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

CONTENTS

EAST MALLING RESEARCH

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Authentication

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

..... D S Johnson
Signature

Date .....

Evaluation and development of new rootstocks for apples, pears, cherries and plums

Grower Summary

Headline

- ‘Gisela 5’ proved to be a consistently high performing cherry rootstock
- Three cherry rootstocks provided yield efficiencies similar to ‘Gisela 5’ namely ‘Gisela 4’, ‘Weiroot 53’ and ‘G523-02’
- Russian cherry rootstocks LC-52 and VSL-2 are very precocious and high yielding

Background and expected deliverables

The recent review of HDC-funded rootstock research projects (project TF158) acknowledged that there is a strong need for new or improved rootstocks for apples, pears, plums and cherries that are dwarfing, precocious, high yielding and offer some measure of drought tolerance. The report recognised that rootstocks are a vital component of the growing system for tree fruits, but those currently used in tree fruit production have been grown for decades and all have some limitations. Breeding programmes in the UK and abroad have generated a number of promising rootstocks in recent years, which are becoming increasingly available to growers. The report recommended that UK trialling of promising UK and overseas material should continue and that technology transfer should be improved.

Requirements in new apple rootstocks

The report emphasised the need for rootstocks with intermediate vigour between M.27 and M.9 and a replacement for M.26 that does not suffer from burr knotting and poor calcium uptake. Fortuitously three new trials comprising eight rootstock selections in the required vigour range were planted spring 2003 and 2004 as part of the previous HDC project (TF134). The performance of these promising selections will be measured during the course of this project. Results of earlier screening trials have been published (Johnson *et al*., 2005) and four of the eight selections that were highlighted are included in the new trials at EMR and further selections are being built up in a commercial nursery prior to raising trees for future plantings.

Requirements in new pear rootstocks

The report stressed the need for increased dwarfing of pear scions to suit them for high-density systems without the need to resort to the use of either plant growth regulating chemicals or root pruning. Although it was recognised that dwarfing quince rootstocks are the best way forward for scions such as ‘Conference’ and ‘Comice’, most new pear varieties are incompatible with quinces and require the use of expensive interstocks. A fully dwarfing and easy to propagate *Pyrus* stock would be beneficial to provide a much wider range of graft compatibility with new pear varieties, as well as providing better tolerance of drought and alkaline soils. New dwarfing rootstocks that improve pear cropping precocity are vital if pears are to remain economically viable.

Requirements in new sweet cherry rootstocks

The report identified the major requirement for a rootstock that is more dwarfing than either ‘Gisela 5’ or ‘Tabel’ that would control the vigour of trees sufficiently for easy growth within tunnels. Ideally these dwarfing stocks would be easier to propagate than either ‘Tabel’ or ‘Gisela 5’ since this should allow the production of less expensive trees. Other requirements were for dwarfing rootstocks that are more suited to heavy clay soils (‘Gisela’ clones perform poorly in wet soils) and for dwarfing stocks that induce large fruit size.

Requirements in new plum rootstocks

The report recognised that there is a major requirement to provide increased dwarfing for plum trees to facilitate production under fully high density systems and for rootstocks that induce precocious and consistently abundant yields of large good quality fruits.

Overall objective

The main aim of the project is to acquire, evaluate and develop in UK growing conditions new apple, pear, cherry and plum rootstocks produced by breeding programmes both at EMR and abroad.

Specific objectives

Apple

- To select and develop apple rootstocks with intermediate vigour between M.27 and M.9, which performs well in the nursery and which produces precocious and consistently abundant yields of high quality fruits of the marketable size grades
- To select and develop a replacement rootstock in the M.26 vigour category, which does not suffer from burr knotting, poor calcium uptake or physiological disorders. This rootstock should also induce precocious and abundant yields of high quality fruits
- To select and develop dwarfing rootstocks for apple which exhibit improved resistance to drought, (weed competition) replant disease and soil borne diseases (e.g. collar/crown rot)

Pear

- To select and develop quince rootstocks more dwarfing than 'Quince C' with improved precocity of cropping
- To select dwarfing *Pyrus* rootstocks that are easy to propagate, and that induce good yield precocity/productivity

Cherry

- To select fully dwarfing rootstocks, more dwarfing then 'Gisela 5', that are easy to propagate and that induce good yield precocity, fruit size and sustained productivity

Plum

- To select, from material available overseas, dwarfing rootstocks that induce precocious and consistently high yields of large good quality fruits

Summary of the project and main conclusion

Apple rootstock trials planted at EMR

Trials descriptions

Currently, three trials of apple rootstocks raised by breeders at EMR are planted.

A trial was planted in spring 2003 (Plot EE 195) to evaluate new rootstocks from the breeding program at EMR. Trees of 'Queen Cox' on three new rootstock selections (AR 486-1, AR 295-6 and AR 120-242) are being compared with M.9 and trees of 'Bramley's Seedling' on four new rootstock selections (AR 628-2, AR 69-7, AR 360-19 and AR 801-11) are being compared with M.27. These same rootstock selections are being compared in similar trials planted at the same time in the organic area (Plot GE 182) at EMR.

This was followed by a trial planted in spring 2004 (Plot CE 190) to evaluate new rootstocks from the breeding program at EMR. Trees of 'Cox La Vera' on two new rootstock selections (AR 801-11 and AR 680-2) are being compared with M.9.

Main conclusions

It is too early to draw any conclusions from trials planted in 2003 (Plots EE 195 and GE 182) and 2004 (Plot CE 190). There have been insufficient cropping years to draw conclusions regarding yield and yield efficiency. The vigour of the rootstock selections is generally as expected based on results of previous trials.

It was noted previously (see first year report for TF172) that the control rootstocks in the CE 190 trial were not performing as expected. It was strange that M.M.106 trees had smaller girths than M.9 or M.26, particularly as all trees in the trial were of the same age and were raised in the same nursery. In order to reconcile the lack of differences in vigour among control trees, samples of root tissue were taken for DNA fingerprinting. The tests showed conclusively that all control trees were the same genetically and were most likely to be M.9.

It is encouraging that after 3 years from planting 'Cox' ('La Vera') trees on AR 801-11 are less vigorous than on M.9 but cropping similarly. Whilst AR 486-1 and AR 120-242 provide a slightly lower and higher vigour for 'Queen Cox' respectively than M.9, it is disappointing that the yield efficiencies are currently much lower than for M.9. On 'Bramley' a range of vigour is being provided by new rootstock selections. Apart from AR 628-2 the performance of new selections has been similar to M.27. As in the 'Cox' ('La Vera') trial, Bramley on AR801-11

continues to perform well. It is interesting to note the extent of the general suppression of tree growth and cropping under organic management (Table 1). Undoubtedly the failure to control rosy apple aphid (RAA) has played a significant part in the poor performance of trees in the organic plots. If the current strategy for the control of RAA i.e. autumn applications of pyrethrum fails to provide sufficient control of the problem then it may be necessary to grub these trials. New trials are proposed in the organic area in the winter of 2009-10 using more invigorating rootstocks (M.M.106/M.116 range) and a more appropriate scion cultivar ('Red Falstaff').

Table A. Growth and cropping in 2007 of 'Queen Cox' and 'Bramley's Seedling' trees on a range of rootstocks from the EMR breeding program planted in spring 2003. Data are means of all rootstocks being tested

	'Queen Cox'		**'Bramley's Seedling'**	
	Conventional	**Organic**	**Conventional**	**Organic**
Girth (cm / tree)	11.0	7.9	10.2	8.5
Tree volume (m^3)	8.4	2.8	3.6	1.2
Yield (kg / tree)	13.1	0.3	5.8	0.5

Pear rootstock trials planted at EMR

Trials descriptions

Two trials of quince and *Pyrus* rootstocks planted at EMR continue to be evaluated. These trials include C132, a quince rootstock from the EMR breeding programme, which is slightly more dwarfing than 'Quince C' and possibly more winter hardy. In one of these trials (Plot PR 184) C132 is compared with 'Quince C'' (EMC) and a promising Swedish *Pyrus* selection (BP30) and, in the other (Plot PR 173), it is compared with EMC and a dwarfing *Pyrus* selection from the EMR programme, QR 708/2.

Main conclusions

Results with C132, a quince rootstock from the EMR breeding programme, in the two trials at EMR continue to be contradictory particularly as regards the vigour of the rootstock in comparison with EMC. In the younger trial there was no greater dwarfing effect of C132 on either 'Conference' or 'Comice'. Overall the cumulative yields for C132 and EMC were similar and, on 'Comice', C132 cumulative yields of large fruit were higher. In the older trial 'Conference' on C132 was less vigorous than on EMC (smaller girth, tree volume and lower grubbing weight) and although cumulative yield tended to be lower the yield efficiencies of C132 and EMC were the same. These results indicate that C132 can provide the UK industry with a smaller tree than EMC with no loss of yield efficiency.

Tree density may be a factor influencing the comparative vigour of 'Conference' on the different stocks. In the older trial the trees were more densely planted than in the younger trial. In trials done in the UK and the Netherlands C132 has shown potential as a rootstock more dwarfing than EMC with similar yield efficiency and fruit size. Within the current phase of HDC-funded rootstock trialling it is intended that C132 is compared with EMC in grower trials. Two hundred C132 rootstocks and a similar number of EMC have been lined out at EMR and will be budded with 'Conference' during summer 2008. It is anticipated that 2-year-old 'Conference' trees of C132 and EMC will be available for planting in grower trials in the winter of 2009/10. These on-farm trials will be organised by FAST Ltd on behalf of HDC. Overall the performance of BP30 (a promising Swedish *Pyrus* selection) has been similar to that of EMC and remains a promising selection where *Pyrus* rootstocks are preferred to Quince.

Results for QR708/2, a dwarfing *Pyrus* selection from the EMR programme, have not been promising. QR708/2 continues to be more vigorous than EMC but has a lower cumulative yield and yield efficiency and appears to be incompatible with 'Conference' with the result that 50% of the trees have died.

<u>Cherry rootstock trials planted at EMR</u>

Trials descriptions

There are currently four trials of cherry rootstocks raised at EMR and abroad.

A major international trial testing 15 rootstock selections was planted at EMR (plot MP 165) in spring 1999 using the cultivar 'Lapins'. Previous funders of the trial include the East Malling Trust for Horticultural Research in collaboration with the Stone Fruit Club. The trial was completed after the 2007 season and the trees have been grubbed. A report on rootstock performance up to 2003 was presented at an EMRA Day in August 2003 and in EMRA News (Spencer, 2004).

Various smaller trials have been planted recently. These include a comparison of two Russian (Krymsk) selections (LC-52 and VSL-2) using the cultivar 'Summersun' (plot MP 177) planted spring 2002. LC-52 is drought and cold tolerant and non-suckering. VSL-2 is similar in vigour to 'Gisela 5' and is precocious, non-suckering and can be propagated from cuttings. Four new selections from EMR are being compared with 'Tabel Edabriz' and 'Gisela 5' using the cultivar 'Sunburst'. This trial was planted on plot MP183 in spring 2005. The latest trial was planted in the spring of 2006 and will compare the performance of 'Gisela

3' with 'Gisela 5' using the cultivar 'Penny'. 'Gisela 3' is considered to be the more dwarfing stock and therefore more amenable to tunnel production.

Main conclusions

The international ('Lapins') rootstock trial planted in 1999 was concluded in 2007. 'Gisela 5' proved to be a consistently high performer with a high cumulative yield and yield efficiency. There were only three rootstocks that provided yield efficiencies similar to 'Gisela 5' namely 'Gisela 4', 'Weiroot 53' and 'G523-02'. Mean fruit weight averaged over 5 years (2003-7 inclusive) was higher for 'Gisela 4' than for 'Gisela 5'. 'Weiroot 53' was much less vigorous than 'Gisela 5' but maintained a similar level of yield efficiency. Whilst the use of 'Gisela 4' and 'Weiroot 53' may have advantages over 'Gisela 5' in terms of fruit size and smaller tree size respectively, there appears to be no specific advantage of 'G523-02'.

The Russian 'Krymsk' rootstocks LC-52 and VSL-2 have proved to be very precocious in terms of yield of 'Summersun' cherries. LC52 continues to be more vigorous and higher yielding than VSL2 and is more yield efficient.

The EMR rootstock selection C113-3 on 'Sunburst' continues to be more dwarfing than 'Gisela 5' but no cropping data is available yet in this trial planted in 2005.

In the second year of a trial comparing 'Gisela 3' and 'Gisela 5' on the cultivar 'Penny', the former tended to be less vigorous than 'Gisela 5' but not significantly so. The trees carried a few fruits in 2007 (average 7/tree) with Gisela 3 tending to produce less fruit than 'Gisela 5'.

<u>Plum rootstock trial planted on a commercial farm</u>

Trial description

A major international trial testing 5 rootstock selections was planted on a commercial farm in East Kent in spring 2002 using the cultivars 'Opal', 'Valor' and 'Avalon'. One year of funding (2003-4) of the trial was obtained from the East Malling Trust for Horticultural Research in collaboration with the Stone Fruit Club.

Main conclusions

The trial suffered serious damage from hail on three occasions prior to harvest. Consequently the decision was made not to take any records in 2007.

Financial benefits

There are major financial implications of identifying rootstocks with improved agronomic performance and that satisfy consumer requirements in terms of fruit size and quality.

Action points

- The dwarfing quince rootstock C132 has performed well and will be compared with ‘Quince C’ in more extensive grower trials on ‘Conference’ planned for the winter of 2009-10

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Science Section

Introduction

For the six years leading up to 31 March 2001 the selection, development and evaluation of new apple and pear rootstocks in the UK was funded by the East Malling Trust for Horticultural Research (EMTHR) with additional funding from the Apple and Pear Research Council (APRC) in 2000-01. A report on the work carried out during that 6-year period was prepared by Dr. Tony Webster and colleagues and submitted to APRC (SP 123) and the EMTHR Trust in 2001. In 2001-02 the evaluation and development of new rootstocks for apples and pears was continued in a 1-year APRC project (SP 134) and a report on the work carried out from April 2001 until March 2002 was submitted to APRC in April 2002. Subsequently the APRC agreed to continue project SP 134 for a further three years (March 2005) and they also decided to fund additional work (SP 141) to evaluate and develop in organic growing conditions new apple rootstocks produced by the breeding programme at EMR. From April 2003 to March 2005 these projects have been funded by the HDC (TF 134 and TF 141). In 2004, the HDC funded Dr David Pennell (then of ADAS) and Dr Tony Webster (consultant and formerly of HRI, East Malling) to carry out a review of HDC-funded rootstock research projects. The results of the review were not available in sufficient time for EMR to develop a new rootstock proposal before the 2005 growing season (Pennell, 2005). An interim proposal (TF 168) was prepared and accepted by HDC in order that the recording of existing trials could be continued. A report on the work carried out from April 2005 until March 2006 was submitted to the HDC in August 2006. During 2006 a new proposal for the evaluation and development of new rootstocks for apples, pears, cherries and plums was accepted by the HDC (TF 172). Funding is now secured for at least 6 years which will allow the introduction of new material from EMR and abroad and the testing of the most promising selections on growers farms.

Recent successes of the trialling programme include the release in 2001 of a new dwarfing quince rootstock for pears (EMH) and a new apple rootstock resistant to crown /collar rot (M.116).

Objectives

Apple

- To select and develop apple rootstocks with intermediate vigour between M.27 and M.9, which perform well in the nursery and which produce precocious and consistently abundant yields of high quality fruits of the marketable size grades

- To select and develop a replacement rootstock in the M.26 vigour category, which does not suffer from burr knotting, poor calcium uptake or physiological disorders. This rootstock should also induce precocious and abundant yields of high quality fruits

- To select and develop dwarfing rootstocks for apple which exhibit improved resistance to drought, (weed competition) replant disease and soil borne diseases (e.g. collar/crown rot)

Pear

- To select and develop quince rootstocks more dwarfing than 'Quince C'' with improved precocity of cropping

- To select dwarfing *Pyrus* rootstocks that are easy to propagate, and that induce good yield precocity/productivity

Cherry

- To select fully dwarfing rootstocks, more dwarfing then 'Gisela 5', that are easy to propagate and that induce good yield precocity, fruit size and sustained productivity

Plum

- To select from material available overseas dwarfing rootstocks that induce precocious and consistently abundant yields of large good quality fruits

Apple rootstock trials planted at EMR

Currently there are three trials of apple rootstocks raised and planted at EMR.

A trial was planted on 8 May 2003 (Plot EE 195) to evaluate new rootstocks from the breeding program at EMR. Using 'Queen Cox' three new rootstock selections (AR 486-1, AR 295-6 and AR 120-242) are being compared with M.9 and using 'Bramley's Seedling' four new rootstock selections (AR 628-2, AR 69-7, AR 360-19 and AR 801-11) are being compared with M.27. These same rootstock selections are being compared in similar trials planted at the same time in the organic area (Plot GE 182) at EMR.

A trial was planted on 18 May 2004 (Plot CE 190) to evaluate new rootstocks from the breeding program at EMR. Using 'Cox La Vera' two new rootstock selections (AR 801-11 and AR 680-2) are being compared with M.9.

Pear rootstock trials planted at EMR

Two trials of quince and *Pyrus* rootstocks planted at EMR continue to be evaluated. These trials include C132, a quince rootstock from the EMR breeding programme, which is slightly more dwarfing than 'Quince C' and possibly more winter hardy. In one of these trials (Plot PR 184) C132 is compared with 'Quince C' (EMC) and a promising Swedish *Pyrus* selection (BP30) and, in the other (Plot PR 173), it is compared with EMC and a dwarfing *Pyrus* selection from the EMR programme, QR 708/2.

Cherry rootstock trials planted at EMR

There are currently four trials of cherry rootstocks raised by breeders at EMR and abroad.

A major international trial testing 15 rootstock selections was planted at EMR (plot MP 165) in spring 1999 using the cultivar 'Lapins'. Previous funding of the trial was provided by the EMTHR in collaboration with the Stone Fruit Club. HDC have funded the trial since 2006. The trial was completed in 2007 and the trees have been grubbed. A report on rootstock performance up to 2003 was presented at an EMRA Day in August 2003 and in EMRA News (Spencer, 2004).

Various smaller trials have been planted recently. These include a comparison of two Russian (Krymsk) selections (LC-52 and VSL-2) using the cultivar 'Summersun' (plot MP

177) planted spring 2002. LC-52 is drought and cold tolerant and non-suckering. VSL-2 is similar in vigour to 'Gisela 5' and is precocious, non-suckering and can be propagated from cuttings. Four new selections from EMR are being compared with 'Tabel Edabriz' and 'Gisela 5' using the cultivar 'Sunburst'. This trial was planted on plot MP 183 in spring 2005. The latest trial was planted in the spring of 2006 and will compare the performance of 'Gisela 3' with 'Gisela 5' using the cultivar 'Penny'. 'Gisela 3' is considered to be the more dwarfing stock and therefore more amenable to tunnel production.

Plum rootstock trial planted on a commercial farm

A major international trial testing five rootstock selections was planted on a commercial farm in East Kent in spring 2002 using the cultivars 'Opal', 'Valor' and 'Avalon'. One year of funding (2003-4) of the trial was obtained from the EMTHR in collaboration with the Stone Fruit Club. Although there has been no funding for the trial in the past 2 years the trial has been recorded and these results are being made available to the HDC in order that cumulative data can be provided in this and subsequent reports.

Materials and Methods

In all of the EMR trials, the tree rows were maintained weed free using conventional herbicides (excluding the organic trial on Plot GE 182) and the alleys between the rows were grassed down and maintained by frequent mowing. No supplementary irrigation was supplied to the trees. Minimal pruning was undertaken in the first few years following planting; the trees were, however, headed when necessary to encourage the production of lateral branches, but no branch tipping was undertaken. Where appropriate, very upright branches were tied down towards the horizontal and a modified form of 'long spur pruning' employed. No chemical growth regulators or root pruning techniques have been used to supplement growth control in any of the trials reported on.

Measurements were taken of trunk girth 25 cm above ground level for cherry, 45 cm above ground level for plum and 15 cm above ground level for apple and pear. Where appropriate, numbers and lengths of shoots or heights and spreads of the tree crowns (apple and pear) were recorded along with fresh weights at the time of grubbing. Total yields and yields of class one fruit >65 mm (or >80 mm for 'Bramley' and >55 mm for 'Conference') were measured for each tree and cumulative yields and yield efficiencies were calculated. Average fruit weights were calculated for cherry and plum. In the cherry and plum trials the numbers

of suckers per tree were recorded. In all trials notes on tree health, graft compatibility and anchorage were made as required.

Results and Discussion

Performance of 'Queen Cox' on new East Malling rootstock selections

Under conventional management

Selections AR 801-11 and 680-2 (Plot CE190)

It was noted previously (see first year report for TF 172) that the control rootstocks were not performing as expected. It was strange that M.M.106 trees had smaller girths than M.9 or M.26 particularly as all trees in the trial were of the same age and were raised in the same nursery. In order to reconcile the lack of differences in vigour among control trees samples of root tissue were taken for DNA fingerprinting. The tests showed conclusively that all control trees were the same genetically and were most likely to be M.9. It is fortunate that molecular techniques have advanced to a stage that allows these checks to be made. It is clear that serious mistakes were made in the nursery used to raise trees for EMR trials. As a result of the molecular tests we are only able to compare the performance of the new selections, AR 801-11 and AR 680-2, with M.9.

AR 801-11 is less vigorous than M.9 as evidenced by a significantly smaller trunk girth (Table 1). Tree volume of AR 801-11 also tended be lower than that of M.9. There were no significant differences in yield or yield efficiency between M.9 and the new selections (Tables 1 and 2). It is encouraging that after 3 years from planting AR 801-11 is less vigorous than M.9 but cropping similarly.

Table 1. Growth and cropping in 2007 of 'La Vera Cox' trees (Plot CE 190) on rootstocks from the East Malling Research breeding programme planted in spring 2004. (SED–Standard Error of the Difference between means, LSD–Least Significant Difference between means, df–degrees of freedom, rootstock effect was either non-significant (n.s.) or significant at the 5 (*), 1 (**) or 0.1% (***) level of probability)

Rootstock	Girth 2007 (cm / tree)	Tree Volume 2007 (m^3)	Yield 2007 (kg/tree)	Yield Class 1 >65 mm 2007 (kg / tree)	Suckers 2007 (No. / tree)
AR 680-2	8.6	4.0	4.2	3.0	1.1
AR 801-11	8.0	2.7	3.6	2.5	1.8
M.9	9.4	4.2	2.1	1.3	1.3
SED (30 df)	0.61	0.91	1.34	0.94	0.66
LSD (P=0.05)	1.25	1.85	2.74	1.93	1.36
Rootstock effect	*	n.s.	n.s.	n.s.	n.s.

Table 2. Cumulative yield and yield efficiency of 'Queen Cox' trees (Plot CE 190) on rootstocks from the East Malling Research breeding programme planted in spring 2004. (SED–Standard Error of the Difference between means, LSD–Least Significant Difference between means, df–degrees of freedom, rootstock effect was either non-significant (n.s.) or significant at the 5 (*), 1 (**) or 0.1% (***) level of probability)

Rootstock	Cumulative yield 2004-07 (kg / tree)		Yield efficiency (kg / cm^2)
	Total	Class 1 >65 mm	
AR 680-2	7.1	4.5	1.1
AR 801-11	5.5	3.4	1.2
M.9	5.8	2.9	0.9
SED (df)	1.24	1.10	0.20
LSD (P=0.05)	2.55	2.26	0.42
Rootstock effect	n.s.	n.s.	n.s.

Selections AR 486-1, AR 295-6 and 120-242 (Plot EE 195)

At the time of planting (8 May 2003) there were only sufficient grafted 2-year-old trees of AR 295-6 and AR 120-242 to complete blocks 4 and 5 of the eight blocks respectively. The remaining blocks were completed using budded 1-year-old trees. The analysis of the data up to 2006 was necessarily restricted to the four complete blocks of grafted trees. It is anticipated that as the trees get older any potential differences between the budded and grafted trees will diminish and it will be appropriate to use all eight replicate trees in the statistical analysis.

AR 486-1 continues to be less vigorous than M.9 with a smaller tree volume but in 2007 AR 486-1 yielded poorly compared with M.9 and cumulative yield and yield efficiency were significantly lower (Tables 3 and 4). AR 120-242 is more vigorous than M.9 with a larger trunk girth and tree volume but with cropping levels similar to M.9 the yield efficiency of AR 120-242 was significantly lower. The growth and cropping of AR 295-6 was generally similar to M.9 although cumulative yield tended to be lower.

Whilst AR 486-1 and AR 120-242 provide a slightly lower and higher vigour respectively than M.9, it is currently disappointing that the yield efficiencies are much lower than for M.9. It will be interesting to follow the cropping performance of these selections in future years.

Table 3. Growth and cropping in 2007 of 'Queen Cox' trees (EE 195) on rootstocks from the East Malling Research breeding programme planted in spring 2003. Data presented for blocks 1-IV only (see text). (SED–Standard Error of the Difference between means, LSD–Least Significant Difference between means, df–degrees of freedom, rootstock effect was either non-significant (n.s.) or significant at the 5 (*), 1 (**) or 0.1% (***) level of probability)

Rootstock	Girth 2007 (cm / tree)	Tree Volume 2007 (m^3)	Yield 2007 (kg/tree)	Yield Class 1 >65 mm 2007 (kg / tree)	Suckers 2007 (No. / tree)
M.9	10.7	7.8	18.5	6.9	2.5
AR 486-1	10.1	5.3	3.6	2.1	0.5
AR 295-6	10.2	9.5	14.3	10.6	0
AR 120-242	13.0	11.2	15.9	12.0	0
SED (9 df)	0.46	1.02	4.66	2.73	1.17
LSD (P=0.05)	1.04	2.31	10.55	6.19	2.66
Rootstock effect	***	**	*	*	n.s.

Table 4. Cumulative yield and yield efficiency of 'Queen Cox' trees (Plot EE 195) on rootstocks from the East Malling Research breeding programme planted in spring 2003. Data presented for blocks 1-IV only (see text). (SED–Standard Error of the Difference between means, LSD–Least Significant Difference between means, df–degrees of freedom, rootstock effect was either non-significant (n.s.) or significant at the 5 (*), 1 (**) or 0.1% (***) level of probability)

Rootstock	Cumulative yield 2004-07 (kg / tree)		Yield efficiency (kg / cm^2)
	Total	Class 1 >65 mm	
M.9	30.0	11.5	3.3
AR 486-1	15.6	6.3	2.0
AR 295-6	23.1	14.3	2.8
AR 120-242	29.5	16.9	2.2
SED (9 df)	3.77	3.36	0.47
LSD (P=0.05)	8.53	7.60	1.06
Rootstock effect	**	*	n.s.

Under organic management

Selections AR 486-1, AR 295-6 and 120-242 (Plot GE 182)

There were only sufficient grafted 2-year-old trees of AR 295-6 to complete four of the eight blocks respectively. The remaining blocks were completed using budded 1-year-old trees. In order to compare all rootstocks the analysis of the growth data was necessarily restricted to the four complete blocks of grafted trees. It is anticipated that as the trees get older any

potential differences between the budded and grafted trees will diminish and it will be appropriate to use all eight replicate trees in the statistical analysis. To compare only AR 486-1, AR 120-242 and M.9 the data can be restricted so that the data for all eight blocks are used.

Trunk girth and tree volumes for M.9 and the new selections were similar and there was virtually no crop on any of the trees in 2007 (Tables 5 and 6). As noted previously (see first year report for TF 172) there was a major impact of the production system on tree performance. Rosy apple aphid (RAA) has been the most serious problem affecting the trees despite autumn applications of pyrethrum. Average tree volume and trunk girth were reduced from 8.4 m^3 and 11.0 cm to 2.8 m^3 and 7.9 cm respectively through the adoption of organic management. Whilst trees under conventional management produced an average yield of 13.1 kg, those under organic conditions yielded only 0.3 kg.

Table 5. Growth in 2007 of 'Queen Cox' trees (Plot GE 182) on rootstocks from the East Malling Research breeding programme planted in spring 2003 and managed under organic conditions. Data presented for blocks 1-IV only (see text). (SED–Standard Error of the Difference between means, LSD–Least Significant Difference between means, df–degrees of freedom, rootstock effect was either non-significant (n.s.) or significant at the 5 (*), 1 (**) or 0.1% (***) level of probability)

Rootstock	Girth 2007 (cm / tree)	Tree Volume 2007 (m^3)	Yield 2007 (kg/tree)	Yield Class 1 >65 mm 2007 (kg / tree)	Suckers 2007 (No. / tree)
M.9	7.9	3.1	0	0	0
AR 486-1	7.3	2.0	0	0	0
AR 295-6	7.7	3.3	0.4	0.2	0
AR 120-242	8.6	2.7	0.7	0.5	0
SED (8 df)	0.56	0.55	0.5	0.37	-
LSD (P=0.05)	1.29	1.28	1.16	0.86	-
Rootstock effect	n.s.	n.s.	n.s.	n.s.	-

Table 6. Cumulative yield and yield efficiency of 'Queen Cox' trees (Plot GE 182) on rootstocks from the East Malling Research breeding programme planted in spring 2003. Data presented for blocks 1-IV only (see text). (SED–Standard Error of the Difference between means, LSD–Least Significant Difference between means, df–degrees of freedom, rootstock effect was either non-significant (n.s.) or significant at the 5 (*), 1 (**) or 0.1% (***) level of probability)

Rootstock	Cumulative yield 2004-07 (kg / tree)		Yield efficiency (kg / cm^2)
	Total	Class 1 >65 mm	
M.9	3.3	0.4	0.7
AR 486-1	1.7	0.2	0.5
AR 295-6	2.8	0.4	0.6
AR 120-242	3.6	0.5	0.6
SED (8 df)	0.8	0.50	0.17
LSD (P=0.05)	1.84	1.16	0.39
Rootstock effect	n.s.	n.s.	n.s.

Performance of 'Bramley's Seedling' on new East Malling Research rootstock selections

Under conventional management

Selections AR 628-1, AR 69-7, AR 360-19 and AR 801-11(Plot EE195)

The design of the trial on EE 195 was complicated by insufficient numbers of grafted trees for AR 360-19 and AR 801-11 to complete eight blocks as planned. There were sufficient trees for five blocks of these rootstocks and eight blocks of AR 628-2, AR 69-7 and M.27 controls. Additional trees on AR 628-2, AR 69-7 were used to complete the blocks.

The analysis of the data was necessarily restricted to the five complete blocks of grafted trees. In addition the trees with eight replicates (AR 628-2, AR 69-7 and M.27) were analysed separately.

It is expected that the new rootstock selections will confer tree sizes in the M.27-M.9 range with the exception of AR 801-11 which should have a vigour status closer to M.26. It is anticipated that as the trees get older any potential differences due to tree age at planting will diminish. Clearly it will take a number of growing seasons for the trees to establish and produce significant quantities of fruit.

Currently the selections AR 360-19 and AR 69-7 are performing similarly to M.27 in terms of growth and cropping (Tables 7 and 8). AR 628-2 is less vigorous than M.27 as evidenced by a smaller girth and tree volume but yields have been poor and yield efficiency much less than for M.27. AR 801-11 continues to be more vigorous and to crop more heavily than M.27 and to provide similar yield efficiency.

Table 7. Growth and cropping in 2007 of 'Bramley's Seedling' trees (Plot EE 195) on rootstocks from the East Malling Research breeding programme planted in spring 2003. Data presented for blocks 1-V only (see text). (SED–Standard Error of the Difference between means, LSD–Least Significant Difference between means, df–degrees of freedom, rootstock effect was either non-significant (n.s.) or significant at the 5 (*), 1 (**) or 0.1% (***) level of probability)

Rootstock	Girth 2007 (cm / tree)	Tree Volume 2007 (m^3)	Yield 2007 (kg/tree)	Yield Class 1 >80 mm 2007 (kg / tree)	Suckers 2007 (No. / tree)
M.27	9.7	3.3	4.2	3.2	1.0
AR 360-19	9.4	2.4	5.1	3.9	2.2
AR 69-7	9.9	2.0	4.1	2.5	0.2
AR 628-2	7.8	0.7	1.0	0.1	0.4
AR 801-11	14.1	9.5	14.6	11.0	0.6
SED (16 df)	0.69	1.22	2.75	2.14	0.97
LSD (P=0.05)	1.47	2.59	5.84	4.53	2.06
Rootstock effect	***	***	**	***	n.s.

Table 8. Cumulative yield and yield efficiency of 'Bramley's Seedling' trees (Plot EE 195) on rootstocks from the East Malling Research breeding programme planted in spring 2003. Data presented for blocks 1-V only (see text). (SED–Standard Error of the Difference between means, LSD–Least Significant Difference between means, df–degrees of freedom, rootstock effect was either non-significant (n.s.) or significant at the 5 (*), 1 (**) or 0.1% (***) level of probability)

Rootstock	Cumulative yield 2004-07 (kg / tree)		Yield efficiency (kg / cm^2)
	Total	Class 1 >80 mm	
M.27	9.8	6.9	1.3
AR 360-19	8.4	6.1	1.2
AR 69-7	8.8	6.1	1.2
AR 628-2	3.0	0.1	0.7
AR 801-11	20.6	15.2	1.2
SED (16 df)	3.52	3.00	0.29
LSD (P=0.05)	7.61	6.48	0.62
Rootstock effect	**	**	n.s.

Under organic management

Selections AR 628-1, AR 69-7, AR 360-19 and AR 801-11(Plot GE 182)

The constraints on the design of the orchard under conventional management imposed by lack of sufficient grafted trees (see above) applied also to the orchard planted in the organic area at EMR.

As in the previous year AR 801-11 had a larger girth measurement than M.27 (Table 9). The growth of the remaining new selections was similar to M.27. There was virtually no yield on any of the trees in 2007 which precluded any assessment of rootstock effects. The results for AR 801-11 were similar to those obtained in the orchard managed conventionally. It should be borne in mind that any differences in girth measurements may reflect the fact that the control (M.27) trees were one year old when planted and were obtained from a different UK nursery to the two-year-old trees on the experimental rootstocks. However it is expected that these rootstocks are likely to provide tree sizes in the M.27-M.9 range with the exception of AR 801-11 which should have a vigour status closer to M.26. It is anticipated that as the trees get older any potential differences due to tree age at planting will diminish.

Overall there was a major impact of the production system on tree performance. Rosy apple aphid (RAA) has been the most serious problem affecting the trees despite autumn applications of pyrethrum. Tree volume and trunk girth were reduced from 3.6 m^3 and 10.2 cm to 1.2 m^3 and 8.5 cm respectively through the adoption of organic management. Whilst trees under conventional management produced an average yield of 5.8 kg those under organic conditions yielded only 0.5 kg.

Table 9. Growth and cropping in 2007 of 'Bramley's Seedling' trees (Plot GE 182) on rootstocks from the East Malling Research breeding programme planted in spring 2003. Data presented for blocks 1-V only (see text). (SED–Standard Error of the Difference between means, LSD–Least Significant Difference between means, df–degrees of freedom, rootstock effect was either non-significant (n.s.) or significant at the 5 (*), 1 (**) or 0.1% (***) level of probability)

Rootstock	Girth 2007 (cm / tree)	Tree Volume 2007 (m^3)	Yield 2007 (kg / tree)	Yield Class 1 >80 mm 2007 (kg / tree)	Suckers 2007 (No. / tree)
M.27	7.3	1.0	0.6	0.1	0
AR 360-19	6.7	0.3	0.2	0	0
AR 69-7	8.8	1.0	0.5	0.1	0
AR 628-2	6.8	0.3	0.2	0	0
AR 801-11	12.8	3.6	1.0	0	0
SED (16 df)	1.09	0.45	0.44	0.08	-
LSD (P=0.05)	2.32	0.96	0.94	0.18	-
Rootstock effect	***	***	n.s.	n.s.	-

Table 10. Cumulative yield and yield efficiency of 'Bramley's Seedling' trees (Plot GE 182) on rootstocks from the East Malling Research breeding programme planted in spring 2003. Data presented for blocks 1-V only (see text). (SED–Standard Error of the Difference between means, LSD–Least Significant Difference between means, df–degrees of freedom, rootstock effect was either non-significant (n.s.) or significant at the 5 (*), 1 (**) or 0.1% (***) level of probability)

Rootstock	Cumulative yield 2004-07 (kg / tree)		Yield efficiency (kg / cm^2)
	Total	Class 1 >80 mm	
M.27	1.4	0.1	0.4
AR 360-19	0.7	0.1	0.2
AR 69-7	1.2	0.2	0.2
AR 628-2	0.6	0	0.2
AR 801-11	1.9	0.1	0.2
SED (16 df)	0.57	0.10	0.15
LSD (P=0.05)	1.22	0.22	0.33
Rootstock effect	n.s.	n.s.	n.s.

Performance of 'Comice' and 'Conference' on Quince (EMC and C132) and *Pyrus* (BP30) rootstocks

The trees on PR 184 were budded at a height of 10 and 25 cm. Previous work (see final report for APRC on SP 123) had shown that increasing the height of budding on 'Comice' reduced the vigour of trees on EMC rootstock.

In 2007 tree volume and total yield of trees on BP30 rootstocks was lower than on EMC and there was less large fruit (>65 mm) (Table 11). Cumulative yield on BP30 rootstocks was also lower than on EMC and, on 'Comice', cumulative yield of large fruit was also lower. In 'Comice' budded at 25 cm BP30 was less yield efficient than EMC.

The vigour of C132 and EMC trees budded at 25 cm was similar but at the lower bud height the trunk girth of C132 exceeded that of EMC (Table 12). Overall the tree volumes of C132 and EMC were similar. 'Conference' on C132 tended to yield less than on EMC but there was no effect on 'Comice'. Overall the cumulative yields for C132 and EMC were similar and, on 'Comice', C132 cumulative yields of large fruit were higher.

Table 11. Cropping in 2007 of 'Comice' and 'Conference' trees on Quince (EMC and C132) and *Pyrus* (BP30) rootstocks planted spring 1999 (Plot PR 184). (SED–Standard Error of the Difference between means, LSD–Least Significant Difference between means, df–degrees of freedom, rootstock effect was either non-significant (n.s.) or significant at the 5 (*), 1 (**) or 0.1% (***) level of probability)

Cultivar	Rootstock	Bud height (cm)	Total yield (kg / tree)		Yield Class 1 >65 mm (kg / tree)	
			2007	Cumulative	2007	Cumulative
'Comice'	EMC	10	10.4	55.4	9.3	44.4
	EMC	25	11.5	58.5	10.2	46.0
	BP30	10	6.7	46.9	4.4	34.8
	BP30	25	9.0	48.6	6.7	39.9
	C132	10	13.4	63.6	12.0	58.1
	C132	25	11.5	59.4	10.2	54.2
'Conference'	EMC	10	8.8	37.7	1.9	2.8
	EMC	25	11.6	43.5	1.7	2.8
	BP30	10	4.7	35.0	1.4	5.7
	BP30	25	5.9	37.6	0.1	3.9
	C132	10	6.7	40.9	3.5	6.0
	C132	25	3.8	39.1	2.2	7.7
Overall effect	EMC		10.6	48.8	5.8	24.0
	BP30		6.6	42.0	3.1	21.1
	C132		8.8	50.8	7.0	31.5
SED(92 df)			1.66	3.33	1.20	2.50
LSD (P=0.05)			3.30	6.61	2.39	4.96
Rootstock effect			*	*	**	***

Table 12. Growth in 2007 of 'Comice' and 'Conference' trees on Quince (EMC and C132) and *Pyrus* (BP30) rootstocks planted spring 1999 (Plot PR 184). (SED–Standard Error of the Difference between means, LSD–Least Significant Difference between means, df–degrees of freedom, rootstock effect was either non-significant (n.s.) or significant at the 5 (*), 1 (**) or 0.1% (***) level of probability)

Variety	Rootstock	Bud height (cm)	Girth 2007 (cm / tree)	Tree Volume 2007 (m^3)	Yield efficiency (kg / cm^2)
'Comice'	EMC	10	21.6	6.6	1.5
	EMC	25	19.7	6.6	1.9
	BP30	10	20.2	4.5	1.5
	BP30	25	21.1	5.4	1.4
	C132	10	23.5	6.5	1.5
	C132	25	20.3	7.5	1.8
'Conference'	EMC	10	15.9	4.9	1.9
	EMC	25	14.9	4.0	2.5
	BP30	10	14.0	3.5	2.0
	BP30	25	15.9	4.2	1.8
	C132	10	17.7	4.9	1.7
	C132	25	15.3	4.6	2.1
Overall effect	EMC		18.0	5.5	1.9
	BP30		17.8	4.4	1.7
	C132		19.2	5.9	1.8
SED (92 df)			0.55	0.34	0.11
LSD (P=0.05)			1.09	0.68	0.23
Rootstock effect			*	***	*

Performance of 'Conference' on 'Quince' (EMC and C132) and *Pyrus* (QR708/2) rootstocks

This trial was completed in 2007 and the trees were grubbed during the winter of 2007/8.

QR708/2 continued to be more vigorous than EMC as evidenced by a greater girth in 2007 and higher grubbing weight but yield efficiency was poor (Tables 13 and 14). As noted in previous reports, there appears to be an incompatibility between 'Conference' and QR708/2 with the result that 50% of the trees have died.

Statistical analysis of the data was restricted in order to compare EMC and C132 without the effect of missing data values for QR708/2 in the analysis of variance. Analysis of the restricted data showed that C132 was less vigorous than EMC (smaller girth, tree volume and lower grubbing weight) and although cumulative yield tended to be lower the yield efficiencies of C132 and EMC were the same (Table 14). Results in 2007 were therefore essentially the same as those obtained in the previous years. These results indicate that C132 can provide the UK industry with a smaller tree than EMC with no loss of yield efficiency.

Table 13. Growth and cropping in 2007 of 'Conference' trees on Quince (EMC and C132) and *Pyrus* (QR 708/2) rootstocks planted spring 1997 (Plot PR 173). (SED–Standard Error of the Difference between means, LSD–Least Significant Difference between means, df–degrees of freedom, rootstock effect was either non-significant (n.s.) or significant at the 5 (*), 1 (**) or 0.1% (***) level of probability)

Rootstock	Girth 2007 (cm / tree)	Yield 2007 (kg / tree)			Tree volume 2007 (m^3)
		Total	Class 1 55-65 mm	Class 1 >65 mm	
QR 708/2	24.2	5.7	3.1	1.8	5.0
C132	15.2	6.5	2.7	2.5	3.2
EMC	17.8	7.9	3.4	2.3	5.3
SED (13 df)	0.92	1.21	0.60	0.95	0.67
LSD (P=0.05)	2.01	2.64	1.32	2.08	1.46
Rootstock effect	***	n.s.	n.s.	n.s.	**

Table 14. Cumulative yield and yield efficiency of 'Conference' trees on Quince (EMC and C132) and *Pyrus* (QR708/2) rootstocks planted spring 1997 (Plot PR 173). (SED–Standard Error of the Difference between means, LSD–Least Significant Difference between means, df–degrees of freedom, rootstock effect was either non-significant (n.s.) or significant at the 5 (*), 1 (**) or 0.1% (***) level of probability)

Rootstock	Cumulative yield 1999-07 (kg / tree)		Yield efficiency (kg / cm^2)	Grubbing weight (kg)	Suckers 2007 (No. / tree)
	Total	Class 1 >65 mm			
QR 708/2	43.8	7.3	0.8	8.1	7.0
C132	45.6	8.0	2.5	3.4	3.5
EMC	57.2	8.0	2.2	5.6	3.6
SED (13 df)	5.86	1.85	0.14	0.77	2.41
LSD (P=0.05)	12.91	4.08	0.32	1.68	5.22
Rootstock effect	n.s.	n.s.	***	***	n.s.

International plum rootstock trial

The trial suffered serious damage from hail on three occasions prior to harvest. Consequently the decision was made not to take any records in 2007. It was considered that the serious damage and loss of fruit experienced in 2007 was likely to distort yield data in 2007 and more importantly the cumulative yield and yield efficiency data. It is planned to resume recording of the trial in 2008.

Cherry rootstock trials at EMR

International trial (plot MP 165)

2007 was the final year of the trial on MP 165 and the trees have now been grubbed.

Since ‘Gisela 5’ has generally become the industry standard rootstock for cherry it is more appropriate to consider this as the control for the experiment rather than Colt which proved to be the most vigorous and least yield efficient rootstock in the trial.

There were only three rootstocks that provided yield efficiencies similar to ‘Gisela 5’, namely ‘Gisela 4’, ‘Weiroot 53’ and ‘G523-02’ (Table 16). ‘Gisela 4’ and ‘G523-02’ were similar in vigour to ‘Gisela 5’ and although cumulative yield and yield efficiencies were similar the mean fruit weight averaged over 5 years (2003-7 inclusive) was higher for ‘Gisela 4’ (see year 1 report for fruit size data in previous years) (Table 15). ‘Weiroot 53’ was less vigorous than ‘Gisela 5’. Based on measurements of trunk girth, tree volume and grubbing weight the size of ‘Weiroot 53’ trees was 70, 65 and 59% of ‘Gisela 5’ trees respectively and yet maintained a similar level of yield efficiency. Colour measurements made at harvest suggested that fruit on ‘Weiroot 53’ were at a more advanced stage of maturity than those on ‘Gisela 5’ rootstocks. A similar effect was noted on other very dwarfing rootstocks such as Tabel Edabriz and Weiroot 158.

Whilst the use of ‘Gisela 4’ and ‘Weiroot 53’ may have advantages over ‘Gisela 5’ in terms of fruit size and smaller tree size respectively there appears to be no significant advantage of ‘G523-02’ unless this selection proved to be easier to propagate.

Table 15. The effect of rootstock on the growth of ‘Lapins’ cherry trees planted on plot MP 165 at East Malling Research in March 1999. (SED–Standard Error of the Difference between means, LSD–Least Significant Difference between means, df–degrees of freedom, rootstock effect was either non-significant (n.s.) or significant at the 5 (*), 1 (**) or 0.1% (***) level of probability)

	Girth 2007 (cm / tree)	**Tree Volume 2007 (m^3)**	**Grubbing weight (kg)**	**Suckers 2007 (No. / tree)**
Tabel Edabriz	26.4	15.1	10.5	0.2
Gisela 4	30.5	22.5	17.1	1.0
PHL-B	29.9	18.2	16.1	0.3
PHL-A	35.3	21.7	20.6	0.2
Weiroot 158	27.2	14.9	10.8	0.2
Gisela 5	29.2	24.9	16.3	0
Damil	24.1	20.3	12.2	0.1
G 497-8	33.8	29.4	24.5	0.4
Piku 4	32.9	26.3	22.4	0.4
Weiroot 53	20.4	16.3	9.6	0.5
G 148-8	33.4	23.2	21.5	0.1
G195-20	27.4	15.2	12.2	0.3
G154-7	29.6	25.8	19.3	2.5
G523-02	29.0	28.9	18.2	0.6
Colt	43.8	37.0	44.1	0.6
SED (102 df)	1.80	3.39	2.71	0.41
LSD (P=0.05)	3.57	6.73	5.37	0.82
Rootstock effect	***	***	***	***

Table 16. The effect of rootstock on the cropping of 'Lapins' cherry trees planted on plot MP 165 at East Malling Research in March 1999. (SED–Standard Error of the Difference between means, LSD–Least Significant Difference between means, df–degrees of freedom, rootstock effect was either non-significant (n.s.) or significant at the 5 (*), 1 (**) or 0.1% (***) level of probability)

	Yield (kg/tree)	Mean fruit Wt. (g)	Cumulative yield (kg/tree)	Yield efficiency (kg/cm^2)	Fruit colour
Tabel Edabriz	7.5	7.8	24.2	0.45	5.2
Gisela 4	11.4	10.9	39.9	0.55	3.6
PHL-B	11.2	10.5	35.7	0.47	3.6
PHL-A	13.2	10.7	41.4	0.41	3.1
Weiroot 158	4.6	10.3	21.9	0.38	4.8
Gisela 5	12.3	10.7	42.1	0.63	3.4
Damil	5.1	10.4	20.2	0.42	3.2
G 497-8	17.3	10.6	49.6	0.53	3.4
Piku 4	14.5	9.2	45.7	0.53	3.2
Weiroot 53	7.4	9.2	19.6	0.58	5.1
G 148-8	14.8	9.7	42.1	0.49	3.4
G195-20	10.3	11.5	30.3	0.51	2.8
G154-7	10.7	10.9	37.9	0.53	3.2
G523-02	17.9	9.9	45.9	0.69	3.5
Colt	8.3	10.2	28.2	0.18	3.0
SED (102 df)	2.20	0.62	4.76	0.043	0.31
LSD (P=0.05)	4.36	1.22	9.45	0.086	0.62
Rootstock effect	***	***	***	***	***

Russian ('Krymsk') rootstock trial (plot MP 177)

Both LC-52 and VSL-2 have proved to be very precious in terms of their cropping. After five growing seasons LC-52 continues to be more vigorous (larger trunk girth) and higher yielding (2007 and cumulative) than VSL-2 and has achieved a higher yield efficiency (Table 17). LC-52 also produced few suckers compared with VSL-2.

Table 17. The effect of rootstock on the growth and cropping of 'Summersun' cherry trees planted on plot MP 177 at East Malling Research on 18 April 2002. (SED–Standard Error of the Difference between means, LSD–Least Significant Difference between means, df–degrees of freedom, rootstock effect was either non-significant (n.s.) or significant at the 5 (*), 1 (**) or 0.1% (***) level of probability)

	Girth 2007 (cm / tree)	Yield (kg / tree)	Mean Fruit Wt. (g)	Cumulative Yield (kg / tree)	Yield Efficiency (kg / cm^2)	Suckers 2007 (No. / tree)
LC-52	32.6	14.6	9.3	44.4	0.53	0.2
VSL-2	28.7	8.4	8.8	30.8	0.47	3.2
SED (17 df)	1.07	1.66	0.50	2.22	0.017	0.86
Rootstock effect	**	**	n.s.	***	**	**

'Gisela 3' and '5' comparison (plot MP 186)

After two growing seasons 'Gisela 3' tended to be less vigorous (lower shoot length and smaller trunk girth) than 'Gisela 5' but not significantly so (Table 18). The average yield of trees in 2007 was 7 fruits. Although there were no significant effects of rootstock on yield, Gisela 3 tended to produce fewer fruits.

Table 18. The effect of Gisela rootstocks on the growth and cropping of 'Penny' cherry trees planted on plot MP 186 at East Malling Research in March 2006. (SED–Standard Error of the Difference between means, LSD–Least Significant Difference between means, df–degrees of freedom, rootstock effect was either non-significant (n.s.) or significant at the 5 (*), 1 (**) or 0.1% (***) level of probability)

Rootstock	Girth 2007 (cm/tree)	Total shoot no./tree 2007	Total shoot length 2007 (dm/tree)	Yield 2007 (fruit no./tree)	Mean fruit weight (g)	Suckers 2007 (no./tree)
Gisela 3	10.7	24.9	102.8	4.2	11.5	0.3
Gisela 5	11.8	23.5	128.4	10.4	10.4	0
SED (7 df)	0.57	2.98	14.41	3.41	1.13	0.25
LSD (P=0.05)	1.37	7.04	34.08	8.06	2.76	0.59
Rootstock effect	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

EMR rootstock selections tested on 'Sunburst' (plot MP 182)

C376-1 is more vigorous and C113-3 less vigorous than 'Gisela 5' as evidenced by significant effects on trunk girth and tree volume (Table 19). Although the girths of C376-4, C376-5 and 'Tabel Edabriz' were similar to that of 'Gisela 5', tree volumes tended to be lower. Cropping data is not yet available for this trial.

Table 19. The effect of East Malling Research rootstock selections on the growth of 'Sunburst' cherry trees planted on plot MP 182 at EMR in April 2005. (SED–Standard Error of the Difference between means, LSD–Least Significant Difference between means, df–degrees of freedom, rootstock effect was either non-significant (n.s.) or significant at the 5 (*), 1 (**) or 0.1% (***) level of probability)

Rootstock	Girth 2007 (cm/tree)	Tree Volume 2007 (m^3)	Suckers 2007 (no./tree)
C113-3	11.8	4.5	0.4
C376-1	17.0	15.3	0.4
C376-4	15.5	6.7	0.2
C376-5	14.3	8.5	0.4
Tabel Edabriz	15.5	7.7	0.2
Gisela 5	14.9	10.3	0.2
SED (14 df)	1.08	2.16	0.34
LSD (P=0.05)	2.34	4.64	0.73
Rootstock effect	**	**	n.s.

Conclusions

Apple rootstock trials planted at EMR

It is too early to draw any conclusions from trials planted in 2003 (Plots EE 195 and GE 182) and 2004 (Plot CE 190). There have been insufficient cropping years to draw conclusions regarding yield and yield efficiency. The vigour of the rootstock selections is generally as expected, based on results of previous trials. It is encouraging that after 3 years from planting 'Cox' ('La Vera') trees on AR 801-11 are less vigorous than on M.9 but cropping similarly. Whilst AR 486-1 and AR 120-242 provide a slightly lower and higher vigour for 'Queen Cox' than M.9 respectively the yield efficiencies are currently much lower than for M.9. On Bramley a range of vigour is being provided by new rootstock selections. Apart from AR 628-2 the performance of new selections has been similar to M.27. As in the 'Cox' ('La Vera') trial, 'Bramley' on AR801-11 continues to perform well. It is interesting to note the extent of the general suppression of tree growth and cropping under organic management. Undoubtedly the failure to control rosy apple aphid has played a significant part in the poor performance of trees in the organic plots.

Pear rootstock trials planted at EMR

Results with C132, a quince rootstock from the EMR breeding programme, in the two trials at EMR continue to be contradictory, particularly as regards the vigour of the rootstock in comparison with EMC. In the younger trial there was no greater dwarfing effect of C132 on either 'Conference' or 'Comice'. Overall the cumulative yields for C132 and EMC were similar, and on 'Comice' C132 cumulative yields of large fruit were higher. In the older trial 'Conference' on C132 was less vigorous than on EMC (smaller girth, tree volume and lower grubbing weight) and, although cumulative yield tended to be lower, the yield efficiencies of C132 and EMC were the same. These results indicate that C132 can provide the UK industry with a smaller tree than EMC with no loss of yield efficiency.

Tree density may be a factor influencing the comparative vigour of 'Conference' on the different stocks. In the older trial the trees were more densely planted than in the younger trial. In trials done in the UK and the Netherlands C132 has shown potential as a rootstock more dwarfing than EMC with similar yield efficiency and fruit size. Within the current phase of HDC-funded rootstock trialling it is intended that C132 is compared with EMC in grower trials. Two hundred C132 rootstocks and a similar number of EMC have been lined out at EMR and will be budded with 'Conference' during summer 2008. It is anticipated that 2-year-old 'Conference' trees of C132 and EMC will be available for planting in grower trials in the winter of 2009/10. Overall the performance of BP30 (a promising Swedish *Pyrus* selection)

has been similar to that of EMC and remains a promising selection where *Pyrus* rootstocks are preferred to Quince.

Results for QR708/2, a dwarfing *Pyrus* selection from the EMR programme, have not been promising. QR708/2 continues to be more vigorous than EMC but has a lower cumulative yield and yield efficiency and appears to be incompatible with 'Conference' with the result that 50% of the trees have died.

International plum rootstock trial on a commercial farm

The trial suffered serious damage from hail on three occasions prior to harvest. Consequently the decision was made not to take any records in 2007.

Cherry rootstock trials planted at EMR

The international ('Lapins') rootstock trial planted in 1999 was concluded in 2007. 'Gisela 5' proved to be a consistently high performer with a high cumulative yield and yield efficiency. There were only three rootstocks that provided yield efficiencies similar to 'Gisela 5' namely 'Gisela 4', 'Weiroot 53' and 'G523-02'. Mean fruit weight averaged over 5 years (2003-7 inclusive) was higher for 'Gisela 4' than for 'Gisela 5'. 'Weiroot 53' was much less vigorous than 'Gisela 5' but maintained a similar level of yield efficiency. Whilst the use of 'Gisela 4' and 'Weiroot 53' may have advantages over 'Gisela 5' in terms of fruit size and smaller tree size respectively there appears to be no specific advantage of 'G523-02'.

Russian 'Krymsk' rootstocks LC-52 and VSL-2 have proved to be very precocious in terms of yield of 'Summersun' cherries. LC-52 continues to be more vigorous and higher yielding than VSL-2 and is more yield efficient.

The EMR rootstock selection C113-3 on 'Sunburst' continues to be more dwarfing than 'Gisela 5' but no cropping data is available yet in this trial planted in 2005.

In the second year of a trial comparing 'Gisela 3' and 'Gisela 5' worked with the cultivar 'Penny', the former tended to be less vigorous than 'Gisela 5' but not significantly so. The trees carried a few fruits in 2007 (average 7/tree) with Gisela 3 tending to produce less fruit than 'Gisela 5'.

Technology Transfer

No activity in 2007/8.

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