

Project title: Evaluation and development of new rootstocks for apples and pears – new work on new plantings

Project number: TF 172b

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Report: Annual report, April 2015

Previous report: TF 172 Final report 2012

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Date project commenced: 01 May 2012

Date project completed (or expected completion date): Due 30 April 2016 but was merged into TF 224 on 30 March 2015

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AUTHENTICATION

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

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GROWER SUMMARY

Headline

- Five *Pyrus* and two quince pear rootstock selections for pear from the EMR programme are being propagated for evaluation with 'Conference' in a trial due to be planted in 2016.

Background and expected deliverables

A review of AHDB Horticulture-funded rootstock research projects (project TF 158) acknowledged that there was 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 part of the currently used growing systems 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. This work was then undertaken in AHDB Horticulture project TF 172 (*Evaluation and development of new rootstocks for apples, pears, cherries and plums*).

This project is a continuation of AHDB Horticulture project TF 172 but focuses only on apple and pear rootstocks. The main aim of the project was to acquire, evaluate and develop (in UK growing conditions) new apple and pear rootstocks produced by breeding programmes both at EMR and abroad. This project provided continuity of the trialling of fruit tree rootstocks at EMR, looking for rootstocks of intermediate vigour between M27 and M9 and a replacement for M26 in apple, and for pears a rootstock with increased dwarfing using quince or preferably *Pyrus*.

Selection and release of improved rootstocks to the industry will be of benefit to growers as the introduction of new rootstocks with increased precocity and yield with fewer requirements for chemical or mechanical growth control will have a huge impact on the profitability of UK orchards.

Summary of the project and main conclusions

Nine selections of Canadian apple rootstocks, selected for winter hardiness, disease resistance, dwarfing habit, precocity and ease of propagation, that had been grafted with

'Braeburn' and/or 'Gala' scions, were planted in a field trial in August 2014. The selections came from a breeding programme initially in Morden, Manitoba, then transferred to St-Jean-sur-Richelieu, Quebec, and comprised: SJM15, SJM127, SJM167, SJM188, SJM189, SJP84-5217, SJP84-5231, SJP84-5162 and SJP84-5174. These were grafted alongside M9, M26, M27 and MM106.

Seven promising rootstock selections (five *Pyrus* and two quince) from the East Malling Rootstock Club (EMRC) are being propagated for trial with Conference in 2016.

Although this project is being terminated a year earlier than planned, both trials will continue and form part of a new project that will integrate these trials with the activities for the EMR rootstock breeding programme project (TF 182). The new project (TF 224) was agreed by the AHDB Horticulture Tree Fruit Panel in March 2015 and started on 1 April 2015.

Financial benefits

It is too early in the project for any financial benefits to be apparent. A selected *Pyrus* rootstock would be of great benefit to the industry as this would overcome many incompatibility problems and remove the need for an inter stock. New apple rootstock material from overseas may have the potential to be useful to UK growers.

Action points for growers

- There are no action points at this stage of the project.

SCIENCE SECTION

Introduction

A review of AHDB Horticulture-funded rootstock research projects (project TF 158) acknowledged that there was 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 part of the current growing systems 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. This work was then undertaken in AHDB Horticulture project TF 172 'Evaluation and development of new rootstocks for apples, pears, cherries and plums'.

This new project TF 171b is a continuation of AHDB Horticulture project TF 172 but focuses only on apple and pear rootstocks. The main aim of the project was to acquire, evaluate and develop in UK growing conditions new apple and pear rootstocks produced by breeding programmes both at EMR and abroad. This project provided continuity of the trialling of fruit tree rootstocks at EMR, looking for rootstocks of intermediate vigour between M27 and M9 and a replacement for M26 in apple and in pear a rootstock with increased dwarfing using quince or preferably *Pyrus*. The specific objectives were:

Apple

- To select and develop apple rootstocks with intermediate vigour between M27 and M9, 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 M26 vigour category, which does not suffer from burr knotting, poor calcium uptake or physiological disorders in the scion fruit. 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.

Selection and release of improved rootstocks to the industry will be of benefit as the introduction of new rootstocks with increased precocity and yield, and with fewer requirements for chemical or mechanical growth control, will have a huge impact on the profitability of UK orchards.

Further assessment of rootstocks will be integrated and assessed as part of project TF224 from April 2015, as agreed by the AHDB Horticulture Tree Fruit Panel (March 2015).

Materials and methods

Apple

Propagation of apple trees by grafting cvs. 'Braeburn' and 'Gala' on to a range of rootstocks was carried out in February 2013. Nine Canadian apple rootstock selections (SJM15, SJM127, SJM167, SJM188, SJM189, SJP84-5162, SJP84-5174, SJP84-5217, SJP84-5231) and four controls (M9, M26, M27 and MM106) were used. The SJM and SJP84 series were selected for winter hardiness, disease resistance, dwarfing habit, precocity and ease of propagation.

Trees were planted in a randomised block design (seven blocks each containing twenty rootstock/scion combinations) in August 2014. DNA analysis from root tissue was carried out to confirm that rootstocks were in the correct position and true-to-type to ensure future statistical analysis would be valid. For this, DNA was extracted from young roots taken from all the trees available for the trial and profiles for eight SSR markers compared amongst them. Guard rows were planted around the plot using spare rootstock/scion combinations. Tissue samples of all the Canadian rootstocks have been requested via Meiosis from the original stock (in Canada) and the UK propagation nursery (FP Matthews, Worcestershire (FPM)) and further tests in 2015 will aim to completely confirm 'trueness-to-type'. FPM has already provided liners from all the rootstocks (received at EMR, April 2015) and we hope to receive leaf samples from the original stock soon. Additionally, we are seeking permission

from the breeder/license holder to include these genotypes in a range of pest and disease screening experiments over the duration of the trial.

Measurements of tree height and girth were made post planting. However, due to the uneven growth of scions on individual trees throughout the trial, in February 2015, it was decided, in consultation with Andrew Tinsley (AHDB Horticulture) and the EMRBC management committee, to cut all trees back to 90cm above ground level removing all branches below this point. This will allow a much more meaningful comparative assessment of tree vigour and habit in future years.

Pear/Quince

Hardwood cuttings of the quince and *Pyrus* rootstocks selected by the East Malling Rootstock Breeding Club in January 2015 were collected in February 2015 and potted up (if rooted) or placed in a heated rooting bin (if un-rooted).

Results

Apple

Examination of trees prior to planting suggested that an inter-stock may have been used between the rootstock and scion. However, examination of the nursery records and discussions with the rootstock supplier (FPM) indicate that this was not the case. Therefore we have to conclude that all scions must have been cut back hard soon after grafting, resulting in this appearance.

The numbers of trees from each scion/rootstock combination are shown in Table 1. All trees established well following planting in August 2014 (Figure 1), however DNA analysis of root tissue (post planting) indicated that 20 rootstocks from the 198 (10%) planted were not true-to-type. The actual number of rootstock/scion combinations planted (as confirmed by DNA analysis) is shown in Tables 1 and 2. The issue of off-types was discussed at the East Malling Rootstock Breeding Club Policy Group meeting (January 2015) and at the AHDB Horticulture Tree Fruit Panel meeting (February 2015). It was agreed that the off-type trees should not be lifted and replaced/moved but that they should be left in situ, and the method of statistical analysis should be tailored to take into account the changes to the original experimental design. A further two trees will need to be re-tested as DNA extractions failed

(new tissue to be collected in spring 2015). The correct position of each tree is shown in the modified plot plan in Table 2.

Measurements of tree height and girth were made post planting, but due to the uneven nature of scions on individual trees all were cut back as described in the **Materials and methods** section to allow for a comparative assessment of tree vigour and habit in future years.

Table 1. Rootstock/scion combinations planted in 2014

Key (for Fig 2)	Rootstock	Scion cv.	Rootstock/scion combination	Number of trees planted
1	M9	Braeburn	M9 Braeburn	5
2	M26	Braeburn	M26 Braeburn	8
3	M27	Braeburn	M27 Braeburn	8
4	MM106	Braeburn	MM106 Braeburn	6
5	SJM127	Braeburn	SJM127 Braeburn	7
6	SJM167	Braeburn	SJM167 Braeburn	8
7	SJM188	Braeburn	SJM188 Braeburn	6
8	SJP84-5217	Braeburn	SJP84-5217 Braeburn	8
9	SJP84-5162	Braeburn	SJP84-5162 Braeburn	7
10	SJP84-5174	Braeburn	SJP84-5174 Braeburn	8
11	M9	Gala	M9 Gala	9
12	M26	Gala	M26 Gala	7
13	M27	Gala	M27 Gala	6
14	MM106	Gala	MM106 Gala	8
15	SJM15	Gala	SJM15 Gala	7
16	SJM167	Gala	SJM167 Gala	5
17	SJM189	Gala	SJM189 Gala	7
18	SJP84-5217	Gala	SJP84-5217 Gala	6
19	SJP84-5231	Gala	SJP84-5231 Gala	8
20	SJP84-5174	Gala	SJP84-5174 Gala	6

Table 2. Plot design for apple rootstock/scion combinations (numbers within the grid relate to rootstock/scion combinations with a key to these shown in Table 1), plot SP250 planted August 2014

Tree #	Row A	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row B
X	M9/B T4	SJM189/G T11	M26/B T13	SJM189/G T10	MM106/G T11	M27/B T9	M26/B T11	M26/B T9	SJP84-5162/B T9
1	M9/G T3	11	17	16	15	1	7	3 (TBC)	SJP84-5231/G T12
2	M26/B T3	5	10	20	9	14	4	12	SJM189/G T7
3	M26/G T5	6	8	13	19	18	2	7	MM106/G T10
4	M27/B T25	16	15	6	11	20	18	17	M27/B T7
5	M27/G T5	1	12	14	8	4	3	2	M26/G T10
6	MM106/G T2	9	13	5	3	19	3	11	M26/B T7
7	SJM15/G T9	13	20	10	14	15	6	4	M9/B T8
8	SJM167/B T5	18	5	8	14	3	17	9	SJP84-1574/G T8
9	SJM167/G T2	7	19	12 (TBC)	6	10	19	1	SJP84-5162/B T8
10	SJM189/G T2	17	4	11	10	16	15	13	SJP84-5231/G T8
11	SJP84-5216/B T4	14	9	3	11	2	20	6	SJP84-5217/G T9
12	SJP84-5217/G T5	8	8	18	2	17	5	10	SJM189/G T5
13	SJP84-5231/G T1	12	16	9	5	8	13	19	MM106/G T9
14	SJP84-5162/B T3	4	11	2	2	7	14	15	M27/G T8
15	SJP84-5174/G T1	3	14	17	6	6	10	8	M27/B T5
16	M9/B T6	20	12	1	10	11	9	19	M26/G T7
17	M9/G T4	15	2	7	18	13	12	5	M26/B T6
18	M26/B T5	19	3	15	17	5	11	18	M9/B T7
19	M26/G T6	10	1	19	7	12	16	14	SJP84-5162/G T2
20	M27/B T3	2	6	4	11	9	8	20	SJP84-5162/B T4
Y	M27/G T7	MM106/G T3	SJM15/G T10	SJM167/B T8	SJM167/B T5	SJM189/G T3	SJP84-5217/B T10	SJP84-5217/G T6	SJP84-5231/G T5

Plots shaded in purple represent guard rows, those shown in light orange represent trees that were found not to be true-to-type (although the correct combination of rootstock/scion is now shown) and those in dark orange will need to be re-tested to confirm trueness-to-type.



Figure 1. Plot SP250, planted in August 2014. Trees have subsequently been cut back (February 2015) to a height of 90 cm above ground level and branches below this point removed

Pear

Due to the limited success of rooting hardwood cuttings of *Pyrus* and quince cuttings in 2012-14, and after review of the performance of selections at the East Malling Rootstock Breeding Club Policy Group in January 2015, a large number of cuttings of the most promising five *Pyrus* and two Quince selections (Table 3) were taken in February 2015. Despite rooting being generally low also this year (6-59%), we have succeeded in producing at least seven replicates for each genotype, which should be sufficient for the trial to go ahead as planned. Liners of EMA, EMC and, possibly EMH, Pryrodwarf and/or Q-Eline will be sourced in winter 2015-16 as controls and all will be grafted in January 2016 for planting later that year.

Table 3. Number of cuttings of *Pyrus* and quince rootstocks

Rootstock	No. of cuttings		
	collected	rooted	% rooted
<i>Pyrus</i> PQ 34-1	118	7	6
<i>Pyrus</i> PQ 34-3	113	11	10
<i>Pyrus</i> PQ 34-6	55	25	45
<i>Pyrus</i> PQ 35-2	73	10	14
<i>Pyrus</i> PQ 35-3	44	26	59
Quince PQ 5-6	135	16	12
Quince PQ 5-13	132	32	24

Discussion

The apple trial (Plot SP250) planted in August 2014 has established well but further work is required to ensure that all trial material is confirmed as true-to-type and that the experimental design is tailored to allow for valid statistical analysis in 2015/16. Once this has been carried out then growth records will follow in winter 2015/16.

Following a review at the East Malling Rootstock Breeding Club Policy Group meeting in January 2015 it was agreed that five *Pyrus* and two quince rootstocks were of sufficient interest to be propagated and trialed. Cuttings from these have now been taken and although rooting success has been variable, sufficient numbers have rooted and will be grown on for a new trial to be grafted with cv. 'Conference' and planted in 2016.

Conclusions

- Twenty rootstock/scion combinations were planted in a field trial in August 2014. These included nine Canadian selections, selected for winter hardiness, disease resistance, dwarfing habit, precocity and ease of propagation as well three controls (M9, M26, M27) grafted that were grafted with cvs. 'Braeburn' and/or 'Gala'
- Cuttings from seven promising rootstock selections (five *Pyrus* and two quince) from the East Malling Rootstock Breeding Club are being propagated for trial with cv. 'Conference' in 2016