

Project title:	Raspberry: summer fruiting variety trial
Project number:	SF 41c
Project leader:	Janet Allen
Report:	Final report, June 2013
Previous report:	Annual report, August 2012
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:	1 st March 2009
Date project completed (or expected completion date):	30 th June 2013

DISCLAIMER

AHDB, operating through its HDC division seeks to ensure that the information contained within this document is accurate at the time of printing. No warranty is given in respect thereof and, to the maximum extent permitted by law the Agriculture and Horticulture Development Board accepts no liability for loss, damage or injury howsoever caused (including that caused by negligence) or suffered directly or indirectly in relation to information and opinions contained in or omitted from this document.

Copyright, Agriculture and Horticulture Development Board 2013. All rights reserved.

No part of this publication may be reproduced in any material form (including by photocopy or storage in any medium by electronic means) or any copy or adaptation stored, published or distributed (by physical, electronic or other means) without the prior permission in writing of the Agriculture and Horticulture Development Board, other than by reproduction in an unmodified form for the sole purpose of use as an information resource when the Agriculture and Horticulture Development Board or HDC is clearly acknowledged as the source, or in accordance with the provisions of the Copyright, Designs and Patents Act 1988. All rights reserved.

AHDB (logo) is a registered trademark of the Agriculture and Horticulture Development Board.

HDC is a registered trademark of the Agriculture and Horticulture Development Board, for use by its HDC division.

All other trademarks, logos and brand names contained in this publication are the trademarks of their respective holders. No rights are granted without the prior written permission of the relevant owners.

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

ADAS

Signature Date

Harriet Roberts

Horticultural consultant

ADAS

Signature Date

Report authorised by:

Tim O'Neill

Horticulture Research Manager

ADAS

Signature Date

CONTENTS

Grower Summary	1
Headline	1
Background	1
Results of the variety trial	1
Science Section.....	10
Introduction	10
Materials and methods	10
Results	14
Discussion	21
Conclusions.....	35
Technology transfer	35
Appendix 1 - Descriptions of the main entries	36
Appendix 2 - Descriptions of the guard entries.....	41
Appendix 3 – SF 41c Trial Plan	44
Appendix 4 – 2012 Raw data and plot details	45

GROWER SUMMARY

Headline

Glen Fyne, Cowichan and Tadmor are summer fruiting raspberry varieties which are highly suited to UK commercial production.

Background

Glen Ample, Tulameen and Octavia are the principal summer fruiting raspberry varieties currently grown in the UK. These varieties enable UK growers to produce quality fruit under protection from May to late July.

Problems with susceptibility to pest and or disease and in the case of Tulameen of imperfect fruit quality, highlighted the need to evaluate named varieties and advanced selections of summer fruiting raspberries. The intention is to identify varieties which will provide high quality fruit over extended periods which are high yielding, crop reliably, produce firm berries which look appealing, have a good flavour and texture, have a long shelf-life and are practical to grow, manage and pick.

Results of the variety trial

This Grower Summary provides a précis of the trial results and information about the most promising varieties for the UK. Refer to the Science Section for a comprehensive description of the performance of all the varieties included.

Replicated plots of eight new summer fruiting raspberry varieties were planted in 2009 or 2010 at Rectory Farm, Stanton St John, Oxford. The trial site was located within a 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 free draining and of a light loamy sand texture. These eight trial varieties were compared with three control varieties, Glen Fyne, Tulameen and Octavia over two harvest years. Single guard plots of ten additional varieties were examined and compared to Glen Lyon, which was planted as a standard variety for very early fruit production.

Table 1 (below) lists the main entries to the replicated trial. Table 2 (below) lists the guard entries included in the trial.

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

Variety /Selection	Origin	Cropping season	Planted	Harvest period 2011 season	Harvest period 2012 season
9911C-1	Scotland	Early	June 2010	14 Jun - 1 Jul	18 Jun – 6 Aug
CO9	England	Early	June 2009	14 Jun - 20 Jul	18 Jun – 16 Jul
Korpiko	New Zealand	Early	June 2009	16 Jun - 20 Jul	22 Jun – 30 Jul
Glen Fyne	Scotland	Early - mid	June 2009	14 Jun - 25 Jul	25 Jun – 1 Aug
00123A7	Scotland	Early - mid	June 2009	16 Jun - 22 Jul	25 Jun – 10 Aug
Tulameen	Canada	Early - mid	June 2009	16 Jun - 22 Jul	27 Jun – 8 Aug
Cowichan	Canada	Mid - late	June 2009	16 Jun - 25 Jul	25 Jun – 10 Aug
Glen Doll	Scotland	Mid - late	June 2009	18 Jun - 1 Aug	25 Jun – 6 Aug
CO6	England	Late	June 2009	27 Jun - 1 Aug	22 Jun – 6 Aug
Tadmor	New Zealand	Late	June 2009	18 Jun - 25 Jul	29 Jun - 10 Aug
Octavia	England	Late	June 2009	24 Jun - 1 Aug	29 Jun – 10 Aug

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

Variety /Selection	Origin	Cropping season	Planted	Harvest period 2011 season	Harvest period 2012 season
0485K-1	Scotland	Very early	June 2010	14 Jun - 15 Jul	22 Jun – 25 Jul
0453C4	Scotland	Very early	June 2010	14 Jun - 25 Jul	22 Jun – 3 Aug
Glen Lyon	Scotland	Early	June 2009	14 Jun - 20 Jul	25 Jun – 18 Jul
0433F2	Scotland	Early	June 2010	14 Jun - 20 Jul	26 Jun – 3 Aug
TulaMagic	Switzerland	Early	June 2009	14 Jun - 25 Jul	18 Jun – 1 Aug
Cascade Delight	USA	Mid	June 2009	14 Jun - 25 Jul	29 Jun – 10 Aug
Chemainus	Canada	Mid	June 2009	16 Jun - 22 Jul	27 Jun – 8 Aug
Jeanne d'Orléans	Canada	Mid	June 2010	16 Jun - 25 Jul	25 Jun – 10 Aug
9764F-3	Scotland	Mid - late	June 2009	16 Jun - 1 Aug	25 Jun – 8 Aug
0019E2	Scotland	Mid - late	June 2009	18 Jun - 25 Jul	2 Jul – 10 Aug
0304F6	Scotland	Mid - late	June 2009	24 Jun - 1 Aug	25 Jun – 8 Aug

Table 3 (below) lists the yields, % marketable fruit and average berry weight of the main entries in seasons 2011 and 2012. Marketable fruit refers to intact, market quality fruit, in contrast to waste which includes damaged, diseased or under-size fruit.

Table 3. Yield (kg/plant), % marketable fruit and average berry weight in 2011 and 2012 for main entries in summer fruiting raspberry trial in order of yield

Variety	Av. yield/plant (kg)		% Marketable		Av. berry weight (g)	
	2011	2012	2011	2012	2011	2012
Cowichan	2.5	2.1	95.0	79.9	5.4	5.6
Tadmor	1.9	2.1	80.7	92.0	4.6	5.1
Glen Fyne	2.0	1.3	93.9	92.0	3.9	4.1
Korpiko	1.4	1.8	97.5	79.9	4.2	4.9
00123A7	1.5	1.6	87.7	89.0	3.7	4.6
Tulameen	1.4	1.4	96.8	83.3	3.5	4.3
CO6	1.3	1.4	95.1	82.0	3.2	3.4
Octavia	1.3	1.3	96.6	81.7	5.1	5.7
Glen Doll	1.3	1.0	75.8	90.1	3.5	3.7
9911C-1	0.5	1.4	94.2	73.8	4.5	4.6
CO9	1.6	1.3	97.8	75.3	2.8	3.1

Cowichan was the highest yielding of the main entries closely followed by Tadmor. However Tadmor produced a much higher percentage marketable fruit. Cowichan, Tadmor and Octavia had on average the highest berry weight. The lowest yielding varieties were Glen Doll, Octavia and Glen Fyne. Lowest berry weight was observed in CO9, Glen Doll and CO6. Lowest % marketable fruit was observed in 9911-C and CO9 and this was mostly due to uneven fruit shape. Glen Fyne, Tadmor and Glen Doll showed the highest proportion of marketable fruit.

Table 4 lists the yields, % marketable fruit and average berry weight of the guard entries in seasons 2011 and 2012.

Table 4. Yield (kg/plant), % marketable fruit and average berry weight in 2011 and 2012 for the summer fruiting raspberry guard entries (single plots) in order of yield.

Variety	Av. yield/plant (kg)		% Marketable		Av. berry weight (g)	
	2011	2012	2011	2012	2011	2012
Cascade Delight	2.1	2.2	94.2	86.5	5.0	5.9
Chemainus	1.4	2.4	97.6	95.2	3.5	4.5
9764F-3	0.8	2.4	93.2	85.8	4.0	4.0
Jeanne d'Orléans	1.4	1.6	99.7	89.9	3.6	3.8
0019E2	0.7	2.1	73.8	83.3	6.3	5.7
Glen Lyon	1.9	0.7	96.8	75.3	2.7	3.5
TulaMagic	1.8	0.7	97.0	76.3	3.9	4.1
0485K-1	1.1	1.1	98.3	91.6	4.4	5.0
0453C4	0.3	1.3	91.8	82.1	3.8	3.9
0304F6	0.3	1.1	98.0	86.2	4.5	4.0
0433F2	0.2	1.0	98.7	91.6	3.6	4.3

Of the guard entries, Cascade Delight (both years), Chemainus, 9764F-3 and 0019E-2 (in 2012 only) showed the highest yields and of those, Chemainus showed the highest

proportion of marketable fruit in 2012. Berry weight was also high in these varieties along with 0485K-1.

Main entries of particular interest based on 2 full cropping years

The following varieties are of most interest to the industry:

Cowichan 	Tadmor 	0485K-1 
Cascade Delight 	Chemainus 	Jeanne d'Orleans 
0019E2 		

Figure 1. Varieties of most interest to the industry

Cowichan

Throughout its very long harvest this PARC variety produced large berries of a consistent shape. Berry size is also retained well through harvest. The berries were bright, firm, with a moderate to good flavour and shelf life better than Tulameen. Presentation to the pickers and detachment of fruit was superior to that of Tulameen. However the length of the laterals of this variety when grown under protection can increase the risk of them being damaged by pickers, so lateral supports are recommended for the protected crop which also substantially improves presentation of fruit to the picker. Cowichan produces tall very upright and very easy to manage canes which bear a few but generally unobtrusive spines towards their base. Commercial experience has also indicated that it is far less susceptible to foliar & cane diseases than Tulameen. It also has more winter hardiness and is later to break bud than Tulameen, making it less vulnerable to damage during the winter or by spring frosts. Cowichan exhibits field tolerance to raspberry root rot and its reliability of cropping and production of high yields of good sized fruit make it a useful variety for direct from farm sales.

Tadmor

In 2011 the Tadmor harvest was completed just before Octavia and in 2012 at the same time as Octavia. The performance of this variety was very good. The quality of its fruit, especially the colour, brightness and flavour, was superior to Octavia. Throughout harvest, the shelf-life was good, the fruit was well displayed to pickers and easy to detach. Canes are medium to tall, upright to spreading in habit, bear some spines but are generally easy to manage. So far, Tadmor has not proved vulnerable to cane or foliar diseases, but is susceptible to Phytophthora root rot, so on some sites, substrate production is recommended along with routine fungicide applications. Tadmor has exhibited considerable commercial potential and several growers who have planted it have been very pleased by its performance to date.

CO6 and CO9

The berry quality, size and/or yield of marketable fruit produced by the EMR advanced selections **CO6 & CO9** was poor, so these will not be developed further.

Standard varieties

Glen Fyne performed well in 2011, although the presence of Phytophthora root rot infected plants was confirmed in two plots in the late summer of 2010. The disease spread further resulting in plant losses in all of the plots of this entry by spring 2012, causing a marked reduction in yield and berry size in summer 2012. However overall, the results from this

entry were excellent. Its fruit retained size throughout harvest. Berries were bright, attractive, with an excellent flavour, good shelf life, very well presented and easily detached from fruit laterals. In mid harvest during bright weather, the berries became a little dark, but growers have found that this variety can be picked tight with the benefit of having a berry of the desired appearance at the point of sale. Glen Fyne is vulnerable to powdery mildew, although this disease was not a problem during the life of the trial. It is very susceptible to raspberry root rot so production on many sites would be best in substrate rather than in open field or glasshouse soil. Glen Fyne produces adequate numbers of medium to tall canes, which are spine free and with an upright to spreading habit. They are easy to manage provided that they are kept upright as they grow. The laterals are of medium length, strongly attached and do not require support.

Octavia yields in both 2011 & 2012 were much reduced due by cold injury to lower & mid florican buds during the winter (2010-11) or late winter-early spring (2012). In addition in spring 2012, there was a high infestation of spur blight. During the first 8-10 days of the harvest in 2012, a substantial amount of unmarketable unevenly ripened fruit was picked. As yet the cause has not been identified although the appearance of affected fruit appeared to coincide with a change to hot bright sunshine after a long period of cool overcast and very wet weather.

Tulameen berry quality (i.e. shape, firmness & size) produced in the trial was consistently poor. Cane growth was variable and weak in some plants. The origin of the clone for the plants provided by the commercial propagator for the trial is unknown but was not the Tulameen clone held at Naktuinbouw which in HDC project SF105, was shown to produce the best quality of fruit of this variety.

Guard entries of particular interest

0485K-1

0485K-1 has an exceptionally early fruiting season so could be considered as a replacement for Glen Lyon and Glen Moy. It produces attractive, evenly set, conic, cohesive fruit with a very good flavour. Fruit is well displayed to pickers on medium to very long laterals. The canes are spine free, plentiful in number and upright to spreading in their habit. This selection is known to be susceptible to *Phytophthora* root rot, but in project SF 41c neither this nor any foliar or cane diseases were noted as being a problem.

JHI and the UK Raspberry Breeding Consortium have decided to trial this selection further. It has therefore been proposed as a main entry for SF 41d (the next HDC summer fruiting raspberry variety trial).

Cascade Delight

Cascade Delight has consistently produced high yields of marketable fruit, with very large, bright, attractive and sweet berries. The berries are very cohesive, but soft and easily damaged by wind and rain. This variety is therefore best suited to tunnel rather than outdoor production. Supermarkets have shown some interest in this variety, although it is likely to be of interest mainly for PYO, farm shop and local market sales. Further fruit samples will be submitted to determine their suitability for fresh fruit supermarket sales in 2013.

The primocane is very tall (never less than 1.8m), upright to spreading, with some spines but generally pleasant to handle. Lateral support is recommended for this variety, be it planted in the open or provided with protection during most of its growing season. Because of its strong growth, additional space between rows is recommended to facilitate tractor and picker access in the plantation later in the season.

Cascade Delight can exhibit considerable field resistance to *Phytophthora* root rot, though it can succumb to this disease. In addition the fruit and canes are susceptible to *Botrytis*.

Chemainus

Chemainus is a mid-season variety. Like Cowichan, it was a promising guard entry in HDC project SF 41b. However it proved to be more susceptible to *Phytophthora* root rot and succumbed before the end of the trial. In this trial (SF 41c) it has consistently produced very bright attractive and very firm fruits, of moderate flavour and size. These were of a very regular shape, very cohesive, well displayed to the picker and easily detached.

The plant habit is very similar to that of Cowichan with tall upright canes bearing a few spines, adequate in number and very easy to manage when compared to Tulameen. No foliar, fruit or cane disease problems were noted as affecting this variety during the trial and unlike some other entries, spring frost or winter cold injury did not affect its floricanes, with bud break in both 2011 & 2012 down more or less the whole length of canes.

Jeanne d'Orleans

A mid-season fruiting variety from Quebec in Canada. Berries have very distinct aromatic sweet deep 'raspberry' flavour, are a mid-dark red in colour, and are 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 or Octavia and is on a par with that of Glen Fyne. Canes are adequate in number, tall, upright to spreading and bear very noticeable spines. These do not hamper picking but make cane management very

unpleasant (particularly on young plants). Fruiting laterals are medium to long, ascending in habit. They are very strongly attached and present fruit well to the picker.

Although unlikely to become a widely planted commercial variety, its exceptional fruit flavour may provide it with a place in niche markets where this attribute is a major consideration. Meiosis has the marketing rights to Jeanne d'Orleans in the UK and has indicated that they may develop it further, at least for fruit production by amateurs.

0019E2

0019E2 has a very late harvest and is being considered as a replacement for Octavia. In addition it consistently produces very large, firm, cohesive, attractive, bright fruit with a moderate flavour (superior to that of Octavia, i.e. no off flavour) and has an excellent shelf life. Canes are upright in habit, spine free, adequate in number, medium to long with ascending laterals which present fruit well to pickers.

In 2012, a high number of buds in the lower–mid region of floricanes failed to break bud. The reason for this is unknown, although cold injury around bud break may be implicated; in trials at JHI it would appear that this selection may require considerable chilling (as per Ample) to ensure even bud break and flower lateral production down the full length of the floricanes. At harvest, the laterals were long and susceptible to being broken away from their base by pickers. Lateral support is likely to be required for this variety.

At the SF41c variety trial open day, there was considerable grower interest in this selection and trial results elsewhere have led to JHI and the UK Raspberry Breeding Consortium deciding to develop this selection further. It has therefore been proposed as a main entry for SF 41d (the next HDC summer fruiting raspberry variety trial).

Other guard entries

Although there was some interest in the selection **0453C4**, JHI and the UK Raspberry Breeding Consortium have decided to delist this and the other JHI selections which were guards in this trial. Similarly the trial has shown that ***Tula Magic*** has no commercial value in the UK.

Main conclusions

- The potential of Glen Fyne, Tadmor and Cowichan as suitable summer fruiting raspberry varieties for UK growers was confirmed in this trial.
- Four further guard entries (Jean d'Orleans, Chemainus, 0485K-1, 0019E-2 and Cascade Delight) were identified as promising selections.

- Results achieved by Tulameen, Glen Doll and Octavia in terms of yield and berry quality were disappointing in 2011 and 2012.

SCIENCE SECTION

Introduction

Currently 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 are the dominant summer fruiting raspberry cultivars grown commercially in the UK.

These cultivars enable UK growers to produce quality fruit under protection from established plantations from May – late July, 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 and more recently Octavia, 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. The intention has been to identify the those in the next generation of cultivars that will provide high quality fruit over the above periods each year. These will display some and hopefully all of the following attributes:-

- High yielding
- Reliable cropping
- Firm berries with a long shelf life
- 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 south facing commercial planting of raspberries and protected from adverse weather by Spanish tunnels from first fruit set until the end of harvest.

The soil is a free draining light loamy sand. The raspberries are planted 0.45 m 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 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 5 and 6 below) planting took place in either June 2009 or 2010.

There are eight entries in the main i.e. replicated part of the trial these include (full details of each variety, their origin and a description is shown in Appendix 1):

- Two coded selections CO9 & CO6 from East Malling Research
- Two coded selections 00123A7, 9911C-1 & 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 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 & 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.

Table 5. Main cultivar entries, propagation details and planting date

Treatment number	Cultivar/ Selection	Country of origin	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	UK, JHI	Root cuttings	June 2009
5	Korpiko	New Zealand, HortResearch	Root cuttings	June 2009
6	Tadmor	New Zealand, HortResearch	Root cuttings	June 2009
7	00123A7	UK, JHI	Root cuttings	June 2009
8	9911C-1	UK, JHI	Root cuttings	June 2010
9	CO6	UK, EMR	Root cuttings	June 2009
10	CO9	UK, EMR	Root cuttings	June 2009
11	Cowichan	Canadian, PARC	Root cuttings	June 2009

Table 6. Guard cultivar entries propagation details and planting date

Cultivar/ Selection	Propagated from	Country of origin	Planted
Cascade Delight	Root cuttings	USA, Puyallup Research & Extension Centre WSU	June 2009
Glen Lyon	Root cuttings	UK, JHI	June 2009
TulaMagic	Root cuttings	Switzerland, Reto Neuweiler	June 2009
Chemainus	Root cuttings	Canadian, PARC	June 2009
Jeanne d'Orléans	Root cuttings	Canada, McGill university	June 2010
0485K-1	Root cuttings	UK, JHI	June 2010
9764F-3	Root cuttings	UK, JHI	June 2009
0019E2	Root cuttings	UK, JHI	June 2009
0453C4	Root cuttings	UK, JHI	June 2010
0304F6	Root cuttings	UK, JHI	June 2010
0433F2	Root cuttings	UK, JHI	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 & 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 produced a full crop. It was decided that, although in some cases they had made only a small amount of growth, some floricanes of plants delivered and planted in June 2010 were to be left in situ to bear fruit in 2011. After harvest floricanes were removed and canes were thinned to six per metre.

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 were trickle irrigated and fertigated and trained using a vertical wall trellis, with mobile primocane support wires. Primocane control was 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) were 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 2011 season commenced on 14 June, with fruit picked from the main entries 9911C-1, CO9 and Glen Fyne and the guards 0485K-1, 0453C4, Glen Lyon, Jeanne d'Orléans and TulaMagic.

In 2012 the season commenced on 18 June with fruit picked from Korpiko, 9911C-1, CO9 in the main entries and from TulaMagic in the guards.

Assessments

The weight of marketable fruit and that of 25 berries selected at random from the harvested fruit was recorded for each plot at every pick. In addition once per week the appearance of the fruit was 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 were available from each plot, fruit was placed in cold store for two days at 3°C. When withdrawn from storage the fruit was assessed using a 1-5 scoring system for:

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

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

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

Throughout the life of the trial, the following additional data was 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, number, spines, height, number, 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.

In spring of 2011 and 2012 vine weevil and two spotted spider mite were problems pre-harvest but both were successfully brought under control. Powdery mildew was not a significant problem but was detected on a few fruits of three cultivars, namely Glen Fyne, CO9 and CO6.

Results

Highlights from 2011 season

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 floricanes 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.

Cowichan produced the highest yield, in part because its floricanes displayed superior bud break, fruiting laterals and flower numbers compared with most of the other main entries.

Tadmor and Glen Fyne also performed well, despite Glen Fyne losing up to 30% of their

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. This was primarily due to the clone of Tulameen used for this trial. A recent HDC funded trial (SF 105) 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.

2012 results

Results of yield and berry weight were recorded at each picking date; data were examined by analysis of variance. Table 7 shows the dates at which each cultivar reached 25, 50 and 75% harvest. Harvest of the earliest varieties started on 18 June with Korpiko, 9911C-1 and CO9 being picked on that date. The earliest guard entry was TulaMagic again on 18 June and 0485K-1 on 22 June.

The latest fruiting cultivars and plant selections were Octavia, Tadmor and Cowichan which all completed their harvest on 10 August. Of the guards 0019E-2 was the latest and also finished on this date

In terms of yield Cowichan and Tadmor produced the greatest volume of fruit with over 2 kg fruit/plant, followed by Korpiko and 00123A7. Glen Doll and Octavia had the lowest yield at 1.0 kg/plant and 1.25 kg/plant respectively. In terms of waste, proportion class one fruit was generally very high, with just CO9, 911C-1 and Korpiko showing less than 80% class one (Figure 2).

Table 7. Harvest data in 2012 for main entry cultivars, with date at which each cv. achieved 25%, 50% and 75% harvest.

Variety	25%	50%	75%	Yield kg/plot	Av. yield kg/plant	% Marketable	Average yield (tonnes per ha)
Glen Fyne	06-Jul	14-Jul	23-Jul	10.83	1.33	91.8	10.3
Tulameen	11-Jul	16-Jul	25-Jul	13.54	1.35	84.3	10.9
Octavia	18-Jul	30-Jul	06-Aug	12.46	1.25	81.6	10.1
Glen Doll	11-Jul	18-Jul	25-Jul	9.99	1.00	90.6	8.1
Korpiko	02-Jul	11-Jul	18-Jul	17.51	1.79	78.3	14.6
Tadmor	16-Jul	23-Jul	01-Aug	20.76	2.08	91.8	16.8
00123A7	14-Jul	20-Jul	30-Jul	16.07	1.61	89.2	13.0
9911C-1	02-Jul	11-Jul	20-Jul	13.08	1.39	73.8	11.5
C06	11-Jul	18-Jul	25-Jul	13.79	1.43	81.8	11.5
CO9	27-Jun	02-Jul	09-Jul	9.01	1.36	72.8	10.8

Cowichan	14-Jul	18-Jul	30-Jul	21.01	2.10	79.9	17.0
		SED(30d.f.)		2.33	0.27	4.31	
		F prob		<0.001	0.006	<0.001	

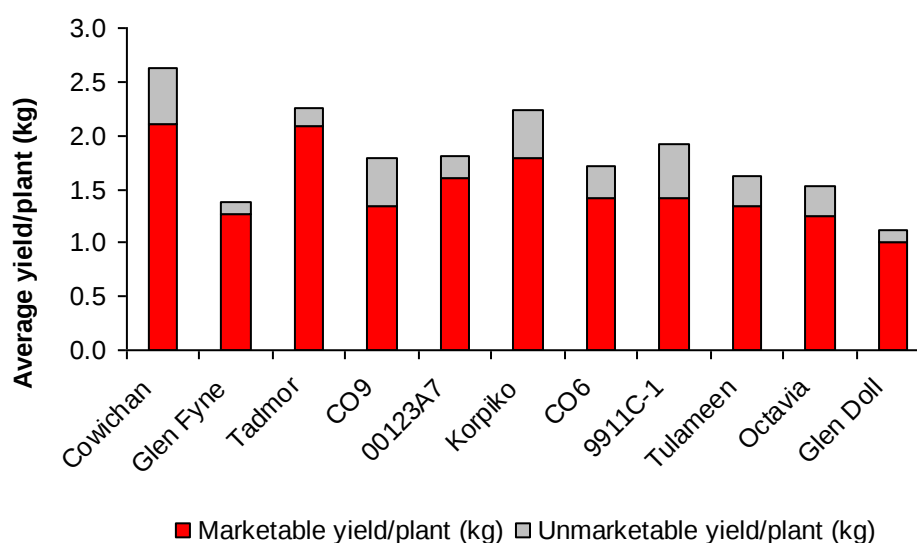


Figure 2. Total average fruit yield per plant and proportion marketable for the main entries over the 2012 season – Rectory Farm, Stanton St John.

Table 8 shows the same data for the guard entries, here TulaMagic, 0485K-1, 0453C4 were early cultivars commencing harvest on 18 June. Cascade Delight, Jeanne d' Orleans and Chemainus were the latest selections finishing harvest on 10 August.

Cascade Delight, Chemainus, 9764F-3 and 0019E-2 showed the highest yields, producing over 2 kg/plant of marketable fruit. Glen Lyon, TulaMagic and 0433F2 produced the lowest yields, below 1 kg/plant. All selections produced over 80% marketable fruit with the exception of Glen Lyon and TulaMagic. Chemainus, 0485K-1, 0433F2 and Jeanne d' Orleans produced very high percentage of marketable fruit.

Table 8. 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%	50%	75%	Yield kg/plot	Av. yield kg/plant	% Marketable	Average yield (tonnes per ha)
Cascade Delight	14-Jul	23-Jul	01-Aug	22.44	2.24	86.6	18.2
Glen Lyon	04-Jul	11-Jul	14-Jul	6.57	0.73	75.2	5.3
Tulamagic	04-Jul	14-Jul	23-Jul	7.42	0.74	76.6	6.0
Chemainus	14-Jul	20-Jul	30-Jul	28.77	2.40	95.2	19.4
Jeanne d'Orleans	18-Jul	23-Jul	30-Jul	16.05	1.60	89.8	13.0
0485K-1	02-Jul	06-Jul	14-Jul	10.88	1.09	91.6	8.8

Variety	25%	50%	75%	Yield kg/plot	Av. yield kg/plant	% Marketable	Average yield (tonnes per ha)
9764F-3	12-Jul	18-Jul	25-Jul	21.23	2.36	85.9	19.1
0019E-2	14-Jul	23-Jul	01-Aug	12.56	2.09	83.3	17.0
0453C4	04-Jul	14-Jul	18-Jul	13.26	1.33	81.8	10.7
0304F6	14-Jul	18-Jul	30-Jul	10.65	1.07	86.5	8.6
0433F2	09-Jul	16-Jul	20-Jul	9.83	0.98	91.1	8.0

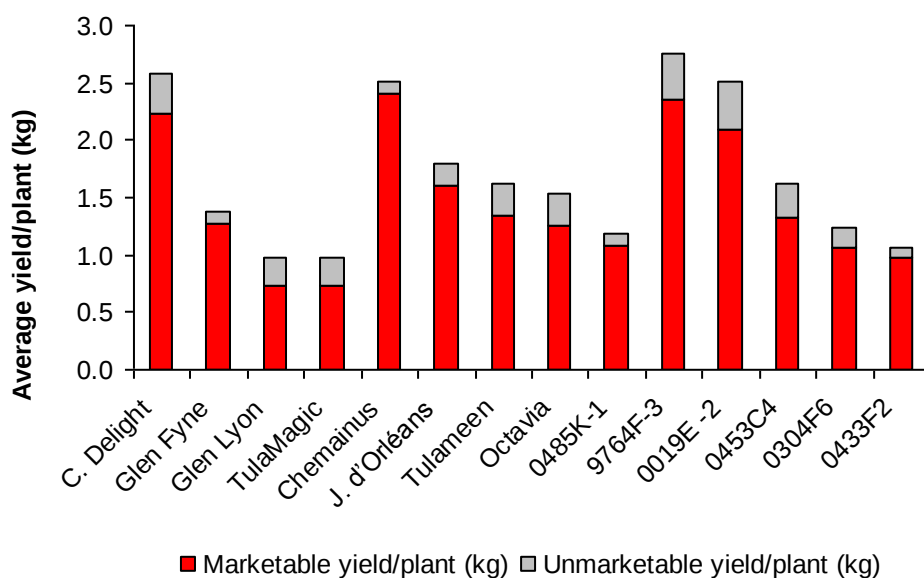


Figure 3. Total average fruit yield per plant and proportion marketable for the guard entries over the 2012 season – Rectory farm, Stanton St John.

Berry weight is displayed in Tables 9 and 10 for the main entries and guard entries respectively. Cowichan and Octavia had consistently the highest berry weight up to 6g/berry ($P = <0.001$ SED 0.21). Korpiko, 00123A7 and 9911C-1 showed the next highest berry weight at around 4-5 g/berry. Lowest berry weight was observed in Glen Doll, CO6 and CO9 down at 3-4 g/berry.

In the guard entries berry weight in Cascade Delight, 0019E-2 and 0485K-1 were comparable to Cowichan. The rest of the varieties showed comparable berry weights of around 4.5 g. The smallest berries i.e. with an average berry weight of 3.5g were produced by Glen Lyon and Jean D'Orleans and 0453C4 with berry weights of respectively of 3.8 & 3.9g.

Table 9. Main entry cultivar berry weights (g) at 25%, 50%, 75% harvest and 2011 season average.

Variety	25%	50%	75%	min	max	season average
Glen Fyne	4.27	4.21	3.47	3.47	4.77	4.06
Tulameen	4.30	4.36	3.42	3.42	5.28	4.23
Octavia	5.05	6.01	5.62	5.05	7.64	5.65
Glen Doll	4.20	3.58	2.95	2.95	4.43	3.63
Korpiko	5.34	5.44	5.02	3.96	5.58	4.89
Tadmor	5.60	4.52	4.82	4.15	6.40	5.06
00123A7	4.97	4.31	4.18	3.36	5.62	4.50
9911C-1	5.02	4.50	3.83	3.78	5.72	4.47
C06	3.76	3.32	2.85	2.52	4.68	3.36
C09	3.09	3.28	3.28	2.67	3.49	3.10
Cowichan	6.51	5.75	5.21	3.32	7.08	5.64
SED (30d.f)						0.21
Fprob						P<0.001

Figure 10. Guard entry cultivar berry weights (g) at 25%, 50%, 75% harvest and 2011 season average.

Variety	25%	50%	75%	min	max	season average
Cascade Delight	6.44	5.52	4.48	4.48	7.00	5.89
Glen Lyon	3.68	3.96	4.08	2.44	4.08	3.52
TulaMagic	4.20	4.40	4.36	3.72	4.64	4.12
Chemainus	4.88	4.56	3.96	3.52	6.04	4.53
Jeanne d'Orleans	4.16	3.32	3.36	3.00	5.72	3.81
0485K-1	6.04	4.92	5.76	3.40	6.04	4.99
9764F-3	4.48	4.48	3.40	3.40	4.76	4.01
0019E-2	6.00	5.20	6.00	5.04	6.64	5.73
0453C4	4.60	3.84	3.48	3.16	4.76	3.91
0304F6	4.12	4.48	3.80	3.24	4.88	4.02
0433F2	5.00	4.64	4.00	3.32	5.00	4.34

When sufficient fruit was available a punnet of marketable fruit 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 assessment. Shelf life was analysed on six occasions. Table 11 shows the average scores attained by the entries during the 2012 harvest. No rotten berries were observed after 48 hours in any variety. Of the main entry varieties Cowichan, Tadmor, Glen Fyne, Octavia and Glen Doll held their texture best and,

along with Glen Fyne and 00123A7, maintained brightest berry appearance. Tulameen and CO6 and CO9 gave the poorest scores (Table 11).

In the guard varieties (Table 12), again no varieties showed any rots after the cold storage, OO19E2, Glen Lyon and Jean d'Orleans showed best berry texture and along with 0304F6, 0453C, Cascade Delight and Chemainus had best berry appearance.

Table 11. 2012 Shelf life assessment data after 48 hours at 3°C - main entries

Main entries	Rotten berries	Texture of berries	Berry appearance
	5 = No rots 1 = More than 5 rotten berries	5 = As picked 1 = Collapsed	5 = Bright 1 = Dull
Glen Fyne	5.0	3.6	4.2
Tulameen	5.0	2.9	3.7
Octavia	5.0	3.8	4.0
Glen Doll	5.0	3.8	4.1
Korpiko	5.0	2.8	3.0
Tadmor	5.0	3.6	3.8
00123A7	5.0	3.3	3.9
9911C-1	5.0	3.0	3.0
CO6	5.0	2.8	3.2
CO9	5.0	2.4	2.5
Cowichan	5.0	3.6	3.9

Table 12. 2012 Shelf life assessment data after 48 hours at 3°C - guard entries

Guard entries	Rotten berries	Texture of berries	Berry appearance
	5 = No rots 1 = More than 5 rotten berries	5 = As picked 1 = Collapsed	5 = Bright 1 = Dull
Cascade Delight	5.0	3.0	3.7
0485K-1	5.0	3.0	3.5
Chemainus	5.0	3.0	3.6
9764F-3	5.0	3.5	3.0
OO19E2	5.0	4.0	4.2
Jeanne d' Orleans	5.0	3.8	4.2
Glen Lyon	5.0	4.0	3.0
0453C4	5.0	3.3	3.7
0304F6	5.0	3.4	3.8
0433F2	5.0	2.2	3.0
TulaMagic	5.0	2.4	2.6

Once a week throughout the harvest the marketable fruit from every plot was examined and its qualities appraised, the average scores for the harvest period of 2012 are given below in Table 13 for the main and in Table 14 for the guard entries.

The fruit of Octavia, 00123A7, and particularly CO6 were rather pale and those of Glen Fyne, Tulameen and Cowichan a bit dark when fully ripe. CO9 was a little dull in colour compared with the other berries. In terms of fruit outline, Tadmor and Korpiko had the most even shape while fruit from Tulameen, CO9 and 9911C-1 was quite irregular.

In terms of berry texture 9911C-1 and Glen Doll had the firmest and Tulameen, CO9 and CO6 the softest texture. The skins of the fruit of Cowichan, Octavia, Glen Doll and Tadmor were the strongest and Tulameen the weakest. Tulameen also showed the lowest berry cohesion. In terms of flavour Glen Fyne, Tulameen and Glen Doll had the best and CO9 the poorest flavour.

Of the guards most berries showed a nice bright red colour with only 0304F6 being a little pale. With the exception of TulaMagic all showed a consistent regular berry shape; TulaMagic, along with 0433F2, showed the softest fruit and the weakest skin strength, which was easily ruptured or led to collapse of fruit soon after picking.

Jeanne d' Orleans and Chemainus had the most cohesive berry structure and 0453C4 and TulaMagic the least and at some stage during harvest both of the latter produced some crumbly fruit.

The best flavoured fruit was produced by Jeanne d' Orleans and Cascade Delight. Glen Lyon had the weakest flavoured fruit; no unpleasant off flavours were detected however with either of these entries.

Table 13. Berry quality assessments - main entry cultivars

Variety / selection	Berry quality (1-5 score)						
	Redness	Brightness	Outline	Texture	Skin strength	Berry cohesion	Flavour
	5= pale 1=dark	5=bright 1=v.dark	5=even 1=v.irreg	5= firm 1=v.soft	5=strong 1=weak	5=whole 1=crumbly	5=v.good 1=v.poor
Glen Fyne	2.98	4.88	4.00	3.39	3.88	4.28	4.20
Tulameen	2.96	4.81	3.04	2.83	3.33	3.54	4.08
Octavia	3.81	4.67	3.78	3.36	4.13	4.01	3.16
Glen Doll	3.00	4.74	4.04	3.79	4.17	4.58	4.27
Korpiko	2.90	4.78	4.12	3.02	3.80	4.70	3.28
Tadmor	3.00	4.88	4.38	3.33	4.00	4.79	3.96
00123A7	3.93	4.68	3.86	3.38	3.70	4.81	3.96
9911C-1	3.00	4.75	3.48	3.96	3.96	3.90	3.91
CO6	4.79	4.74	3.79	2.83	3.88	4.68	3.04

Variety / selection	Berry quality (1-5 score)						
	Redness	Brightness	Outline	Texture	Skin strength	Berry cohesion	Flavour
	5= pale 1=dark	5=bright 1=v.dark	5=even 1=v.irreg	5= firm 1=v.soft	5=strong 1=weak	5=whole 1=crumbly	5=v.good 1=v.poor
CO9	3.22	3.81	3.33	2.53	3.78	4.11	2.11
Cowichan	2.83	4.70	4.00	3.31	4.06	4.61	3.82

Table 14. Berry quality assessments - Guard entry cultivars

Variety / selection	Berry quality (1-5 score)						
	Redness	Brightness	Outline	Texture	Skin strength	Berry cohesion	Flavour
	5= pale 1=dark	5=bright 1=v.dark	5=even 1=v.irreg	5= firm 1=v.soft	5=strong 1=weak	5=whole 1=crumbly	5=v.good 1=v.poor
Cascade Delight	2.63	4.75	4.00	3.00	4.00	4.50	4.13
Glen Lyon	3.00	4.50	3.50	3.50	4.50	4.50	2.25
TulaMagic	2.40	4.40	2.90	2.30	2.80	3.80	3.50
Chemainus	3.00	5.00	4.40	3.20	4.20	5.00	3.60
Jeanne d'Orleans	2.70	5.00	4.20	3.50	4.00	4.80	4.50
0485K-1	3.25	4.00	4.25	3.00	4.00	4.50	3.75
9764F-3	2.60	4.43	3.43	3.43	4.00	4.14	3.57
0019E-2	3.00	4.83	3.83	3.33	3.67	4.17	3.50
0453C4	2.90	5.00	3.33	3.00	4.00	3.90	4.00
0304F6	4.00	4.67	3.67	3.67	4.67	4.33	3.50
0433F2	3.20	4.80	3.50	2.60	3.80	4.00	3.60

Full descriptions of cane habit, management recommendations and pest and disease susceptibilities are shown in Appendix 1 and 2.

Discussion

The trial has identified several main and guard entries of interest to raspberry growers, these are discussed below. Full descriptions of all main and guard entries are displayed in Appendices 1 and 2.

Main entries

9911C-1



Figure 4. 9911C-1

Early fruit production, produced bright attractive fruit, which was cohesive and 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 and produces an adequate number of tall, but rather spreading, spine free canes.

The fruiting laterals are long and require support during harvest, or a high percentage can be expected to break away at their base especially those positioned in the upper half of floricanes.

Variable fruit quality and appearance has meant the JHI have decided not to further develop this advanced selection.

Korpiko



Figure 5. Korpiko

Very early, this cultivars fruit have an attractive appearance, bright, cohesive but are a bit soft and have only a moderate flavour.

The shelf life of the fruit in 2011 & 2012 was poor.

The canes of this cultivar are spiny, of moderate vigour, plentiful in number and not very easy to manage.

Hargreaves Plants Ltd have indicated they are unlikely to continue to market this cultivar.

00123A7



Figure 6. 00123A7

This entry did well in trial in project SF41b. A mid – late mid season cropping selection, produces medium to large pale salmon red fruit, which were a bit variable in shape (primarily blunt conic); fruit 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.

JHI have decided not to proceed further with this selection as they have had variable results with it in trial, also its berry colour is a bit pale.

Cowichan



Figure 7. Cowichan

Throughout its very long harvest this PARC cultivar produced large berries of a consistent shape. Berry size is also retained well through harvest.

The berries were bright, firm, with a moderate to good flavour and shelf life better than Tulameen.

Presentation to the pickers and detachment of fruit from the long laterals of this cultivar when grown under protection was superior to that of Tulameen.

However the length of the laterals of this cultivar when grown under protection can increase the risk of them being damaged by pickers, so lateral supports are recommended for the protected crop which will also substantially improve presentation of fruit to the picker.

Cowichan produces tall very upright and 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 cultivar. Commercial experience has also indicated that it is far less susceptible to foliar & cane diseases, has more winter

hardiness, is later to break bud and therefore less vulnerable to damage during the winter or by spring frosts than Tulameen.

Cowichan exhibits considerable field tolerance to raspberry root rot and its reliability of cropping and production of high yields of well sized fruit makes it a useful cultivar for sites where direct from farm sales are an important market.

Unfortunately the flavour is not as good as that of Tulameen or Tadmor and the appearance and shelf life of the Cowichan berries is not as good as those of Chemainus.

Tadmor



Figure 8. Tadmor

In 2011 the harvest of this entry was completed just before and in 2012 at the same time as Octavia. The performance of this cultivar was very 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, bear some spines but are generally easy to manage.

Tadmor has so far not proved to be particularly vulnerable to cane or foliar diseases, but is susceptible to *Phytophthora* root rot, so on some sites in-substrate production is recommended along with routine fungicide applications to provide protection against this disease.

Tadmor has exhibited considerable commercial potential and several growers who have planted it have been very pleased by its performance to date.

Other selections

The berry quality, size and or yield of marketable fruit produced by the EMR advanced selections CO6 & CO9 was poor so these will not be developed further.

Standard cultivars

Glen Fyne

This performed well in 2011, although the presence of *Phytophthora* root rot infected plants were confirmed in two plots in the late summer of 2010. Further spread of the disease and plant losses in all of the plots of this entry by spring 2012 caused a marked reduction in yield and berry size that summer. However, overall the results from this entry were excellent, its fruit retained their size throughout harvest, were bright attractive, with an excellent flavour, good shelf life, very well presented and easily detached from fruit laterals.

In mid harvest in bright weather the berries did become a little dark, but growers have found that this cultivar can be picked tight i.e. when just ripe without any substantial berry weight or flavour loss but with the benefit of having a berry of the desired appearance at the point of sale. This cultivar is vulnerable to powdery mildew, although this disease was not a problem during the life of the trial, it is very susceptible to raspberry root rot so production on many sites would be best in substrate rather than in open field or glasshouse soil.

Glen Fyne produces, adequate, medium to tall canes, which are spine free and with an upright to spreading habit. They are easy to manage provided that they are kept upright as they grow. The laterals are of medium length, strongly attached and do not require support.

Octavia

The yields in both 2011 & 2012 were much reduced due to cold injury to lower and mid florican buds during the winter (2010-11) or late winter-early spring (2012). In addition in 2012 during the first 8-10 days of the harvest a substantial amount of unmarketable unevenly ripened fruit was picked. This problem was reported as affecting this cultivar on many commercial farms during the early part of the 2012 harvest. As yet the cause has not been identified although the appearance of affected fruit in the case of the trials in project SF 41c appeared to coincide with a change to hot bright sunny weather after a long period of cool overcast and very wet weather.

Tulameen

Berry quality i.e. shape, firmness & size produced by the plants of the plants in the trial was consistently poor. Cane growth was variable and from some plants weak. The source of the

clone for the plants provided by a commercial propagator for the trial is unknown but was not the Tulameen clone held at Naktuinbouw which in HDC SF 105 was shown to produce the best quality of fruit of this cultivar.

Guard entries of particular interest

The following advanced selections & cultivars were found to have considerable potential:

0485K-1



Figure 9. 0485K-1

This was exceptionally early fruiting and so could be considered as a replacement for Glen Lyon and Glen Moy.

It produces attractive, evenly set, conic, cohesive fruit with a very good flavour. Fruit is well displayed to pickers on medium to very long laterals.

The canes of this selection are spine free, plentiful and upright to spreading in their habit.

This selection is known to be susceptible to *Phytophthora* root rot, but in trial in project SF 41c, neither this nor any foliar or cane diseases were noted as being a problem.

JHI and the UK Raspberry Breeding Consortium have decided to trial this selection further, it has therefore been proposed as a main entry for the new trials in the new project SF41d.

0019E2



Figure 10. 0019E2

This had a very late harvest and so is definitely being considered as a replacement for Octavia.

In addition it consistently produces very large firm cohesive, attractive bright fruit with a moderate flavour (but superior to that of Octavia) and has an excellent shelf life.

Canes are very tall, upright in habit, spine free, adequate in number, medium to long, ascending laterals which present fruit well to pickers.

In 2012 a high number of buds in the lower–mid region of floricanes failed to break bud. The reason for this is at unknown, although cold injury around bud break may be implicated.

In trials at JHI it would appear that this cultivar may require considerable chilling (as per Glen Ample) to ensure even bud break and flower lateral production down the full length of the floricanes.

Also in 2012 due to the unevenness of bud break and lateral production, at harvest the laterals were longer and more susceptible to being broken away from their base by pickers during harvest. Lateral support is likely to be required for this cultivar.

At the SF 41c open day there was considerable grower interest in this selection and trial results elsewhere have led to JHI and the UK Raspberry Breeding Consortium deciding to develop this selection further, it has therefore been selected as a main entry for the new project SF 41d.

Cascade Delight



Figure 11. Cascade Delight

This consistently produced high yields of marketable, 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 variety is in the open during harvest. The fruit is so easily damaged by rain or by strong winds when it is close to ripeness or is actually ripe that this cultivar is best suited to tunnel production.

Although primarily of interest for PYO, farm shop and local market sales, the good flavour, excellent berry shape and size led to the submission of samples of fruit for this cultivar along with those of Glen Fyne and Cowichan to two supermarkets during the 2012 harvest for their appraisal. Further fruit samples will be submitted to determine their suitability for fresh fruit supermarket sales in 2013.

The primocane of Cascade Delight is very tall (never less than 1.8 m) upright to spreading, with some spines but generally pleasant to handle, fruiting laterals long to very long, and bow over without support obscuring fruit from picker.

Lateral support is recommended therefore for this cultivar be it planted in the open or provided with protection during most of its growing season.

Because of its strong growth, additional space between rows is recommended to facilitate tractor and later picker access in the plantation.

Cascade Delight can exhibit considerable field resistance to *Phytophthora* root rot, but can succumb to this disease. In addition the fruit and canes are susceptible to *botrytis*.

Jeanne d' Orleans



Figure 12. Jeanne d'Orleans

This is a mid-season fruiting cultivar from Quebec. The berries have very distinct aromatic sweet deep 'raspberry' flavour, are a mid-dark red in colour, very bright and attractive both 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 or Octavia and on a par with that of Glen Fyne.

Canes are adequate in number, tall, upright to spreading and bear very noticeable spines, and although these do not hamper picking, they do make cane management, at least of young plants, very unpleasant.

Fruiting laterals are medium to long, ascending in habit, very strongly attached and present fruit well to the picker.

Although unlikely to become a widely planted commercial cultivar the exceptional flavour of the fruit of this cultivar may provide it with a place in niche markets where this attribute is a major consideration e.g. processing, jams, coulis, juices, 'Individual Quick Freeze' (IQF) mixed fruit packs for supermarkets & food manufacturing.

Meiosis has the marketing rights to this cultivar in the UK and have indicated that they may develop it further at least for fruit production by amateurs.

Chemainus



Figure 13. Chemainus

With mid-season cropping this cultivar, like Cowichan, was a promising guard in HDC project SF 41b. However it proved to be *Phytophthora* susceptible and succumbed to root rot before the end of the trial.

In trial in project SF 41c it has consistently produced very bright attractive and very firm fruits of moderate flavour and size. These were of a very regular shape, very cohesive, well displayed to the picker and easily detached.

The plant habit of this cultivar was very similar to that of Cowichan, with tall upright canes bearing a few spines, adequate in number and very easy to manage when compared to Tulameen.

No foliar, fruit or cane disease problems were noted as affecting this variety during the trial and unlike some other entries spring frost or winter cold injury did not affect its floricanes, with bud break in both 2011 & 2012 down more or less the whole length of canes.

Other selections/cultivars

Although there was some interest in the selection **0453C4**, JHI and the UK Raspberry Breeding Consortium have decided to delist this and the other JHI selections which were

guards in this trial. Similarly the trial has shown that ***Tula Magic*** has no commercial value in the UK.

Conclusions

The potential of three summer fruiting raspberry varieties (Glen Fyne, Tadmor and Cowichan) for UK growers was confirmed in this trial and four further guard entries were identified as very promising selections.

- The results achieved by Tulameen, Glen Doll and Octavia in terms of yield and berry quality were disappointing in both 2011 and 2012
- Glen Fyne, Tadmor and Cowichan from the main entries and Jean d'Orleans, Chemainus and Cascade Delight from the guards show great potential and are suitable for UK production and are available to plant
- 0485K-1 and 0019E-2 were very promising selections and will be trialled further as main entries in subsequent varieties trials including the new project SF41d
- Korpiko showed some promise as an early variety, but the berries' poor flavour mean that it is unlikely to continue to be marketed in the UK
- The James Hutton Institute's 9911C-1 performed well in 2012 but this advanced selection along with 00123A7 and the other coded guards (0453C4, 9764F3, 0304F6 and 0433F2) included in the trials will not be developed further and will therefore not become available to the industry
- TulaMagic consistently produced, on both flori & primocane, fruit of poor quality and was shown to have limited commercial value in the UK.
- CO6 and CO9 showed poor quality, size and or yield of marketable fruit and will not be developed further.

Technology transfer

Open day 5 July 2011

Presentation at the HDC/EMR members' day in December 2011

Input to an item on UK Raspberry breeding trials (at JHI and SF41c) written by HDC for the HDC Soft fruit review in December 2011

Summer fruiting raspberry factsheet 2011

Open day 12 July 2012

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 of large raspberry aphid, resistant to cane <i>Botrytis</i> , 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 of large raspberry aphid, resistant to cane <i>Botrytis</i> , moderately resistant to spur blight, midge blight & cane spot. Susceptible to <i>Phytophthora</i> . 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 floricanes in 2012	Resistant to biotypes 1-4 large raspberry aphid. Susceptible to <i>Phytophthora</i> 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 in 2011, better in 2012, appears to be prone to frost damage post Christmas	Resistant to biotypes 1-4 large raspberry aphid. Spur blight lesions noted on floricanes in early 2013

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 floricanes) in 2011 & 2012.	Resistant to biotypes 1-4 large raspberry aphid. Susceptible to <i>Phytophthora</i> 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. Lateral support does not appear to be necessary	Susceptible to <i>Phytophthora</i> root rot. The floricanes of Tadmor were found to be free of cane <i>Botrytis</i> , spur blight & cane blight in February 2013

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 and do not appear to require any support, leafy canopy. Variable bud break from base to middle of floricane in some years	Resistant to biotypes 1-4 large raspberry aphid, very susceptible to <i>Phytophthora</i> & to powdery mildew. The floricanes of Glen Fyne were found to be free of cane <i>botrytis</i> , spur blight & cane blight in February 2013
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 <i>Botrytis</i> , spur blight & cane spot. Susceptible to <i>Phytophthora</i>
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 <i>Phytophthora</i> . Cane <i>Botrytis</i> and spur blight affecting base to middle of majority of floricane in February 2013

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 <i>Phytophthora</i> . The floricanes of Chemainus were found to be free of cane <i>Botrytis</i> , spur blight & cane blight in February 2013
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 <i>Botrytis</i> , spur blight & <i>Phytophthora</i> . Cane <i>Botrytis</i> lesions affecting most floricanes from base to middle in February 2013
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. Floricane free of <i>Botrytis</i> , spur & cane blight in February 2013
9764F-3	Mid – late	3.6 – 5.2	Conic some variation in fruit shape & drupelet size. 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, berry size poor in 2012	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 <i>Botrytis</i> Good tolerance to <i>Phytophthora</i>
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	Florican free of <i>Botrytis</i> , spur & cane blight in February 2013
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. Cane <i>Botrytis</i> lesions affecting most florican from base to middle in February 2013

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

Appendix 4 – 2012 Raw data and plot details

	Variety	Plots	No. plants cropping	Total yield for each treatment (4 plots) or per guard (1 plot) (kgs)			Marketable berries only	
				Marketable	Waste	Total	Average yield per plant (kgs)	Average yield per treatment or guard (tonnes per ha)
Main entries	Glen Fyne	9,20,23,29	34	43.3	3.7	47.0	1.3	10.3
	Tulameen	8,22,31,35	40	54.1	10.8	64.9	1.4	10.9
	Octavia	10,15,28,42	40	49.9	11.3	61.2	1.2	10.1
	Glen Doll	4,21,33,36	40	39.9	4.2	44.2	1.0	8.1
	Korpiko	7,16,29,44	39	70.1	17.4	87.4	1.8	14.6
	Tadmor	11,19,25,41	40	83.1	7.3	90.3	2.1	16.8
	00123A7	2,17,26,43	40	64.3	7.9	72.2	1.6	13.0
	9911C-1	3,13,32,37	37	52.3	18.4	70.7	1.4	11.5
	CO6	1,18,30,40	39	55.1	12.0	67.2	1.4	11.5
	CO9	5,14,24,38	27	36.0	11.7	47.8	1.3	10.8
	Cowichan	6,12,27,34	40	84.0	21.2	105.2	2.1	17.0
Guards	Cascade Delight		10	22.4	3.5	25.9	2.2	18.2
	Glen Lyon		10	6.6	2.2	8.7	0.7	5.3
	TulaMagic		10	7.4	2.3	9.7	0.7	6.0
	Chemainus		12	28.8	1.4	30.2	2.4	19.4
	Jeanne d'Orleans		10	16.0	1.8	17.9	1.6	13.0
	0485K-1		10	10.9	1.0	11.9	1.1	8.8
	9764F-3		9	21.2	3.5	24.7	2.4	19.1
	0019E-2		6	12.6	2.5	15.1	2.1	17.0
	0453C4		10	13.3	2.9	16.2	1.3	10.7
	0304F6		10	10.7	1.7	12.3	1.1	8.6
	0433F2		10	9.8	1.0	10.8	1.0	8.0
Total (tonnes) >				0.8	0.1	0.9	1.8	14.3