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Project leader: Adam Whitehouse, NIAB EMR

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Key staff: Adam Whitehouse

Abigail Johnson

Andy Passey

Katie Hopson

David Simpson

Location of project: NIAB EMR

Industry Representative: Louise Sutherland

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The results and conclusions in this report are based on an investigation conducted over a one-year period. The conditions under which the experiments were carried out and the results have been reported in detail and with accuracy. However, because of the biological nature of the work it must be borne in mind that different circumstances and conditions could produce different results. Therefore, care must be taken with interpretation of the results, especially if they are used as the basis for commercial product recommendations.

AUTHENTICATION

We declare that this work was done under our supervision according to the procedures described herein and that the report represents a true and accurate record of the results obtained.

Adam Whitehouse

Programme Leader

NIAB EMR



Signature

Date 14th May 2018

[Name]

[Position]

[Organisation]

Signature Date

Report authorised by:

Signature Date

[Name]

[Position]

[Organisation]

Signature Date

CONTENTS

Grower Summary

Headline.....	5
Background.....	5
Results of selection trials	5

Science Section

Introduction	14
Trial methods	13
Results and Discussion	15
Conclusions	38
Knowledge and Technology Transfer	40
Appendices	41

GROWER SUMMARY

Headline

Nine new selections, six June-bearers and three everbearers, were selected from the 2017 East Malling Strawberry Breeding (EMSBC) preliminary trials to go forward to UK growers' trials. Of the six June-bearers; two were early selections, one was mid-season and three were late season types. All will be trialled on UK growers' sites in 2019/20. In addition, 14 advanced selections were trialled on growers' sites, with five of these progressing to further trials, one selection, an everbearer (EMR639), is being considered for commercialisation.

Background

The main objective of the East Malling Strawberry Breeding Club (EMSBC) strawberry breeding programme is to develop improved strawberry varieties, both June- and everbearing with increased yield, larger fruit size, an extended season of production and greater resistance to fungal diseases. Funding for the programme was renewed in 2013 to follow on from the first tranche of the EMSBC breeding programme which had started in 2008 and that delivered the June-bearer variety *Malling™ Centenary*. AHDB continues to contribute to the EMSBC via project SF 96a. In 2017 it was agreed that AHDB would continue to remain a member of the EMSBC and continue funding the programme until May 2023.

This report covers three preliminary trials held at NIAB-EMR in 2017 that are part-funded by the AHDB membership of the EMSBC (June-bearer main crop, 60-day and everbearer trials), as well as a brief summary of more advanced selections that have been assessed on offsite EMSBC growers' sites.

Results of selection trials

Descriptions and results from the most promising selections in each of the 2017 trials are shown in the following below, accompanied with tables of results for each preliminary trial:

June-bearer (main crop) NIAB EMR trial

Six selections were considered for assessment in growers' trials in 2019/20; descriptions and data for each selection appear below in season order (earliest to latest), and in Tables 1 and 2:

EM2541 has a higher Class 1 yield than Malling Centenary, Elsanta and Flair with large average fruit size (86% >35mm) and a high percentage of Class 1 (86%). However, average size can vary large with 32% of fruit being greater than 45mm in the NIAB EMR trial. EM2541 has an early season of production, with 50% harvest date between Flair and Vibrant. Plants are vigorous and may be too leafy for tunnel production.

EM2544 has an average Class 1 yield similar to Elsanta, but with larger average fruit size (86% >35mm) and higher percentage of Class 1 fruit (89%). Cropping season is slightly earlier than Elsanta, and nearer to Vibrant season. Berries are uniform, firm and attractive with good colour with high overall average Brix scores (9.1°). However plants are vigorous and may be too leafy for tunnel production.

EM2248 is a midseason selection that has a Class 1 yield similar to Elsanta but with better fruit size (75% >35 mm) and a higher percentage of Class 1 fruit (87%). Plants have moderate vigour with well-displayed fruit. Berries are glossy with good colour and uniform shape; with average Brix scores similar to Elsanta but with better scores for sensory flavour.

EM2588 is a high-yielding, late season selection with a high percentage of Class 1 fruit (83%) and moderate fruit size. Harvest date is similar to Florence but with a different yield profile and with a long season of production. Plants have moderate vigour with the fruit very well displayed on long trusses. Berries are attractive and glossy with good shape, with high average Brix (11.3°) and good sensory flavour scores.

EM2434 is a late season (10 days later than Elsanta), very high yielding (1.7 kilograms per plant) selection, with large fruit-size (78% >35mm) and with a high percentage of Class 1 fruit. Berries have a uniform shape and high average Brix (9.4 °) but sometimes have uneven colour (Figure 2.a.).

EM2622 has a late fruiting season, with a high Class 1 yield (1.3 grams per plant) and fruit size similar to Florence (69% >35mm). Plants are tall and vigorous but with

a very erect habit and good fruit display. Berries are firm and attractive with a good, regular shape, and an average Brix score (8.8°) slightly higher than Florence and Elsanta, and the sensory flavour was liked by visitors at trial walks in 2017.

Table 1 . June-bearer selections. Main crop yield, fruit size and season

Selection	Class 1 yield (g/plant)	% Class 1	% large fruit (>35mm)	50% pick date
EM2248	747	87	75	5 Jun
EM2434	1681	89	78	15 Jun
EM2541	898	86	86	30 May
EM2544	821	89	86	1 Jun
EM2588	1300	83	61	12 Jun
EM2622	1307	82	69	15 Jun
<i>Elsanta</i> ¹	739	80	67	5 Jun
<i>M. Centenary</i>	643	89	80	5 Jun

¹Mean of three plots

Table 2. June-bearer selections. Main crop fruit quality scores

Selection	Appearance (1-9)	Skin firmness (1-9)	Flesh firmness (1-9)	Flavour (1-9)	Shelf life (1-5)	Mean Brix
EM2248	5.5	5.8	5.8	5.7	3.3	8.4
EM2434	5.0	5.4	5.6	5.6	3.5	9.4
EM2541	5.4	5.9	6.1	5.4	3.0	8.2
EM2544	5.7	5.9	5.9	5.9	3.0	9.1
EM2588	5.7	6.1	5.9	6.1	3.8	9.9
EM2622	5.8	6.1	5.9	5.2	4.0	8.8
<i>Elsanta</i> ¹	4.7	5.4	5.0	5.0	3.2	8.7
<i>M. Centenary</i>	6.6	6.1	6.1	5.6	4.0	7.7

¹Mean of three plots

Full descriptions of the fruit quality scoring system can be found in Appendix I of the main report, but as a guide 1=poor, 9=excellent, shelf life comparison 1=worse, 3=same, 5 better than standard

June-bearer (60-day) NIAB EMR trial

This trial included five selections (EM2181, EM2448, EM2464, EM2483, EM2494) that have progressed for assessment in growers' trial in 2018/19. Summarised data from the trial is shown in Table 3. Exceptionally hot weather during establishment and at cropping led to the trial plants performing atypically and therefore it was difficult to draw meaningful conclusions from the trial. All five selections will however continue for assessment in offsite growers' trials in 2018/19.

Table 3. June-bearer selections. 60-day yield, crown size and season

Selection	Marketable yield ¹ (g/plant)	% marketable yield	Mean crown diameter (mm)	Marketable (g/plant) yield per mm crown diameter	50% pick date
EM2181	64.2	62.1	10.1	6.3	6 Jul
EM2448	82.5	57.3	9.8	8.4	3 Jul
EM2464	85.0	48.3	8.9	9.6	29 Jun
EM2483	105.1	77.8	8.3	12.7	3 Jul
EM2494	74.2	52.0	8.3	9.0	3 Jul
<i>M Centenary</i>	<i>144.4</i>	<i>77.8</i>	<i>9.4</i>	<i>15.4</i>	<i>3 Jul</i>

¹ >28 mm

Full descriptions of the fruit quality scoring system can be found in Appendix I of the main report, but as a guide 1=poor, 9=excellent

Everbearer NIAB EMR trial

Three new selections were considered for assessment in growers' trials in 2019. Data (Table 4 & 5) and descriptions are shown below:

EMR773 is an exceptionally high yielding selection with excellent fruit size and high percentage of Class 1 fruit. Fruit is attractive with very good shelf life, but some uneven ripening has been seen on early and late picks in the season. Berries are very firm, with a 'watery sweet' flavour and a good average Brix score (8.1°).

EMR794 produces a high Class 1 yield with a high percentage of large fruit. Fruit is glossy, with a bright, orange-red skin colour, and very firm, often with a crunchy texture. Flavour is often juicy, with watery sweet flavour. In shelf-life tests, EMR794 is noted for retaining its glossy appearance.

EMR797 produces a high yield of Class 1 fruit, with moderate fruit size. However, berries are very attractive with a glossy skin and a very regular conic shape. Flavour is consistently good and often described as sweet, being noteworthy in retailer sampling for its sweetness and high average Brix score (8.8°). Fruit is held on long

trusses giving an excellent fruit display.

Table 4. Everbearer selections. Yield, fruit size and season

Selection	Class 1 yield (g/plant)	% Class 1	% large fruit (>35mm)	50% pick date
EMR773	1769	81	71	10 Aug
EMR794	1704	78	75	21 Aug
EMR797	1358	70	48	21 Aug
<i>Evie 2</i>	<i>1295</i>	<i>68</i>	<i>61</i>	<i>21 Aug</i>
<i>Finesse</i>	<i>1326</i>	<i>67</i>	<i>38</i>	<i>7 Aug</i>
<i>Murano</i>	<i>1014</i>	<i>63</i>	<i>22</i>	<i>4 Sept</i>

Table 5. Everbearer selections. Fruit quality scores

Selection	Appearance	Skin firmness (1-9)	Flesh firmness (1-9)	Flavour (1-9)	Shelf life (1-5)	Mean Brix
EMR773	5.3	6.7	7.4	5.3	4.0	8.1
EMR794	5.5	5.9	6.4	5.6	3.5	8.5
EMR797	5.7	6.1	6.0	5.8	3.0	8.8
<i>Evie 2</i>	<i>5.4</i>	<i>5.6</i>	<i>5.6</i>	<i>4.8</i>	<i>2.8</i>	<i>6.7</i>
<i>Finesse</i>	<i>5.1</i>	<i>5.9</i>	<i>5.8</i>	<i>5.1</i>	<i>3.5</i>	<i>7.7</i>
<i>Murano</i>	<i>5.1</i>	<i>6.2</i>	<i>6.1</i>	<i>5.4</i>	<i>2.7</i>	<i>8.0</i>

Full descriptions of the fruit quality scoring system can be found in Appendix I of the main report, but as a guide 1=poor, 9=excellent, shelf life comparison 1=worse, 3=same, 5 better than standard

Offsite main crop (June-bearer) growers' trial

Three advanced selections (EM2056, EM2157 and EM2192). EM2056 and EM2192 were considered to have been superseded by later selections and will not progress for further trialling. EM2157 has already been put forward commercialisation in 2016 and will be released in 2018/19 as the variety Malling Allure.

Offsite 60-day (June-bearer) growers' trial

Three advanced selections, EM2199, EM2380 and EM2421, performed sufficiently well in the 60-day trial to progress to main crop growers' trials in 2018.

EM2199 is an early season selection, with attractive fruit, with good skin and flesh firmness scores across sites and good flavour with a mean Brix score across sites. Initial disease screening assessments indicate that EM2199 has intermediate resistance to crown rot, moderate resistance to Verticillium wilt, but moderate susceptibility to powdery mildew.

EM2380 is an early, high-yielding selection, with a high percentage of Class 1 fruit, and fruit size comparable to Elsanta. Fruit quality is judged to be very good, with good scores for appearance, skin and flesh firmness and Brix (mean 8.6°). Initial disease screening assessments indicate that EM2380 does not have strong resistance to the major strawberry diseases.

EM2421 is a large-fruited, mid-season selection. It has good scores for appearance, firmness and a high average Brix (9.3°). Initial disease screening assessments indicate that EM2421 has intermediate resistance to crown rot and moderate resistance to powdery mildew, but shows moderate susceptibility to Verticillium wilt.

Offsite everbearer growers' trial

Two advanced selections, EMR693 and EMR704 will progress forward for further trialling in large-scale trials in 2019. EMR639 which was being trialled in large-scale trials is currently being considered for commercialisation.

EMR639 yields a moderate Class 1 yield of glossy and attractive berries. Flavour is pleasant with a good mean Brix score of 8.8° from growers' trials. EMR639 has good disease resistance based on initial tests carried out at NIAB EMR, with good resistance to crown rot and powdery mildew, and moderate resistance to powdery mildew.

EMR693 has a good Class 1 yield of moderately-sized berries. Fruit is very attractive with a uniform shape and colour, good skin and flesh firmness and pleasant, often sweet flavour. Retailer and visitor feedback was also excellent, with triallists suggesting that it had clear cultivar potential. Initial disease screening assessments indicate that EMR693 moderately susceptible to Verticillium wilt, intermediate resistance for crown rot and moderately resistant to powdery mildew.

EMR704 is a high yielding everbearer with excellent fruit size. Appearance and firmness are good, with berries having a pleasant flavour combined with a high mean Brix score (9.0°) in growers' trials. An early season of production was reported with some triallists. Initial disease screening assessments indicate that EMR704 has intermediate resistance to Verticillium wilt, but good resistance to crown rot and powdery mildew.

SCIENCE SECTION

Introduction

This report covers three trials (June-bearer main crop, 60-day and everbearer) as part of the preliminary trials assessed at NIAB EMR in 2017 on behalf of the East Malling Strawberry Breeding Club (EMSBC). The EMSBC was set up in 2008 to continue the national strawberry programme that has operated at EMR since 1983 with the AHDB contributing via project SF 96. A second tranche of the EMSBC was agreed in 2013 for a 10-year term (with a break clause after five years) and commenced on 1 June 2013. In 2017 the AHDB agreed to remain a member of the EMSBC and continue part funding the programme until 2023 via project SF 96a.

It is the intention of the breeding programme to release new varieties, which show advantage over those currently available for a particular purpose or slot in the season. This advantage may be in terms of fruit quality, yield, resistance to diseases (to minimise pesticide applications and the reliance on soil fumigation), fruit size and display (to reduce picking costs) or any combination of these characters.

In addition, the programme is benefiting from associated research projects funded at NIAB EMR that feed into the breeding work, primarily those associated with the development of molecular markers linked with disease resistance. The integration of basic science to benefit the programme has recently been demonstrated by the adoption of a marker-assisted approach to the design of a number of crosses that have been carried out with the specific aim of pyramiding markers associated with resistance to *Verticillium* wilt (*Verticillium dahliae*), powdery mildew and *Phytophthora* species (as part of a linked BBSRC IDRIS project).

Trial methods

All trials at NIAB EMR were performed on the Churchfields West plot (sandy loam soil) at NIAB EMR, New Road, East Malling, Kent ME19 6BJ. Each trial was planted into fumigated raised beds as double rows at 0.5m spacing for all trials. Each raised bed was covered by blue polythene mulch and fertigated at fruiting stage via trickle irrigation (12:6:36 NPK, 25kg/ha per week from fruiting) and alleys were strawed. These trials were covered prior to flowering with polythene clad tunnels for rain

protection and also with netting against bird damage. An industry standard spray programme was followed for each trial and is shown in Appendix II.

Fruit was harvested twice-weekly from each trial into individual trays that were assigned a unique alpha-numeric plot code (to avoid selection bias). Fruit was graded into five categories, primarily based on fruit size (diameter in mm): giant (>45mm), large (>35mm), medium (>28mm), small (<28mm) and waste (fruit rendered unmarketable due to damage (physical and/or pathological), misshape or rots. Class 1, or marketable fruit, was classified as fruit >28mm diameter, with unmarketable (for the June-bearer 60-day trial) being defined as <28mm diameter and waste fruit. Yield is presented as the mean of all plants in each individual plot.

Fruit quality (appearance, skin and flesh firmness and flavour) assessments were performed immediately after each pick, using the scoring system shown in Appendix I. Assessments were carried out by a panel of experienced breeders.

Post-harvest records of Brix^o (soluble sugars) and shelf-life, were taken as often as possible throughout the season with a minimum of three records for each selection per season.

Brix was measured using a sample of two berries per selection per pick that were halved longitudinally with the juice from each half-fruit being assessed using a hand-held refractometer. The mean score for each selection across the season are presented in the results section.

Shelf-life tests were performed on ten unblemished fruit that were sampled once a week for each selection during its fruiting season. Samples were collected at the fruit evaluation stage immediately after picking and were transferred in open, 454g punnets to a +2°C cold-store for 24h. After 24h these samples were transferred to a controlled environment cabinet and maintained at 17°C at 70% RH for a further 72h. An assessment of each sample was then performed via a comparative assessment against a standard cultivar using the scoring system shown in the Appendix 1. The mean scores for each selection across the season are presented in the results section.

Main crop (June-bearer) trial

The main crop trial contained 87 new selections, 17 advanced, re-cycled or re-trialled selections and eleven industry/season standard cultivars (including Elsanta, Sonata and Malling™ Centenary). It was established from misted tips planted on 9th August 2016. Plots consisted of a maximum of six plants per selection, with the exception of re-trialled/recycled selections or standards, which were replicated as two (2x six plants) plots.

60-day trial

The 60-day trial included five advanced selections and Malling™ Centenary as the standard. The trial was established using bare-root, cold stored runners planted on 17th May 2017. Plots consisted of maximum of ten plants per selection.

Everbearer trial

The everbearer trial contained 24 new selections, and six advanced selections, plus standard cultivars (Finesse, Evie 2 and Murano). It was established from potted plants derived from pinned down tips, taken in August 2016, and planted on 28th March 2017. Plants were de-blossomed on 20th May 2017 and harvesting began on 22nd June 2017 and continued twice weekly until 28th September 2017. Plots were of maximum of ten plants per selection, with the exception of re-trialled/recycled selections or standards, which were replicated as two (2x ten plants) plots.

Offsite Growers trials

EMSBC offsite growers' trials are hosted and financed by individual EMSBC members on their own farms, so only a brief summary of trial methods for these trials are presented. Four offsite growers' trials were used for 60-day, maincrop and everbearer trials.

Offsite main crop (June-bearer) growers' trials

Three advanced selections were assessed for yield and fruit quality in main crop trials in 2017: two (EM2157 and EM2192) in small-scale trials (60 tray or waiting bed plants per site) and one (EM2056) in large-scale trial (1000 tray or waiting beds per site). The selections in small-scale trials were assessed on four UK growers' sites in 2017 having first been assessed as 60-day plants in 2016, and originally selected for growers' trials in 2014. These plantings were in substrate, with three trials assessed under polythene-clad tunnels and one under glasshouse production. EM2056 was being assessed in large-scale trials having being selected for growers' trials in 2011.

Offsite 60-day (June-bearer) growers' trials

Five advanced selections were assessed for yield and fruit quality in 60-day offsite trials in 2017: four (EM2199, EM2379, EM2380, EM2421) in small-scale trials (60 tray or waiting bed plants per site) and one (EM2170) in large-scale trial (1000 tray or waiting beds per site). All plantings were in substrate, with four trials assessed under polythene-clad tunnels and one under glasshouse. EM2170 was being assessed in large-scale trials having being selected for growers' trials in 2012, and the remaining selections in small-scale trials having been selected for growers' trials in 2015.

Offsite everbearer growers' trials

Six advanced everbearer selections were assessed for yield and fruit quality in offsite trials in 2017: five (EMR688, EMR693, EMR701, EMR704, and EMR710) in small-scale trials (60 tray or waiting bed plants per site) and one (EMR639) in large-scale trial (1000 tray or waiting beds per site). All UK plantings were in substrate in under polythene-clad tunnels. EMR639 were being assessed in large-scale trials having being selected for growers' trials in 2013, and the remaining selections in small-scale trials (60 tray plants per site) having been selected for growers' trials in 2015.

Results and Discussion

Main crop (June-bearer) NIAB EMR trial

The planting was completed slightly later than schedule due to slow growth of the misted tips struck at the end of June 2016 and therefore plants were smaller at planting than normal. However, plants did establish quickly in warm autumn conditions. A cold winter followed by unseasonably warm weather in April and May 2017 led to a very early fruiting season, with the first harvests on early lines on May 18th and the first significant harvests from Malling Centenary and Elsanta on May 30th. A hard frost (-5°C) on the 26th April 2017, when many plots were at full flower caused some damage to primary flowers on some plots, but this was limited by the use of double fleece for protection. The fruiting season was very condensed with an overlap of early and late lines on some picks, but harvesting continued on some very late lines until July 10th. The weather during the main fruiting period was sunny with very warm day temperatures, exceeding 30°C on a number of occasions, with below average rainfall, which led to some fragility in skin strength and darker skin colour on some picks.

The results from the most promising selections for UK growers is summarised in Table 6. Data on quality, yield and plant characteristics were considered together to identify the most promising selections and the EMSBC Board decided to progress six new selections for UK growers' trials in 2019/20. These selections were:

EM2248 (Midseason)

This selection was being re-trialled in 2017 having previously being tested in 2015 where it produced a good yield and fruit size but with weak flavour. Average Class 1 yield (747 grams per plant) was similar to Elsanta but with better fruit size (75% >35 mm) and higher percentage Class 1 (87%). Cropping season was similar to Elsanta (Figure 1.b) but had been later (Fenella season) in 2015. Plants had moderate vigour with big leaves and fruit was well displayed. Berries were glossy with good colour and uniform shape, but uneven ripening was noted on some picks (Figure 1.a). Average Brix scores were similar to Elsanta (Table 6) but with better scores for sensory flavour (Table 6).



Figure 1.a. Fruit of EM2248

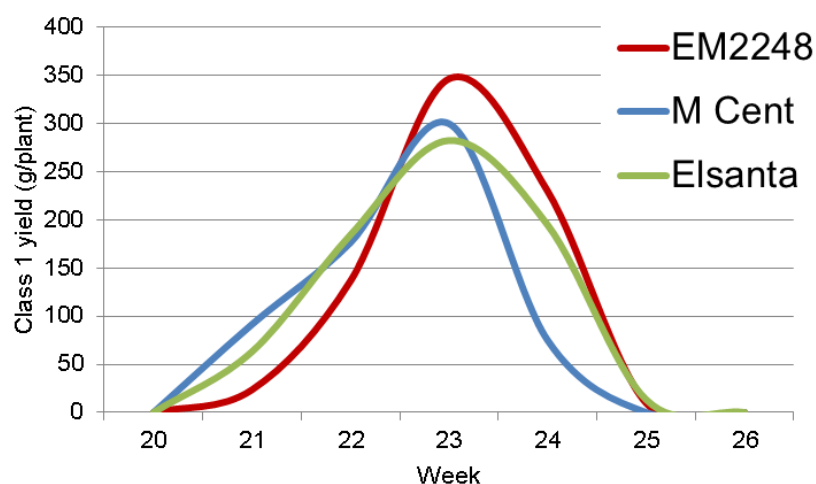


Figure 1.b. Cropping profile of EM2248

EM2434 (Late season)

EM2434 was being re-trialled, having first being tested in 2015 where it gave a very high Class 1 yield (2.5 kilograms per plant) but was found to have a blotchy appearance and weak flavour.

In 2017, EM2434 once again gave a high yield (1.7 kilograms per plant), and was the highest yielding selection in the trial, with excellent fruit size (78% >35mm) and a high percentage (89%) of Class 1 (89%) fruit. Fruiting season was similar to Florence, with a 50% harvest date 10 days later than Elsanta (Figure 2.b), but plants were less leafy and had a better fruit display than Florence. Berries have uniform shape but sometimes had uneven colour (Figure 2.a). Average brix score was high (9.4°), but flavour was a balance between high sugars and high acid, which divided opinion for sensory scores.



Figure 2.a. Fruit of EM2434

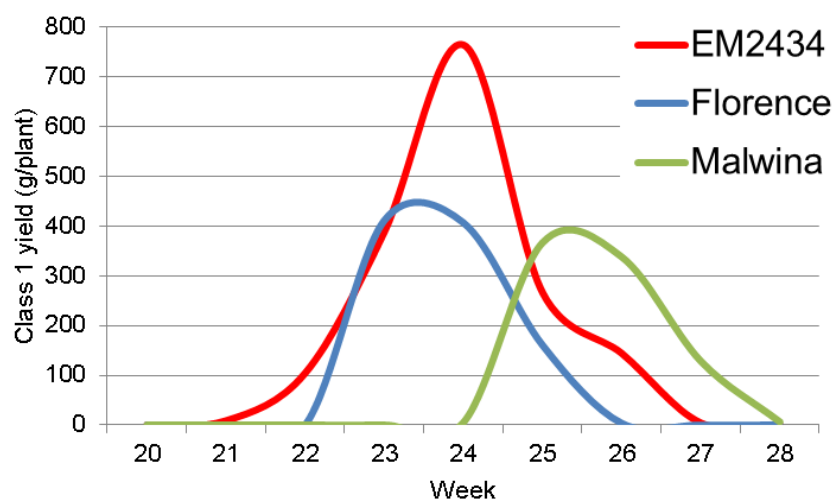


Figure 2.b. Cropping profile of EM2434

EM2541 (Early season)

This early selection gave a higher Class 1 yield than Malling Centenary, Elsanta and Flair (Table 6) with large average fruit size (86% >35mm) and a high percentage of Class 1 (86%). Average size was found to be very large with 32% of fruit being greater than 45mm. Cropping season was four days later than Flair (Figure 3.b). Berries were firm with good colour and had a good appearance although shape was sometimes a bit irregular (Figure 3.a). Brix scores and sensory flavour scores were variable but on average were similar to Elsanta (Table 6). Plants were vigorous and may be too leafy for tunnel production.



Figure 3.a. Fruit of EM2541

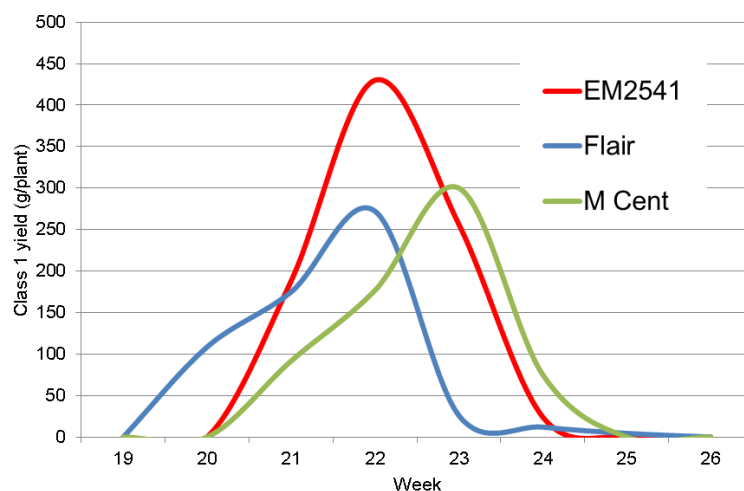


Figure 3.b. Cropping profile of EM2541

EM2544 (Early season)

EM2544 gave an average Class 1 yield (821 grams per plant) similar to Elsanta, but with larger average fruit size (86% >35mm) and high percentage Class 1 (89%). Cropping season was slightly earlier than Elsanta, and nearer to Vibrant season (Table 4.b). Berries were uniform, firm and attractive with good colour (Figure 4.a). Brix scores were variable throughout the season, but the overall average was high (9.1°) and this selection received consistently good scores for sensory flavour (Table 6). As with EM2541, plants were vigorous and may be too leafy for tunnel production.



Figure 4.a. Fruit of EM2544

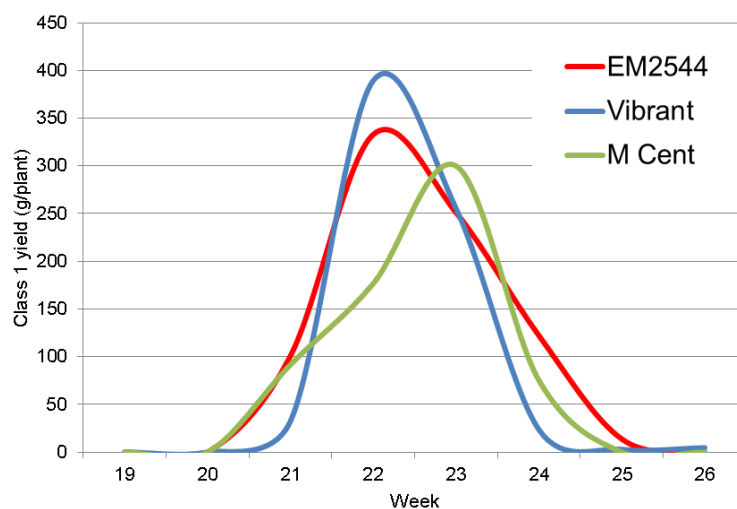


Figure 4.b. Cropping profile of EM2544

EM2588 (Late season)

EM2588 was a high yielding selection (1.3 kilograms per plant) with a high percentage of Class 1 fruit (83%). Average fruit size was lower than with the standards (61% >35mm). Harvest date was similar to Florence but with a different yield profile and with a long season of production (Figure 5.b). Plants had moderate vigour with the fruit very well displayed on long trusses. Berries were attractive and glossy with good shape but often had white necks at harvest (Figure 5.a). Brix scores were high (average 11.3°) and scores for sensory flavours were consistently good (Table 6).



Figure 5.a. Fruit of EM2588

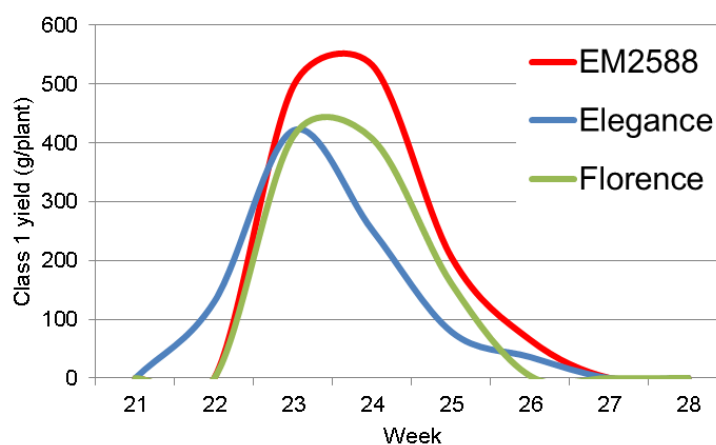


Figure 5.b. Cropping profile of EM2588

EM2622 (Late season)

EM2622 gave a very high Class 1 yield (1.3 kilograms per plant) with fruit size similar to Florence (69% >35mm). Cropping season was a few days later than Florence and with a longer season of production (Figure 6.b). Plants were tall and vigorous but with a very erect habit and good fruit display. Berries were firm and attractive with a good, regular shape (Figure 6.a). Average Brix score (8.8°) was slightly higher than Florence and Elsanta, and flavour was liked by visitors at trial walks.



Figure 6.a. Fruit of EM2622

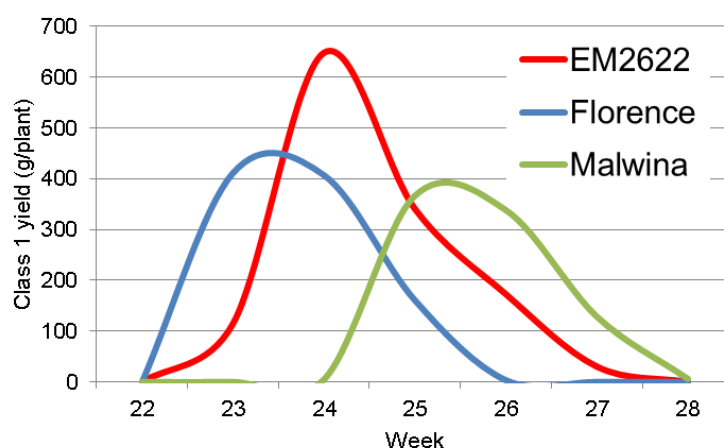


Figure 6.b. Cropping profile of EM2622

60-day NIAB EMR trial

The 60-day trial included five advanced selections and Malling™ Centenary as a standard. The trial was established using bare root cold stored runners planted on May 17th 2017.

Rapid growth was observed soon after planting, following very warm day temperatures. Marketable yields produced were lower than expected, partly as a consequence of change in grading to 28mm minimum but also the rapid ripening of fruit before it was fully-sized in the very hot weather that followed planting. Harvesting commenced on June 20th 2017, and fruit was picked and recorded twice weekly until July 11th 2017. The time taken from planting to first fruit was 34 days, the shortest period recorded at East Malling for fruit production in this system - an unprecedented 2.5 weeks earlier than average. The season was also very condensed with 36 days from first pick to last, compared to an average of 52 days, attributable to the very hot weather experienced in May and June.

The results of the trial are shown in Table 7. All the selections tested were inferior to Malling™ Centenary in terms of marketable yield (g/plant and yield per crown diameter) and % marketable yield, but descriptions on the performance of each selection are shown below:

EM2181, a late season selection, had a 50% pick date three days later than Malling™ Centenary and three other selections. It had the lowest marketable yield both as grams per plant and yield per crown diameter despite it having the largest mean crown diameter. However, Brix scores were consistently high, with an average of 10.5°, representing the highest score from all of the selections tested.

EM2448 gave a similar marketable yield per plant as EM2464, although this was from plants with larger crown size. 50% pick date and Brix scores were similar to Malling™ Centenary, although flavour was often judged to be sweet. Skin colour was noted as darkening in the warm weather, and on a couple of occasions exhibited sun damage.

EM2464 had the earliest 50% pick date of all the selections tested which corresponds well to its season in main crop trial. Although the marketable yield was

around average for the selections tested it was still 40% lower than for Mallings™ Centenary. Brix scores were slightly lower than for Mallings™ Centenary, although not significantly so, and flavour was found to be variable.

EM2483 produced the highest marketable yield of all the selections tested, and gave a similar total yield (grams per plant) as Mallings™ Centenary. However mark out was also high (42.5%), mainly attributed to misshapes. Brix scores were similar to the standard, but flavour was noted as being mediocre with very firm, 'crunchy' flesh.

EM2494 yielded only 50% of the marketable yield of Mallings™ Centenary and although the fruit had a higher mean Brix score and produced attractive, regular, conic-shaped fruit, there was very little else that made it stand out from the other selections tested.

It is difficult to draw reliable conclusions from this trial due to atypical behaviour of the plants to the extreme temperatures experienced after planting and during the main fruiting period. However, there is no reason to consider rejecting any selections based on the data gathered and so the EMSBC Board agreed that those selections already selected for assessment in growers' trials in 2018/19 should continue.

Everbearer NIAB EMR trial

Trial plants established well after planting and developed well, with the exception of plants of Murano which were found to be weak and so replacement tray plants were planted on 5th May. Plants were de-blossomed on 20th May. Harvesting began on 22nd June and continued twice weekly until 28th September 2017. However, temperatures from mid-May through to the end of June were hotter than average, with a prolonged hot spell from mid-June when temperatures exceeded 30°C for five consecutive days. This led to problems with flower quality, to which the large number of misshapes recorded at the start of the season may have been attributable to. In addition, and despite early releases of predatory mites, an outbreak of tarsonemid mite coincided with this period of hot weather, and although this was treated quickly, pockets of infestation proved to be particularly persistent on some plants and these were removed, and data from these plants excluded from the data summaries. Spotted-wing drosophila also became problematic in mid-August through to early

September and may have contributed to the higher incidence of rots observed during this period. Powdery mildew was notably absent from the trial this season, despite conducive conditions for the disease in September. Overall, the fruit quality of the trial was good, with sweet flavours and good Brix levels noted. Yields were slightly higher than average, due in part to the extended season. However fruit size was notably smaller than expected on some of the standards and advanced selections and there may have been a number of contributory factors, including higher percentage of mark out of large fruit, rapid ripening of fruit before sizing up and possibly some environmental interaction on truss architecture in response to elevated temperatures.

Of the new selections trialled, the EMSBC Board decided to progress three to UK growers' trials in 2018 and the descriptions of these selections appears below:

EMR773

This selection had an exceptionally high Class 1 yield (1.8 kilogram per plant), giving the highest yield in trial. Fruit size (81% >35mm) was excellent with a good percentage of Class 1 fruit (71%), with mark out mainly due to rots late in the season. Berries had a regular shape and bright colour, but with sunken seeds, and fruit was prone to uneven ripening on some early and late season picks (Figure 9.a). Flavour and Brix were variable throughout the season, being described as bland at the beginning of the season but 'watery sweet' and pleasant in August and start of September. Brix scores on average (8.1°) were better than the standards. Flesh was exceptionally firm, often giving a crunchy texture to the fruit. Shelf-life was also good, with berries retaining their brightness and calyx remaining fresh and scoring higher than the standards (Table 8). Plants had moderate vigour with good fruit display and had sparse runner production. There were no signs of disease, although one plant that showed some stunting (tarsonemid) was removed early in the season.



Figure 7.a. Fruit of EMR773

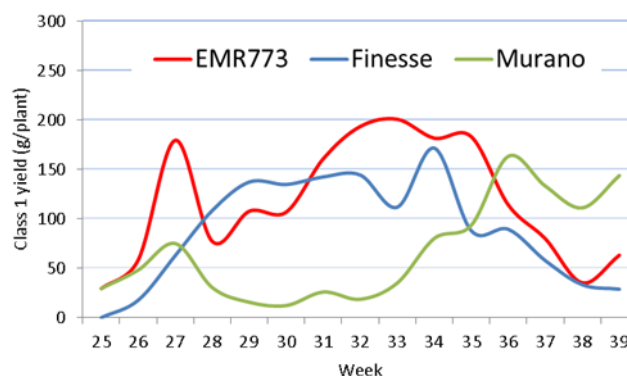


Figure 7.b. Cropping profile of EMR773

EMR794

EMR794 produced the second highest Class 1 yield in trial, with a yield similar to EMR773 and with a high percentage of large fruit (75% >35mm). The percentage of Class 1 fruit was relatively high (78%), with mark outs being attributed predominantly to misshape and rots. Fruit was glossy, with a bright, orange-red skin colour, but with pale flesh. The calyx was reflexed, and the seeds were sunken and shape could be a little uneven, with some knobbly fruit noted on some occasions (Figure 8.a). Berries were very firm, with a crunchy texture, but were still juicy and had a watery, sometimes sweet flavour (Table 8). Brix scores were variable but on average (8.5°) and better than the standards. Shelf-life was similar to the standards, and fruit was noted as retaining its glossy appearance. Plants were uneven in the plot, but generally had moderate vigour with good fruit display. Although plants were disease free, calcium tip burn was noted on both the plants and fruit calyx.



Figure 8.a. Fruit of EMR794

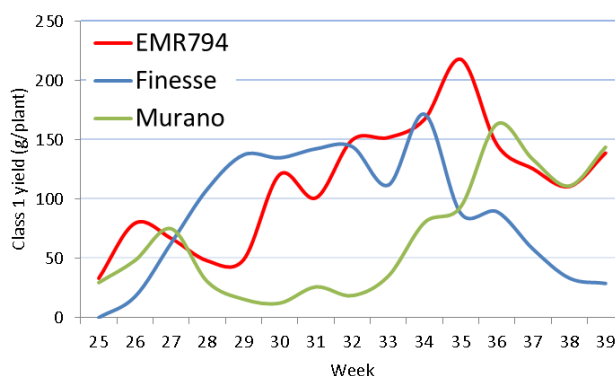


Figure 8.b. Cropping profile of EMR794

EMR797

EMR797 produced a high yield of Class 1 fruit (1.4 kilograms per plant), but had only moderate fruit size (48% >35mm) and percentage of Class 1 fruit (70%). However, berries were very attractive with a glossy skin and a very regular conic shape (Figure 11.a). Flavour was consistently good and often sweet, and was picked out during a retailer sampling session as being noteworthy for its sweetness. Brix scores overall were high, with a mean of 8.8°, but with some variation throughout the season. Shelf-life was comparable to the standards, and although berries retained their glossy appearance and fresh calyx they were marked down for numbers of rots. Plants had vigour similar to Evie 2, but were slightly uneven in the plot. Fruit was held on long trusses giving an excellent fruit display. Runner production was low. Plants appeared to be disease free.



Figure 9.a. Fruit of EMR797

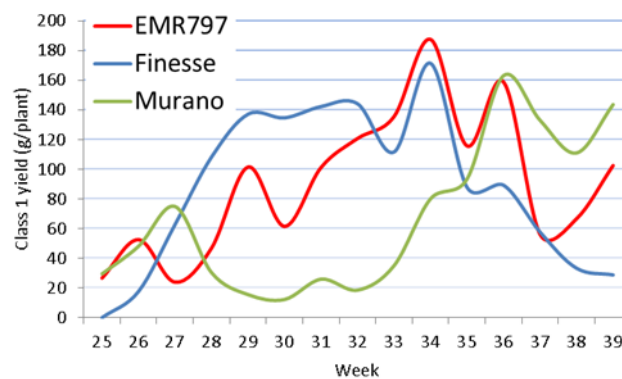


Figure 9.b. Cropping profile of EMR797

Offsite main crop (June-bearer) growers' trials

Of the three selections trialled, one (EM2157) had already been fast tracked to commercialisation in 2016 (AHDB Annual Report SF96a 2016), and the remaining two (EM2056 and EM2192) were considered to have been superseded by later selections, which had better attributes overall and so the EMSBC Board decided not to progress EM2056 and EM2192 for further trialling or commercialisation.

Offsite 60-day (June-bearer) growers' trials

The results of the offsite growers' trials were reviewed by the EMSBC Board in October 2017 and it was agreed that three selections (EM2199, EM2380 and EM2421) trialled should continue in main crop offsite trials in 2018. Trialling of two selections, EM2170 and EM2379 were discontinued as disease susceptibilities in both selections were considered to render the selections commercially unviable. A summary of the performance of each of the selections across all trial sites is given below:

EM2199

EM2199 is an early season selection. Fruit was judged to be attractive, with good skin and flesh firmness scores across sites and good flavour with a mean Brix score across sites of 8.2°. Mean fruit size was comparable to Elsanta (mean berry weight, 16.3g). Initial disease screening assessments indicate that EM2199 has intermediate resistance to crown rot, moderate resistance to Verticillium wilt, but moderate susceptibility to powdery mildew. It was also noted to have re-flowered at one site in mid-August.

EM2380

An early selection, which gave a high yield and high percentage of Class 1 fruit, however average fruit size was relatively small, comparable to Elsanta (mean berry weight, 16.3g). Fruit quality across sites was judged to be very good, with good scores for appearance, skin and flesh firmness and Brix (mean 8.6°). Initial disease screening assessments indicate that EM2380 does not have strong resistance to the major strawberry diseases.

EM2421

This selection is a large-fruited (mean berry weight, 20.3g), mid-season selection. It received good scores for appearance, firmness and high Brix (9.3°), but with variable sensory flavour scores and a disappointing average Class 1 yield (330g per plant). Initial disease screening assessments indicate that EM2421 has intermediate resistance to crown rot and moderate resistance to powdery mildew, but shows moderate susceptibility to Verticillium wilt.

All the above selections will continue to be assessed in large-scale offsite main crop growers' trials in 2018. More detailed summaries of each of the selections attributes when tested at East Malling in 2015 can be found in the 2016 AHDB SF96a Annual Report.

Offsite everbearer growers' trials

The results of the offsite growers' trials were reviewed by the EMSBC Board in October 2017 and two selections, EMR693 and EMR704, were progressed to large-scale trials in 2019. The remaining selections (EMR688, EMR701 and EMR710) were deselected due to small fruit size, disease susceptibility and inferior performance respectively. EMR639 which had been in large-scale trials showed a number of positive attributes and its status for commercialisation is still being considered by the EMSBC Board. The performance of each selection that is to be progressed to large-scale offsite trials or possible commercialisation is summarised below:

EMR639

EMR639 was being trialled in large-scale growers' trials. It had a moderate Class 1 yield (mean 838g per plant) with good average size (mean berry weight, 21g). Fruit was glossy and attractive (Figure 10) but had some uneven shapes on some sites. Flesh firmness was good but skin was described as fragile on some occasions. Flavour was pleasant with a good mean Brix score of 8.8°. EMR639 has shown good disease resistance based on initial tests carried out at NIAB EMR, with good resistance to crown rot and powdery mildew, and moderate resistance to powdery mildew.

Progression of this selection towards commercialisation is still under discussion with a decision expected in August 2018.



Figure 10. Fruit of EMR639

EMR693

EMR693 had a good Class 1 yield, with a mean of 1 kilogram per plant and with moderate fruit size (mean berry weight, 19g). Berries were scored highly for appearance, showing uniform shape and colour (Figure 11), with good skin and flesh firmness and pleasant, often sweet flavour although the mean Brix score was 7.9°. Trials at St Truiden, Belgium rated EMR693 the best for fruit quality from their everbearer trial. Retailer and visitor feedback was also excellent, with triallists suggesting that it had clear cultivar potential. Initial disease screening assessments indicate that EMR693 moderately susceptible to Verticillium wilt, intermediate resistance for crown rot and moderately resistant to powdery mildew.

This selection will progress to large-scale growers' trials in 2019.



Figure 11. Fruit of EMR693

EMR704

EMR704 was the highest yielding of the everbearer selections in small-scale offsite trials, with a mean Class 1 yield of 1184 grams per plant, and having the largest fruit size (mean berry weight, 23g). Overall appearance was good (Figure 12), but did vary between sites. Skin and flesh firmness was judged to be good, combined with a pleasant flavour and a high mean Brix score of 9.0°. An early season of production was reported by triallists in Scotland with a flush of large fruit in June 2017. However plants were vigorous, and there was divided opinion on its variety potential. However, on balance, the EMSBC Board agreed to progress it to large-scale commercial trials. Initial disease screening assessments indicate that EMR704 has intermediate resistance to *Verticillium* wilt, but good resistance to crown rot and powdery mildew.

This selection will progress to large-scale growers' trials in 2019.



Figure 12. Fruit of EMR704

Table 6. Main crop (June-bearer) results (standards in *italics*)

Selection	Class 1 yield (g/plant)	% Class 1	% large fruit (>35mm)	Appearance (1-9)	Skin firm (1-9)	Flesh firm (1-9)	Flavour (1-9)	Shelf life score (1-5)	Mean Brix (min-max)	50% pick date	Vigour (1-9)	Density (1-5)	Display (1-3)
EM2248	747	87	75	5.5	5.8	5.8	5.7	3.3	8.4 (5.3-12.3)	5 Jun	6	3	3
EM2434	1681	89	78	5.0	5.4	5.6	5.6	3.5	9.4 (6.4-12.2)	15 Jun	7	3	3
EM2541	898	86	86	5.4	5.9	6.1	5.4	3.0	8.2 (5.3-13.0)	30 May	7	4	2
EM2544	821	89	86	5.7	5.9	5.9	5.9	3.0	9.1 (6.8-11.6)	1 Jun	7	4	2
EM2588	1300	83	61	5.7	6.1	5.9	6.1	3.8	9.9 (7.9-14.5)	12 Jun	6	3	3
EM2622	1307	82	69	5.8	6.1	5.9	5.2	4.0	8.8 (6.0-13.9)	15 Jun	7	3	3
<i>Elsanta</i> ¹	739	80	67	4.7	5.4	5.0	5.0	3.2	8.7 (5.5-13.3)	5 Jun	5	3	3
<i>M. Cent</i>	643	89	80	6.6	6.1	6.1	5.6	4.0	7.7 (5.6-10.4)	5 Jun	7	3	3

¹Mean of three plots

The key to fruit and plant characteristics scores are shown in Appendix I

Table 7. 60-day (June-bearer) trial results (standards in *italics*)

Selection	Marketable yield ¹ (g/plant)	Unmarketable ² yield (g/plant)	% marketable yield	Mean crown diameter (mm)	Marketable (g/plant) yield per mm crown diameter	50% pick date	Brix	
							Mean	Range
EM2181	64.2	39.2	62.1	10.1	6.3	6 July	10.5	(9.1-12.7)
EM2448	82.5	61.5	57.3	9.8	8.4	3 July	8.5	(5.9-13.4)
EM2464	85.0	48.3	63.8	8.9	9.6	29 June	8.7	(6.9-11.1)
EM2483	105.1	77.8	57.5	8.3	12.7	3 July	8.4	(7.0-9.3)
EM2494	74.2	52.0	58.8	8.3	9.0	3 July	9.0	(8.1-10.2)
<i>M Centenary</i>	<i>144.4</i>	<i>41.2</i>	<i>77.8</i>	<i>9.4</i>	<i>15.4</i>	<i>3 July</i>	<i>8.4</i>	<i>(6.7-9.4)</i>

¹ >28 mm

² <28mm & waste

The key to fruit and plant characteristics scores are shown in Appendix I

Table 8. Everbearer trial results (standards in *italics*)

Selection	Class 1 yield (g/plant)	% Class 1	% large fruit (>35mm)	Appearance (1-9)	Skin firm (1-9)	Flesh firm (1-9)	Flavour (1-9)	Shelf life score (1-5)	Mean Brix (min-max)	50% pick date	Vigour (1-9)	Density (1-5)	Display (1-3)
EMR773	1769	71	81	5.3	6.7	7.4	5.3	4.0	8.1 (5.8-13.1)	10 Aug	5	4	3
EMR794	1704	78	75	5.5	5.9	6.4	5.6	3.5	8.5 (6.6-10.9)	21 Aug	5	3	3
EMR797	1358	70	48	5.7	6.1	6.0	5.8	3.0	8.8 (6.4-11.7)	21 Aug	6	3	3
<i>Evie 2</i>	<i>1295</i>	<i>68</i>	<i>61</i>	<i>5.4</i>	<i>5.6</i>	<i>5.6</i>	<i>4.8</i>	<i>2.8</i>	<i>6.7 (4.8-9.0)</i>	<i>21 Aug</i>	<i>6</i>	<i>4</i>	<i>2</i>
<i>Finesse</i>	<i>1326</i>	<i>67</i>	<i>38</i>	<i>5.1</i>	<i>5.9</i>	<i>5.8</i>	<i>5.1</i>	<i>3.5</i>	<i>7.7 (5.8-10.5)</i>	<i>7 Aug</i>	<i>5</i>	<i>4</i>	<i>3</i>
<i>Murano</i>	<i>1014</i>	<i>63</i>	<i>22</i>	<i>5.1</i>	<i>6.2</i>	<i>6.1</i>	<i>5.4</i>	<i>2.7</i>	<i>8.0 (5.7-11.0)</i>	<i>4 Sep</i>	<i>4</i>	<i>3</i>	<i>3</i>

The key to fruit and plant characteristics scores are shown in Appendix I

Conclusions

Main crop (June-bearer) trial

- Six selections, EM2248, EM2434, EM2541, EM2544, EM2588 and EM2622 were identified as being of sufficient interest to progress to growers' trials in 2018 (60-day) and 2019 (main crop). EM2434 had an exceptionally high yield for the trial and high average Brix scores which make it a particularly interesting selection for further assessment.

60-day trial

- Selections in the 60-day trial showed atypical behaviour in the extreme temperatures experienced during the cropping season. Although none of the selections performed better than Malling™ Centenary there was no reason to consider rejecting any at this stage and so selections already considered for assessment in growers' trials in 2018 would continue.

Everbearer trial

- Three new selections, EMR773, EMR794 and EMR797 were identified as being of sufficient interest to progress to growers' trials in 2018, the latter two having very good fruit quality, and the former displaying exceptionally high yield and large fruit size.

Offsite main crop (June-bearer) trials

- Three advanced selections (EM2056, EM2157 and EM2192) were trialled but only EM2157, which had already progressed to commercialisation, would continue to be trialled, the other two selections considered to have been superseded by later selections.

Offsite 60-day (June-bearer) trials

- Three advanced selections, EM2199, EM2380 and EM2421, performed sufficiently well in the 60-day trial to progress to main crop trials in 2018. EM2199 is an early season selection with good flavour and attractive fruit. EM2380 is another early selection with high yield and percentage Class 1 fruit. EM2421 is a large-fruited mid-season selection, with high Brix scores and resistance to powdery mildew.

Offsite everbearer trials

- Two advanced selections, EMR639 and EMR704 will progress to large-scale growers' trials in 2019, both having good fruit quality attributes and some useful disease resistance. EMR639 is still being considered for commercialisation.

Knowledge and Technology Transfer

A joint AHDB/EMRA fruit walk was organised for the 8th June 2016 to allow AHDB levy payers to sample and discuss the latest selections from the EMSBC programme. In addition, AHDB representatives (Rachel McGauley and Louise Sutherland) were able to attend Board meetings (February, August and October), where updates on the programme, trials and selections were made. *Ad hoc* sampling sessions were also carried out to AHDB representatives throughout the summer.

In addition, Adam Whitehouse presented, “Promising selections from the East Malling Strawberry Breeding Club” at the AHDB Soft Fruit Day, NIAB EMR, Kent on 21st November 2017.

Appendices

Appendix I. Scoring system employed for fruit and plant characteristics

Fruit characteristics:

Appearance	3=poor 5=acceptable 7=attractive
Skin Firmness	3=weak 5=acceptable 7=tough
Flesh Firmness	3=soft 5=acceptable 7=firm
Flavour	1=unpleasant 3=poor 5=acceptable 7=pleasant 9=very pleasant

Shelf life:

Comparison to standard	1=Much worse 2=Worse 3=Same 4=Better 5=Much better
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Plant characteristics:

Plant Vigour	1=weak 5=intermediate 9=excessive
Plant Density	1=open 3=intermediate 5=dense
Fruit Display	1=poor 2=intermediate 3=good

Appendix II. Details of spray programme

Main crop (June-bearer) NIAB EMR trial

Date (2017)	Chemical	Target
29-Mar	Corbel	Mildew
29-Mar	Paarat	<i>Phytophthora</i>
29-Mar	Calypso	Aphid
19-Apr	Lunar Sensation	Mildew
19-Apr	Calypso	Aphid
12-May	Fruipica	Mildew/Botritus
12-May	Systhane 20	Mildew
12-May	Teldor	Botritus
12-May	Bandu/Decis	Caterpillar
18-May	Lunar Sensation	Mildew
18-May	PeK Acid	Nutrition
18-May	Maxicrop	Nutrition
27-May	Amistar	Mildew
27-May	Scala/Pryus	Botritus
02-Jun	Signum	Mildew
09-Jun	Fruipica	Mildew/Botritus
09-Jun	PeK Acid	Mildew
09-Jun	Acriff Seaweed	Nutrition
15-Jun	Calypso	Blossom weevil
15-Jun	Nimrod/Maritime	Mildew
15-Jun	Teldor	Botritus
23-Jun	Takumi	Mildew
23-Jun	Rovral	Botritus
30-Jun	Nimrod/Maritime	Mildew
30-Jun	Teldor	Botritus
06-Jul	Rovral	Botritus
06-Jul	Switch/Clayton Gear	Mildew
06-Jul	Hallmark	SWD
06-Jul	Dynamec	Tarsonemid Mite
06-Jul	Activator 90	Wetter
14-Jul	Lunar Sensation	Mildew
14-Jul	PeK Acid	Nutrition
20-Jul	Dynamec	Tarsonemid Mite
27-Jul	Pot Bicarbonate	Mildew
28-Jul	Signum	Mildew/Blackspot
04-Aug	Pot Bicarbonate	Mildew

Appendix II cont. Details of spray programme

Main crop (60-day) NIAB EMR trial

Date (2017)	Chemical	Target
02-Jun	Signum	Mildew
09-Jun	Fruipica	Mildew/Botritus
09-Jun	PeK Acid	Mildew
09-Jun	Acriff Seaweed	Nutrition
15-Jun	Calypso	Blossom weevil
15-Jun	Nimrod/Maritime	Mildew
15-Jun	Teldor	Botritus
23-Jun	Takumi	Mildew
23-Jun	Rovral	Botritus
30-Jun	Nimrod/Maritime	Mildew
30-Jun	Teldor	Botritus
06-Jul	Rovral	Botritus
06-Jul	Switch/Clayton Gear	Mildew
06-Jul	Hallmark	SWD
06-Jul	Dynamec	Tarsonemid Mite
06-Jul	Activator 90	Wetter
14-Jul	Lunar Sensation	Mildew
14-Jul	PeK Acid	Nutrition
20-Jul	Dynamec	Tarsonemid Mite
27-Jul	Pot Bicarbonate	Mildew
28-Jul	Signum	Mildew/Blackspot
04-Aug	Pot Bicarbonate	Mildew
08-Aug	Topas/Topenco	M
15-Aug	Pot Bicarbonate	Mildew
18-Aug	Bravo 500	Mildew
24-Aug	Lunar Sensation	Mildew
24-Aug	PeK Acid	Nutrition
24-Aug	Hallmark	SWD
01-Sep	Switch/Clayton Gear	Mildew
01-Sep	Rovral	Botritus
01-Sep	PeK Acid	Nutrition
01-Sep	Benevia 100D	SWD
08-Sep	Pot Bicarbonate	Mildew
22-Sep	Pot Bicarbonate	Mildew

Appendix II cont. Details of spray programme

Everbearer NIAB EMR trial

Date (2017)	Chemical	Target
06-Apr	Fenomenal	<i>Phytophthora</i>
19-Apr	Lunar Sensation	Mildew
19-Apr	Calypso	Aphid
12-May	Fruipica	Mildew/Botritus
12-May	Systhane 20	Mildew
12-May	Teldor	Botritus
12-May	Bandu/Decis	Caterpillar
18-May	Lunar Sensation	Mildew
18-May	PeK Acid	Nutrition
18-May	Maxicrop	Nutrition
27-May	Amistar	Mildew
27-May	Scala/Pryus	Botritus
02-Jun	Signum	Mildew
09-Jun	Fruipica	Mildew/Botritus
09-Jun	PeK Acid	Mildew
09-Jun	Acriff Seaweed	Nutrition
15-Jun	Calypso	Blossom weevil
15-Jun	Nimrod/Maritime	Mildew
15-Jun	Teldor	Botritus
23-Jun	Takumi	Mildew
23-Jun	Rovral	Botritus
30-Jun	Nimrod/Maritime	Mildew
30-Jun	Teldor	Botritus
06-Jul	Rovral	Botritus
06-Jul	Switch/Clayton Gear	Mildew
06-Jul	Hallmark	SWD
06-Jul	Dynamec	Tarsonemid Mite
06-Jul	Activator 90	Wetter
14-Jul	Lunar Sensation	Mildew
14-Jul	PeK Acid	Nutrition
20-Jul	Dynamec	Tarsonemid Mite
27-Jul	Pot Bicarbonate	Mildew
28-Jul	Signum	Mildew/Blackspot
04-Aug	Pot Bicarbonate	Mildew
08-Aug	Topas/Topenco	Mildew
15-Aug	Pot Bicarbonate	Mildew
18-Aug	Bravo 500	Mildew
01-Sep	Switch/Clayton Gear	Mildew
01-Sep	Rovral	Botritus
01-Sep	PeK Acid	Nutrition
01-Sep	Benevia 100D	SWD
08-Sep	Pot Bicarbonate	Mildew
22-Sep	Pot Bicarbonate	Mildew