Project Title	Evaluation of a Range of Plum Rootstocks
Project Number:	TF 157
Project Leader	Don Vaughan, Farm Advisory Services Team Ltd., Crop Technology Centre, Brogdale Farm, Faversham, Kent, ME13 8XZ.
Report:	Final Report, December 2009
Previous Reports	First Year Report 31st December 2005 Second Year Report 31st December 2006 Third Year Report 31st December 2007 Fourth Year Report 31st December 2008
Key Staff	Don Vaughan Gary Saunders (2004 – 2008) James Carew (2009)
Location of Project	Gaskains Ltd, Norham Farm, Selling, Kent, ME13 9RL. E.S & L.E Dawes, Mount Ephraim, Hern Hill, Kent, ME13 9TX.
Project Coordinator	N/A
Project commenced:	1st April 2004
Project Completion:	31st December 2009
Key Words:	Plum, Opal, Victoria, Jubileum, Marjorie's Seedling, rootstock

Contents

Grower Summary

Headlines

Plumina offers a dwarfing rootstock that can increase fruit numbers on Jubileum, Marjorie's Seedling and Opal.

Background and expected deliverables

The plum rootstock St. Julian A has been used as the industry standard for many years. Because of the inherent vigour it confers to the scion variety, pruning and training is required to maintain consistent cropping. There are a number of other shortcomings of this rootstock which include the need for careful tree management to achieve adequate tree control, lack of precocity and moderate fruit size.
The two new rootstock introductions Ishtara and Plumina offer potential improvements over some or all of these shortcomings. A further rootstock, Pixy, has seen limited use on established varieties and needs testing to determine its potential benefits. Previous research has been limited to the continent where results have been variable, depending on geographical location and scion variety. Based solely on the published literature, it is not possible to adequately classify the effects of these rootstocks, particularly under UK conditions.

This project was commissioned to examine the differences between the rootstocks Plumina, Pixy, Ishtara and St. Julian A under UK conditions and to determine their effect on the four main plum varieties grown in the UK (Opal, Victoria, Jubileum and Marjorie's Seedling). The effect of pruning and training system on the fruiting of the four test varieties on the rootstocks Plumina, Pixy, Ishtara and St. Julian A was also investigated.

The commercial objectives of this project are to:

- Provide practical recommendations on best rootstock/variety combinations.
- Provide practical recommendations on best pruning and tree training methods.
- Provide an idea of expected yields in the initials years of an orchard with varieties grown on these rootstocks.

Summary of the project and main conclusions

Fruit number and size was recorded over the duration of the project from 2004 to 2009. In the final year of the project, shoot growth was recorded to determine relative vegetative vigour of each rootstock.

The effect of pruning and training treatment was inconsistent across all varieties. In addition, the effect differed between years.

In general, Plumina produced a greater fruit size than the other rootstocks. The exception to this was where the rootstocks were grafted onto Marjorie's Seedling. Here the difference between rootstocks was less clear.

There was a clear relationship between fruit number and fruit size whereby the fruit size decreased with increased fruit number. This relationship was of the form y=a+bx+cx2 where x is the fruit number and y is fruit size. This relationship is only valid for the range of fruit numbers observed here though.

The effect of rootstock on vegetative growth is clear. Pixy and St. Julian A had a similar level of vigour whereas Plumina was very much more dwarfing than either Pixy or Plumina. The effect of rootstock did vary slightly between scion varieties particularly for Pixy.

The following table summarises the data in a usable format and compares the characteristics of the rootstocks. However, the effect of rootstock cannot be easily classified. Over the course of the project, fruit number varied between 0 fruit per tree and 600 fruit per tree. This was affected by weather, growth, variety and biennial characteristics, as well as by rootstock. Growth was affected by as many factors again. The data shown below must therefore be used only as a guide. This is particularly the case with fruit size which was significantly affected by fruit number.

Rootstock	Pixy	Plumina	St. Julian A
Growth	Vigorous	Dwarfing	Semi-vigorous
Fruit number	Low	High	Medium
Fruit Size	Medium	Large	Medium

Financial benefits

The selection of correct rootstocks is critical to the viability of a plum orchard. In this trial, there were yield increases with the use of Plumina. However, the extent of this increase varied and so it is impossible to calculate reliable financial benefits.

Action points for growers

- Choosing the correct rootstock at an early stage when planning new orchards is critical. Alternatives to the standard rootstocks must be considered.

- The use of the rootstock Plumina with Jubileum, Marjorie's Seedling and Opal will improve fruit number. This may be seen as a benefit in years where fruit number is generally low but a disadvantage in years where fruit number is high, as thinning may be required.

- Plumina is a more dwarfing rootstock than the other rootstocks tested. Pixy is less dwarfing for Marjorie's Seedling than St. Julian A.

- Thinning fruit is usually necessary. Fruit number can be used as a measure to determine fruit size and thinning to particular fruit numbers can achieve a particular fruit size.

Science Section

Introduction

The rootstock Pixy is described as a dwarfing rootstock selected from seedlings of *Prunus insititia* St. Julien d'Orleans types. Pixy was evaluated and tested by East Malling Research Station and was found to be a dwarfing plum rootstock which induces more precocious fruiting than St. Julian A. Heavy crops are borne early in the tree's life and fruit thinning may be necessary in certain seasons to maintain good size on the heavy bearing trees (Beakbane, 1977). Kosina (2004) also found Pixy to be dwarfing but found it to yield less than the rootstocks to which it was compared. In other work though, the size of tree did not differ between Pixy and St. Julian A. The relative yields differed depending on variety with only Reeves responding well to Pixy when compared to St. Julian A (Meland and Moe, 2007). Pixy is a truly dwarfing rootstock for both plums and gages, producing trees half to two-thirds the size of trees on St. Julian A. It induces precocious and regular cropping but often reduces fruit size slightly (Webster, 1981). Meland, M. and Frøynes, O. (2006) found that Opal trees produced on Plumina were smaller but also produced a smaller crop than the same variety on St. Julian A. However, in reviewing current rootstocks Webster (2002) also reported that Ferlenain (Plumina) produced fruits of very good size and has vigour slightly less than Pixy in many situations (Webster, 2002). The other main rootstock is the Russian VVA1 which in trials on Opal in Holland significantly out yielded St. Julian A. In addition the dwarfing effect of VVa1 was significant (Balkhoven-Baart and Maas, 2004). Problems with propagation have limited its availability.

The plum rootstock St. Julian A has now been used as the industry standard for many years. It is very vigorous and needs stringent vigour control to maintain regular cropping, especially for the more vigorous varieties. There are however a number of shortcomings for this rootstock including the need for expensive tree management and/or growth regulators to achieve adequate tree control, lack of precocity and moderate fruit size.

The new rootstock introductions, Ishitara and Plumina, offer improvements in some or all of these areas and on the continent have been shown to have better crown volume to yield ratios than St. Julian A. Pixy has seen limited use on established varieties and may have benefits with new introductions.

Previous work has clearly described the varying characteristics of the rootstocks included in this project. The effect of the rootstock does seem to vary between scion varieties. The work outlined above was conducted in different parts of Europe and so it seems likely that the different climates will have affected the results. Based solely on the literature, it is not possible to classify the effects definitively. The reason this project was conducted was to examine the differences between the rootstocks Plumina, Pixy, Ishtara and St. Julian A under UK conditions and to determine their effect on the four main Plum varieties grown in the UK (Opal, Victoria, Jubileum and Marjorie's Seedling).

One further factor which will affect the growth and production characteristics of the rootstocks is the pruning and training system. A system which encourages a limit on vegetative growth will mask the dwarfing effect of the rootstock. For this reason the project

described here aimed to determine the effect or training on the fruiting of the four test varieties on the rootstocks Plumina, Pixy, Ishtara and St. Julian A.

The commercial objectives of this project are to:

- Provide practical recommendations on best rootstock/variety combinations.
- Provide practical recommendations on best pruning and tree training methods.
- Provide an idea of expected yields in the initials years of an orchard with varieties grown on these rootstocks.

Materials and Methods

This trial was conducted at Gaskains Ltd, Norham Farm, Selling, Faversham, Kent by kind permission of Charles Gaskain and at E.S & L.E Dawes, Mount Ephraim, Hernehill, Faversham, Kent by kind permission of Sandys Dawes. The location of the trial trees was within 5 orchards on the above farms. The orchards having soil of the following types and tree combinations:

Cage

Soil Type:	Silty Clay Loam
Rootstocks:	Pixy, Plumina & St. Julian A
Variety:	Marjorie's Seedling

Green Lane

Soil Type:	Silty Clay Loam
Rootstocks:	Pixy, Plumina & St. Julian A
Variety:	Jubileem

Orchards

Soil Type:	Sandy Loam
Rootstocks:	Ishtara
Variety:	Opal

Rhode Court

Soil Type:	Silty Clay Loam
Rootstocks:	Plumina & St. Julian A
Variety:	Victoria

Shottenden

Soil Type:	Silty Clay Loam
Rootstocks:	Pixy, Plumina & St. Julian A
Variety:	Marjorie's Seedling

For each treatment 5 trees of each variety and rootstock combination were planted in Autumn 2002. Pruning and training treatments were superimposed over the above variety/rootstock combinations. These treatments included control, pruned, pruned & cracked and pruned & tied.

- **Pruned**: Large unnecessary units removed, vertical shoots removed
- **Pruned and cracked**: Large unnecessary units removed, vertical 1 year shoots cracked to below horizontal

- **Pruned and tied**: Large unnecessary units removed, vertical 1 year shoots required for fruiting tied to below horizontal

These treatments were imposed at the time of planting. For Ishtara, only one scion variety was available (Opal). This was planted on a separate farm. It is therefore very difficult to draw comparisons between the Ishtara and the Pixy and St. Julian A rootstocks as any effects will be due to location as well as rootstock.

The project began in 2002 and ran for a total of 7 years until 2009. Each year fruit number and size was recorded for each plot. In addition, in 2009 shoot length was recorded.

Due to the nature of the planting plan, it has not been possible to conduct rigorous statistical analysis of data and so only indications of significance of effects can be inferred.

Results and Discussion

Effect of rootstock on fruit number per tree

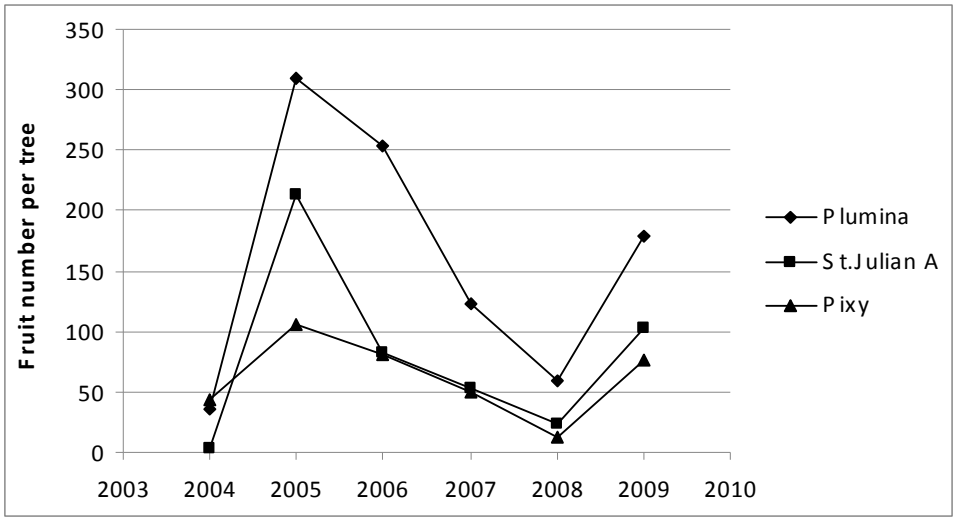

Figure 1. The effect of rootstock on number of fruit produced per tree of the variety Marjorie's Seedling from 2004 to 2009.

The effect of rootstock on the number of fruit produced by Marjorie's Seedling over the duration of the project is shown in Figure 1. During 2004 relatively few fruit were produced by trees on any of the rootstocks, with fruit number per tree being less than 50 fruit. In 2005 however, there were large differences between the numbers of fruit produced by trees on the different rootstocks. Trees on Plumina produced the greatest number of fruit followed by St. Julian A and Pixy. In 2006 and 2007 Plumina did cause more fruit to be produced than the other rootstocks but the fruit number of trees on St. Julian A and Pixy were similar. It is of note that the fruit number showed a consistent decline from 2005 to 2008 when there were very few plums produced at all.

There is clear evidence here that Plumina does have the potential to cause Marjorie's Seedling to produce a greater yield than either of the other two rootstocks as long as fruit size can be maintained.

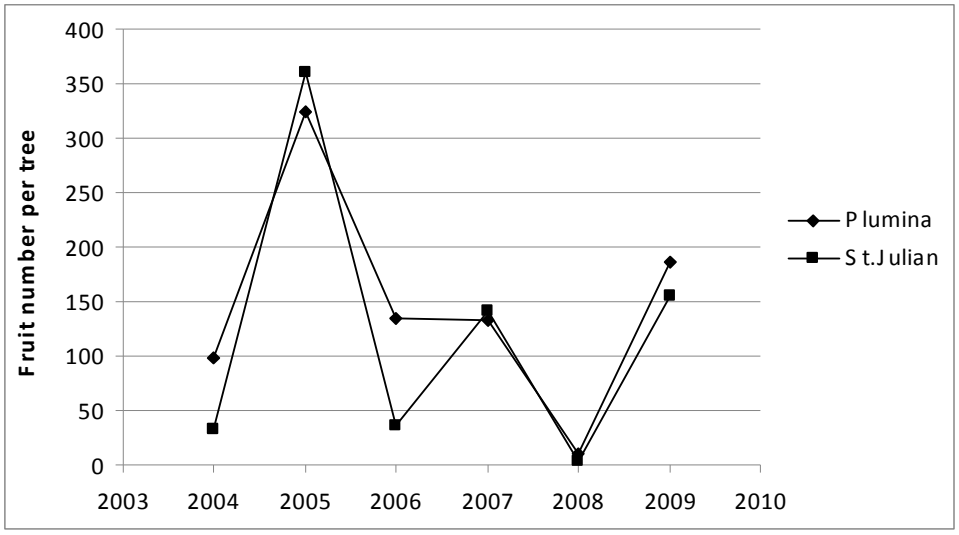

Figure 2. The effect of rootstock on number of fruit produced per tree of the variety Victoria from 2004 to 2009.

Figure 2 shows the effect of the two rootstocks Plumina and St. Julian on the fruit number per tree produced by Victoria. There is considerable variation in fruit number from year to year with fruit number showing a marked biennial pattern. This may not be internally controlled, 2008 in particular being determined by the weather. There is little or no difference between fruit number of trees on Plumina and St. Julian A.

This is very different to the effects seen for Marjorie's Seedling where the difference between these two rootstocks was significant with Plumina causing a significant increase in fruit number. For Victoria, there was very little difference in fruit number between rootstocks.

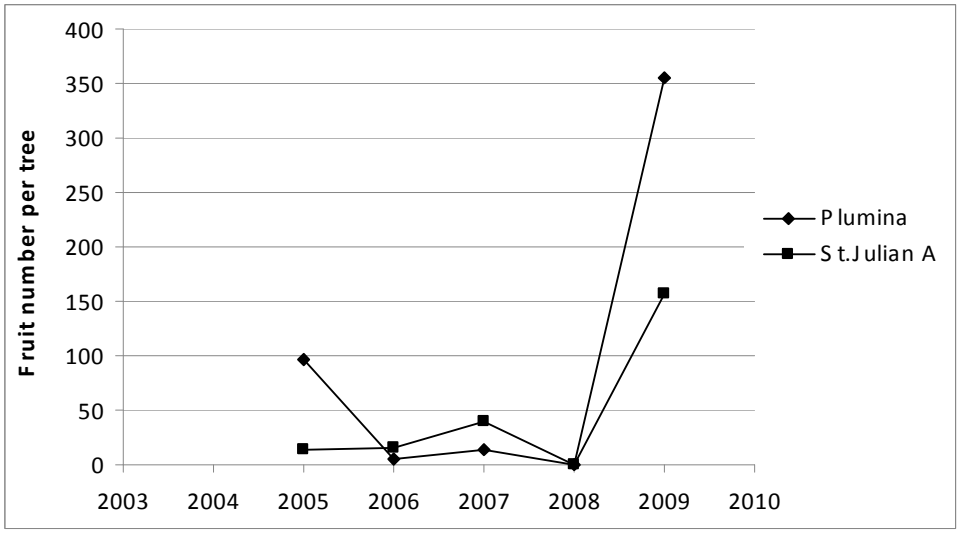

Figure 3. The effect of rootstock on number of fruit produced per tree of the variety Opal from 2004 to 2009.

The effect of rootstock on the number of fruit produced by Opal on the two rootstocks is shown in Figure 3. Between 2006 and 2008, the fruit number produced by each tree is relatively low with fruit number generally varying between 0 and 50 fruit per tree. In 2009

there was a massive increase in fruit number with averages of 350 fruit for Plumina and 150 fruit for St. Julian A. In 2009 Plumina produced significantly more fruit than the trees on St. Julian A.

It is possible that from 2006 to 2008 the reason that Plumina did not cause a greater number of fruit to be produced was simply tree to tree variation. Where the fruit numbers were larger in 2005 an 2008, trees on Plumina did cause a greater number of fruit to be produced.

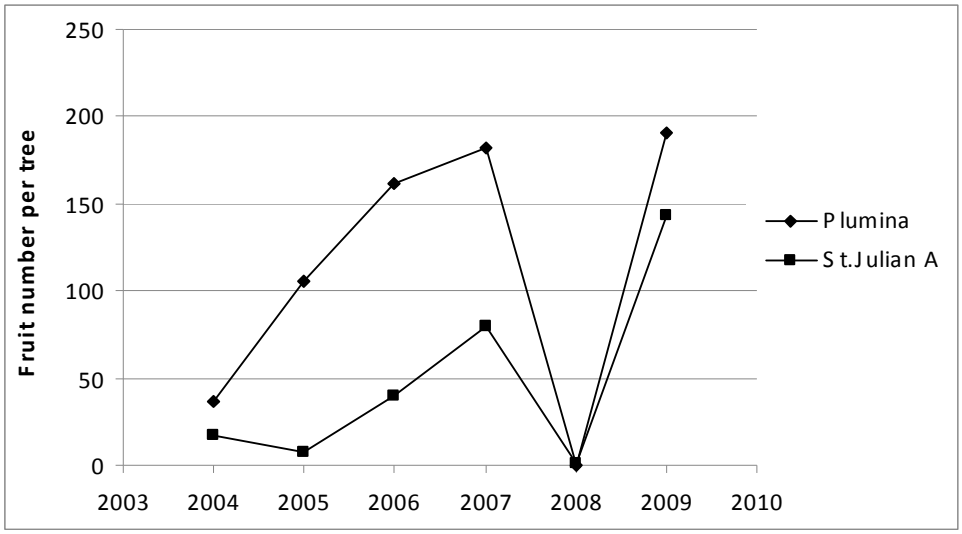

Figure 4. The effect of rootstock on number of fruit produced per tree of the variety Jubileum from 2004 to 2009.

Figure 4 shows the effect of rootstock on the number of fruit produced by Jubileum on the two rootstocks Plumina and St. Julian A. There is a general trend of increasing fruit number between 2004 and 2009 with 2008 being the exception when fruit number was very low. Plumina consistently caused Jubileum to produce more fruit than St. Julian A with differences of up to 100 fruit per tree.

There is certainly a common effect whereby trees on Plumina generally produced a greater number of fruit than those on Pixy or St. Julian A. Where this was not the case, overall fruit number was generally low. This contrasts with work carried out in Norway which showed Opal trees on Plumina producing a smaller crop than St. Julian A (Meland and Frøynes, 2006). It is likely that the different soil and climate conditions may have affected this result as well as the training and pruning treatments carried out in this work.

Effect of pruning and training treatments on fruit number per tree
Marjorie's Seedling on Pixy

	2004	**2005**	**2006**	**2007**	**2008**	**2009**
Control	43.2	105.8	80.2	49.8	12.6	76.8
Snaked & tied	31.4	163	314.8	31	9.0	83
Snaked & pruned	43.2	144.8	396	27.8	12.2	77.6
Snaked, pruned & cracked	37.6	126.4	339	41	13.3	104.1

Table 1. The effect of pruning and training system on fruit number per tree for Marjorie's Seedling on the rootstock Pixy.

Table 1 shows the effect of pruning treatment on the fruit number per tree for Marjorie's Seedling on the rootstock Pixy. During 2004 there was no effect of treatment on fruit number. During 2005, only the tied trees produced significantly more fruit than the control trees but in 2006 there was a significant increase in fruit number in all the pruning/training treatments. Fruit number increased from 80 to over 300 fruit per tree with pruning and training. In the last three years of the project, there was no significant difference between the control trees and the pruning/training treatments. There was no consistent effect of pruning and training system on fruit number.

Marjorie's Seedling on Plumina

	2004	**2005**	**2006**	**2007**	**2008**	**2009**
Control	35.4	309.4	252.8	122.6	58.6	179.2
Snaked & tied	42.6	166	340	48	40.0	200.2
Snaked & pruned	47.8	214.2	298.4	63.8	37.0	114.4
Snaked, pruned & cracked	23.6	193.8	340.2	57.4	53.0	126.8

Table 2. The effect of pruning and training system on fruit number per tree for Marjorie's Seedling on the rootstock Plumina.

The effect of pruning treatment on the fruit number per tree for Marjorie's Seedling on the rootstock Plumina is shown in Table 2. During 2004, there was no effect of the pruning/training treatments on fruit number. However, in 2005 the treated trees produced about 100 fruit per tree less than the control trees, fruit number falling from more than 300 per tree to less than 200 per tree in two of the treatments. In 2006 the opposite was the case with fruit number being significantly higher in all the pruning/training treatments than in the control. In 2007 the fruit number per tree was generally lower than 2006 suggesting that the high fruit number in 2006 caused a reduction in flowering and fruiting in 2007. In 2008 there was no effect of treatment primarily because of the extremely low fruit number but in 2009 the trees which had been pruned produced a much lower fruit number. Again there was no consistent difference between the effects of the pruning treatments.

Marjorie's Seedling on St. Julian A

	2004	**2005**	**2006**	**2007**	**2008**	**2009**
Control	2.4	212.6	82.4	52.8	23.2	103
Snaked & tied	11.2	157.4	292.6	89.2	18.8	85.6
Snaked & pruned	4.4	175.6	409	56	12.2	97.4
Snaked, pruned & cracked	0.6	147.2	266.2	97.4	20.8	143.4

Table 3. The effect of pruning and training system on fruit number per tree for Marjorie's Seedling on the rootstock St Julian A.

The effect of the treatments on Marjorie's Seedling on the rootstock St. Julian A is shown in Table 3. In 2004, fruit number was very low and the difference between treatments was not consistent. In 2005, the pruning/training treatments generally caused a reduction in fruit number. However, in 2006 and 2007 a significant increase in fruit number was observed in the pruning/training treatments, the increase being as much as 300 fruit per tree in 2006 but only 40 fruit per tree in 2007. In 2008 the fruit number per tree was very low ranging between 12 and 23 fruit per tree. In 2009 the fruit number per tree varied depending on treatment but there was no overall trend.

Victoria on Plumina

	2004	2005	2006	2007	2008	2009
Control	98.6	323.6	134.2	133.4	9.8	187
Cut leader & pruned	212.6	284.8	332.8	205.6	9.2	257
Snaked, pruned & cracked	206	321.5	272	162.8	5.8	187.2
Snaked, tied & cracked	190.4	281	330.2	155.6	4.2	175.2

Table 4. The effect of pruning and training system on fruit number per tree for Victoria on the rootstock Plumina.

In 2004 there was a significant effect of pruning/training treatment on fruit number (Table 4). Fruit number increased by around 100 fruit per tree in the treated trees. However, in 2005 there was a decrease in fruit number per tree. In 2006, all treatments caused significant increases in fruit number when compared to the control trees, with the difference being as much as 200 fruit per tree. In 2007 however, only the pruned trees produced a significantly higher number of fruit, overall fruit number was lower in 2007 than in 2006. Fruit number in 2008 was very low in all treatments with fruit number varying between 4 and 9 fruit per tree.

Victoria on St. Julian A

	2004	2005	2006	2007	2008	2009
Control	33.4	360.2	36.4	140.6	3.8	155
Cut leader & pruned	66.6	235.8	219	154.2	3.8	170.6
Snaked, pruned & cracked	73	197.5	265.5	60.8	2.4	182
Snaked, tied & cracked	60.4	276.4	158.2	225	3	157.8

Table 5. The effect of pruning and training system on fruit number per tree for Victoria on the rootstock St. Julian A.

The effect of pruning and training system on Victoria on St. Julian A is shown in Table 5. The first three years of the project saw significant variation in fruit number in the control treatments being 33 fruit per tree in 2004, 360 fruit per tree in 2005 and 36 fruit per tree in 2006. This affected the difference between the control trees and the treated trees. In 2004 the effects of all three pruning and training treatments resulted in higher fruit numbers for the treated trees. Fruit number was increased by around 30 fruit in all treatments. Conversely in 2005 fruit number was reduced by treatment. In 2006 there was a significant increase in fruit number in all treatments, increasing by more than 100 fruit per tree in all treatments. Thereafter, there was no consistent effect of pruning and training.

Opal on Plumina

	2005	2006	2007	2008	2009
Control	95.8	4.6	13.8	0	355.8
Snaked, cracked & twisted	109	34.6	136	0.6	511.4
Snaked & tied	213.4	42.4	178.6	0	569.8
Cut leader, cracked & twisted	166.8	55	198.6	0.4	623.4
Cut leader & tied	124.4	44.2	116.2	0	492.8
Snaked & pruned	204.8	40	171.6	0.6	576.6

Table 6. The effect of pruning and training system on fruit number per tree for Opal on the rootstock Plumina.

There were consistent effects of pruning and training treatments on fruit number of Opal on Plumina (Table 6). Pruning and training treatments caused a consistent increase in fruit number across all years of the project. The only year where this was not the case was 2008 and in this year the fruit number was very low indeed, actually averaging less than one fruit per tree in all treatments. A clear biennial fruiting pattern can be seen with fruit number alternating between years in all treatments.

Opal on St. Julian A

	2005	**2006**	**2007**	**2008**	**2009**
Control	14	16	39.6	0.2	156.6
Snaked & tied	36.6	21.6	71.8	0.8	337
Snaked, pruned & cracked	24.6	16.2	79.4	0.2	316.8

Table 7. The effect of pruning and training system on fruit number per tree for Opal on the rootstock St. Julian A.

The effect of pruning and training treatment on fruit number in Opal on the rootstock St. Julian A is shown in Table 7. There was a consistent effect of pruning and training treatment whereby the treated trees produced a greater number of fruit than the control in all years except 2008 where the fruit number across all trees was very low.

Jubileum on Plumina

	2004	**2005**	**2006**	**2007**	**2008**	**2009**
Control	36.8	105.5	162.0	182.0	0.0	190.5
Snaked, pruned & cracked	29.0	41.8	103.5	142.5	0.3	113.0
Snaked, pruned & tied	50.6	84.8	121.0	192.3	0.3	207.8
Snaked & pruned	39.8	101.8	135.7	254.7	0.3	196.7
Cut leader, pruned & cracked	12.0	48.0	81.0	153.2	0.4	132.0
Cut leader & tied	9.0	94.4	93.3	143.5	0.8	211.0

Table 8. The effect of pruning and training system on fruit number per tree for Jubileum on the rootstock Plumina.

The effect of pruning and training treatment on the fruit number of Jubileum on the rootstock Plumina is shown in Table 8. In general there was no consistent effect of treatment on fruit number except that in 2005 and 2006 fruit number was generally lower in the treated trees than the control trees.

Jubileum on St. Julian A

	2004	**2005**	**2006**	**2007**	**2008**	**2009**
Control	17.25	8	40	79.8	1.2	143
Snaked, pruned & cracked	22.4	79.4	119.8	283	0.4	112.6
Snaked, pruned & tied	16.8	41	142	273.5	1	88.8
Snaked & pruned	20	67.25	161.8	205.6	2.8	139.25

Table 9. The effect of pruning and training system on fruit number per tree for Jubileum on the rootstock St. Julian A.

In contrast the effect of pruning and training treatment on Jubileum on St. Julian A was very different. In 2005, 2006 and 2007 there was a significantly higher fruit number in the treated trees than the control trees. This difference however was not repeated in 2008 or 2009. In 2008 there was no effect because fruit number was so low and in 2009 the pruning and training treatments actually caused a decrease in fruit number.

Effect of rootstock on fruit size - Marjorie's Seedling

Fruit size of Marjorie's Seedling differed more between years than between rootstocks. In four out of six years the fruit size was greatest from trees on Plumina. Only in 2004 was there any difference in fruit size between trees on St. Julian A and Pixy. In 2004 and 2009 the greatest fruit sizes were observed.

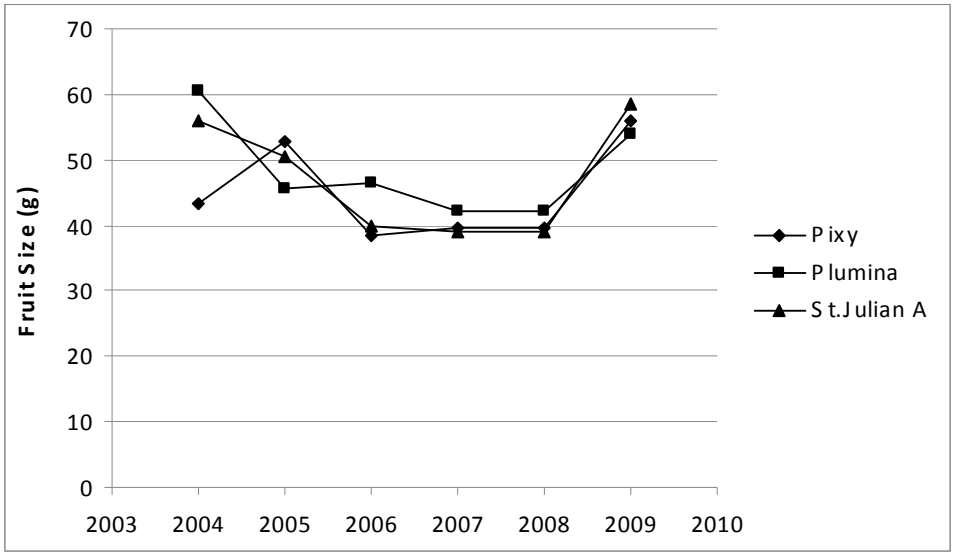

Figure 5. The effect of rootstock on fruit size for the control treatment for the variety Marjorie's Seedling.

Victoria

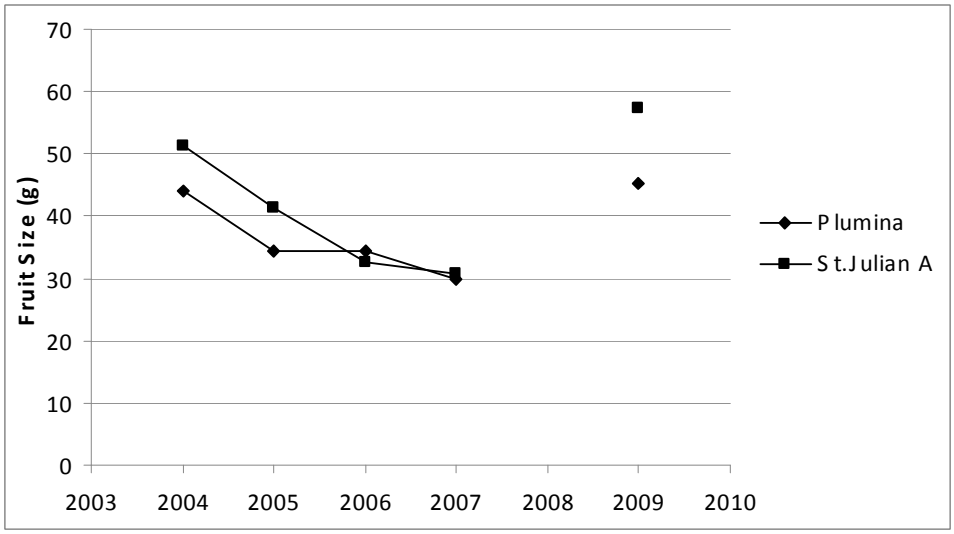

Figure 6. The effect of rootstock on fruit size for the control treatment for the variety Victoria.

No data was recorded in 2008 because there was no fruit produced. Fruit size was greater from trees on St. Julian A than Plumina in all years except 2006 and 2007. Again the fruit size was generally greater in 2004 and 2009 than in the intervening years.

Jubileum

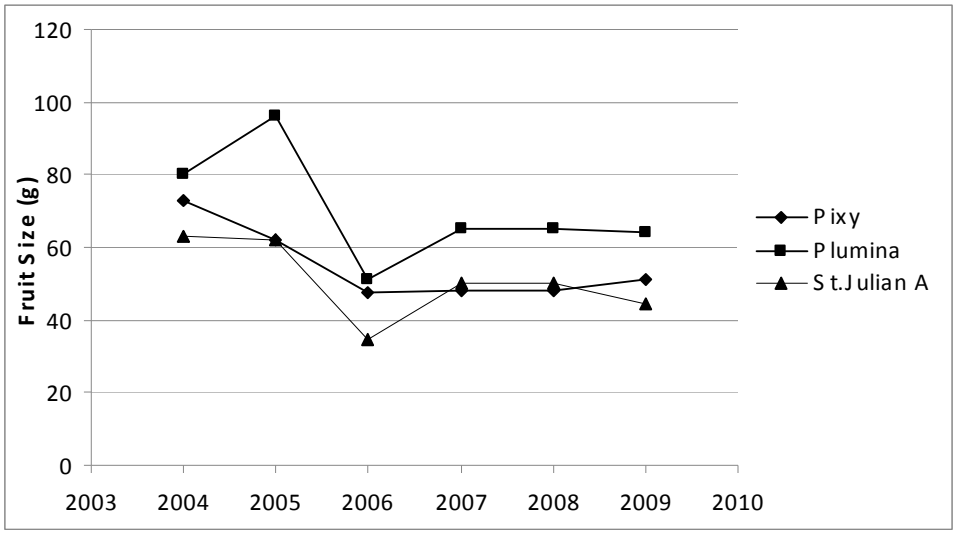

Figure 7. The effect of rootstock on fruit size for the control treatment for the variety Jubileum.

In all years, the fruit size was greatest from trees on Plumina than either Pixy or St. Julian A. In three out of six years the fruit size was greater from trees on Pixy than St. Julian A.

Opal

The relationship between fruit size and fruit number is given in Figure 5 for Opal. As fruit number increases so there is a decrease in fruit size which is to be expected. The effect is in the form of a x^2 polynomial. This relationship is only valid for the ranges shown as this form of relationship would suggest that if fruit number increased further, the fruit size would eventually increase. Clearly this is not the case but sufficient fruit numbers above 800 per tree are not available to extend the relationship in this way. Fruit number is not the only determinant of fruit size but these data do show that there is a relationship between fruit size and fruit number. Clearly analysis and interpretation of data must be made in light of this.

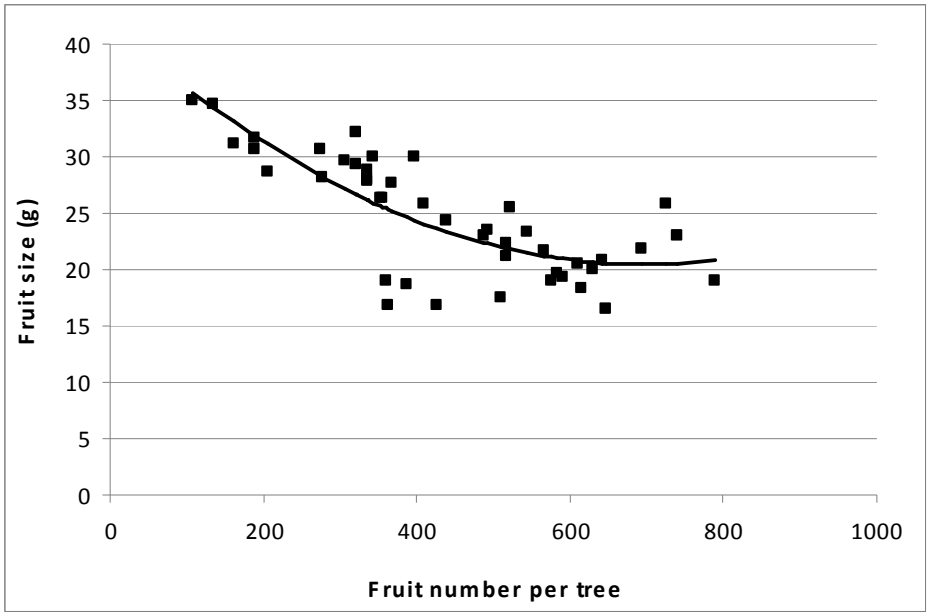

Figure 8. The relationship between fruit number and fruit size for Opal on St. Julian and Plumina. Blue line represents multiple linear regression prediction in the form $y=a + bx + cx^2$ where a=42.0 (Standard Error=2.87, P=4.6 x 10^{-18}, b=0.062 (Standard Error=0.014, P=5.03x10^{-5}) and c=4.5 x 10^{-5} (Standard Error=1.52x10-5 and P=0.0051).

Effect of rootstock on shoot growth

Shoot growth was only recorded in 2009. New shoot growth from 2009 was recorded for the shoot developing from the proximal bud from the branches arising out of the main stem. For each tree, the length of five shoots was measured. This definition was used to standardise the measurement of shoot growth. The effect of rootstock can be clearly seen in Figure 9.

Trees of Jubileum on Pixy and St. Julian A had a similar vigour, with an average shoot growth of just over 38cm. For Marjorie's Seedling the shoot growth on Pixy was slightly greater than on St. Julian A. Plumina caused less shoot growth than either Pixy or St. Julian A, this effect being most pronounced for Victoria and Opal where the length of new shoots on St. Julian A were almost twice that on Plumina. Only Opal was grown on Ishtara. Its vigour was greater than Plumina but less than St. Julian A.

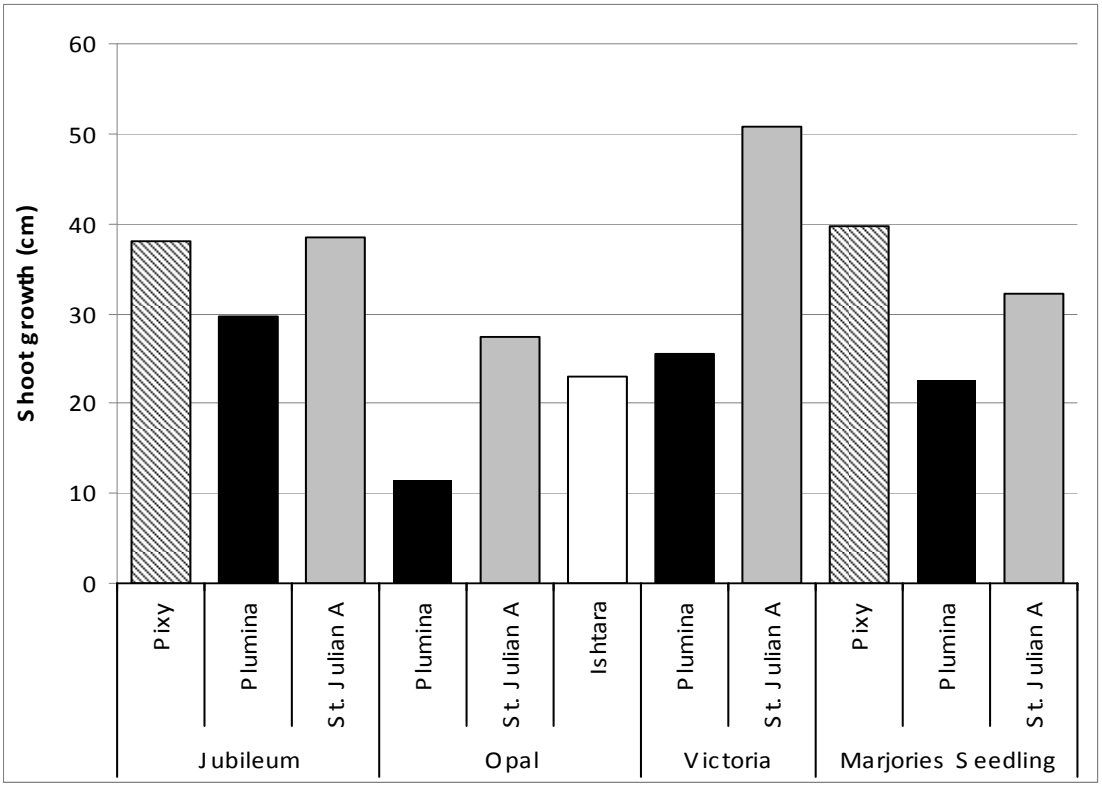

Figure 9. The effect of rootstock on shoot growth of the four scion varieties.

Conclusions

The effect of pruning and training treatment was not consistent across all varieties. In addition, the effect differed between years.

In general the trees on Plumina produced fruit which was larger than from trees on the other rootstocks. The exception to this was Marjorie's Seedling where the difference between rootstocks was less clear.

Individual fruit weight was used as the measure of fruit size because the fruit shape is taken into consideration whereas if diameter or length is used, this is not the case.

There was a clear relationship between fruit number and fruit size whereby the fruit size decreased with increased fruit number. This relationship was of the form $y=a+bx+cx^2$ where x is the fruit number and y is fruit size. This relationship is only valid for the range observed here.

The effect of rootstock on vegetative growth is clear. Pixy and St. Julian A had a similar level of vigour whereas Plumina was very much more dwarfing than either Pixy or St. Julian A. The effect of rootstock did vary slightly between scion varieties but the overall trend was clear.

The following table attempts to summarise the data in a usable format and compares the characteristics of the rootstocks. However, the effect of rootstock cannot be easily classified. Over the course of the project fruit number varied between 0 fruit per tree and 600 fruit per tree. This was affected by weather, growth, variety and bienniality as well as by rootstock. Growth was affected by as many factors again. The data shown below must therefore be used only as a guide. This is particularly the case with fruit size which was significantly affected by fruit number.

Rootstock	Pixy	Plumina	St. Julian A
Growth	Vigorous	Dwarfing	Semi-vigorous
Fruit number	Low	High	Medium
Fruit Size	Medium	Large	Medium

References

Beakbane, B.A. (1977). Patent:PP04061. Plum rootstock--Pixy variety. http://www.freepatentsonline.com/PP04061.html

Kosina J. (2004). Orchard performance of some new plum rootstocks in the Czech Republic. Acta Horticulturae 734: 393-396.

Meland, M. and Moe, M.E. (2007). Early performance of four plum rootstocks to six European Plum cultivars growing in a northern climate. Acta Horticulturae 734:235-241.

Webster, A.D. (1981). Dwarfing rootstocks for Plums and Cherries. Acta Horticulturae 114:201-207.

Webster, A.D. (2002). Dwarfing rootstocks: past, present and future. Robert F. Carlson Distinguished Lecture presented at the 45th Annual IDFTA Conference, February 16-20, 2002, Kelowna, British Columbia, Canada.

Balkhoven-Baart, J.M.T. and Maas, F.M. (2004). Evaluation of Rootstock VVA1 with the plum cultivars Opal ‘Avalon and Excalibur. Acta Horticulturae 658:99-102.

Meland, M. and Frøynes, O. (2006). Performance of five plum rootstocks to the plum cultivars 'Opal' and 'Reine Claude GF 1119' growing in Norway. 2006,ISSN:0236-4212,V:25,N:4,PG:179-186. Abstract Only.

Appendix 1

Marjorie's Seedling – May 2005

Pixy Pruned	Plumina Pruned	St. Julian A Pruned

Jubileum – May 2005

Pixy Pruned & Cracked	Plumina Pruned & Cracked	St. Julian A Pruned & Cracked

Victoria – May 2005

Plumina Pruned

St. Julian A Pruned

Opal – May 2005

Plumina
Snaked & Tied

St. Julian A
Snaked & Tied

Victoria – August 2004

Plumina Control	Plumina Pruned	Plumina Pruned & Cracked	Plumina Tied & Cracked

Victoria - August 2004

St. Julian A Control	St. Julian A Pruned	St. Julian A Pruned & Cracked	St. Julian A Tied & Cracked