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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

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Date 8th June 2017

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GROWER SUMMARY

Headline

 Six new selections, four June-bearers and two everbearers, were selected from the 2016 East Malling Strawberry Breeding (EMSBC) preliminary trials to go forward to UK growers' trials.

Background

The main objective of the East Malling Strawberry Breeding Club (EMSBC) strawberry breeding programme is to develop improved strawberry varieties, both June-bearing and ever-bearing 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 had delivered the June-bearer variety Malling[™] Centenary. AHDB continues to contribute to the EMSBC via project SF 96a.

This report covers three preliminary trials held at NIAB-EMR in 2016 that are partfunded 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 EMSBC growers' sites.

Results of selection trials

Descriptions and results from the most promising selections in each of the 2016 trials are provided below and are accompanied by tables of results for each preliminary trial:

June-bearer (main crop) trial

Four selections were considered for assessment in growers' trials in 2018/19; descriptions and data for each selection appear below and in Tables 1 and 2:

EM2448 – a very-early season type with a 50% pick date comparable to Clery. Fruit size was good (57% >35mm), with a moderate yield but an excellent percentage of Class 1 fruit (91%). Berries were attractive, with good shelf-life and judged to have better flavour than both of the early standards (Clery and Vibrant).

EM2464 - has potential as an early season variety, with a 50% pick date slightly earlier than Vibrant. A good Class 1 yield (683g/plant) of attractive fruit, with very little grade out (96% Class 1) was produced. Fruit size was good (60% >35mm) and berries showed excellent shelf-life. This selection showed sufficient promise to be fast-tracked to **large-scale growers' trials** in 2018.

EM2483 - an early-mid season selection with a very high yield for this trial (1.3kg/plant) combined with excellent fruit size (73% >35mm). Berries were very attractive with good colour and shelf-life but were marked down for some uneven shapes on the first pick.

EM2494 - a mid-late season type, producing very attractive fruit a few days later than Elsanta which also performed very well in shelf-life tests. Yield was high for this trial (1kg/plant), and combined with good fruit size (57% >35mm) and a high percentage Class 1 (90%), makes this an interesting selection for further assessment.

Selection	Class 1 yield	% Class 1	% large fruit	50% pick date
	(g/plant)		(>35mm)	
EM2448	473	91	57	16 Jun
EM2464	683	96	60	16 Jun
EM2483	1276	89	73	20 Jun
EM2494	1048	90	57	27 Jun
Elsanta ¹	925	75	44	23 Jun
<i>M.</i> Centenary ²	676	91	63	20 Jun

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

¹Mean of three plots

²Mean of two plots

Selection	Appearance	Skin	Flesh	Flavour	Shelf	Mean
	(1-9)	firmness	firmness	(1-9)	life	Brix
		(1-9)	(1-9)		(1-5)	
EM2448	5.4	6.0	5.6	5.7	3.0	7.9
EM2464	5.6	5.7	5.7	5.6	4.3	7.9
EM2483	4.9	5.5	5.6	5.2	3.6	7.7
EM2494	6.1	6.3	6.3	5.6	3.0	8.0
Elsanta ¹	4.6	5.8	5.2	5.4	2.7	7.9
M. Centenary ²	6.1	6.3	6.2	6.0	2.9	8.7

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

¹Mean of three plots

²Mean of two 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) trial

This trial included selections that have progressed for assessment in growers' trial in 2017 or to be retrialled. Summarised data from the trial is shown in Table 3. Two selections showed good potential in the 60-day (programmed cropping system):

EM2199 - an early-mid season selection, which was comparable to Sonata in terms of yield and plant size, and Malling Centenary when considering yield per mm of crown. It had a high % Class 1 for this trial (79%) and had an early 50% pick date, ahead of Malling Centenary. Fruit was considered to be very attractive with good colour and gloss throughout the season.

EM2421 - a mid-late season selection that gave a marketable yield that was similar to Elsanta but with a higher % Class 1, more comparable to Malling Centenary. The

mean Brix score was also very high (9.8°). These results correlate well with its performance in main crop production in 2015.

Selection	Marketable yield ¹ (g/plant)	% marketable yield	Mean crown diameter (mm)	Marketable (g/plant) yield per mm crown diameter	50% pick date
EM2199	130.0	79.0	9.1	14.3	14 Jul
EM2370	72.1	60.0	11.8	6.1	11 Jul
EM2380	96.4	69.9	11.1	8.7	18 Jul
EM2421	115.9	72.7	9.6	12.1	28 Jul
Elsanta ²	113.2	62.6	12.1	9.5	22 Jul
М	144.9	73.8	10.4	14.1	18 Jul
Sonata ²	136.7	60.4	9.5	14.6	22 Jul

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

¹ >28 mm

² mean of two plots

Everbearer trial

Two new selections were considered for assessment in growers' trials in 2018. Data (Table 4 & 5) and descriptions are shown below:

EMR722 - an early season everbearer selection, with a moderate yield (649g/plant) but excellent fruit size (71% >35mm) and high % Class 1 (84%) as well as a high mean Brix score (9.1°). Fruit quality was very good, with good flavour combined with good firmness (Table 5).

EMR721 - had very good fruit size (63% >35mm) and high percentage of Class 1 fruit (80%). Berries were glossy, a pleasant flavour and good mean Brix score (8.1°) and appeared to be mildew resistant.

Selection	Class 1	% Class 1	% large fruit	50% pick date
	yield		(>35mm)	
	(g/plant)			
EMR722	649	84	71	1 Aug
EMR721	7999	80	63	8 Aug
Evie 2	908	63	66	11 Aug
Finesse	889	76	42	15 Aug
M. Star	815	70	50	1 Aug

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

Table 5. Everbearer selections. Fruit quality scores

Selection	Appearance	Skin	Flesh	Flavour	Shelf life	Mean
		firmness	firmness	(1-9)	(1-5)	Brix
		(1-9)	(1-9)			
EMR722	5.3	6.4	6.6	5.6	2.0	9.1
EMR721	5.5	6.2	6.3	5.6	1.0	8.5
Evie 2	5.2	5.5	5.5	5.0	1.6	6.3
Finesse	5.4	6.4	6.2	4.9	3.5	7.3
M. Star	5.6	6.1	6.1	5.9	2.8	9.0

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

Five advanced selections (EM1974, EM2290, EM2298, EM2315, and EM2320) were trialled but none will progress to further trials.

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

Three advanced selections, EM2192, EM2056 and EM2157, performed sufficiently well in the 60-day trial to progress to main crop trials in 2017, with EM2157 also being fast tracked towards commercialisation with first commercial sales expected in 2018/19.

EM2192 - is an early selection, with a season similar to Vibrant, but with glossy, brighter berries and also showing resistance to crown rot.

EM2056 - is a mid-late selection producing large, well-displayed fruit and has good all round disease resistance.

EM2157 - is a late 'Malling Centenary'-type selection, having a season similar to 'Florence' but with better fruit size, Brix scores, appearance and plant habit.

Offsite everbearer growers' trial

Two advanced selections, EMR564 and EMR635 will progress to further trialling, both having good fruit quality attributes and disease resistance. EMR564 has been put forward for commercialisation with first commercial sales expected in 2018/19, and EMR635 will progress to large-scale growers' trials in 2018/19.

EMR564 - has an early season of production with a high Class 1 yield and large fruit size. Fruit was glossy and attractive with very uniform colour, firm skin and very firm flesh. Flavour was judged to be pleasant with an average Brix score of 7.9°. Fruit was displayed on long trusses. Initial assessments indicate that EMR564 shows resistance to crown rot and Verticillium wilt, with moderate resistance to mildew.

EMR635 - a high-yielding everbearer with excellent fruit size and a high percentage of Class 1 fruit. Fruit was well-displayed, with an attractive appearance and slightly aromatic flavour. Initial assessments indicate that EMR635 shows resistance to mildew and crown rot.

Main conclusions

Six new selections, four June-bearers and two everbearers, were selected from the 2016 East Malling Strawberry Breeding (EMSBC) preliminary trials to go forward to UK growers' trials. Of the four June-bearers; two were early selections, one was early-mid season and the fourth was a mid-late season type. All will be trialled on UK growers' sites in 2018/19. In addition, 16 advanced selections were trialled on growers' sites, with five of these progressing to further trials and two selections, a late June-bearer and an everbearer, have been identified to go forward for commercialisation.

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 2016 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 HDC 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. The funding members of the EMSBC are currently Berry Gardens Growers, CPM Retail, East Malling Services, AHDB, Mack Multiples and Meiosis. The AHDB continues to contribute to the EMSBC 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 dahlia*e), powdery mildew and *Phytophthora* species (as part of a linked BBSRC IDRIS project).

Trial methods

All trials were performed on the Ditton Rough 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, 25kh/ha per week from fruiting) and alleys strawed. These trials were covered prior to flowering with polythene clad tunnels for rain protection and also with netting against bird damage (see photo, Appendix IV). A standard spray programme was followed for each trial the details of which appear 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 the Appendices. 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 handheld refractometer. The mean score for each selection across the season are presented.

Shelf-life tests were performed on a ten unblemished fruit that were sampled once a week from each selection. 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 Appendices. The mean scores for each selection across the season are presented

Main crop (June-bearer) trial

The main crop trial contained 89 new selections, 17 advanced, re-cycled or re-trialled selections and ten industry/season standard cultivars (including Elsanta, Fenella, Sonata, MallingTM Centenary, and Vibrant). It was established from misted tips planted on 4 August 2015. Plots consisted of a maximum of six plants per selection, with the exception of re-trialled/recycled selections or standards which were replicated as either two (2x six plants) or three (3x six plants) plots.

60-day trial

The 60-day trial included three advanced selections, one retrial and three standards (Elsanta, Sonata and Malling[™] Centenary). The trial was established using bare root cold stored runners planted on 20 May 2016. Plots consisted of maximum of ten plants per selection, with the exception of standards which were replicated as two (2x ten plants) plots.

Everbearer trial

The everbearer trial contained 36 new selections, and five advanced selections, plus standard cultivars (Finesse, Evie 2 and Malling[™] Star). It was established from potted plants derived from pinned down tips, taken in August 2015, and planted on 13 April 2016. Plants were de-blossomed during the second week of May and harvesting began on 30 June 2016 and continued twice weekly until 29 September 2016. Plots were of maximum of ten plants per selection, with the exception of re-trialled/recycled selections or standards.

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 and results for these trials are presented.

Offsite main crop (June-bearer) growers' trials

Five advanced selections (EM1974, EM2290, EM2298, EM2315, and EM2320) were assessed in main crop trials on six UK growers' sites in 2016 having first been assessed as 60-day plants in 2015. All plantings were in substrate, with five trials assessed under polythene-clad tunnels and one under glasshouse. EM1974 was being assessed in large-scale trials (1000 tray plants per site) having being selected for growers' trials in 2010, and the remaining selections in small-scale trials (60 tray plants per site) having been selected for growers' trials in 2013.

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

Five advanced selections (EM2056, EM2157, EM2192, EM2206, and EM2358) were assessed in 60-day trials on five UK growers' sites in 2016. All plantings were in substrate, with four trials assessed under polythene-clad tunnels and one under glasshouse. EM2056 was being assessed in large-scale trials (1000 tray plants per site) having being selected for growers' trials in 2011, and the remaining selections in small-scale trials (60 tray plants per site) having been selected for growers' trials in 2014.

Offsite everbearer growers' trials

Six advanced selections (EMR564, EMR590, EMR635, EMR644, EMR645, and EMR647) were assessed in everbearer trials on five UK growers' sites in 2016. All plantings were in substrate, with four trials assessed under polythene-clad tunnels and one under glasshouse. EMR590 and EMR564 were being assessed in large-scale trials (1000 tray plants per site) having being selected for growers' trials in 2011, and the remaining selections in small-scale trials (60 tray plants per site) having been selected for growers' trials in 2014.

Results and Discussion

Main crop (June-bearer) trial

The planting was completed on schedule and the majority of plants appeared to have established well by early autumn 2015 in mild but wet conditions. By spring 2016 a few of the 6-plant plots were showing uneven vigour with five plots having very weak plants which were removed and will be re-trialled in 2017. Yields on all the standards were lower than normal which may have been attributed to lack of chill in mild winter conditions; combined with lower average fruit size of some of the standards.

Despite a mild winter and predictions of an early season, the poor weather in late spring led to a later season than 2015 with the first harvests on early lines on June 6th and the first significant harvests from Elsanta on June 20th. The early part of the season was fairly condensed with an overlap of early and mid-season lines, but harvesting continued on some very late lines until July 28th.

The weather during the main fruiting period was very poor, with daily rainfall which at times was torrential. This combined with poor light levels contributed to Brix levels that were below average and on many harvests the flavour was weak and rather bland, making it difficult to distinguish between selections for sensory eating quality.

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 four new selections for UK growers' trials in 2018/19. These selections were:

EM2448 (early season)

This selection had a moderate Class 1 yield (473g per plant), but had an early season, comparable to Flair and slightly ahead of Vibrant (Figure 1.b.). It was characterised by good fruit size (57% >35 mm) and a high percentage of Class 1 fruit (91%). Skin and flesh firmness were shown to be much firmer than Elsanta and berries were attractive and glossy, with a regular shape and a much better skin colour than Vibrant (Figure 1.a) that was retained during shelf-life tests. Sensory flavour scores were judged to be better than Vibrant and Elsanta, although average Brix scores were similar to Elsanta (Table 6). Plant habit and vigour were similar to Vibrant.



Figure 1.a. Fruit of EM2448



Figure 1.b. Cropping profile of EM2448

EM2464 (Early season)

EM2464 had a moderately high yield for an early season selection, with very high percentage of Class 1 and very good fruit size. (Table 6). Its season was slightly earlier than Vibrant (Figure 2.b.). Plants had a good habit for tunnel production, displaying moderate vigour and with a good fruit display. Berries were attractive, with a uniform mid-red good colour and very glossy, although seeds were slightly sunken (Figure 2.a.). Both skin and flesh firmness were good, and the fruit performed very well in shelf life tests. Brix scores were slightly higher than Vibrant although sensory flavour scores were judged to be similar (Table 6).



Figure 2.a. Fruit of EM2464



Figure 2.b. Cropping profile of EM2464

EM2483 (Early-mid season)

This selection had a very high yield for this trial with excellent fruit size and good percentage of Class 1 fruit (Table 6). It had an early season, similar to Vibrant (Figure 3.b.). Plants were slightly more vigorous than Vibrant but with similar fruit display. Berries were very attractive with good colour but with some uneven-shaped fruit on the first pick (Figure 3.a.). Fruit had both good skin and flesh firmness with shelf-life scores similar to the standards. Flavour was initially considered to be weak but improved as the season progressed, however Brix scores was very variable but which gave an average score similar to Vibrant.



Figure 3.a. Fruit of EM2483



Figure 3.b. Cropping profile of EM2483

EM2494 (mid-late season)

EM2494 gave a moderately high Class 1 yield with good fruit size and high percentage of Class 1 (Table 6). Cropping season was a few days later than Elsanta (Figure 4.b.). Plant vigour was found to be variable within the plot but fruit was always well displayed. Berries had a very uniform conic shape, with slightly sunken seeds and a large calyx on early picks (Figure 4.a.). Skin and flesh firmness scores were good, and fruit performed well in shelf life tests (Table 6). Sensory flavour scores improved over the season with Brix scores similar to Elsanta.



Figure 4.a. Fruit of EM2494



Figure 4.b. Cropping profile of EM2494

60-day trial

The trial established well but plants grew away slowly in cool and wet conditions in June. Marketable yields produced from standards were lower than average from EMR 60-day trials, partly as a consequence of change in grading to form 25mm to 28mm minimum to bring grading in line with commercial practise as requested by the EMSBC Board. Harvesting commenced on July 11th, and fruit was picked and recorded twice weekly until August 30th 2016. The results of the trial are shown in Table 7.

The selections tested, with exception of EM2370 which is to be re-trialled, had been selected in 2015 to go forward for UK growers' trials in 2017, and a summary of their performance as 60-day plants is shown below:

EM2199, performed well in the 60-day system, being comparable to Sonata in terms of yield and plant size, and Malling Centenary when considering yield per mm of crown. It had a high % Class 1 for this trial (79%) and had an early 50% pick date, ahead of Malling Centenary. However, the mean Brix scores were the lowest in the trial, matching those recorded when it was assessed in main crop trial. Fruit was considered to be very attractive with good colour and gloss (Figure 5) throughout the season.



Figure 5. Fruit of EM2199

Although **EM2370** had a very early 50% pick date, a very high mean Brix score (10.6°) and relatively large average crown size, it showed little potential in terms of yield, having the lowest marketable yield and yield per mm of crown combined with

the lowest % Class 1. Even when considering total yield per plant it still yielded less than the marketable yield of some of the standards and selections. This is in contrast to the main crop trial results where it gave a high marketable yield and low Brix scores. In addition mildew was noted on fruit from mid-August.



Figure 6. Fruit of EM2370

EM2380 also performed poorly, with a relatively low yield despite having a large average crown size. The 50% pick date and mean Brix scores were very similar to Malling Centenary; the yield in all categories was inferior to the standards. However fruit quality was very good, with glossy, regular-shaped fruit and good flavour.



Figure 7. Fruit of EM2380

EM2421 had the latest 50% pick date of all the selections and standards in the trial. It gave a marketable yield that was similar to Elsanta from a relatively small crown size but with a higher % Class 1, comparable to Malling Centenary. The mean Brix score was also very high (9.8°). These results, with exception of the late season (midseason in main crop) correlate well with its performance in main crop production. Fruit was noted as having reflexed calyxes on a number of occasions.



Figure 8. Fruit of EM2421

The EMSBC Board agreed that those selections already selected for assessment in growers' trials in 2017/18 should continue based on these trial results.

Everbearer trial

Trial plants established well after planting and developed well. Wet, cool weather from mid-August led a decrease in percentage Class 1 fruit due to an outbreak of powdery mildew, but this was brought under control in early-September and warm day temperatures in the latter part of that month allowed picking to continue until September 28th.

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

EMR721

This selection had a moderately high yield (799 g/plant) with good fruit size (63% >35mm) and a high percentage of Class 1 fruit (80%). Berries were glossy, with a regular, slightly elongated conic shape but with sunken seeds (Figure 9.a.). Skin and flesh firmness were good, although this was not reflected in the single shelf-life test that was conducted where it was marked down for rots. Flavour was pleasant, often described as 'watery sweet' but with a good mean Brix score (8.5°). Plants were more vigorous than 'Finesse' but appeared disease free with no mildew. The plants were also shy to produce runners. The cropping profile for EMR721 is shown in Figure 9.b.



Figure 9.a. Fruit of EMR721



Figure 9.b. Cropping profile of EMR721

EMR722

EMR722 is an early season everbearer selection (Figure 10.b.), with a moderate yield (649g/plant), excellent fruit size (71% >35mm) and high percentage of Class 1 fruit (84%). The fruit was glossy with a pale-red skin colour (Figure 10.a.), but occasionally had white necks and was displayed very well on the plant. This selection was only scored once for shelf-life and was found to have soft rots which gave it an inferior score to the standard despite having very good firmness scores at harvest. Flavour was slightly variable throughout the season but generally judged to be pleasant, with high Brix (9.1°). Plant vigour was similar to 'Finesse' but showed some susceptibility to mildew, and had low-moderate runnering ability.



Figure 10.a. Fruit of EMR722



Figure 10.b. Cropping profile of EMR722

Offsite main crop (June-bearer) growers' trials

The EMSBC Board decided not to progress any of the selections from this trial further trialling or commercialisation. Although fruit quality attributes from many of these selections was very good, susceptibility to diseases and reduced yields were evident.

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

The results of the offsite growers' trials were reviewed by the EMSBC Board in October 2016 and it was agreed that three selections (EM2056, EM2157 and EM2192) trialled should continue in main crop trials in 2017, with EM2157 also being fast tracked towards commercialisation. A summary of the performance of each of the selections across all trial sites is given below:

EM2056

EM2056 is a mid-late season selection. Fruit was judged to be attractive, being glossy with a uniform conic shape, and pale-red/orange skin colour. Mean Brix was 9.0° cf. 8.6° with Elsanta, although flavour scores varied across sites. Mean fruit size (18.8g cf. 16.8g with Elsanta) and percentage Class 1 (90%) were both good, and fruit was very well displayed and easy to pick. However, the mean Class 1 yield was lower than Elsanta (281g/plant cf. 372g/plant for Elsanta). Initial assessments indicate that EM2056 has resistance to crown rot and Verticillium wilt, and intermediate resistance to mildew.

This selection will continue to be assessed in large-scale offsite main crop growers' trials in 2017.



Figure 11(a). Fruit of EM2056



Figure 11(b). Plants of EM2056

EM2157

This late selection (50% harvest date 6 days later in Kent, 9 days later in Perth than Elsanta) gave the highest mean Class 1 yield (442 g/plant cf. 372 g/plant for Elsanta) and percentage of Class 1 fruit (mean 92%) of all of the selections trialled in the 60-day offsite trials in 2016. It was noted for its large mean fruit size (21.1g cf. 16.8g for Elsanta), attractive appearance, although some primary berries were creased and good flavour scores and high mean Brix (9.1°, range 8.4-10.4°). Fruit was firm but with some bruising post-harvest was noted on some sites. Initial assessments indicate that EM2157 has no strong resistance to wilt, has some susceptibility to powdery mildew and crown rot.

This selection will progress to <u>commercialisation</u> with first commercial sales expected in 2018/19. It will continue to be assessed in offsite main crop growers' trials in 2017.



Figure 12(a). Fruit of EM2157



Figure 12(b). Plants of EM2157

EM2192

An early selection (50% harvest date 11 days earlier in Kent than Elsanta) with a mean Class 1 yield similar to Elsanta. Average fruit size was slightly smaller than Elsanta (15.5g cf. 16.8g for Elsanta), but it had a glossy, firm, regular conic shape although a bit dark on some sites. Flavour scores were variable between sites but average mean Brix was 8.0° (range 7.1°-8.9°). Initial assessments indicate that EM2192 has some susceptibility to powdery mildew (noted on one site) but resistance to crown rot.

This selection will continue to be assessed in offsite main crop growers' trials in 2017.



Figure 13(a). Fruit of EM2192



Figure 13(b). Plants of EM2192

Offsite everbearer growers' trials

The results of the offsite growers' trials were reviewed by the EMSBC Board in October 2016 and two selections, EMR564 and EMR635, were retained for commercialisation and further trialling respectively:

EMR564

EMR564 was being trialled in large-scale growers' trials. It had an early season of production, with a high Class 1 yield (mean 935g/plant) and large fruit size (mean berry weight, 24g/plant). Fruit was glossy and attractive with very uniform colour. Apart from some irregular king berries, the shape and colour were very uniform (Figure 14(a)) and had firm skin and very firm flesh. Flavour was judged to be pleasant with an average Brix score of 7.9°. Fruit was displayed on long trusses. Initial assessments indicate that EMR564 shows resistance to crown rot and Verticillium wilt, and moderate resistance to mildew.

This selection will progress to <u>commercialisation</u> with first commercial sales expected in 2018/19.



Figure 14(a). Fruit of EMR564



Figure 14(b). Plants of EMR564

EMR635

EMR635 was the highest yielding of the everbearer selections in small-scale offsite trials, with a mean Class 1 yield of 987grams per plant cf. 826g/plant Finesse. Fruit size was also good with a mean berry weight of 24gcf. 18.2g from Finesse and a good percentage of Class 1 fruit (mean of 80%). Fruit was well-displayed, with an attractive appearance (Figures 15 (a) and (b)), although primary berries were often creased. Mean Brix from all sites was 8.2°, with flavour judged to be good, with some aroma, although there was some variation across sites. Flesh and skin firmness were better than the standard (Finesse), although some bruising was noted after storage. Initial assessments indicate that EMR635 shows resistance to mildew and crown rot.

This selection will progress to large-scale growers' trials in 2018.



Figure 15(a). Fruit of EMR635



Figure 15(b). Plants of EMR635

Selection	Class 1	%	% large	Appeara	Skin	Fles	Flavo	Shelf life	Mean Brix	50% pick	Vigo	Densi	Displ
	yield	Class 1	fruit	nce	firm	h	ur	score	(min-max)	date	ur	ty	ay
	(g/plant)		(>35mm)	(1-9)	(1-9)	firm	(1-9)	(1-5)			(1-9)	(1-5)	(1-3)
						(1-9)							
EM2448	473	91	57	5.4	6.0	5.6	5.7	3.0	7.9 (5.0-10.1)	16 Jun	5	3	3
EM2464	683	96	60	5.6	5.7	5.7	5.6	4.3	7.9 (5.7-10.6)	16 Jun	5	3	3
EM2483	1276	89	73	4.9	5.5	5.2	5.2	3.6	7.7 (5.8-11.0)	20 Jun	6	3	3
EM2494	1048	90	57	6.1	6.3	5.6	5.6	3.0	8.0 (6.5-10.3)	27 Jun	5	3	3
Elsanta ¹	925	75	44	4.6	5.8	5.2	5.4	2.7	7.9 (5.4-13.2	23 Jun	6	4	3
M. Cent ²	676	91	63	6.1	6.3	6.2	6.0	2.9	8.7 (6.0-12.0)	20 Jun	6	3	2
Flair	599	87	47	5.3	5.7	5.6	5.5	3.7	8.9 (7.1-11.8)	13 Jun	6	3	2
Elegance	1023	75	43	5.6	6.5	6.3	4.9	3.8	7.4 (4.8-11.6)	27 Jun	6	4	2
Vibrant ²	668	94	54	5.2	5.7	5.5	5.6	3.3	7.7 (4.0-10.4)	20 Jun	5	3	3

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

¹Mean of three plots

²'Mean of two plots

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

Selection	Marketable	ble		Mean crown	Marketable		Brix	
	yield ¹ (g/plant)	Unmarketable ² yield (g/plant)	% marketable yield	diameter (mm)	(g/plant) yield per mm crown diameter	50% pick date	Mean	Range
EM2199	130.0	34.6	79.0	9.1	14.3	14 July	7.5	(5.4-8.6)
EM2370	72.1	48.0	60.0	11.8	6.1	11 July	10.6	(8.0-15.4)
EM2380	96.4	41.6	69.9	11.1	8.7	18 July	8.3	(5.0-10.3)
EM2421	115.9	43.6	72.7	9.6	12.1	28 July	9.8	(8.8-11.0)
Elsanta ³	113.2	70.9	62.6	12.1	9.5	22 July	9.2	(7.5-10.7)
M Centenary	144.9	49.1	73.8	10.4	14.1	18 July	8.4	(6.1-9.9)
Sonata ³	136.7	89.9	60.4	9.5	14.6	22 July	9.4	(6.6-13.4)

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

¹ >28 mm

² < 28mm & waste

³ mean of two plots

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

Selection	Class 1	%	% large	Appeara	Skin	Fles	Flavo	Shelf life	Mean Brix	50% pick	Vigo	Densi	Displ
	yield	Class	fruit	nce (1-9)	firm	h	ur	score	(min-max)	date	ur	ty	ay
	(g/plant)	1	(>35mm)		(1-9)	firm	(1-9)	(1-5)			(1-9)	(1-5)	(1-3)
						(1-9)							
EMR721	799	80	63	5.5	6.2	6.3	5.6	1.0 ¹	8.5 (6.6-11.1)	8 Aug	6	3	3
EMR722	649	84	71	5.3	6.4	6.6	5.6	2.0	9.1 (7.7-11.9)	1 Aug	4	3	3
Evie 2	908	63	66	5.2	5.5	5.5	5.0	1.6	6.3 (5.0-7.5)	11 Aug	7	3	2
Finesse	889	76	42	5.4	6.4	6.2	4.9	3.5	7.3 (5.7-10.7)	15 Aug	4	3	3
M. Star	815	70	50	5.6	6.1	6.1	5.9	2.8	9.0 (6.8-12.4)	1 Aug	5	3	3

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

¹ Shelf life score for this selection is based on a single assessment and is low due to incidences of rots

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

Conclusions

Main crop (June-bearer) trial

Four new selections, EM2448, EM2464, EM2483 and EM2494 were identified as being
of sufficient interest to progress to growers' trials in 2018 (60-day) and 2019 (main crop).
 EM2464 shows most promise as an early cultivar and will be fast-tracked to large-scale
trials in 2018.

60-day trial

Two selections, EM2199 and EM2421 showed the greatest potential in the 60-day system, having a comparable or greater marketable yield (grams per plant) to Elsanta, and with a higher percentage of Class 1 fruit. Both selections had desirable fruit quality attributes: EM2199 being very attractive with good colour and gloss, and EM2421 having a very high mean Brix score (9.8°). Both of these selections will be assessed further in growers' trials (60-day) in 2017.

Everbearer trial

• Two new selections, EMR721 and EMR722 were identified as being of sufficient interest to progress to growers' trials in 2018, both having good flavour and Brix levels, and the former displaying good tolerance to powdery mildew.

Offsite main crop (June-bearer) trial

• Five advanced selections (EM1974, EM2290, EM2298, EM2315, and EM2320) were trialled but none will progress to further trials.

Offsite 60-day (June-bearer) trial

 Three advanced selections, EM2056, EM2157 and EM2192, performed sufficiently well in the 60-day trial to progress to main crop trials in 2017, with EM2157 also being fast tracked towards commercialisation with first commercial sales expected in 2018/19. EM2056 is a mid-late selection producing large, well-displayed fruit and as good all round disease resistance. EM2157 is a late 'Malling Centenary' type selection, having a season similar to 'Florence' but with better fruit size, appearance and plant habit. EM2192 is an early selection, with a season similar to Vibrant, but with glossy, brighter berries and also showing resistance to crown rot.

Offsite everbearer trial

 Two advanced selections, EMR564 and EMR635 will progress forward further trialling, both having good fruit quality attributes and disease resistance. EMR564 has been put forward for commercialisation with first commercial sales expected in 2018/19, and EMR635 will progress to large-scale growers' trials in 2018/19.

Knowledge and Technology Transfer

A joint HDC/EMRA fruit walk was organised for the 16 June 2016 to allow AHDB levy payers to sample and discuss the latest selections from the EMSBC programme. This was hosted by Adam Whitehouse and was the best attended AHDB Fruit Walk in a number of years. A recording for the BBC Radio 4 'Farming Today' programme was also made at this meeting, and included interviews with both the strawberry breeding team and key growers, and was broadcast on 5 July 2016. In addition AHDB representatives (Rachel Lockley and Louise Sutherland) were able to attend an EMSBC Board meetings and *ad hoc* sampling throughout the summer. Updates on the programme, trials and selections were also made to AHDB representatives at the EMSBC Board meetings in August and October 2016 and January 2017.

In addition, Adam Whitehouse presented, "Progress in Strawberry Breeding at NIAB-EMR" as well as a poster entitled, "Malling Centenary, a short-day cultivar from NIAB-EMR" to an international audience at the 8th International Strawberry Symposium, Quebec, Canada on 14 August 2016.

Appendices

Appendix I. Scoring system employed for fruit and plant characteristics

Fruit characteristics:

Appearance	3=poor
	5=acceptable
	7=attractive
Skin Firmnoss	3-wook
OKITT IIIIII033	5-accentable
	7-tough
	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
	0 \// area

2=Worse
3=Same
4=Better
5=Much better

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) trial

Date	Chemical	Active ingredient	Rate per litre	Unit	Target
28/08/2015	Paarat	Dimethomorph	3	litre	crown rot
28/08/2015	Stroby	Kresoxim-methyl	0.3	litre	mildew
12/02/2016	Sluxx	Methaldehyde	7	kg	Slugs
22/03/2016	Captan 80 WG	Captan	2	kg	Botrytis
27/03/2016	Equity	Chlorpyrifos	1.5	litre	Aphid
29/04/2016	Corbel	Fenpropimorph	1	litre	Mildew
29/04/2016	PeKacid	Phosphorous/Potassium	5	Kg	Nutrition/mildew
29/04/2016	Maxicrop	Seaweed	2	litre	Nutrition
06/05/2016	Corbel	Fenpropimorph	1	litre	Mildew
06/05/2016	PeKacid	Phosphorous/Potassium	5	Kg	Nutrition/mildew
12/05/2016	Systhane 20	Myclobutanil	0.45	litre	Mildew
20/05/2016	Amistar	Azoxystrobin	1	litre	Mildew
20/05/2016	Teldor	Fenhexamid	1	litre	Botrytis
27/05/2016	Signum	Boscalid + pyraclostrobin	1.8	kg	Mildew
27/05/2016	PeKacid	Phosphorous/Potassium	5	Kg	Nutrition/mildew
10/06/2016	Fruipica	Mepanipyrim	0.6	litre	Botrytis
10/06/2016	Teldor	Fenhexamid	1.5	kg	Botrytis
22/06/2016	Kindred	Meptyldinocap	0.6	litre	Mildew
22/06/2016	PeKacid	Phosphorous/Potassium	5	Kg	Nutrition/mildew
24/06/2016	Pyrus	Azoxystrobin	2	litre	Mildew
01/07/2016	Nimrod	Bupirimate	1.4	litre	Mildew
01/07/2016	Teldor	Fenhexamid	1.5	kg	Botrytis
01/07/2016	Calypso	Thiacloprid	0.25	litre	Capsid
08/07/2016	Scala	Pyrimethanil	2	litre	Mildew
08/07/2016	PeKacid	Phosphorous/Potassium	5	Kg	Nutrition/mildew
15/07/2016	Systhane 20	Myclobutanil	0.45	litre	Mildew
15/07/2016	Teldor	Fenhexamid	1.5	Kg	Botrytis
15/07/2016	Calypso	Thiacloprid	0.25	litre	Capsid
22/07/2016	Topas	Penconazole	0.5	litre	Mildew
28/07/2016	Amistar	Azoxystrobin	1	litre	Mildew
28/07/2016	Systhane 20	Myclobutanil	0.45	litre	Mildew
05/08/2016	Dynamec	Abemectin	0.5	litre	Tarsonemid mite
05/08/2016	Systhane 20	Myclobutanil	0.45	litre	Mildew
12/08/2016	Topas	Penconazole	0.5	litre	Mildew
19/08/2016	Frupica	Mepanipyrim	0.6	litre	Botrytis

Appendix II (continued). Details of spray programme

60-day (June-bearer) trial

Date	Chemical	Active ingredient	Rate per litre	Unit	Target
06/05/2016	Aphox	Pirimicarb	0.56	kg	Aphid
06/05/2016	Corbel	Fenpropimorph	1	litre	Mildew
06/05/2016	Pek Acid	Phosphorous/Potassium	5	Kg	Nutrition/mildew
12/05/2016	Systhane 20	Myclobutanil	0.45	litre	Mildew
20/05/2016	Amistar	Azoxystrobin	1	litre	Mildew
20/05/2016	Teldor	Fenhexamid	1	litre	Botrytis
27/05/2016	Paarat	Dimethomorph	3	kg	Crown rot
27/05/2016	Signum	Boscalid + pyraclostrobin	1.8	kg	Mildew
27/05/2016	Pek Acid	Phosphorous/Potassium	5	Kg	Nutrition/mildew
10/06/2016	Frupica	Mepanipyrim	0.6	litre	Botrytis
10/06/2016	Teldor	Fenhexamid	1.5	kg	Botrytis
22/06/2016	Kindred	Meptyldinocap	0.6	litre	Mildew
22/06/2016	Pek Acid	Phosphorous/Potassium	5	Kg	Nutrition/mildew
24/06/2016	Pyrus	Azoxystrobin	2	litre	Mildew
01/07/2016	Nimrod	Bupirimate	1.4	litre	Mildew
01/07/2016	Teldor	Fenhexamid	1.5	kg	Botrytis
01/07/2016	Calypso	Thiacloprid	0.25	litre	Capsid
08/07/2016	Scala	Pyrimethanil	2	litre	Mildew
08/07/2016	PeKacid	Phosphorous/Potassium	5	Kg	Nutrition/mildew
15/07/2016	Systhane 20	Myclobutanil	0.45	litre	Mildew
15/07/2016	Teldor	Fenhexamid	1.5	Kg	Botrytis
15/07/2016	Calypso	Thiacloprid	0.25	litre	Capsid
22/07/2016	Topas	Penconazole	0.5	litre	Mildew
28/07/2016	Amistar	Azoxystrobin	1	litre	Mildew
28/07/2016	Systhane 20	Myclobutanil	0.45	litre	Mildew
05/08/2016	Dynamec	Abemectin	0.5	litre	Tarsonemid mite
05/08/2016	Systhane 20	Myclobutanil	0.45	litre	Mildew
12/08/2016	Topas	Penconazole	0.5	litre	Mildew
19/08/2016	Frupica	Mepanipyrim	0.6	litre	Botrytis
26/08/2016	Systhane 20	Myclobutanil	0.45	litre	Mildew
09/09/2016	Scala	Pyrimethanil	2	litre	Mildew
14/09/2016	Systhane 20	Myclobutanil	0.45	litre	Mildew
15/09/2016	Pot Bicarb	Potassium bicarbonate	8	kg	Mildew

Appendix II (continued). Details of spray programme

Everbearer trial

Date	Chemical	Active ingredient	Rate per litre	Unit	Target
06/05/2016	Aphox	Pirimicarb	0.56	kg	Aphid
06/05/2016	Corbel	Fenpropimorph	1	litre	Mildew
06/05/2016	PeKacid	Phosphorous/Potassium	5	Kg	Nutrition/mildew
27/05/2016	Paarat	Dimethomorph	3	kg	Crown rot
27/05/2016	Signum	Boscalid + pyraclostrobin	1.8	kg	Mildew
27/05/2016	PeKacid	Phosphorous/Potassium	5	Kg	Nutrition/mildew
10/06/2016	Frupica	Mepanipyrim	0.6	litre	Botrytis
10/06/2016	Teldor	Fenhexamid	1.5	kg	Botrytis
22/06/2016	Kindred	Meptyldinocap	0.6	litre	Mildew
22/06/2016	PeKacid	Phosphorous/Potassium	5	Kg	Nutrition/mildew
24/06/2016	Pyrus	Azoxystrobin	2	litre	Mildew
24/06/2016	Teldor	Fenhexamid	1.5	kg	Botrytis
01/07/2016	Nimrod	Bupirimate	1.4	litre	Mildew
01/07/2016	Teldor	Fenhexamid	1.5	kg	Botrytis
01/07/2016	Calypso	Thiacloprid	0.25	litre	Capsid
08/07/2016	Scala	Pyrimethanil	2	litre	Mildew
08/07/2016	PeKacid	Phosphorous/Potassium	5	Kg	Nutrition/mildew
15/07/2016	Systhane 20	Myclobutanil	0.45	litre	Mildew
15/07/2016	Teldor	Fenhexamid	1.5	Kg	Botrytis
15/07/2016	Calypso	Thiacloprid	0.25	litre	Capsid
22/07/2016	Topas	Penconazole	0.5	litre	Mildew
28/07/2016	Amistar	Azoxystrobin	1	litre	Mildew
28/07/2016	Systhane 20	Myclobutanil	0.45	litre	Mildew
05/08/2016	Dynamec	Abemectin	0.5	litre	Tarsonemid mite
05/08/2016	Systhane 20	Myclobutanil	0.45	litre	Mildew
12/08/2016	Topas	Penconazole	0.5	litre	Mildew
19/08/2016	Frupica	Mepanipyrim	0.6	litre	Botrytis
09/09/2016	Scala	Pyrimethanil	2	litre	Mildew
15/09/2016	Pot Bicarb	Potassium bicarbonate	8	kg	Mildew

Appendix III. NIAB-EMR trial plot (main crop trial)

