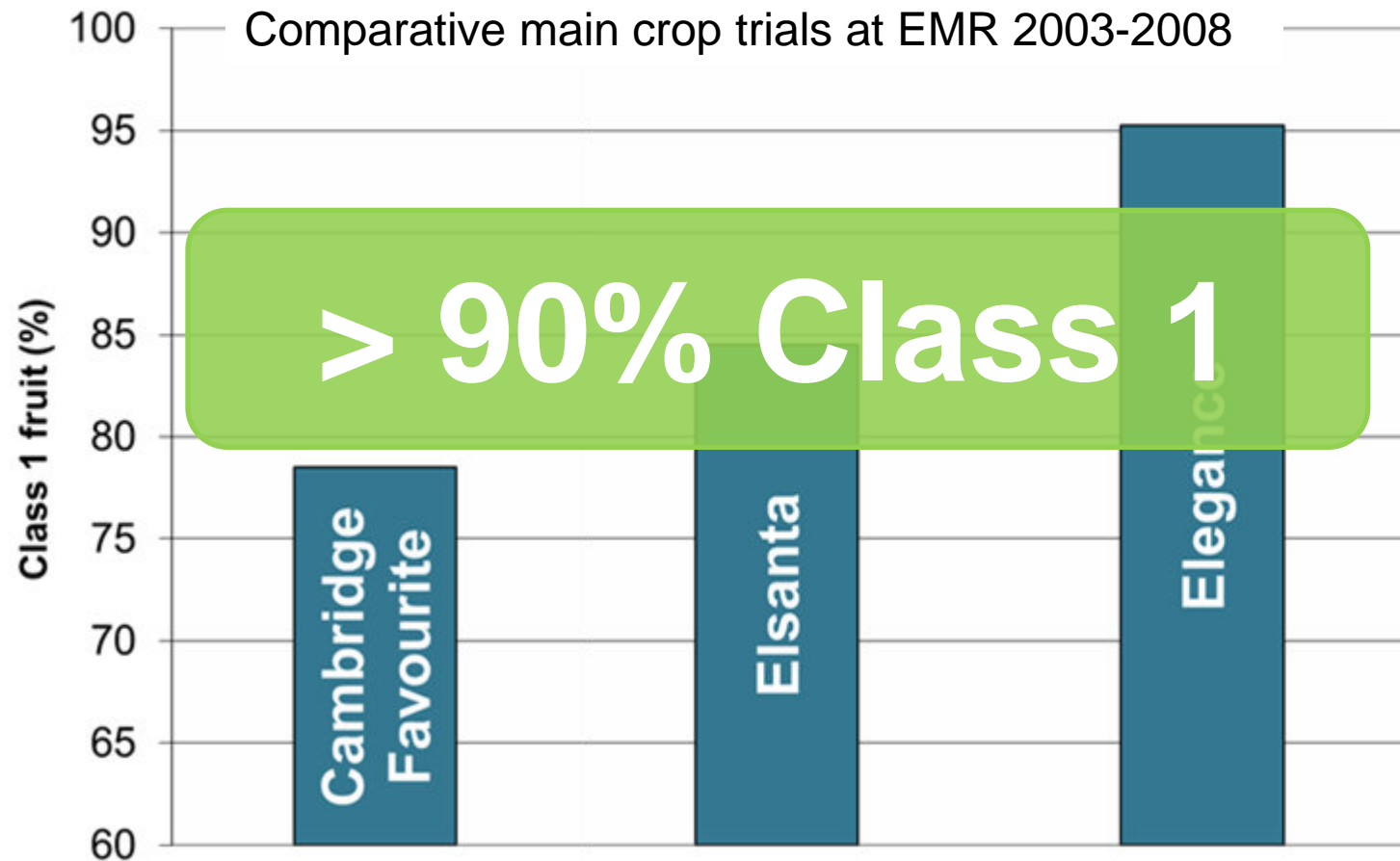
June-bearers

20 % \downarrow > Elsanta

Everbearers

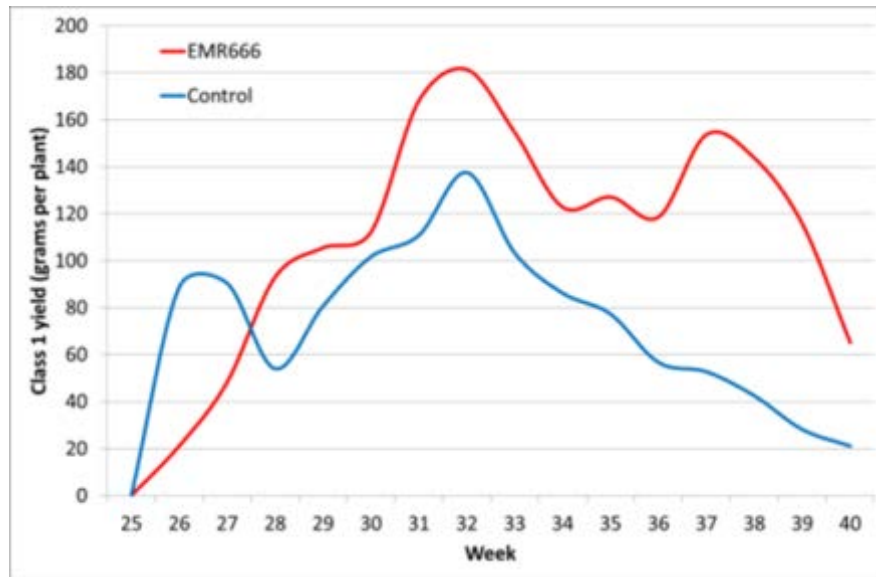
> 1.2 kg/plant

% Class 1 fruit

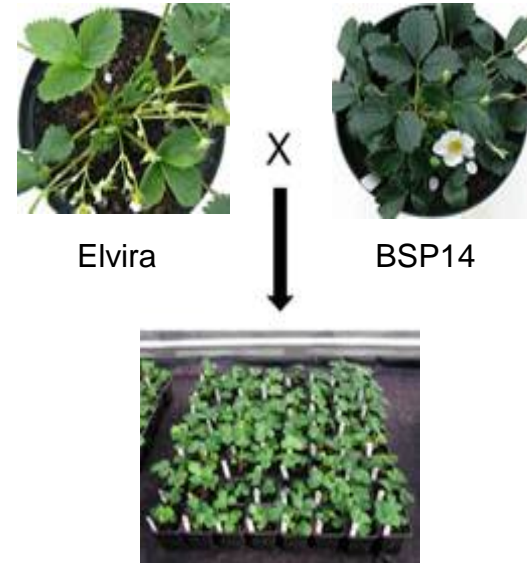


Climate change

- 🍓 Heat tolerance
- 🍓 *F. virginiana*/old cvs
- 🍓 Breeding lines

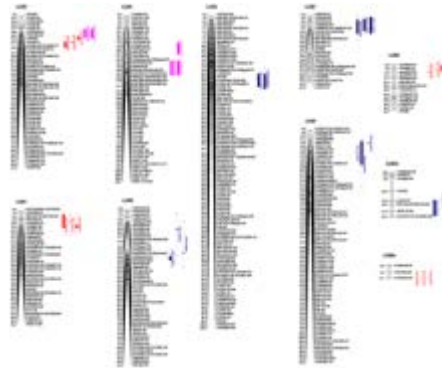


- 🍓 Water use efficiency
- 🍓 Drought conditions
- 🍓 QTLs identified



Marker assisted breeding (MAB)

Verticillium wilt



Markers

Marker assisted breeding (MAB)



**Verticillium
wilt**



**Powdery
mildew**



***Phytophthora*
spp.**



Varieties bred at East Malling

Fenella



Buddy



Vibrant



Finesse



Elegance



Latest varieties EMSBC



June-bearer

Malling™ Centenary



Everbearer

Malling™ Star



Malling™ Centenary (EM1764)



- ◆ **Outstanding** fruit quality
- ◆ **Early-mid** season
- ◆ High % **class 1**
- ◆ Excellent **fruit size**
 - Increased picking speeds/costs
- ◆ Excellent results in substrate
- ◆ Use heavy plants in soil
- ◆ Listed with all major retailers



Media Profile



BBC programmes

BBC one

Chelsea Flower Show 2013



WINNER 2016 Best New Variety (Fruit)

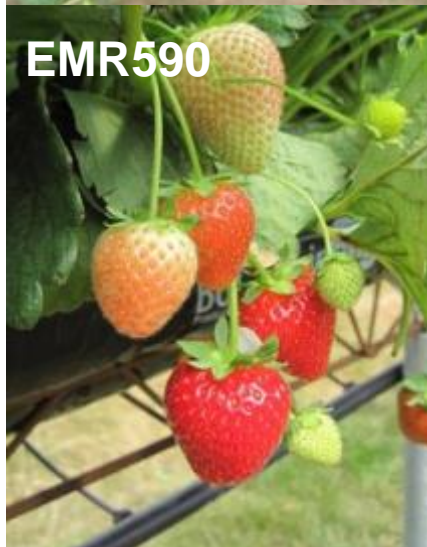
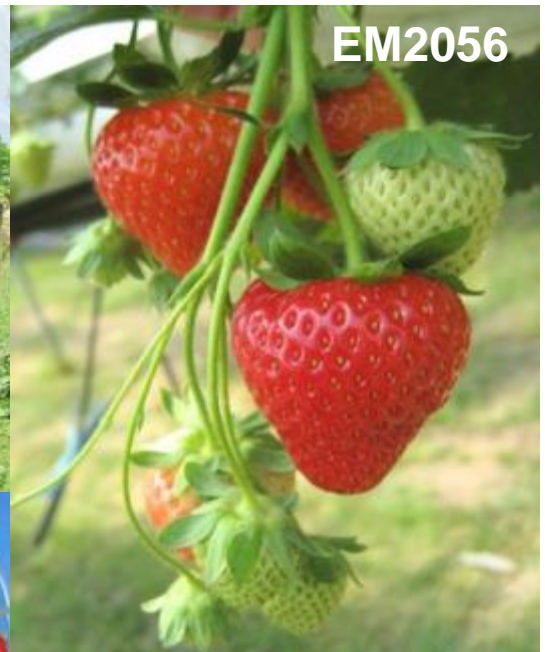
Malling™ Star (EMR470)



- Everbearer
- **Early** season
- Good yield, **high % class 1**
- **Firm** berry, **regular** shape
- **Consistently sweet** flavour
- High Brix (mean 9.5°)
- Moderately **resistant** to mildew



Future varieties? EMSBC



June-bearers



EM1974

- Early-mid season
- Firm, bright, glossy
- High % **class 1** (93%)
- High mean **Brix** (9.1°)
- Mildew **resistant**



EM2056

- Mid-late season
- High **yield** (1.9kg C1)
- High % **Class 1** (89%)
- **Large fruit size** (66%)
- **Resistant** crown rot & wilt



EM2170

- Early season
- Good % **class 1** (85%)
- **High yield** (1.4kg C1)
- **Pleasant** flavour
- **Large fruit size** (66%)



Everbearers

EMR564

- High **yield** (1.2kg C1)
- High % **class 1** (91%)
- **Large** fruit size (~21g)
- **Attractive**, glossy
- Good brix (8.3°)
- Mod **res** to wilt & mildew



EMR590

- **V high yield** (1.5kg C1)
- **Large** fruit size (~ 23g)
- **Attractive**, good flavour
- Good brix (8.5°)
- Mod **res** to crown rot & mildew



EMR639

- Good yield (1 kg C1)
- **Large** fruit size (~ 22g)
- High **brix** (9.2°)
- Excellent **shelf life**
- Mod **res** to crown rot & mildew





Malling Sunrise



EM1552

Emily x EM1231 Early season



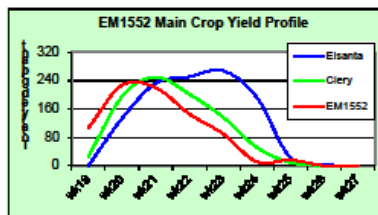
PLANT: Upright, leafy, open habit with good plant vigour. Small flowers. Good fruit display.

DISEASE: Susceptible to *Verticillium* wilt and mildew at EMR. Showed a susceptibility to crown rot (*Phytophthora cactorum*) in a couple of grower trials.



FRUIT QUALITY:

Appearance: Attractive
Berry shape: Regular conic.
Berry size: Average 18g (Elsanta 17g), reduces after peak pick
Colour: Slightly darker red than Elsanta
Firmness: Moderate
Flavour: Aromatic flavour
2011 Brix: 8.2 (Elsanta 8.5)
Shelf life: Similar to Elsanta
50% harvest: 10 days before Elsanta
60-day yield: Low
Main crop yield: Good for early selection



	EM1552			ELSANTA		
	C1 g/plant	Berries > 35mm %	Class 1 %	C1 g/plant	Berries > 35mm %	Class 1 %
60-day 2007 EMR r.bed	168	23%	76	222	41%	89
60-day 2010 raised bed	84	32%	80	165	27%	83
Main crop 2008 EMR r.bed	1,387	51%	86	1,153	57%	74
Main crop 2009 raised bed	713	-	72	686	-	87
Main crop 2010 raised bed	993	-	87	1,228	-	84
Main crop 2011 raised bed	712	30%	88	949	36%	88

SUMMARY: EM1552 is around 10 days earlier than Elsanta with good main crop but lower 60-day yields. Berries have a good size initially, though later in pick they reduce in size. Flavour is sweetly aromatic, brix levels usually good and firmness average. Plants show more susceptibility to crown rot than Elsanta so second-hand beds should be avoided but in substrate and sterilised soil plant losses have been minimal. Good potential for early season cropping.

Malling Glow



EM1677

EM881 x Elegance Mid Season



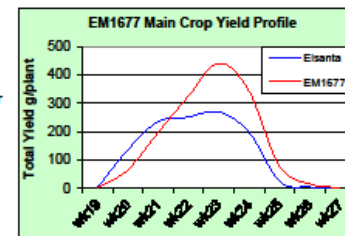
PLANT: Open habit, sparse foliage with glossy small leaflets and moderate vigour. Good fruit display. Similar truss and flower numbers to Elsanta.

DISEASE: Good resistance to *Verticillium* wilt. Similar susceptibility to crown rot (*Phytophthora cactorum*) and mildew as Elsanta but not considered a problem in grower trials.



FRUIT QUALITY:

Appearance: Attractive, bright berries with sunken seeds.
Berry shape: Regular conic, occasionally shows hollow, double first berries
Berry size: 16g (Elsanta 17g)
Colour: Bright orange/red, retained good colour after picking, paler flesh.
Firmness: Good skin strength with firm flesh
Flavour: Pleasantly sweet
2011 brix: 8.0 (Elsanta 8.5)
Shelf life: Very good
50% harvest: Up to 3 days later than Elsanta
60-day C1 yield: Similar to Elsanta
Main crop C1 yield: Total yield very good, small berries reduced % Class 1.



	EM1677			ELSANTA		
	C1 g/plant	Berries > 35mm %	Class 1 %	C1 g/plant	Berries > 35mm %	Class 1 %
60-day 2008 EMR r.bed	164	16%	40	222	40%	88
60-day 2010 raised bed	176	37%	99	165	27%	83
60-day 2010 substrate	229	-	83	176	-	80
60-day 2010 substrate, tray	269	-	99	400	-	96
Main crop 2007 EMR r.bed	1302	44%	-	1382	45%	84
Main crop 2010 raised bed	1552	-	85	1228	-	84
Main crop 2011 raised bed	981	25%	78	949	36%	88

SUMMARY: Midseason EM1677 has excellent fruit quality in particular good skin strength and shelf life with an attractive glossy bright red appearance. EM1677 has the potential to produce high main crop class 1 yields with reasonable 60-day performance, fruit size is slightly smaller than Elsanta. The plants have very good tolerance to wilt and, moderate to good vigour enabling production in both soil and substrate production systems. In the 2012, 2013 and 2014 PCF Tongeren/Sint-Truiden variety trials in Belgium EM1677 was ranked second only to parent Elegance for its good fruit quality attributes.

Malling Silk



EM1669 'Ken Muir'

EM834 x EM1267 Mid season



PLANT: Vigorous, leafy, upright habit with dark matt leaves. Runners well.

DISEASE: Shows tolerance to *Verticillium* wilt with similar susceptibility to mildew as Elsanta.



FRUIT QUALITY:

Appearance: Attractive deep red glossy berries

Berry shape: Regular conic, reflex calyx

Berry size: 15g (Elsanta 17g)

Colour: Mid to deep red, glossy

Firmness: Good

Flavour: Sweet and juicy

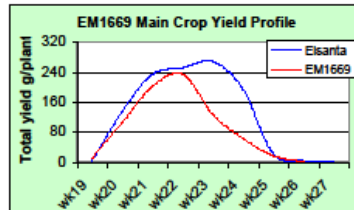
2011 brix: 8.6 (Elsanta 8.5)

Shelf life: Good

50% harvest: Up to 3 days before Elsanta

60-day yield: Moderate

Main crop yield: Similar to Elsanta



	EM1669			ELSANTA		
	C1 g/plant	Berries >35mm	% Class 1	C1 g/plant	Berries >35mm	% Class 1
60-day 2008 EMR r.bed	135	27%	72	222	40%	90
60-day 2009 raised bed	139	-	80	192	-	71
60-day 2010 raised bed	87	26%	89	165	27%	83
Main crop 2007 EMR raised bed	1296	45%	82	1382	45%	83
Main crop 2010 raised bed	1371	-	86	1228	-	84
Main crop 2011 raised bed	672	24%	92	949	36%	88

SUMMARY:

EM1669 is a midseason cropping selection with attractive deep red berries that have a good skin strength and shelf life. 60-day yield is only moderate though main crop yields and are similar to Elsanta. Flavour is reliably sweet and with a juicy texture it has scored high in most tastings. Brix levels are usually higher than those of Elsanta. EM1669 shows good tolerance to *Verticillium* wilt. Currently sold into the amateur marketplace as 'Ken Muir' by Ken Muir Ltd. An application for PVR was made in 2013.

Malling Beauty



EM1696

EM1326 x EM1033 Mid/late season



PLANT: Upright, dense habit with large sharply serrated glossy leaves and vigorous tall growth. Runners well.

DISEASE: Similar susceptibility to *Verticillium* wilt as Elsanta. Good tolerance of mildew.



FRUIT QUALITY:

Appearance: Attractive, glossy berries with prominent seeds and spider-like calyx

Berry shape: Conic, good uniformity

Berry size: 15g (Elsanta 17g)

Colour: Good, orange/red glossy

Firmness: Good

Flavour: Sweet, pleasant taste. Crunchy seeds

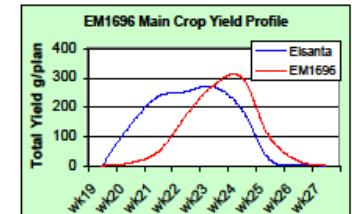
2011 brix: 8.5 (Elsanta 8.5)

Shelf life: Good

50% harvest: 6 days later than Elsanta

60-day C1 yield: Moderate

Main crop C1 yield: Similar to Elsanta



	EM1696			ELSANTA		
	C1 g/plant	Berries >35mm	% Class 1	C1 g/plant	Berries >35mm	% Class 1
60-day 2008 EMR r.bed	213	28%	86	222	40%	89
60-day 2009 raised bed	159	-	80	192	-	71
60-day 2010 raised bed	176	36%	95	165	27%	83
Main crop 2007 EMR r.bed	1179	48%	93	1382	45%	83
Main crop 2010 raised bed	1044	-	94	1228	-	84
Main crop 2011 raised bed	756	31%	98	949	36%	88

SUMMARY:

EM1696 is a mid/late season selection with similar yield potential to Elsanta but higher class 1 percentages. Berries are uniformly conic with good bright orange/red skin colour. Seeds are prominent, flavour is pleasantly sweet and brix levels good. EM1696 has a good shelf life. The plants have vigorous growth with no disease problems noted in grower trial, its tolerance to mildew is of particular interest.

EM1592

EM972 x EM980 Very late season



PLANT: Upright habit, very dense leafy compact plant. Short truss length. Many runners.

DISEASE: In EMR disease trials showed a susceptibility to *Verticillium* wilt and similar susceptibility as Elsanta to mildew.



FRUIT QUALITY:

Appearance: Prominent seeds.

Berry shape: Heart shaped, very regular berries

Berry size: Average 19g (Elsanta 17g), reduces after peak pick

Colour: Orange skin, pale flesh

Firmness: Good

Flavour: Variable but usually sweet.

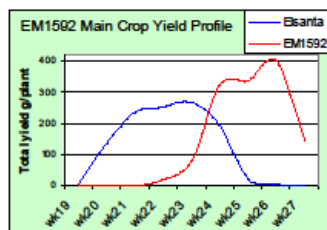
2011 brix: 8.5 (Elsanta 8.5)

Shelf life: Good

50% harvest: 19 days after Elsanta

60-day yield: Less than Elsanta

Main crop yield: Good for a late season selection. Similar to Elsanta.



	EM1592			ELSANTA		
	C1 g/plant	Berries >35mm	% Class 1	C1 g/plant	Berries >35mm	% Class 1
80-day 2007 EMR r bed	193	8%	84	222	41%	89
80-day 2010 raised bed	136	38%	80	165	27%	83
80-day 2010 substrate	61	-	47	104	-	86
Main crop 2008 EMR r bed	1022	23%	88	1153	57%	74
Main crop 2009 raised bed	537	-	70	686	-	67
Main crop 2010 raised bed	1370	-	83	1228	-	84
Main crop 2011 raised bed	1113	35%	99	949	36%	88

SUMMARY: EM1592 fruits up to 19 days later than Elsanta, berries are firm with orange/red colour and moderate in size. Total main crop yields are high, class 2 produced consists mainly smaller size berries. Flavour is variable but usually sweet with a crunchy texture. Seeds are prominent. Shelf life is superior to Elsanta. Plants show a susceptibility to wilt, re-plant beds should be avoided.