

**Project Title:** Evaluation and development of new rootstocks for apples and pears in conventional management and for apples under organic conditions

**Project Numbers:** TF 134 & TF 141

**Project leader:** David Johnson  
East Malling Research  
New Road  
East Malling, Kent  
ME19 6BJ  
Tel: 01732 843833 Fax: 01732 849067

**Report:** Report (Year 3 TF 134 and Year 3 TF 141) issued August 2005

**Previous reports:** Annual report to 31 March 2003  
Annual report to 31 March 2004

**Project consultant:** None

**Location:** East Malling Research

**Technical Manager:** Andrew Tinsley

**Project co-ordinator:**

**Date commenced:** 1 April 2002 (TF141 1 October 2002)

**Key words:**

Whilst reports issued under the auspices of the HDC are prepared from the best available information, neither the authors nor the HDC can accept any responsibility for inaccuracy or liability for loss, damage or injury from the application of any concept or procedure discussed

The contents of this publication are strictly private to HDC members. No part of this publication may be copied or reproduced in any form or by any means without prior written permission of the Horticultural Development Council.

## CONTENTS

<b>Grower summary .....</b>	<b>4</b>
Headline .....	4
Background and expected deliverables .....	4
Summary of the project and main conclusions .....	6
Financial benefits .....	10
Action points for growers .....	10
<b>Science Section .....</b>	<b>12</b>
Apple rootstock trials planted at East Malling .....	12
Pear rootstock trials planted at East Malling .....	13
Materials and methods .....	14
Results and discussions .....	15
Conclusions .....	33
Technology transfer .....	35
References .....	35

## **EAST MALLING RESEARCH**

### **Principal scientists and authors of report:**

D S Johnson (Post-harvest Physiologist and project leader)

Ms J E Spencer (Agronomist)

### **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 .....

## **TF 134 and TF 141**

### **Evaluation and development of new rootstocks for apples and pears in conventional management and for apples under organic conditions**

#### **Grower Summary**

##### **Headline**

- In Queen Cox trials at EMR, a number of rootstocks from the Geneva New York breeding programme have performed better than M.9 and are worthy of further evaluation by UK apple growers, particularly G.11 and G.202 which have been released for commercial propagation.
- The vigour and yield efficiency of G.30 was similar to MM.106 and this too has been released for commercial propagation and could be considered where a more vigorous tree is required.
- EMH has continued to perform well as a rootstock for Concorde but poor yields when used for Conference favours the continued use of EMC for this cultivar.

##### **Background and expected deliverables**

The traditional rootstocks used for apple production in the UK have served growers well over the last 40 years. M.9 and M.26 have induced the required vigour control and have also induced good precocity of flowering/fruitletting and acceptable yield abundance in scions worked upon them. However, yields of commodity varieties, such as Gala, are very much higher in parts of southern Europe making costs of production there much cheaper. New dwarfing rootstocks, which induce increased yield, will be required if production of these varieties in the UK is to remain viable. In addition, the trend towards reduced chemical use for fumigation will bring with it a requirement for dwarfing rootstocks with strong resistance to replant disease (SARD). Reduction in herbicide use and water shortages in areas such as Kent will also increase the need for

dwarfing rootstocks, which have improved drought tolerance compared with M.9 or M.27.

Where more invigorating trees have been needed, as in cider/juice production or on sub-optimal soils, rootstocks such as MM.106 or MM.111 have performed adequately in the past. However, the winter of 2000/2001 showed how vulnerable trees on MM.106 are to root asphyxiation and the associated sensitivity to collar/crown rots (*Phytophthora sp.*). New semi-dwarfing rootstocks are needed, which show improved tolerance to wet soils and collar/crown rots.

Most pear trees in the UK are grown on either Quince A or Quince C rootstocks. Two of the main problems concerning use of the dwarfing Quince C or Adams quince stocks for Conference are sub-optimal fruit size in some situations and inadequate vigour control to tailor trees to very high-density systems.

New quince rootstocks are needed which induce improved fruit size and which are more dwarfing and induce precocious cropping, making them more suitable for high density planting systems.

Although Comice shows very good graft compatibility with quince, the compatibility of Conference is sometimes slightly suspect. Quince stocks are also sensitive to both winter cold injury and high pH soils and are also poorly anchored compared with *Pyrus* rootstocks. Most new varieties of pears produced worldwide show incompatibility with quince stocks and should UK growers wish to plant any of these growers will need to use compatible interstocks, if improved compatible rootstocks cannot be selected. Growers in the USA use *Pyrus* seedling or clonal stocks for pears and these show good graft compatibility with all pear varieties. However, most traditional *Pyrus* rootstocks are very invigorating and the clonal selections are difficult to propagate. Recent breeding and selection work carried out in Europe has produced several clones of *Pyrus communis* which are dwarfing and many pear producing countries are now beginning to test these as alternatives to use of quince rootstocks.

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

The specific objectives are as follows:

- To select and develop dwarfing apple rootstocks which induce increased yield productivity in comparison with M.9 or M.26.
- 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).
- To select and develop semi-dwarfing rootstocks which show improved resistance to soil asphyxiation and collar/crown rots than MM.106.
- To select and develop quince rootstocks, which induce improved fruit size.
- To select and develop quince rootstocks more dwarfing than Quince C.
- To select dwarfing *Pyrus* rootstocks, which are easy to propagate, and induce good yield precocity/productivity.
- To select rootstocks for both apple and pear that are suited to organic systems of production.

## **Summary of the project and main conclusion**

### **Apple rootstock trials planted at East Malling**

#### *Trials descriptions*

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

In the older (Queen Cox) trial planted in spring 1995 (Plot DM167) new rootstocks from the Geneva New York breeding programme are being compared with M.9 and MM106. These rootstocks, some of which are now becoming available commercially in Europe, were bred to provide improved resistances to winter cold injury, fireblight, 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 M.26 than to M.9 one or more of these rootstocks may have potential on sites where there is significant weed/grass competition for water and nutrients.

The younger (Mondial Gala) trial planted in spring 2000 (Plot DM172) compares three of the rootstocks raised at the Vineland Research Station in Canada with the French Pajam 2 rootstock. These rootstocks are M.9-M.26 in vigour but possibly have better cold and drought resistance than M.9. 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.

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 programme at East Malling. 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 GE182) at East Malling. Although the performance of rootstocks under organic management is being assessed in a separate project (TF141), it is appropriate to combine the reporting of rootstock trials under conventional and organic management.

A new trial was planted in spring 2004 (Plot CE 190) to evaluate new rootstocks from the breeding program at East Malling. Trees of Queen Cox on two new rootstock selections (AR 801-11 and AR 680-2) are being compared with M.9, M.26 and MM106.

### *Main conclusions*

Generally, the rootstocks from the Geneva New York breeding programme have performed well in the trial on Queen Cox. G.902 and G.730 were less vigorous than M.9 but tended to have higher yield efficiency. G.11, G.179, G.202 and G.210 were similar in vigour and yield efficiency to M.9 but G.202 and G.179 had a higher cumulative yield of Class 1 fruit above 65mm. The vigour and yield efficiency of G.30 was similar to MM.106. Five of the Geneva rootstocks have been released for commercial propagation and these include three of those in trial at East Malling (G.11, G.30 and G.202). Tree performance of these rootstock selections has been good in the trial at EMR but growers need to consider additional potential benefits such as pest and disease resistance / tolerance and to assess performance in trials done elsewhere before deciding on whether to plant in preference to Malling rootstocks. Further information on Geneva (G) and Cornell Geneva (CG) rootstocks should be available through commercial nurseries. No further evaluation of this trial is planned.

The Mondial Gala trial compares three of the rootstocks raised at the Vineland Research Station in Canada with the French Pajam 2 rootstock. At the time of planting in March 2000 the tree quality of these bench grafts was very poor in comparison with the trees on Pajam 2. Currently, the number of dead or diseased trees for rootstocks V.1, V.3, V.4 and Pajam 2 is one, five, three and one out of six respectively. Clearly, it is not possible to assess the performance of trees on V.3 rootstock and results for V.4 are based on only 50% of the trees originally planted. It is hoped that V.3 can be included in future trials, as in current trials in the USA it has produced moderately dwarfed reasonably yield-efficient trees (Autio *et al.*, 2005). V.1 was not considered an outstanding rootstock in USA trials and at EMR V.1 performed similarly to Pajam 2. The yield efficiencies of V.1 and V.4 were similar but tended to be lower than for Pajam 2. V.4 was more vigorous than Pajam 2, with a greater number and length of shoots. In view of the tree health problem, the trial will be terminated in the coming winter.

It is too early to make any conclusions from trials planted in 2003 (Plots EE195 and GE182) and 2004 (Plot CE190). However, it is interesting to note the extent of the general suppression of tree growth under organic management.

## **Pear rootstock trials planted at East Malling**

### *Trials descriptions*

Three trials of quince and *Pyrus* rootstocks planted at East Malling continue to be evaluated. Two of these trials include C.132, a quince rootstock from the HRI breeding programme, which is slightly more dwarfing than Quince C and possibly more winter hardy. In one of these trials (Plot PR 184) C.132 is compared with Quince C (EMC) and a promising Swedish *Pyrus* selection (BP30) and, in the other (Plot PR173), it is compared with EMC and a dwarfing *Pyrus* selection from the HRI programme, QR 708/2. In the third trial (Plot PR187) a new dwarfing *Pyrus* selected at Geisenheim, in Germany, named ‘Pyrodwarf’ is being evaluated along with the quince rootstock ‘Sobu’, and pear scion varieties planted as potential rootstocks.

The performance of EMH, EMA and EMC rootstocks on Concorde and Conference has continued at one commercial orchard in East Kent.

### *Main conclusions*

Results with C132, a quince rootstock from the HRI breeding programme, in the two trials at East Malling have been 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, though cumulative yield (total and Class 1 fruit above 65mm) was higher than for EMC and yield efficiency was similar. In an older trial, Conference on C132 was slightly more dwarfing than EMC and, although cumulative yield was lower, the yield efficiencies of C132 and EMC were the same. 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.

BP30 (a promising Swedish Quince selection) has proved more vigorous than EMC but yield in 2004, cumulative yield and yield efficiency were lower.

QR708/2, a dwarfing *Pyrus* selection from the EMR programme, 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.

*Pyrus* scion varieties (Geiser Wildeman, Delbuena and Dolacom) as rootstocks for Conference and Comice were generally more vigorous and less yield-efficient than EMC and gave lower cumulative yields.

Contrary to expectations, the *Pyrus* rootstock 'Pyrodwarf' has proved more vigorous than EMC and is less yield-efficient although in 2004 'Pyrodwarf' produced higher yields (total and Class 1 55-65mm) of Conference pears than EMC.

There is an incompatibility problem with the Quince rootstock Sobu and, as a result, 30% of the Comice and 60% of the Conference trees have died.

In a commercial orchard in East Kent, Concorde trees on EMH continue to be less vigorous than on EMA and surprisingly Conference trees on EMH continue to be smaller than those on EMC. Yields of Concorde on EMH were lower than on EMA although EMH was more yield-efficient. Yields of Conference on EMH were lower (by 84%) compared with EMC, although, not surprisingly, mean fruit weight was higher for EMC. No further evaluation of this trial is planned.

### **Financial benefits**

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

### **Action points**

- On the evidence of nine years of results from a Queen Cox trial at EMR growers should consider planting trees raised on rootstocks from the Geneva New York breeding programme as possible alternatives to M.9. G.902 and G.730 were less vigorous than M.9 but tended to have higher yield efficiency. G.11, G.179, G.202 and G.210 were similar in vigour and yield efficiency to M.9. It is advised that UK growers should examine the portfolio of the five Geneva rootstocks that have been released for commercial propagation three of which (G.11, G.30 and G.202) have been trialled at EMR.
- Rootstocks V.1 and V.4 from the Vineland Research Station in Canada offer no advantages to the UK apple grower when compared with Pajam 2, a French selection of M.9.
- In a commercial orchard trial EMH has continued to perform well as a rootstock for Concorde, providing higher yield efficiency than EMA but with reduced tree size. Growers considering further plantings of Concorde are advised to consider the use of EMH as the most suitable rootstock.
- In the UK the traditional EMC rootstock is preferred to EMH for Conference pears due to poor fruit yields obtained with EMH.
- The dwarfing quince rootstock C132 has performed well and may merit further and more extensive trialling