

Project title: To assess the performance of new June-bearing strawberry varieties and advanced selections in a commercial UK substrate production system over two harvest periods.

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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.

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GROWER SUMMARY

Headline

- Jive and Vivaldi produce high yields as tray plants in this substrate grown strawberry variety trial.

Background

For the strawberry industry to make the best use of substrate production, varieties are a key ingredient for success. Elsanta remains the most widely grown June-bearing variety in substrate production but it has limitations, which include the production of a high proportion of medium size berries, a characteristic that leads to higher picking costs, and it has a tendency to produce misshapen fruit due to its sensitivity to cool temperatures at flowering. Finding a variety that reliably produces large size berries with a high proportion of class 1 fruit could significantly increase profitability without requiring any major change to current production systems. The purpose of this project is to assess a range of new strawberry varieties and numbered selections from a range of European strawberry breeding programmes and compare them with Elsanta for yields, fruit quality, plant habit and pest and disease resistance.

New Farm Produce hosted the variety trial on their site in Elmhurst in Staffordshire. Particular thanks are extended to Stephen McGuffie of New Farm Produce for his support with the project. The trial was housed within a permanently skinned enclosed poly tunnel with vents and removable doors for ventilation as required. The tunnel contained four double rows of table top production. The trial was located in the centre three double rows. The trial used half metre troughs filled with coir substrate. The rows ran north to south. Truss supports were used. Fertigation was supplied to each trough. The trial was managed by New Farm Produce for all fertigation and agrochemical inputs. The feeding regime was based on a standard crop of Elsanta.

The trial was planted from 4 – 8 February 2014. The harvest began on 30 April (week 18) and continued until 30 June (week 27), a total of nine weeks. Fruit was picked three times per week for the majority of harvest.

During the trial assessments were made for plant vigour, plant habit, runner production, truss number, incidence of powdery mildew. During the harvest period, records were collected for berry size categories, percentage class 1 and class 2. Fruit appearance, quality, flavour and shelf-life were also assessed.

The trial details and results are only briefly summarised in this Grower summary section. For full and comprehensive information about the trial and the full results, refer to the full trial report below this Grower summary.

Table 1 lists the varieties included, breeding programmes, country of origin, production season and plant types used.

Table 1: Varieties and numbered selections included in the trial

Variety/ Selection	Breeder	Country	Season	Plant Type
EM1552	East Malling Research	UK	Early	Tray 9cm x 7cm
Magnum	Marionnet SARL	France	Early	Tray 9cm x 7cm
Fleurette	Goossens Flevoplants	Netherlands	Early	Tray 9cm x 7cm
Garda	CRA - FRF	Italy	Early-mid	Tray 9cm x 7cm
Malling Centenary	East Malling Research	UK	Early-mid	Tray 9cm x 7cm
EM1677	East Malling Research	UK	Mid	Tray 9cm x 7cm
Elsanta	Plant Research International (PRI)	Netherlands	Mid	Tray 9cm x 7cm
EM1996	East Malling Research	UK	Mid-late	Tray 9cm x 7cm
EM1998	East Malling Research	UK	Mid-late	Tray 9cm x 7cm
EM2044	East Malling Research	UK	Mid-late	Tray 9cm x 7cm
EM2056	East Malling Research	UK	Mid-late	Tray 9cm x 7cm
Vivaldi	Fresh Forward	Netherlands	Mid-late	Tray 9cm x 7cm
Jive	Fresh Forward	Netherlands	Late	Tray 9cm x 7cm

Results

The trial results are only briefly summarised in this Grower summary section. For full and comprehensive results from year 1 (2014), refer to the full trial report below this Grower summary. A summary of plant characteristics in year 1 of the trial is presented in Table 2.

Table 2: Plant characteristics

Variety	Plant losses <i>out of 60 planted</i>	Plant vigour <i>1 = low 5 = very vigorous</i>	Runner production <i>1 = none 5 = prolific</i>	Average crown number per plant	Average flower number per truss	Powdery mildew <i>1 = none 5 = high incidence</i>
EM1552	5	3.5	3.5	2.0	31	2
Magnum	0	4.0	1.0	3.0	30	0
Fleurette	2	5.0	2.5	4.0	21	2
Garda	1	2.3	0.5	3.0	29	1
Malling Centenary	0	3.5	1.0	2.0	79	0
EM1677	0	3.3	0.7	2.0	43	0
Elsanta	0	3.2	1.3	2.0	65	2
EM1998	0	4.0	3.5	2.5	17	1
EM2044	1	3.5	3.0	2.5	23	0
EM2056	0	4.2	3.5	2.0	53	0
Jive	0	4.3	1.5	3.0	21	1
Vivaldi	0	4.3	1.5	4.0	16.5	0
EM1996	0	3.4	2.3	2.5	43	2

A summary of yield data collected during year 1 harvest (2014) is presented in Table 3.

Table 3: 2014 Year 1 fruit yield data

Variety	50% pick date	Total yield (g/plant)	Class 1 yield (g/plant)	% Class 1
EM1552	14/05/14	165.9	158.7	95.7
Magnum	20/05/14	330.9	314.0	95.0
Fleurette	21/05/14	340.8	332.4	97.5
Garda*	18/05/14	203.1	177.3	87.3
Malling Centenary	21/05/14	290.5	286.7	98.7
EM1677	19/05/14	205.0	198.9	97.0
Elsanta	20/05/14	374.0	326.9	87.4
EM1996	22/05/14	153.3	137.3	89.6
EM1998	19/05/14	102.5	98.3	96.3
EM2044	20/05/14	156.6	153.4	98.0
EM2056	15/05/14	131.0	128.8	98.3
Vivaldi	30/05/14	577.7	542.8	94.0
Jive	06/05/14	603.2	567.8	94.1

Conclusions

In this first year of the project the following conclusions are drawn from 60-day cropping of 12 varieties in a commercial UK substrate production system in comparison with Elsanta:

- Jive and Vivaldi produced significantly higher fruit yields than Elsanta and the other nine varieties/selections in trial, though both had weak fruit flavour.
- EM2056, EM1677, EM1996, EM2044, Fleurette and Jive all produced a high proportion of large berries.
- Garda and EM1552 are the least promising varieties in trial in year 1 production. Both gave lower fruit yields and poorer fruit quality than Elsanta.
- A number of varieties in trial have the potential for successful production in the UK but their year 2 main crop performance will be the deciding factor for profitable production.
- The second year main crop results are required before any firm conclusions can be drawn.

SCIENCE SECTION

Introduction

Protected table top substrate systems are an increasingly important sector of the strawberry fruit production industry. This production system can provide the means to overcoming soil borne disease problems, give season extension at both ends of the year and improve picking efficiency.

For the industry to make the best use of substrate production, varieties are a key ingredient for success. Elsanta remains the most widely grown June-bearing variety in substrate production but it has limitations, which include the production of a high proportion of medium size berries, a characteristic that leads to higher picking costs, and it has a tendency to produce misshapen fruit due to its sensitivity to cool temperatures at flowering. Finding a variety that reliably produces large size berries with a high proportion of class 1 fruit could significantly increase profitability without requiring any major change to current production systems.

There are many breeding programmes worldwide investing heavily in the production and marketing of new varieties and each year a number of new varieties are released into the marketplace. Screening these new varieties and near-market June bearer selections in substrate culture on one site under the same growing conditions, to compare their productivity and fruit quality against the market standard, provides useful information to the fruit grower. Assessment of the potential to provide season extension, increased productivity, improved harvest efficiency and/or fruit quality characteristics such as berry size, flavour and shelf life, are all key aspects of a variety.

New improved varieties enable the UK to continue to produce a high quality product and meet the ever-increasing demands of its market outlets and consumers. Season extension is one example of how UK produced fruit can increase its share of annual UK fruit sales, whilst the introduction of new varieties into the marketplace can in itself lead to an increase in demand for the fruit.

Materials and methods

Varieties and numbered selections

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

Table 4 lists the varieties included, breeding programmes, production season and plant types used.

Table 4: Varieties and numbered selections included in the trial

Variety/ Selection	Breeder	Country	Season	Plant Type
EM1552	East Malling Research	UK	Early	Tray 9cm x 7cm
Magnum	Marionnet SARL	France	Early	Tray 9cm x 7cm
Fleurette	Goossens Flevoplants	Netherlands	Early	Tray 9cm x 7cm
Garda	CRA - FRF	Italy	Early-mid	Tray 9cm x 7cm
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EM1996	East Malling Research	UK	Mid-late	Tray 9cm x 7cm
EM1998	East Malling Research	UK	Mid-late	Tray 9cm x 7cm
EM2044	East Malling Research	UK	Mid-late	Tray 9cm x 7cm
EM2056	East Malling Research	UK	Mid-late	Tray 9cm x 7cm
Vivaldi	Fresh Forward	Netherlands	Mid-late	Tray 9cm x 7cm
Jive	Fresh Forward	Netherlands	Late	Tray 9cm x 7cm

Trial site details

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

The trial was housed within a permanently skinned enclosed poly tunnel with vents and removable doors for ventilation as required. The tunnel contained four double rows of table top production. The trial was located in the centre three double rows. The trial used half metre troughs filled with coir substrate. The rows ran north to south. Truss supports were used. Fertigation was supplied to each trough.

The trial was managed by New Farm Produce for all fertigation and agrochemical inputs. The feeding regime was based on a standard crop of Elsanta.

Production details

Planting date: 4 - 8 February, 2014.

Protection: Permanent polytunnel, fully enclosed with vents and removable doors

Fertigation: Drippers provided the fertigation to each trough

Crop protection: As required

Runners cut: Three times during the season

Leaf removal: None

Year 1 harvest: 30 April (week 18) to 30 June 2014 (week 27) - 9 weeks in total

Year 2 harvest: 2015

Harvest frequency: Picked 3 times a week for the majority of harvest

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 (*Podosphaera aphanis*) on leaves 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 made on at least four dates during the two harvest seasons for:

- External berry colour score (1 =light orange; 8 = dark wine red) (*Appendix 9.2*)
- 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 deg C (1 = poor; 9 = excellent)
- Flavour score (1 =poor; 9 = excellent)
- Brix readings on 3 berries on at least 4 dates during peak harvest

Photographs: Plants pre and post planting

Plants at the flowering stage (*Appendix 9.1*)

- Year 1 plants in fruit
- Six berries per variety at 3 dates during harvest
- Berry sections
- Fruit post cold storage

Trial design

Trial type: Coir substrate table top production under protection

Trial design: Randomised block using 3 replicates

Varieties: 12 new and near-market varieties/selections as detailed in Table 1

Trial control: Elsanta tray plants

Plant types: Tray plants except for variety 'Garda' where only A+ plants were available

Plot size: 20 plants per plot/replicate, 60 plants in total per variety

Plant spacing: 5 plants per 0.5 metre trough

Statistical analysis: Fruit yields were analysed by statistician Dr David Simpson, EMR (*see appendix 9.3 for the statistical report*)

Results

The trial established well in early spring 2014 under protection.

Spring 2014 was relatively mild. There were a couple of late frosts in April but no particular variety showed any cold damage in the flowers. The early varieties started to flower in March. The first ripe berries were present on 30 April. The temperatures through May and June were moderate with no excessive heat.

Plant characteristics

Table 5: Plant characteristics

Variety	Plant losses <i>out of 60 planted</i>	Plant vigour <i>1 = low 5 = very vigorous</i>	Runner producti on <i>1 = none 5 = prolific</i>	Average crown number <i>per plant</i>	Average flower number <i>per truss</i>	Powdery mildew <i>1 = none 5 = high incidence</i>
EM1552	5	3.5	3.5	2.0	31	2
Magnum	0	4.0	1.0	3.0	30	0
Fleurette	2	5.0	2.5	4.0	21	2
Garda	1	2.3	0.5	3.0	29	1
Malling Centenary	0	3.5	1.0	2.0	79	0
EM1677	0	3.3	0.7	2.0	43	0
Elsanta	0	3.2	1.3	2.0	65	2
EM1998	0	4.0	3.5	2.5	17	1
EM2044	1	3.5	3.0	2.5	23	0
EM2056	0	4.2	3.5	2.0	53	0
Jive	0	4.3	1.5	3.0	21	1
Vivaldi	0	4.3	1.5	4.0	16.5	0
EM1996	0	3.4	2.3	2.5	43	2

Tray plants of all the EMR selections, including the variety Malling Centenary, were not as well rooted on delivery as the other varieties in the trial. This appeared to delay establishment and affect subsequent fruit production as the plants did not achieve sufficient root or foliage growth before fruit production began. EM1996 suffered the most as the plants supplied were particularly small.

EM1552 had an open, erect plant habit with good plant vigour. The plants were quite variable in size. There were 5 plant losses which were spread over all the replicates. On examination, crown rot (*Phytophthora cactorum*) looked to be the cause of the losses. Some mildew symptoms were seen on the leaves but the fruit was not affected. The plants produced 2 crowns on average. The leaf petioles and trusses were thin and spindly. Fruit was displayed on short trusses.

Magnum tray plants were well rooted on planting and produced vigorous early leaf growth. Plants had an upright plant habit forming compact moderate size plants with dense leaf growth. Trusses were strong and of good length. The fruit was well presented to the picker. Leaves were very thick and robust. On average 3 crowns were produced per plant.

Fleurette tray plants were delivered with very good root growth. After planting, growth was very strong, producing the largest plants with the most vigorous growth of all the varieties in the trial. Two plant losses occurred in replicate 2, which may have been due to *Phytophthora cactorum*. The plants were tall and upright with a dense leaf canopy, glossy mid-green leaves and strong fruiting trusses of moderate length. The plants produced 4 crowns on average. A plant density of 10 per metre may prove too dense in year 2 and some crown thinning will be required at the end of the season. The leaves showed some mildew towards the end of harvest but the fruit remained clean and fruit display was good.

Garda had moderate vigour. Plants were compact with a domed leaf canopy and thick leaf petioles and trusses. Trusses were generally short. On average, 3 crowns were produced per plant.

Malling Centenary had a slightly more vigorous growth than Elsanta with an upright, tall plant habit. Leaves were large and glossy and trusses were short, which was atypical for the variety. On average 2 crowns were produced per plant.

EM1996 plants had an open habit with moderate vigour and sparse leaf growth. The plants were tall with long leaf petioles and trusses. Fruit display was good. The plants were very small on delivery to the trial, which put the variety at a disadvantage as plant development and fruiting were competing for resources. 2 or 3 crowns were produced. Some mildew symptoms were seen on the leaves.

EM1998, as with all the EMR selections, were not as well rooted on delivery as the other varieties in trial. EM1998 displayed an open erect plant habit with sparse, floppy, soft leaf growth. The plants were tall and the trusses long. The plants produced 2 or 3 crowns. Runner production was quite high.

EM2044 produced compact, strong plants with healthy matt leaf growth. The plant habit was open and upright and the trusses very short. One plant showed a chimera on the leaf, which also showed through on to the fruit. One plant was lost during establishment. 2 or 3 crowns were produced per plant.

EM2056 had vigorous leafy plant growth with an upright habit and thick, strong petioles and trusses. Leaves were dark matt green remaining clean through the season. Many runners were produced. On average each plant produced 2 crowns.

Jive and **Vivaldi** tray plants were delivered as well rooted plants with good leaf growth. Growth was strong after planting with a tall, dense leaf canopy produced. Jive produced thick, dark matt green leaves with an upright plant habit. Fruit became tangled in the foliage at harvest which hindered picking. One plant showed white streaks (chimera) on a few leaves but this did not appear on the fruit. Vivaldi had a more open plant habit with lighter green leaves. The trusses were of average length with some flowers produced within the foliage. The fruit was displayed in bunches.

Disease

A spray programme was applied to the trial. The varieties Elsanta, EM1552, Fleurette and EM1996 showed some powdery mildew (*Podosphaera aphanis*) symptoms on the leaves but this did not affect the fruit.

The East Malling Research varieties have undergone disease trials and results indicate that EM1552 is susceptible to crown rot (*Phytophthora cactorum*). Five plant losses in the trial were considered to be caused by crown rot (*Phytophthora cactorum*). EM1677 has been shown to have good resistance to *Verticillium* wilt with a similar susceptibility to crown rot and mildew as Elsanta. In trial it showed no disease problems. EM1996 and EM2044 have a similar susceptibility to *Verticillium* wilt as Elsanta. EM2056 is resistant to crown rot.

2014 Year 1 fruit production results

The first year harvest commenced on 30 April 2014 and harvest continued until 30 June. The fruit was picked three times a week. At each pick class 1 fruit (>25mm) was weighed into three size categories: medium 25-35mm, large 35-45mm and extra large >45mm. The class 2 fruit which consisted mainly of small (<25mm) and misshapen fruit was also recorded.

Table 6 shows the year 1 yield data gathered. All varieties except Garda were planted as tray plants. A+ plants of Garda were used. The East Malling Research selections plus Malling Centenary tray plants were less well rooted than the other varieties in trial. This may

account for the lower yields recorded for these entries and therefore this should be taken into consideration when comparing the yield data below.

Table 6: 2014 Year 1 Fruit Yield data

* Garda plants used were A+. All other varieties were tray plants.

Variety	50% pick date	Total yield (g/plt)	Class 1 yield (g/plt)	% Class 1	Berry size %				
					Extra-large >45mm	Large 35-45mm	Medium 25-35mm	Small <25mm	Misshapes all sizes
EM1552	14/05/14	165.9	158.7	95.7	2	40	58	Class 1 only	
					2	38	55	1	3
Magnum	20/05/14	330.9	314.0	95.0	4	48	48	Class 1 only	
					3	46	46	1	5
Fleurette	21/05/14	340.8	332.4	97.5	2	57	41	Class 1 only	
					2	56	40	1	2
Garda*	18/05/14	203.1	177.3	87.3	1	33	66	Class 1 only	
					1	29	58	7	6
Malling Centenary	21/05/14	290.5	286.7	98.7	2	51	47	Class 1 only	
					2	50	46	0	1
EM1677	19/05/14	205.0	198.9	97.0	5	54	41	Class 1 only	
					5	52	40	1	2
Elsanta	20/05/14	374.0	326.9	87.4	6	45	49	Class 1 only	
					5	38	41	1	15
EM1996	22/05/14	153.3	137.3	89.6	0	60	40	Class 1 only	
					0	53	36	1	10
EM1998	19/05/14	102.5	98.3	96.3	1	57	43	Class 1 only	
					1	54	41	2	2
EM2044	20/05/14	156.6	153.4	98.0	4	62	34	Class 1 only	
					4	60	33	1	1
EM2056	15/05/14	131.0	128.8	98.3	24	56	20	Class 1 only	
					24	55	19	0	1
Vivaldi	30/05/14	577.7	542.8	94.0	1	37	62	Class 1 only	
					1	35	58	5	1
Jive	06/05/14	603.2	567.8	94.1	8	56	36	Class 1 only	
					8	52	34	1	5

Figure 1: Year 1 Fruit Yield (g/plant)

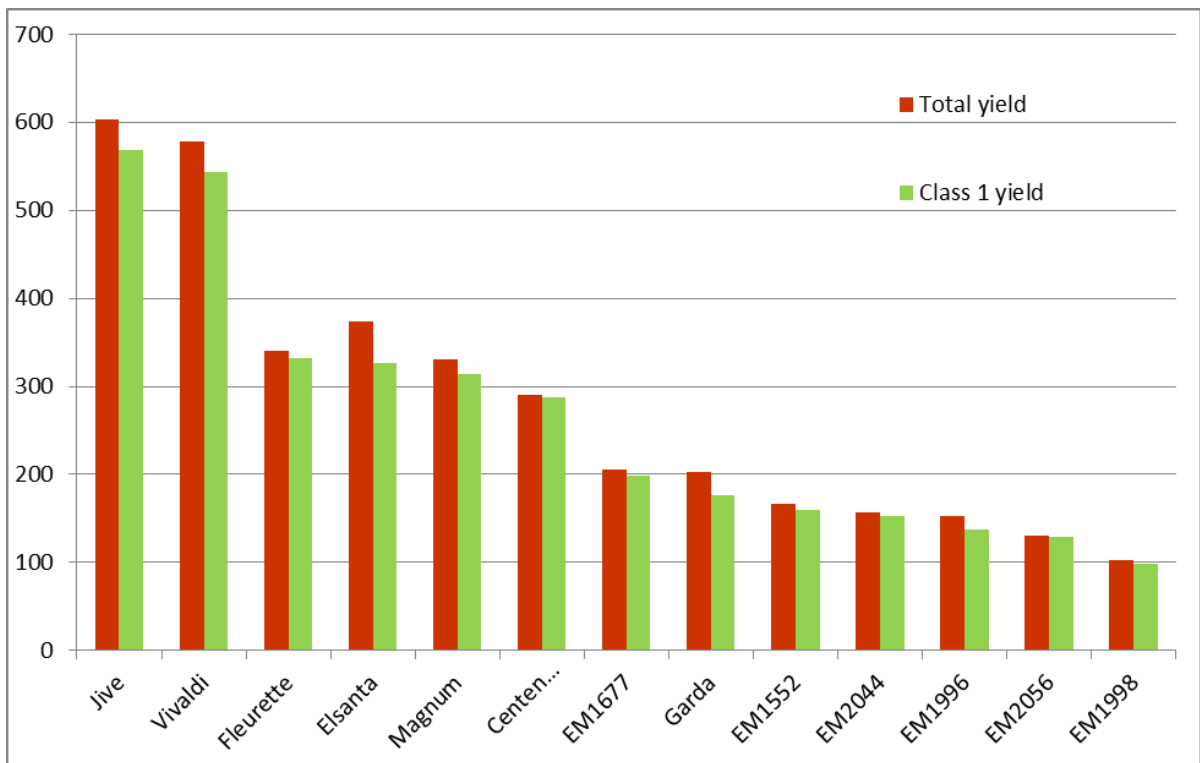
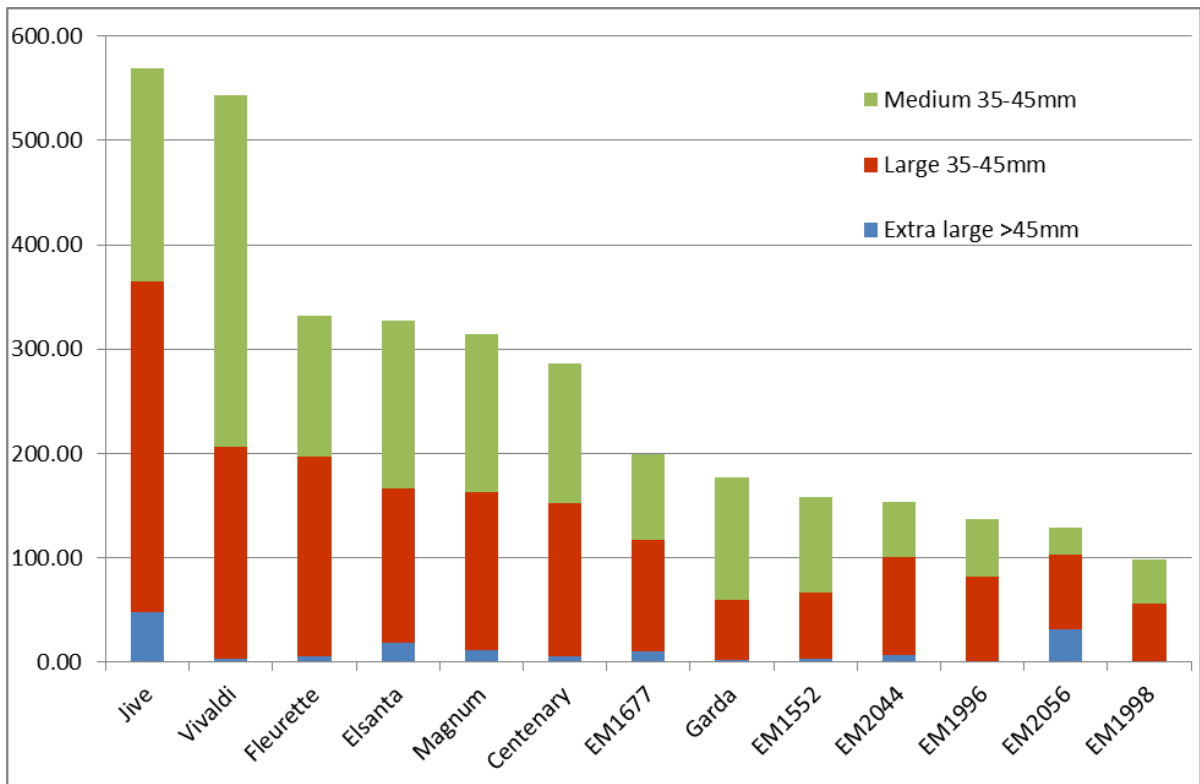


Figure 2: Year 1 Class 1 Berry Size



Each variety in the trial produced relatively consistent yield data in each of the three replicates suggesting that the plants, substrate and environmental conditions were uniform within the trial.

The Elsanta tray plant control produced an average total yield of 374g per plant and class 1 yield of 326.9g per plant with a high class 1 percentage of 87.4%. The class 2 fruit mainly consisted of misshapes. 43% of the class 1 fruit was large (>35mm) in size.

Jive and Vivaldi produced significantly higher total and class 1 yields than Elsanta and all other varieties in the trial.

The class 1 yield of Malling Centenary, Fleurette and Magnum was not significantly different to Elsanta. The other seven varieties in trial all had much lower class 1 yields than Elsanta and the other varieties in the trial.

The percentage class 1 was good for all varieties in trial, the lowest being for Garda, Elsanta and EM1996 at between 87.3% and 89.6%. All the other varieties produced 94% or higher class 1 fruit.

EM2056 produced the highest percentage of large berries (>35mm) of which 24% were in the extra- large (>45mm) size category. EM1677, EM1996, EM2044, Fleurette and Jive had a significantly higher percentage of large berries (>35mm) than Elsanta with most of the berries falling into the large (35-45mm) rather than extra-large (>45mm) category, which meant they were all saleable.

Malling Centenary, EM1998 and Magnum produced fruit of a similar size to Elsanta, whilst EM1552, Garda and Vivaldi produced significantly smaller fruit than Elsanta.

Fruit quality

Fruit quality including Brix readings were assessed on at least four dates during harvest. Shelf-life was assessed on two dates after 7-8 days in cold store. Photographs were taken of the fruit on the plant, in the punnet, sliced and after cold storage. The mean variety scores for each assessment are presented in Table 7.

Table 7 Fruit Quality

Variety	External berry colour	Uniformity of berry shape	Firmness	Berry appearance	Fruit flavour	Shelf life	Mean Brix
	<i>1 light orange</i>	<i>1 irregular</i>	<i>1 soft</i>	<i>1 poor</i>	<i>1 poor</i>	<i>1 poor</i>	(sugar content)
	<i>8 dark wine-red</i>	<i>9 uniform</i>	<i>9 firm</i>	<i>9 excellent</i>	<i>9 excellent</i>	<i>9 excellent</i>	
EM1552	7.0	7.5	6.0	6.5	6.0	6.0	10.1
Magnum	7.5	6.5	8.0	6.5	7.5	8.0	11.2
Fleurette	5.0	7.0	7.0	7.5	7.0	8.0	8.9
Garda	7.5	7.5	8.0	7.0	6.0	6.0	7.3
Malling Centenary	6.0	8.5	8.0	9.0	8.0	7.5	8.6
EM1677	7.0	8.0	8.0	8.0	7.5	7.0	9.3
Elsanta	6.5	6.5	7.0	6.0	7.5	6.5	8.9
EM1998	6.0	7.5	7.0	7.5	7.5	7.0	10.7
EM2044	6.0	7.5	7.5	7.5	6.5	7.8	9.9
EM2056	6.5	7.0	7.0	7.0	7.0	7.0	10.5
Jive	6.0	7.0	6.5	7.0	6.0	6.5	6.7
Vivaldi	8.0	6.5	8.0	8.0	6.0	6.0	6.4
EM1996	6.0	7.5	7.5	7.5	7.5	7.5	10.4

EM1552 berries had a conic shape with a distinct neck that was susceptible to splitting under the calyx at a couple of picks. The berries were attractive and were darker red colour than Elsanta. The texture was soft and flavour was pleasantly aromatic.

Magnum berries were blunt conic in shape with wide shoulders and a reflex calyx. There was some irregularity to the shape especially during the first couple of harvests when the berries had a very knobbly appearance. Berry colour was darker than Elsanta with less gloss. The berries had good skin strength and dense, firm flesh. Shelf life scores were usually good with little deterioration. The flavour varied from bland to sweet. Brix levels were usually one of the highest at an average 11.2 compared with Elsanta at 8.9.

Fleurette produced attractive glossy bright uniformly orange berries of moderate size. There was some irregularity to the shape. Due to the orange colour, bruising was very apparent. Flavour was variable ranging from bland to acidic. Flesh texture was good. Brix levels were similar to Elsanta.

Garda had very attractive, glossy red-orange berries with a small reflex calyx and long bi-conic shape. There was good uniformity of shape between berries. Some splitting was seen on the neck around the calyx at one pick. Early in the season berries were quite wedge shaped. The flesh was firm and the skin showed few bruises but the skin colour darkened in storage. Flavour was quite acidic and brix levels usually lower than Elsanta.

Malling Centenary berries were glossy, bright orange-red with a uniformly regular conic shape. The skin had good strength and flesh was firm. In shelf life tests the berries retained a good gloss and darkened only slightly. Flavour was pleasantly sweet with a crisp texture and brix levels consistently higher than Elsanta.

EM1677 produced attractive, glossy bright red-orange berries with a uniformly pointed conic shape. Skin showed good strength and flesh had good firmness. Bruising became more noticeable with storage. Flavour was pleasantly sweet though at some picks it was quite bland. Brix levels were slightly higher than Elsanta.

EM1996 had regular pointed conic berries with a red-orange colour slightly darker than Elsanta. The berries were glossy with good colour uniformity and firmness. In shelf life tests the fruit performed better than Elsanta. The flavour was sweet and brix levels good.

EM1998 had moderate sized, glossy orange berries. Berry shape was rounded conic with wide shoulders. Flesh was quite soft with bruising showing on many berries after storage. Flavour was sweet and juicy with good brix levels.

EM2044 had attractive pointed conic berries with a glossy red-orange skin colour. The berries had good uniformity. The skin had good strength and the flesh was firm. Flavour was quite bland at most picks with a dry texture. Brix levels were slightly higher than Elsanta.

EM2056 produced very glossy orange to orange-red berries with few seeds and a rounded conic shape. The skin was quite sensitive to damage though in shelf life tests the berries stored well. Flavour was acceptable but the texture quite dry. Brix levels were generally higher than Elsanta.

Vivaldi had very attractive, glossy berries that were round in shape with wide shoulders. There was some irregularity in shape similar to that found in Elsanta. The calyx was small and slightly reflexed. Berry colour was darker than Elsanta. The skin was quite strong and

the flesh firm. In store the berries darkened in colour but remained very glossy with little bruising. Berry texture was good but flavour was bland or sometimes slightly acidic. Brix levels were significantly lower than Elsanta.

Jive produced attractive large blunt conic shaped berries with an orange-red glossy skin. At the start of pick the fruit was very large and furrowed. The skin was quite sensitive and the texture soft. Some skin splitting under the calyx was noted at a couple of picks. The flavour was quite weak at most picks with very little sweetness. Brix levels were lower than Elsanta.

Discussion

The final results from this project will not be available until September 2015 when a full picture of each of the varieties' fruit yield, fruit quality, plant habit, disease susceptibility and seasonality of production will be presented. The discussion that follows is based only on the results available from year 1; the conclusions drawn may therefore differ to those in the final report.

It should be noted that the 2014 first year fruit yield results are likely to have been affected by the difference in tray plant quality.

The project's first year results show Jive and Vivaldi produced the highest total and class 1 fruit yields, much higher than any of the other varieties in the trial. Of the two varieties, Jive had better fruit attributes. Berries were large in size (62% >35mm) and had reasonably good fruit quality though flavour was disappointing and brix levels lower than Elsanta. Vivaldi had a high proportion of small size berries that were darker in colour with a weak flavour and low brix levels.

EM2056 stood out for the high proportion of large fruit it produced though up to 24% was excessively large and not suitable for inclusion in class 1.

The early season EM1552 had disappointing fruit quality and suffered from more plant losses in trial than any other variety. Garda had a weak flavour with low brix levels and darkened in storage. The earliness of both these varieties will be of note next season to determine whether they have a place in commercial production.

At this mid-point in the trial there are many varieties/selections with results similar to Elsanta and of these some stand out in terms of fruit quality. More information is required from the 2015 harvest before any decisions can be made as to the suitability for UK production of any of these varieties.

Conclusions











In this first year of the project the following conclusions are drawn from 60-day cropping of 12 varieties in a commercial UK substrate production system in comparison with Elsanta:

- Jive and Vivaldi produced significantly higher fruit yields than Elsanta and the other nine varieties/selections in trial, though both had weak fruit flavour.
- EM2056, EM1677, EM1996, EM2044, Fleurette and Jive all produced a high proportion of large berries.
- Garda and EM1552 are the least promising varieties in trial in year 1 production. Both gave lower fruit yields and poorer fruit quality than Elsanta.
- A number of varieties in trial have the potential for successful production in the UK but their year 2 main crop performance will be the deciding factor for profitable production.
- The second year main crop results are required before any firm conclusions can be drawn.

Appendix

Photographs

Tray Plants

 <p>EM1677</p>	 <p>EM-1996</p>	 <p>EM1998</p>
 <p>EM2056</p>	 <p>Fleurette</p>	 <p>Jive</p>
 <p>Vivaldi</p>	 <p>Magnum</p>	 <p>Malling Centenary</p>
 <p>Elsanta</p>		

Fruiting Plants



EM1552



EM1677



EM1996



EM1998



EM2044



EM2056



Elsanta



Fleurette



Garda



Magnum



Malling Centenary



Jive



Vivaldi

Fruit in punnet



EM1552



EM1677



EM1996



EM1998



EM2044



EM2056



Elsanta



Fleurette



Garda



Jive



Magnum



Malling Centenary



Vivaldi

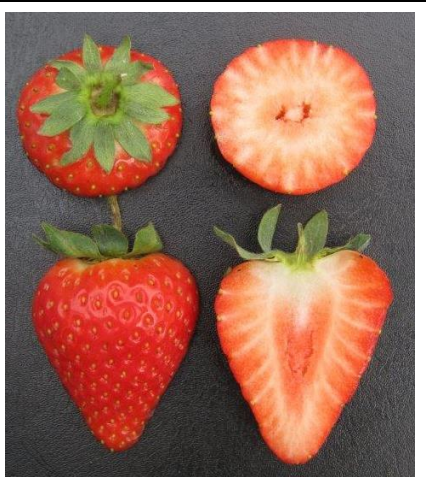
Berry sections



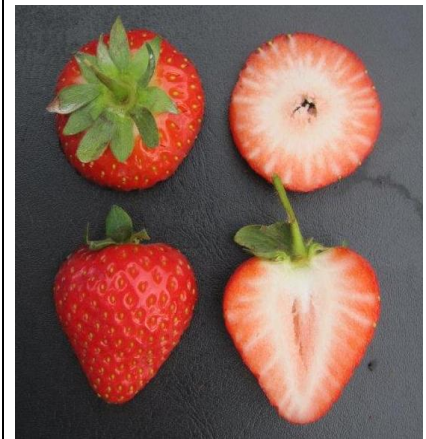
EM1552



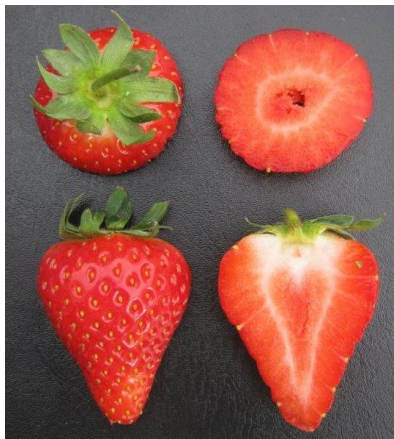
EM1677



EM1996



EM1998



EM2044



EM2056



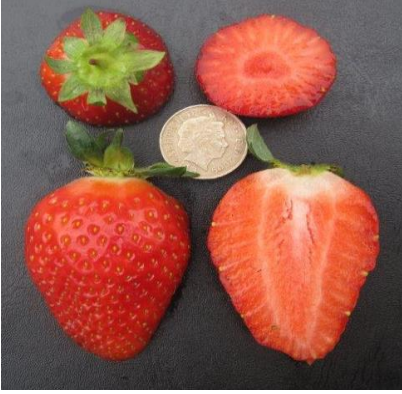
Elsanta



Fleurette



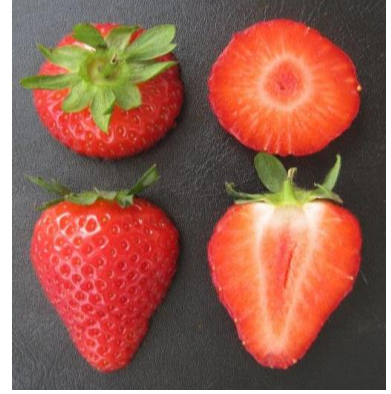
Garda



Jive



Magnum



Malling Centenary



Vivaldi

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

4 = Brick red

7 = Cardinal red

2 = Light orange

5 = Bright red

8 = Wine red

3 = Darker orange

6 = Blood red

9 = Dark wine red

Berry shape

1 = Oblate

4 = Ovoid

7 = Necked

2 = Globose

5 = Cordiform

8 = Long wedge

3 = Globose conic

6 = Long conic

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 = Unpleasant

4 = bland

7 = very sweet

2 = very acidic

5 = acceptable

8 = mildly aromatic

3 = mildly acidic

6 = pleasant/sweet

9 = very aromatic

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

2014 Year 1 Statistical summary

The following pages detail the statistical analysis and interpretation of the Year 1 fruit yield results. The categories analysed are Total Yield, Class 1 yield, 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		69.4	34.7	0.07
Block.*Units* stratum						
Variety		12	835493.1	69624.4	133.64	<.001
Residual		24	12503.4	521.0		
Total		38	848065.9			

Tables of means

Variate: Class_1_Yield

Grand mean 263.3

Variety	Centenary	Elsanta	EM1552	EM1677	EM1996	EM1998	EM2044
	286.7	326.9	158.7	198.8	137.3	98.3	153.4
Variety	EM2056	Fleurette	Garda	Jive	Magnum	Vivaldi	
	128.8	332.4	177.3	567.8	314.0	542.8	

JIVE and VIVALDI had significantly higher Class 1 yield than Elsanta and all other varieties in the trial

The Class 1 yield of Centenary, Fleurette and Magnum was not significantly different from Elsanta

The other seven varieties all had significantly lower Class 1 yield than Elsanta

Standard errors of differences of means

Table	Variety
rep.	3
d.f.	24
s.e.d.	18.64

Least significant differences of means (5% level)

Table	Variety
rep.	3
d.f.	24
l.s.d.	38.46

Analysis of variance

Variate: TOTAL YIELD

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	2	107.5	53.8	0.11	
Block.*Units* stratum					
Variety	12	953669.2	79472.4	167.06	<.001
Residual	24	11416.9	475.7		
Total	38	965193.6			

Tables of means

Variate: Total_Yield

Grand mean 279.6

Variety	Centenary	Elsanta	EM1552	EM1677	EM1996	EM1998	EM2044
	290.5	374.0	165.9	205.0	153.3	102.5	156.6
Variety	EM2056	Fleurette	Garda	Jive	Magnum	Vivaldi	
	131.0	340.8	203.1	603.2	330.9	577.7	

JIVE and VIVALDI had significantly higher total yield than Elsanta and all other varieties in the trial

The total yield of Fleurette was not significantly different from Elsanta

The other nine 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.	17.81

Least significant differences of means (5% level)

Table	Variety
rep.	3
d.f.	24
l.s.d.	36.75

Analysis of variance

Variate: PERCENTAGE CLASS 1

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	2	20.161	10.080	2.34	
Block.*Units* stratum					
Variety	12	572.701	47.725	11.09	<.001
Residual	24	103.325	4.305		
Total	38	696.186			

Tables of means

Variate: %_Class_1

Grand mean 94.50

Variety	Centenary	Elsanta	EM1552	EM1677	EM1996	EM1998	EM2044
	98.69	87.38	95.67	96.98	89.60	96.26	97.95
Variety	EM2056	Fleurette	Garda	Jive	Magnum	Vivaldi	
	98.26	97.51	87.28	94.06	94.96	93.96	

The percentage Class1 of Garda and EM1996 was not significantly different from Elsanta
 All other varieties had significantly higher percentage Class 1 than Elsanta

Standard errors of differences of means

Table	Variety
rep.	3
d.f.	24
s.e.d.	1.694

Least significant differences of means (5% level)

Table	Variety
rep.	3
d.f.	24
l.s.d.	3.497

Analysis of variance

Variate: PERCENTAGE LARGE BERRIES >35MM

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Block stratum	2	182.48	91.24	4.59	
Block.*Units* stratum					
Variety	12	5500.63	458.39	23.07	<.001
Residual	24	476.87	19.87		
Total	38	6159.98			

Tables of means

Variate: %_Large

Grand mean 55.06

Variety	Centenary	Elsanta	EM1552	EM1677	EM1996	EM1998	EM2044
	53.04	50.81	42.59	59.18	59.94	57.25	65.66
Variety	EM2056	Fleurette	Garda	Jive	Magnum	Vivaldi	
	80.34	59.30	33.82	64.30	51.56	37.97	

EM2056 had a significantly higher percentage of large berries (>35mm) than all other varieties in the trial

EM1677, EM1996, EM2044, Fleurette and Jive had a significantly higher percentage of large berries (>35mm) than Elsanta

EM1552, Garda and Vivaldi had a significantly lower percentage of large berries (>35mm) than Elsanta

The other three varieties were not significantly different from Elsanta

Standard errors of differences of means

Table	Variety
rep.	3
d.f.	24
s.e.d.	3.640

Least significant differences of means (5% level)

Table	Variety
rep.	3
d.f.	24
l.s.d.	7.512