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Background

For the 6 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 with additional funding from APRC in 2000-01. A report on the work carried out during that 6-year period was prepared by Tony Webster and colleagues and submitted to APRC (Project SP123) and the EM 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 3 years (March 2005). This is a report on the work carried out from April 2002 until March 2003. 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 (M116).

Apple rootstock trials

Introduction

Currently two trials of apple rootstocks raised by breeders based outside of the UK are planted.

In the trial planted in spring 1995 with Queen Cox, new rootstocks from the Geneva New York breeding programme are being compared with M9 and MM106. These rootstocks, some of which are now becoming available commercially in Europe, were bred to provide improved resistances to winter cold injury, fire blight, woolly apple aphid, crown rot and tomato ringspot virus. Several rootstocks from this programme are showing initial promise in trials conducted in New Zealand and the USA. With vigour closer to M26 than to M9 one or more of these rootstocks may have potential on sites where weed/grass competition for water and nutrients is significant.

The trial planted in spring 2000 with Mondial Gala, compares three of the rootstocks raised at the Vineland Research Station in Canada with the French Pajam 2 rootstock. These rootstocks are M9-M26 in vigour but possibly have better cold and drought resistance than M9. The Vineland series of rootstocks were bred to provide improved cold tolerance, but have also performed well in less severe conditions on some USA sites.

I - Evaluation of Queen Cox on Geneva Rootstocks

Results & Discussion

Sufficient data has been gathered since 1995 to make an objective assessment of the performance of Queen Cox on the Cornell-Geneva rootstocks (see Tables 1 & 2). Vigour of the rootstocks can be assessed by the annual girth measurement and by the estimates of tree volume that were done less frequently (last done in the winter of 2001-02 and included in the Report to 31 March 2002).

Table 1. Size and yields (2002 crop) of Queen Cox trees planted on Cornell-Geneva (USA) rootstocks in 1995

Rootstock	**Trunk girth (cm/tree in year 2002)**	**Yield (kg/tree) in year 2002**	
		Total	Class 1 >65 mm
G11	23.2	9.3	5.6
G30	28.5	11.3	6.9
G902	20.7	8.2	5.3
G730	17.5	7.1	5.4
G202	23.8	10.0	6.2
G210	25.2	7.6	5.7
G179	23.1	6.4	5.1
M9	23.9	9.7	6.5
MM106	29.0	18.8	13.4

Table 2. Accumulated yields and yield efficiencies of Queen Cox trees planted on Cornell-Geneva (USA) rootstocks in 1995

Rootstock	**Cumulative yield (kg / tree) 1996-2002**		**Yield efficiency (kg / cm^2)**
	Total	Class 1 >65 mm	Cumulative total yield / Trunk cross sectional area in 2002-03
G11	73.0	43.0	1.70
G30	103.8	59.3	1.61
G902	56.4	33.2	1.66
G730	43.5	28.3	1.78
G202	80.0	47.7	1.77
G210	62.6	37.4	1.24
G179	64.4	40.3	1.52
M9	51.6	35.4	1.14
MM106	117.9	72.2	1.76

Geneva 11 (G11) produced similar sized trees to M9 but with a higher cumulative yield and a higher percentage of Class 1 fruit. Consequently the yield efficiency of G11 was higher (1.7) than M9 (1.1).

Geneva 30 (G30) was of similar vigour to MM106 but cumulative yields (total and % Class 1) and yield efficiency were lower.

Geneva 902 (G902) has produced trees slightly smaller than M9. Although yields and grade-outs for G902 have been similar to those from M9, yield efficiency was greater for G902.

Geneva 730 (G730) is the most dwarfing rootstock in the trial with a tree volume of half that of M9 (see Report to 31 March 2002). However, yield efficiency was much higher in G730 (1.8) compared with M9 (1.1) and the percentage of class 1 fruit (65%) was only slightly below that of M9 (69%).

Geneva 202 (G202) produced similar sized trees to M9 but with a higher yield efficiency. G202 and G730 had the highest yield efficiencies in the trial but the percentage of Class 1 fruit was lower for G202 (59%) than for G730 (65%) and M9 (69%).

Geneva 210 (G210) produced similar sized trees to M9. Although yield efficiency was similar to M9 it was the lower than all other Geneva rootstocks in the trial.

Geneva 179 (G179) had a tree volume greater than anticipated from girth measurements (see Report to March 2002). Although yield efficiency (1.5) was only intermediate between M9 and the best of the Geneva rootstocks, the grade-out in 2002 was quite good (63% of fruit in Class 1 above 65 mm).

Conclusion

G11 and G202 performed particularly well in this trial. Although of similar vigour to M9, G11 and G202 out-yielded M9 in the period 1996-2002 by 41% and 55% respectively. These yield increases would have more than compensated for a 10% reduction in the percentage of Class 1 fruit produced by trees on these rootstocks.

II - Evaluation of Mondial Gala on Vineland Rootstocks

Results & Discussion

At noted previously (see report on SP 134 to 31 March 2002) at the time of planting in March 2000 the tree quality of these bench grafts was very poor in comparison with the controls used on Pajam 2. The growth of the Vineland rootstocks was poor in the first year but total shoot growth exceeded that of Pajam 2 in 2002 (Table 3). Trees on Vineland rootstocks produced their first significant crop in 2002 but further years of sustained cropping are needed before meaningful assessments of their performance can be made (Table 4).

Table 3. Growth in 2002 of Mondial Gala trees on Vineland rootstocks planted spring 2000

Rootstock	**Girth (cm / tree)**	**Total shoot length (dm / tree)**	**Mean shoot length (dm / tree)**	**Total shoot number**
V1	8.7	130.6	4.1	27
V3	8.3	117.0	4.5	26
V4	10.5	197.3	5.7	35
Pajam 2	9.0	100.3	3.3	30

Table 4. Cropping in 2002 of Mondial Gala trees on Vineland rootstocks planted spring 2000

Rootstock	**Total yield (kg / tree)**		**Yield Class 1 >65 mm (kg / tree)**	
	2002	Cumulative	2002	Cumulative
V1	3.7	4.2	2.0	2.5
V3	2.7	3.4	1.5	2.2
V4	0.9	0.9	0.7	0.7
Pajam 2	5.8	8.6	3.6	6.2

Pear rootstock trials

Introduction

Three trials of quince and *Pyrus* rootstocks planted at HRI-East Malling continue to be evaluated. Two of these trials include C132, a quince rootstock from the HRI breeding programme, which is slightly more dwarfing than Quince C and possibly more winter hardy. In the first trial (Plot PR 184), C132 is compared with Quince C (EMC) and a promising Swedish *Pyrus* selection (BP30). In the second trial (Plot PR173), C132 is compared with EMC and a dwarfing *Pyrus* selection from the HRI programme, QR708/2. In the third trial (Plot PR187) a new dwarfing *Pyrus* selected at Geisenheim, in Germany, named 'Pyrodwarf' is being evaluated.

I - Evaluation of Comice and Conference on Quince (EMC, C132 and BP30) rootstocks

Results & Discussion

The trees in plot PR184 were budded at 10 and 25 cm and planted in spring 1999. Previous work (see final report on SP 123) had shown that increasing the height of budding on Comice reduced the vigour of Quince C rootstock. Although the trees produced their first significant crops in 2002 they have not yielded sufficiently to determine any effects of rootstocks on yield (see Table 5). On Comice grafted at 10 cm there was less total shoot growth on BP30 than on C132 or EMC rootstocks but on trees grafted at 25 cm least growth occurred on C132 (Table 6).

There were no consistent effects of rootstock on total shoot growth of Conference. As in the previous year (see Report to 31 March 2002 for SP 123) the girth data indicated no greater dwarfing effect from BP30 or C132 on either variety. Early indications are that budding at 25 cm has reduced the girth of Comice particularly on C132 rootstock.

Table 5. Cropping in 2002 of Comice and Conference trees on Quince rootstocks planted spring 1999 (Plot PR 184).

Variety	**Rootstock**	**Graft height (cm)**	**Total yield (kg / tree)**		**Yield Class 1 >65 mm (kg / tree)**	
			2002	cumulative	2002	Cumulative
Comice	EMC	10	4.4	5.1	3.6	4.3
	EMC	25	5.5	6.9	4.4	5.8
	BP30	10	6.4	7.2	5.5	6.3
	BP30	25	6.5	7.2	5.5	6.2
	C132	10	6.1	7.3	5.0	6.2
	C132	25	5.9	6.6	4.8	3.4
Conference	EMC	10	3.8	6.1	0.7	0.8
	EMC	25	4.4	7.6	0.3	0.6
	BP30	10	3.9	6.5	0.7	1.4
	BP30	25	3.8	6.1	0.8	1.7
	C132	10	3.1	4.6	0.6	1.1
	C132	25	3.8	5.8	2.2	3.4

Table 6. Growth in 2002 of Comice and Conference trees on Quince rootstocks planted spring 1999 (Plot PR 184).

Variety	**Root-stock**	**Graft height (cm)**	**Girth (cm/ tree)**	**Total shoot length (dm/tree)**	**Mean shoot length (dm tree)**	**Total shoot number**
Comice	EMC	10	13.6	217.6	5.0	43
	EMC	25	13.1	208.9	4.6	45
	BP30	10	14.3	173.5	3.9	44
	BP30	25	13.9	193.4	4.1	48
	C132	10	14.2	205.7	4.4	47
	C132	25	12.5	169.7	4.8	36
Conference	EMC	10	10.6	91.9	3.6	26
	EMC	25	10.4	98.0	3.1	31
	BP30	10	11.1	81.2	3.1	27
	BP30	25	11.7	108.5	3.2	32
	C132	10	11.4	98.8	2.8	32
	C132	25	10.9	105.8	4.1	26

II - Evaluation of Conference on Quince (EMC and C132) and *Pyrus* (QR708/2) rootstocks

Results & Discussion

In this trial (Plot PR173) planted in spring 1997, C132 is compared with EMC and a dwarfing *Pyrus* selection from the HRI programme, QR708/2. QR708/2 continues to be more vigorous than either of the Quince rootstocks but again has produced the least crop (Table 7). As noted in the previous report (see TF 134 annual report for 2002), there appears to be an incompatibility between Conference and QR708/2 with the result that a number of trees have died.

EMC and C132 produced similar yields in 2002 but accumulated yield is higher for EMC.

Table 7. Growth (girths) and cropping in 2002 of Conference trees on Quince (EMC and C132) and *Pyrus* (QR708/2) rootstocks planted spring 1997 (Plot PR 173)

Rootstock	**Girth 2002 (cm / tree)**	**Yield 2002 (kg / tree)**		**Cumulative yield 1999-02 (kg / tree)**	
		Total	Class 1 >65 mm	Total	Class 1 >65 mm
QR708/2	15.4	3.3	0.4	8.5	1.0
C132	12.0	5.1	1.1	12.6	2.8
EMC	13.1	5.8	1.8	17.4	4.1

III - Evaluation of Conference and Comice on Quince (Sobu and EMC) and *Pyrus* (Gieser Wildeman, Delbuena, Dolacomi and Pyrodwarf) rootstocks

Results & Discussion

The trees planted in this trial in the spring of 2000 were 2 years old and well feathered. Although the first significant crop was produced in 2002 the effects of rootstock on cropping can only be assessed after a number of years of sustained yields.

With the exception of Delbuena the *Pyrus* rootstocks have yielded less than the quince rootstocks (Table 8). On both pear varieties Sobu trees continue to have smaller girths than EMC whereas trees on *Pyrus* rootstocks were of similar or greater girth than those on EMC rootstock. Sobu looks promising due to the good yield and better % Class 1 than the others with Conference and, except for EMC also with Comice.

Table 8. Growth (girths) and cropping in 2002 of Conference and Comice trees on Quince (Q) and *Pyrus* (P) rootstocks planted spring 2000 (Plot PR 187).

Rootstock	**Girth (cm / tree)**	**Yield 2002 (kg / tree)**		**Cumulative yield 1999-2002 (kg / tree)**	
		Total	Class 1 >65 mm	Total	Class 1 >65 mm
Conference					
G Wildeman (P)	13.7	1.6	0.2	1.7	0.2
Delbuena (P)	13.1	2.2	0.2	2.3	0.2
Dolacomi (P)	13.3	1.2	0.1	1.3	0.1
Pyrodwarf (P)	15.1	1.4	0	1.4	0
Sobu (Q)	10.8	2.3	1.1	2.9	1.5
EMC (Q)	11.3	2.6	0.3	3.7	0.7
Comice					
G Wildeman (P)	13.5	0.1	0	0.1	0
Delbuena (P)	15.4	0.8	0.5	1.0	0.7
Dolacomi (P)	14.6	0.2	0.1	0.2	0.1
Pyrodwarf (P)	16.4	0.2	0.2	0.2	0.2
Sobu (Q)	12.8	1.7	1.3	2.0	1.5
EMC (Q)	14.1	3.3	2.3	3.8	2.9

IV - Evaluation of EMH (QR 193-16) in a commercial orchard

Results & Discussion

The performance of EMH, EMA and EMC rootstocks on Concorde and Conference has continued at one commercial orchard in East Kent. As expected Concorde trees on EMH continue to be less vigorous than on EMA. Surprisingly Conference trees on EMH continue to be smaller than those on EMC (Table 9). As mentioned in the previous report EMH is usually more vigorous than EMC although in hot dry conditions such as in the south of France Comice and Conference trees on EMH were smaller than those on EMC. Trees are just coming into crop in the commercial orchard. Yields of Concorde on EMA and EMH were similar but higher yields of Conference were obtained on EMC compared with EMH. Previous trials have shown that trees on EMH begin cropping more slowly than trees on EMC but by the fifth leaf yields on EMH are normally equal to EMC.

Table 9. Girth measurements and cropping of pears in 2002 on EMA, EMC and EMH rootstocks in a commercial orchard in East Kent.

	Rootstock	**Girth 2002 (cm/ tree)**	**Yield 2002 (kg/tree)**	**Mean fruit weight (g)**	**Fruit number/ tree 2002**	**Cumulative fruit number/ tree 2000-02**
Concorde	EMA	19.6	3.4	194	18	26
	EMH	15.3	2.4	201	12	21
Conference	EMC	16.1	5.9	162	37	63
	EMH	13.6	1.6	214	8	16