

**Project title:** The performance of new June-bearing strawberry varieties and advanced selections in raised soil beds.

**Project number:** SF 134

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**Previous report:** Year 1 Annual Report

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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.

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## ***GROWER SUMMARY***

### **Headline**

Flair, Vibrant EM1905, Malling Centenary, FF1005, EM1990 and FF1004 performed very well in this soil grown June-bearing strawberry variety trial.

### **Background**

One of the most widely used strawberry production systems in the UK is two-row raised bed soil culture. There are many June-bearing varieties currently suited to this type of production system. However, each year there are new varieties being released into the industry from breeding programmes worldwide, some of which may provide the UK grower with better performance than the varieties currently grown.

To compare new varieties with those currently grown, it's important to trial them on the same site in commercial production under the same UK growing conditions. This enables true comparisons to be made between varieties, rather than relying on individual trial results from diverse locations using varying plant types, where comparison between the performances of varieties can be unreliable.

New and near-market selections could provide improvements through season extension, increased productivity, harvest efficiency and/or improvements in fruit quality characteristics such as berry size, flavour and shelf life. The data gathered during this project should provide a good foundation for growers to identify varieties that best suit their growing system and ultimate market outlet, so reducing the risk a grower takes when choosing to use new varieties.

### **Results Summary**

The following is a summary of the information provided in the 'SF 134 Full Trial Report', available from the HDC.

Table 1 lists the varieties, breeding programmes, plant suppliers and plant types used.

**Table 1: Varieties and numbered selections included in the trial**

Variety/ Selection	Breeder	Country	Season	Plant Type
Flair	Goossens Flevoplants BV	Netherlands	Early	Tray 9cm x 7cm
Vibrant	East Malling Research	UK	Early	Tray 9cm x 7cm
EM1905	East Malling Research	UK	Early	Tray 9cm x 7cm
Capriss	CIREF	France	Early-mid	Tray 9cm x 7cm
FC15	CRA-FRF	France	Early-mid	Tray 9cm x 7cm
Malling Centenary	East Malling Research	UK	Early-mid	Medium waiting bed
CIR903	CIREF	France	Early-mid	Tray 9cm x 7cm
Elsanta	Plant Research International (PRI)	Netherlands	Mid	Tray 9cm x 7cm
EM1746	East Malling Research	UK	Mid-late	Tray 9cm x 7cm
EM1990	East Malling Research	UK	Mid-late	Tray 9cm x 7cm
EM1942	East Malling Research	UK	Mid-late	Tray 9cm x 7cm
FF1005 (Vivaldi)	Fresh Forward	Netherlands	Mid-late	Heavy waiting bed
FF1004	Fresh Forward	Netherlands	Late	Heavy waiting bed

The varieties/selections were planted in raised bed production and protected during fruiting with Spanish tunnels on New Farm Produce's site at Hanch near Elmhurst in Staffordshire. The trial was located in the centre three beds of a five-bed tunnel. It was managed for fertigation and agrochemical inputs in the same way as the surrounding commercial Malling Centenary crop. Planting took place on 17<sup>th</sup> March 2013 (week 12) at a spacing of 40 cm between plants in the row (24,500 plants per hectare); three replicates were planted. The aim was to use tray plants of all varieties but Malling Centenary was only available as a medium waiting bed plant and FF1004 and FF1005 as heavy waiting bed plants.

A summary of the project results is given below.

**Table 2: Year 1 Fruit Yield data - 2013**

Variety	50% harvest date	Total yield g/plant	Class 1 Yield g/plant	Class 1 yield as a % of Elsanta	% Class 1	Class 1 Berry Size %		
						Extra large >45 mm	Large 35-45 mm	Medium 25-35 mm
Flair	02/07/13	394	351	109%	89.3	5.08	55.40	39.52
Vibrant	05/07/13	354	331	102%	93.7	4.05	68.35	27.60
EM1905	05/07/13	224	219	68%	97.5	12.57	62.76	24.67
Capriss	07/07/13	268	237	73%	88.0	3.26	46.14	50.60
FC15	08/07/13	311	283	88%	91.0	27.39	48.43	24.18
Malling Centenary*	09/07/13	306	300	93%	97.9	16.24	61.22	22.55
CIR903	12/07/13	593	491	152%	82.8	4.82	39.04	56.40
Elsanta	09/07/13	405	323	100%	79.7	3.95	55.56	40.49
EM1746	11/07/13	304	236	73%	78.0	0.80	49.22	49.97
EM1990	10/07/13	254	248	77%	97.5	16.13	60.54	23.30
EM1942	14/07/13	290	275	85%	94.8	9.18	52.42	38.40
FF1005 *	12/07/13	657	531	164%	80.5	4.91	34.77	60.32
FF1004 *	17/07/13	605	496	153%	82.0	18.17	49.18	32.65

\* FF1004 and FF1005 were planted as heavy waiting bed plants. Malling Centenary was a medium waiting bed plant. All other varieties in trial were tray plants.

**Table 3: Year 2 Fruit Yield data - 2014**

Variety	First pick date	50% harvest (days) cv Elsanta	Total Yield g/plant	Class 1 Yield g/plant	% Class 1	Berry Size %				
						Extra large >45mm	Large 35-45mm	Medium 25-35mm	Small <25mm	Mishapen All sizes
Flair	20/05	-12	981	784	80	1	37	43	4	16
						1	46	53	Class 1 only	
Vibrant	25/05	-7	1065	978	92	1	45	45	4	4
						1	49	49	Class 1 only	
EM1905	25/05	-5	1380	1184	86	4	55	27	5	9
						4	65	31	Class 1 only	
Capriss	28/05	-5	343	232	68	1	19	48	10	22
						1	28	71	Class 1 only	
FC15	28/05	-5	1238	985	80	15	48	17	2	19
						18	61	21	Class 1 only	
Malling Centenary	31/05	-1	1119	843	75	4	46	26	3	22
						5	61	34	Class 1 only	
CIR903	05/06	+2	1509	942	62	0	13	50	20	18
						0	20	79	Class 1 only	
Elsanta	05/06	14/06/14	1262	918	73	1	33	37	10	20
						1	47	52	Class 1 only	
EM1746	08/06	+6	1010	598	59	1	20	38	13	27
						2	34	64	Class 1 only	
EM1990	09/06	+5	1172	1010	86	6	45	35	6	8
						6	53	41	Class 1 only	
EM1942	05/06	+2	1172	891	76	2	35	39	11	13
						2	47	51	Class 1 only	
FF1005	05/06	+3	1387	1121	80	0	25	55	10	10
						0	31	69	Class 1 only	
FF1004	09/06	+6	1334	969	72	7	30	36	10	17
						9	41	50	Class 1 only	

### ***Most interesting varieties and selections***

The following varieties/selections are of most interest to the industry. Full information on all varieties can be found in the 'SF 128 Full Trial Report'.

#### ***Early season varieties***

**Flair** was the earliest variety to pick with a 50% pick date 11 days before Elsanta. Fruit yields were lower than Elsanta and the fruit quality average. It is a variety that would probably be better suited to substrate culture. Fruit yield was similar or lower than Elsanta in both harvest years.

Not as early as Flair but still providing an advantage in earliness over Elsanta, **Vibrant** and **EM1905** both gave significant improvements over Elsanta for berry size and percentage class 1. EM1905 also gave the highest class 1 yield in trial in year two. Class 1 percentage for Vibrant was 92% and for EM1905 86%, compared to Elsanta's 73%.

#### ***Midseason varieties***

**Malling Centenary** had a picking season very similar to Elsanta's, although in other trials and commercial production it has been shown to be a few days earlier. Class 1 yields in both seasons were similar to Elsanta but with much improved berry size and shape. Finding the optimum production system to increase fruit yields would be worthwhile as the fruit quality of this variety is well suited to most markets.

**FF1005** was three days later than Elsanta. It showed good class 1 yields in both year 1 and 2 but the proportion of medium size berries (25-35mm) was one of the highest in the trial. The plants were very vigorous. Developing an optimum feeding regime and production system may help to improve the fruit quality and berry size.

**EM1942** started picking eight days later than Elsanta, but 50% pick date was only two days later. Class 1 yields were similar to Elsanta. The fruit size was not as large (>35mm) as Malling Centenary.

### Later season varieties

**FF1004** produced higher class 1 yields than Elsanta in both harvest seasons. In the main crop year, the percentage class 1 (72%) was quite low due to misshapen and small fruit. The class 1 consisted of a higher proportion of medium (25-35mm) rather than large (>35mm) berries.

**EM1990** produced significantly larger fruit than Elsanta. Class 1 yields were lower in year one than Elsanta but in year two, the yield was higher than Elsanta with a higher proportion of large berries (>35mm) and good percentage class 1 of 86.

**EM1746** had lower total and class 1 fruit yields than Elsanta. The percentage class 1 was particularly low at 59%. There were more medium (25-35mm) than large (>35mm) berries in the class 1 category.

**Table 4: Fruit Quality**

Variety	External berry colour 1 = light orange 8 = dark wine-red	Uniformity of berry shape 1 = irregular 9 = uniform	Skin firmness 1 = soft 9 = firm	Berry appearance 1 = poor 9 = excellent	Fruit flavour 1 = poor 9 = excellent	Shelf life 1 = poor 9 = excellent	Mean Brix (sugar content)
Flair	7.5	6.5	6.6	7.0	8.0	6.0	10.7
Vibrant	8.0	8.0	7.5	8.0	8.5	6.5	9.0
EM1905	7.5	8.5	6.8	7.8	7.0	6.8	9.2
Capriss	7.0	6.2	6.2	5.5	8.0	5.3	11.2
FC15	4.5	7.0	7.4	7.0	4.5	4.0	7.8
Malling Centenary	6.0	8.5	8.0	9.0	8.0	7.5	9.0
CIR903	6.5	7.0	6.0	4.5	4.0	2.5	7.6
<b>Elsanta</b>	<b>6.5</b>	<b>5.5</b>	<b>7.0</b>	<b>6.0</b>	<b>6.5</b>	<b>6.0</b>	<b>8.8</b>
EM1746	5.8	7.0	7.5	8.5	6.5	6.5	10.1
EM1990	7.0	8.5	8.0	8.5	7.0	7.5	9.9
EM1942	6.0	6.5	7.5	7.8	8.0	5.0	9.6
FF1005	8.6	6.0	7.5	7.5	5.0	7.0	7.8
FF1004	7.3	7.0	6.5	5.5	4.5	6.0	8.2

**Malling Centenary** produced the best fruit quality scores of all varieties in trial and markedly higher than for Elsanta. The flavour was sweet and the texture juicy. Brix levels were consistently higher than Elsanta. The berries were very attractive with a bright glossy orange/red colour, pointed conic very regular uniform shape with slightly indented seeds giving the skin a very smooth look. Both skin and flesh had good firmness. The calyx was of average size and in proportion to the berries. The berries retained their gloss when stored, showing only slight darkening in store.

**Flair** was pleasantly sweet tasting with a smooth, soft texture though not always very juicy. Brix levels were consistently higher than those of Elsanta. The berries were glossy and attractive, darker than Elsanta with an irregular conic shape and some variability of size. The seeds were indented. Skin and flesh had moderate firmness. In store the berries showed some darkening and bruising.

**Vibrant** had a good sweet/acid balanced flavour which scored highly in tastings, described as sometimes sharp but always tasty. The berries were very juicy. Brix levels were similar to Elsanta. Berries are a uniform, regular conic shape with glossy darker skin colour than Elsanta. The flesh was firm and the skin strong. In shelf life tests, the berries darkened in colour and any bruising became more noticeable.

**EM1905** had a clean uncomplicated sweet to bland flavour. The texture was juicy and good. Brix levels were similar to Elsanta. The berries were very attractive, glossy red/orange, slightly darker than Elsanta but lighter than Vibrant. The seeds were slightly indented with a uniformly regular conic shape. Petal retention under the calyx occurred mostly during the first half of harvest, which detracted from the appearance. The skin was moderately firm and the flesh firm. Shelf life was similar to Elsanta.

**EM1942** had a sweet classic strawberry flavour with good juicy texture. Brix levels were slightly higher than Elsanta. At the Open Day it was noted for its very good appearance. Berries were glossy, orange to orange/red in colour with a rounded globose shape that had some irregularity like Elsanta. The flesh and skin were quite firm. In shelf life tests the orange skin colour showed bruising quite readily. The skin darkened in storage.

**FF1005** had a watery, sometimes quite bland taste with low sweetness. Brix levels were lower than that of Elsanta. The berries had a very glossy bright attractive appearance with a darker red skin colour than Elsanta and a white neck under the small reflexed calyx. The

berry shape was round with a similar irregularity of shape to Elsanta. The skin and flesh had good firmness. In storage the fruit retained its gloss but did darken in colour and bruises became more noticeable.

**EM1990** had variable flavour. Usually the darker the colour the sweeter the berry tasted, though brix levels were consistently higher than Elsanta. The berries were very attractive with a glossy bright orange/red skin and uniformly conic shape with wide shoulders. The seeds slightly protruded from the berry surface, which sometimes gave it a seedy appearance. EM1990 scored highly for appearance at the Open Day. The berries were firm with a dense texture, white flesh colour and the skin had good strength. The calyx was quite large. All quality scores including shelf life, were better than for Elsanta.

**EM1746** had variable flavour, very good tasting at some picks and bland at others. The texture was juicy. Brix levels were higher than Elsanta. The berries were very attractive, glossy with an orange/red colour. Berry shape was an irregular round wedge, of medium size with some splitting noted later in pick. In shelf life tests the berries stored slightly better than Elsanta.

**Capriss** had a good flavour and brix level but other quality scores were poor. **FF1004**, **CIR903** and **FC15** were also found to have poor fruit quality.

## **Main conclusions**

The following conclusions are drawn from the 2013 and 2014 cropping season of the twelve varieties grown in raised bed soil culture:

- **Flair** is a promising variety for very early production. In soil production the fruit yields were similar to Elsanta in year 1 but lower in year 2. The berries were a slightly better size and the percentage class 1, 80% or above. The fruit had a good taste but showed some deterioration in store. To get the best from this variety it may be better suited to growing in substrate with a tailored feed regime and agronomic husbandry (crown thinning, etc.) specific to the variety.
- **Early** season **Vibrant** and **EM1905** both gave significant improvements over Elsanta for berry size, shape and percentage class 1 in soil culture. EM1905 produced the highest class 1 yield in trial. Vibrant yields were also higher than Elsanta. These

attributes should provide growers with the opportunity to start picking earlier in the season and greatly improve picking speeds. Vibrant has already demonstrated that it is suited to substrate culture. EM1905 may benefit from being grown in substrate as it has a susceptibility to *Verticillium* wilt similar to Elsanta. EM1905 fruit suffered from petal retention, which detracted from the appearance post storage.

- **Malling Centenary** had excellent fruit quality characteristics providing a marked improvement over Elsanta in soil culture for berry size, shape and percentage class 1. Class 1 fruit yields were similar to Elsanta. The use of good plant material and tailoring agronomic practice to help increase yields would be worthwhile as the fruit quality is well suited to most markets. In this trial the fruiting season was similar to Elsanta though it has often been shown to crop a few days earlier.
- **FF1005** was 3 days later than Elsanta and had good fruit yields, though a much higher proportion of the fruit was medium (25-35 mm) rather than large (>35mm) in size. Flavour was quite weak with low brix levels. The plants were very vigorous so a feed regime and alternative agronomic practice suited to the variety would be needed to help improve fruit quality and berry size.
- **EM1942** had a similar season to Elsanta. Fruit quality including flavour was generally good, though it did have a lower shelf life score than Elsanta. Class 1 yields were similar to Elsanta but fruit size was smaller than Malling Centenary. With a susceptibility to *Verticillium* wilt there were some plant losses noted in trial, which will limit its use in soil production. With no particularly outstanding qualities it may not provide sufficient improvements to compete with other midseason varieties.
- For a later fruiting variety, **EM1990** had good fruit quality with a significantly higher proportion of large berries (>35mm) and higher percentage class 1 than Elsanta. Fruit yields were lower than Elsanta in year one but higher in year two. With a moderate susceptibility to *Verticillium* wilt but moderate resistance to crown rot (*Phytophthora cactorum*), it may provide sufficient improvement over the currently grown mid/late season varieties to warrant a place in UK soil production systems.
- **FF1004** had good class 1 yields and a similar percentage class 1 to Elsanta. Fruit size was similar to Elsanta. Fruit quality scores were generally lower than Elsanta including flavour and brix levels. The late season and good yields may be of interest

to growers but with poor fruit quality scores it may not be readily accepted by the market.

- **EM1746** was 6 days later than Elsanta. Class 1 fruit yields in both cropping seasons were significantly lower than Elsanta with a particularly low percentage class 1 of 59 in year two, well below expectations for this selection. Fruit flavour and shelf life were similar or better than Elsanta. The plants were very vigorous and in EMR tests showed good resistance to crown rot (*Phytophthora cactorum*), advantageous for a later season variety, and intermediate tolerance to *Verticillium* wilt.
- In this trial, early season **Capriss** and **FC15**, and midseason **CIR903** had generally poor fruit quality and/or low yields, which are unlikely to be overcome by alternative growing systems. Other varieties may be better suited to UK soil production systems.

## **SCIENCE SECTION**

### **Introduction**

Today one of the most widely used strawberry production systems in the UK is two-row raised bed soil culture. There are many June-bearing varieties currently suited to this type of production system, however, each year there are new varieties being released into the industry from breeding programmes worldwide, some of which may provide the UK grower with better performance than the existing varieties grown.

To assess new varieties coming to the market there is a need for a trial to bring these varieties together under commercial UK growing conditions. Using plant material of a uniform plant-type, and locating the trial where each variety will experience the same environmental and cultural growing conditions, should deliver a true comparison between new varieties and provide a reliable assessment of their commercial potential in the UK.

New and near-market selections when grown in soil production systems could provide the UK grower with improvements over the currently grown varieties through season extension, increased productivity, harvest efficiency and/or improvements in fruit quality characteristics such as berry size, flavour and shelf life. This project offers the opportunity to trial such varieties on one site to compare productivity and fruit quality characteristics to determine the value of each to the industry. The data gathered should provide a good foundation for growers to identify varieties that best suit their growing system and ultimate market outlet, so reducing the risk a grower takes when selecting new varieties.

Elsanta is one of the most widely grown June-bearing varieties used in soil production systems over the last 25 years. There is a wealth of data and information available on the performance of Elsanta and most growers will be very familiar with its performance on their own sites. It was therefore selected as the control variety but it does have its limitations, which include producing a high proportion of medium size berries - a characteristic that leads to higher picking costs and a tendency to produce misshapen fruit caused by sensitivity to cool temperatures at flowering. Neither does Elsanta show resistance to any of the main strawberry pathogens of note in UK production. Disease pressure is an ever present problem, both in propagation and fruit production. Varieties with resistance are becoming much more sought after with the restrictions in agrochemical usage and concern with regard to pesticide residue levels. Finding a variety, which in soil culture reliably produces larger berries with a higher proportion of regular shaped class 1 fruit and some

disease resistance, should significantly increase profitability without requiring any major change to current production systems.

There are many breeding programmes worldwide that are investing in the production and marketing of new varieties. Varieties selected for inclusion in this trial are from European programmes as these are more likely to produce varieties suited to UK growing conditions and the marketplace. Where possible varieties have been selected that have no exclusivity to grower groups.

The introduction of new varieties into the marketplace can in itself lead to an increase in demand for strawberries.

### Varieties and numbered selections

The varieties selected for inclusion in this project are from European breeding programmes, which are considered more likely to produce varieties suited to UK production and markets.

Table 5 lists the varieties, breeding programmes, seasonality and plant types used.

**Table 5. Varieties and numbered selections included in the trial**

Variety/ Selection	Breeder	Country	Season	Plant Type
Flair	Goossens Flevoplants BV	Holland	Early	Tray 9cm x 7cm
Vibrant	East Malling Research	UK	Early	Tray 9cm x 7cm
EM1905	East Malling Research	UK	Early	Tray 9cm x 7cm
Capriss	CIREF	France	Early-mid	Tray 9cm x 7cm
FC15	CRA-FRF	France	Early-mid	Tray 9cm x 7cm
Malling Centenary	East Malling Research	UK	Early-mid	Medium waiting bed
CIR903	CIREF	France	Early-mid	Tray 9cm x 7cm
Elsanta	Plant Research International (PRI)	Netherlands	Mid	Tray 9cm x 7cm
EM1746	East Malling Research	UK	Mid-late	Tray 9cm x 7cm
EM1990	East Malling Research	UK	Mid-late	Tray 9cm x 7cm
EM1942	East Malling Research	UK	Mid-late	Tray 9cm x 7cm
FF1004	Fresh Forward	Netherlands	Mid/late	Heavy waiting bed
FF1005 (Vivaldi)	Fresh Forward	Netherlands	Late	Heavy waiting bed

## Trial site details

New Farm Produce hosted the variety trial on their Hanch site in Staffordshire. Particular thanks are extended to Stephen McGuffie of New Farm Produce for his support with the project.

The field used for the trial had grown raspberry plants in the previous cropping year. Raised beds were formed in autumn 2012, sterilised with Basamid and covered in black polythene. The trial was planted adjacent to a commercial crop of Malling Centenary, which was planted at a similar time as the HDC trial. On the other side of the trial was a crop of Elegance planted in the previous year, which remained in-situ for the duration of the two-year trial. The area of the field used for the variety trial was selected for its uniformity of aspect, slope, drainage and soil type. The trial was completely surrounded by a commercial crop, eliminating any edge effects.

The trial was located in the centre three 2-row beds of a 5-bed tunnel. Fertigation and agrochemical inputs were managed by New Farm Produce exactly the same as the surrounding commercial crop of Malling Centenary.

## Production details

Soil type:	Medium/heavy loam that holds water well
Previous cropping	Raspberry
Soil preparation	Beds formed and sterilised with Basamid in autumn 2012, then covered with black polythene
Planting date	14 - 18 March 2013
Fertigation	Two T tapes supplied water and feed to each bed
pH	5.8 - 6.0
EC	1.0 – 2.0
Feeding regime	Sonata feed, 2 - 3 times per day during fruiting, once a day at other times
Agrochemical input	As for the surrounding commercial Malling Centenary crop
Runners cut	Twice during each fruiting season
Leaf removal	None
Duration of trial	Two harvest years (2013 & 2014)
Protection	Year 1 Spanish tunnel at harvest. Year 2 from the 15 April 2014
Crown thinning	Year 2 at the end of February replicates A and B
Year 1 harvest	25 June 2013 (week 26) to 6 August (week 32) - 7 weeks in total
Year 2 harvest	20 May 2014 (week 21) to 7 July (week 28) - 7 weeks in total
Harvest frequency	Picked three times a week for the majority of the Year 1 harvest and twice a week in Year 2

Plant assessments	Plant vigour score (1 = poor, 5 = very vigorous) Plant habit description Runner production (score 1 = none, 5 prolific) Truss number (counted) Incidence of powdery mildew ( <i>Podosphaera aphanis</i> ) on leave score (1 = none, 5 very high)
Fruit yield	Recorded in the berry size categories: Class 1 (>45mm extra-large; large 35-45mm; medium 25-35mm); Class 2 (<25mm and misshapes) at each of the harvest dates
Fruit quality assessments were made on at least four dates during the two harvests for:	
	External berry colour score (1 =light orange; 8 = dark wine red) Berry appearance score (1 = unattractive; 9 = attractive) Berry shape (score 1-9) Berry shape uniformity score (1 = irregular; 9 = uniform) Skin firmness score (1 = soft; 9 = firm) Shelf life score, 7 days @ 3-6°C (1 = poor; 9 = excellent) Flavour score (1 =poor; 9 = excellent) Brix readings on 3 berries on at least 4 dates during peak harvest <i>See Appendix 9.3 for a selection of photographs</i>
Photographs	Plants pre and post planting. Plants at the flowering stage. Plot overview Plants during fruiting. Six berries per variety at 2 dates during each harvest. Berry sections during each harvest year. Berries in punnet. Fruit post cold storage. <i>See Appendix 2 for a selection of photographs</i>
Statistical analysis	Fruit yields were analysed by statistician Dr David Simpson, EMR ( <i>see Appendix 4 for the statistical reports</i> )

Tray plants of all varieties were ordered for trial in February 2012, however, on delivery three varieties namely Malling Centenary, FF1004 and FF1005, were available only as waiting bed plants. FF1004 and FF1005 were heavy waiting beds and Malling Centenary medium waiting beds. These three varieties were included in the trial but the 60-day year 1 fruit yields are not directly comparable to the other ten varieties in trial.

## Trial design

Trial type	Raised bed soil production with fertigation
Trial design	Randomised block using 3 replicates. One replicate per bed
Varieties	Twelve new and near-market varieties/selections as detailed in Table 5
Plant types	Nine varieties as tray plants, where tray plants were not available three varieties were supplied as waiting bed plants, see Table 5
Trial controls	Elsanta tray plants
Plot size	Twenty plants per plot/replicate, 60 plants in total per variety
Plant spacing	40cm in-row, 35cm between row spacing
Plants/hectare	24,500

## Trial results and data collected

The trial established well in spring 2013 with only two plant losses, one from Vibrant in replicate A and one from EM1905 in replicate B. These deaths occurred soon after planting and were not easily attributed to disease. In May it was noted that the plants of CIR903 and Elsanta in replicate C were showing signs of stunting. The fruit formed to thumb nail size but the plants then almost ceased growth. Examination showed that the roots had not grown out of the root ball and were blackened, which suggested that they had experienced water stress during establishment. The plots were adjacent to one another within the trial. CIR903 plants also showed evidence of crown rot (*Phytophthora cactorum*) infection. By harvest 2013 the fruit produced from both these varieties was very small and dry and many of the plants were suffering dieback. Replicate C has therefore been excluded from the yield data presented in this report.

Spring 2013 experienced temperatures below normal from planting through to mid-June. This delayed plant development - the first flowers were seen on Capriss, CIR903 and Flair during the second week of May but it was not until a month later that all varieties were flowering. The first ripe berries were present on 19 June despite the early planting date. The weather then turned hot and from the first week in July temperatures reached above 20°C each day. The maximum temperature of 29.9°C was reached on 22 July. The average 24 hour temperature was above 20°C on 8 July and remained between 18°C and 22.7°C for most of July. This sudden temperature increase led to quick development of the fruit. Harvest began on 17 June and continued until 8 August.

Winter 2013/14 was not exceptionally cold. During March there were seven nights when temperatures dipped between 0°C and -2.7°C, the lowest recorded temperature of -4.6°C occurred on 24 March. In April temperatures dipped below zero (-1.5°C) on 15 April but the tunnels were then skinned at this time. In early April the early season varieties Flair, Capriss, Vibrant and EM1905 began flowering and there was some frost damage to the flowers noted in these varieties.

The trial received a standard Sonata feed and water regime. This suited some varieties better than others. The more vigorous varieties may have performed better in terms of yield, fruit size and percentage Class 1 on a lower feed regime; these being Capriss, EM1746, CIR903, FF1004 and FF1005. This should be considered when looking at the final yield results.

### **Plant characteristics**

**CIR903** produced tall, large, leafy plants with lush, glossy, soft, floppy leaves. Plants produced seven or more crowns, which were tightly packed and low, making them difficult to thin without damaging the plant. With an open habit the trusses were moderate to long, pulling the leaves down as the fruit increased in size, which made picking difficult as the fruit was hard to find within the foliage. Chimeras were noted on a few plants in each replicate, these occurred on both the leaf and the fruit.

**Capriss** plants were very upright in habit with tall dense vigorous leaf growth, though there was some variability of plant size within plots. The leaves were soft, glossy and quite droopy. Trusses were usually quite long, with fewer flowers per truss than CIR903. A number of plants produced only one truss. There were a number of aborted flowers noted on every plant. Being an early fruiting variety the flowers were open in early to mid-April, at this time there were a few nights when temperatures dropped below 0°C.

**Table 6:** Plant characteristics

Variety	% Plant losses	Plant vigour 1 = low 5 = very vigorous	Runner production 1 = none 5 = prolific	Plant Habit	Average fruit number per truss	Powdery mildew 1 = none 5 = high incidence
Flair	3.0%	3.0	2.0	Open	12	2.0
Vibrant	1.6%	3.0	2.0	Upright	8	1.0
EM1905	8.0%	3.5	3.5	Very upright	7	1.0
Capriss	8.3%	4.5	4.0	Upright	7	1.0
FC15	1.6%	3.5	3.5	Open	6	3.0
Malling Centenary	3.0%	4.5	2.0	Upright	6.5	0.0
CIR903	5.0%	3.7	2.0	Open	12	1.5
Elsanta	5.0%	3.0	2.0	Open	11	2.0
EM1746	0%	4.0	3.5	Upright	12	0.0
EM1990	11.6%	3.0	4.5	Upright	7.5	1.5
EM1942	13.3%	3.7	4.5	Upright	8	1.5
FF1005	0%	4.5	3.5	Upright	11.5	1.5
FF1004	1.6%	3.7	2.0	Upright / open	14	0.5

**FF1004** had a tall, leafy, very upright habit, more open than FF1005. Leaves were large, petioles and trusses were long and strong. Fruit was well displayed. On average there were six crowns per plant. Crown thinning to three-four crowns appeared to slightly improve the fruit yield.

**FF1005** produced large, upright, tall, bushy plants with very dense, leafy, vigorous growth. The fruit was produced in bunches on short trusses. The plants produced many crowns, which were difficult to thin as they were low and not easily separated without causing damage to the remaining crowns. The crown thinning that occurred in replicates A and B gave higher yields and larger size fruit than in replicate C where the plants were not crown

thinned. Fruit numbers per truss were high. On average FF1005 produced high yields of mainly medium to small berries.

**FC15** had an open habit similar to Elsanta with leathery, large, glossy leaves and moderate vigour. The leaves had moderately long petioles, which became tangled in the fruit trusses at harvest, though due to the large fruit size this did not unduly hinder picking. Trusses were of moderate length, with on average 6 flowers per truss, resulting in a high percentage of large berries. The plants in replicates A and B had two-three crowns removed leaving on average three crowns per plant. Fruit yields recorded on the thinned and the non-thinned plots were very similar (Appendix 9.1).

**EM1905** had a very tall upright plant habit with vigorous growth and large, soft floppy leaves with long petioles. Trusses were long, giving a good fruit display. Trusses were simple with on average seven flowers per truss. There was a small amount of flower abortion noted on some plants. Plants produced on average four crowns, these were thinned to three, though this may not have been necessary due to the low fruit numbers produced per flowering truss. The un-thinned EM1905 plot in replicate C suffered from reduced vigour and plant growth, most likely due to it being situated on the edge of a patch of Verticillium wilt in the field, which had affected the adjacent commercial crop. It was therefore not possible to get any indication of whether crown thinning may have affected yields. EM1905 has a similar susceptibility to Verticillium wilt as Elsanta.

**Vibrant** had an upright plant habit with sparse foliage growth and moderate vigour. Flowers were large, bold and held well above the foliage. The plants had moderate vigour. The characteristically long simple trusses produced on average eight good size berries per truss. Crown thinning was not necessary as there were on average no more than three-four crowns per plant.

**EM1746** had vigorous plant growth with a compact, upright habit. The leaves were dark green, matt with a very dense leaf canopy and some distortion and scorching was visible on most plants. The trusses were of moderate length. The lower Class 1 percentage of 59 in Year 2 was mainly down to misshapen fruit in the sample, which may have been caused by the dense leaf canopy hindering pollination during flowering.

**EM1990** produced upright, compact, small plants of moderate vigour. On average six crowns were produced per plant. The trusses were simple with on average eight berries per truss. At fruiting a good proportion of large berries were produced. The un-thinned EM1990

plot in replicate C suffered from reduced vigour and plant growth most likely due to it being situated on the edge of a patch of wilt in the field, which had affected the adjacent commercial crop. It was therefore not possible to get any indication of whether crown thinning may have affected yields. EM1990 has moderate susceptibility to Verticillium wilt.

**EM1942** had dark green, matt leaves with vigorous, dense, leafy plant growth. Plant habit was upright and compactly domed. The leaves were small, some with five leaflets. Fruit display was good on long trusses. EM1942 suffered the most plant losses in the trial. Crowns were short, making them difficult to remove. Where crowns were thinned the plants gave higher yields than the un-thinned plants.

**Malling Centenary** had vigorous, robust, upright, tall plant growth with large glossy leaves. The plants had an upright habit with long trusses giving a good fruit display. Trusses were simple producing on average eight good size berries. Plants were thinned from five to on average 3.5 trusses, though the plant could probably support a higher crown number without unduly affecting fruit size.

**Flair** produced plants with moderate vigour and an open habit. Plant size was variable within the plot. Leaves had long thin petioles and were soft, drooping and curled. On average eight crowns were produced per plant, these were thinned to three-four crowns, though the yield on the un-thinned plot was very similar to the thinned plots. The trusses were long and became tangled in the foliage during harvest, which hindered picking and gave the plant an untidy, floppy appearance. Flowers numbers per truss were high.

### **Crown thinning**

To provide yield results comparable to those achievable in commercial production, replicates A and B were crown thinned in February 2014 to three-four crowns per plant (see Table 7). Replicate C was not crown thinned as it had been affected by poor establishment in 2013 and the EM1990 and EM1905 plots in this replicate were situated at the edge of a patch of Verticillium wilt, which had reduced the plant vigour.

**Table 7. Crown thinning (replicates A and B only)**

Variety	Number of crowns		Comments
	Before thinning	After thinning	
Flair	8.0	4.0	Bold separate crowns, easy to remove
Vibrant	3.5	3.5	No crowns removed
EM1905	4.0	3.0	Large tall separate crowns, easy to remove
Capriss	6.0	3.5	Easy to remove
FC15	5.0	3.0	Large tall crowns, easy to remove
Malling Centenary	5.0	3.5	Some plants had crowns that were close together, difficult to remove cleanly
CIR903	7.0	5.0	Many crowns but tight together and low, difficult to remove more than two per plant without causing too much damage
Elsanta	4.0	3.0	Tall crowns, easy to remove
EM1746	5.0	3.5	One crown per plant removed
EM1990	6.0	3.5	Moderately tall crowns, easy to remove
EM1942	5.0	3.5	Short tight crowns difficult to remove
FF1005 (Vivaldi)	8.0	4.0	Many crowns
FF1004	6.0	3.5	Many crowns, low and short, difficult to remove

Variety CIR903 had crowns that were difficult to thin as they were closely packed together and short within the plant, crowns were removed only if their removal did not unduly damage the plant.

A comparison of the yields taken from the crown thinned plots versus non-crown thinned plots is given in Appendix 1. As the non-crowned thinned plots were not replicated and had suffered from poor establishment in 2013, the data given may not be reproducible in commercial production.

## Disease

Powdery mildew (*Podosphaera aphanis*) was not a problem in trial, though a few varieties were observed with curled new foliage during fruiting. These were Elsanta, Flair, CIR903, EM1990, EM1942 and FC15. FC15 was the only variety that showed slight symptoms of mildew on the harvested fruit.

Replicate C suffered more plant losses and poor plant growth than any of the other replicates. Poor establishment due to water stress had affected some plants in 2013. Also in replicate C, the plots of EM1905 and EM1990 located on the corner of the trial appeared to be affected by an area of Verticillium wilt that was noticeably affecting the growth of the adjacent commercial crop. The plants of both these selections were severely stunted with some plant losses. EM1990 did not suffer any losses or reduced growth in either of the other two replicates. One EM1905 plant was removed from replicate B as it was very small.

EM1942 suffered the most plant losses in trial from either the plants dying or being removed from trial due to severe stunting, plant losses occurred in all replicates. Verticillium wilt was suspected to be the cause.

In EMR disease trials EM1942 and EM1905 were found to have a similar Verticillium wilt susceptibility to Elsanta. EM1990 was found to have moderate susceptibility and EM1746 intermediate susceptibility Verticillium wilt.

EM1905 and EM1746 were found to be resistant to crown rot (*Phytophthora cactorum*) and EM1990 and EM1942 to have moderate resistance to crown rot when tested at EMR.

CIR903 suffered from crown rot in Year 1, which reduced the vigour of many plants.

Capriss, Malling Centenary and Flair lost two plants in replicates A and B either because they had died or were removed due to suffering from very stunted growth.

No other disease problems were noted in the trial.

## **Fruit yields**

### ***2013 Year 1 yield results***

The first year harvest commenced on 17 June 2013 and continued until all fruit was picked on 8 August. The fruit was picked three times a week and at each pick class 1 fruit >25mm was weighed into three size categories:

- Medium 25-35mm;
- Large 35-45mm;
- Extra-large >45mm.

Class 2 fruit was also recorded and consisted mainly of small (<25mm) and misshapen fruit.

All varieties except FF1004, FF1005 and Malling Centenary were planted as tray plants. FF1004 and FF1005 were planted as heavy waiting bed and Malling Centenary as medium waiting bed. Though the use of heavy waiting bed plants did not appear to cause any yield reduction, the use of medium waiting bed plants may have reduced the yield of Malling Centenary compared to the other varieties in trial. Table 8 shows the Year 1 yield data gathered.

Of the three replicates in the trial, replicate C produced the least consistent data. Plants of CIR903 and Elsanta suffered from poor stunted growth in replicate C and produced significantly lower fruit yields than in replicates A and B. The plots of Malling Centenary and Vibrant, which were either side of the CIR903 and Elsanta plots, also suffered lower yields; therefore replicate C yield data for these varieties has not been included in Table 8.

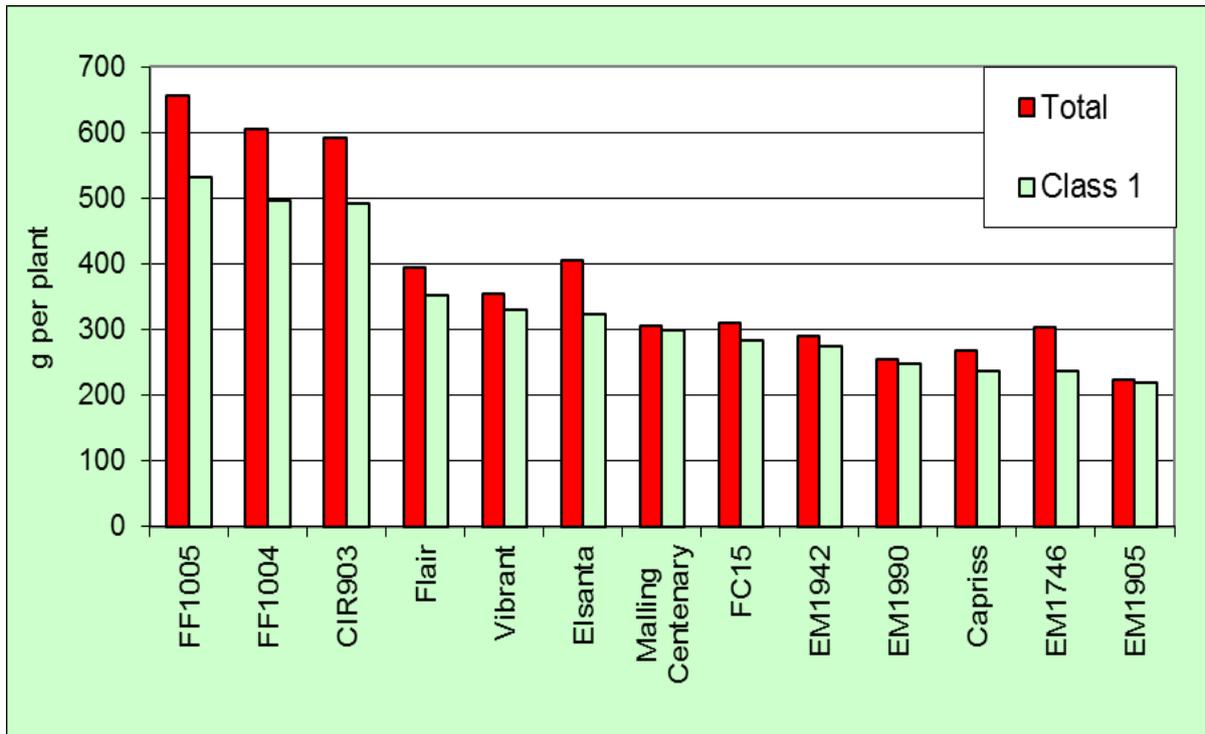
The Elsanta tray plant control produced an average total yield of 405g per plant and Class 1 yield of 323g per plant with a Class 1 percentage of 79.7%. 59.5% of the Class 1 fruit was >35mm.

**Table 8. 2013 Year 1 fruit yield data** (listed by Class 1 yield)

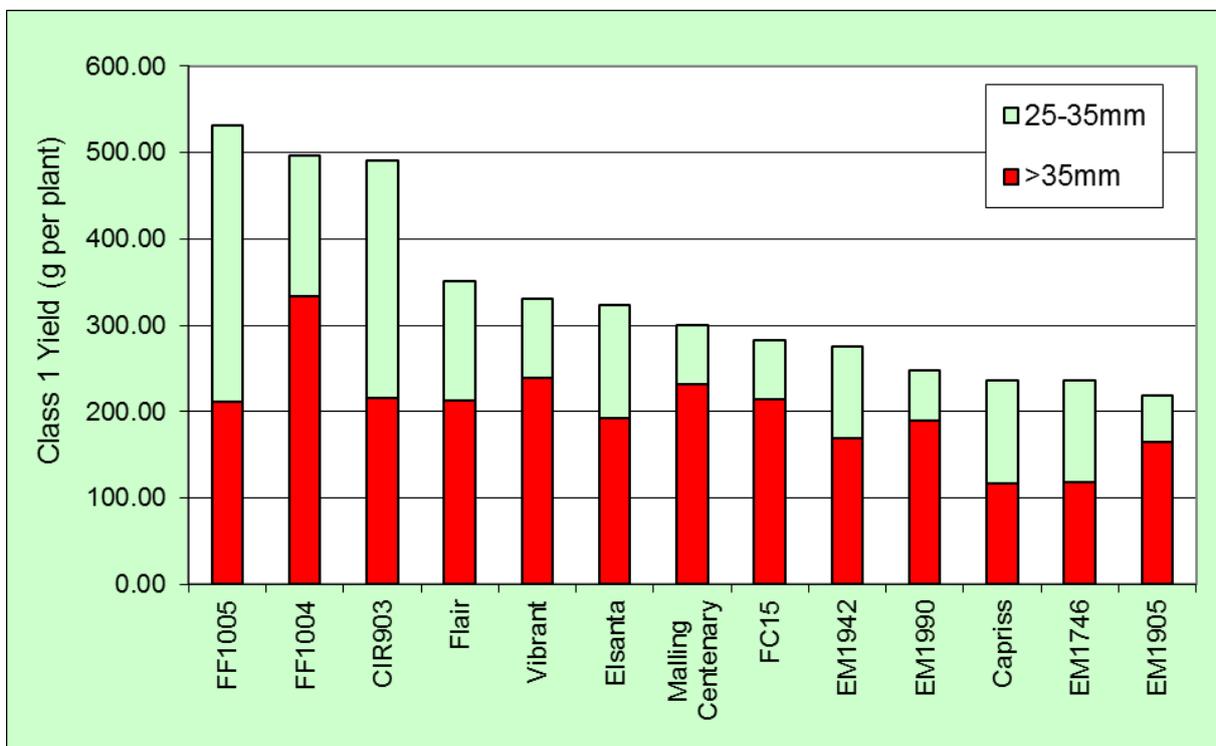
*\* FF1004 and FF1005 were planted as heavy waiting bed plants. Malling Centenary was a medium waiting bed plant. All other varieties in trial were tray plants.*

Variety	50% harvest date	Total yield g/plant	Class 1 Yield g/plant	Class 1 yield as a % of Elsanta	% Class 1	Class 1 Berry Size %		
						Extra large >45 mm	Large 35-45 mm	Medium 25-35 mm
FF1005 *	12/07/13	657	531	164%	80.5	4.91	34.77	60.32
FF1004 *	17/07/13	605	496	153%	82.0	18.17	49.18	32.65
CIR903	12/07/13	593	491	152%	82.8	4.82	39.04	56.40
Flair	02/07/13	394	351	109%	89.3	5.08	55.40	39.52
Vibrant	05/07/13	354	331	102%	93.7	4.05	68.35	27.60
Elsanta	09/07/13	405	323	100%	79.7	3.95	55.56	40.49
Malling Centenary*	09/07/13	306	300	93%	97.9	16.24	61.22	22.55
FC15	08/07/13	311	283	88%	91.0	27.39	48.43	24.18
EM1942	14/07/13	290	275	85%	94.8	9.18	52.42	38.40
EM1990	10/07/13	254	248	77%	97.5	16.13	60.54	23.30
Capriss	07/07/13	268	237	73%	88.0	3.26	46.14	50.60
EM1746	11/07/13	304	236	73%	78.0	0.80	49.22	49.97
EM1905	05/07/13	224	219	68%	97.5	12.57	62.76	24.67

**Figure 1. Year 1 fruit yield**



**Figure 2. Year 1 Class 1 berry size**



FF1005, FF1004 and CIR903 produced significantly higher total and Class 1 yields than Elsanta and all other varieties. FF1005 achieved the highest average Class 1 yield, 64% higher than that of Elsanta. The Class 1 percentage was 80.5%, though the majority of Class 1 fruit produced fell into the medium berry size category (25-35mm diameter), at 60% this was the variety with the highest proportion of medium size fruit. Class 2 fruit was equally split between small fruit below 25mm and misshapen fruit.

CIR903 had a large proportion of medium size fruit in the Class 1 category (56%).

67% of FF1004 fruit was >35mm and of this 18% was in the extra-large category (>45mm). The Class 2 consisted of mainly large, misshapen fruit.

The Class 1 yields produced by Flair, Vibrant, Malling Centenary, FC15 and EM1942 were not significantly different to Elsanta. Though over 70% of Vibrant, Malling Centenary and FC15 fruit was >35mm in size and 27% of fruit from FC15 was greater than 45mm.

Vibrant, Malling Centenary, FC15 and EM1942 had Class 1 percentages over 90%.

EM1990, Capriss, EM1746 and EM1905 produced significantly lower Class 1 fruit yields than Elsanta. Of these both EM1990 and EM1905 produced over 70% large fruit (>35mm) of which 16% was >45mm for EM1990 and 12% of EM1905.

### ***2014 Year 2 main crop fruit yield***

The trial was not protected over the winter and it was skinned on 15 April 2014 when the early varieties were in flower. The second year harvest commenced on 20 May 2014 and temperatures during the seven weeks of harvest were moderate to high. Harvest continued until 3 July.

Table 9 shows the Year 2 yield data. The 50% harvest date (the date when 50% of the total fruit yield has been harvested) is given so that the season of each of the varieties can be compared to Elsanta. The varieties were replicated three times.

Yields were consistent between replicates for all selections other than EM1905 and EM1990. In replicate C plots of both these varieties were located on the edge of a patch of Verticillium wilt that was noticeably affecting the growth of the adjacent commercial crop. The yield data given for EM1905 and EM1990 is therefore from replicates A and B only.

The Elsanta control variety produced a total yield of 1,262g per plant, of which 73% of fruit was Class 1, giving a Class 1 yield of 918g per plant. Slightly more medium (25-35mm) size fruit was produced than large (>35mm) fruit.

**Table 9. Year 2 Main crop yield data** (listed by Class 1 yield)

Variety	First pick date	50% harvest (days) cv Elsanta	Total Yield g/plant	Class 1 Yield g/plant	% Class 1	Berry Size %				
						Extra large >45mm	Large 35-45mm	Medium 25-35mm	Small <25mm	Misshapen All sizes
EM1905	25/05	-5	1380	1184	86	4	55	27	5	9
						4	65	31	Class 1 only	
FF1005	05/06	+3	1387	1121	80	0	25	55	10	10
						0	31	69	Class 1 only	
EM1990	09/06	+5	1172	1010	86	6	45	35	6	8
						6	53	41	Class 1 only	
FC15	28/05	-5	1238	985	80	15	48	17	2	19
						18	61	21	Class 1 only	
Vibrant	25/05	-7	1065	978	92	1	45	45	4	4
						1	49	49	Class 1 only	
FF1004	09/06	+6	1334	969	72	7	30	36	10	17
						9	41	50	Class 1 only	
CIR903	05/06	+2	1509	942	62	0	13	50	20	18
						0	20	79	Class 1 only	
Elsanta	05/06	14/06/14	1262	918	73	1	33	37	10	20
						1	47	52	Class 1 only	
EM1942	05/06	+2	1172	891	76	2	35	39	11	13
						2	47	51	Class 1 only	
Malling Centenary	31/05	-1	1119	843	75	4	46	26	3	22
						5	61	34	Class 1 only	
Flair	20/05	-12	981	784	80	1	37	43	4	16
						1	46	53	Class 1 only	
EM1746	08/06	+6	1010	598	59	1	20	38	13	27

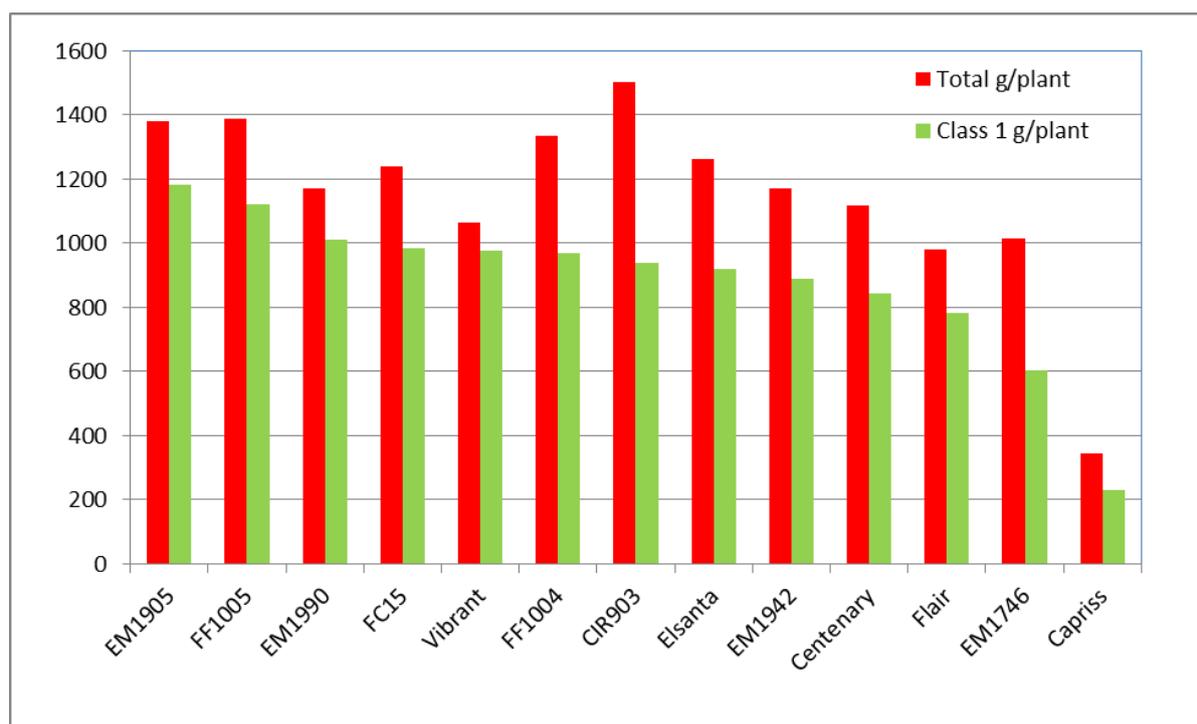
						2	34	64	Class 1 only	
Capriss	28/05	-5	343	232	68	1	19	48	10	22
						1	28	71	Class 1 only	

Capriss and EM1746 had significantly lower Class 1 yields than Elsanta. The Class 1 yield of the other ten varieties was not significantly different from Elsanta. Seven varieties gave similar or higher Class 1 yields than Elsanta; these were the early season EM1905, FC15, Vibrant and CIR903, the midseason FF1005 and later season EM1990 and FF1004.

Capriss and Flair had significantly lower total yield than Elsanta. The total yield of the other ten varieties was not significantly different from Elsanta. Four varieties gave higher total yields than Elsanta these were the early season EM1905 and CIR903, midseason FF1005, and later season FF1004.

The early season EM1905, FC15, Vibrant and Flair, midseason FF1005 and later season EM1990 and FF1004 had significantly higher percentage Class 1 fruit than Elsanta. Whilst the early season CIR903 and late season EM1746 had significantly lower percentage Class 1 than Elsanta. The percentage Class 1 of FF1004, EM1942, Malling Centenary and Capriss was not significantly different to Elsanta.

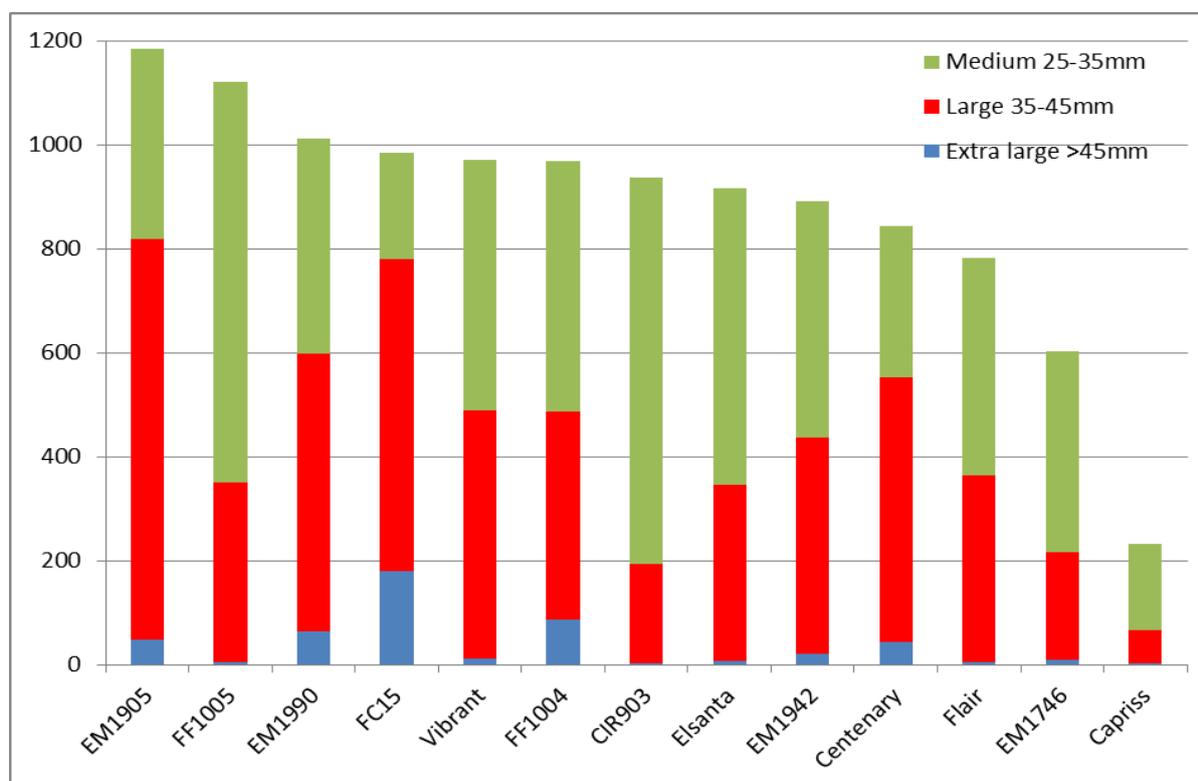
**Figure 3. Year 2 Main crop total and class 1 yield**



Malling Centenary, EM1905, EM1942, EM1990 and FC15 had a significantly higher percentage of large berries (>35mm) than Elsanta.

CIR903 had a significantly lower percentage of large berries (>35mm) than Elsanta. The other six varieties in trial (FF1005, FF1004, Vibrant, Flair, EM1746 and Capriss) were not significantly different from Elsanta.

**Figure 4. Year 2 Main crop class 1 yields showing berry size**



**Cropping profiles**

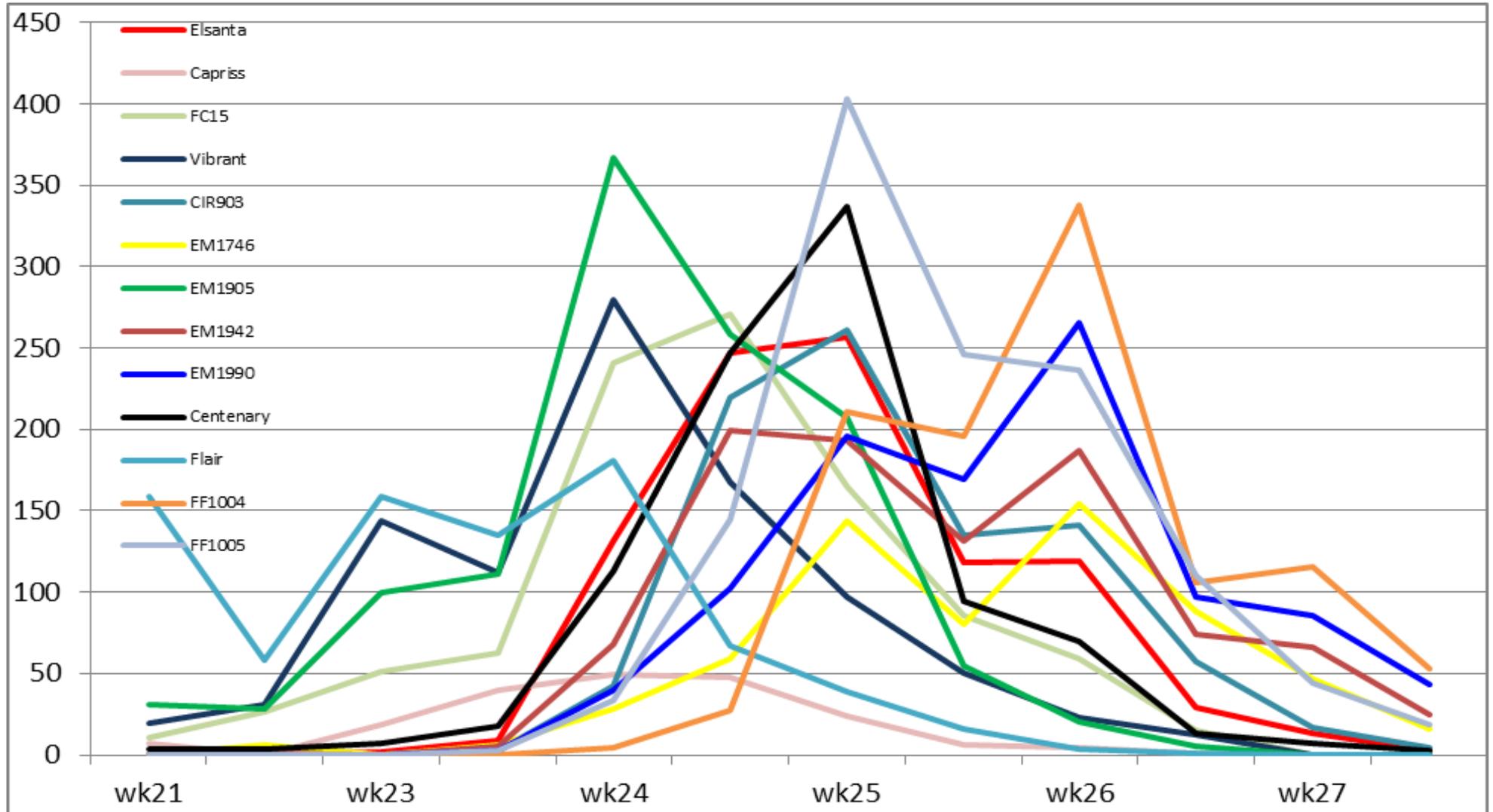
Looking at the 50% pick dates, Flair was the earliest fruiting variety with a 50% pick date 12 days before Elsanta. Vibrant, EM1905, Capriss and FC15 were approximately six days earlier than Elsanta. EM1746, FF1004, and EM1990 were the latest to fruit at six days after Elsanta. Malling Centenary had a pick date similar to Elsanta, though in other trials and in commercial production it has been shown to be a few days earlier than Elsanta.

**Table 10. Yield profiles** (indication of seasonality of varieties)

Month	May			June								July
Day	20	25	28	02	07	09	13	16	19	23	27	03
Flair				50%								
Vibrant					50%							
EM1905						50%						
Capriss						50%						
FC15						50%						
Centenary							50%					
Elsanta							50%					
CIR903								50%				
EM1942								50%				
FF1005								50%				
EM1990									50%			
EM1746									50%			
FF1004									50%			

The cropping profiles for each variety are shown in the following graph.

**Figure 5: Variety Profiles** (Class 1 grams per plant)



## **Fruit quality**

Fruit quality, including Brix° readings, were assessed on at least four dates during harvest, shelf-life on two dates after eight days in cold store and photographs were taken of the fruit on the plant, in the punnet, sliced and post cold storage. The mean variety scores for each assessment are given in table 11; these include the results recorded at the trial open day on 19 June 2014.

Of all the varieties in trial, Malling Centenary received consistently high scores for all quality attributes. EM1990 also scored highly. CIR903 and Capriss had below average fruit quality scores, except for flavour where Capriss scored higher than Elsanta.

FF1005 had the darkest skin colour of all the varieties in the trial, followed by Vibrant.

Only Capriss had a more irregular berry shape than Elsanta.

CIR903, FC15, Capriss and EM1942 had poor shelf life scores. Malling Centenary and EM1990 had the highest. The temperatures during harvest were in the mid 20's, reaching 30°C on a couple of days in June, which led to quick deterioration in fruit quality and therefore lower scores than expected for many varieties.

The flavour score for Elsanta was 6.5 and its flavour was moderately sweet through the harvest period. Flair, Vibrant, Capriss, EM1990 and EM1942 had average flavour scores higher than Elsanta. CIR903, FF1004, FF1005 and FC15 had low scores for flavour.

The average Brix reading for Elsanta was 8.8°. Flair, Capriss, EM1746 and EM1990 all produced average Brix reading above that of Elsanta.

**Table 11. Fruit quality**

Variety	External berry colour  1 = light orange 8 = dark wine-red	Uniformity of berry shape  1 = irregular 9 = uniform	Skin firmness  1 = soft 9 = firm	Berry appearance  1 = poor 9 = excellent	Fruit flavour  1 = poor 9 = excellent	Shelf life  1 = poor 9 = excellent	Mean Brix  (sugar content)
Flair	7.5	6.5	6.6	7.0	8.0	6.0	10.7
Vibrant	8.0	8.0	7.5	8.0	7.5	6.5	9.0
EM1905	7.5	8.5	6.8	7.8	7.0	6.8	9.2
Capriss	7.0	6.2	6.2	5.5	8.0	5.3	11.2
FC15	4.5	7.0	7.4	7.0	4.5	4.0	7.8
Malling Centenary	6.0	8.5	8.0	9.0	8.0	7.5	9.0
CIR903	6.5	7.0	6.0	4.5	4.0	2.5	7.6
Elsanta	6.5	5.5	7.0	6.0	6.5	6.0	8.8
EM1746	5.8	7.0	7.5	8.5	6.5	6.5	10.1
EM1990	7.0	8.5	8.0	8.5	7.0	7.5	9.9
EM1942	6.0	6.5	7.5	7.8	8.0	5.0	9.6
FF1005	8.6	6.0	7.5	7.5	5.0	7.0	7.8
FF1004	7.3	7.0	6.5	5.5	4.5	6.0	8.2

Comments on the fruit quality of each variety are given below:

**Malling Centenary** produced quality scores higher than Elsanta. The flavour was sweet and the texture juicy. Brix levels were consistently higher than Elsanta. The berries were very attractive, with a bright glossy orange/red colour, pointed conic very regular uniform shape and slightly indented seeds, giving the skin a very smooth look. Both skin and flesh had good firmness. The calyx was of average size and in proportion to the berries. The berries retained their gloss when stored, showing only slight darkening in store.

**EM1990** had variable taste, sometimes sweet, other times acidic or even bland. Usually the darker the colour the sweeter the berry tasted. Brix levels were consistently higher than Elsanta. The berries were very attractive, with a glossy bright orange/red skin and uniformly

conic shape with wide shoulders. The seeds slightly protruded from the berries surface, which sometimes gave it a seedy appearance. EM1990 scored highly for appearance at the Open Day. The berries were firm with a dense texture, white flesh colour and the skin had good strength. The calyx was quite large. All quality scores including shelf life, were better than for Elsanta.

**Flair** was pleasantly sweet tasting with a smooth, soft texture though not always very juicy. Brix levels were consistently higher than those of Elsanta. The berries were glossy and attractive, darker than Elsanta with an irregular conic shape and some variability of size. The seeds were indented. Skin and flesh had moderate firmness. In store the berries showed some darkening and bruising.

**FF1005** had a watery, sometimes quite bland taste with low sweetness. Brix levels were lower than that of Elsanta. The berries had a very glossy bright attractive appearance with a darker red skin colour than Elsanta and a white neck under the small reflexed calyx. The berry shape was round with a similar irregularity of shape to Elsanta. The skin and flesh had good firmness. In storage the fruit retained its gloss but did darken in colour and bruises became more noticeable.

**FF1004** had a bland sometimes sharp taste, the texture was juicy and Brix levels were generally lower than Elsanta. The berries were bright, blunt conic, slightly irregular in shape, with widely spaced seeds and a slightly reflexed calyx. The skin and flesh had moderate firmness. The colour was a bit darker than Elsanta. In shelf life tests the berries showed bruising quite easily and lost their shine.

**Capriss** had a good sweet taste and juicy texture. Brix levels were the highest of all varieties in trial. The berries were darker in colour than Elsanta, small and glossy with a long conic shape and a tendency to become quite necked. The calyx was reflexed. Appearance scores were consistently very low. The skin was sensitive to bruising and the texture quite soft. There was some mildew noted on the fruit towards the end of pick. In shelf life tests it showed bruising quickly and darkened in colour, though remained glossy.

**FC15** had a sharp to bland taste and crunchy, dry, dense texture. Brix levels were on average lower than Elsanta. The berries were very large, sometimes hollow with a pale orange colour, glossy skin and indented seeds. Berry shape was long blunted conic, sometimes ribbed with a strong skin and firm flesh. In shelf life tests the pale colour showed bruises very easily.

**Vibrant** had a good sweet/acid balanced flavour which scored highly in tastings, described as sometimes sharp but always tasty. The berries were very juicy, Brix levels were similar to Elsanta. With a uniform, regular conic shape, glossy darker skin colour than Elsanta the flesh remained firm and the skin strong. In shelf life tests the berries darkened in colour and any bruising became more noticeable.

**CIR903** had a variable flavour, sometimes sweet to slightly acid, other times bland. The texture was dry. Brix levels were slightly lower than Elsanta. The berries had a seedy, dull appearance with slightly irregular blunt conic shape. The berries were medium size and quite sensitive to bruising. A chimera was noted on the fruit and calyx of a few of the berries. In storage the berries deteriorated quickly.

**EM1746** was very good tasting at some picks and bland at others. The texture was juicy. Brix levels were higher than Elsanta. The berries were very attractive, being glossy with an orange/red colour. Berry shape was an irregular round wedge, of medium size with some splitting noted in a few berries later in picks. In shelf life tests the berries stored slightly better than Elsanta.

**EM1905** had a clean uncomplicated sweet to bland flavour. The texture was juicy and good. Brix levels were similar to Elsanta. The berries were very attractive, glossy red/orange, slightly darker than Elsanta. The seeds were slightly indented with a uniformly regular conic shape. Petal retention under the calyx occurred mostly during the first half of harvest. The skin was moderately firm and the flesh firm. Shelf life was similar to Elsanta.

**EM1942** had a sweet classic strawberry flavour with good juicy texture. Brix levels were slightly higher than Elsanta. At the Open Day it was noted for its very good appearance. Berries were glossy, orange to orange/red in colour with a rounded globose shape that had some irregularity like Elsanta. The flesh and skin were quite firm. In shelf life tests the orange skin colour showed bruising quite readily. The skin darkened in storage.

## **Discussion**

Following two harvest seasons a number of promising varieties have been identified for production in soil culture under rain covers.

Those varieties that did not produce improved results over Elsanta may be better suited to alternative growing systems and feeding regimes, may benefit from improved plant quality to increase yields in Year 1 or may just not have the desired attributes to compete favourably in the field or marketplace to give the UK grower and customer improved performance over the current varieties grown.

### **Early varieties:**

Five varieties showed the advantage of reaching 50% pick before Elsanta, these were:

- Flair at 12 days (-12 days) before Elsanta and Vibrant (-7 days);
- EM1905 (-5 days);
- Capriss (-5 days);
- FC15 (-5 days).

Of these EM1905, FC15 and Vibrant had higher Class 1 yields than Elsanta with significantly better Class 1 percentages and a larger fruit size in both the first and second year harvests. FC15 had lower flavour, shelf life and Brix levels than Elsanta, whilst the other four early varieties had similar or better fruit quality than Elsanta.

### ***Flair***

Due to its very early season and under the right growing conditions, Flair is a promising variety for very early production although the fruit yields were lower than Elsanta in the soil and the fruit quality average. It is a variety that would probably be better suited to growing in substrate. In the previous HDC variety trial (SF128) Flair was grown in substrate culture and produced very similar total and Class 1 yields to the soil trial. However, in the substrate trial the plants were not crown thinned and were given an Elsanta feed regime. Growing in substrate culture with a tailored feed regime for the variety with crown thinning would probably give the best results for this variety.

### ***Vibrant and EM1905***

Not as early as Flair but still providing an advantage in earliness over Elsanta of six days, Vibrant and EM1905 both gave significant improvements over Elsanta for berry size, shape and percentage class 1. EM1905 also gave the highest Class 1 yield in trial in Year 2. Class 1 percentage for Vibrant was 92% and for EM1905 86%, compared to Elsanta's 73%. These attributes should provide growers with the opportunity to start picking earlier in the spring and greatly improve picking speeds. Both varieties had similar or better fruit quality than Elsanta, the skin of EM1905 is slightly lighter in colour than Elsanta but it did suffer from petal retention, which detracted from the appearance and shows a susceptibility to *Verticillium* wilt similar to Elsanta.

### ***FC15***

This selection has the advantage of producing very large fruit, though a proportion of this was in the extra-large category (>45mm) making it too large for many markets. Low Brix, flavour and shelf life performance show that other varieties are more suitable for UK production than FC15. Growing the variety in an alternative production system is unlikely to overcome all of the deficiencies.

### ***Capriss***

This had good flavour and Brix levels but its poor shelf life, small fruit size and low fruit yield make it unsuitable for commercial production in the UK.

### **Midseason varieties:**

Four varieties had a 50% pick date within three days of Elsanta, these were Malling Centenary (-1 day), EM1942 (+2 days), CIR903 (+2 days) and FF1005 (+3 days). In Year 1, CIR903 and FF1005 had significantly higher Class 1 yields than Elsanta, whilst Malling Centenary and EM 1942 had similar yields to Elsanta.

In Year 2 all had similar Class 1 yields to Elsanta though EM1942 and FF1005 had smaller fruit size. In year two Malling Centenary and EM1942 had significantly larger fruit size, whilst CIR903 had a significantly smaller fruit size than Elsanta.

Malling Centenary had the best fruit quality scores in trial and the quality remained consistently high through the picking season. EM1942 had better fruit quality than Elsanta except for shelf life and its flavour scores were particularly good. FF1005 had lower flavour scores and Brix levels than Elsanta. CIR903 did not perform well in any of the fruit quality categories.

### ***FF1005***

This selection was three days later than Elsanta, it showed good Class 1 yields in both Year 1 and Year 2 but the proportion of medium size berries (25-35mm) was one of the highest in trial. Fruit quality attributes were good except for flavour and Brix levels, which were lower than for Elsanta. The plants were very vigorous so a feed regime and alternative agronomic practice may improve the fruit quality and berry size.

### ***Malling Centenary***

This had excellent quality characteristics providing a marked improvement over Elsanta. Season was very similar to Elsanta's in this trial, though in other trials it has been shown to be a few days earlier. Class 1 yields in both seasons was similar to Elsanta but with much improved berry size and shape. In Year 1 the plants used were medium waiting beds whereas the other varieties were either tray plants or heavy waiting beds, which will have put the variety at a disadvantage. Tailoring the agronomic practice to the variety may help to increase fruit yields, which would be worthwhile as the fruit quality of this variety is well suited to most markets.

### ***EM1942***

This was a similar season to Elsanta, only two days later for the 50% pick date. Fruit quality including flavour was generally good though it did have a lower shelf life score than Elsanta. Class 1 yields were similar to Elsanta though the fruit size was not as large as Malling Centenary.

### ***CIR903***

This had poor fruit quality but good fruit yields, though the proportion of misshapen fruit as well as small (<25mm) and medium (25-35mm) size fruit was high. Percentage Class 1 was only 62%.

### **Later season varieties:**

Three varieties had 50% pick dates five days or more after Elsanta, these were EM1990 (+5 days), EM1746 (+6 days) and FF1004 (+ 6 days).

In the first cropping year FF1004 had a significantly higher Class 1 yield than Elsanta, whilst EM1990 and EM1746 had significantly lower Class 1 yields. These results may have been affected by plant quality in Year 1 as the FF1004 plants used were large waiting bed. In the second cropping year, FF1004 and EM1990 had similar Class 1 yields to Elsanta, whilst EM1746 had a significantly lower Class 1 yield.

### **EM1990**

This selection produced significantly larger fruit than Elsanta whilst the fruit size of EM1746 and FF1004 was similar to Elsanta.

### **FF1004**

This had good Class 1 yields but a similar percentage Class 1 to Elsanta with a higher proportion of medium than large berries. Fruit quality scores were generally lower than Elsanta including flavour and Brix levels. The late season and good yields may be of interest to some growers but fruit quality is quite weak.

### **EM1746**

This had lower total and Class 1 fruit yields than Elsanta, the percentage Class 1 was particularly low at 59%. Fruit flavour and shelf life were similar to Elsanta. The plants were very vigorous and in EMR tests showed good resistance to crown rot (*Phytophthora cactorum*), both advantageous for a later season variety. This selection may not have sufficient yield to make it economic to grow unless its percentage of saleable fruit can be improved.

### **EM1990**

This had lower Class 1 yields in Year 1 than Elsanta but good fruit quality and Class 1 yields with a significantly higher proportion of large berries (>35mm) and higher percentage Class 1. For a later fruiting variety it may have a place in soil production systems.

## **Conclusions**

The following conclusions are drawn from the 2013 and 2014 cropping season of the twelve varieties grown in raised bed soil culture:

- **Flair** is a promising variety for very early production. In soil production the fruit yields were similar to Elsanta in Year 1 but lower in Year 2. The berries were a slightly better size and the percentage Class 1 80% or above. The fruit had a good taste but showed some deterioration in store. To get the best from this variety it may be better suited to growing in substrate with a tailored feed regime and agronomic husbandry (crown thinning, etc.) specific to the variety.

- Early season **Vibrant** and **EM1905** both gave significant improvements over Elsanta for berry size, shape and percentage Class 1 in soil culture. EM1905 produced the highest Class 1 yield in trial, Vibrant yields were also higher than Elsanta. These attributes should provide growers with the opportunity to start picking earlier in the season and greatly improve picking speeds. Vibrant has already demonstrated that it is suited to substrate culture, EM1905 may benefit from being grown in substrate as it has a susceptibility to *Verticillium* wilt similar to Elsanta. EM1905 fruit suffered from petal retention, which detracted from the appearance post storage.
- **Malling Centenary** had excellent fruit quality characteristics providing a marked improvement over Elsanta in soil culture for berry size, shape and percentage Class 1. Class 1 fruit yields were similar to Elsanta. The use of good plant material and tailoring agronomic practice to help increase yields would be worthwhile as the fruit quality is well suited to most markets. In this trial the fruiting season was similar to Elsanta though it has often been shown to crop a few days earlier.
- **FF1005** was three days later than Elsanta and had good fruit yields though a much higher proportion of the fruit was medium (25-35 mm) rather than large (>35mm) in size. Flavour was quite weak with low Brix levels. The plants were very vigorous, therefore a feed regime and alternative agronomic practice suited to the variety would be needed to help improve fruit quality and berry size.
- **EM1942** had a similar season to Elsanta. Fruit quality including flavour was generally good though it did have a lower shelf life score than Elsanta. Class 1 yields were similar to Elsanta but fruit size was smaller than Malling Centenary. With a susceptibility to *Verticillium* wilt there were some plant losses noted in trial, which will limit its use in soil production. With no particularly outstanding qualities it may not provide sufficient improvements to compete with other midseason varieties.
- For a later fruiting variety **EM1990** had good fruit quality with a significantly higher proportion of large berries (>35mm) and higher percentage Class 1 than Elsanta. Fruit yields were lower than Elsanta in year one but higher in year two. With a moderate susceptibility to *Verticillium* wilt but moderate resistance to crown rot (*Phytophthora cactorum*) it may provide sufficient improvement over the currently grown mid/late season varieties to warrant a place in UK soil production systems.

- **FF1004** had good Class 1 yields and a similar percentage Class 1 to Elsanta. Fruit size was similar to Elsanta. Fruit quality scores were generally lower than Elsanta including flavour and Brix levels. The late season and good yields may be of interest to growers but with poor fruit quality scores it may not be readily accepted by the market.
- **EM1746** was six days later than Elsanta. Class 1 fruit yields in both cropping seasons were significantly lower than Elsanta with a particularly low percentage Class 1 of 59 in Year 2, well below expectations for this selection. Fruit flavour and shelf life were similar or better than Elsanta. The plants were very vigorous with a dense leaf canopy. EMR tests showed good resistance to crown rot (*Phytophthora cactorum*), advantageous for a later season variety and intermediate tolerance to *Verticillium* wilt.
- In this trial early season **Capriss** despite its good flavour attributes, and **FC15** despite large fruit size, and the midseason variety **CIR903** all had generally poor fruit quality and/or low yields, which are unlikely to be overcome by alternative growing systems. Other varieties may be better suited to UK soil production systems.

### Technology transfer

An annual report of the first year trials results from the first cropping season was produced in 2013. Fruit Walks were held at the trial site in Hanch in Year 1 on 11 July 2013 and in Year 2 on 19 June 2014 to showcase the varieties in trial. The fruiting plants were observed and discussed and fruit from each variety was available for blind sampling on the day. Supermarket technologists were invited to visit the trial during fruiting.

On completion of the trial a summary of the results was produced as a PowerPoint presentation for circulation to HDC members. A presentation of the final results will be made at the HDC / EMRA day held at East Malling Research in November 2014. The full trial report is to be made available to HDC members.

## Appendices

### Appendix 1. Crown thinning assessment

As the yield data given below for crown thinning varieties in replicates A and B but not in replicate C were not produced from a fully replicated trial and some of the plants in the non-crowned thinned plots had been affected by poor establishment in 2013, should be used with caution as they may not be indicative of performance in commercial production.

In replicate C the un-thinned plots of EM1905 and EM1990 suffered from reduced vigour and plant growth most likely due to both being located at the corner of the trial where the soil was situated on the edge of a patch of wilt in the field, which had affected the adjacent commercial crop, it was therefore not possible to get any indication of whether crown thinning may have affected these varieties.

#### 2014 Crown thinning yield comparison data (listed by Class 1 yield)

Variety	Crown thinned	Total yield g/plt	Class 1 yield g/plt	Class 1 %	Berry Size %					Crown thinned plots produced:
					>45 mm	35-45mm	25-35 mm	<25 mm	Mis shapes	
FF1005	Yes	1465	1239	85	0	29	55	7	9	Larger fruit, higher class1 %
	No	1230	884	72	1	15	56	16	12	
EM1905	Yes	1380	1184	86	4	55	27	5	9	Larger fruit, higher yield
	No	746	605	81	1	21	59	15	3	
FF1004	Yes	1443	1057	73	6	31	36	9	18	Slightly higher yield
	No	1114	792	71	8	28	35	14	15	
EM1990	Yes	1172	1010	86	6	45	35	6	8	Higher yield
	No	752	679	90	2	44	45	9	1	
FC15	Yes	1231	987	80	16	49	15	2	18	No differences
	No	1252	982	78	12	47	20	1	20	
EM1942	Yes	1266	952	75	2	37	36	9	16	Higher total yield

	No	982	770	78	1	30	47	16	6	
Vibrant	No	1021	927	91	1	40	49	5	4	No thinning occurred
	No	1126	1056	94	1	54	39	1	5	
Elsanta	Yes	1286	927	72	1	25	47	11	17	No differences
	No	1213	898	74	1	31	42	6	20	
Malling Centenary	Yes	1188	914	77	4	48	24	2	22	Slightly higher yield and larger fruit
	No	980	700	71	3	39	30	7	22	
CIR903	Yes	1413	882	62	0	12	50	22	16	Slightly lower yield
	No	1682	1049	62	0	14	48	17	21	
Flair	Yes	1009	813	81	1	38	42	4	16	No differences
	No	915	718	79	0	33	46	6	15	
EM1746	Yes	1029	631	61	1	22	38	13	26	Higher class %
	No	989	543	55	0	17	38	14	31	
Capriss	Yes	299	197	66	1	16	50	10	24	No differences
	No	430	302	70	0	21	49	13	17	

## Appendix 2. Photographs

Page 32: Year 1 Plants at harvest

Page 33: Year 2 Plants at harvest

Page 34: Year 2 Plants at harvest and fruit in punnet

Page 35: Year 2 fruit in punnet

Page 36: Six berry display

Page 37: Berry sections

Page 38: Overhead view of Year 1 plots on 29<sup>th</sup> July 2013 (Replicate 1)

Page 39: Control variety Elsanta and fruit in punnet after shelf life tests

Page 40: Fruit in punnet after shelf life tests

2013 Year 1 Harvest: Flair



Vibrant



EM1905



Capriss



FC15



Malling Centenary



Elsanta



EM1746



EM1990



CIR903



EM1942



FF1005



FF1004



## 2014 Year 2 Harvest

Flair



Vibrant



EM1905



Capriss



FC15



Malling Centenary



EM1746



EM1990



CIR903



EM1942



FF1004



FF1005



Elsanta

Elsanta



Vibrant



Flair



Capriss



EM1905



FC15



Malling Centenary



EM1746



EM1990



CIR903



EM1942



FF1004



FF1005



Six berry photos

Vibrant



Flair



EM1905



Capriss



FC15



Malling Centenary



FF1004



EM1746



EM1990



CIR903



EM1942

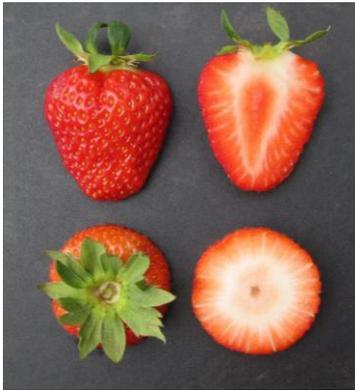


FF1005

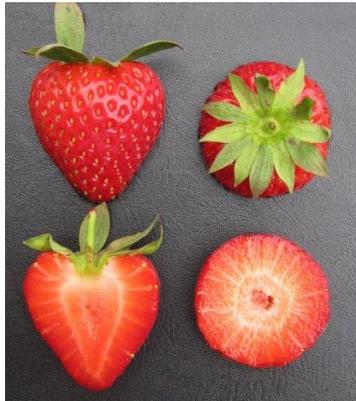


Berry sections

Flair



Vibrant



EM1905



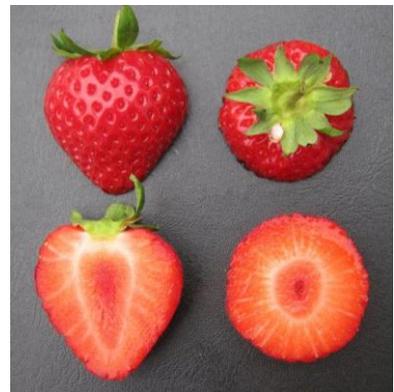
Capriss



FC15



Malling Centenary



EM1746



EM1990



CIR903



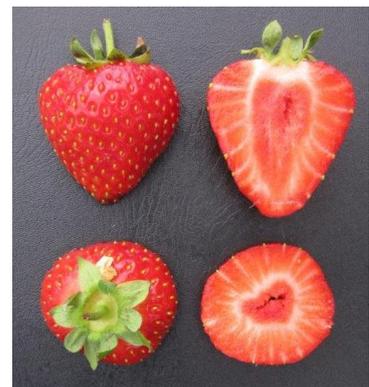
EM1942



FF1005



FF1004



Plot photos

Flair



Vibrant



EM1990



Capriss



FC15



Malling Centenary



EM1746



EM1990



CIR903



EM1942



FF1004



FF1005



Photographs of the Control variety Elsanta:



Shelf life – Fruit after 8 days in cold storage at @ 3-6°C

Elsanta



Vibrant



Capriss

Flair



EM1905



FC15



Malling Centenary

EM1746



EM1990  
CIR903



EM1942

FF1005



## Appendix 3. Assessments

### Plant number

Count plants at planting, pre-harvest, post-harvest

### Plant vigour

1 = very poor vigour/plant growth

5 = very vigorous plant growth

### Disease susceptibility (specify disease)

1 = very high susceptibility/plant death

5 = no visual symptoms of disease

### Plant habit

Description

### Fruit display

Description

### Number of trusses per plant

Assess 3 or 4 plants per plot, calculate mean

### Number of flowers per truss

Assess 3 or 4 plants per plot, calculate mean

### Fruit yield

Net weight in grams per plot of fruit harvested at each harvest date:

Divide fruit into Class 1 (>25mm no misshapes)

Class 2 fruit (<25mm plus misshapen fruit)

Class 1 may be further divided into medium size 25-35mm; large 35-45mm; extra-large >45mm.

Waste (any damaged fruit)

### Berry weight

Weigh 3 berries from each size category, 4 times during the season.

### Berry appearance

Visual assessment of fruit in punnet to include colour, shape, size, skin, gloss, seeds, calyx.

1 = very unattractive

9 = very attractive

### Berry colour

1 = White

2 = Light orange

3 = Darker orange

4 = Brick red

5 = Bright red

6 = Blood red

7 = Cardinal red

8 = Wine red

9 = Dark wine red

### Berry shape

1 = Oblate

2 = Globose

3 = Globose conic

4 = Ovoid

5 = Cordiform

6 = Long conic

7 = Necked

8 = Long wedge

9 = Short wedge

### Berry shape uniformity

1 = very irregular

9 = very uniform/regular

### Berry firmness

Rub berry skin between index finger and thumb with slight pressure, count number of rubs required to break skin.

1 = very soft/sensitive

9 = very firm

### Fruit flavour

1 = Unacceptable

5 = Acceptable

9 = Excellent

### Brix

Cut berry in half; squeeze juice from one half onto refractometer. Close cover, read scale. Wipe clean after each reading.

At least 3 berries per plot sampled from 4 harvest dates.

### Shelf life

7 days at 3-6C or state method used

1 = Very poor

9 = Very good/no deterioration

## Appendix 4. Statistical summary

2013 Year 1

The following pages detail the statistical analysis and interpretation of the Year 1 fruit yield results. The categories analysed are Total Yield, Class 1, Percentage class 1 and Percentage large fruit (>35mm).

Block.\*Units\* stratum

Variety	12	809639.	67470.	36.63	<.001
Residual	24	44206.	1842.		

Total	38	863356.			
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## Tables of means

Variate: **TOTAL YIELD**

Grand mean 367.5

Variety	<b>Capriss</b> 263.8	<b>Centenary</b> 285.1	<b>CIR903</b> 591.0	Elsanta 402.2	<b>EM1746</b> 258.0	<b>EM1905</b> 215.7	<b>EM1942</b> 284.8
Variety	<b>EM1990</b> 237.9	<b>FC15</b> 310.5	<b>FF1004</b> 600.9	<b>FF1005</b> 655.2	Flair 333.0	Vibrant 339.2	

**CIR903, FF1004 and FF1005 had significantly higher total yield than Elsanta and all other varieties in the trial**

**The total yield of Flair and Vibrant was not significantly different from Elsanta**

The other seven varieties all had significantly lower total yield than Elsanta

### Standard errors of differences of means

Table	Variety
rep.	3
d.f.	24
s.e.d.	35.04

### Least significant differences of means (5% level)

Table	Variety
rep.	3
d.f.	24
l.s.d.	72.32

### Analysis of variance

Variate: **CLASS 1 YIELD**

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	2	9072.	4536.	2.50	
Block.*Units* stratum					
Variety	12	451229.	37602.	20.74	<.001
Residual	24	43512.	1813.		
Total	38	503813.			

### Tables of means

Variate: **CLASS 1 YIELD**

Grand mean 320.1

Variety	<b>Capriss</b>	Centenary	<b>CIR903</b>	Elsanta	<b>EM1746</b>	<b>EM1905</b>	EM1942
	<b>233.1</b>	277.9	<b>489.2</b>	321.1	<b>197.0</b>	<b>210.7</b>	271.2
Variety	<b>EM1990</b>	FC15	<b>FF1004</b>	<b>FF1005</b>	Flair	Vibrant	
	<b>231.9</b>	283.2	<b>492.0</b>	<b>529.8</b>	303.4	320.2	

**CIR903, FF1004 and FF1005 had significantly higher Class 1 yield than Elsanta and all other varieties in the trial**

**Capriss, EM1746, EM1905 and EM1990 had significantly lower Class 1 yield than Elsanta**

**The other five varieties were not significantly different from Elsanta**

### Standard errors of differences of means

Table	Variety
rep.	3
d.f.	24
s.e.d.	34.77

## Least significant differences of means (5% level)

Table	Variety
rep.	3
d.f.	24
l.s.d.	71.75

## Analysis of variance

Variate: **PERCENTAGE CLASS 1**

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	2	11.257	5.628	1.06	
Block.*Units* stratum					
Variety	12	2163.740	180.312	33.99	<.001
Residual	24	127.303	5.304		
Total	38	2302.300			

## Tables of means

Variate: **% CLASS 1**

Grand mean 88.80

Variety	<b>Capriss</b>	<b>Centenary</b>	CIR903	Elsanta	EM1746	<b>EM1905</b>	<b>EM1942</b>
	<b>87.97</b>	<b>97.43</b>	82.87	79.90	76.00	<b>97.67</b>	<b>96.20</b>
Variety	<b>EM1990</b>	<b>FC15</b>	FF1004	FF1005	<b>Flair</b>	<b>Vibrant</b>	
	<b>97.40</b>	<b>91.00</b>	81.83	80.50	<b>91.10</b>	<b>94.53</b>	

**Capriss, Centenary, EM1905, EM1942, EM1990, FC15, Flair and Vibrant all had a significantly higher percentage of Class 1 fruit than Elsanta**  
**The other four varieties were not significantly different from Elsanta**

## Standard errors of differences of means

Table	Variety
rep.	3
d.f.	24
s.e.d.	1.880

## Least significant differences of means (5% level)

Table	Variety
rep.	3
d.f.	24
l.s.d.	3.881

## Analysis of variance

Variate: **PERCENTAGE LARGE BERRIES >35MM**

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	2	291.15	145.57	1.68	
Block.*Units* stratum					
Variety	12	6925.21	577.10	6.67	<.001
Residual	24	2077.68	86.57		
Total	38	9294.04			

## Tables of means

Variate: **% LARGE > 35mm**

Grand mean 60.17

Variety	Capriss 48.57	Centenary 73.79	<b>CIR903</b> <b>43.46</b>	Elsanta 58.94	<b>EM1746</b> <b>40.43</b>	<b>EM1905</b> <b>74.58</b>	EM1942 60.88
Variety	<b>EM1990</b> <b>77.41</b>	<b>FC15</b> <b>75.30</b>	FF1004 67.25	<b>FF1005</b> <b>38.25</b>	Flair 56.79	Vibrant 66.61	

**EM1905, EM1990 and FC15 had a significantly higher percentage of large berries (>35mm) than Elsanta**

**CIR903, EM1746 and FF1005 had a significantly lower percentage of large berries (>35mm) than Elsanta**

**The other six varieties were not significantly different from Elsanta**

## Standard errors of differences of means

Table	Variety
rep.	3
d.f.	24
s.e.d.	7.597

## Least significant differences of means (5% level)

Table	Variety
rep.	3
d.f.	24
l.s.d.	15.679

2014 Year 2

The following pages detail the statistical analysis and interpretation of the Year 2 fruit yield results. The categories analysed are Total Yield, Class 1, Percentage class 1 and Percentage large fruit (>35mm).

## Analysis of variance

Variate: **CLASS 1 YIELD**

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	2	190194.	95097.	4.66	
Block.*Units* stratum					
Variety	12	1811052.	150921.	7.39	<.001
Residual	24	490104.	20421.		
Total	38	2491350.			

## Tables of means

Variate: Class\_1\_Yield

Grand mean 857.

Variety	<b>Capriss</b> 232.	Centenary 843.	CIR903 937.	Elsanta 918.	<b>EM1746</b> 602.	EM1905 991.	EM1942 891.
Variety	EM1990 900.	FC15 985.	FF1004 969.	FF1005 1121.	Flair 781.	Vibrant 970.	

**Capriss and EM1746 had significantly lower Class 1 yield than Elsanta**  
**The Class 1 yield of the other ten varieties was not significantly different from Elsanta**

## Standard errors of differences of means

Table	Variety
rep.	3
d.f.	24
s.e.d.	116.7

## Least significant differences of means (5% level)

Table	Variety
rep.	3
d.f.	24
l.s.d.	240.8

## Analysis of variance

Variate: **TOTAL YIELD**

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	2	209009.	104504.	3.99	
Block.*Units* stratum					
Variety	12	2848346.	237362.	9.06	<.001
Residual	24	628702.	26196.		
Total	38	3686057.			

## Tables of means

Variate: Total\_Yield

Grand mean 1123.

Variety	<b>Capriss</b> 343.	Centenary 1119.	CIR903 1503.	Elsanta 1262.	EM1746 1016.	EM1905 1168.	EM1942 1172.
Variety	EM1990 1032.	FC15 1238.	FF1004 1334.	FF1005 1387.	<b>Flair</b> <b>977.</b>	Vibrant 1056.	

**Capriss and Flair had significantly lower total yield than Elsanta**

**The total yield of the other ten varieties was not significantly different from Elsanta**

## Standard errors of differences of means

Table	Variety
rep.	3
d.f.	24
s.e.d.	132.2

## Least significant differences of means (5% level)

Table	Variety
rep.	3
d.f.	24
l.s.d.	272.7

## Analysis of variance

Variate: **PERCENTAGE CLASS 1**

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	2	24.66	12.33	1.01	
Block.*Units* stratum					
Variety	12	3181.24	265.10	21.65	<.001
Residual	24	293.82	12.24		
Total	38	3499.73			

## Tables of means

Variate: %\_Class\_1

Grand mean 76.09

Variety	Capriss 67.73	Centenary 75.08	<b>CIR903</b> <b>62.23</b>	Elsanta 72.81	<b>EM1746</b> <b>59.26</b>	<b>EM1905</b> <b>84.23</b>	EM1942 76.06
Variety	<b>EM1990</b> 87.58	<b>FC15</b> 79.60	FF1004 72.50	<b>FF1005</b> <b>80.34</b>	<b>Flair</b> <b>79.94</b>	<b>Vibrant</b> <b>91.80</b>	

**EM1905, EM1990, FC15, FF1005, Flair and Vibrant had significantly higher percentage Class 1 than Elsanta**

**CIR903 and EM1746 had significantly lower percentage Class 1 than Elsanta**

**The percentage Class1 of the other four varieties was not significantly different from Elsanta**

## Standard errors of differences of means

Table	Variety
rep.	3
d.f.	24
s.e.d.	2.857

## Least significant differences of means (5% level)

Table	Variety
rep.	3
d.f.	24
l.s.d.	5.896

## Analysis of variance

Variate: **PERCENTAGE LARGE BERRIES >35MM**

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	2	306.51	153.26	1.89	
Block.*Units* stratum					
Variety	12	9359.61	779.97	9.60	<.001
Residual	24	1950.64	81.28		
Total	38	11616.77			

## Tables of means

Variate: %\_Large

Grand mean 46.2

Variety	Capriss 26.6	<b>Centenary</b> 64.8	<b>CIR903</b> 20.3	Elsanta 37.9	EM1746 35.9	<b>EM1905</b> 54.8	EM1942 48.2
Variety	<b>EM1990</b> 56.3	<b>FC15</b> 79.2	FF1004 50.2	FF1005 30.5	Flair 46.1	Vibrant 49.8	

**Centenary, EM1905, EM1942, EM1990 and FC15 had a significantly higher percentage of large berries (>35mm) than Elsanta**

**CIR903 had a significantly lower percentage of large berries (>35mm) than Elsanta**

**The other six varieties were not significantly different from Elsanta**

## Standard errors of differences of means

Table	Variety
rep.	3
d.f.	24
s.e.d.	7.36

## Least significant differences of means (5% level)

Table	Variety
rep.	3
d.f.	24
l.s.d.	15.19