Project title:	Evaluation of a range of Plum rootstocks
Project number:	TF 157
Project leader:	Mr Don Vaughan Farm Advisory Services Team Ltd. Experimental Farm North Street Sheldwich Faversham Kent ME13 0LN
Report:	Annual report, January 2006
Previous reports:	None
Key workers:	Mr D Vaughan Mr G M Saunders
Location of project:	Gaskains Ltd., Norham Farm, Selling, Faversham, Kent. ME13 9RL E.S. & L.E. Dawes, Mount Ephraim, Hernhill, Faversham, Kent. ME13 9TX
Grower co-ordinator:	To be advised
Date project commenced:	1 April 2004
Date completion due:	31 December 2009
Key words:	

Contents

Grower Summary

Headline

- Results so far have indicated that for Jubileem, Marjorie's Seedling and Opal, the Plumina rootstock will produce a greater yield per acre than either St Julian A or Pixie but for Victoria results have been variable.
- The commercial tree management practices of snaking, cracking, tying down and leader height reduction to reduce vigour and improve yield potential were shown to have an effect on fruit number.

Background and expected deliverables

The standard plum rootstock, St Julian A, has a number of shortcomings including:

- the need for expensive tree management and/or growth regulators to achieve adequate tree control
- lack of precocity
- 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. Pixie has seen limited use on established varieties and may have benefits with new introductions. Current information on the performance of these rootstocks is only available from work in other countries and does not evaluate UK preferred varieties. This trial was designed to assess these rootstocks in relation to the UK climate and preferred varieties.

The intended deliverables of this project are assessments of the rootstocks, varieties and pruning methods that will:

- 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 initial years of an orchard with varieties grown on these rootstocks

Summary of the project and main conclusions

The results this year show that for Jubileem, Marjorie's Seedling and Opal that fruit number can be increased during the initial years of an orchard by using Plumina as a rootstock.

There is little influence of rootstock on fruit size apart from in the case of Jubileem grown on Plumina compared to St Julian A or Pixie where trees on Plumina yielded fruit 14.8% bigger than fruit on St Julian A.

The results of average fruit weight this year, show more variation than the results for fruit size. For Jubileem, the rootstock Plumina produces heavier fruit than St Julian A or Pixie. In the case of Opal there was no difference in average fruit weight from either St Julian A or Plumina. For Marjorie's Seedling and Victoria, St Julian A produced heavier fruit than Plumina in 2005.

The stress conditions experienced in 2005 due to the summer weather, may have negatively affected the more dwarfing rootstocks more than the more vigorous St. Julian A. Results of yields in 2006 should shed more light on the variations experienced in 2005.

For the varieties Jubileem, Marjorie's Seedling and Opal, the use of the rootstock Plumina results in a greater yield per acre than the industry standard St Julian A or the rootstock Pixie. In the case of Victoria, the rootstock St Julian A gave a greater yield per acre than Plumina, however this is the reverse of the 2004 data where use of the rootstock Plumina resulted in greatest yield. This is a long term trial and future yields will be of interest to see how the yield pattern develops.

The results from this trial have shown that for the initial years of the orchards, rootstock choice has exerted an influence on fruit number and size. The trial has also shown that for the same time period, training of the tree had a large influence on mean fruit number.

By snaking the leader around the support stake and then either pruning out unwanted units or cracking down vigorous units, all varieties showed a yield improvement in managed trees over the control (Tables 4 – 7).

Table 4. The effects of training on average fruit number/tree for Jubileem in 2005.

	St Julian A	Pixie	Plumina
Control	8.0	56.8	105.5
Snaked leader, pruned	67.3		101.8
Snaked leader, pruned & cracked	79.4	104.2	41.8
Snaked leader, pruned & tied	41.0	61.0	84.8
Cut leader, pruned & cracked			48.0
Cut leader, tied			94.4

Table 5. The effects of training on average fruit number/tree for Marjorie's Seedling in 2005.

	St Julian A	Pixie	Plumina
Control	212.6	105.8	309.4
Snaked leader, pruned	175.6	144.8	214.2
Snaked leader, pruned & cracked	147.2	126.4	193.8
Snaked leader, tied	157.4	163.0	166.0

Table 6. The effects of training on average fruit number/tree for Opal in 2005.

	St Julian A	Plumina
Control	14.0	95.8
Snaked leader, pruned		204.8
Snaked leader, pruned & cracked	24.6	
Snaked leader, tied	36.6	213.4
Snaked leader, cracked & twisted		109.0
Cut leader, tied		124.4
Cut leader, cracked & twisted		166.8

Table 7. The effects of training on average fruit number/tree for Victoria in 2005.

	St Julian A	Plumina
Control	360.2	323.6
Cut leader, pruned	235.8	284.8

Snaked leader, pruned & cracked	197.5	321.5
Snaked leader, tied & cracked	276.4	281.0

Action points for growers

- When planting Jubileem, Marjorie's Seedling and Opal, the rootstock Plumina will give greater earlier yields per hectare.
- When planting Victoria, the rootstock Plumina or St Julian A could be considered, however future results from this trial will determine which of these two rootstocks will be preferred.
- For best yield and tree control, snake the leader around the support stake and then either pruning out unwanted units or crack down vigorous units.

Science section

Introduction

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. Pixie has seen limited use on established varieties and may have benefits with new introductions. Current information on the performance of these rootstocks is only available from work in other countries and does not evaluate UK preferred varieties. This trial was designed to assess these rootstocks in relation to the UK climate and preferred varieties.

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 initial 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, Hernhill, 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: Pixie, Plumina, St Julian A

Variety: Marjorie's Seedling

Green Lane,

Soil type: silty clay loam

Rootstocks: Pixie, Plumina, St Julian A

Variety: Jubileem

Orchards,

Soil type: sandy loam

Rootstocks: Ishtara

Variety: Opal

Rhode Court,

Soil type: silty clay loam

Rootstock: Plumina, St Julian A

Variety: Victoria

Shottenden,

Soil type: clay loam

Rootstock: Plumina, St Julian A

Variety: Opal

Pruning and training treatments were superimposed over the above variety/rootstock combinations. These treatments included control, pruned, pruned & cracked and pruned & tied. The combinations and layout of the rootstock/variety/training treatments is shown in Appendix I.

The following measurements were recorded for each assessed tree:

- fruit number
- average fruit size (diameter, mm)
- average fruit weight (g)

In subsequent years crown volume will also be assessed and yield:crown size ratios calculated.

Results

Effects of rootstock on fruit number

Fruit number was recorded on 18th July 2005 for Jubileem, 25th July 2005 for Marjorie's Seedling, 18th July 2005 for Opal and 18th July 2005 for Victoria.

Table 1. The effects of rootstock on fruit number/tree in Jubileem, Marjorie's Seedling, Opal and Victoria for the control treatment in 2005.

	St Julian A	Pixie	Plumina	Ishtara
Jubileem	8.0	56.8	105.5	
Marjorie's Seedling	212.6	105.8	309.4	
Opal	14.0		95.8	65.0
Victoria	360.2		323.6	

The results show that in all cases except for Victoria that fruit number can be increased during the initial years of an orchard by using Plumina as a rootstock. Jubileem and Marjorie's seedling on Pixie in both cases yielded far fewer fruit than when grown on Plumina.

Effects of rootstock on fruit size

Fruit size was recorded on 4th August 2005 for Jubileem, 24th August 2005 for Marjorie's Seedling, 26th July 2005 for Opal and 8th August 2005 for Victoria.

Table 2. The effects of rootstock on average fruit diameter (mm) in Jubileem, Marjorie's Seedling, Opal and Victoria for the control treatment in 2005.

	St Julian A	Pixie	Plumina
Jubileem	46.0	46.4	52.8
Marjorie's Seedling	42.6	43.0	40.8
Opal	38.4		38.8
Victoria	39.1		36.6

Table 2 shows that there is little influence of rootstock on fruit size apart from in the case of Jubileem grown on Plumina compared to St Julian A or Pixie where trees on Plumina yielded fruit 14.8% bigger than fruit on St Julian A.

Effects of rootstock on fruit weight

Fruit weight was recorded on 4th August 2005 for Jubileem, 24th August 2005 for Marjorie's Seedling, 26th July 2005 for Opal and 8th August 2005 for Victoria.

Table 3. The effects of rootstock on average fruit weight (g) in Jubileem, Marjorie's Seedling, Opal and Victoria for the control treatment in 2005.

	St Julian A	Pixie	Plumina
Jubileem	62.0	61.9	96.4
Marjorie's Seedling	50.5	52.7	45.7
Opal	37.1		37.1
Victoria	41.2		34.3

The results of average fruit weight (Table 3) show that for Jubileem, the rootstock Plumina produces heavier fruit than St Julian A or Pixie. In the case of Opal there was no difference in average fruit weight from either St Julian A or Plumina. For Marjorie's Seedling and Victoria, St Julian A produced heavier fruit than Plumina.

Effects of training on average fruit number

Tables 4-7 show the effect of training treatment on fruit number/tree for Jubileem, Marjorie's Seedling, Opal and Victoria when grown on St Julian A, Pixie and Plumina.

Tree training appears to have beneficial effect on fruit numbers on Plumina trees when compared to all varieties on either St Julian A or Pixie. Fruit numbers on control trees of Victoria on St Julian A are higher but this could be detrimental to fruit size and subsequent returns, if trees become stressed later in the season.

Table 4. The effects of training on average fruit number/tree for Jubileem in 2005.

	St Julian A	Pixie	Plumina
Control	8.0	56.8	105.5
Snaked leader, pruned	67.3		101.8
Snaked leader, pruned & cracked	79.4	104.2	41.8
Snaked leader, pruned & tied	41.0	61.0	84.8
Cut leader, pruned & cracked			48.0
Cut leader, tied			94.4

Table 5. The effects of training on average fruit number/tree for Marjorie's Seedling in 2005.

	St Julian A	Pixie	Plumina
Control	212.6	105.8	309.4
Snaked leader, pruned	175.6	144.8	214.2
Snaked leader, pruned & cracked	147.2	126.4	193.8
Snaked leader, tied	157.4	163.0	166.0

Table 6. The effects of training on average fruit number/tree for Opal in 2005.

	St Julian A	Plumina
Control	14.0	95.8
Snaked leader, pruned		204.8
Snaked leader, pruned & cracked	24.6	
Snaked leader, tied	36.6	213.4
Snaked leader, cracked & twisted		109.0
Cut leader, tied		124.4
Cut leader, cracked & twisted		166.8

Table 7. The effects of training on average fruit number/tree for Victoria in 2005.

	St Julian A	Plumina
Control	360.2	323.6
Cut leader, pruned	235.8	284.8
Snaked leader, pruned & cracked	197.5	321.5
Snaked leader, tied & cracked	276.4	281.0

Effects of rootstock on total yield

When the combination of average fruit number per tree (control), average weight of fruit per tree (control) and planting density are taken into account, the 2005 yield per variety/rootstock combination can be calculated.

Table 8. Yield in Tonnes per hectare for variety/rootstock combinations in 2005.

	St Julian A	Pixie	Plumina
Jubileem	0.94	6.70	19.37
Marjorie's Seedling	15.34	7.96	20.19
Opal	0.91		6.77
Victoria	28.29		21.13

From the yield results (Table 8) it can be seen that for all varieties except Victoria, the use of the rootstock Plumina results in a greater yield per acre than the industry standard St Julian A or the rootstock Pixie. In the case of Victoria, the rootstock St Julian A gave a greater yield per hectare than Plumina in 2005.

Discussion

Effects of rootstock on fruit number

The results indicate that in all cases except for Victoria that fruit number can be increased during the initial years of an orchard by using Plumina as a rootstock. However it must be noted that for Victoria, during the previous year use of the rootstock Plumina resulted in a greater number of fruit per tree than St Julian A. Jubileem and Marjorie's seedling on Pixie in both cases yielded far fewer fruit than when grown on Plumina. The data for Marjorie's Seedling supports data from the continent where the rootstock Plumina was shown to produce the greatest yield, followed by St Julian A and then Pixie.

Effects of rootstock on fruit size

There is little influence of rootstock on fruit size apart from in the case of Jubileem grown on Plumina compared to St Julian A or Pixie where trees on Plumina yielded fruit 14.8% bigger than fruit on St Julian A.

Effects of rootstock on fruit weight

The results of average fruit weight show more variation than the results for fruit size. For Jubileem, the rootstock Plumina produces heavier fruit than St Julian A or Pixie and this is also shown in fruit size measurements. In the case of Opal there was no difference in average fruit weight from either St Julian A or Plumina. For Marjorie's Seedling and Victoria, St Julian A produced heavier fruit than Plumina.

Effects of training on average fruit number

The results from 2005 season do indicate that by Snaking the tree initially and then either pruning and tying units down, fruit numbers can be significantly improved. Numbers were significantly improved in all varieties when these methods were used over the control. However we still need to determine the optimum numbers of fruits that Plumina or Pixie can carry year on year without affecting yield/fruit size ratios.

By the time that this trial is completed, we hope to ascertain the optimum fruit numbers each rootstock can maintain without affecting either fruit size or the long term viability of the tree.

Effects of rootstock on total yield

From the 2005 yield results it can be seen that for all varieties except Victoria, the use of the rootstock Plumina results in a greater yield per acre than the industry standard St Julian A or the rootstock Pixie. In the case of Victoria, the rootstock St Julian A gave a greater yield per acre than Plumina, however this is a long term trial and future yields will be of interest to see if this trend continues.

Conclusions

The results from this trial have shown that for the initial years of the orchards, rootstock choice has exerted an influence on fruit number and size. The trial has also shown that for the same time period, training of the tree had a large influence on mean fruit number.

For the precocious variety Victoria the rootstock St Julian A has produced the greatest yields per acre in 2005. For the other varieties trialled Jubileem, Marjorie's Seedling and Opal the rootstock Plumina is far superior with yields far in excess of St Julian A or Pixie.

Appendix I.

Jubileem at Green Lane

ROW		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
32	JUBILEEM	PC	PC	PC	PC	PC	PT	PT	PT	PT	PT	P	P	P	P	XX	P	C	C	C	→					
28	JUBILEEM																									
27	JUBILEEM																									
26	VICTORIA																									
25	VICTORIA																									
24	JUBILEEM																									
23	JUBILEEM																									
22	VICTORIA																									
21	VICTORIA																									
20	JUBILEEM																									
19	JUBILEEM	PC	PC	PC	PC	XX	PT	PT	PT	PT	PT	PT	P	P	P	CC	CC	CC	CC	CC	CT	CT	CT	CT		
18	VICTORIA																									
17	VICTORIA																									
16	JUBILEEM	PC	PC	PC	PC	PC	PT	PT	PT	PT	PT	C	C	C	→											
15	JUBILEEM																									
14	VICTORIA																									
13	VICTORIA																									
12	JUBILEEM																									
11	JUBILEEM																									

.= ST JULIAN A

.= PIXIE

.= PLUMINA

C = CONTROL
P = PRUNED
T = TIED
P.T = PRUNED/TIED

PC = PRUNED / CRACKED
CC = CUT LEADER CRACKED / PRUNED
CT = CUT LEADER TIED

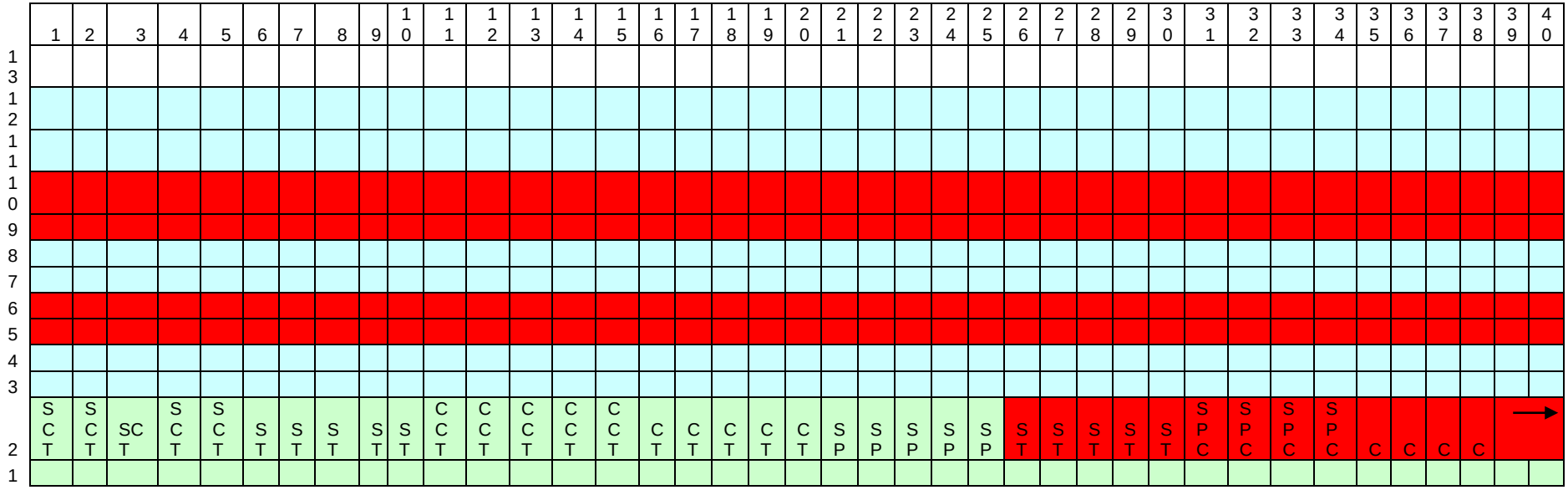
Marjorie’s Seedling at Cage

	VARIETY	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5
1	Marjorie's Seedling																																	
2	Marjorie's Seedling																																	
3	Marjorie's Seedling	PC	PC	PC	PC	PC	PC	PC	T	T	T	T	T	P	P	P	P	P	PC	PC	PC	PC	PC	T	T	T	T	T	P	P	P	P	P	PC
4	Marjorie's Seedling																																	
5	Marjorie's Seedling																																	
6	Marjorie's Seedling																																	
7	Marjorie's Seedling																																	
8	Marjorie's Seedling																							T	T	T	T	T	P	P	P	P	P	PC
	Marjorie's Seedling																																	

PIXIE
PLUMINA
ST.JULIAN A

C = CONTROL
P = PRUNED
T = TIED
PT = PRUNED & TIED
PC = PRUNED & CRACKED

Opal at Shottenden



= OPAL ON PLUMINA
= VICTORIA ON ST JULIAN A
= OPAL ON ST JULIAN A

SCT = SNAKED LEADER CRACKED & TWISTED
ST = SNAKED LEADER TIED
CCT = CUT LEADER CRACKED & TWISTED

CT = CUT LEADER TIED
SP = SNAKED LEADER PRUNED
SPC = SNAKED LEADER PRUNED & CRACKED
C = CONTROL

Opal at Orchards

ROW	VARIETY	ROOTSTOCK	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
7	Victoria	ST.JULIAN A																
6	Opal	ISHTARA	Control	P T	P T	P T	P T Cu6	P T Cu4	P T Cu2	P	P	P	P	P	P	P	P	Control
5	Opal	ISHTARA	Control	P T	P T	P	P Cu2	P T Cu4	P Cu6	Cu2	Cu4	Cu6	Cu8	P Cu2	P Cu4	P Cu6	P Cu8	Control
4	Victoria	ST.JULIAN A																
3	Victoria	ST.JULIAN A																
2	Victoria	ST.JULIAN A																
1	Victoria	ST.JULIAN A																

ST.JULIAN A
ISHTARA

C = CONTROL
P = PRUNED

T = TIED
Cu = Cultar ml/tree

Cultar applied to soil in 500ml water

Victoria at Rhode Court

Row	Variety	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	VICTORIA																								
2	VICTORIA	PC	PC	PC	PC	PC	P	P	P	P	P	TC	TC	TC	TC	TC	C	C	C						
3	VICTORIA	PC	PC	PC	PC	PC	P	P	P	P	P	TC	TC	TC	TC	TC	C	C	C						
rest																									

= PLUMINA
= ST.JULIAN A

C = CONTROL
P = PRUNED (CUT TREES)
T =TIED

PT = PRUNED & TIED
PC = PRUNED & CRACKED (SNAKED TREES)
TC = TIED & CRACKED (SNAKED TREES)

Appendix II.

Photographs taken June 2005.

Jubileem (pruned and cracked)

Pixie

Plumina

St Julian A

Marjorie’s Seedling (pruned and cracked)

Pixie

Plumina

St Julian A

Opal (control)

Plumina

St Julian A

Ishtara

Victoria (pruned and cracked)

Plumina

St Julian A