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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

- Four new summer fruiting raspberry cultivars/selections from the main entries to the trial show considerable promise for commercial production in the UK, including Squamish (very early), 0485K-1 (early-mid), EM6805/142 (late) and EM6804/81 (late), with the guard selections PARC BC1-88-6 and three clones of Tulameen from Canada also showing potential.

Background

There is a continuing requirement to identify raspberry varieties for commercial production which meet the evolving needs of the market, whilst offering opportunities for profitable production to growers. The project was established within a commercial plantation of raspberries to enable the identification of varieties and advanced selections which would offer growers:

- High yields and reliable cropping over the longest possible season
- Reduced labour costs through ease of cane management and improved fruit presentation for picking
- Fruit with an attractive appearance, good flavour, texture and shelf-life
- Potential to reduce reliance on traditional crop protection methods through improved tolerance or resistance to major pests and diseases

In combination, these traits will enable the UK industry to maintain and increase its market share, extend the harvest season and, importantly, reduce unit costs.

This trial was designed to critically evaluate cultivars and advanced selections, sourced from UK and overseas raspberry breeding programmes. It aimed to appraise cultivars that are now, or soon may be, available to growers for which there is little or no experience as to their suitability for growing in the UK or elsewhere in Europe. The trial included two advanced selections from James Hutton Ltd. (0485K-1 and 0019E-2) and Jeanne d' Orleans from the Agricultural and Agri-Food Research Canada sub-

station in L'Acadie, Quebec. These were identified as having considerable commercial potential in the previous AHDB Horticulture funded raspberry variety trial (SF 041c).

Results of the trials

This is a summary of the information presented in the Full Trial Report. Please refer to the 'Full Trial Report' for full and comprehensive information on the results.

Tables 1 and 2 provide details of the varieties and numbered selections included in both the main replicated plots and those included in the single guard plots. The majority of selections were planted in 2013, established in 2014 and cropped and recorded in 2015 and 2016. Those marked * were planted in 2014, established in 2015 and cropped and recorded in 2016. All selections were planted as module plants.

Table 1. Details of the main entry selections, in order of season

Cultivar	Source, country	Season	2015 Harvest start date	2015 Harvest end date	2016 Harvest start date	2016 Harvest end date
0435D-3	JHI, Scotland	Very Early	18/06/15	03/08/15	15/06/16	15/07/16
BC 92-9-15 (Squamish)	PARC, Canada	Early	18/06/15	29/07/15	15/06/16	25/07/16
0485K-1	JHI, Scotland	Early-mid	26/06/15	03/08/15	20/06/16	19/08/16
Tulameen (Naktuinbouw clone)	RW Walpole, England	Mid	26/06/15	12/08/15	20/06/16	08/08/16
AAC Eden (KO6-2)	PARC, Canada	Mid	18/06/15	10/08/15	15/06/16	17/08/16

Cultivar	Source, country	Season	2015 Harvest start date	2015 Harvest end date	2016 Harvest start date	2016 Harvest end date
0019 E2	JHI, Scotland	Mid-Late	01/07/15	12/08/15	27/06/16	19/08/16
Octavia	RW Walpole, England	Late	01/07/15	12/08/15	20/06/16	19/08/16
EM6803/16	EMR, England	Late	29/06/15	10/08/15	01/07/16	10/08/16
EM6805/142	EMR, England	Late	01/07/15	12/08/15	25/06/16	19/08/16
EM6804/68	EMR, England	Late	01/07/15	03/08/15	29/06/16	19/08/16
0447C-5	JHI, Scotland	Late	26/06/15	12/08/15	23/06/16	19/08/16
EM6804/81	EMR, England	Late - V Late	29/06/15	12/08/15	04/07/16	19/08/16

Table 2. Details of the guard entry selections, in order of season

Cultivar	Source, country	Season	2015 Harvest start date	2015 Harvest end date	2016 Harvest start date	2016 Harvest end date
0658 C-5	JHI, Scotland	Early	26/06/15	10/08/15	15/06/16	19/08/16
0550 E4	JHI, Scotland	Early	29/06/15	10/08/15	23/06/16	19/08/16
Glen Fyne	JHI, Scotland	Early	03/07/15	05/08/15	29/06/16	19/08/16
0460 F-5	JHI, Scotland	Early	03/07/15	05/08/15	29/06/16	03/08/16
RU004 03067*	Graminor, Norway	Early-Mid	-	-	25/06/16	19/08/16
RU044 03073*	Graminor, Norway	Early-Mid	-	-	27/06/16	19/08/16
WSU 1568	WSU, America	Early-Mid	03/07/15	29/07/15	20/06/16	25/07/16
BC 1- 88-6	PARC, Canada	Early-Mid	01/07/15	03/08/15	20/06/16	03/08/16
RU004 04106*	Graminor, Norway	Early-Mid	-	-	06/07/16	19/08/16
WSU 1607	WSU, America	Early-Mid	03/07/15	05/08/15	27/06/16	08/08/16

Cultivar	Source, country	Season	2015 Harvest start date	2015 Harvest end date	2016 Harvest start date	2016 Harvest end date
WSU 1605	WSU, America	Mid	03/07/15	12/08/15	29/06/16	19/08/16
Tulameen Pearl Clone 299-5	PARC, Canada	Mid	03/07/15	10/08/15	23/06/16	19/08/16
Tulameen Pearl Clone 300-5	PARC, Canada	Mid	29/06/15	12/08/15	20/06/16	19/08/16
Tulameen Pearl Clone 301-5	PARC, Canada	Mid	03/07/15	10/08/15	20/06/16	19/08/16
0658 E-1	JHI, Scotland	Mid	26/06/15	29/07/15	20/06/16	19/08/16
0427 G-7*	JHI, Scotland	Mid	-	-	25/06/16	03/08/16
EM6804/42	EMR	Mid - Late	29/06/15	05/08/15	25/06/16	19/08/16
0534RB1	JHI, Scotland	Mid - Late	26/06/15	12/08/15	15/06/16	03/08/16
0015F-1	JHI, Scotland	Late	29/06/15	29/07/15	29/06/16	10/08/16
Ukee	PARC	Late	01/07/15	03/08/15	27/06/16	03/08/16
Jean d'Orléans	PARC (L'Acadie, Quebec)	Late	01/07/15	03/08/15	29/06/16	19/08/16

Trial design and establishment

The trial was located at Rectory Farm, Oxford and located within an established commercial plantation of Tulameen (Naktuinbouw clone) which is south facing and protected with Spanish style multi-bay polythene tunnels. The soil is a free draining, light, loamy sand. Vegetatively propagated module raised plants were used at planting. The modules were planted into polythene mulched raised beds which are supplied with water and most nutrients via trickle irrigation. The distance between plants in the row was 0.45 m and a 1 metre gap was maintained between individual plots throughout the trial. Four replicate plots of each of the main entries were planted with 10 plants. Guard entries were single unreplicated 10 plant plots. The main entry plots were set up with two rows of plants per tunnel bay and the guard entries with three rows per bay.

All of the main and the majority of the guard entries were planted as planting material became available in June, July or August of 2013. The exceptions were four selections in the guard plots (0427G, RU004 03067, RU044 03073 and RU004 04106) and a single plot of the main entry EM6803/16, which were all planted in July 2014. For this East Malling selection in the main entries, this was done to check that the plants supplied and planted were true to type. As in 2013 all the additional planting material was supplied as module raised plants.

The plants supplied in 2013 established a large root system and, in the majority of cases, reasonable amounts of primocane growth during the year of planting. However, so as to ensure that all plants were as even in growth as possible and that their first harvest would be as fully cropping plants, all of the canes produced by them in 2013 were removed whilst they were fully dormant, by cutting out at ground level in mid-February 2014.

In late May, the first flush of primocane produced by these cut back plants was thinned by hand down to three to four per plant. This was repeated in early August 2014. A further thinning of the canes was made between September and early October 2014, so as to leave approximately three canes/plant or six floricanes per linear run of crop row, to fruit in 2015. After this final thinning, the retained canes were secured (laced

with twine) to the fixed wires of the crop support trellis. Canes were managed as per commercial practice on site throughout 2015 with, as in the previous growing season, unwanted primocane removed from the crop rows in May and June and finally immediately post-harvest.

Harvest in 2015 commenced on the 19 June and was completed on 12 August. Yield, berry weight, fruit quality, shelf life, ease of picking, plant habit and pest and disease susceptibility were assessed in 2015 and 2016. In 2016 harvest commenced on 15 June and was finished on 19 August.

2015 and 2016 yield results

A summary of the yields and berry weights for the main entries and guard plots in 2015 and 2016 is included in Tables 3-6.

Table 3. Average yield and berry weights collected in **2015** for the **main entry** cultivars in order of season – Stanton St John

Cultivar / Selection	Marketable yield (kg/plant)	Waste (g/plant)	% Marketable yield	Average berry weight (g)	Min. berry weight (g)	Max. berry weight (g)
0435D-3	2.2	347.9	86.1	3.8	2.6	5.8
BC 92-9-15 (Squamish)	2.0	238.6	89.5	4.0	2.6	5.6
0485K-1	1.4	95.6	93.5	4.7	2.6	6.5
Tulameen (Naktuinbouw clone)	1.7	365.8	82.5	4.4	3.3	5.9
AAC Eden	1.9	1252.6	60.5	4.8	3.3	7.4
0019 E2	2.1	343.2	86.0	4.9	3.8	7.1
Octavia	1.6	380.3	81.4	5.0	3.1	7.8
EM6803/16*	1.9	3664.7	35.9	4.7	3.4	6.4
EM6805/142	2.0	245.4	89.1	5.1	3.8	7.2
EM6804/68	1.3	430.1	74.8	4.4	3.2	6.5
0447C-5 (Glen Dee)	2.1	188.2	92.0	5.4	3.9	7.6
EM6804/81	2.1	220.9	90.3	4.8	3.6	6.6

Table 4. Average yield and berry weights collected in **2015** for the **guard selections** in order of season – Stanton St John

Cultivar / Selection	Marketable yield (kg/plant)	Waste (g/plant)	% Marketable yield	Average berry weight (g)	Min. berry weight (g)	Max. berry weight (g)
0658 C-5	2.8	605.5	82.1	4.7	3.4	6.0
0550 E4	1.6	337.0	82.4	3.7	2.4	5.6
Glen Fyne	1.0	701.2	59.8	3.5	2.6	5.0
0460 F-5	1.4	71.6	95.1	4.2	3.4	5.5
WSU 1568	1.8	232.8	88.3	4.3	3.2	6.0
BC1 88-6	3.7	1512.0	70.8	4.9	2.6	6.1
WSU 1607	2.5	389.2	86.4	5.8	4.6	7.9
WSU 1605	2.1	265.4	88.6	5.5	4.5	7.4
Tulameen Pearl Clone 299-5	2.8	286.0	90.6	5.0	4.2	6.6
Tulameen Pearl Clone 300-5	2.9	389.3	88.3	4.9	3.7	6.1
Tulameen Pearl Clone 301-5	3.7	433.3	89.5	5.4	4.5	6.7
0658 E-1	2.7	917.1	74.7	4.8	3.4	7.0
EM6804/42	2.0	487.8	80.2	4.1	3.4	5.4
0534RB1	2.4	469.4	83.7	5.2	4.2	6.5
0015F-1	0.8	221.1	77.3	3.5	2.6	4.4
Ukee	2.0	412.6	83.0	3.5	2.8	5.0
Jean d'Orléans	1.8	341.4	83.7	3.1	1.2	4.0

Table 5. Average yield and berry weights collected in **2016** for the **main entry** varieties in order of season - Stanton St John

Cultivar/ Selection	Marketable yield (Kg/plant)	Waste (g/plant)	% Marketable yield	Average berry weight (g)	Min. berry weight (g)	Max. berry weight (g)
0435D-3	1.6	212.3	88.2	3.9	3.0	4.9
BC 92-9-15 (Squamish)	1.2	126.6	92.1	4.3	3.7	4.9
0485K-1	0.9	107.9	93.9	5.3	4.1	6.2
Tulameen (Naktuinbouw clone)	1.2	247.5	82.1	4.8	3.9	5.9
AAC Eden	1.2	765.5	60.3	5.2	4.2	6.3
0019 E2	1.4	260.2	83.8	5.3	4.3	6.2
Octavia	1.3	434.2	76.3	5.2	3.7	6.9
EM6803/16						
EM6805/142	1.6	202.2	88.5	5.2	4.1	6.6
EM6804/68	1.5	240.3	85.1	4.7	3.7	6.0
0447C-5 (Glen Dee)	1.6	150.5	91.7	5.5	4.5	7.3
EM6804/81	2.2	179.8	92.2	5.7	3.9	7.8

Table 6. Average yield and berry weights collected in **2016** for the **guard selections** - Stanton St John

Cultivar/ Selection	Marketable yield (kg/plant)	Waste (g/plant)	% Marketable yield	Average berry weight (g)	Min. berry weight (g)	Max. berry weight (g)
0658 C-5	2.6	487.4	84.3	5.2	4.0	7.0
0550 E4	1.4	389.6	77.7	4.1	2.8	6.4
Glen Fyne	0.5	483.8	50.5	4.0	3.3	4.9
0460 F-5	1.1	71.6	94.1	4.9	4.2	5.5
RU0043067	2.8	234.5	92.3	5.7	4.2	7.2
RU04403073	1.5	246.6	85.9	4.6	3.4	6.3
WSU 1568	0.7	171.1	79.4	4.9	4.1	5.8
BC1 88-6	1.3	353.5	78.9	5.6	4.6	6.8
RU04106	1.0	428	69.2	5.7	5.7	5.7
WSU 1607	1.9	170.9	91.5	6.5	4.6	8.5
WSU 1605	1.9	162.3	92.0	6.2	4.3	8.2
Tulameen Pearl Clone 299-5	1.8	283.1	86.4	5.0	3.6	6.3
Tulameen Pearl Clone 300-5	2.1	265.8	88.9	5.2	3.9	7.1
Tulameen Pearl Clone 301-5	2.3	288.5	89.0	5.9	4.3	5.8
0658 E-1	1.7	882.6	65.2	5.2	3.8	6.7
0427 G-7*	0.4	215.3	66.0	4.7	4.0	5.4

Cultivar/ Selection	Marketable yield (kg/plant)	Waste (g/plant)	% Marketable yield	Average berry weight (g)	Min. berry weight (g)	Max. berry weight (g)
EM6804/42	1.6	415.2	79.6	4.9	3.4	6.9
0534RB1	1.3	394.8	77.0	5.2	4.2	6.7
0015F-1	1.3	406.4	78.3	4.1	3.3	5.0
Ukee	1.4	208.0	87.3	3.9	3.0	5.1
Jean d'Orléans	1.4	281.6	83.4	3.4	2.6	4.8

Main Conclusions

Selections of particular interest from the main trial were Squamish and 0485K-1. Both attracted a lot of interest at the Summer Fruiting Raspberry Walks arranged by AHDB Horticulture on 20th July 2015 and 14th July 2016.

Squamish

Squamish was exceptionally early to be harvested and produced 2 kg/plant of fruit during harvest in 2015 and 1.2kg/plant in 2016. The fruit of Squamish was not very large but had an excellent flavour, was evenly set, looked bright and attractive in the punnet and had a good shelf life (**Figure 1**). Other benefits of this selection are that it is reported to have tolerance to *Phytophthora* root rot and in this trial its plant growth habit and lateral characteristics made it very easy and cheap to pick and grow.



Figure 1. Squamish (BC 92-9-15)

0485K-1

0485K-1 was attractive and was very uniform in size and shape (**Figure 2**). The selection had large, attractive, evenly set and cohesive berries, meaning that a very high proportion of the fruit picked was marketable. Berry flavour was excellent and shelf-life was also good. The fruit was well displayed to pickers on long laterals and was easy to pick. However, support for the fruiting laterals is recommended to avoid

unacceptable lateral breakage during harvest. Recent research at the James Hutton Institute confirms that this selection has a high chilling requirement (in excess of that of Glen Ample). This was supported by the very poor bud break displayed by the floriculture of 0485K-1 in spring 2015. Fruit production in this year was confined to the top third section of floriculture, with the majority of buds below this point failing to develop. As a consequence, the full yield potential of this entry was not achieved in 2015.



Figure 2. 0485K-1

Other cultivars/selections of interest

Other high yielding selections include **0019E2** (JHI) which produced a high yield in 2015 and large fruit, although this selection also showed problems with poor bud break and lateral breakage in 2015. **EM6805/142** and **EM6804/81** (from EMR) produced good yields and the berries of both selections looked good in a punnet. However the flavour of all three of these entries was not as good as Squamish (BC 92-9-15) or 0485K-1.

Three of the guard selections were outstanding. These included BC 1-88-6 (PARC), WSU 1607 and 0534RBI (JHI). BC 1-88-6 (PARC) had a very high yield and very good quality berries and was the highest scored selection at the open day in 2015 (**Figure 3**). WSU 1607, a mid to late selection from Washington State, had a very large average berry size (5.8 g), a long harvest period, distinct fruit flavour and was very popular with

growers who visited the open days, along with the two other WSU selections (**Figure 4**). 0534RBI (JHI) was also rated highly by visitors to the trial. This selection had a wonderful flavour, had a late harvest season, produced large average fruit size (5.2 g) and had an average marketable yield of 2.4 kg/plant in 2015 and 1.3kg/plant in 2016 (**Figure 5**). The three Graminor selections (RU0043067, RU04403073 and RU04106) were also of particular interest. RU0043067 had a very high yield (2.8 Kg/plant in 2016) and a good average berry weight (5.7 g). RU04403073 produced very firm, strong and cohesive fruit. The three Tulameen Pearl clones also performed very well out of the guard selections.



Figure 3. JHI BC1-88-6

Figure 4. WSU 1607

Figure 5. JHI 0534RBI

Financial benefits

At this stage there are no immediate financial benefits for growers. However, if growers decide to take up any of the promising varieties that were shown in this trial then savings could be made due to reduced labour costs and profits could be increased due to higher yielding varieties.

Action points for growers

Growers should consider planting any of the following varieties in the future:

- Squamish (BC 92-9-15)
- 0485K-1
- 0019E2
- EM6805/142
- EM6804/81

- RU0043067
- RU04403073
- BC 1-88-6
- RU04106
- WSU 1607
- Tulameen Pearl Clones (299-5, 300-5 and 301-5)
- 0534 RB1

FULL TRIAL REPORT

Introduction

There is a continuous requirement to identify raspberry varieties for commercial production which meet the evolving needs of the market, whilst offering profitable production to growers. This project set out to identify new cultivars and advanced selections which will offer UK raspberry producers the following criteria:

- Higher yields than the current industry standards
- Superior quality fruit (size, uniformity of shape, colour, texture, flavour and a long shelf life)
- Present fruit well to pickers, on strongly attached laterals, which ideally do not require support, with fruit which is readily detached, making it cheap to harvest
- Plants with adequate vigour and primocane production for growing in soil or in substrate, with a good upright cane habit, making them easy and cheap to grow
- Plants that will offer better tolerance to winter and spring cold injury
- Pest and disease tolerance or resistance

Together, these qualities will enable the UK industry to maintain and increase its market share, extend the harvest season and reduce unit costs.

The project's aims were to evaluate and identify cultivars and advanced selections from the UK and other breeding programmes, to be utilised by UK growers to either replace or extend the harvest period of the current industry standard cultivars for fresh fruit production.

Cultivars and numbered selections included

This trial examined cultivars and advanced selections sourced from two UK raspberry breeding programmes; East Malling Research (EMR) and the James Hutton Institute (JHI) and four non-UK raspberry breeding programmes; Agricultural and Agri-Food Research Canada, Agricultural Agri-Food Research Canada substation in L'Acadie (PARC), Washington State University (WSU) and Graminor AS in Norway. It offered the opportunity to appraise cultivars that will or may soon be available to growers for

which there is little or no experience as to their suitability for growing in the UK or elsewhere in Europe. The trial also included two advanced selections from JHI (0485K-1 and 0019E-2) and Jeanne d' Orleans from Agricultural and Agri-Food Research Canada sub-station in L'Acadie, Quebec. These were identified as having considerable commercial potential in the previous AHDB Horticulture funded raspberry variety trial (SF 041c).

Details of the main entry raspberry cultivars are detailed in **Table 7** and the guard entries are detailed in **Table 8**.

Table 7. Details of the main entry selections included in the trial – listed in order of season

Cultivar	Source, country	Planting material	Season	Planting date
0435D-3	JHI, Scotland	Module plants	Very Early	18 June 2013
BC92-9-15	PARC, Canada	Module plants	Early	17 June 2013
0485K-1	JHI, Scotland	Module plants	Early-Mid	17 June 2013
Tulameen	PARC, Canada	Module plants	Mid	17 June 2013
AAC Eden (KO6-2)	PARC, Canada	Module plants	Mid	17 and 21 June 2013
0019 E2	JHI, Scotland	Module plants	Mid-Late	18 June 2013
Octavia	EMR, England	Module plants	Late	17 June 2013

Cultivar	Source, country	Planting material	Season	Planting date
EM6803/16	EMR, England	Module plants	Late	12 August 2013
EM6805/142	EMR, England	Module plants	Late	12 August 2013
EM6804/68	EMR, England	Module plants	Late	12 August 2013
0447C-5	JHI, Scotland	Module plants	Late	18 June 2013
EM6804/81	EMR, England	Module plants	Late - Very Late	12 August 2013

*JHI – James Hutton Institute, EMR – East Malling Research, WSU – Washington State university, PARC – Pacific Agri-Food Research Centre

Table 8. Details of the additional guard entry selections included in the trial – listed in order of season

Cultivar	Source, country	Planting material	Season	Planting date
0658 C-5	JHI, Scotland	Module plants	Early	18 June 2013
0550 E4	JHI, Scotland	Module plants	Early	18 June 2013
Glen Fyne	JHI, Scotland	Module plants	Early	18 June 2013
0460 F-5	JHI, Scotland	Module plants	Early	18 June 2013
RU004 03067*	Graminor, Norway	Module plants	Early-Mid	2 July 2014
RU044 03073*	Graminor, Norway	Module plants	Early-Mid	2 July 2014
WSU 1568	WSU, America	Module plants	Early-Mid	2 July 2013

Cultivar	Source, country	Planting material	Season	Planting date
BC1 88-6	PARC, Canada	Module plants	Early-Mid	18 June 2013
RU004 04106*	Graminor, Norway	Module plants	Early-Mid	2 July 2014
WSU 1607	WSU, America	Module plants	Early-Mid	2 July 2013
WSU 1605	WSU, America	Module plants	Mid	2 July 2013
Tulameen Pearl Clone 299-5	PARC, Canada	Module plants	Mid	18 June 2013
Tulameen Pearl Clone 300-5	PARC, Canada	Module plants	Mid	18 June 2013
Tulameen Pearl Clone 301-5	PARC, Canada	Module plants	Mid	18 June 2013
0658 E-1	JHI, Scotland	Module plants	Mid	18 June 2013
0427 G-7*	JHI, Scotland	Module plants	Mid	22 June 2014
EM6804/42	EMR	Module plants	Mid - Late	12 August 2013
0534RB1	JHI, Scotland	Module plants	Mid - Late	18 June 2013
0015F-1	JHI, Scotland	Module plants	Late	18 June 2013
Ukee	PARC	Module plants	Late	18 June 2013
Jean d'Orléans	PARC (L'Acadie, Quebec)	Module plants	Late	18 June 2013

*JHI – James Hutton Institute, EMR – East Malling Research, WSU – Washington State university, PARC – Pacific Agri-Food Research Centre

Trial site details

The trial was kindly hosted by Richard Stanley at Rectory Farm, Stanton St John, Oxford, OX33 1HF. The trial area was located within a commercial, south facing, plantation of raspberries. The selections were planted in a free draining, light loamy sand soil.

Production details

The trial was located within a commercial south facing plantation of summer fruiting raspberries (cv. Tulameen - Naktuinbouw clone). The soil is a free draining light loamy sand.

All of the main and the majority of the guard entries were planted as planting material became available in June, July or August of 2013. The exceptions were four selections in the guard plots (0427G, RU004 03067, RU044 03073 and RU004 04106) and a single plot of the main entry EM6803/16, which were all planted in July 2014. For this East Malling selection in the main entries, this was done to check that the plants supplied and planted were true to type. As in 2013 all the additional planting material was supplied as module raised plants and all the plants for this trial were supplied as virus indexed and/or PHPS certified module raised plants grown from root cuttings.

All the plants were supplied with trickle irrigation and fertigated from planting onwards, as per the commercial planting of raspberries surrounding the trial. No trellis was in position at the time of planting. This was installed in early spring of 2014, so that the primocane of all the entries could be supported.

The plants supplied in 2013 established a large root system and in the majority of cases, reasonable amounts of primocane growth during the year of planting. However, so as to ensure that all plants are as even in growth as possible and that their first harvest would be as fully cropping plants, all of the canes produced by the 2013 planted plants were cut through at ground level and removed from the plantation in early February 2014, whilst fully dormant. Primocane produced by the plants during the spring and summer of 2014 were thinned by hand in early May, June and in August so that by the late summer, 2.5 - 3 canes/plant or 5.5 - 6.6 floricanes/m of crop row,

were retained to crop in 2015.

To prevent them being damaged by the wind, the primocane was held securely together and upright by two pairs of mobile wires affixed to the crop support trellis at 1.5 and 1.8 m above the ground. In late September 2014, as soon as their rind had sufficiently matured, the primocane was secured (laced using twine) onto the two fixed wires on the support trellis into their fruiting positions for 2015.

The primocane was managed in 2015 as per the previous growing season, so that by early June the majority of the primocane to crop in 2016 had been selected (2.5 - 3 canes/plant or 5.5 - 6.6 floricanes/m of crop row). Primocane was separated from the developing floricanes and guided upwards through the centre of the crop rows using the two mobile wires fitted to the support trellis which were moved down or upwards to suitable points on the trellis as the primocane increased in height. Soon after the onset of harvest, strings were also affixed to the posts of the support trellis and run along either side of the crop canopy at 1.5 - 1.8 m above the ground so as to pull any primocane with a spreading habit back against the floricanes to prevent it from impeding harvest.

Immediately post-harvest all floricanes were cut through at ground level and left in position to wilt for 4 - 5 days, prior to their removal from the crop rows. As per 2014 the primocane was supported by the mobile wires of the trellis, placed in suitable positions to keep it upright and to prevent its damage by the wind. When sufficiently mature, it was laced to the trellis in late September to its 2016 fruiting position.

Pest, disease, weed control and the nutrition of the trial since planting has been as per required for the trial plants and since spring 2015, dictated by the requirements of the commercial planting of raspberries that surrounds it. In spring and early summer 2015 high levels of potato and the large raspberry aphid were experienced on the trial plants, including those with the A10 gene, and despite several attempts to eradicate these pests, full control was not achieved until the end of the harvest.

During the trial pest, disease, weed control and nutrition were managed according to the requirements of the plants and advised by BASIS and FACTS qualified agronomist Janet Allen.

Trial design

The main part of the trial was set up as a randomised block design with 12 varieties which are replicated four times with 10 plants in each plot. The trial plan is detailed in **Appendix 1**. The guard entry plots consist of unreplicated 10 plant plots (depending on plant availability). The raspberries were planted 0.45 m apart into polythene mulched raised soil beds, with 2.4 m between the crop rows and a 1 m wide plant free gap between each plot.

The main (replicated) trial was planted so that it could be protected in the cropping years using two Spanish style multi-bay tunnels. Each tunnel contains two rows of raspberries, with each row containing a replicate of each main entry and standard cultivars.

The guard entries were planted in an adjacent three row tunnel with the same spacing as described above.

Results

Plant architecture and pest/disease susceptibility

Four assessments were carried out during 2014/2015 to identify the characteristics of the primocane of the trial entries planted in 2013, including height, thickness, vigour, pest and disease susceptibility and growth habit. The plants were assessed on 7 February 2014, 2 July 2014 and 15 and 22 January 2015.

On 7 February 2014, assessments were carried out to determine how much growth the canes had achieved in their first growing season (i.e. planting year - **Table 9**). Results from the assessment showed that of the main entry varieties, BC92-9-15 (Squamish), AAC Eden (KO6-2) and 0447C-5 produced the tallest floricanes, which was over 1 m in height. The shortest cane was produced by 0485K-1 and EM6803/16, both

producing floriculture 1.5 m in height. Of the guard entries, 0658 C-5, BC1-88-6, Tulameen Pearl Clone 299-5, Ukee and Jean d'Orléans all produced floriculture that was over 1 m tall. WSU 1568, 0658E-1 and 0015F1 produced the shortest canes that averaged 1 m in height.

The bud condition of the selections was assessed in 2014 to give an indication of earliness. Buds were awarded a score of either 1 or 2, with 1 used to score buds which were dormant and 2 for buds that were green. The main entry cultivars with the most advanced buds at the assessment on 7 February were 0447C-5, EM6803/16 and EM6804/68. Of the guard entries, buds of WSU 1568, WSU 1607, WSU 1605, Tulameen Pearl Clone 299-5, Tulameen Pearl Clone 300-5, Tulameen Pearl Clone 301-5, 0534RB1, 0015F-1, Ukee and Jean d'Orléans all scored 2, meaning that they were green and were the most advanced of these guard selections.

No disease was observed on any of the selections at the assessment carried out on 7 February 2014.

Table 9. Details of the mean cane height, bud condition and presence of disease of main and guard entry selections on February 2014 - Stanton St John

Cultivar	Average height of canes 1=0-30cm, 2=30-60cm, 3=60-100cm, 4=100cm +	Average bud condition: 1 = dormant, 2= green	Average of disease Y=1, N=0
0435D-3	3.50	1.75	0
BC92-9-15	4.00	1.00	0
0485K-1	1.50	1.00	0
Tulameen (Naktuinbouw clone)	4.00	1.75	0
AAC Eden	4.00	1.50	0

Cultivar	Average height of canes 1=0-30cm, 2=30-60cm, 3=60-100cm, 4=100cm +	Average bud condition: 1 = dormant, 2= green	Average of disease Y=1, N=0
(KO6-2)			
0019E2	1.75	1.25	0
Octavia	4.00	1.25	0
EM6803/16	1.50	2.00	0
EM6805/142	2.00	1.00	0
EM6804/68	1.75	2.00	0
0447C-5	4.00	2.00	0
EM6804/81	1.75	1.50	0
Guard Entries			
0658 C-5	4.00	1.00	0
0550E-4	2.00	1.00	0
Glen Fyne	3.00	1.00	0
0460F-5	2.00	1.00	0
RU0043067*	-	-	-
RU04403073*	-	-	-
WSU 1568	1.00	2.00	0
BC1 88-6	4.00	1.00	0
RU04106*	-	-	-

Cultivar	Average height of canes 1=0-30cm, 2=30-60cm, 3=60-100cm, 4=100cm +	Average bud condition: 1 = dormant, 2= green	Average of disease Y=1, N=0
WSU 1607	2.00	2.00	0
WSU 1605	2.00	2.00	0
Tulameen Pearl Clone 299-5	4.00	2.00	0
Tulameen Pearl Clone 300 -5	3.00	2.00	0
Tulameen Pearl Clone 301 - 5	2.00	2.00	0
0658E-1	1.00	1.00	0
0427 G-7*	-	-	-
EM6804/42	3.00	1.00	0
0534RB1	3.00	2.00	0
0015F-1	1.00	2.00	0
Ukee	4.00	2.00	0
Jean d'Orléans	4.00	2.00	0

*Planted in 2014

At the assessment carried out in February 2014 the following main entries were noted as having spines present down the full length of their canes: BC92-9-15 (Squamish),

Tulameen (Naktuinbouw clone), Octavia, EM6803/16, EM6804/68 and EM6804/81 (**Table 10**). Out of the guards the selections with spines on their canes included: WSU 1568, BC1 88-6, WSU 1607, WSU 1605, Tulameen Pearl Clone 299-5, Tulameen Pearl Clone 300-5, Tulameen Pearl Clone 301-5, EM6804/42, Ukee and Jean d'Orléans.

0435D-3, BC92-9-15 (**Figure 6**), AAC Eden, 0019E2, EM6805/142 (**Figure 7**), and EM6804/81 (**Figure 8**) were the main entry selections that had an upright growth habit. EM6804/68 primocanes had a noticeable spreading growth habit and all of the other main entries had an upright to spreading primocane growth habit. The three guard entries from Washington State University (WSU 1568, WSU 1607 and WSU 1605) had very stiff upright canes. Canes of 0550E-4, 0460F-5, 0015F-1, and Jeanne d'Orléans also had an upright growth habit and all of the other guard entries were found to have an upright to spreading growth habit.



Figure 6. BC 92-9-15 (Squamish) displaying an upright growth habit



Figure 7. EM6805/142



Figure 8. EM6804/81

No disease was found affecting the foliage of any of the entries at the assessment carried out in July 2014. However light infestations of two-spotted spider mite and large raspberry aphid were identified on the foliage of all the entries. Common green capsid, caterpillars and small raspberry sawfly were also found on a few leaves throughout the trial site. Large raspberry aphid was found on raspberry selections which have the A10 gene. Based on these findings, an acaricide and insecticide were applied to bring these

pests under control, to the extent that neither became a problem pest for the remainder of the summer or into the autumn of 2014.

Table 10. Details of spine occurrence, position of spines on the canes and the primocane habit of the different selections in July 2014 - Stanton St John

Cultivar	Spines (1) Spine free (0)	Position of spines on canes	Primocane habit
0435D-3	0	-	Upright
BC92-9-15	1	Full height	Upright
0485K-1	0	-	Upright-spread
Tulameen (Naktuinbouw clone)	1	Full height	Upright-spread
AAC Eden (KO6-2)	0	-	Upright
0019E2	0	-	Upright
Octavia	1	Full height	Upright-spread
EM6803/16	1	Full height	Upright-spread
EM6805/142	0	-	Upright
EM6804/68	1	Full height	Spreading
0447C-5	0	-	Upright-spread
EM6804/81	1	Full height	Upright
Guard Entries			
0658 C-5	0	-	Upright-spread
0550E-4	0	-	Upright

Cultivar	Spines (1) Spine free (0)	Position of spines on canes	Primocane habit
Glen Fyne	0	-	Upright-spread
0460F-5	0	-	Upright
RU0043067*	-	-	-
RU04403073*	-	-	-
WSU 1568	1	Full height	Upright
BC1-88-6	1	Full height	Upright-spread
RU04106*	-	-	-
WSU 1607	1	Full height	Upright
WSU 1605	1	Full height	Upright
Tulameen Pearl Clone 299-5	1	Full height	Upright
Tulameen Pearl Clone 300 -5	1	Full height	Upright
Tulameen Pearl Clone 301 - 5	1	Full height	Upright
0658E-1	0	-	Upright-spread
0427 G-7*	-	-	-
EM6804/42	1	Full height	Upright-spread
0534RB1	0	-	Upright-spread
0015F-1	0	-	Upright
Ukee	1	Full height	Upright-spread

Cultivar	Spines (1)	Position of spines	Primocane habit
	Spine free (0)	on canes	
Jean d'Orléans	1	Full height	Upright

*Planted in 2014

The number of plants in a plot were counted on 15 and 22 January 2015 (**Table 11**). On this occasion cane height, cane diameter and the number of floricanes were also assessed. Selections from the Norwegian raspberry breeding programme (Graminor) and a single plot of the main entry EM6803/16 were not included as these selections were planted in 2014.

Cane height was recorded on a scale of 1 to 3, with 1 being tall and 3 being short. All of the main entry and guard selections achieved an adequate average height and were classed as being either tall or medium, with the exception of EM6803/16 which was classed as having short canes. However this selection did not appear to be true to type, producing thin, highly branched canes with crinkled leaves.

Cane diameter was scored on a scale of 1 to 3, with 1 being stout and 3 being thin. Cane thickness was good for the majority of the main and guard entries, with most having medium to stout canes in thickness. Two exceptions were the main entry EM6803/16, which was classed as having thin canes, and the guard entry 0658E-1, which was classed as having thin to medium canes.

There was some variation in the number of floricanes between varieties. Of the main entries, EM6803/16 had the lowest number of floricanes (1.8 canes per plant). However these plants displayed abnormal growth characteristics. The main entry selection with the highest number of floricanes was the JHI advanced selection 0447C-5 which had 3 canes per plant. All the other main entries had at least 2 canes per plant and most had 2.5 or more canes per plant. Of the guard entries, BC 1-88-6 had the highest number of floricanes, with 3.5 canes per plant. 0550E-4 and 0015F-1 had the lowest number of floricanes, with 2.2 canes per plant on average. All of the other guards had at least 2.5 floricanes per plant and 0658C-5, WSU 1568, WSU 1607, WSU 1605, Tulameen Pearl 299-5, Tulameen Pearl 300-5, EM6804/42, 0534RB1, Ukee, and Jean d'Orléans had 3 or more canes per plant.

Table 11. Number of plants in a plot, average height, diameter and number of floricanes assessed in January 2015 - Stanton St John

Cultivar	No of plants/ plot	Average height of canes* 1=tall 2=medium 3=short	Cane diameter 1=Stout 2=average 3=thin	Average floricanes number/ plant
0435D-3	10	1	1-2	2.8
BC92-9-15	10	1	2	2.9
0485K-1	10	1	2-1	2.7
Tulameen (Naktuinbouw clone)	10	1	1-2	2.9
AAC Eden (KO6-2)	10	1	1	2.8
0019E2	10	1	1	2.5
Octavia	10	1	2	2.2
EM6803/16*	10	3	3	1.8
EM6805/142	10	1	1-2	2.2
EM6804/68	10	1	1-2	2.5
0447C-5	10	1	1-2	3.0
EM6804/81	10	1	1-2	2.5
Guard Entries				

Cultivar	No of plants/ plot	Average height of canes* 1=tall 2=medium 3=short	Cane diameter 1=Stout 2=average 3=thin	Average floricanes number/ plant
0658 C-5	10	1	2	3.0
0550E-4	10	1-2	2	2.2
Glen Fyne	10	1-2	2	2.8
0460F-5	10	1	1	2.9
RU0043067*	10	-	-	-
RU04403073*	10	-	-	-
WSU 1568	10	1	1	3.0
BC1-88-6*	4	1	1	3.5
RU04106*	5	-	-	-
WSU 1607	10	1	1	3.0
WSU 1605	10	1	1	3.1
Tulameen Pearl 299-5	6	1	1	3.1
Tulameen Pearl 300-5	6	1	1	3.0
Tulameen Pearl 301-5	3	1	1	2.7
0658E-1	7+3**	1-2	2-3	2.6

Cultivar	No of plants/ plot	Average height of canes* 1=tall 2=medium 3=short	Cane diameter 1=Stout 2=average 3=thin	Average floricanes number/ plant
0427 G-7*	3	-	-	-
EM6804/42	10	1-2	2	3.0
0534RB1	10	1	1-2	3.3
0015F1	10	1	2	2.2
Ukee	10	1	2	3.1
Jean d'Orléans	10	1	2	3.2

*BC1-88-6 plot also contains 6 rogue plants of a primocane fruiting selection

** 3 plants re-planted in 2014

An assessment was carried out in February 2015 for levels of disease (**Table 12**). Disease was scored on a scale of 0 to 10, with 0 being no canes affected and 10 being 90 to 100% of canes affected by the disease. No cane blight or cane spot was detected in any of the cultivars at the assessment. Spur blight and cane botrytis were detected on all selections. Levels of spur blight ranged between 10 to 40% with the highest levels occurring on guard selections WSU 1568, Tulameen Pearl 300-5 and Tulameen Pearl 301-5. 0485K-1, 0015F-1 and Ukee were the selections with the lowest level of spur blight. Levels of cane botrytis ranged between 8 to 30% with EM6804/68, WSU 1605, Tulameen Pearl 299-5 Tulameen Pearl 300 5 and Tulameen Pearl 301-5 having the highest levels, whilst EM6805/142 had the lowest levels of infection.

Splitting of the rind was seen at the assessment carried out in February 2015 and was scored on a scale of 1 to 10, with 1 being no splitting and 10 being severe splitting of the rind. The splitting observed was confined to the outer oldest rind of canes, with no observations of patch lesions produced by the feeding of the larvae of raspberry cane

midge, or other damage to underlying suberized rind or vascular tissue. Of the main entries, 0485K-1 showed the least amount of splitting, scoring 1.5 on the scale. Tulameen (Naktuinbouw clone), EM6803/16, EM6804/81, 0658 C-5, 0460F-5, WSU 1568, BC1-88-6, WSU 1607, WSU 1605 Tulameen Pearl 299-5, Tulameen Pearl 300-5, Tulameen Pearl 301-5, 0534RB1 and Jean d'Orléans had moderate levels of splitting of rind from the bottom to a quarter, or sometimes a third, of the way up the height of the canes.

Table 12. Assessment of cane disease and rind splitting carried out for the main entries and guard entries in February 2015 - Stanton St John

Cultivar	Level of disease infection (1 = 0-10% of canes affected with a few disease lesions and 10 = 90-100% canes displaying a high level of disease infection)				Splitting of rind (1=none 10=severe)
	Spur blight	Cane blight	Cane botrytis	Cane spot	
0435D-3	1.5	0.0	1.3	0.0	3.3
BC92-9-15 (Squamish)	1.5	0.0	1.3	0.0	2.3
0485K-1	1.0	0.0	1.0	0.0	1.5
Tulameen (Naktuinbouw clone)	3.0	0.0	2.8	0.0	4.0
AAC Eden (KO6-2)	1.5	0.0	1.0	0.0	3.5
0019E2	1.5	0.0	1.0	0.0	3.0
Octavia	1.5	0.0	2.0	0.0	2.5
EM6803/16*	1.3	0.0	2.0	0.0	4.0
EM6805/142	1.8	0.0	0.8	0.0	2.8

Cultivar	Level of disease infection (1 = 0-10% of canes affected with a few disease lesions and 10 = 90-100% canes displaying a high level of disease infection)				Splitting of rind (1=none 10=severe)
	Spur blight	Cane blight	Cane botrytis	Cane spot	
EM6804/68	2.8	0.0	3.0	0.0	3.8
0447C-5 (Glen Dee)	1.8	0.0	1.3	0.0	3.0
EM6804/81	2.0	0.0	2.0	0.0	3.8
Guard entries					
0658 C-5	3.0	0.0	1.0	0.0	4.0
0550E-4	2.0	0.0	1.0	0.0	3.0
Glen Fyne	2.0	0.0	1.0	0.0	3.0
0460F-5	2.0	0.0	2.0	0.0	4.0
RU0043067	-	-	-	-	-
RU04403073	-	-	-	-	-
WSU 1568	4.0	0.0	1.0	0.0	4.0
BC1-88-6*	2.0	0.0	1.0	0.0	4.0
RU04106	-	-	-	-	-
WSU 1607	3.0	0.0	2.0	0.0	4.0
WSU 1605	2.0	0.0	3.0	0.0	4.0
	3.0		3.0	0.0	5.0

Cultivar	Level of disease infection (1 = 0-10% of canes affected with a few disease lesions and 10 = 90-100% canes displaying a high level of disease infection)				Splitting of rind (1=none 10=severe)
	Spur blight	Cane blight	Cane botrytis	Cane spot	
Tulameen Pearl 299-5		0.0			
Tulameen Pearl 300 -5	4.0	0.0	3.0	0.0	5.0
Tulameen Pearl 301 - 5	4.0	0.0	3.0	0.0	5.0
0658E-1	2.0	0.0	1.0	0.0	3.0
0427 G-7*	-	-	-	-	-
EM6804/42	2.0	0.0	1.0	0.0	3.0
0534RB1	2.0	0.0	1.0	0.0	4.0
0015F-1	1.0	0.0	1.0	0.0	2.0
Ukee	1.0	0.0	1.0	0.0	1.0
Jean d'Orléans	2.0	0.0	1.0	0.0	4.0

* Off type plants in plot, only true to type plants scored

Harvest results for 2015

Harvest commenced with the earliest selections on 18 June and concluded on 12 August. **Table 13** details the dates at which each selection started and finished picking, along with an idea of the picking profile.

Table 13. 2015 harvest dates – including start date, 25%, 50%, 75% and end date - Stanton St John

Cultivar/Selection	Start	25%	50%	75%	End
0435D-3	18-Jun	10-Jul	10-Jul	17-Jul	03-Aug
BC92-9-15 (Squamish)	18-Jun	06-Jul	08-Jul	13-Jul	29-Jul
0485K-1	26-Jun	15-Jul	13-Jul	17-Jul	03-Aug
Tulameen (Naktuinbouw clone)	26-Jun	13-Jul	17-Jul	24-Jul	12-Aug
AAC Eden (KO6-2)	18-Jun	13-Jul	17-Jul	24-Jul	10-Aug
0019 E2	01-Jul	13-Jul	17-Jul	24-Jul	12-Aug
Octavia	01-Jul	15-Jul	24-Jul	03-Aug	12-Aug
EM6803/16	29-Jun	15-Jul	22-Jul	27-Jul	10-Aug
EM6805/142	01-Jul	17-Jul	24-Jul	03-Aug	12-Aug
EM6804/68	01-Jul	13-Jul	17-Jul	24-Jul	03-Aug
0447C-5 (Glen Dee)	26-Jun	06-Jul	24-Jul	31-Jul	12-Aug
EM6804/81	29-Jun	15-Jul	24-Jul	03-Aug	12-Aug
Guard Entries					
0658 C-5	26-Jun	10-Jul	17-Jul	27-Jul	10-Aug
0550 E4	29-Jun	15-Jul	22-Jul	29-Jul	10-Aug
Glen Fyne	03-Jul	13-Jul	17-Jul	22-Jul	05-Aug

Cultivar/Selection	Start	25%	50%	75%	End
0460 F-5	03-Jul	13-Jul	17-Jul	24-Jul	05-Aug
WSU 1568	03-Jul	08-Jul	13-Jul	17-Jul	29-Jul
BC1 88-6	01-Jul	06-Jul	13-Jul	17-Jul	03-Aug
WSU 1607	03-Jul	13-Jul	17-Jul	24-Jul	05-Aug
WSU 1605	03-Jul	13-Jul	22-Jul	27-Jul	12-Aug
Tulameen Pearl Clone 299-5	03-Jul	13-Jul	17-Jul	24-Jul	10-Aug
Tulameen Pearl Clone 300-5	29-Jun	10-Jul	17-Jul	24-Jul	12-Aug
Tulameen Pearl Clone 301-5	03-Jul	13-Jul	17-Jul	27-Jul	10-Aug
0658 E-1	26-Jun	08-Jul	13-Jul	22-Jul	29-Jul
EM6804/42	29-Jun	10-Jul	17-Jul	27-Jul	05-Aug
0534RB1	26-Jun	13-Jul	17-Jul	27-Jul	12-Aug
0015F-1	29-Jun	10-Jul	15-Jul	22-Jul	29-Jul
Ukee	01-Jul	13-Jul	17-Jul	24-Jul	03-Aug
Jean d'Orléans	01-Jul	13-Jul	19-Jul	24-Jul	03-Aug

Fruit was picked by farm staff to commercial grade. Yields were recorded three times a week between 18 June and 12 August 2015. Fruit was graded into marketable and unmarketable, and berry weight was recorded by averaging the weight of 25 representative berries (**Table 14** for the main selections and **Table 15** for the guard selections). Analysis of variance (ANOVA) was used for statistical analysis.

Of the main entries, the very early fruiting JHI selection 0435D-3 had the highest yield, which was higher than the standards Octavia and Tulameen. This was closely followed by the JHI selections 0447C-5 (Glen Dee), 0019-E2 and EM6804/81 from EMR, all

producing over 2 kg/plant. The lowest yielding selections were EM8804/68 (EMR) and 0485K-1 (JHI), although the latter had 93% marketable fruit on average, significantly better than Octavia and Tulameen, suggesting high quality fruit and a fast picking potential. The main cause of the low yield of 0485K-1 was lack of bud break, with crop production confined in the majority of the plants to the top third of their floricanes. EM6805/142 (EMR) and the PARC selection BC 92-9-15 (Squamish) also showed a very high percentage marketable fruit.

Of the EMR selection EM6803/16, a high proportion of the plants supplied produced primocane which had excessive side branches and irregular growth. In 2015 the canes of this entry produced a large amount of crumbly, poor flavoured, irregular fruit that was inconsistent with previous observations by EMR of the performance and growth of this selection. An additional guard plot of this selection was planted as a comparison in 2014 which also showed the same traits. Having discussed this with EMR, it was agreed that this must be an unstable selection and it was removed from the trial.

Average berry weights ranged between 3.8 and 5.4 g. 0447C-5 (Glen Dee) had the largest berries on average and 0435D-3 had the smallest. Berry weights varied quite a bit over the season with several of the selections achieving berry weights of over 7 g at their peak (e.g. Octavia and 0447C-5 - Glen Dee). Tulameen (Naktuinbouw clone) had the smallest difference between minimum and maximum berry weights, suggesting that this variety had the most uniform fruit over the season. Octavia and AAC Eden had the largest difference in berry weight (over 4 g) across their respective harvest periods.

Table 14. Average yield and berry weights collected in 2015 for the main entry varieties in order of season – Stanton St John

Cultivar/ Selection	Marketable yield (kg/plant)	Waste (g/plant)	% Marketable yield	Average berry weight (g)	Min. berry weight (g)	Max. berry weight (g)
0435D-3	2.2	347.9	86.1	3.8	2.6	5.8
BC 92-9-15 (Squamish)	2.0	238.6	89.5	4.0	2.6	5.6
0485K-1	1.4	95.6	93.5	4.7	2.6	6.5
Tulameen (Naktuinbouw clone)	1.7	365.8	82.5	4.4	3.3	5.9
AAC Eden	1.9	1252.6	60.5	4.8	3.3	7.4
0019 E2	2.1	343.2	86.0	4.9	3.8	7.1
Octavia	1.6	380.3	81.4	5.0	3.1	7.8
EM6803/16*	1.9	3664.7	35.9	4.7	3.4	6.4
EM6805/142	2.0	245.4	89.1	5.1	3.8	7.2
EM6804/68	1.3	430.1	74.8	4.4	3.2	6.5
0447C-5 (Glen Dee)	2.1	188.2	92.0	5.4	3.9	7.6
EM6804/81	2.1	220.9	90.3	4.8	3.6	6.6

The guards produced some very large yields in the 2015 season. 0658 C-5, BC1-88-6, WSU1568, and the Tulameen Pearl clones produced yields in excess of 2.8 kg/plant, with mean berry weights nearing or above 5 g. Some of these results do need to be

treated with caution as the guard plot data is unreplicated and some plots contained fewer than 10 plants which may have allowed greater yield by the substantial reduction of plant to plant competition for light, nutrients and water compared to plots containing a full complement of plants. However, these data highlight the significant potential of these selections. 0460 F-5, the WSU selections and the Tulameen Pearl clones showed the highest percentage of marketable fruit and WSU 1607 (**Figure 9**) and WSU 1605 had exceptionally large conic berries (**Figure 10**).



Figure 9. WSU 1607



Figure 10. WSU 1605

Table 15. Average yield and berry weights collected in 2015 for the guard selections in order of season – Stanton St John

Cultivar/ Selection	Marketable yield (kg/plant)	Waste (g/plant)	% Marketable yield	Average berry weight (g)	Min. berry weight (g)	Max. berry weight (g)
0658 C-5	2.8	605.5	82.1	4.7	3.4	6.0
0550 E4	1.6	337.0	82.4	3.7	2.4	5.6
Glen Fyne	1.0	701.2	59.8	3.5	2.6	5.0
0460 F-5	1.4	71.6	95.1	4.2	3.4	5.5
WSU 1568	1.8	232.8	88.3	4.3	3.2	6.0
BC1 88-6	3.7	1512.0	70.8	4.9	2.6	6.1
WSU 1607	2.5	389.2	86.4	5.8	4.6	7.9
WSU 1605	2.1	265.4	88.6	5.5	4.5	7.4
Tulameen Pearl Clone 299-5	2.8	286.0	90.6	5.0	4.2	6.6
Tulameen Pearl Clone 300-5	2.9	389.3	88.3	4.9	3.7	6.1
Tulameen Pearl Clone 301-5	3.7	433.3	89.5	5.4	4.5	6.7
0658 E-1	2.7	917.1	74.7	4.8	3.4	7.0
EM6804/42	2.0	487.8	80.2	4.1	3.4	5.4
0534RB1	2.4	469.4	83.7	5.2	4.2	6.5
0015F-1	0.8	221.1	77.3	3.5	2.6	4.4
Ukee	2.0	412.6	83.0	3.5	2.8	5.0
Jean d'Orléans	1.8	341.4	83.7	3.1	1.2	4.0

Berry quality 2015

Once a week throughout harvest, marketable fruit from each plot was examined and fruit quality was appraised on a 1 to 5 scale for seven quality parameters including: colour (i.e. redness and brightness), outline, texture, skin strength, berry cohesiveness and flavour (**Table 16** for the main entries and **Table 17** for the guard entries). Brix° (sugar content) was also measured weekly using a refractometer.

Average Brix° over the season was highest in BC 92-9-15 (Squamish) and 0485K-1, closely followed by Tulameen (Naktuinbouw clone) and AAC Eden. 0435D-3 and 0019 E2 had the lowest Brix° readings. The selections with the higher Brix scores tended to score more highly on flavour. As discussed previously, EM6803/16 was the only selection which produced poor quality fruit. All the other selections produced fruit of adequate colour, shape, texture and cohesiveness. Of particular note were BC 92-9-15 (Squamish) (**Figure 11**), 0485K-1 (**Figure 12**) and EM6804/81 which scored highest when all the berry quality parameters were aggregated. Out of the main entries, EM6805/142 produced the palest fruit. However the fruit was very bright and scored high for evenness and skin strength (**Figure 13**). EM6804/81 scored highly for Brix°, brightness, outline, skin strength and berry cohesiveness (**Figure 14**).



Figure 11. BC 92-9-15 (Squamish)



Figure 12. 0485K-1



Figure 13. EM6805/142



Figure 14. EM6804/81

Most of the fruit produced by the guard plots had a nice bright red colour and Brix° score above 8, with the Tulameen Pearl clones, 0534RB1, WSU 1568, WSU 1605 and 0460 F-5 all having an average Brix° of around 10. The fruit with the best flavour was produced by the Tulameen Pearl clones and Jean d' Orleans. However in 2015 none of the entries exhibited unpleasant or off-flavours, with all fruit scoring equal to or above Octavia.

Table 16. Average berry quality scores and Brix° readings over the 2015 harvest period for the main selections in order of season – Stanton St John

		<i>5=pale</i> <i>1=dark</i>	<i>5=bright</i> <i>1=dull</i>	<i>5=even</i> <i>1=irreg.</i>	<i>5=firm</i> <i>1=soft</i>	<i>5=strong</i> <i>1=weak</i>	<i>5=whole</i> <i>1=crumbly</i>	<i>5= good</i> <i>1= poor</i>
Cultivar/ Selection	Brix°	Redness	Bright- ness	Outline	Texture	Skin strength	Berry cohes'nes	Flavour
0435D-3	6.9	3.1	3.8	3.7	2.9	3.4	3.9	3.1
BC 92-9-15 (Squamish)	10.5	3.1	4.0	3.6	3.5	3.9	4.0	4.2
0485K-1	10.0	2.7	4.1	4.2	3.4	4.0	4.1	3.9
Tulameen (Naktuinbouw clone)	9.5	2.7	4.3	4.0	3.0	3.8	3.9	4.4
AAC Eden	9.0	2.7	3.8	3.7	3.1	3.7	3.7	4.0
0019 E2	6.9	2.9	4.1	3.9	3.7	4.1	4.1	3.3
Octavia	8.3	3.8	3.6	3.4	3.5	4.0	4.0	2.9
EM6803/16	7.3	3.5	4.3	2.7	2.5	3.4	3.0	3.0
EM6805/142	7.4	3.9	4.0	3.9	3.4	4.0	4.0	2.9
EM6804/68	7.5	2.4	3.5	3.7	3.2	3.8	3.8	2.9
0447C-5 (Glen Dee)	8.0	3.2	3.9	3.8	3.4	3.9	4.0	3.8
EM6804/81	8.4	2.8	4.2	4.2	3.7	4.0	4.2	3.4

Table 17. Average berry quality scores and Brix° readings over the 2015 harvest period for the guard selections in order of season – Stanton St John

		<i>5=pale</i> <i>1=dark</i>	<i>5=bright</i> <i>1=dull</i>	<i>5=even</i> <i>1=irreg.</i>	<i>5=firm</i> <i>1=soft</i>	<i>5=strong</i> <i>1=weak</i>	<i>5=whole</i> <i>1=crumbly</i>	<i>5= good</i> <i>1= poor</i>
Cultivar/ Selection	Brix°	Redness	Bright- ness	Outline	Texture	Skin strength	Berry cohes'nes	Flavour
0658 C-5	8.6	3.8	4.0	3.5	3.8	4.0	4.2	3.7
0550 E4	9.4	2.6	4.0	3.4	4.0	4.0	4.0	4.0
Glen Fyne	8.6	2.8	4.0	4.0	3.8	4.3	4.0	4.0
0460 F-5	10.0	2.0	4.0	4.0	4.0	4.3	4.3	4.0
WSU 1568	10.0	3.0	5.0	4.0	3.3	3.7	4.0	4.0
BC1 88-6	9.4	2.6	4.3	3.4	3.8	4.2	4.0	3.6
WSU 1607	8.2	2.8	5.0	4.0	3.5	4.3	4.5	3.5
WSU 1605	9.8	2.6	4.5	4.2	3.4	4.0	5.0	4.0
Tul. Pearl Clone 299-5	10.7	2.8	4.0	3.8	3.0	3.8	4.3	4.5
Tul. Pearl Clone 300-5	10.8	2.8	4.3	3.3	3.7	3.7	3.7	4.5
Tul. Pearl Clone 301-5	9.7	2.5	4.5	4.3	3.3	3.5	4.3	4.5
0658 E-1	8.0	3.5	3.7	3.8	3.0	3.8	4.0	4.0
EM6804/42	9.4	3.0	3.7	3.8	3.8	3.8	4.0	3.3

		<i>5=pale</i> <i>1=dark</i>	<i>5=bright</i> <i>1=dull</i>	<i>5=even</i> <i>1=irreg.</i>	<i>5=firm</i> <i>1=soft</i>	<i>5=strong</i> <i>1=weak</i>	<i>5=whole</i> <i>1=crumbly</i>	<i>5= good</i> <i>1= poor</i>
Cultivar/ Selection	Brix°	Redness	Bright- ness	Outline	Texture	Skin strength	Berry cohes'nes	Flavour
0534RB1	10.3	2.7	3.3	4.0	3.8	4.2	4.3	3.8
0015F-1	6.0	3.0	4.0	3.7	3.7	4.0	4.0	3.7
Ukee	8.2	4.0	3.5	4.0	3.0	4.0	4.3	3.8
Jean d'Orléans	9.8	2.0	3.7	3.8	3.6	4.0	4.4	4.2

When sufficient fruit was available, a punnet of marketable fruit that had been harvested from each plot was placed in cold store at 3 - 4°C for 48 hours. The fruit was then withdrawn from store and allowed to warm to the ambient temperature before being assessed. Shelf-life was analysed on six occasions. **Tables 18** and **19** show the average scores attained by the entries during the 2015 harvest. No rotten berries were observed after 48 hours in any of the varieties and shelf-life was consistently good. Of the main entry varieties: 0019 E2, 0447C-5 (Glen Dee) and EM6804/81 held their texture the best and, along with BC 92-9-15 (Squamish) and EM6805/142, maintained the brightest berry appearance. EM6803/16 had the poorest scores.

In the guard varieties, no varieties showed any rots after cold storage. 0658 C-5, EM6804/42 and WSU 1607 were firmest after 48 hours and, along with WSU 1568; the Tulameen Pearl Clones; 0534RB1 and Jean d'Orléans, had the best overall appearance.

Table 18. Average shelf-life scores over the 2015 harvest period for the main selections in order of season – Stanton St John

	5 = no rots 1 = > 5 rots	5 = firm 1 = v. soft	5 = bright 1 = v. dull
Cultivar/Selection	Rotten berries	Texture	Appearance
0435D-3	5	3.2	3.3
BC 92-9-15 (Squamish)	5	3.6	4.1
0485K-1	5	4.0	3.9
Tulameen (Naktuinbouw clone)	5	3.6	3.9
AAC Eden (KO6-2)	5	3.4	3.5
0019 E2	5	4.2	4.3
Octavia	5	3.8	4.0
EM6803/16	5	3.0	3.1
EM6805/142	5	4.1	4.1
EM6804/68	5	3.9	4.0
0447C-5 (Glen Dee)	5	4.3	4.1
EM6804/81	5	4.4	4.3

Table 19. Average shelf-life scores over the 2015 harvest period for the guard selections in order of season – Stanton St John

	5 = no rots 1 = > 5 rots	5 = firm 1 = v. soft	5 = bright 1 = v. dull
Cultivar/Selection	Rotten berries	Texture	Appearance
0658 C-5	5	4.4	4.6
0550 E4	5	4.0	4.0
Glen Fyne	5	4.0	4.0
0460 F-5	5	4.3	4.0
WSU 1568	5	4.0	4.3
BC1 88-6	5	4.3	4.0
WSU 1607	5	4.5	4.5
WSU 1605	5	3.5	3.8
Tulameen Pearl Clone 299-5	5	4.3	4.5
Tulameen Pearl Clone 300-5	5	4.2	4.2
Tulameen Pearl Clone 301-5	5	3.3	4.0
0658 E-1	5	3.8	3.8
EM6804/42	5	4.4	4.4
0534RB1	5	4.2	4.2
0015F-1	5	4.3	4.0

	5 = no rots 1= > 5 rots	5 = firm 1 = v. soft	5 = bright 1 = v. dull
Cultivar/Selection	Rotten berries	Texture	Appearance
Ukee	5	3.0	3.3
Jean d'Orléans	5	4.3	4.3

Visitors to the AHDB open day for this trial on 22 July 2015 were asked to score the fruit for brightness, texture, colour and flavour and to state whether they felt the fruit had commercial potential or not. Data are presented in **Tables 20** and **21**. BC92-9-15, (Squamish) and EM6805/142 were most favoured for flavour. Of the guard entries BC 1-88-6, Tulameen Pearl Clones, 0534RB1, WSU 1568 and WSU 1605 were also very popular. This data does need treating with caution as the harvest of the earliest selections e.g. 0435D-3 was nearly completed by this date so their fruits were not at their best.

Table 20. Average quality scores given by visitors to the trial open day 20 July 2015 for the main selections in order of season – Stanton St John

Cultivar/ Selection	Has it commercial potential? (>values greater potential)	Brightness 5=bright 1=dull	Texture 5=firm 1=soft	Colour 5=pale 1=dark	Flavour 5=good 1=poor
0435D-3	2.0	2.8	2.1	2.5	2.1
BC 92-9-15 (Squamish)	8.0	3.6	3.3	2.8	3.5
0485K-1	3.0	3.5	3.2	3.0	2.8
Tulameen (Naktuinbouw)	4.0	3.6	2.6	2.6	3.4

Cultivar/ Selection	Has it commercial potential? (>values greater potential)	Brightness 5=bright 1=dull	Texture 5=firm 1=soft	Colour 5=pale 1=dark	Flavour 5=good 1=poor
clone)					
AAC Eden (KO6-2)	4.0	2.8	2.9	2.7	2.9
0019 E2	5.0	2.9	3.4	2.9	2.7
Octavia	5.0	2.9	3.1	2.0	2.9
EM6803/16	3.0	3.6	2.6	3.3	2.4
EM6805/142	5.0	3.0	3.1	3.3	3.4
EM6804/68	5.0	2.6	2.6	2.6	3.0
0447C-5 (Glen Dee)	4.0	3.7	3.4	3.0	2.8
EM6804/81	6.0	3.1	3.8	2.3	3.0

Table 21. Average quality scores given by visitors to the trial open day 20 July 2015 for the guard selections in order of season – Stanton St John

Variety/ Selection	Has it commercial potential? (>values greater potential)	Brightness 5=bright 1=dull		Texture 5=firm 1=soft	Colour 5=pale 1=dark	Flavour 5=good 1=poor
0658 C-5	2	2.7		3.3	3.3	2.4
0550 E4	1	2.5		3.7	2.3	2.3
Glen Fyne	3	3.4		2.8	3.3	3.0

Variety/ Selection	Has it commercial potential? (>values greater potential)	Brightness 5=bright 1=dull		Texture 5=firm 1=soft	Colour 5=pale 1=dark	Flavour 5=good 1=poor
0460 F-5	2	2.8		2.4	2.5	2.8
WSU 1568	2	3.9		2.4	3.1	2.9
BC1 88-6	4	3.8		4.5	3.9	3.4
WSU 1607	4	4.0		3.3	3.0	2.6
WSU 1605	4	3.5		3.1	3.8	2.9
Tul.Pearl Clone 299-5	3	3.7		3.1	3.6	3.3
Tul. Pearl Clone 300-5	4	3.0		2.5	2.4	2.4
Tul. Pearl Clone 301-5	5	3.6		3.0	2.8	3.4
0658 E-1	3	3.4		2.7	3.3	2.5
EM6804/42	3	2.7		2.9	2.0	3.1
0534RB1	3	3.2		3.0	2.8	3.5
0015F-1	2	2.3		3.4	3.0	2.0
Ukee	2	1.6		1.6	3.8	1.9
Jean d'Orléans	2	2.6		3.4	2.4	2.8

Harvest results for 2016

Out of the main varieties, 0435D-3, BC92-9-15 (Squamish) and AAC Eden (KO6-2) had the earliest harvest start dates (15 June), although BC92-9-15 ranged from 15 to 20 June and AAC Eden (KO6-2) ranged from 15 to 27 June (**Table 22**). The selection with the latest start date was EM6804/81, where harvest commenced on 4 to 6 July. The end of harvest date for 0435D-3 was the earliest of the main entry selections on 25 July and BC92-9-15 (Squamish) finished harvest on 25 July to 17 August. Despite having one of the earliest start dates, 0485K-1 had one of the latest harvest dates (19 August). EM6805/142 and EM6804/81 also had an end date of 19 August. Several other main selections had final harvest dates on 19 August including 0019 E2, Octavia, EM6804/68 and 0447C-5 (Glen Dee). However some plots of each of these varieties finished earlier than 19 August.

Table 22. 2016 harvest dates for the main entry varieties – including start date, 25%, 50%, 75% and end date - Stanton St John

Cultivar/ Selection	Start	25%	50%	75%	End
0435D-3	15 Jun	27 Jun – 29 Jun	01 Jul – 06 Jul	08 Jul – 13 Jul	25 Jul
BC92-9-15 (Squamish)	15 Jun – 20 Jun	27 Jun – 29 Jun	01 Jul – 06 Jul	08 Jul – 11 Jul	25 Jul – 17 Aug
0485K-1	20 Jun – 29 Jun	08 Jul – 11 Jul	13 Jul – 18 Jul	22 Jul – 01 Aug	19 Aug
Tulameen (Naktuinbouw clone)	20 Jun – 01 Jul	11 Jul – 15 Jul	15 Jul – 20 Jul	20 Jul – 25 Jul	03 Aug – 08 Aug
AAC Eden (KO6-2)	15 Jun – 27 Jun	06 Jul – 11 Jul	13 Jul – 18 Jul	22 Jul – 25 Jul	03 Aug – 17 Aug

Cultivar/ Selection	Start	25%	50%	75%	End
0019 E2	27 Jun – 29 Jun	11 Jul – 13 Jul	18 Jul	22 Jul – 25 Jul	03 Aug – 19 Aug
Octavia	20 Jun – 06 Jul	22 Jul - 25 Jul	29 Jul – 01 Aug	05 Aug - 08 Aug	17 Aug – 19 Aug
EM6803/16	01 Jul – 06 Jul	15 Jul – 22 Jul	20 Jul – 25 Jul	25 Jul – 03 Aug	03 Aug – 10 Aug
EM6805/142	25 Jun – 06 Jul	18 Jul – 25 Jul	25 Jul – 01 Aug	05 Aug – 10 Aug	19 Aug
EM6804/68	29 Jun – 01 Jul	11 Jul – 18 Jul	18 Jul – 25 Jul	22 Jul – 29 Jul	01 Aug – 19 Aug
0447C-5 (Glen Dee)	23 Jun – 27 Jun	15 Jul – 18 Jul	22 Jul – 25 Jul	27 Jul – 03 Aug	03 Aug - 19 Aug
EM6804/81	04 Jul – 06 Jul	20 Jul – 22 Jul	25 Jul – 27 Jul	03 Aug	19 Aug

Out of the guard entries, 0534RB1 and 0658 C-5 had the earliest harvest start dates on 15 June (**Table 23**). 0534RB1 finished harvest on 3 August and 0658 C-5 finished harvest on 19 August. RU04106 had the latest start date on 6 July and was one of the last varieties to finish cropping on 19 August. The guard variety that was the earliest to finish cropping was WSU 1568 on 25 July. The latest final harvest date was 19 August which was when 0658 C-5, Tulameen Pearl Clone 300-5, Tulameen Pearl Clone 301-5, 0658 E-1, 0550 E4, Tulameen Pearl Clone 299-5, EM6804/42, RU0043067, RU04403073, Glen Fyne, WSU 1605, Jean d'Orléans and RU04106 finished cropping.

Table 23. 2016 harvest dates for the guard selections – including start date, 25%, 50%, 75% and end date - Stanton St John

Cultivar	Start	25%	50%	75%	End
0658 C-5	15-Jun	08-Jul	15-Jul	22-Jul	19-Aug
0550 E4	23-Jun	13-Jul	22-Jul	01-Aug	19-Aug
Glen Fyne	29-Jun	13-Jul	20-Jul	29-Jul	19-Aug
0460 F-5	29-Jun	08-Jul	13-Jul	20-Jul	03-Aug
RU0043067	25-Jun	20-Jul	29-Jul	08-Aug	19-Aug
RU04403073	27-Jun	18-Jul	25-Jul	01-Aug	19-Aug
WSU 1568	20-Jun	08-Jul	11-Jul	18-Jul	25-Jul
BC1 88-6	20-Jun	01-Jul	08-Jul	15-Jul	03-Aug
RU04106	06-Jul	13-Jul	15-Jul	25-Jul	19-Aug
WSU 1607	27-Jun	11-Jul	18-Jul	25-Jul	08-Aug
WSU 1605	29-Jun	13-Jul	18-Jul	25-Jul	19-Aug
Tulameen Pearl Clone 299-5	23-Jun	11-Jul	18-Jul	25-Jul	19-Aug
Tulameen Pearl Clone 300-5	20-Jun	11-Jul	15-Jul	25-Jul	19-Aug
Tulameen Pearl Clone 301-5	20-Jun	11-Jul	13-Jul	22-Jul	19-Aug
0658 E-1	20-Jun	11-Jul	18-Jul	25-Jul	19-Aug
EM6804/42	25-Jun	15-Jul	22-Jul	29-Jul	19-Aug
0534RB1	15-Jun	06-Jul	11-Jul	20-Jul	03-Aug
0015F-1	29-Jun	11-Jul	18-Jul	25-Jul	10-Aug
Ukee	27-Jun	11-Jul	15-Jul	22-Jul	03-Aug
Jean d'Orléans	29-Jun	15-Jul	20-Jul	25-Jul	19-Aug

Yield and berry weight assessments were carried out over the harvest period of the trial in 2016 (**Table 24**). The fruit was picked by farm staff three times a week and measurements were carried out by ADAS.

Out of the main selections, EM6804/81 produced the highest volume of marketable fruit over the harvest period (2.2 Kg/plant), significantly more than Tulameen and Octavia. Selections 0435D-3, EM6805/142 and 0447C-5 (Glen Dee) had the second

highest marketable yields out of the main entries (1.6 Kg/plant). The main entry with the lowest marketable yield was 0485K-1 (0.9 Kg/plant). The variety with the lowest amount of waste out of the main entries was 0485K-1 (107.9 g/plant), meaning that this variety had the highest percentage marketable yield (93.9%). AAC Eden had the highest amount of waste (765.5 g/plant) and had the lowest percentage marketable yield (60.3%). Octavia produced the second highest amount of waste (434.2 g/plant) and had the second lowest percentage marketable yield (76.3%).

The main entry selection with the highest average berry weight was EM6804/81 (5.7 g). Of the main selections, 0447C-5 (Glen Dee) had the second highest berry weight on average (5.5 g). 0435D-3 had the lowest berry weight on average out of the main entries (3.9 g).

Table 24. Average marketable yield, waste, percentage marketable yield, berry weight and minimum and maximum berry weights collected in 2016 for the main selections - Stanton St John

Cultivar/ Selection	Marketable yield (Kg/plant)	Waste (g/plant)	% Marketable yield	Average berry weight (g)	Min. berry weight (g)	Max. berry weight (g)
0435D-3	1.6	212.3	88.2	3.9	3.0	4.9
BC 92-9-15 (Squamish)	1.2	126.6	92.1	4.3	3.7	4.9
0485K-1	0.9	107.9	93.9	5.3	4.1	6.2
Tulameen (Naktuinbouw clone)	1.2	247.5	82.1	4.8	3.9	5.9
AAC Eden	1.2	765.5	60.3	5.2	4.2	6.3
0019 E2	1.4	260.2	83.8	5.3	4.3	6.2
Octavia	1.3	434.2	76.3	5.2	3.7	6.9
EM6803/16						
EM6805/142	1.6	202.2	88.5	5.2	4.1	6.6
EM6804/68	1.5	240.3	85.1	4.7	3.7	6.0
0447C-5 (Glen Dee)	1.6	150.5	91.7	5.5	4.5	7.3
EM6804/81	2.2	179.8	92.2	5.7	3.9	7.8

Out of the guard selections, RU0043067 had the highest marketable yield (2.8 Kg/plant) and 0658 C-5 had the second highest marketable yield (2.6 Kg/plant) (**Table 25**). Glen Fyne had the lowest marketable yield per plant (0.5 Kg/plant) and WSU 1568

had the second lowest marketable yield (0.7 Kg/plant). The guard entry with the lowest amount of waste fruit was 0460 F-5 (71.6 g/plant). This selection also had the highest percentage marketable yield (94.1%). Selection 0658 E-1 had the highest amount of waste fruit (882.6 g/plant) and a percentage marketable yield of 65.2%. The guard selection with the lowest marketable yield percentage was Glen Fyne (50.5%).

The guard selection with the highest average berry weight was WSU 1607 (6.5 g) and the lowest average berry weight was Jean d'Orléans (3.4 g).

Table 25. Average marketable yield, waste, percentage marketable yield, berry weight and minimum and maximum berry weights collected in 2016 for the guard selections - Stanton St John

Cultivar/ Selection	Marketable yield (kg/plant)	Waste (g/plant)	% Marketable yield	Average berry weight (g)	Min. berry weight (g)	Max. berry weight (g)
0658 C-5	2.6	487.4	84.3	5.2	4.0	7.0
0550 E4	1.4	389.6	77.7	4.1	2.8	6.4
Glen Fyne	0.5	483.8	50.5	4.0	3.3	4.9
0460 F-5	1.1	71.6	94.1	4.9	4.2	5.5
RU0043067	2.8	234.5	92.3	5.7	4.2	7.2
RU04403073	1.5	246.6	85.9	4.6	3.4	6.3
WSU 1568	0.7	171.1	79.4	4.9	4.1	5.8
BC1 88-6	1.3	353.5	78.9	5.6	4.6	6.8
RU04106	1.0	428	69.2	5.7	5.7	5.7
WSU 1607	1.9	170.9	91.5	6.5	4.6	8.5
WSU 1605	1.9	162.3	92.0	6.2	4.3	8.2

Cultivar/ Selection	Marketable yield (kg/plant)	Waste (g/plant)	% Marketable yield	Average berry weight (g)	Min. berry weight (g)	Max. berry weight (g)
Tulameen Pearl Clone 299-5	1.8	283.1	86.4	5.0	3.6	6.3
Tulameen Pearl Clone 300-5	2.1	265.8	88.9	5.2	3.9	7.1
Tulameen Pearl Clone 301-5	2.3	288.5	89.0	5.9	4.3	5.8
0658 E-1	1.7	882.6	65.2	5.2	3.8	6.7
0427 G-7*	0.4	215.3	66.0	4.7	4.0	5.4
EM6804/42	1.6	415.2	79.6	4.9	3.4	6.9
0534RB1	1.3	394.8	77.0	5.2	4.2	6.7
0015F-1	1.3	406.4	78.3	4.1	3.3	5.0
Ukee	1.4	208.0	87.3	3.9	3.0	5.1
Jean d'Orléans	1.4	281.6	83.4	3.4	2.6	4.8

At the start of harvest, the highest berry weight was recorded for 0485K-1 (6 g) and the lowest berry weight was recorded for BC92-9-15 (Squamish) (4.5 g) out of the main entries (**Table 26**). By the end of harvest Tulameen and 0019 E2 had the highest berry weight (4.8 g). The main selection with the lowest berry weight at the end of harvest was 0435D-3 (3.3 g).

Table 26. Average berry weights (g) 2016 for the main selections – including berry weight at the start date, 25%, 50%, 75% and end date - Stanton St John

Cultivar/Selection	Start	25%	50%	75%	End
0435D-3	4.8	4.1	3.9	3.6	3.3
BC92-9-15 (Squamish)	4.5	4.2	4.2	4.6	4.3
0485K-1	6.0	5.9	5.6	5.0	4.1
Tulameen (Naktuinbouw clone)	4.7	5.2	4.6	4.8	4.8
AAC Eden (KO6-2)	5.2	5.3	5.3	4.9	4.4
0019 E2	5.8	5.8	5.3	5.4	4.8
Octavia	5.6	5.5	4.9	5.1	4.2
EM6803/16	4.9	5.3	5.2	4.8	4.7
EM6805/142	5.4	5.1	4.9	4.5	4.1
EM6804/68	5.1	5.4	4.7	4.2	3.8
0447C-5 (Glen Dee)	5.6	5.9	5.5	5.0	4.6
EM6804/81	5.1	6.1	5.0	5.0	4.3

The guard entry with the highest berry weight at the start of harvest was 0658 C-5 (7 g) and the entry with the lowest berry weight at the start of harvest was Jean d'Orléans (3.8 g) (**Table 27**). On the final harvest date selection BC1 88-6 had the highest berry weight (6.8 g) and Jean d'Orléans had the lowest berry weight (2.7 g), closely followed by 0550 E4 (2.8 g).

Table 27. Average berry weights (g) 2016 for the guard selections – including berry weight (g) at the start date, 25%, 50%, 75% and end date - Stanton St John

Cultivar	Start	25%	50%	75%	End
0658 C-5	7.0	5.1	5.6	5.0	4.2
0550 E4	4.2	5.3	4.2	4.0	2.8
Glen Fyne	4.8	5.2	3.3	3.4	3.3
0460 F-5	4.2	4.9	5.0	4.8	4.5
RU0043067	6.2	5.6	5.7	4.6	4.2
RU04403073	5.3	5.3	3.9	4.2	3.4
WSU 1568	4.3	4.6	5.8	5.0	4.1
BC1 88-6	5.6	5.8	4.6	5.8	6.8
WSU 1607	6.7	8.5	7.7	5.3	4.9
WSU 1605	8.0	7.4	6.6	5.9	4.3
Tulameen Pearl Clone 299-5	5.1	6.3	6.0	5.3	3.6
Tulameen Pearl Clone 300-5	5.0	6.1	5.4	5.0	3.9
Tulameen Pearl Clone 301-5	4.9	5.0	5.3	5.0	4.3
0658 E-1	5.7	6.7	4.9	4.2	4.8
EM6804/42	5.8	5.1	5.2	4.2	4.2
0534RB1	4.9	4.4	6.5	4.6	4.6
0015F-1	5.0	4.0	4.4	4.0	3.3
Ukee	4.1	4.7	3.9	3.5	3.1
Jean d'Orléans	3.8	4.8	3.0	2.9	2.7

Berry quality 2016

Of the main entry cultivars, the highest average Brix° score was recorded for Tulameen (Naktuinbouw clone) (7.5°), which was closely followed by BC 92-9-15 (Squamish) and EM6805/142 (both having Brix° scores of 7.4°) (**Table 28**). The lowest average Brix° score was recorded for AAC Eden (5.9°).

The redness of berries was scored on a scale of 1 to 5 with 1 being dark and 5 being pale. The palest berries were produced by Octavia (scoring 3.6) which was closely followed by AAC Eden and EM6805/142 (both scoring 3.6). The darkest berries were produced by 0485K-1, which scored 2.7 on the redness scale. Brightness of berries was scored on a scale of 1 to 5 with 1 being dull and 5 being the brightest. Selections BC 92-9-15 (Squamish) and 0485K-1 both had the brightest berries (scoring 4.6 on the brightness scale). The dullest berries were recorded in 0435D-3 (3.4).

The outline of berries was scored on a scale of 1 to 5 with 1 being irregular and 5 being even. The most even berries were produced by 0485K-1 (scoring 4.1) and the most irregular berries were produced by Octavia and 0447C-5 (Glen Dee) (both scoring 3.4). Texture of berries was scored on a scale of 1 to 5 with 1 being soft and 5 being firm. In relation to texture the firmest berry texture was recorded for sections 0485K-1 and 0019 E2 (3.8). The berries with the softest texture were produced by selection 0435D-3 (2.7). The skin strength of berries was scored on a scale of 1 to 5 with 1 being weak and 5 being strong. Berries with the strongest skin were from selection 0485K-1 (4.2). Berries with the weakest skin were from Tulameen (Naktuinbouw clone) (3.9). Berry cohesiveness was measured on a scale of 1 to 5 with 1 being crumbly berries and 5 being whole berries. In terms of berry cohesiveness the least crumbly berries were from selection 0485K-1 (4.3) and the most crumbly berries were produced by Octavia (3.6).

Berry flavour was scored on a scale of 1 to 5 with 1 being poor and 5 being good. Selections BC 92-9-15 (Squamish) and 0485K-1 scored highest for berry flavour (4.4), whilst selection 0435D-3 scored the lowest for flavour (2.8).

Table 28. Average berry quality scores and Brix° readings over the 2016 harvest period for the main selections in order of season - Stanton St John

		<i>5=pale 1=dark</i>	<i>5=bright 1=dull</i>	<i>5=even 1=irreg.</i>	<i>5=firm 1=soft</i>	<i>5=strong 1=weak</i>	<i>5=whole 1=crumbly</i>	<i>5=good 1=poor</i>
Cultivar/ Selection	Brix°	Red- ness	Bright- ness	Outline	Texture	Skin strength	Berry cohes'nes	Flavour
0435D-3	7.2	3.2	3.4	3.8	2.7	4.0	4.0	2.8
BC 92-9-15 (Squamish)	7.4	2.9	4.6	3.6	3.4	4.0	3.9	4.4
0485K-1	7.2	2.7	4.6	4.1	3.8	4.2	4.3	4.4
Tulameen (Naktuinbo uw clone)	7.5	2.9	4.2	3.7	3.3	3.9	4.1	4.3
AAC Eden	5.9	3.6	3.7	3.6	2.9	4.0	3.8	2.9
0019 E2	6.3	3.0	4.1	3.6	3.8		4.0	3.2
Octavia	6.1	3.9	3.7	3.4	3.6	4.0	3.6	2.9
EM6805/14 2	7.4	3.6	3.9	3.7	3.4	4.0	3.8	2.9
EM6804/68	6.8	3.4	3.8	3.6	3.4	4.0	4.0	3.5
0447C-5 (Glen Dee)	6.7	3.1	4.0	3.4	3.4	4.0	4.0	3.5
EM6804/81	7.0	2.8	4.1	4.0	3.5	4.0	4.0	3.7

The berry quality scores for the guard selections were recorded as per the main entry varieties. The guard selection with the highest Brix° score was WSU 1605 (8.5°) and the guard selection with the lowest Brix° score was Tulameen Pearl Clone 299-5 (6.4°) (**Table 29**). The guard entry with the palest berries was Ukee (4.5), whilst the guard entries with the darkest berries were 0460 F-5 and Jean d'Orléans (both scoring 2). The guard selections with the brightest berries were BC1 88-6 and WSU 1607 (5). The dullest berries were produced by Ukee (3). In terms of outline, WSU 1607 had the most even outline (4.6) whilst berries from selections 0550 E4 and RU04403073 had the most irregular outline (2.9). The firmest berries were produced by selections BC1 88-6 and RU04403073, both scoring 4.3, whilst the most crumbly berries were produced by 0550 E4 (3.3). The berries with the best flavour were produced by Tulameen Pearl Clone 300-5 (5). The poorest flavour were berries from Ukee (2.4).

Table 29. Average berry quality scores and Brix° readings over the 2016 harvest period for the guard selections – Stanton St John

		<i>5=pale</i> <i>1=dark</i>	<i>5=bright</i> <i>1=dull</i>	<i>5=even</i> <i>1=irreg.</i>	<i>5=firm</i> <i>1=soft</i>	<i>5=strong</i> <i>1=weak</i>	<i>5=whole</i> <i>1=crumbly</i>	<i>5= good</i> <i>1= poor</i>
Cultivar/ Selection	Brix°	Redness	Bright- ness	Outline	Texture	Skin strength	Berry cohes'nes	Flavour
0658 C-5	7.2	3.6	4.3	3.6	3.4	4.0	3.7	3.8
0550 E4	8.2	3.0	3.6	2.9	3.0	3.9	3.3	3.0
Glen Fyne	5.8	2.5	4.5	3.3	3.5	4.0	4.0	3.0
0460 F-5	6.5	2.0	4.8	4.3	4.0	4.3	4.3	4.3
RU0043067	6.6	3.3	3.9	3.3	3.5	3.9	3.6	3.4
RU04403073	6.9	2.1	3.7	2.9	4.3	4.1	4.0	3.3
WSU 1568	7.8	2.8	4.7	3.8	3.5	4.3	3.8	3.5
BC1 88-6	8.3	2.8	5.0	3.8	4.3	4.3	4.0	4.0
RU04106								
WSU 1607	6.7	2.4	5.0	4.6	4.2	4.6	4.6	3.5
WSU 1605	8.5	2.7	4.2	4.0	3.2	4.0	3.8	3.0
Tul. Pearl Clone 299-5	6.4	3.0	4.8	3.6	3.4	4.0	4.2	4.8
Tul. Pearl Clone 300-5	7.7	3.0	4.8	3.8	3.3	3.8	4.3	5.0
Tul. Pearl Clone 301-5	7.6	3.0	4.8	3.8	3.3	4.0	4.3	4.7
0658 E-1	6.9	3.6	4.0	3.2	3.0	4.0	4.0	3.3
EM6804/42	7.0	3.4	4.0	3.6	3.8	4.0	4.0	3.5

		<i>5=pale</i> <i>1=dark</i>	<i>5=bright</i> <i>1=dull</i>	<i>5=even</i> <i>1=irreg.</i>	<i>5=firm</i> <i>1=soft</i>	<i>5=strong</i> <i>1=weak</i>	<i>5=whole</i> <i>1=crumbly</i>	<i>5= good</i> <i>1= poor</i>
Cultivar/ Selection	Brix°	Redness	Bright- ness	Outline	Texture	Skin strength	Berry cohes'nes	Flavour
0534RB1	8.3	2.5	4.5	3.5	3.8	4.0	3.7	4.2
0015F-1	7.4	2.7	4.0	3.0	4.0	4.0	4.0	3.7
Ukee	7.7	4.5	3.0	3.5	2.8	4.2	3.7	2.4
Jean d'Orléans	6.5	2.0	4.3	4.3	3.5	4.3	4.3	3.7

Post-harvest rots were scored on a scale of 1 to 5 with 1 meaning greater than 5 berries were rotten and 5 meaning that no rots were present. No rots were seen in any of the shelf-life assessments from the main entries (**Table 30**). Texture was scored on a scale of 1 to 5 with 1 being very soft and 5 being firm fruit. The results from the shelf life tests found the main entries with the firmest berries were 0485K-1 and 0447C-5 (Glen Dee) (3.6). 0435D-3 was the main selection with the softest berries in the shelf-life assessments (2.4). Brightness was scored on a scale of 1 to 5 with 1 being very dull fruit and 5 being very bright fruit. The main selections with the brightest berries after the shelf life-tests were 0485K-1, Octavia, 0447C-5 (Glen Dee), 0019 E2 and EM6804/81 (3.7). The dullest berries were 0435D-3 (2.3).

Table 30. Average shelf-life scores over the 2016 harvest period for the main selections – Stanton St John 2016

	5 = no rots 1 = > 5 rots	5 = firm 1 = v. soft	5 = bright 1 = v. dull
Cultivar/Selection	Rotten berries	Texture	Appearance
0435D-3	5.0	2.4	2.3
BC 92-9-15 (Squamish)	5.0	3.3	3.3
0485K-1	5.0	3.6	3.7
Tulameen (Naktuinbouw clone)	5.0	2.8	3.4
AAC Eden (KO6-2)	5.0	2.6	2.8
0019 E2	5.0	3.5	3.7
Octavia	5.0	3.3	3.7
EM6803/16	5.0		
EM6805/142	5.0	3.1	3.4
EM6804/68	5.0	2.7	3.0
0447C-5 (Glen Dee)	5.0	3.6	3.7
EM6804/81	5.0	3.5	3.7

There were no rots observed from the guard selections in the shelf-life tests (**Table 31**). Out of the guard selections, fruit from 0658 E-1 and Jean d'Orléans had the firmest textures after the shelf-life tests (4) and 0658 C-5 had the softest berries (2.4). Out of the guards 0658 E-1 had the brightest berries (4.3) and 0658 C-5 had the duller berries (2.6).

Table 31. Average shelf-life scores over the harvest period for the main selections in order of season - Stanton St John 2016

	5 = no rots 1 = > 5 rots	5 = firm 1 = v. soft	5 = bright 1 = v. dull
Variety/Selection	Rotten berries	Texture	Appearance
0658 C-5	5.0	2.4	2.6
0550 E4	5.0	3.3	3.3
Glen Fyne	5.0	3.7	3.4
0460 F-5	5.0	3.7	3.7
RU0043067	5.0	4.0	4.0
RU04403073	5.0	3.5	3.5
WSU 1568	5.0	4.0	4.0
BC1 88-6	5.0	2.8	3.5
RU04106	5.0	3.5	4.0
WSU 1607	5.0	3.5	3.3
WSU 1605	5.0	3.7	3.7
Tulameen Pearl Clone 299-5	5.0	3.8	3.4
Tulameen Pearl Clone 300-5	5.0	3.0	3.0
Tulameen Pearl Clone 301-5	5.0	2.6	3.6
0658 E-1	5.0	4.0	4.3
EM6804/42	5.0	2.6	2.8
0534RB1	5.0	3.6	3.6
0015F-1	5.0		
Ukee	5.0	3.0	4.0

	5 = no rots 1 = > 5 rots	5 = firm 1 = v. soft	5 = bright 1 = v. dull
Variety/Selection	Rotten berries	Texture	Appearance
Jean d'Orléans	5.0	4.0	4.0

Discussion

Results from the growth assessments carried out in February 2014 showed that the main entry cultivars BC92-9-15, AAC Eden (KO6-2) and 0447C-5 achieved similar levels of growth to the commercial standards Octavia and Tulameen, producing floriculture over 1 m in height. Out of the guard entries, 0658 C-5, BC1-88-6, Tulameen Pearl Clone 299-5, Ukee and Jean d'Orléans all produced similar levels of growth to Octavia and Tulameen. The poor cane growth of the EMR entries (EM6805/142, EM6804/68, EM6803/16, EM6804/81) was primarily due to their late planting. However in the main, plants in the plots planted in 2013 had extensive root systems by February 2014, including those which had produced few canes or ones of poor stature in the planting year.

Out of the main entries the selections found to be spine free on the primocanes included 0435D-3, AAC Eden (KO6-2), 0485K-1, 0447C-5, EM6805/142 and 0019E2. Of the guards, the selections with primocanes found to be spine free were 0534RB1, 0658 C-5, 0658E-1, 0550E-4, 0460F-5, 0015F1 and Glen Fyne. Spine free raspberry cultivars are preferable for growers because they are easier to handle and manage compared to those with spines.

A raspberry cane with an upright growth habit is preferable as this makes it easy to support and cheap to grow. Of the main selections, those with an upright growth habit and therefore desirable are 0435 D-3, BC92-9-15, AAC Eden (KO6-2), EM6805/142, 0019 E-2 and EM6804/81. The varieties from the guard plots which exhibited upright growth habit include WSU 1568, Tulameen Pearl Clone 300-5, Tulameen Pearl Clone 301-5, 0550 E-4, Tulameen Pearl Clone 299-5, WSU 1607, 0460 F-5, 0015F1, WSU 1605 and Jean d'Orléans. Varieties with an upright-spreading or spreading habit can still be considered desirable if they offer other beneficial traits e.g. spine free canes,

high pest and disease resistance, stout, short or medium length self-supporting fruiting laterals, but these will require more primo and floricanes training (management) and a more sophisticated support trellis to keep them upright to present fruit well to pickers.

Raspberry plants producing taller canes indicate better vigour than those producing shorter canes; taller canes can also indicate higher yields. All of the main entry varieties in the trial produced tall canes, except for EM6803/16 which produced small canes. However the EM6803/16 in this trial was believed to be an off type which would account for the selection's poor vigour and short canes.

Thickness of cane is also a good indicator of plant vigour. The majority of selections in the trial had desirable thick to medium canes, but most particularly all clones of Tulameen and also the advanced selections from the PARC and WSU breeding programmes all produced very tall and stout canes. The only selection to have thin canes was EM6803/16, whilst 0658E-1 produced medium to thin canes.

The number of floricanes produced by plants varied between cultivars. A higher number of floricanes indicates that the plants have better vigour than those which produce fewer floricanes. All of the main entries in the trial had similar or higher numbers of floricanes compared to Octavia, except EM6803/16, and 0447C-5 had a higher number of floricanes than Tulameen. All of the guard entries had equal or higher numbers of floricanes than Octavia. 0534RB1, 0658 C-5, WSU 1568, BC1-88-6, Tulameen Pearl 300-5, Tulameen Pearl 299-5, EM6804/42, Ukee, WSU 1607, WSU 1605 and Jean d'Orléans had higher numbers of floricanes compared to the standard Tulameen.

No cane blight or cane spot was detected in any of the cultivars during the trial, whilst spur blight and cane botrytis were detected on all selections. The standard Tulameen selection was one of the cultivars to have one of the higher levels of spur blight (30%), whilst Octavia had fairly low levels (15%). The selections with the lowest level of spur blight were 0485K-1, Ukee and 0015F1. The standard Tulameen had one of the higher levels of cane botrytis (28%) and Octavia had slightly lower levels (20%). EM6805/142 had the lowest levels of cane botrytis infection.

Varieties with split rind are more likely to have problems with raspberry cane midge due to the adults laying their eggs in splits and wounds in the bark at the base of the

primocanes. The eggs then hatch and the larvae of the midge do the damage. For this reason, cultivars with no rind splitting are favourable to growers. Out of the main entries, 0485K-1 had the least amount of split rind. Out of the guard entries Ukee had the least amount of split rind.

Pests were found at low levels on foliage of most entries when plant assessments were carried out in July of 2014. This included the large raspberry aphid found on the majority of entries including those with A10 gene resistance to the four common strains of this pest. Two-spotted spider mite, leafhopper, caterpillar and sawfly were also found. The presence of pests could indicate that certain cultivars are more susceptible to certain pests. However this is hard to be sure of with the very low level pest infestation observed at this stage and will only be determined by further assessments.

The selection with the highest marketable yield in 2016 was RU0043067 which was closely followed by 0658 C-5, followed by EM6804/81. RU0043067 and 0658 C-5 had over double the marketable yield of Tulameen and Octavia. The only selections to have lower yields than Tulameen were 0485K-1, WSU 1568 and Glen Fyne. The selection with the highest percentage marketable yield was 0460 F-5, closely followed by 0485K-1. These both had higher percent marketable yields than both the Tulameen and Octavia. AAC Eden, 0658 E-1 and Glen Fyne were the only selections to have lower percentage marketable yields than Octavia. The selection with the highest berry weight was WSU 1607. The selections with lower berry weights than Octavia were 0435D-3, BC 92-9-15 (Squamish), EM6804/68, 0550 E4, Ukee, 0015F-1, Glen Fyne and Jean d'Orléans.

0435D-3, BC92-9-15 (Squamish), AAC Eden (KO6-2), 0534RB1 and 0658 C-5 had the earliest harvest start dates (15 June). BC92-9-15 ranged from 15 to 20 June and AAC Eden (KO6-2) ranged from 15 to 27 June. These selections started cropping five days earlier than both Tulameen and Octavia. RU04106 was the last selection to start harvest on 6 July and EM6804/81 started harvest on 4 to 6 July. The selections to finish cropping the earliest were 0435D-3 and WSU 1568, on 25 July, nine days earlier than Tulameen and 23 days earlier than Octavia.

Out of all the entries, the selection with the highest berry weight at the start of harvest in 2016 was 0658 C-5, which had a higher berry weight than both Tulameen and

Octavia. The only entries to have a lower berry weight than Tulameen at the beginning of harvest were BC92-9-15 (Squamish), WSU 1568, 0550 E4, Ukee, 0460 F-5 and Jean d'Orléans. The selections with the highest berry weight at the end of harvest was BC1 88-6. This selection's berry weight was higher than both the Tulameen and Octavia at the end of harvest. The following varieties had lower berry weights than Octavia at the end of harvest: 0435D-3, 0485K-1, EM6805/142, EM6804/68, WSU 1568, Tulameen Pearl Clone 300-5, 0550 E4, Tulameen Pearl Clone 299-5, Ukee, RU04403073, 0015F-1, Glen Fyne and Jean d'Orléans.

Brix measures the percentage of solids (TSS) in a given weight of plant juice, taking into account sucrose, fructose, vitamins, minerals, amino acids, proteins, hormones, and other solids. The Brix measurement varies directly with the quality of the berry. The higher the Brix score generally the better the flavour of the berry. In the trial Brix scores varied from 5.8° to 8.5°. The entry with the highest Brix score was WSU 1605 which had a higher Brix score than both the standards Tulameen and Octavia. The varieties that had lower Brix scores than Octavia were AAC Eden and Glen Fyne. The following varieties had higher Brix scores than the standard Tulameen: 0534RB1, WSU 1568, BC1 88-6, Tulameen Pearl Clone 300-5, Tulameen. Pearl Clone 301-5, 0550 E4, Ukee and WSU 1605.

The majority of the selections produced fruit that was either as bright or was brighter than the standards Octavia and Tulameen. The following selections were the only varieties to produce duller fruit than Octavia: 0435D-3, 0550 E4, RU0043067, RU04403073 and Ukee.

The following selections scored equal to or higher than Octavia in terms of outline meaning that fruit had a more even appearance: 0435D-3, BC 92-9-15 (Squamish), AAC Eden, 0485K-1, 0447C-5 (Glen Dee), EM6805/142, 0019 E2, EM6804/68, 0534RB1, 0658 C-5, WSU 1568, BC1 88-6, Tulameen Pearl Clone 300-5, Tulameen Pearl Clone 301-5, Tulameen Pearl Clone 299-5, EM6804/42, Ukee, WSU 1607, 0460 F-5, WSU 1605 and Jean d'Orléans.

The majority of the selections produced fruit that was firmer than Octavia and Tulameen. The only selections to have softer fruit than the two standards, Octavia and Tulameen, were: 0435D-3, AAC Eden, 0658 E-1, 0550 E4, Ukee and WSU 1605. The

crumbliest fruit was produced by 0550 E4. Octavia and RU0043067 had the second most crumbly fruit of the selections.

Most of the selections in the trial scored higher than the Octavia in terms of flavour. The only ones to score lower on flavour than Octavia were: WSU 1568, 0658 E-1, 0550 E4, EM6804/42, RU0043067, Ukee, WSU 1607, RU04403073, Glen Fyne and WSU 1605. There were several selections that had as good as or better flavour than the standard Tulameen: BC 92-9-15 (Squamish), 0485K-1, Tulameen Pearl Clone 299-5, Tulameen Pearl Clone 300-5, Tulameen Pearl Clone 301-5, and 0460 F-5.

Conclusions

The selections of particular interest from the main trial are Squamish (BC 92-9-15), and 0485K-1.

Squamish was exceptionally early in 2015 and produced 2kg/plant. Unfortunately, fruit was not that large but the berries had an excellent flavour which had a Brix superior to Tulameen. The berries looked bright and attractive in the punnet and showed a good shelf-life. Another benefit of this selection is that it has root rot tolerance and its plant growth and lateral characteristics make it very cheap to pick and grow. A lot of interest in this cultivar was shown by the visitors to the AHDB Summer fruiting raspberry walk held at the trial on the 22 July 2015. Although by that date it was nearing the end of its harvest, its fruit was small and it was far from being at its best, it still achieved a substantial score and was considered to have commercial potential. Many attendees asked if they could appraise it on their own farms if plant material was available to plant in winter 2015/16 or spring/early summer 2016.

0485K-1, a James Hutton Ltd. Selection, also gained a lot of interest at the open day. The fruit is attractive and very uniform in size and shape. The selection has a high proportion of marketable fruit, excellent flavour and shelf-life, and was easy to pick. However, as has been noted previously, this selection does require substantial winter chilling, which may not be reliably achieved for plantings outdoors during an average winter in the south of England. If chilling requirement could be overcome, its superb fruit qualities (including size, flavour and high potential class I) offers it considerable commercial potential. It might be possible to develop it as a cultivar for annual early -

mid or even late season fruit production from successive plantings (from March to June) of cold stored modular or bare root long cane planting material.

Other high yielding selections include **0019E2** from James Hutton Ltd. which produced a high yield and large fruit. However, this selection displayed problems including poor bud break (due to lack of sufficient winter chilling) and long laterals which, without support, were very prone to breakage.

EM6805/142 and **EM/6804/81** from EMR were very late fruiting so could be considered to be replacements for Octavia. They both produced a good yield and large berries which looked attractive in the punnet. These two selections broke bud better, cropped better and had larger and better quality fruit than Octavia. However, the flavour of both, although better than Octavia, was not very special.

Of the guards three selections were outstanding, these included **BC1-88-6**, **WSU 1607** and **0534RBI**. BC1-88-6 had a very high yield and high quality berries and was the highest scored selection at the open day in 2015. WSU 1607, a mid to late selection from Washington State, had a very large average berry size of 5.8 g, a long harvest period, distinct fruit flavour and was very popular with growers who visited the open day, along with the two other WSU selections. 0534RBI was also rated highly by visitors to the trial. It has a wonderful flavour, is late harvested, has good fruit size, yield and high percentage marketable yield. Also in the guard selections the three Tulameen Pearl clones performed well. In 2016, **RU0043067** had the highest yield of all the selections and the early guard selection **0658 C-5** produced the second highest amount of marketable fruit. Both of these produced double the yield of the standards (Tulameen and Octavia). 0658 C-5 also produced fruit with the highest berry weight. The fruit from this selection was very even in terms of outline. **RU04403073** produced nice looking berries with a firm texture which were strong in terms of skin strength and also in terms of cohesiveness.

Knowledge and Technology Transfer

Summer fruiting raspberry walks were arranged by AHDB Horticulture in summer 2015 (20 July) and summer 2016 (14 July) at the trial site (**Figure 15**) and was attended by growers and industry representatives. On the day fruit was available for visitors to taste and score and guided walks around the trial plots were led by Mrs Janet Allen of ADAS.

A PowerPoint presentation (**Figure 16**) has been produced and is available on the AHDB Horticulture website <http://horticulture.ahdb.org.uk/publication/presentation-raspberry-selections-ahdb-horticulture-raspberry-variety-trial>



Figure 15. Samples of all the selections and attendees to the open day 20 July 2015

BC92-9-15 (Squamish)

- Bred by PARC
- Early cropping season, before Glen Lyon - Malahat is a parent
- Glossy, medium - darkening red fruit, similar in size to Tulameen, with conical, firm fruits, large drupelets and good shelf life with an aromatic, excellent flavour
- Tall upright canes, adequate in number, short laterals at top, long at bottom - support not required
- Spines, most prominent at base

2015 results

Harvest season	Marketable yield	Av. berry weight	% Marketable
18-Jun – 29-Jul	2.0 kg/plant	4 g (2.6-5.7)	89 %

Root rot	Cane disease	Powdery mildew	L R Aphid	RBDV
MR	S	Not a problem	R*	S

* American large raspberry aphid

Figure 16. Screen shot of the SF 41d cultivar presentation

This details all the cultivars and selections involved in the trial with images of fruit on the plant and in the punnet along with key details about plant habit and management requirements and pest and disease susceptibility.

A PowerPoint presentation 'Promising new selections of summer fruiting raspberry varieties' was made by Mrs Janet Allen of ADAS UK Ltd at the EMRA/AHDB Soft fruit day meeting at East Malling research on the 25 November 2015.

Appendices

Appendix 1 – Trial layout

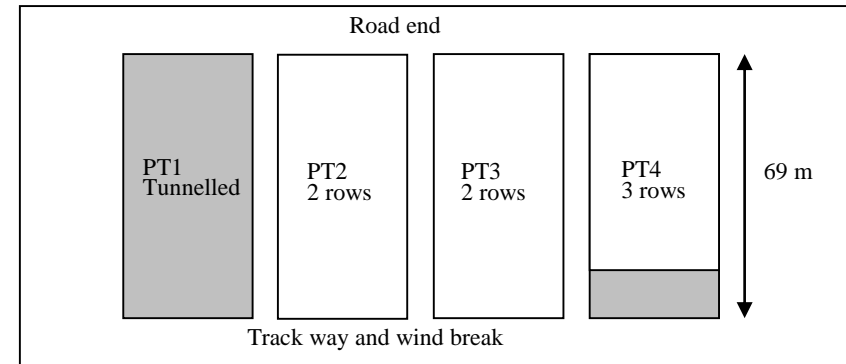
	Block 1	Tunnel 2
Plot	Treat	Variety
1	9	0447C-5
2	3	BC92-9-15
3	8	EM6804/81
4	4	AAC Eden (KO6-2)
5	10	0435D-3
6	11	0485K-1
7	5	EM6803/16
8	2	Tulameen
9	1	Octavia
10	7	EM6804/68
11	12	0019 E2
12	6	EM6805/142

	Block 2	Tunnel 2
Plot	Treat	Variety
13	11	0485K-1
14	8	EM6804/81
15	12	0019 E2
16	10	0435D-3
17	3	BC92-9-15
18	5	EM6803/16
19	7	EM6804/68
20	9	0447C-5
21	6	EM6805/142
22	1	Octavia
23	4	AAC Eden (KO6-2)
24	2	Tulameen

	Block 3	Tunnel 3
Plot	Treat	Variety
25	1	Octavia
26	10	0435D-3
27	6	EM6805/142
28	7	EM6804/68
29	11	0485K-1
30	3	BC92-9-15
31	5	EM6803/16
32	12	0019 E2
33	9	0447C-5
34	2	Tulameen
35	8	EM6804/81
36	4	AAC Eden (KO6-2)

	Block 4	Tunnel 3
Plot	Treat	Variety
37	7	EM6804/68
38	2	Tulameen
39	4	AAC Eden (KO6-2)
40	8	EM6804/81
41	10	0435D-3
42	1	Octavia
43	9	0447C-5
44	6	EM6805/142
45	12	0019 E2
46	3	BC92-9-15
47	11	0485K-1
48	5	EM6803/16

Guards			Tunnel 4		
	Row 1		Row 2		Row 3
1	0015F1	8	0550 E-4	15	Glen Fyne
2	WSU 1568	9	WSU 1605	16	0460 F-5
3	Ukee	10	Jean d'Orleans	17	WSU 1607
4	0658 C-5	11	0534RB1	18	0427 G-7
5	Tulameen Pearl clone 299-5 (6 plants)	12	Tulameen Pearl clone 300-5 (6 plants)	19	0658 E-1
6	BC1-88-6	13	Tulameen Pearl clone 301-5 (2 plants)	20	EM6804/42
7	RU0043067	14	RU04403073	21	RU04106



Appendix 2- AHDB SF 41d - Descriptions of the entries

Cultivar/ Selection		Harvest period SF41d in 2015	Fruit Size Average (Max- min) SF41d 2015 (g)	Fruit	Plant	Pest & Disease susceptibility
	Control varieties					
Tulameen (Naktuinbouw)		Mid - late 29 June – 12 August	4.4 (5.9-3.3)	Large-very large, bright attractive, excellent flavour, even set berries. Moderate - high yield	Long-very long laterals, protected crop needs lateral support. Bud break down length of canes. Some spines, upright-spreading very tall cane, moderate in number, some spines.	Very susceptible to raspberry root rot, also spur blight & cane botrytis
Octavia		Late 1 July – 12 August	5.0 (7.8-3.1)	Large round-conical berries, moderate flavour, pink berries with salmon undertones, reasonably bright, variable drupelet size & berry shape, berry can be uneven in shape. Moderate shelf life	Long - very long laterals, variable bud break mainly top - middle of canes, needs lateral support as protected crop. Spines especially noticeable on primocane.	Has A10 but is very susceptible to raspberry root rot, also cane blight

Cultivar/ Selection		Harvest period SF41d in 2015	Fruit Size Average (Max- min) SF41d 2015 (g)	Fruit	Plant	Pest & Disease susceptibility
From: East Malling Research						
EM6803/16		Late 29 June – 10 August	4.7 (6.4-3.4)	A high percentage of the plants in each plot not true to type, producing multi-branched canes & round, crumbly fruit. True to type plants have round-conic good size fruit, moderate -good flavour higher brix than G. Ample in EMR trials. Moderate - poor shelf-life	Vigorous, glabrous canes with long ascending laterals becoming drooping as fruit ripens, can break at top of canes, but lateral support may not be needed. Most laterals top-middle of canes. Spiny but most spines are not very prominent, very upright habit, vigorous plant.	Has A10
EM6804/68		Mid-Late 1 July – 3 August	4.4 (6.5-3.2)	Firm fruits conical of good colour and easy to plug, a bit uneven in shape. Moderate flavour, like Octavia but higher Brix, moderate shelf life	Vigorous, glabrous canes with long ascending laterals becoming drooping as fruit ripens. Laterals roll over each other, needs lateral support Spiny but most spines are not very prominent, upright cane, moderate vigour	A10

Cultivar/ Selection		Harvest period SF41d in 2015	Fruit Size Average (Max- min) SF41d 2015 (g)	Fruit	Plant	Pest & Disease susceptibility
EM6805/142		Late 1 July-12 August	5.1 (7.2-3.8)	Large firm attractive fruits; pale with good shelf-life. Moderate flavour	Vigorous, late emerging glabrous upright canes. The bottom half of the cane can be a bit bare. Long ascending laterals multi-flowered, strongly attached, may need lateral support. Good fruit presentation and easily plugged	A10
EM6804/81		Late 29 June – 12 August	4.8 (6.6-3.6)	Very firm, attractive fruits with excellent shelf-life. Fairly good flavour	Moderate vigour with late emerging glabrous canes. Laterals long, most top to mid- cane, laterals break & roll over need lateral support, fruit easily plugged Canes very upright, vigorous, spiny but most spines are not very prominent,	A10
EMR Guard						

Cultivar/ Selection		Harvest period SF41d in 2015	Fruit Size Average (Max- min) SF41d 2015 (g)	Fruit	Plant	Pest & Disease susceptibility
EM6804/42		Mid 29 June – 5 August	4.1 (5.4-3.4)	Firm fruits of good colour, higher brix & flavour than Octavia. Fairly good shelf-life	Vigorous, glabrous canes with long horizontal laterals. The fruit is well presented and easy to plug Spines	A10
From: James Hutton Ltd.						
0435D-3		V. early 18 June – 3 August	3.8 (5.8-3.8)	Neat, conical fruit with moderate flavour at times sweet & aromatic high yield. Good shelf life	Bud break full length of cane, short to med length laterals, strongly attached no lateral support required Productive over a long season Upright - spreading tall canes Spine free cane moderate vigour	Not known

Cultivar/ Selection		Harvest period SF41d in 2015	Fruit Size Average (Max- min) SF41d 2015 (g)	Fruit	Plant	Pest & Disease susceptibility
0485K-1		Early -Mid 26 June – 3 August	4.7 (6.5-2.6)	Large, conical fruit, very glossy and very attractive in punnet, darken as ripen High yield at JHI 2 kg/plant good flavour, good shelf life	Bud break top -mid cane only. Tall, upright to spreading canes, vigorous. Requires lateral supports. Otherwise easy and cheap to pick, easy to manage Spine free cane.	Has A10 & Gene H tolerance to cane botrytis & spur blight, very susceptible to raspberry root rot
0019 E2		Mid-late 1 July – 12 August	4.9 (7.1-3.8)	Very large conical fruit, large drupes, cohesive, but looks a little unevenly set, good shelf- life moderate to good – moderate flavour, high yield	Tall stout upright cane, easy to manage, fruit laterals very long need support as readily can break. Uneven bud break top-mid cane only, due to lack of winter chilling Spine free.	Has A10

Cultivar/ Selection		Harvest period SF41d in 2015	Fruit Size Average (Max- min) SF41d 2015 (g)	Fruit	Plant	Pest & Disease susceptibility
0447C-5 (Glen Dee)		Mid-Late 26 June – 12 August	5.4 (7.6-3.9)	Large, conical fruit with pleasant flavor Brix 8.0. Good shelf life. Consistent high yield. Fruit a bit uneven in set does not look very neat in punnet, bright appearance	Very long laterals, mostly top to middle of cane, droop at tip, fruit well displayed to pickers, strongly attached, lateral support not required Tall stout canes, upright habit, adequate number Spine free Variable date of bud burst so majority of canes completed harvest just before that of Octavia	Has A10
James Hutton Ltd. Guards						

Cultivar/ Selection		Harvest period SF41d in 2015	Fruit Size Average (Max- min) SF41d 2015 (g)	Fruit	Plant	Pest & Disease susceptibility
0460F-5		Mid 3 July – 5 August	4.2 (5.5-3.4)	Attractive but rather dark, even set, conical fruit, shiny. Good flavour, Brix 10. Good shelf life	Laterals top to bottom of canes, medium-long droop with weight of fruit but good presentation. Very upright cane habit adequate in number Spine free	A10
0658C-5		Early-Mid 26 June – 10 August	4.7 (6.0-3.4)	Conical fruit, variable size & shape, bright, a bit pale, high yield, moderate to good flavour can be good, fruity, juicy, 'raspberry' and 'elderflower' notes Brix 8.6. Good shelf-life	Laterals short to very long at cane base, bow over but display fruit well lateral support may be required. Plentiful supply of tall cane vigorous upright-spreading cane. Spine free	A10

Cultivar/ Selection		Harvest period SF41d in 2015	Fruit Size Average (Max- min) SF41d 2015 (g)	Fruit	Plant	Pest & Disease susceptibility
0658E-1		Early-Mid 26 June – 29 July	4.8 (7.0-3.4)	Bright, conical Sweet, fruity, juicy, 'raspberry' and 'elderflower' notes. Not as good a flavour as Tulameen Good shelf-life	Laterals full length of canes, short at top, medium-long at base, well displayed, a few laterals broken but lateral support may not be required. Medium vigour, upright- spreading canes, adequate number Spines	Moderate resistance to root rot (no symptoms after 3 years at JHI)
Glen Fyne		Mid 3 July – 5 August	3.5 (5.0-2.6)	Medium sized round-conical berries (some variability in berry set) bright, very sweet, good flavour, Brix 8.6, good shelf life, berries darken when fully ripe, poor yield in 2015, good shelf life	Medium -long laterals, strongly attached, lateral support not required. Bud break down length of canes. Spine free cane spreading, difficult to keep upright, no spines, moderate vigour & cane number.	Has A10 very susceptible to raspberry root rot & powdery mildew
0427G-7*		Mid <i>(not fruiting in 2015)</i>	?	Bright fruit with a round shape. Shelf-life very good, maintains colour and uniformity	Spines and Gene H, hairy cane phenotype	?

Cultivar/ Selection		Harvest period SF41d in 2015	Fruit Size Average (Max- min) SF41d 2015 (g)	Fruit	Plant	Pest & Disease susceptibility
0534RB1		Mid – Late 26 June – 12 August	5.2 (6.5-4.2)	Very large, conical fruit, reasonably bright, with very sweet excellent flavour, Brix 10.3 (consistently higher than that of Tulameen), high yield, good shelf life	Medium-long laterals at top- middle & very long at base, laterals full length of canes. Bow over a bit with fruit weight, but support not required. Tall stout canes, upright-spreading, moderate vigour. Spine free	A10
0550E-4		Mid – Late 29 June – 10 August	3.7 (5.6-2.4)	Firm fruit, rather dark when fully ripe, conical, slightly hairy (makes it look dull), moderate to good flavour. Shelf-life good, maintains colour and firmness. Moderate yield.	Laterals medium-long at top to long-very long at base, full length of canes. Fruit well displayed to pickers support unnecessary. Adequate numbers of medium to tall cane, upright-spreading habit Spine free, but hairy canes	A10 and moderate resistance to root rot (No symptoms. after 3 years at James Hutton Ltd). Has Gene H phenotype tolerance to cane botrytis & spur blight,

Cultivar/ Selection		Harvest period SF41d in 2015	Fruit Size Average (Max- min) SF41d 2015 (g)	Fruit	Plant	Pest & Disease susceptibility
0015 F1		Mid - Late 29 June – 29 July	3.5 (4.4-2.6)	Fruit is conical, pale-mid red, slightly dull when fully ripe, moderate - good flavour, good shelf life	Short- Medium - long laterals, most at top to mid-cane, bow over with ripe fruit needs lateral support. Very open cane canopy, Tall cane, medium diameter, moderate in number, upright habit - spreading and a neat lateral presentation Spine free	Moderate resistance to root rot (no symptoms after 3 years at James Hutton Ltd.)
From: Pacific Agri-Food Research Centre						

Cultivar/ Selection		Harvest period SF41d in 2015	Fruit Size Average (Max- min) SF41d 2015 (g)	Fruit	Plant	Pest & Disease susceptibility
BC92-9-15 (Squamish)		V. early 18 June – 29 July	4.0 (5.6-2.6)	Glossy, medium sized, darkening red, conical, reasonably firm, large drupelets, cohesive, good aromatic flavour, Brix 10.5 consistently higher than that of Tulameen, good shelf life. High yield	Laterals full length of canes short at top - long at base, present fruit well, lateral support not required. Tall upright -spreading canes, adequate number Spines, most prominent at base	Good field resistance to root rot
AAC Eden (KO6-2)		Early – Mid 18 June – 10 August	4.8 (7.4-3.3)	Fruit size greater than Tulameen. Firm, neat conic, but not glossy (looks a bit greasy) light –mid red, good flavour, easy to pick, softer than Squamish. Some variability in fruit set & shape suspect off types planted. Yield good but less than that of & shelf life not as good as Squamish.	Long laterals, most laterals at top-middle of canes. Ascending-horizontal pose, strongly attached, present fruit well to pickers. Support not required. Very upright, spine free tall, adequate number, vigorous cane.	Not Known
Pacific Agri-Food Research Centre Guards						
BC1-88-6		Early – Mid 1 July – 3 August	4.9 96.1-2.6	Fruit large long-conical, very bright, small drupelets, cohesive, mid red, good flavour, Brix 9.4 & good shelf life	Upright to spreading habit, tall, stout, high numbers. Long fruit laterals fruit easy to find & detach. Spines	Not Known

Cultivar/ Selection		Harvest period SF41d in 2015	Fruit Size Average (Max- min) SF41d 2015 (g)	Fruit	Plant	Pest & Disease susceptibility
Tulameen Pearl Clone 299-5		Mid - Late 3 July – 10 August	5.0 (6.6-4.2)	Like Tulameen	Like Tulameen,	As per Tulameen in main trial
Tulameen Pearl Clone 300-5		Mid - Late 29 June – 12 August	4.9 (6.1-3.7)	Like Tulameen	Like Tulameen,	“
Tulameen Pearl Clone 301-5		Mid - Late 3 July – 10 August	5.4 (6.7-4.5)	Like Tulameen	Like Tulameen,	“

Cultivar/ Selection		Harvest period SF41d in 2015	Fruit Size Average (Max- min) SF41d 2015 (g)	Fruit	Plant	Pest & Disease susceptibility
Ukee (BC92-6-41)		Early – Mid 1 July – 3 August	3.5 (5.0-2.8)	Fruit smaller than Tulameen, conical, small drupelets, very cohesive, light red, moderate flavour. Good shelf life. Some variability in drupelet size & as consequence variable fruit set	Tall cane, upright, vigorous, adequate in number, more upright than Tulameen, strong long laterals, full length of canes, present fruit well. But bow over so lateral support required Spines	Tolerant of Root rot
Jean d' Orleans		Mid 1 July – 3 August	3.1 (4.0-1.2)	Medium – large fruit neat, small even sized & shaped drupelets, well set very cohesive, firm, mid red, excellent sweet lingering flavour, aromatic	Medium-tall, upright – spreading canes, short - medium length ascending laterals which present fruit very well to pickers Spines	Resistant to powdery mildew
From: Washington State University (WSU)						
WSU Guards						

Cultivar/ Selection		Harvest period SF41d in 2015	Fruit Size Average (Max- min) SF41d 2015 (g)	Fruit	Plant	Pest & Disease susceptibility
WSU1605		Mid-Late 3 July – 12 August	5.5 (7.4-4.5)	Very large fruited, long conical, glossy, cohesive a bit variable in shape, firm, easily detached, good flavour, good shelf life high yield.	Top laterals medium-long all others very long, bow over with weight of & hides fruit, needs lateral support. Laterals full length of canes. Upright- spreading, tall, stout canes. Leafy, vigorous Spines	Not Known
WSU1568		Mid 3 – 29 July	4.3 (6.0-3.2)	Large long conical, firm, glossy, well flavoured fruit, easily picked, good shelf life. High yield.	Long-very long laterals, bow over each other so lateral support required, laterals down full length of canes. Canes tall, stout, very upright, adequate in number Spines	Not known
WSU1607		Mid – Late 3 July – 5 August	5.8 (7.9-4.6)	Large, long conical, glossy, very firm, good flavoured fruit, with excellent shelf life, easily detached from laterals.	All laterals very long, roll over with weight of fruit need lateral support. Tall upright & stout, adequate in number Spines	Not known
	From: Graminor AS, Norway (Plant breeders information)					
	Graminor Guards					

Cultivar/ Selection		Harvest period SF41d in 2015	Fruit Size Average (Max- min) SF41d 2015 (g)	Fruit	Plant	Pest & Disease susceptibility
RU044 03073*		Early-mid		Berries firmer with better shelf life than Glen Ample. Darker colour but better taste than Ample	Very strong against raspberry leaf and bud mite, susceptibility to cane diseases as Glen Ample. No winter damage problems observed up to know. Spine free	strong against raspberry leaf and bud mite
RU004 04106*		Early-mid	5.3 g	Berries smaller than Glen Ample but berries are firmer and have much better taste than Glen Ample. Conic shape with good colour	Habit description to come Spine free	
RU004 03067*		Early-mid season		Berries with lighter colour than Glen Ample, quite similar scores for appearance and taste. higher yielding than Glen Ample	More susceptible to frost damage than Glen Ample. Spine free	strong against raspberry leaf and bud mite, susceptible to cane diseases