Project title:	Raspberry: summer fruiting variety trial
Project number:	SF 41c
Project leader:	Janet Allen
Report:	Annual report, August 2012
Previous report:	None
Key staff:	Janet Allen, ADAS Harriet Roberts, ADAS Chris Dyer (statistician), ADAS
Location of project:	Stanton St John, Oxford
Industry representative:	Tim Place, Place UK Ltd. Norfolk
Date project commenced:	1st March 2009
Date project completed (or expected completion date):	31st March 2013

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

AUTHENTICATION

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

Janet Allen

Horticultural Consultant

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CONTENTS

GROWER SUMMARY

Headline

Ten new raspberry varieties examined have potential to extend the harvest period or to replace current UK commercial summer fruiting raspberry varieties.

Background

Currently three summer fruiting varieties, Glen Ample, Tulameen and Octavia dominate the industry. These varieties enable UK growers to produce quality fruit under protection from May to late July.

Problems with susceptibility to pest or disease and imperfect fruit quality (in the case of Tulameen) elicited this evaluation of new varieties and advanced selections of summer fruiting raspberries. The intention is to identify varieties which will provide high quality fruit over extended periods and display some, and hopefully all, of the following attributes:-

- High yields
- Reliable cropping
- Firm berries with a long shelf life, which have a good flavour and texture
- Attractive berries (colour, shape, size) which are easy to pick (i.e. well displayed on the plant and easy to detach)
- Plants which are robust, easy to manage and ideally resistant to, or at least have good tolerance of, the major pests and diseases that affect this crop

With these parameters in mind this HDC Summer Fruiting Raspberry Variety Trial (SF 41c) was planted during the summers of 2009 and 2010.

Results of the variety trials

The following information summarises the results. Refer to the 'Science Section' for full and comprehensive information on the results.

Replicated plots of eight new summer fruiting raspberry varieties planted in 2009 or 2010 are being compared with three control varieties, Glen Fyne, Tulameen and Octavia (Table 1) over two harvest years. In addition single guard plots of 10 additional varieties were examined (Table 2); Glen Lyon was planted as a standard variety for very early fruit production.

Table 1: Main entries of summer fruiting raspberry variety trial (listed according to cropping season)

Cultivar/Selection	Bred by**	Cropping season	Planted	Harvest period 2011 season
9911C-1*	JHI	Early	June 2010	14 June - 1 July
CO9	EMR	Early	June 2009	14 June - 20 July
Korpiko	HR	Early	June 2009	16 June - 20 July
Glen Fyne	JHI	Early - mid	June 2009	14 June - 25 July
00123A7	JHI	Early - mid	June 2009	16 June - 22 July
Tulameen	PARC	Early - mid	June 2009	16 June - 22 July
Cowichan	PARC	Mid - late	June 2009	16 June - 25 July
Glen Doll	JHI	Mid - late	June 2009	18 June - 1 August
CO6	EMR	Late	June 2009	27 June - 1 August
Tadmor	HR	Late	June 2009	18 June - 25 July
Octavia	EMR	Late	June 2009	24 June - 1 August

* Only a few, short and thin floricane of 9911C-1 were retained to crop which may well have resulted in a far shorter harvest for this entry than would normally be expected.

****** Breeders details and country of origin:

JHI – James Hutton Institute, Scotland

EMR – East Malling Research, England

HR – HortResearch, New Zealand

PARC – Pacific Agri-Food Research Centre, Canada

WSU – Washington State University, USA

S – Reto Newweiler, Switzerland

Q – University and Agricultural & Agri-Food Canada, Quebec

Table 2: Guard entries of summer fruiting raspberry variety trial (listed according to cropping season)

Cultivar/Selection	Bred by*	Cropping season	Planted	Harvest period 2011 season
0485K-1	JHI	Very early	June 2010	14 June - 15 July
0453C4	JHI	Very early	June 2010	14 June - 25 July
Glen Lyon	JHI	Early	June 2009	14 June - 20 July
0433F2	JHI	Early	June 2010	14 June - 20 July
TulaMagic	S	Early	June 2009	14 June - 25 July
Cascade Delight	WSU	Mid	June 2009	14 June - 25 July
Chemainus	PARC	Mid	June 2009	16 June - 22 July
Jeanne d'Orléans	Q	Mid	June 2010	16 June - 25 July
9764F-3	JHI	Mid - late	June 2009	16 June - 1 August
0019E2	JHI	Mid - late	June 2009	18 June - 25 July
0304F6	JHI	Mid - late	June 2009	24 June - 1 August

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Q – University and Agricultural & Agri-Food Canada, Quebec

To obtain a full yield in their first cropping year, the primocane of all of the plants planted in June 2009 were cut through at ground level and removed from the crop rows in January 2010. These and the plants planted in June 2010 were cropped in 2011. Of the latter, some plants only produced a small number of primocane of sufficient height during 2010 to crop in 2011, so the yields of fruit from these later planted plots was in the main very small.

Phytophthora rubi was confirmed as the cause of collapse and death of some plants of Glen Fyne in the late summer of 2009. This disease has continued to cause further plant loss of

Glen Fyne despite applications of fluazinam (as Shirlan) being made as a drench to the soil surface around the roots of all the plants in the trial every March and October.

Due to cold damage to fruit buds in December 2010 and April/May 2011 the yield was much lower for the entries planted in June 2009 than would be expected from plants in their first full cropping year. In the majority of cases the entries planted in June 2010 produced a very small yield as by the end of their first growing season many of them had produced very few primocanes suitable for retention to crop in 2011.

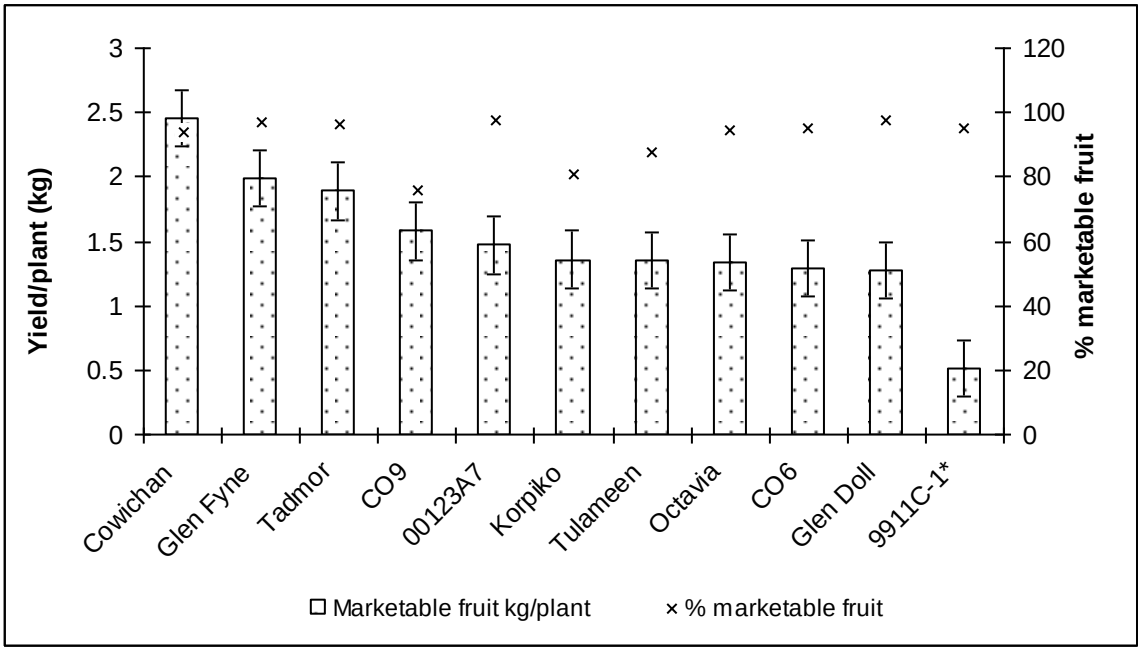


Figure 1*:* Yield (kg/plant) and % marketable fruit in 2011 for main entries in summer fruiting raspberry trial in order of yield (* planted June 2010).

Cowichan produced the highest yield, in part because its floricane displayed superior bud break, fruiting lateral and flower numbers compared with most of the other main entries. Tadmor and Glen Fyne also performed well, despite Glen Fyne loosing up to 30% of its fruit buds. The amount of waste fruit produced by CO9 and Korpiko was high compared to the other entries most probably due to cold injury to flower buds in May 2011.

The marketable yield of Tulameen was poor and the amount of waste fruit relatively high, which was primarily due to the clone of Tulameen used for this trial. A recent HDC funded trial (SF105) and commercial experience has shown that the Dutch clone of this variety held at Naktuinbouw produces higher yields and fruit of superior quality. The yield of Octavia was also very low due to frost damage.

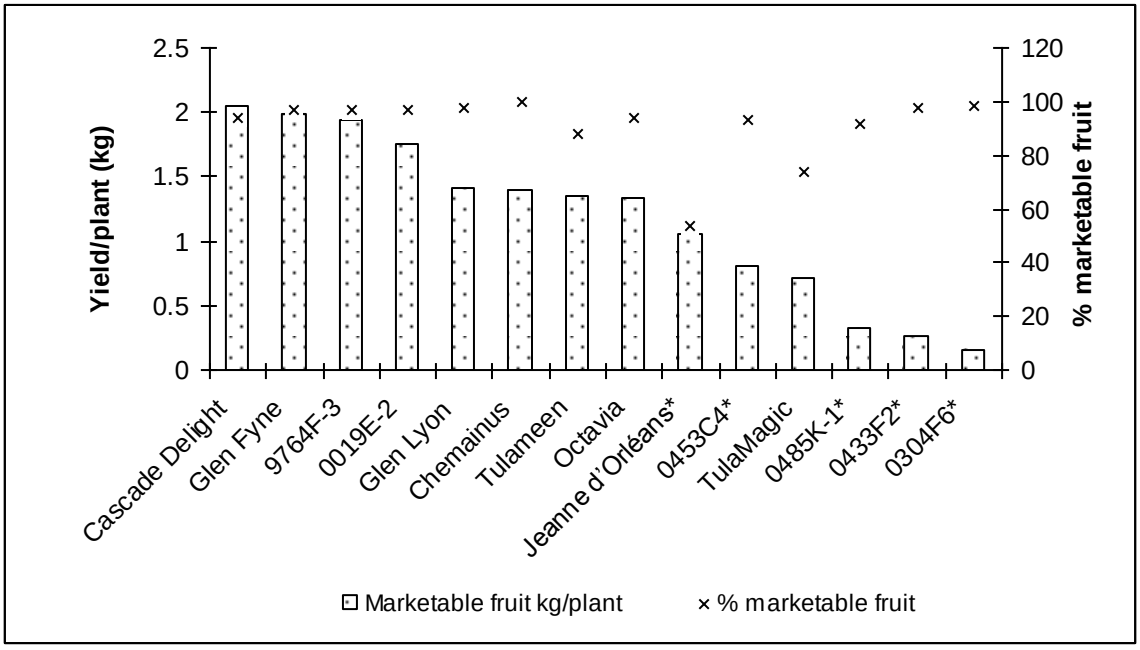


Figure 2*:* Yield (kg/plant) and % marketable fruit in 2011 for the summer fruiting raspberry guard entries (single plots) in order of yield (* planted June 2010).

Of the guard entries the highest marketable yield was produced by Cascade Delight and the late cropping advanced selection 0019E2. Of the 2009 planted entries the performance of TulaMagic was particularly poor as a result of its floricane having produced a substantial yield of fruit from their tips downwards in the late summer and early autumn of 2010.

Berry weight was greatest in Octavia and Cowichan and lowest in Tulameen, Glen Doll, CO6 and CO9. In the guard entries Cascade Delight and 0019-E2 produced berries in excess of 5 g.

Main entries of particular interest

9911C-1

Very early fruit production, producing bright attractive fruit, which was cohesive, sweet, but a bit irregular in shape. The berries were easy to pick and had a good shelf life. The plant of 9911C-1 is very vigorous, produces an adequate number of tall but rather spreading spine free canes. The fruiting laterals are long and require support during harvest.

Korpiko

A very early variety producing fruit with an attractive appearance, bright, cohesive but a bit soft and only moderate flavour. The shelf life of the fruit in 2011 was poor. The canes of this variety are spiny, of moderate vigour, plentiful in number but not particularly easy to manage.

00123A7

A mid season cropping selection, producing medium to large pale salmon red fruit, which were a bit variable in shape. They are very well presented to the picker and easy to detach. Berry flavour and shelf life was good. The plant of 00123A7 is vigorous, the canes very tall, stout, spine free, upright in habit and easy to manage.

Cowichan

Throughout its very long harvest this PARC variety produced large berries of a consistent shape. The berries were bright, firm, with a moderate to good flavour and shelf life. Presentation to the pickers and detachment of fruit was good and superior to that of Tulameen. Cowichan produces tall very upright, very easy to manage canes which bear a few but generally unobtrusive spines towards their base. Generally Cowichan has proved so far to be a very reliable variety.

Tadmor

In 2011 the harvest of this entry was completed just before that of Octavia, however the performance of this variety was good and the quality of its fruit, especially the colour, brightness and flavour, was superior to Octavia. Throughout harvest, the shelf life of Tadmor was good, the fruit was well displayed to pickers and easy to detach. The canes of Tadmor are medium to tall, upright to spreading in habit, bearing some spines, but are generally easy to manage.

Guard entries of particular interest

In their first cropping year, the following appeared to be particularly interesting:

0485K-1

Exceptionally early fruiting, which could be considered as a replacement for Glen Lyon and Glen Moy, producing attractive, evenly set, conic, cohesive fruit with a very good flavour. Fruit well displayed, presented to pickers on medium to very long laterals. The canes of this selection are spine free, plentiful and upright to spreading in their habit.

Cascade Delight

A mid season variety, producing high yields of very large bright, attractive, sweet fruit. The berries are very cohesive, but soft and easily damaged by wind and rain if this variety is in the open during harvest. Of interest mainly for PYO, farm shop and local market sales. Canes very tall, upright to spreading, with some spines, but generally pleasant to handle. Fruiting laterals are long to very long, and bend over without support, obscuring fruit from pickers.

Chemainus

A midseason variety which, like Cowichan, was a promising guard in HDC project SF 41b. However, in that trial, it proved to be more susceptible to *Phytophthora* root rot and succumbed before the end of the trial. In SF 41c it produced very bright attractive firm fruits of moderate flavour and size. These were of a very consistent shape and very cohesive, well displayed to the picker and easily detached. The plant habit of this variety was very similar to that of Cowichan with tall upright canes, bearing a few spines, adequate in number and very easy to manage.

Jeanne d'Orleans

An early-mid season variety, producing berries with very distinct aromatic sweet deep 'raspberry' flavour, which are a mid-dark red in colour, very bright and attractive on the plant and in the punnet. Texture is slightly soft but fruit has an excellent shelf life which is far superior to that of Tulameen. Canes adequate in number, tall, upright to spreading and bear noticeable spines. These do not hamper picking but make cane management unpleasant, of young canes at least. Fruiting laterals are medium to long, ascending in habit, very strongly attached and present fruit well.

0019E2

Very late harvest, which offers a potential replacement for Octavia. Consistently produces very large firm cohesive, attractive bright fruit with a moderate flavour and excellent shelf life. Canes upright in habit, spine free, adequate in number, medium to long, ascending laterals which present fruit well to picker.

Financial benefits

This project seeks to identify new summer fruiting varieties with fruit of good quality and flavour. Berries should have a long shelf life, be easy (i.e. cheap) to harvest and grow and have resistance to pests and diseases. Identifying such improved varieties will increase grower choice, reduce costs of production and also the dependency on current industry standard and exclusive varieties.

Action points

There are no action points at this stage in the project.

SCIENCE SECTION

Introduction

Currently three summer fruiting cultivars, namely Glen Ample from the James Hutton Institute (formerly SCRI), Tulameen from the Pacific Agri-food Research Centre (PARC) in Canada and Octavia from East Malling Research dominate the industry.

These cultivars enable UK growers to produce quality fruit under protection from established plantations from May – late July and by using several plantings of 'long cane' plants each year from late April – to October. In the open field they provide a harvest period from late June/early July to early August each year.

Problems with susceptibility to pest and or disease and, particularly in the case of Tulameen, of imperfect fruit quality, have caused growers and industry representatives to continue to ask HDC to fund the evaluation of new cultivars and advanced selections of summer fruiting raspberries, with the intention that the next generation of cultivars to provide high quality fruit over the above periods each year will be identified. Potentially successful new cultivras shouldl display some, and hopefully all, of the following attributes:-

- High yielding
- Reliable cropping
- Produce firm berries with a long shelf life
- Fruit with a good flavour and texture
- Attractive appearance (colour, shape, size)
- Easy to pick (i.e. well displayed on the plant and easy to detach fruits)
- Robust and easy to manage plants
- Ideally resistant to, or at least have good tolerance of, the major pests and diseases that affect this crop.

With these parameters in mind the HDC Summer Fruiting Raspberry Variety Trial (SF 41c) was planted during the summer of 2009 and 2010.

Materials and methods

The trial is planted at Rectory Farm, Stanton St John, Oxford OX33 1HF. Located within a well sheltered commercial south facing planting of raspberries and protected from adverse weather by Spanish tunnels from just prior to the start until the end of harvest.

The soil is a free draining light loamy sand. The raspberries were planted 0.45m apart into polymulch covered raised beds with 2.4 m between the crop rows and with a 1m wide plant free gap between each plot. Each tunnel protects two rows (two replicates) of raspberries. There are four replicates of each of the main entries and, if available, 10 plants of each were planted in each plot. The trial plan is displayed in Appendix 3. All the plants for this trial were supplied as virus indexed and/or PHPS certified module raised plants grown from root cuttings. As not all the main or guard entries were available at the same time, as indicated in Table 1 and 2 below, planting took place in either June 2009 or June 2010.

There are eight entries in the main (i.e. replicated) part of the trial and these include:

- Two coded selections CO9 and CO6 from East Malling Research
- Two coded selections 00123A7 and 9911C-1 and the named cultivar Glen Doll from the James Hutton Institute (formerly the Scottish Crop Research Institute)
- Two cultivars Korpiko & Tadmor from HortResearch, New Zealand
- Cowichan from the Canadian (PARC) raspberry breeding programme.
- Three control varieties: Glen Fyne, Tulameen and Octavia.

In addition eleven single plot guards (10 plants) have been planted with:

- Cascade Delight from Washington State University Puyallup Research & Extension Centre, USA
- Six advanced and coded selections 0453C4, 0433F2, 0485K-1, 9764F-3, 0304F6 & 0019E2 from the James Hutton Institute
- TulaMagic bred by Reto Neuweiler, Truttikon, Switzerland
- Jeanne d'Orléans bred by Shahrokh Khanizadeh, tested at McGill University and Agricultural and Agri-Food Canada substation in L'Acadie, Quebec
- Chemainus from the Canadian (PARC) raspberry breeding programme
- Glen Lyon from the James Hutton Institute, planted as a standard cultivar for very early fruit production.

Full details of each selection or cultivar, its origin and a description are in Appendix 1.

Table 1. Main cultivar entries, propagation details and planting date

Treatment number	Cultivar/Selection	Propagated from	Planted
1	Glen Fyne	Root cuttings	June 2009
2	Tulameen	Root cuttings	June 2009
3	Octavia	Root cuttings	June 2009
4	Glen Doll	Root cuttings	June 2009
5	Korpiko	Root cuttings	June 2009
6	Tadmor	Root cuttings	June 2009
7	00123A7	Root cuttings	June 2009
8	9911C-1	Root cuttings	June 2010
9	CO6	Root cuttings	June 2009
10	CO9	Root cuttings	June 2009
11	Cowichan	Root cuttings	June 2009

Table 2. Guard cultivar entries, propagation details and planting date

Cultivar/Selection	Propagated from	Planted
Cascade Delight	Root cuttings	June 2009
Glen Lyon	Root cuttings	June 2009
TulaMagic	Root cuttings	June 2009
Chemainus	Root cuttings	June 2009
Jeanne d'Orléans	Root cuttings	June 2010
0485K-1	Root cuttings	June 2010
9764F-3	Root cuttings	June 2009
0019E2	Root cuttings	June 2009
0453C4	Root cuttings	June 2010
0304F6	Root cuttings	June 2010
0433F2	Root cuttings	June 2010

Plants were supplied in modules, raised by East Malling Research, the James Hutton Institute, Promo Fruit in Switzerland, Meiosis Ltd, Hargreaves Plants Ltd and R W Walpole Ltd.

The canes produced by all of the plants supplied and planted in June 2009 were cut to the ground in early January 2010, so that in 2011 all the plants were full cropping. It was decided that although they had made in some cases only a small amount of growth that some floricane of plants delivered and planted in June 2010 would be left in situ to bear some fruit this year so as to obtain at least some idea of their potential.

The plants in the trial were grown on raised beds, with the soil surface covered with polymulch, to provide both weed control and to maintain the soil as dry as possible during the winter and early spring months. They are trickle irrigated and fertigated and have been supplied and trained using a vertical wall trellis, with mobile primocane support wires. Primocane control is carried out by hand in the spring pre and during blossom and post harvest.

In the early autumn of the planting year *Phytophthora rubi* was confirmed as the cause of the collapse and then death of plants in one of the four plots of Glen Fyne. This disease has now caused the loss of plants in the other plots of this cultivar which is known to be very susceptible to *Phytophthora* root rots. Since the autumn of 2009 two applications of fluazinam (Shirlan) are being used in the plantation each year to contain this disease.

Pest, disease and weed control is as per the adjacent planting of summer fruiting raspberries and the other plantations on the farm.

Harvest

The 2012 season commenced on 14 June, with fruit picked from the main entries 9911C-1, CO9 & Glen Fyne and the guards 0485K-1, 0453C4, Glen Lyon, Jeanne d'Orléans & TulaMagic.

Assessments

The weight of marketable fruit and that of 25 berries selected at random from the harvested fruit is recorded for each plot at every pick. In addition, once per week the appearance of the fruit is assessed (scoring 1-5), again for each plot, for:

- Redness
- Brightness
- Texture

- Outline
- Skin strength
- Berry cohesiveness
- Flavour

Also once per week throughout harvest, when adequate quantities are available from each plot, fruit is placed in cold store for two days at 3^0C. When withdrawn from storage the fruit is assessed using a 1-5 scoring system for:

- The presence of rotten berries
- Berry texture
- Berry appearance

In addition the fruiting habit of plants is assessed during harvest to determine:

- Lateral length
- Lateral angle
- Lateral damage i.e. strength

Throughout the life of the trial the following additional data is being collected for each entry:

- Dates of bud break
- Dates of onset, 50% and end of harvest
- Susceptibility to frost
- Primo and fruiting cane characteristics e.g. cane habit, cane number, spines, height, diameter, levels of splitting of cane rind, foliar density, bud number etc.
- Susceptibility to cane, foliar and fruit pests and diseases
- General ease of plant management

Fruit of the most promising selections has also been evaluated by customers of the farm's PYO unit, alongside the standard cultivars that they are used to purchasing, to see if they meet with consumer approval. This spring vine weevil and two spotted spider mite were a problem but were successfully brought under control. Powdery mildew has not been a significant problem but was detected on a few fruits of one cultivar.

Results

Results of yield and berry weight were recorded at each picking date; data were examined by analysis of variance. Table 3 shows the dates at which each cultivar reached 25, 50 and 75% harvest. The earliest new selection, and also with the shortest harvesting period, was 9911C-1. Cultivars CO9, Korpiko, 00123A7 and CO6 were harvested from approximately 14 June until 25 July, similar to the Glen Fyne and Tulameen season this year. The latest of the new selections were Cowichan, Glen Doll and Tadmor, showing similar seasons to Octavia.

In terms of yield Cowichan produced the greatest volume of fruit, with 2 kg fruit/plant being produced, closely followed by Glen Fyne and Tadmor. 9911C-1 had by far the lowest yield at 0.5 kg/plant. In terms of waste, the proportion class one fruit was generally very high, with just CO9, Korpiko and Tulameen showing less than 80% class one (Figure 1).

Table 3. Harvest data in 2011 for main entry cultivars, with date at which each cv. achieved 25%, 50% and 75% harvest.

Variety	25% harvest reached	50% harvest reached	75% harvest reached	Av yield /plant (kg)	Av waste /plant (kg)
Glen Fyne	29-Jun	04-Jul	11-Jul	2.03	0.07
Tulameen	29-Jun	04-Jul	11-Jul	1.35	0.19
Octavia	06-Jul	15-Jul	22-Jul	1.34	0.08
Glen Doll	08-Jul	15-Jul	22-Jul	1.27	0.03
Korpiko	22-Jun	01-Jul	04-Jul	1.36	0.32
Tadmor	06-Jul	13-Jul	20-Jul	1.89	0.07
00123A7	27-Jun	04-Jul	11-Jul	1.47	0.04
9911C-1	24-Jun	04-Jul	11-Jul	0.49	0.03
C06	04-Jul	08-Jul	15-Jul	1.29	0.07
C09	14-Jun	18-Jun	24-Jun	1.56	0.50
Cowichan	06-Jul	11-Jul	18-Jul	2.46	0.16
			SED (30 d.f.)	0.22	0.36
			F prob	P<0.001	P<0.001

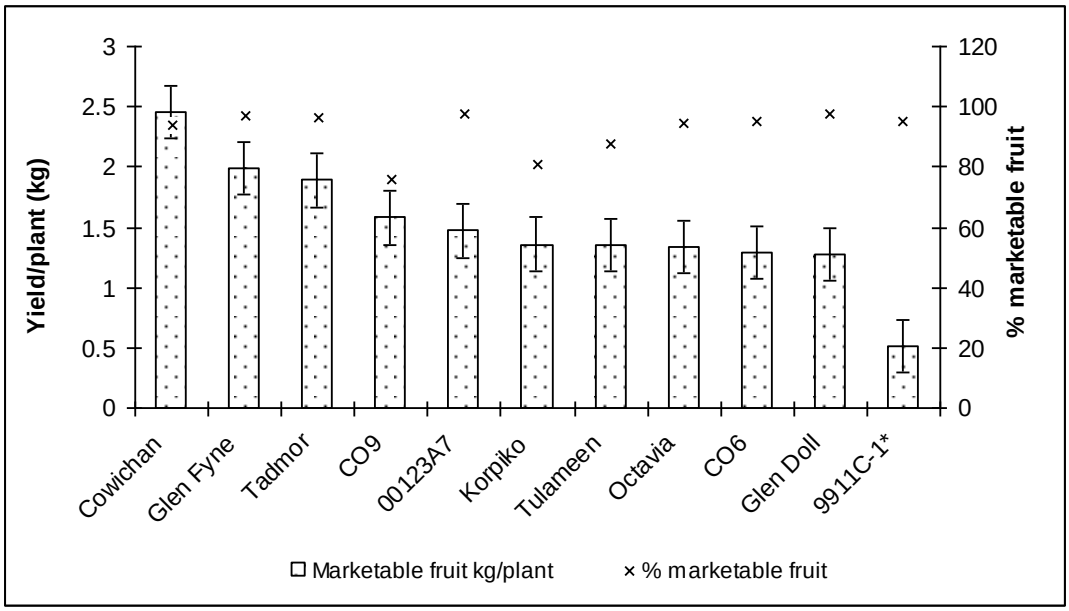


Figure 1. Fruit yield per plant and % marketable yield over the season in order of yield. Yield/plant p=<0.001, SED 0.22, 30 df.

Table 4 shows the same data for the guard entries. TulaMagic, 0485K-1, 0453C4 and 0304F6 were the early cultivars/selections with Cascade Delight, Jeanne d'Orleans, 9764F-3 and 0019E-2 producing a season more like Octavia. Cascade Delight, Glen Fyne and 9764F-3 showed similarly high yields, in the region of 2 kg/plant. New JHI selections 0485K-1, 0433F2 and 0304F6, which were planted in June 2010, had low yields below 0.5 kg/plant, but this was not surprising as the crop was produced from just one, or in some cases two, short floricanes/plant. Chemainus and Jeanne d'Orleans produced a very low percentage of unmarketable fruit and TulaMagic a very high percentage of unmarketable fruit, in the case of the latter due to its very soft and easily bruised fruit. All other varieties produced a consistently high proportion of Class 1 fruit (Figure 2).

Table 4. Harvest data in 2011 for guard entry cultivars, with date at which each cv. achieved 25%, 50% and 75% harvest. Fruit yield per plant over the season.

Variety	25% harvest reached	50% harvest reached	75% harvest reached	Av yield /plant (kg)	Av waste /plant (kg)
Cascade Delight	06-Jul	13-Jul	18-Jul	2.05	0.13
Glen Lyon	22-Jun	29-Jun	04-Jul	1.41	0.03
TulaMagic	18-Jun	24-Jun	29-Jun	0.72	0.25
Chemainus	29-Jun	04-Jul	11-Jul	1.4	0.00
Jeanne d'Orleans	04-Jul	11-Jul	15-Jul	1.05	0.92
0485K-1	16-Jun	20-Jun	24-Jun	0.33	0.03
9764F-3	01-Jul	11-Jul	15-Jul	1.94	0.06
0019E-2	06-Jul	13-Jul	20-Jul	1.75	0.05
0453C4	14-Jun	20-Jun	29-Jun	0.81	0.06
0304F6	18-Jun	24-Jun	06-Jul	0.16	0.00
0433F2	24-Jun	29-Jun	04-Jul	0.26	0.01

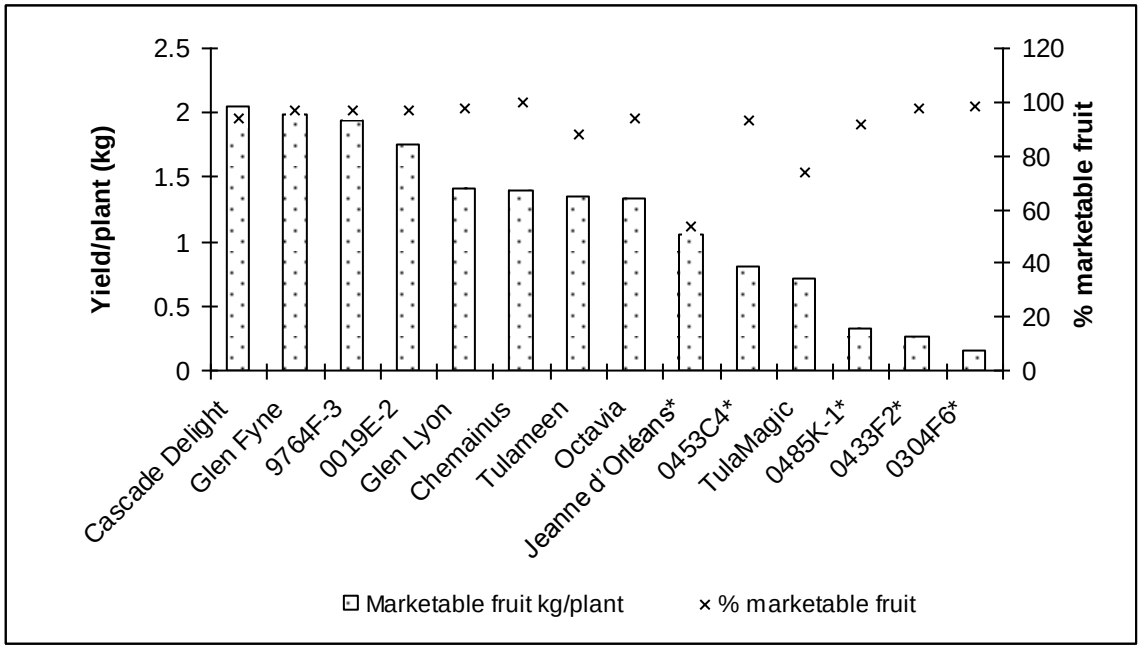


Figure 2. Fruit yield per plot and per plant over the 2011 season.

Berry weight is displayed in Figures 3 and 4 for the main entries and guard entries respectively. The graphs show how the berry weight varied through harvest. Cowichan had consistently the highest berry weight, up to 6g/berry (P= <0.001 SED 0.28). Octavia, Tadmor and 9911C-1 showed the next highest berry weight at around 5 g/berry. Lowest berry weight was observed in CO6 and CO9 down at 3-4 g/berry.

In the guard entries berry weight in 0019E-2 was comparable to Cowichan. Other large berried varieties included Cascade Delight, the rest of the varieties showed comparable berry weights of around 4.5 g. The smallest berries were produced by Glen Lyon at 2.5 g.

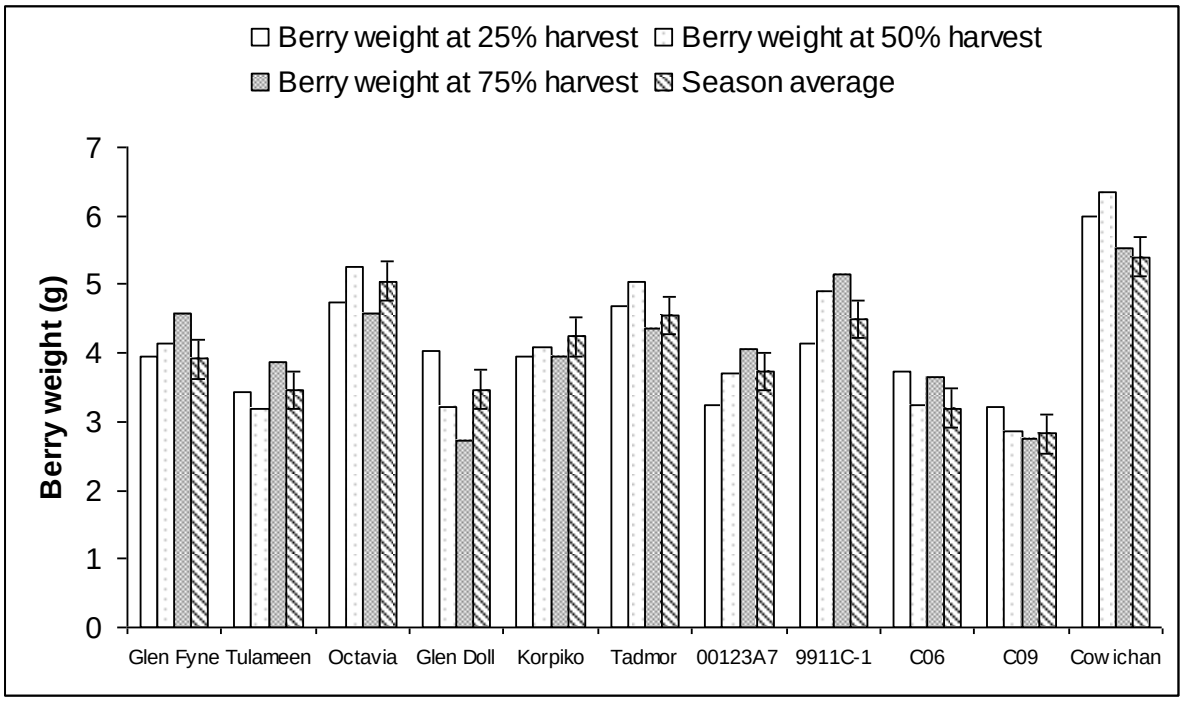


Figure 3. Main entry cultivar berry weights (g) at 25%, 50%, 75% harvest and 2011 season average.

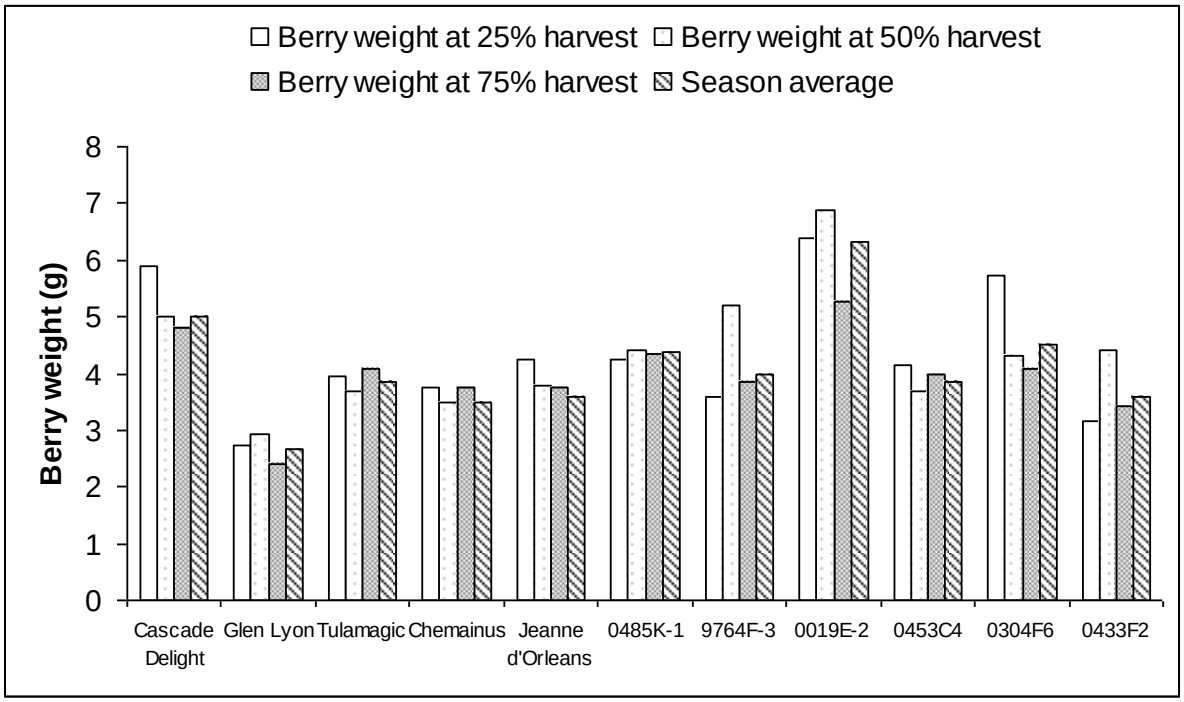


Figure 4. Main entry cultivar berry weights (g) at 25%, 50%, 75% harvest and 2011 season average.

When sufficient fruit was available a punnet of marketable fruit harvested from each plot was placed in cold store at 3-4ºC for 48 hours. The fruit was then withdrawn from store and allowed to warm to the ambient temperature before assessment. Shelf life was analysed on six occasions. Table 5 shows the average scores attained by the entries during the 2011 harvest. No rotten berries were observed in any entry after 48 hours. Of the main entry selections/cultivars Glen Fyne, Glen Doll, 00123A7 and 9911C-1 held their texture best and, along with Tadmor and Cowichan, maintained brightest berry appearance. Tulameen and CO6 and CO9 gave the poorest scores (Table 7-8).

In the guard entries (Table 6) again none showed any rots after the period of cold storage: 0019E2, Glen Lyon, 0453C4 and Chemainus showed best berry texture and, along with Jeanne d'Orleans, had best berry appearance and were brighter than the best main entry cultivars (Tables 9-10).

Table 5. Shelf life assessment data after 48 hours at 3ºC - main entries

Main entries	Rotten berries 5 = No rots 1 = More than 5 rotten berries	Texture of berries 5 = As picked 1 = Collapsed	Berry appearance 5 = Bright 1 = Dull
Glen Fyne	5.0	3.9	4.2
Tulameen	5.0	3.0	3.2
Octavia	5.0	3.5	3.5
Glen Doll	5.0	4.0	4.1
Korpiko	5.0	3.2	3.5
Tadmor	5.0	3.6	3.8
00123A7	5.0	3.9	4.0
9911C-1	5.0	3.8	3.8
CO6	5.0	2.9	3.2
CO9	5.0	2.9	2.7
Cowichan	5.0	3.7	4.2

Table 6. Shelf life assessment data after 48 hours at 3ºC - guard entries

Guard entries	Rotten berries 5 = No rots 1 = More than 5 rotten berries	Texture of berries 5 = As picked 1 = Collapsed	Berry appearance 5 = Bright 1 = Dull
Cascade Delight	5.0	3.4	3.4
0485K-1	5.0	3.5	3.5
Chemainus	5.0	3.8	4.2
9764F-3	5.0	3.6	3.4
0019E2	5.0	4.4	4.8
Jeanne d'Orleans	5.0	3.4	4.2
Glen Lyon	5.0	4.0	4.3
0453C4	5.0	4.0	3.5
0304F6	5.0	-	-
0433F2	5.0	2.0	3.0
TulaMagic	5.0	2.7	3.3

Once a week throughout the harvest the marketable fruit from every plot was examined and the qualities appraised. The average scores for the harvest period of 2011 are given below in Tables 7 and 8 for the main and in Tables 9 and 10 for the guard entries.

The fruit of Octavia and 00123A7 were rather pale and those of Glen Fyne and CO9 quite dark red when fully ripe. Tadmor, CO6 and Glen Fyne had the brightest appearance and Glen Doll, Cowichan, Korpiko and Tadmor the best shaped fruit and Tulameen the poorest.

The fruit of Octavia, Tadmor and 9911C-1 had the firmest and CO9 and CO6 the softest texture. The skins of the fruit of Cowichan, Glen Fyne, Octavia, Glen Doll and Tadmor were the strongest and CO9 the weakest. Tadmor, 00123A7, Glen Doll, Cowichan and C06 had the most cohesive berries and Tulameen and CO9 the least. Glen Fyne had the best berry flavour,with Octavia, CO6 and CO9 having the poorest.

Of the guards 0485K-1, Cascade Delight, Jeanne d'Orleans and TulaMagic when fully ripe had the darkest and 0304F6 the palest colour. Cascade Delight, Chemainus, 9764F-3, Jeanne d'Orleans and 0019E2 had the brightest fruit and 0433F2 the dullest.

With the exception of 9764F-3 and TulaMagic, all had a very consistent regular berry shape. 0453C4, Cascade Delight, Jeanne d'Orleans and TulaMagic had the softest fruit and 0433F2 the firmest.

0019E2 had the strongest skin strength and TulaMagic and 0485K-1 the least, although only that of TulaMagic was easily ruptured or led to collapse of fruit soon after picking.

Jeanne d'Orleans, 9764F-3 and 0433F2 had the most cohesive fruit.0453C4 and TulaMagic had the least cohesive fruit and at some stage during harvest both of the latter produced some crumbly fruit.

The best flavoured fruit was produced by Jeanne d'Orleans, 0485K-1, 9764F3 and 0433F2. Chemainus and Glen Lyon had the weakest flavoured fruit, however no unpleasant off flavours were detected with either of these entries.

Table 7. Berry quality assessments - main entry cultivars

Cultivar	Redness (5=pale – 1=v dark)	Brightness (5=bright-1=dull)	Outline (5=even – 1 = v irregular)
Glen Fyne	2.9	4.8	4.0
Tulameen	3.0	4.6	2.7
Octavia	4.0	4.2	3.9
Glen Doll	3.0	3.6	4.4
Korpiko	3.1	4.5	4.1
Tadmor	3.1	4.9	4.1
00123A7	3.6	4.4	3.8
9911C-1	3.0	4.6	3.9
C06	3.0	4.8	3.7
CO9	2.6	3.5	3.1
Cowichan	3.0	3.9	4.3

Table 8. Berry quality assessments - main entry cultivars

Cultivar	Texture (5=firm – 1=v soft)	Skin strength (5=v strong – 1=weak)	Cohesion (5=whole fruit – 1=crumbly)	Flavour (5=v good – 1=v poor)
Glen Fyne	3.3	4.0	4.0	4.4
Tulameen	3.1	3.2	3.4	3.8
Octavia	3.8	4.0	4.0	2.8
Glen Doll	3.5	4.0	4.4	4.2
Korpiko	3.0	3.5	4.1	3.0
Tadmor	3.6	3.9	4.6	4.2
00123A7	3.4	3.7	4.4	4.0
9911C-1	3.5	3.6	3.9	3.6
C06	3.0	3.8	4.3	2.9
CO9	2.9	3.1	3.4	2.7
Cowichan	3.4	4.3	4.3	3.6

Table 9. Berry quality assessments - guard entry cultivars

Cultivar	Redness (5=pale – 1=v dark)	Brightness (5=bright-1=dull)	Outline (5=even – 1=v irregular)
Cascade Delight	2.8	5.0	4.0
0485K-1*	2.7	4.5	4.0
Chemainus	3.0	5.0	4.0
9764F-3	2.3	5.0	3.7
0019E2*	3.0	4.8	4.0
Jeanne d'Orleans*	2.2	5.0	4.0
Glen Lyon	3.0	3.4	4.0
0453C4*	3.0	4.5	4.0
0304F6*	4.0	4.3	4.0
0433F2*	3.0	4.0	4.0
TulaMagic	2.5	4.2	3.2

* planted June 2010 so only a very small amount of fruit available for assessment, so results may not be fully representative of entry.

Table 10. Berry quality assessments - guard entry cultivars

Cultivar	Texture (5=firm – 1=v soft)	Skin strength (5=v strong – 1=weak)	Cohesion (5=whole fruit – 1=crumbly)	Flavour (5=v good – 1=v poor)
Cascade Delight	3.0	3.7	4.3	3.7
0485K-1*	3.2	3.2	4.2	4.0
Chemainus	3.6	3.8	4.2	3.2
9764F-3	3.7	4.0	5.0	4.0
0019E2*	3.8	4.2	4.4	3.8
Jeanne d'Orleans*	3.0	3.7	5.0	4.5
Glen Lyon	3.8	4.0	4.0	3.2
0453C4*	2.5	4.0	3.7	3.5
0304F6*	3.3	3.7	4.0	3.3
0433F2*	4.0	4.0	5.0	4.0
TulaMagic	3.0	3.2	3.7	3.7

* planted June 2010 so only a very small amount of fruit available for assessment, so results may not be fully representative of entry.

Fruit was assessed by visitors to the HDC open day on 5 July 2011 and their average scores for berry brightness, colour and texture are displayed in Table 11 and 12. Octavia scored consistently highly across all assessments, closely followed by Tadmor, Cowichan and 9911C-1. In terms of flavour alone Glen Fyne, Tulameen, Tadmor, Glen Doll and 9911C-1 scored highest. With the guard entries (Table 12) 0304F6, Chemainus and 0485K-1 overall produced the highest scores with 0485K-1, Chemainus, Cascade Delight and 0304F6* topping the flavour scores

Table 11. Berry quality assessments by open day visitors on 5 July 2011 - main entries

Cultivar	Brightness (5=v bright – 1=v. dull)	Colour (5=v pale – 1=v. dark)	Texture (5=v good – 1=v soft)	Flavour (5=v good – 1=v poor)
Glen Fyne	3.0	2.2	2.9	3.8
Tulameen	3.8	2.5	2.3	4.0
Octavia	4.0	4.7	3.3	3.7
Glen Doll	2.4	2.1	4.0	3.6
Korpiko	3.4	3.6	2.2	2.9
Tadmor	3.9	3.2	3.2	3.8
00123A7	3.2	3.7	2.6	2.5
9911C-1	3.6	2.6	2.9	3.9
C06	2.9	2.8	3.6	2.9
CO9	2.2	3.2	1.5	2.8
Cowichan	3.7	3.4	3.5	3.3

Table 12. Berry quality assessments by open day visitors on 5 July 2011 - guard entries

Cultivar	Brightness (5=v. bright – 1=v. dull)	Colour (5=v. pale – 1=v. dark)	Texture (5=v good – 1=v. soft)	Flavour (5=v. good – 1=v. poor)
Cascade Delight	3.2	3.1	3.2	3.5
0485K-1*	3.9	3.1	2.4	3.8
Chemainus	4.0	3.0	3.3	3.5
9764F-3	2.3	2.2	3.8	2.4
0019E2*	3.3	3.1	5.0	2.7
Jeanne d'Orleans*	3.1	2.7	3.3	3.1
Glen Lyon	2.4	3.1	3.1	2.5
0453C4*	3.0	4.0	3.0	-
0304F6*	2.8	4.3	3.6	3.5
0433F2*	3.0	-	-	-
TulaMagic	2.8	2.7	2.6	2.9

* planted June 2010 so only a very small amount of fruit available for assessment, so results may not be fully representative of entry.

The most promising entries were also evaluated by customers of the farm's PYO unit, alongside the standard cultivars that they are used to purchasing. Up to 100 people taste tested fruit and stated whether they liked the appearance and flavour and whether they would buy the fruit. The results are displayed in Figures 5 and 6. Overall berry appearance of all entries, with the possible exception of TulaMagic, was well received by consumers. Flavour was most favoured in entries Glen Fyne, Tulameen, Glen Doll, 00123A7 and 9911C-1 from the main entries and Cowichan and 0433F2 from the guard entries. These were the entries which consumers would be most inclined to buy.

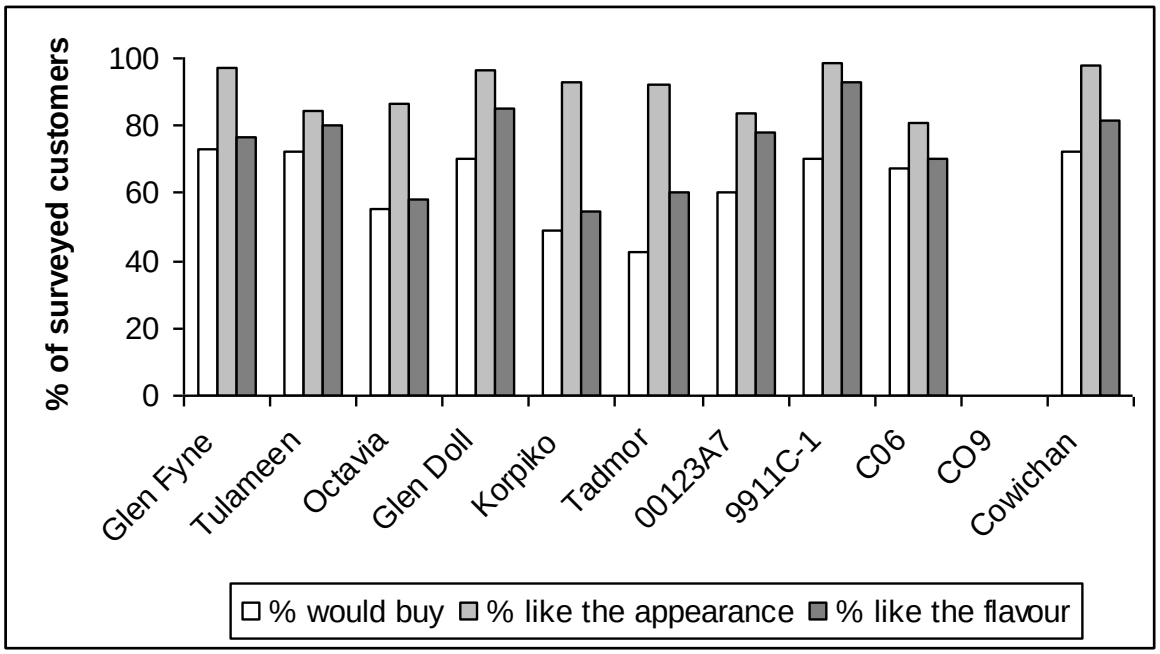
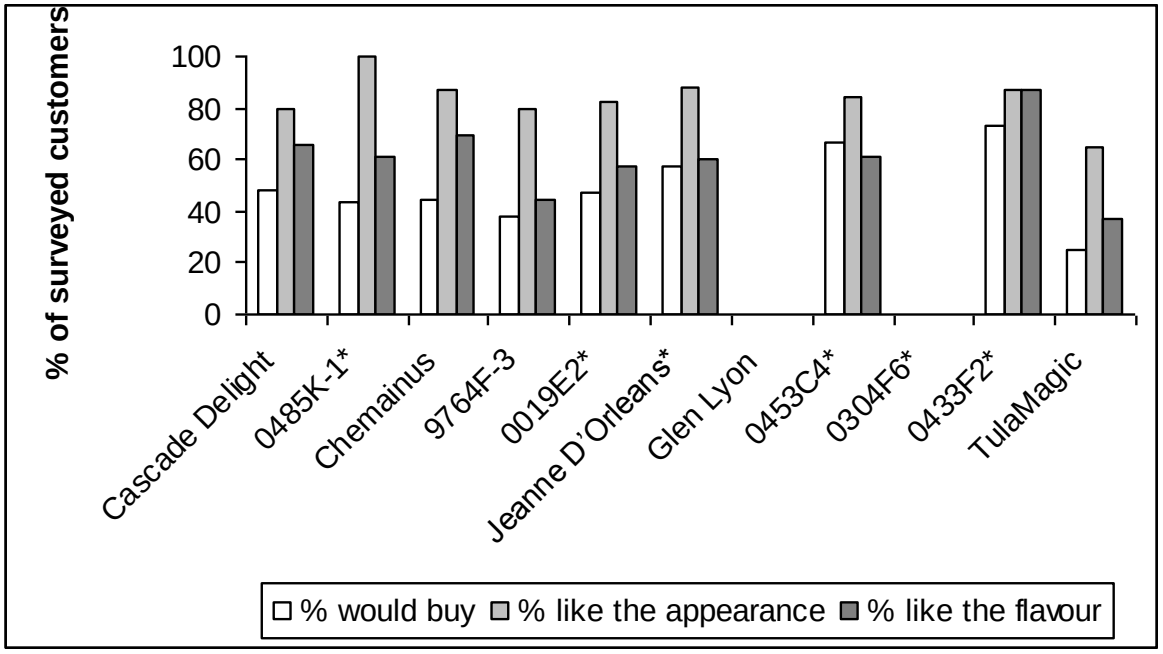


Figure 5. Consumer responses to main entry cultivars.



* planted June 2010 so only a very small amount of fruit available for assessment, so results may not be fully representative of entry

Figure 6. Consumer responses to guard entry cultivars.

Discussion

As throughout the rest of SE England in December 2010 the plants in this summer fruiting raspberry trial were subjected to extremely low temperatures. This was followed by several frosts during April and early May of 2011, and as a result the buds of the mid region of the floricane of some of the entries in the trial failed to break bud. This problem was displayed by 00123A7, Glen Fyne, Octavia and to a lesser extent by Tadmor & Korpiko. This phenomenon was also observed in many commercial plantations of Octavia in 2011. In addition it is suspected that in 2011 frost just prior to or during the early part of the flowering period of some entries, and most especially CO9, may have been the cause of the poorly shaped and small fruit that this entry produced. A reduction of the expected fruit size of CO6, and at times poor appearance of the fruit of Korpiko and 00123A7, also appeared in 2011 to be due to cold injury.

The main entry 9911C-1 and several of the guard entries were delivered as small module plants and were planted in the trial in June 2010. The small number and, in most cases, short canes they produced during the summer of 2010 were left intact and permitted to bear fruit in 2011 and the majority of these plants produced a very small crop. Therefore further yield data in 2012 will be required to better understand the potential of these varieties. The highest marketable yield was produced by Cascade Delight and the late cropping advanced selection 0019E2. Of the 2009 planted entries the performance of TulaMagic was particularly poor as a result of its floricane having produced a substantial yield of fruit from their tips downwards in the late summer and early autumn of 2010.

Despite some difficulties with the weather, based on this year's results the trial has identified several main and guard entries of interest to raspberry growers, these are:

9911C-1

Very early fruit production, produced bright attractive fruit, which was cohesive, sweet, but a bit irregular in shape. The berries were easy to pick and had a good shelf life. The plant of 9911C-1 is very vigorous, produces an adequate number of tall but rather spreading spine-free canes.

Korpiko

Very early, this cultivar's fruit have an attractive appearance, bright, cohesive but a bit soft and only moderate flavour. The shelf life of the fruit in 2011 was poor. The canes of this cultivar are spiny, of moderate vigour plentiful in number but not particularly easy to manage.

00123A7

A mid-season cropping selection producing large fruit, which were a bit variable in shape, but were very well presented to the picker and easy to detach, the berries are a bit pale in colour. Berry flavour and shelf life are good. The plant of 00123A7 is vigorous, the canes very tall, stout, spine-free, upright in habit and easy to manage

Cowichan

Throughout its very long harvest, this PARC cultivar produced large berries of a consistent shape. The berries were bright, firm and with a moderate to good flavour and shelf life. Presentation to the pickers and detachment of fruit was good and superior to that of Tulameen. Cowichan produces tall very upright very easy to manage canes which bear a few, but generally unobtrusive spines, towards their base. Generally Cowichan has proved to be a very reliable cultivar so far.

Tadmor

In 2011 the harvest of this entry was completed just before that of Octavia, however the performance of this cultivar was good and the quality of its fruit, especially the colour, brightness and flavour, superior to Octavia. Throughout harvest the shelf life of Tadmor was good, the fruit was well displayed to pickers and easy to detach. The canes of Tadmor are medium to tall, upright to spreading in habit and bear some spines but are generally easy to manage.

Of the guard entries the following appeared in their first cropping year to be particularly interesting:

0485K-1

Exceptionally early fruiting so might be a replacement for Glen Lyon, attractive, evenly set, cohesive fruit with a very good flavour.

0019E2

Very late harvest so could be considered as a potential replacement for Octavia. The advanced selection has very large, firm, cohesive, attractive, bright fruit, with a good flavour and also an excellent shelf life.

Cascade Delight

High yielding, with very large bright, attractive, sweet fruit, the berries of Cascade Delight are very cohesive but soft and easily damaged by wind and rain if this cultivar is in the open during harvest. Of interest mainly for PYO, farm shop and local market sales.

Jeanne d'Orleans

Early mid-season fruiting, berries have very distinct aromatic sweet deep 'raspberry' flavour, are a mid-dark red in colour, very bright and attractive on the plant and in the punnet. The texture is slightly soft but fruit has an excellent shelf life which is far superior to that of Tulameen. Canes adequate in number, tall, upright to spreading and bear noticeable spines. These do not hamper picking but make cane management unpleasant, particulalry of young plants.

Full descriptions of all main and guard entries are displayed in Appendices 1 and 2.

Conclusions

The first harvest of this trial has confirmed the potential of Glen Fyne and identified five main and five guard entries which have potential to extend the harvest period or to replace current UK commercial summer fruiting raspberry cultivars. These are:

- 9911C-1
- Korpiko
- 00123A7
- Cowichan
- Tadmor
- 0485K-1
- 0019E2
- Cascade Delight
- Jeanne d'Orleans
- Chemainus

The stand out berries in terms of quality and flavour from the main entry cultivars were Glen Fyne, Tadmor and Glen Doll; the blind consumer taste trial also identified 00123A7 and 9911C-1 from the main entries. In the guard entries, Chemainus, 9764F-3, Jeanne d'Orleans and 0433F2 had very good flavour as well as berry brightness and cohesion.

Further assessments will be made of bush and fruit quality in 2012 to further confirm the potential of these promising varieties.

Appendix 1 - Descriptions of the main entries

Cultivar/ Selection	Season (in 2011)	Fruit Size (g)	Fruit	Plant	Pest & Disease susceptibility
From: East Malling Research					
CO9	Early – mid (14 June – 1 July)	2.5 - 4.7	Conical to blunt conical, Readily removed from plug. Very variable drupelet, berry size & shape. Dry texture, moderate to very poor flavour. Fairly bright, mid red, darken as ripen, soft, poor shelf life. Fruit appears hairy,	Tall – very tall, upright to a spreading habit, spine free canes. Plentiful canes, not easy to thin Laterals medium to short well attached, produced well down canes, ascending to horizontal in habit. Generally present fruit well Variable bud break	Resistant to biotypes 1-4 large raspberry aphid, resistant cane *Botrytis*, spur blight, midge blight & cane spot. Susceptible to powdery mildew
CO6	Mid – late (16 June - 25 July)	2.7 – 3.7	Conical to blunt, conical, very variable fruit shape, size & set, easy to remove from plug. Bright attractive mid red berries, but skin easily ruptured, soft texture, prominent seeds. Sweet taste, some off flavour 'grassy'. Poor shelf life	Tall cane, very spiny at base, adequate number moderate vigour, unpleasant to handle when young. Thin spiny laterals, medium to long at base of canes, ascending habit to middle of canes then horizontal, few breakages during harvest, present fruit well. Even bud break down full length of canes.	Resistant to biotypes 1-4 large raspberry aphid, resistant cane *Botrytis*, moderately resistant to spur blight, midge blight & cane spot. Susceptible to *Phytophthora*. Susceptible to powdery mildew

Cultivar/ Selection	Season (in 2011)	Fruit Size (g)	Fruit	Plant	Pest & Disease susceptibility
From: The James Hutton Institute					
9911C-1	Early (14 June – 1 July)	4.1 – 5.28	Conical fruit, easy to plug. Bright attractive mid pink red coloured fruit darkens as ripens. Large drupes variable set so fruit can look uneven 'bumpy' generally cohesive. At start of harvest a little bland improves later sweet pleasant flavour. Good shelf life	Very tall vigorous, produced in adequate numbers, upright to spreading in habit, spine free, can be difficult to manage. Long to very long, spine free laterals, ascending to mainly horizontal in habit, fall over each other and readily break with weight of fruit especially at tops of canes. Will require lateral support if grown under protection. Variable bud break of floricane in 2012	Resistant to biotypes 1-4 large raspberry aphid. Susceptible to phytophthora root rot So far no other disease problems observed
00123A7	Early – mid (16 June – 22 July)	3.2 – 4.2	Blunt conical easy to plug, pale salmon red coloured fruit. Large drupes some uneven set especially early picked fruit. Waxy skin & texture, firm but melting when eaten. Bright when just ripe a little dull post cold storage. Sweet flavour, a few prominent seeds	Very vigorous tall, spine free, upright to slightly spreading, easy to manage, plentiful in number, vigorous. Laterals long, strongly ascending at top to ascending mid to lower part of canes. Strongly attached, present fruit well to picker. Very leafy plants. Very poor bud break ion 2011, better in 2012, appears to be prone to frost damage post Christmas	Resistant to biotypes 1-4 large raspberry aphid. No disease problems noted so far

Cultivar/ Selection	Season (in 2011)	Fruit Size (g)	Fruit	Plant	Pest & Disease susceptibility
Glen Doll	Mid – late (27 June – 1 August)	2.7 – 4.2	Conical to blunt conical. Very firm bright even set, very cohesive. Mid red in colour a little darkening as ripens, good shelf life. Flavour at start of harvest weak, sweet & good when picking well under way. Excellent shelf life, some solar damage following very bright hot weather.	Very upright cane, of medium height, spine free, very easy to manage, present in just adequate numbers, can be a bit thin. Variable bud break in 2011 & 2012 Laterals long strong, strongly ascending at top to ascending-horizontal at bases of canes. Poor bud break (middle of floricane) in 2011 & 2012.	Resistant to biotypes 1-4 large raspberry aphid. Susceptible to *Phytophthora* root rot, other wise no problems seen N.B. the plant vigour, yield and berry size of the Glen Doll in SF41c is not comparable with the results achieved by this cultivar in SF41b. Similar results have been obtained with commercial plantings of this cultivar
From: PARC, Canada					
Cowichan	Mid – late (18 June – 1 August)	4.0 – 6.6	Neat conical, even set fruit very cohesive. Mid red in colour some darkening as ripen. Sweet moderate flavour, no off tastes. Very easily detached from plug. Bright appearance. Some softening with cold storage, but otherwise good. Maintains fruit size well through harvest	Very tall, vigorous, bear some spines at base but not unpleasant to handle. Adequate in number, very upright in habit easy & cheap to manage. Long to very long laterals, strongly attached usually few breakages during harvest but weight of fruit at their tips can pull them down over each other. Lateral supports for protected crop would be beneficial. Very good bud break from top to bottom of canes	Low incidence of cane diseases. Cowichan seems to have some tolerance to root rot probably because of strong vegetative growth habit. No other disease problems noted

Cultivar/ Selection	Season (in 2011)	Fruit Size (g)	Fruit	Plant	Pest & Disease susceptibility
From: HortResearch, New Zealand					
Korpiko	Early – mid (16 June – 20 July)	3.4 – 5.0	Conical – round conic very variable in shape & size of fruit. Mid red colour, bright at times uneven ripening so appears blotchy. Weak to poor flavour, generally cohesive, easily bruised fruit. Moderate to poor shelf life	Tall, numerous, spiny particularly at bases of primocane, very upright good habit, not unpleasant to handle, but difficult to thin. Laterals very thin, bow over at tips with weight of fruit at top of canes, well attached, springy and ascending in habit mid to lower cane. Spines on laterals but do not hamper picking. Very even and good bud break	Some powdery mildew seen on fruit
Tadmor	Mid – late (18 June – 25 July)	3.5 – 5.6	Conic attractive bright firm fruit, cohesive, medium to large drupes, even set sometimes seeds prominent, but does not affect eating quality. Sweet good flavour. Maintains fruit size well through most of harvest. Fruit firm softens during storage but remains of good quality	Tall, moderate to vigorous in growth, plentiful, upright to spreading in habit some spines at base, easy to remove. Laterals short at top to medium to very long at base of canes. Fruit well presented to pickers, very open canopy. Laterals strongly attached, even and good bud break, down the length of canes.	Susceptible to *Phytophthora* root rot

Cultivar/ Selection	Season (in 2011)	Fruit Size (g)	Fruit	Plant	Pest & Disease susceptibility
The standard cultivars:					
Glen Fyne	Early – mid (14 June – 25 July)	3.5 – 4.6	Conic - round conic, cohesive, bright, sweet, firm easily removed from plug. Darkens as ripens, but remains bright and marketable, size maintained well.	Medium to tall spreading, spine free, adequate in number not easy to train. Laterals short at top, long to very long at base of canes, well attached present fruit well to pickers, leafy canopy. Variable bud break.	Resistant to biotypes 1-4 large raspberry aphid, very susceptible to *Phytophthora &* to powdery mildew
Tulameen	Mid (16 June – 22 July)	3.0 – 4.0	Conic in trial fruit very poorly set a great deal of uneven shaped berries which crumble as picked. Mid red, bright, darken as ripening, sweet flavour. Poor shelf life because of poor quality of fruit placed in store	Very tall spreading some spine mainly at base of canes, long to very long laterals well attached some breakage of tips during harvest. Good bud break	Susceptible to cane *Botrytis*, spur blight & cane spot. Susceptible to *Phytophthora*
Octavia	Mid – late (24 June – 1 August)	4.6 – 5.7	Round – conic, pale red, some darkening as ripens. Large drupes some crumble especially towards end of harvest, weak sweet to acid sweet flavour. Variable shelf life	Medium -tall, spreading spiny primocane. Adequate to numerous, difficult to remove. Long to very long laterals well attached, very uneven and protracted bud break	Resistant to biotypes 1-4 large raspberry aphid susceptible to spur blight & cane blight. Very susceptible to *Phytophthora*

Appendix 2 - Descriptions of the guard entries

Cultivar/ Selection	Season (in 2011)	Fruit Size (g)	Berry Appearance	Canes	Pest & Disease susceptibility
From: PARC, Canada					
Chemainus	Mid	2.9 – 3.9	Conical, neat set bright attractive mid red fruit some darkening as ripens, sweet flavour, Berry size retained well Easy to pick, good shelf life	Very tall, vigorous, upright, adequate in number easy to manage, a few spines but mainly at base of canes. Long to very long laterals strongly attached, ascending to horizontal habit. Good bud break	Low incidence of cane disease, susceptible to *Phytophthora*
From: The James Hutton Institute					
Glen Lyon	Early	2.2 – 3.8	Conic – round, some variable set, firm bright, moderate to sweet flavour. Good shelf life, darken as ripen. Some crumble	Medium height, plentiful, spine free, upright to spreading habit	Susceptible to cane *botrytis*, spur blight & *Phytophthora*
0485K-1	Very early	3.8 – 4.7	Conical, neat set, cohesive, medium red darken as ripen, sweet, sometimes a bit bland post storage,	Spine free, upright to spreading canes, training difficult, adequate in number. Laterals leafy, held slightly ascending to horizontal, display fruit well to pickers. Good even bud break	Resistant to biotypes 1-4 large raspberry aphid
9764F-3	Mid – late	3.6 – 5.2	Conic some variation in shape. Firm, very bright but some bloom, mid to dark red, good flavour & shelf life	Moderate vigour, spine free, adequate in number, very upright habit, dense foliar canopy. Laterals, strongly ascending well attached present fruit well. Good bud break.	Resistant to biotypes 1-4 large raspberry aphid

Cultivar/ Selection	Season (in 2011)	Fruit Size (g)	Berry Appearance	Canes	Pest & Disease susceptibility
0019E2	Mid - late	5.0 – 7.5	Blunt conical, even set, large plug hole, fleshy, firm, very cohesive, bright mid red. Excellent shelf life, moderate to good flavour	Upright, tall, adequate in number, late to emerge primocane, good habit spine free. laterals, strongly ascending, present fruit well strongly attached, very variable and protracted bud break	Resistant to biotypes 1-4 large raspberry aphid
0453C4	Very early	3.2 – 5.7	Conic – round-conic, mid red, darken as ripen, bright, good sweet to moderate flavour. Good shelf life	Spine free, upright habit, leafy, moderate to small number of canes. Strongly ascending laterals at top and ascending at base of canes, strongly attached, present fruit well	Resistant to biotypes 1-4 large raspberry aphid
0304F6	Mid - late	4.0 – 5.7	Conic – round conic, cohesive pale – salmon red, large plug hole, uneven set around rim, medium texture moderate flavour	Spine free, upright – spreading, just adequate in number. All laterals horizontal to just ascending habit, some broken by weight of fruit, would benefit from lateral support. Uneven bud break.	Resistant to biotypes 1-4 large raspberry aphid
0433F2	Early	3.2 – 4.4	Conical even set and shape, very bright mid red, hairy appearance, good flavour & firm pre cold storage, poor shelf life, softens rapidly	Spine free, very upright, just adequate in number. Laterals short to medium in length, fruit presented well to picker, horizontal – slightly ascending habit	Resistant to biotypes 1-4 large raspberry aphid

Cultivar/ Selection	Season (in 2011)	Fruit Size (g)	Berry Appearance	Canes	Pest & Disease susceptibility
From: Washington State University, USA					
Cascade Delight	Mid	3.5 – 6.2	Conical, mid red, darkens as ripens, easily detached. Even set cohesive, fruit size maintained bright attractive, damaged by weather (bruised). Softens during cold storage. Sweet flavour.	Very tall, vigorous, spiny at base, not unpleasant to handle, adequate number. Laterals long - very long, horizontal habit, droop at tip and would benefit from lateral support. In open wind-rain can severely damage the laterals & the fruit on them. Good even bud break to base of cane	Susceptible to cane & fruit *Botrytis* Good tolerance to *Phytophthora*
From: Switzerland					
TulaMagic	Early	3.0 – 5.0	Round-conic, very variable set & shape, mid red darkening rapidly as ripens, bright, some crumble. Collapses soon after picking, poor shelf life, flavour can be good	Moderate vigour, very spiny, flower on primocane tips to 30-40% down their length in the autumn. Very unpleasant to handle, upright to spreading, tall. Laterals spiny, medium to long, drop at tip making picking difficult & unpleasant	No information
From: University and Agricultural & Agri-Food Canada, Quebec					
Jeanne d'Orléans	Mid - late	3.2 – 4.2	Conical, neat set, mid red darken as ripen, very cohesive, distinct rich raspberry flavour. Very good shelf life	Tall, vigorous, upright, very spiny, unpleasant to handle when young. Laterals strongly attached, ascending to horizontal habit present fruit well, some variable bud break.	Looks to be a very robust cultivar

Appendix 3 – SF 41c Trial Plan

Tunnel 1		**Tunnel 2**	
Block 1	**Block 2**	**Block 3**	**Block 4**
Plot No., treatment No. & entry	Plot No., treatment No. & entry	Plot No., treatment No. & entry	Plot No., treatment No. & entry
G - Cascade Delight	G - 0019E2	G –Jeanne d'Orléans	G – 0453C4
1 T9 - CO6	12 T11 - Cowichan	23 T1 - Glen Fyne	34 T11 - Cowichan
2 T7 – 00123A7	13 T8 – 9911C-1	24 T10 - CO9	35 T2 - Tulameen
3 T8 – 9911C-1	14 T10 – CO9	25 T6 - Tadmor	36 T4 - Glen Doll
4 T4 – Glen Doll	15 T3 – Octavia	26 T7 - 00123A7	37 T8 - 9911C-1
5 T10 – CO9	16 T5 – Korpiko	27 T11 - Cowichan	38 T10 - CO9
6 T11 – Cowichan	17 T7 – 00123A7	28 T3 - Octavia	39 T1 - Glen Fyne
7 T5 – Korpiko	18 T9 – CO6	29 T5 - Korpiko	40 T9 - CO6
8 T2 – Tulameen	19 T6 - Tadmor	30 T9 - CO6	41 T6 - Tadmor
9 T1 – Glen Fyne	20 T1 – Glen Fyne	31 T2 - Tulameen	42 T3 - Octavia
10 T3 – Octavia	21 T4 – Glen Doll	32 T8 - 9911C-1	43 T7 - 00123A7
11 T6 – Tadmor	22 T2 - Tulameen	33 T4 - Glen Doll	44 T5 - Korpiko
G - 0485K-1	G – 9764F-3	G – Glen Lyon	G TulaMagic
Cascade Delight	Chemainus	G – 0304F6	G – 0433F2