

Project Title: Apples & pears: Evaluation of Braeburn and Conference clones

Project Number: TF 149

Report: Year 2 annual report, April 2005

Previous reports: August 2004

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Date Project commenced: 1 April 2003

Date completion due: 31 March 2006

Keywords: Conference, Braeburn, apple, pear, clones

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The results and conclusions in this report are based on a series of experiments 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.

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

Braeburn clones

On the preliminary evidence from the second cropping season it appears that UK growers are correct in considering the standard clones Lochbuie, Schneider and Hillwell rather than Laimburger, Mariri Red (Redfield), Fenwicks and Royal Braeburn. However, results in subsequent years may modify this conclusion.

The agronomic performance of Lochbuie has been particularly high and was rated the best for appearance by growers and advisers.

Irradiated Conference clones

Early indications are that none of these clones is less vigorous or more productive than the standard EMLA Conference clone. Data is required for the next few seasons before any conclusions can be made about the suitability of any particular clone for UK conditions.

Although the irradiated clone 3-15-46 has shown promise in Italy and has been released as Conference Light, its performance in the UK trial has been disappointing. Consequently UK growers should not consider planting it at this stage.

A completely russeted clone 3-6-58 has attracted interest from growers and appears firmer and higher in soluble solids than most other clones (see Figure 1).

Background and expected deliverables

With funding provided originally by the UK Apple and Pear Research Council (APRC) trees of seven clones of Braeburn (Hillwell, Schneider, Laimburger, Lochbuie, Redfield, Fenwicks, and Royal Braeburn) were planted in the spring of 2001 on the 'Brogdale at Bradbourne' site at East Malling. Trees of compact clones of Conference pears produced using irradiation-breeding techniques by Dr. Predieri at Bologna in Italy were obtained and planted at East Malling in spring 1999.

Significant interest in the clonal trials was expressed by members of the EMR Apple and Pear Breeding Club and the APRC Breeding and Varietal Development and Advisory Committee. Subsequently the Tree Fruit Panel of the HDC expressed a desire to continue with these trials. The current project is scheduled to run until March 2006 by which time the agronomic performance of 6 compact clones of Conference on EMC will have been compared over 7 years (1999-2005) and the cropping and quality of 5 clones of Braeburn on M9 will have been evaluated over 5 years (2001-2005).

The clones of Braeburn apples and Conference pears most suited to UK growing conditions will have been identified.

Summary of the project and main conclusions

Braeburn clones

7 clones of Braeburn (Hillwell, Schneider, Laimburger, Lochbuie, Mariri Red, Fenwicks, and Royal Braeburn) on M9 rootstocks were planted in the spring of 2001 on the 'Brogdale at Bradbourne' site at East Malling. In 2004 the fruit was harvested on 11 October and transported immediately to the Jim Mount Building. On arrival 2 fruits were removed from the crop from each tree and bulked to form samples of each clone for maturity assessment. The remainder of the fruit was placed into air storage at 0-0.5°C and removed on 15 March 2005 for grading and quality assessment.

Overall conclusions

As this was only the second cropping season firm conclusions are not warranted at this stage. Nevertheless, the main conclusions are:

- The trial is only the second cropping year and conclusions are a little premature.
- Hillwell, Schneider and Lochbuie again all performed well.
- Lochbuie has been the most precocious in cropping and together with Schneider produced the greatest amount of fruit above 65 mm diameter.
- The Royal clone again performed badly with poor yields.
- The agronomic performance of Laimburger has been average so far.
- Fenwicks looks poor on this evidence but needs to be picked earlier than other clones and may offer commercial potential with suitable harvest dates.
- Mariri Red is the reddest clone and there are concerns about the commercial acceptability on the basis of its appearance and poor fruit size. Indications are that it is the latest maturing clone in the trial.
- In an appraisal of the appearance of the clones ex-store made by growers and retailers Lochbuie was rated the highest. Mariri Red received a mixed reception with some clearly concerned that this completely red clone was atypical and easily confused with other cultivars such as Empire. This is reminiscent of the situation with Gala when the markets moved against the redder forms of Gala (Galaxy, Must, Brookfield, etc).

Conference clones

Trees of clones of Conference pears produced using irradiation-breeding techniques by Dr. Predieri at Bologna in Italy were planted at East Malling in spring 1999. According to Dr Predieri the main traits of the clones supplied for the UK trial are as follows:

Clone	Characteristics
3-15-46	Very compact with short internodes. Released as Conference 'Light'.
3-6-80	Reduced vigour.
30-6-58	Improved sensory analysis, increased calyx russetting (favourable in Italy).
3-5-9	High, consistent productivity.
3-15-57	Improved sensory analysis, increased calyx russetting (favourable in Italy).
3-6-6	Possible increased resistance to frost.

Overall conclusions

- Data is required for the next few seasons before any conclusions can be made about the suitability of any particular irradiated clone for UK conditions.
- Early indications are that none of them is less vigorous or more productive than the standard EMLA Conference clone.
- Although the irradiated clone 3-15-46 has shown promise in Italy and has been released as Conference Light, its performance in the UK trial has been disappointing showing low yield efficiency. Consequently UK growers should not consider planting it at this stage.
- There was considerable interest in the trial from growers who attended a Pear Walk at EMR on 26 August 2004 organised by HDC. The novelty of the completely russetted clone (3-6-58) appeared to be of particular interest (Figure 1).

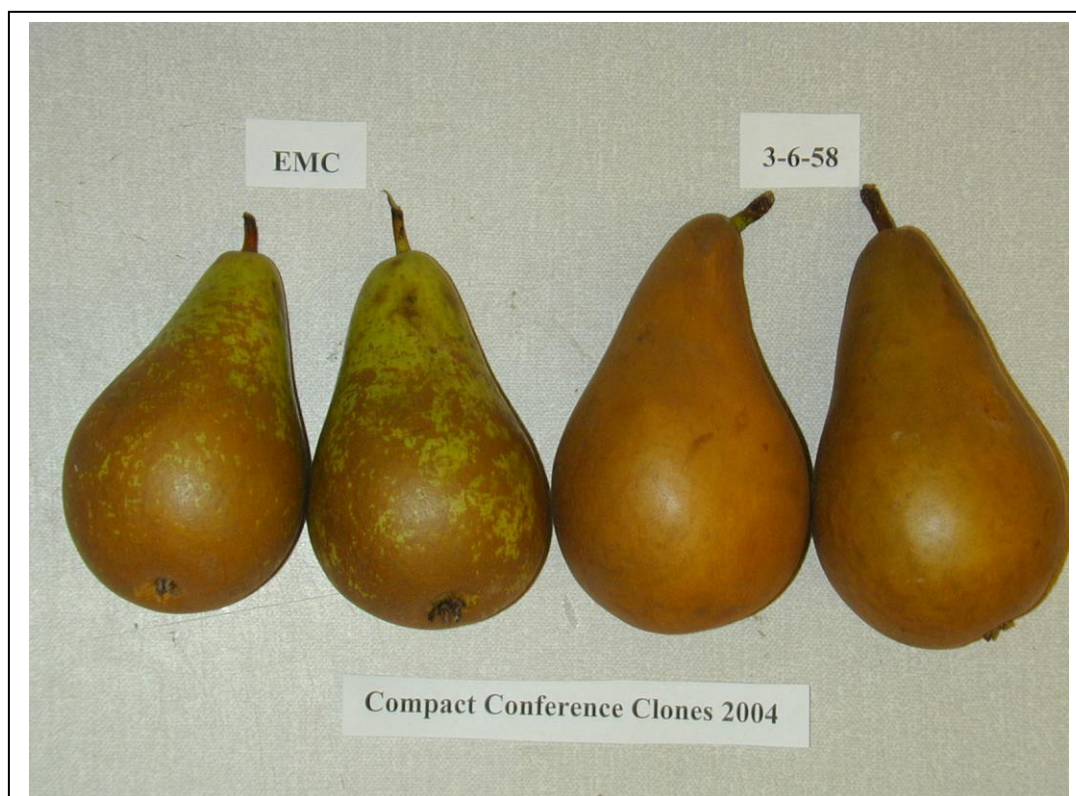
Financial benefits

There are major financial implications of identifying clones of apples and pears with improved agronomic performance and that satisfy consumer requirements in terms of visual and eating quality.

Action points for growers

- On this current preliminary evidence, for new Braeburn plantings growers should continue to select the standard clones, Lochbuie, Schneider and Hillwell, rather than Laimburger, Mariri Red (Redfield), Fenwicks and Royal Braeburn.
- Of the 3 standard clones Lochbuie appears to have the best commercial potential followed by Schneider then Hillwell.
- Although the irradiated Conference clone 3-15-46 has shown promise in Italy and has been released as Conference Light, the UK trials results show disappointingly low yield efficiency for this compact clone and so growers should not consider planting it at this stage.

Figure 1. The russeted Italian clone of Conference 3-6-58 in comparison with the standard EMLA clone in 2004.



Science Section

Introduction

With funding provided by the APRC (project SP 115), trees of seven clones of Braeburn (Hillwell, Schneider, Laimburger, Lochbuie, Mariri Red (Redfield), Fenwicks and Royal Braeburn) were planted in the spring of 2001 on the 'Brogdale at Bradbourne' site at East Malling. Trees of compact clones of Conference pears produced using irradiation-breeding techniques by Dr. Predieri at Bologna in Italy were obtained and planted at East Malling in spring 1999.

The work in project SP 115 was concluded in March 2001 before any of the Braeburn clones had come into crop (see APRC Report for SP115 to 31 March 2001). The trial evaluating the compact Conference clones continued in 2001/02 as part of SP134 'Evaluation and development of new rootstocks for apple and pears' and results were presented in the APRC Report for SP134 to 31 March 2002. Significant interest in the clonal trials was expressed by members of the EMR Apple and Pear Breeding Club and the APRC Breeding and Varietal Development and Advisory Committee when they visited the trial plots on 4 September 2002. Subsequently the Tree Fruit Panel of the HDC expressed a desire to continue with these trials and a new 3-year project was approved from 1 April 2003 with funding from the HDC (Project TF149).

Objective

To select improved clones of Braeburn apples and Conference pears for UK growing conditions.

Materials and Methods

Braeburn

The 7 clones of Braeburn (Hillwell, Schneider, Laimburger, Lochbuie, Mariri Red (Redfield), Fenwicks and Royal Braeburn) on M9 rootstocks were planted in the spring of 2001 on the 'Brogdale at Bradbourne' site (MP168) at an in-row spacing of 2m and an alley width of 4m (1250 trees ha⁻¹). Trees were planted in a randomised block design with 6 replications apart from Royal Braeburn where limited material provided for only 4 replications.

In this trial comparing different clones of Braeburn, records will focus on yield, fruit size, colour and quality. Fruit from these clones and those grown in commercial orchards will be used in storage experiments under HDC project TF 152. To avoid over-cropping all trees were hand-thinned on 15 June 2004 leaving 2 fruits per cluster.

In 2004 the fruit from all trees was harvested on 11 October and transported immediately to the Jim Mount Building. On arrival 2 fruits were removed from the crop from each tree and bulked to form samples of each clone for maturity assessment. The remainder of the fruit was placed into air storage at 0-0.5°C and removed on 15 March 2005 for grading and quality assessment.

To assess maturity at harvest measurements were made of internal ethylene concentration (IEC), background colour and area of red colour, firmness, soluble solids concentration and starch pattern (see below).

Internal ethylene concentration (IEC). A sample of the internal atmosphere of undamaged apples was taken by syringe (0.5ml) and injected into a gas chromatograph fitted with an alumina column and FID detector. Results were expressed as parts per billion (ppb) of ethylene.

Background colour. The colour of the non-blush side of the fruit was assessed using commercial (World Wide Fruit /Qualytech) colour charts. Background colour of each fruit was compared against 4 cards that range from green (1) to yellow (4). The average score was calculated for each sample.

Red colour. The percentage area of red colour on each apple was estimated and assigned to one of six categories i.e. 0, 1-20, 21-40, 41-60, 61-80 and >80% that were ascribed a score of 0, 1, 2, 3, 4 and 5 respectively. The total score was divided by the number of fruit in the sample (12) and multiplied by 20 to give a maximum score of 100.

Fruit firmness. Two measurements were made on the opposite sides of each fruit using an LRX (Lloyd Instruments) materials testing machine fitted with an 11mm probe. Measurements were made in the equatorial region after removal of the peel. Firmness was the maximum force (N) recorded during the insertion of the probe to a depth of 8mm.

Soluble solids concentration. Juice was extracted from each apple using a 'Chylofel' (Copa - Technologie S.A.) apparatus and mixed to form a composite sample. Soluble solids concentration (%) was measured using a BRX-242 refractometer (Camlab Ltd).

Starch test. Half of each apple cut for internal examination was dipped in a solution containing 0.1% w/v iodine and 4% w/v potassium iodide. Dipped sections were left for at least an hour before being assessed. Each apple was scored (1-slight central discoloration to 10-no peripheral discoloration) using the starch conversion chart for apples (circular type) issued by Ctifl. An average score was calculated for each sample.

On removal from store the crop from each tree was size graded (<50, 51-55, 56-60, 61-65, 66-70, 71-75 and 76-80mm) using sizing rings and the number and weight of fruit in each size grade was recorded. The percentage of fruit (by weight and number) in each size category was calculated. A sub-sample of 20 fruit was taken (random selection) from the crop from each tree and inspected for the presence of rots. The length (height) and diameter of each fruit was measured and the percentage area of red colour and intensity of background colour on each apple was estimated and the firmness measured as described above. Finally each apple was cut and examined for the presence of internal physiological disorders.

Conference

Six clones of Conference pear (3-15-46, 3-6-80, 3-6-58, 3-5-9, 3-15-57 and 3-6-6) on EMC rootstock are being trialled (randomised block design with 4 replicates) on plot PR185 at East Malling. These are being compared with the standard clone on EMC rootstock in an adjacent plot (PR184). All trees have been managed in an identical way since they were planted in March 1999. Trees produced their first significant crop in 2001 (see APRC report on project SP134 to March 2002). It is anticipated that the trees will come into regular cropping during the period of the project. By the end of the project (31 March 2006) the agronomic performance of these compact clones of Conference will have been compared over 7 growing seasons (1999-2005).

During 2004 measurements were taken of tree girth, shoot growth (number and length) and counts were made of flower buds (spur, terminal and axillary). The trees were harvested on 8 September 2004 and the total yield of fruit from each tree was recorded and also the weight of fruit above 65mm diameter. Average shoot growth and accumulated yield were calculated for the period since planting (1999-2004) and yield efficiency was calculated from the accumulated yield and the cross sectional area of the trunks of the trees in 2004. The crop from each tree was stored until 22 December 2004 at which time firmness and soluble solids measurements were made on bulked samples of fruit and sensory analysis was carried out on fruit from 2 of the compact clones and on the standard clone. Storage was less than ideal in that fruit was held at 3⁰C for a period after harvest before transferring to a store at the appropriate temperature (-0.5 to -1⁰C). As a consequence, on removal from store the fruits were either fully or partially ripe. Informal sensory analysis was performed on fruit immediately ex-store. Six tasters were asked to score (max. 10) pears on the basis of their aroma, astringency, sweetness, juiciness, firmness, sliminess and grittiness and to give an overall acceptability score out of 9.

Statistical analyses

All data were subjected to an analysis of variance (ANOVA). The overall effects of clones can be compared using the standard errors of the difference between means (s.e.d.) and degrees of freedom (d.f.) given in the tables.

Results and Discussion

Braeburn

The average yield of 11.2 kg tree⁻¹ (14 tonnes ha⁻¹) was slightly higher than in the previous year (11.9 tonnes ha⁻¹) but once again there was a large variation in the yield of fruit from the different clones (Table 1). As in the previous year the poorest yield was from Royal Braeburn (4.6 kg tree⁻¹) and highest from Lochbuie (18.8 kg tree⁻¹). The cropping levels of most of the other clones were close to the average. The pattern of clone effects on yield was generally similar whether assessed on the basis of fruit numbers or weights. Mariri Red and Fenwicks carried crops that were close to the average (12.6 and 11.6 kg tree⁻¹ respectively) but fruit tended to be small when compared to other clones producing similar yields. Average fruit weights and percentages of fruit above 65mm were highest for Schneider, Lochbuie and Royal. However, the mean data for Royal should be viewed with caution since there are two missing plots in the trial that necessitate the estimation of mean values for this clone. Additionally the cropping from the remaining Royal trees was highly erratic.

There were no major cropping deficiencies associated with the 3 clones currently favoured by the UK industry i.e. Hillwell, Schneider and Lochbuie. Although total yields for Hillwell and Schneider were also close to the average, yields for Lochbuie were 67% more than average, which compares with 73% more than average achieved in the previous year. Schneider produced more fruit above 65 mm than Hillwell but not as much as Lochbuie although the percentage of the crop above 65 mm was similar for Lochbuie and Schneider.

Table 1. The yield (number and weight) and mean fruit weight (g) of Braeburn Clones harvested on 11 October 2004.

	Yield by weight			Yield by number			Mean Fruit Wt (g)
	kg tree ⁻¹		%	Number tree ⁻¹		%	
	Total	>65mm	>65mm	Total	>65mm	>65mm	
Hillwell	9.92	4.02	37.4	92	29	29.7	107.0
Schneider	11.86	6.32	52.9	104	45	43.3	113.9
Laimburger	9.09	3.10	33.5	88	23	27.5	105.1
Lochbuie	18.77	9.58	51.5	164	68	42.2	114.3
Mariri Red	12.57	3.49	25.6	129	27	19.6	97.6
Fenwicks	11.64	1.36	11.9	125	11	9.3	93.8
Royal	4.61	1.42	46.2	48	10	41.9	114.2
s.e.d. (26 d.f.)	1.548	1.118	10.45	13.60	7.89	9.91	7.17
Clone effect	***	***	**	***	**	**	*

Apart from Fenwicks the differences in fruit maturity parameters between clones was small. Fenwicks was clearly much more mature at harvest as evidenced by its yellow background colour and the extent of starch loss (Table 2). As in 2003 the Mariri Red apples tended to be least mature as evidenced by a low internal ethylene and soluble

solids concentration. Harvesting at intervals over an extended period would be necessary in order to establish any significant clonal differences in time of ripening.

Table 2. Harvest maturity parameters for different clones of Braeburn harvested on 11 October 2004. Bulk (12-fruit) samples were formed from selecting 2 fruits at random from the crop from each tree. Without formal replication no statistical analysis was possible. On Mariri Red and Royal apples there was insufficient area without red colour to enable an assessment of background colour.

	Red colour cover max. 100	Ground colour 1-green, 4-yellow	Internal ethylene concentration		Firmness (N)	Soluble solids (%)	Starch 1-black, 10-white
			ppb	Log ₁₀ ppb			
Hillwell	77	1.5	100	1.95	93.9	11.0	3
Schneider	93	1.5	91	1.94	92.6	11.2	3
Laimburger	75	1.5	160	2.05	95.6	11.2	3
Lochbuie	93	1.6	102	1.99	92.3	11.5	4
Mariri Red	100	-	28	1.43	96.9	10.7	3
Fenwicks	87	1.7	107	1.98	91.5	11.1	6
Royal	100	-	156	2.11	102.6	11.8	3

There were significant effects of clones for all but the extremes (<50 mm and 76-80 mm) of the size categories in the grading data presented in Tables 3 and 4. Again the Royal data should be viewed with caution since there are two missing plots in the trial that necessitate the estimation of mean values for this clone. Additionally the cropping from the remaining Royal trees was highly erratic. Lochbuie and Schneider are clearly producing more fruit in the higher size ranges (66-70 and 71-75 mm) and less in the lower size ranges (51-55 and 56-60 mm). The converse was true for Mariri Red and Fenwicks.

Table 3. The effect of Braeburn Clones on the percentage (by number) of apples in different size (mm diameter) categories. Trees were harvested on 11 October 2004.

	Fruit diameter range (mm)						
	<50	51-55	56-60	61-65	66-70	71-75	76-80
Hillwell	2.8	7.4	23.2	36.9	22.5	6.9	0.3
Schneider	3.9	3.3	17.5	32.0	32.7	10.6	0
Laimburger	4.1	7.5	22.3	38.7	21.9	5.5	0.2
Lochbuie	2.7	4.6	17.4	33.1	31.1	10.8	0.4
Mariri Red	4.0	11.9	30.4	34.1	17.3	2.4	0
Fenwicks	6.7	13.3	38.5	32.2	9.2	0.1	0
Royal	4.3	8.9	24.8	20.1	18.4	23.5	0
s.e.d. (26 d.f.)	2.24	3.20	5.80	5.61	4.79	6.64	0.21
Clone effect	n.s.	*	**	n.s.	***	*	n.s.

Table 4. The effect of Braeburn Clones on the percentage (by weight) of apples in different size (mm diameter) categories. Trees were harvested on 11 October 2004.

	Fruit diameter range (mm)						
	<50	51-55	56-60	61-65	66-70	71-75	76-80
Hillwell	1.2	4.8	19.5	37.1	27.3	9.7	0.4
Schneider	0.7	1.9	13.7	30.7	38.3	14.5	0
Laimburger	1.9	5.1	19.4	40.1	25.9	7.4	0.3
Lochbuie	1.1	2.6	13.3	31.4	36.2	14.8	0.5
Mariri Red	1.8	8.4	27.3	36.9	22.1	3.6	0
Fenwicks	3.7	10.2	37.1	37.0	11.7	0.2	0
Royal	2.3	6.6	23.3	21.7	19.6	26.6	0
s.e.d. (26 d.f.)	1.14	2.62	6.06	5.46	4.96	7.5	0.32
Clone effect	n.s.	*	**	*	***	*	n.s.

With the exception of Fenwicks, fruit from all clones stored well in air at 0-0.5°C until 15 March 2005 (Table 5). The incidence of rotting was low (2% or less) bearing in mind that none of the harvested fruit had been excluded from store and that no post-harvest fungicide treatments had been applied. There were no external or internal physiological disorders in fruit from any of the clones. Apples from the Fenwicks and Royal clone had a yellow background and Fenwicks fruit were much softer than those from other clones. It is possible that earlier picking could significantly improve its ex-store quality. The remaining clones were generally similar in firmness and background colour.

Visual appearance was assessed by 10 growers/advisers who attended the EMRA/MFSS Storage Day at EMR on 5 April 2005. Lochbuie received the highest rating (7.9 out of a possible score of 10) and Mariri Red the lowest. The assessors were strongly divided in their opinions about the completely red Mariri Red clone with scores ranging from 3 to 9. Clearly some felt that the clone was too red and could result in customers being confused with other cultivars such as Empire. However, the reaction of a major supplier of the multiple retailers (Worldwide Fruit) was that the clone was unlikely to be an issue with their customers provided that there was consistency in the packaged product. Clearly mixing clones with very different appearance in the same pack would be unacceptable to the customer.

It has been pointed out that as trees mature and develop more shading within the canopy the amount of colour on the apples will generally decline. It may be advantageous for growers to plant redder clones in order to meet stringent requirements for red colour imposed by retailers throughout the life of the orchards.

Measurements of the length (height) and diameter of individual fruits showed that Fenwicks was the most elongated apple and significantly more so than Schneider, Lochbuie, Mariri Red and Royal. Conversely Lochbuie was the flattest apple and significantly more so than Hillwell, Laimburger and Fenwicks.

Table 5. The quality of different clones of Braeburn apples harvested on 11 October 2004 and stored in air at 0-0.5°C until 15 March 2005. On Mariri Red apples there was insufficient area without red colour to enable an assessment of background colour. There was insufficient rot data to justify statistical analysis. Visual appearance assessed by 10 growers/advisers who attended the EMRA/MFSS Storage Day at EMR on 5 April 2005.

	Visual appearance	Length / Diameter ratio	Red Colour	Ground colour	Firmness	Rots
	Max. 10		Max. 100	1 green, 4 yellow	(N)	(%)
Hillwell	7.4	0.92	83.3	1.8	70.6	1.6
Schneider	6.7	0.91	84.2	1.8	71.8	0
Laimburger	5.7	0.93	84.5	1.7	71.7	0
Lochbuie	7.9	0.89	92.8	2.0	69.6	0
Mariri Red	5.5	0.91	100	-	73.7	0
Fenwicks	6.0	0.93	90.1	2.3	59.4	0.8
Royal	6.8	0.90	97.8	2.3	77.0	0
s.e.d. (26 d.f.)	-	0.011	3.72	0.12	1.58	-
Clone effect	-	*	***	***	***	-

Conference

According to Dr Predieri the main traits of the clones supplied for the UK trial are as follows:

Clone	Characteristics
3-15-46	Very compact with short internodes. Released as Conference 'Light'.
3-6-80	Reduced vigour.
30-6-58	Improved sensory analysis, increased calyx russetting (favourable in Italy).
3-5-9	High, consistent productivity.
3-15-57	Improved sensory analysis, increased calyx russetting (favourable in Italy).
3-6-6	Possible increased resistance to frost.

In 2004 there were no significant effects of the clones on tree growth, number of floral buds or total fruit yield (Tables 6 and 7). Although clone 3-6-58 and to a lesser extent 3-15-57 had greater shoot length than other clones, the effect just failed to reach significance at the 5% level. Clone 3-6-58 did produce a significantly higher yield of fruit above 65mm diameter (Table 7).

There were significant effects of the clones on accumulated data for shoot length and number, total yield and yield efficiency (Tables 6 and 9). As in 2003 there was a clear pattern in the data as regards growth and cropping over the 5-year period. Clones 3-15-46 and 3-6-58 performed similarly with more shoots and shoot growth, lowest fruit yield and yield efficiency. However, in 2004 clone 3-6-58 produced a significantly higher weight of fruit in the 66-70 mm diameter band than the remaining clones, with the exception of 3-5-9 (Table 8). Clones 3-6-80 and 3-6-6 have the highest cumulative yield and yield efficiency and performed similarly the standard clone.

Unfortunately there are no trees of the standard EMLA clone of Conference in the trial. However, in an adjacent rootstock trial (PR184) there are trees of the normal EMLA clone on EMC that were planted at the same time (23 March 1999) although they originated from a different nursery. At this stage there is no indication that the Italian clones are more 'compact' than the standard EMLA and none have a higher accumulated yield and yield efficiency.

Sensory tests were carried out on clones 3-6-58 and 3-15-57, which were selected originally for high sensory quality. Fruits of clone 3-6-58 received significantly lower scores for sweetness, juiciness and acceptability and higher scores for firmness compared with fruits from the standard clone (Table 11). However, the penetrometer tests showed that the fruit were firmer i.e. less ripe than those of the standard clone and that differences in the responses of the taste panellists may be due to differences in the state of ripeness (Table 10). However, it is interesting that clone 3-15-57 generally received higher sensory scores than 3-6-58 despite being slightly firmer.

In future work it will be necessary to ensure that fruit is placed at the correct storage temperature immediately after harvest and that fruit achieves the same stage of

ripeness after storage before sensory analysis is carried out. Fruits that retain firmness during storage and have high sugar (soluble solids) content would be a commercial advantage. Results in 2004 suggest that both 3-6-58 and 3-15-57 offer an advantage over the standard clone in these respects.

Table 6. The growth of Italian compact clones of ‘Conference’ planted at East Malling in spring 1999 (plot PR185). Treatment effects were non significant (n.s.) or significant at the 5% (*) and 1% (**) level. Data for QC are for trees from an adjacent plot (PR184) planted at the same time but are not strictly comparable with the clone data.

	Shoot growth 2004		Girth 2004 (cm)	Average shoot growth (99-04)		
	Total length (dm)	Number		Total length (dm)	Number	Mean length (dm)
3-15-46	45.5	21	14.6	58.5	23	2.48
3-6-80	38.8	14	12.7	45.2	16	2.79
3-6-58	91.0	28	12.7	66.3	22	3.03
3-5-9	37.0	13	12.5	42.4	15	2.74
3-15-57	60.8	19	11.6	41.9	13	3.14
3-6-6	40.2	16	13.2	46.0	15	3.10
QC	35.9	14	12.6	43.6	16	2.73
Treatment effect	n.s.	n.s.	n.s.	*	**	**
s.e.d. (14 d.f.)	18.55	6.5	0.95	7.39	2.3	0.169

Table 7. Floral bud production and cropping in 2003 of Italian compact clones of ‘Conference’ planted at East Malling in spring 1999 (plot PR185). Treatment effects were non significant (n.s.) or significant at the 5% (*) and 1% (**) level. Data for QC are for trees from an adjacent plot (PR184) planted at the same time but are not strictly comparable with the clone data.

	Yield 2004				Floral bud numbers 2004	
	(kg tree ⁻¹)		Number		Spur and terminal buds	Axillary buds
	Total	Class 1 >65mm	Total	Class 1 >65mm		
3-15-46	4.81	0.09	62	0.4	73	4
3-6-80	6.63	0.11	69	0.7	121	4
3-6-58	5.12	1.13	35	5.8	134	6
3-5-9	2.77	0.58	25	3.0	100	7
3-15-57	3.25	0.10	32	0.5	116	7
3-6-6	6.36	0.01	69	0.1	98	9
QC	7.20	0.02	78	0.1	131	7
Treatment effect	n.s.	*	n.s.	*	n.s.	n.s.
s.e.d. (14 d.f.)	1.497	0.295	19.6	1.52	31.4	5.5

Table 8. Size grading of Italian compact clones of ‘Conference’ planted at East Malling in spring 1999 (plot PR185). Treatment effects were non significant (n.s.) or significant at the 5% (*) and 1% (**) level. Data for QC are for trees from an adjacent plot (PR184) planted at the same time but are not strictly comparable with the clone data.

	Weight (kg tree ⁻¹) of fruit in each size category					
	<50mm	50-55mm	56-60mm	61-65mm	66-70mm	70-75mm
3-15-46	2.13	1.25	0.86	0.47	0.07	0
3-6-80	1.37	2.05	2.35	0.73	0.14	0
3-6-58	0.20	0.28	1.45	2.03	0.90	0.23
3-5-9	0.43	0.52	0.61	0.60	0.42	0.16
3-15-57	0.72	0.82	0.73	0.89	0.08	0
3-6-6	1.58	1.97	1.94	0.85	0.03	0
QC	2.24	2.31	2.12	0.51	0.02	0
Treatment effect	n.s.	n.s	n.s	n.s	*	n.s
s.e.d. (14 d.f.)	0.828	0.710	0.612	0.593	0.260	0.095

Table 9. Cropping of Italian compact clones of ‘Conference’ planted at East Malling in spring 1999 (plot PR185). Treatment effects were non significant (n.s.) or significant at the 5% (*) and 1% (**) level. Data for QC are for trees from an adjacent plot (PR184) planted at the same time but are not strictly comparable with the clone data.

	Cumulative Yield 99-04				Yield efficiency (kg/cm ²)
	(kg tree ⁻¹)		Number		
	Total	Class 1 >65mm	Total	Class 1 >65mm	
3-15-46	8.62	0.41	115	3	0.495
3-6-80	16.74	2.21	145	13	1.155
3-6-58	8.35	1.58	60	9	0.658
3-5-9	10.38	2.65	84	14	0.846
3-15-57	9.33	1.53	78	9	0.890
3-6-6	16.71	2.95	155	16	1.310
QC	17.08	0.87	168	4	1.352
Treatment effect	**	n.s.	**	n.s.	**
s.e.d. (14 d.f.)	2.382	1.085	20.2	5.3	0.1765

Table 10. Firmness (N) and soluble solids concentrations (%) of Italian compact clones of ‘Conference’ planted at East Malling in spring 1999 (plot PR185). Fruit stored in air initially at 3°C and later at -0.5 to -1°C until 22 December 2004. Data for QC are for trees from an adjacent plot (PR184) planted at the same time but are not strictly comparable with the clone data.

	Soluble solids (%)	Firmness (N)
3-15-46	14.1	14.9
3-6-80	13.8	16.1
3-6-58	14.9	18.6
3-5-9	14.3	21.2
3-15-57	14.9	22.8
3-6-6	12.7	14.8
QC	14.0	11.4

Table 11. Sensory analysis of Italian compact clones of ‘Conference’ planted at East Malling in spring 1999 (plot PR185). Fruit stored in air initially at 3°C and later at -0.5 to -1°C until 22 December 2004. Treatment effects were non significant (n.s.) or significant at the 5% (*), 1% (**) and 0.1% (***) level. Data for QC are for trees from an adjacent plot (PR184) planted at the same time but are not strictly comparable with the clone data.

	Sensory scores (maximum of 10)							(max. 9)
	Aroma	Astringency	Sweetness	Juiciness	Firmness	Sliminess	Grittiness	Acceptability
3-6-58	3.5	1.9	4.7	4.8	5.9	2.9	3.4	5.3
3-15-57	4.0	1.2	5.7	7.9	4.2	3.7	2.8	6.5
QC	5.3	1.5	7.2	8.2	3.1	4.3	2.6	7.7
Treatment effect	n.s.	n.s.	*	***	**	n.s.	n.s.	**
s.e.d. (10 d.f.)	0.83	0.35	0.86	0.58	0.70	0.68	0.48	0.48

Conclusions

Braeburn

Data is required for the next few seasons before any conclusions can be made about the suitability of any particular clone for UK conditions. Early indications are that none of the clones currently favoured by UK growers i.e. Hillwell, Schneider and Lochbuie are likely to perform below average as regards total yield, production of fruit above 65mm and average fruit weight.

Based on these agronomic parameters Lochbuie has performed best followed by Schneider and then Hillwell. As in 2003, Mariri Red produced an average yield but fruit size was below average. Cropping was again poorest on Royal Braeburn trees.

As in 2003, Fenwicks was clearly much more mature at harvest than other clones and as a result the fruit had a pronounced yellow background colour after air storage until March and fruit was softer than average. It is possible that poor quality from store can be rectified by earlier harvesting in which case Fenwicks would remain a contender for commercial planting in view of its average performance in terms of yield although fruit size was poor in 2003. It would be important to monitor the performance of this clone in a growing season that is climatically marginal for the variety when other clones may have to be left on the tree very late in order to mature. As expected in the early years of production all clones vastly exceeded the minimum requirement for area of red coloration required by the multiple retailers (currently 40% minimum). However, when samples of the various clones were presented to growers and advisers, there was a mixed reaction to the appearance of the highly coloured clone, Mariri Red. Lochbuie scored highest on the basis of appearance.

The main conclusions thus are:

- The trial is only the second cropping year and conclusions are a little premature.
- Hillwell, Schneider and Lochbuie again all performed well.
- Lochbuie has been the most precocious in cropping and together with Schneider produced the greatest amount of fruit above 65 mm diameter.
- The Royal clone again performed badly with poor yields.
- The agronomic performance of Laimburger has been average so far.
- Fenwicks looks poor on this evidence but needs to be picked earlier than other clones.
- Mariri Red is the reddest clone and there are concerns about the commercial acceptability on the basis of its appearance and poor fruit size. Indications are that it is the latest maturing clone in the trial.
- In an appraisal of the appearance of the clones ex-store made by growers and retailers Lochbuie was rated the highest. Mariri Red received a mixed reception with some clearly concerned that this completely red clone was atypical and easily confused with other cultivars such as Empire. This is reminiscent of the situation with Gala when the markets moved against the redder forms of Gala (Galaxy, Must, Brookfield, etc).

Conference

Data is required for the next few seasons before any conclusions can be made about the suitability of any particular clone for UK conditions. Early indications are that none of the clones are less vigorous or more productive than the standard EMLA Conference clone.

In support of Italian experience and of results obtained in 2003 clone 3-15-46 (Conference 'Light') was most compact in that the mean shoot length based on accumulated data was lowest and significantly lower than for 3-6-58, 3-15-57 and 3-6-6. However, despite its compact nature the yield efficiency of Conference 'Light' has been poor so far. Clone 3-6-80 has not proved to be of particularly low vigour to date nor has 3-5-9 provided a higher productivity or greater yield efficiency than standard EMLA Conference or a number of the other mutant clones.

Clones 3-6-58 and 3-15-57 were firmer and higher in sugar than other clones after 3 months of cold storage but sensory acceptability was lower than that of the standard clone. This may be due to the fact that the standard clone fruit were much riper (softer) and therefore more acceptable. Further work is required to ensure that clones are tested in a way that provides fruit of equivalent ripeness to the taste panel. The effect of frost on the cropping of clone 3-6-6 has not been assessed.

When comparing UK results with those obtained in Italy the following comments can be made:

3-15-46

As in 2003 and in common with Italian experience, clone 3-15-46 (Conference 'Light') was most compact in that it had the lowest mean shoot length. However,

despite its compact nature the yield efficiency of Conference 'Light' has been the poorest so far in this trial.

3-6-80

Clone 3-6-80 has not proved to be of particularly low vigour to date.

3-5-9

Clone 3-5-9 has been less productive than clones 3-6-80, 3-6-6 and normal Conference.

3-6-58 and 3-15-57

The sensory acceptability of 3-6-58 and 3-15-57 was lower than the standard clone despite higher firmness and soluble solids concentration. However, lower acceptability of these clones may relate to their less ripe state and further work is required to evaluate their sensory characteristics using fruit of comparable ripeness.

3-6-6

The effect of frost on the cropping of clone 3-6-6 has not been assessed.

The results are on this evidence rather disappointing, in comparison with those obtained in some Italian trials. The reasons for this may be:

- Conference trees on EMC show varying degrees of partial graft incompatibility. This is increased when they are grown in hot climates, such as in Italy. It is just possible that these compact clones are rather more sensitive to this effect than the standard clone and in the hot summer conditions in Italy they grow more dwarf than in the less stressful conditions in the UK;
- The mutant clones are relatively unstable and have reverted back to a more traditional vigorous type. This instability is made worse if they were hard pruned as part of the propagation procedure prior to them being sent to the UK;
- The controls used for comparison in the UK trial are not strictly valid as they are in adjacent plot. However, from a grower's viewpoint trees planted reasonably close by should suffice for comparative purposes. Nonetheless it would be important to take note of any differences in the two adjacent sites, in terms of pollinators in plot, previous cropping history etc.

Overall conclusions

- Data is required for the next few seasons before any conclusions can be made about the suitability of any particular irradiated clone for UK conditions.
- Early indications are that none of them is less vigorous or more productive than the standard EMLA Conference clone.
- Although the irradiated clone 3-15-46 has shown promise in Italy and has been released as Conference Light, its performance in the UK trial has been

disappointing showing low yield efficiency. Consequently UK growers should not consider planting it at this stage.

- There was considerable interest in the trial from growers who attended a Pear Walk at EMR on 26 August 2004 organised by HDC. The novelty of the completely russeted clone (3-6-58) appeared to be of particular interest (Figure 1).

These results should be discussed with Dr Predieri in the near future. The Conference clone trial has two more years to run during which time it is anticipated that the growth and cropping of the trees will increase substantially and this will allow a more critical appraisal of the performance of the trees.

References

Predieri, S. (1998). Compact pears obtained through in vitro mutagenesis. *Acta Horticulturae* 475: 127-132

Figure 1. The russeted Italian clone of Conference 3-6-58 in comparison with the standard EMLA clone in 2004.

