Project title:	Improvement of cropping of self-fertile queen cox
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Report:	Reports 1991-1993
Project leader:	Dr A Webster
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Project SP11	**Development of self-fertile clones of Queen Cox**
Date	**July 1991**
Project Staff	**Dr.A.D.Webster (Supervisor), Ms.Jane Spencer**

Summary Report

Preliminary tests showed that several Queen Cox clones, originally raised as part of an irradiation breeding programme, were possibly wholly or partially self-fertile. If confirmed, such clones would have great potential, offering more consistent cropping from season to season and the opportunity to dispense with planting unprofitable pollinating varieties.

Two clones, numbers 7 and 18, have been shown to be partially self-fertile in controlled pollination experiments. Work is now focussed on assessing the consistency of cropping of these clones and monitoring the colour, size and storage quality of their fruits.

Blossom clusters of seven other clones, which have also shown some promise of self-fertility, were this year enclosed within bags at late balloon stage to prevent cross-pollination. Flowers in these bagged clusters were self-pollinated at early full bloom, taking care to discard frost damaged flowers. Records of fruit set taken at the end of June show 6 of the 7 tested clones to have set many more fruits than the Queen Cox EMLA controls. Although June Drop was nearing its final stages when this record was taken, it is anticipated that more fruits will drop prior to harvest. No firm conclusions may be made, therefore, until harvest records are taken in September.

APRC PROJECT REPORT

Project SP11	**Development of self-fertile clones of Queen Cox**
Date	**December 1991**
Project Staff	**Dr. A.D. Webster (Supervisor), Ms. J. E. Spencer**

Summary

Earlier pollination tests have indicated that two advanced selections of Queen Cox, S.F. 7 and S.F. 18, are partially self-fertile. Attempts to confirm these results and to assess the cross compatibility of these clones with each other and with the self-sterile EMLA Queen Cox clone were upset in 1991 by severe frost damage to blossom clusters at flowering time. Accumulated yields (1987-1991) were more than 25% grater on these two self-fertile clones compared with the EMLA clone and they both produced more Class I and Extra Class (> 65 mm diameter) fruits than the EMLA controls in 1991.

Experiments on seven other potentially self-fertile Queen Cox selections were also severely affected by spring frost damage. Although six of the seven selections initially set more fruits than the self-sterile EMLA controls, severe fruit drop occurred immediately post flowering and all trees in this experiment cropped very poorly.

Evaluation of self-sterile Queen Cox clones showing improved colour to the EMLA clone have continued at East Malling and on several growers' farms. Clones 4, 9, 74, currently appear to be the best, although clones 15, 48 and 91 have also performed well on some sites.

Plans are being made to provide frost protection for the experimental plantings in 1992.

2. QUEEN COX WITH IMPROVED COLOUR

Objective:

Poor colour stability has been reported for some sources of EMLA Queen Cox. The aim is to select clones of Queen Cox with better colour, size and yield consistency.

Results:

In a young trial planted at East Malling, which compares 13 selected Queen Cox clones with the EMLA clone, cropping was much lighter in 1991 than in 1990. Clones 4, 9 and 74 produced the best yields and grade outs in 1990-1991. Observations from older trials comparing these and other Queen Cox clones planted on three grower sites indicate clones 9, 15, 48, 74 and 91 to be the most promising.

Cropping 1990-1991 of Queen Cox Selections

Clone	Accumulated Total Yield/tree 1990-1991 (kg)	Accumulated yield /tree Class I + Extra (> 65 mm) (kg)	% Class I + Extra 1990-1991
EMLA	17.8	9.5	53
4	18.9	10.7	57
9	19.7	11.2	57
15	12.6	5.5	43
48	12.5	6.5	52
74	19.6	11.3	58
91	9.8	4.0	41
96	15.2	6.3	41

Plant Health Tests

Virus tests have continued on all of the self-fertile selections. Chat fruit was confirmed in two of the Queen Cox clones showing improved fruit colour. It is not certain whether this came from the clone or the rootstock and the tests are being repeated on new material.

APRC Project Report

PROJECT SP 11 Development of Self-fertile clones of Queen Cox
Project Staff: Dr.A.D.Webster, Miss J.Spencer
Date: June 1992

Self-fertile clones of Queen Cox

An experiment was conducted to assess the compatibility of the self-fertile Queen Cox clone 18 with the standard self-sterile EMLA clone of Queen Cox. Results indicate that by the middle of June 1992 there was a 40% set on the EMLA clone of Queen Cox when pollinated with Clone 18. Where the EMLA clone was pollinated by its own pollen there was only a 2% set. Although some fruit from the experiment will be lost during June drop, it indicates that this self-fertile clone 18 has the ability to pollinate a self-sterile Queen Cox orchard when planted as a pollinator.

Self-fertile Queen Cox clones 7 and 18 continue to perform well and it is hoped to carry out storage assessments on these promising clones later this year.

Controlled pollinated experiments were carried out on seven of the other potentially self-fertile Queen Cox clones. Blossom clusters at the same stage of development were selected at late balloon, thinned down to four flowers per cluster and bagged to prevent cross-pollination occuring. Bags were removed when clusters were at full bloom and selfed; the bags were again positioned over the clusters until a stage when flowers were no longer viable.

Results to date show a very low fruit set on all seven of these clones, clone 3800 giving the highest set at 20%. With temperatures this year being high enough for adequate pollination to take place, the potential self-fertility of these clones must be questioned.

Improved coloured Queen Cox

Clones 4, 9 and 74 which have to date given the best yields and grade-out will again be assessed during the 1992 season. Clones 4 and 9 have proved to be healthy after carrying out virus tests. Unfortunately, clone 74 appears to have chat fruit.

Publication

An article was written for the Fruit Grower: Self-fertile clones of Cox - an aid to more consistent yields. Fruit Grower, May 1992 p7.

APRC Project Report

Project SP11: (Rod) Development of Self-fertile clones of Queen Cox

Project Staff: Dr. A.D. Webster, Ms. Jane Spencer

Date: March 1993

Growth and Yield

Orchard comparisons were continued between 9 selected clones of Queen Cox and the control EMLA clone all planted at East Malling. Two clones, numbers 7 and 18, were confirmed as self-fertile in tests conducted in previous years. In 1992 trees of clones 7 and 18 formed fewer extension shoots and produced less total shoot growth than trees of the EMLA clone (Table 1). Yields were much greater (77%) on these self-fertile clones and clone 18 produced 57% more high quality fruit than the EMLA clone. Controlled pollination tests, using bagged blossom clusters, in which the suitability of clone 18 as a pollinator for self-sterile EMLA Queen Cox was assessed, were successful. EMLA Queen Cox set 23% of its blossoms with clone 18 pollen but less than 1% when selfed.

In controlled pollination tests on seven other potentially self-fertile clones of Queen Cox, three clones, numbers 106, 1872 and 3800, all initially set more fruits than the EMLA clone when selfed. However, by harvest time only one of these, clone 3800, still showed improved fruit set. This clone also set most fruit on open pollinated clusters in 1992.

Storage Assessments

Fruit from clones 7 and 18 were stored until March in CA, when no differences from the EMLA clone in terms of incidence of storage disorders were found. Data on other quality attributes including fruit texture are presently being analysed.

Virus Tests

Clones 18 and 7 both gave negative results in woody indexing and chat fruit tests. Tests for other latent viruses, such as Star Crack, using Smoothie Golden Delicious as indicator, have also proved negative in the first two of the three year test.

Multiplication and Distribution:

A small build-up from fruiting tree sources of clone 18 has begun at East Malling; 100 to 200 trees should be grafted spring 1993. A few trees raised from the same sources have also been sent to two NSA nurseries. However, none of this material can ever be considered of EMLA status; it is likely to be marked under the new CAC health designation. Once virus tests are completed (within one year) build-up will begin using the EMLA nuclear stock source held within the gauze tunnels.

Queen Cox Clones with Improved Colour:

Growth and Yield:

The vigour, cropping, fruit size and grade out from trees of 14 Queen Cox selections, including the EMLA clone, were recorded in 1992. The most promising selections both in this East Malling trial

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and in previous trials on several grower sites are clone numbers 4, 9 and 74. Total extension shoot growth in 1992 on all three of these clones was slightly less than on the EMLA clone (Table 2) and this was mainly attributable to reduced numbers of extension shoots. Total yields/tree in 1992 and cumulative yields 1990-1992 are similar for clones 4, 9 and EMLA but slightly greater for clone 74. Yields of Class I + Extra (> 65mm) fruits have in every season been lowest on the EMLA clone.

Virus Tests:

Clone 9 has proved negative in woody indexing and tests for chat fruit. Clones 4 and 74 gave inconsistent results for chat fruit and are being re-tested. Tests using Smoothie Golden Delicious as indicator are incomplete.

Publications/Exhibits/Lectures:

Webster, A.D. Self-fertile Cox clones: An aid to more consistent yields. *The Fruit Grower* May 1992 page 7.

The Cox and Queen Cox clones research was featured at Chelsea Flower Show, Fruit Focus and Marden Fruit Show in 1992.

Table 1

Growth and Yield of Queen Cox clones planted (November 1983) at East Malling

Clone No.	Total extension shoot length 1992 (m)	No. of extension shoots 1992	Floral bud numbers/tree 1992	Fruit No./tree 1992	Yield/tree (kg) 1992	Yield/tree Class I (>65mm) (kg)
7	39.0	132	263	191	23.3	11.0
18	32.5	121	320	172	23.1	14.8
EMLA	56.2	168	301	74	13.1	9.4

Table 2

Growth and Yields of Queen Cox clones exhibiting improved fruit colour.
Planted winter 1987/88 on MM.106

Clone	Total shoot length 1992 (m)	Total Yield/tree 1992 (kg)	Cum. Yield/tree 1990-1992 (kg)	Yield/tree Class I + E (>65mm) 1992 (kg)	Cum. Yield/tree Class I + E. 1990-92 (kg)	Cum. % Class I + Extra
4	75.9	26.9	45.8	19.7	30.4	63.9
9	84.2	25.6	45.3	16.7	27.9	58.3
74	97.8	32.9	52.5	20.4	31.6	61.5
EMLA	112.5	27.3	45.1	14.4	23.9	45.9

APRC PROJECT REPORT

Project SP 11 Development of self-fertile clones of Queen Cox

Project Staff Dr. A.D. Webster Ms. Jane Spencer

Date Report to 30th September, 1993

Trials of Queen Cox clones on 3 grower sites

Controlled pollination tests, carried out for several years on a range of Queen Cox clones, indicated that some of these could set fruit, and crop well, without the need for cross pollination. As a result of this early work, four potentially self-fertile Queen Cox clones were identified for larger-scale testing. Trials comparing these four clones were planted in spring 1990 by commercial growers in Faversham, Ledbury and Wisbech. Approximately 100 trees of each of the Queen Cox clones 7, 13, 14 and 18 on M.9were planted, without pollinators, at each site; the Faversham trees were planted in multi-row bed systems and the other two sites with trees in single rows.

Yields in 1992, recorded by the growers concerned, were generally best from clones 7 and 18 though the crop at the Wisbech site clearly showed clone 18 to be superior.

In 1993, several visits were made to each of the three sites and a range of records was taken. Tree size (estimated by measurements of trunk girth), flower bud production and fruit set/tree, are shown for the three sites in Table 1. Based on trunk girth, the largest trees were on the Faversham site and the smallest at Wisbech. Flower bud cluster numbers were similar on all three sites. Final fruit set/tree was highest on clones 18 and 7. Fruit set on clone 14 was poor, particularly on the Faversham site. Pollination tests indicated that clones 13 and 14 are not self-fertile and it is likely that fruit produced by these resulted from pollination by the other two clones. Details of cropping, mineral composition and storage behaviour will appear in the next report.

In a trial on a fourth site, at Selling in Kent, SF Queen Cox clone 18 set more fruit, when selfed in controlled pollination tests, than five other clones which had previously shown indication of improved fertility.

Self Fertile Clones as Pollinators for other Queen Cox clones.

Tests using bagged blossom clusters indicated that pollen collected from Queen Cox clones 7 or 18 was efficient in pollinating and fertilising Queen Cox -EMLA and also the three Queen Cox clones 4, 9 and 74 selected for improved colour. (Fig. 1).

Fruit from the trial comparing these Queen Cox clones with improved colour is still in store.

Storage of Self Fertile Queen Cox clones 18 and 7 in 1992-93

Examination of fruits collected from an East Malling orchard showed slight qualitative differences pre and post storage between Queen Cox clones 7, 18 and EMLA. Soluble solids (sugars) post storage were slightly but significantly lower in fruits of clone 18 compared with fruits of the EMLA clone. Pressure tests showed that the bioyield (force at surface level) and the force at 8 mm

were slightly lower in both self fertile clones compared with EMLA Queen Cox. However, these differences were considered to be of small importance commercially. Weight loss in store was very similar (4.2 - 4.8%) for both self fertile clones and the EMLA clone fruits. Seed numbers were low in all the stored fruits including the EMLA (only 1.1 - 1.6 fully developed seeds/fruit).

TABLE 1

Trunk girth, flowering and fruit set of Queen Cox clones on three sites

Queen Cox clone	Site		
	Faversham	Ledbury	Wisbech
	Trunk girth (cms)		
18	13.9	11.0	10.1
14	13.9	12.2	10.6
13	14.1	12.9	10.9
7	13.4	10.9	9.9
	No. of Spur and Terminal Flower Clusters		
18	81	78	80
14	83	71	69
13	102	71	75
7	67	69	55
	Final Fruit Set/Tree		
18	49	87	79
14	17	31	48
13	32	46	55
7	51	96	58

Fruit set on bagged clusters - 1st July 1993