HORTICULTURE RESEARCH INTERNATIONAL

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CONTRACT REPORT
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Susceptibility of 42 apple varieties to pests and diseases, 1998-2000

Undertaken for APRC

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Susceptibility of 42 apple varieties to pests and diseases, 1998-2000

Summary

A field experiment to evaluate the susceptibility of 42 apple varieties (four replicate plots of two trees per variety,M9 rootstock) to pests and diseases to determine their suitability for organic production in the UK was planted at Poultry Farm, Marden, in February 1998. No foliar sprays were applied. Pests and diseases and their damage were assessed in June-July and September-October each year (1998, 1999 and 2000). Fruit set and crop growth were also assessed. The incidence of scab and mildew is summarised in the table below.

Variety	scab	mildew	Variety	scab	mildew
A567/19	l	h	Herrings Pippin	m	vl
A931/15	l	m	Judeline	l	l
A93/16	l	m	King of Pippins	l	h
Antonoulka	vl	m	Liberty	m	m
Boscoop	m	m	Lord Lambourne	l	vl
Ceeval	m	m	Mother	vl	m
Delorina	l	h	Northern Greening	h	h
Discovery	l	vl	Prima	vl	vl
Double R.Wealthy	m	m	Princess	l	h
E11/20	l	vl	Priscilla	vl	h
E83/4	m	m	Red Charles Ross	m	m
E210/198	h	m	Red Ellison	m	vl
Early Victoria	l	l	Red Fortune	l	l
Edward VII	l	vl	Redfree	vl	l
Egremont Russet	m	m	Regent	h	m
Falstaff	m	l	Saturn	vl	l
Fiesta	h	m	Sir Prize	l	h
Florina	l	l	Vanda	vl	h
Freedom	vl	h	Wealthy	m	l
Goldrush	l	h	Winston R. Sport	h	m
Greensleeves	m	l	Wyken Pippin	vl	h

Key: vl = very low or absent, l = low, m = moderate, h = high

Sooty blotch occurred on the mature fruits of most varieties, though none was recorded on Antonoulka, Egremont Russet, King of the Pippins, Princess, Red Charles Ross or Redfree. Early Victoria, Falstaff, Goldrush and Sir Prize were the worst affected. Fungal leaf spotting, apparently caused by a *Phoma* sp., was recorded on all varieties, with the most on Mother, Northern Greening and Winston Red Sport. The spotting also occurred on fruits, notably on Early Victoria. High levels of rosy apple aphid infestation and damage were recorded on Discovery, E11/20, Egremont Russet, Greensleeves and Vanda. The varieties E11/20, Falstaff, Judeline and Saturn set good numbers of fruit in 1999 and 2000. E11/20, Florina, Judeline and Prima made particularly good growth. Antonoulka, Early Victoria, Red Charles Ross and Wealthy were comparatively weak.

Continuation of the experiment for a further 3 years and the planting of a second experiment at a different site are recommended.

Introduction

Organic apple production in the UK is only likely to be successful if apple varieties with resistance or at least low susceptibility to important pests and diseases are used. Resistance or low susceptibility to scab and mildew are particularly important as these are debilitating diseases to which the plant is susceptible throughout most of the growing season and which require programmes of sprays to control them effectively.

An important objective in the development of successful methods of organic apple production for the UK is to identify apple varieties with resistance to apple scab and low susceptibility to mildew. A replicated field experiment, planned to last at least three years, was planted in March 1998 to determine the susceptibility of 42 apple varieties to pests and diseases. The varieties were chosen by Dr D. Pennell, Brogdale Horticultural Trust, as being potentially suitable for organic production using a range of criteria, though information about their susceptibility to pests and diseases was limited.

The levels of pests and diseases that occurred in the experiment in the first three growing seasons after planting are reported in this paper.

Methods and materials

The experiment was planted on 16 February 1998 with two-year-old nursery trees supplied by the Brogdale Horticultural Trust. It consists of 8 rows of 42 trees. The rows are spaced 10 feet (= 3.05 m) apart with a spacing of 5 feet (= 1.52 m) between trees in the row. The design of the experiment is a randomised block with four replicates. Each plot consists of two adjacent trees in a row. Hence each row contains 21 plots. No foliar sprays of plant protection products or nutrients have been applied to the trees. They were mulched with straw in June 1998.

The incidence of pests and diseases and the damage caused by them on each tree were assessed in June-July and in September-October each year (Table 1). The methods of assessment were tailored to the range and levels of pests and diseases present. Data were collated and analysed statistically by ANOVA where appropriate.

Results

Scab (Table 2)

No scab was recorded on the varieties Antonoulka, Freedom, Mother, Prima, Priscilla, Redfree, Saturn, Vanda or Wyken Pippin.

Trace amounts of scab were recorded on A567/19, A931/15, A93/16, Delorina, Discovery, E11/20, Early Victoria, Edward VII, Florina, Goldrush, Judeline, King of Pippins, Liberty, Lord Lambourne, Princess, Red Fortune and Sir Prize.

Low but significant scab infection occurred on Boscoop, Ceeval, Double Red Wealthy, E83/4, Egremont russet, Falstaff, Greensleeves, Herrings Pippin, Red Charles Ross, Red Ellison and Wealthy

Damaging levels of scab infection occurred on E210/198, Fiesta, Northern Greening, Regent and Winston Red Sport.

Mildew (Table 3)

Only very low levels (mean score consistently < 2) of mildew occurred on Discovery, E11/20, Edward VII, Herrings Pippin, Lord Lambourne, Prima and Red Ellison.

Low levels (mean score < 3) occurred on Early Victoria, Falstaff, Florina, Greensleeves, Judeline, Red Free, Saturn and Wealthy. Red Fortune nearly fell in this category.

High levels of mildew occurred on A567/19, Delorina, Freedom, Goldrush, King of the Pippins, Liberty, Northern Greening, Princess, Priscilla, Sir Prize, Vanda and Wyken Pippin.

Sooty blotch (Table 4)

Sooty blotch occurred on the mature fruits of most varieties, though none was recorded on Antonoulka, Egremont Russet, King of the Pippins, Princess Red Charles Ross or Redfree. Early Victoria, Falstaff, Goldrush and Sir Prize were worst affected.

Leaf spot (Table 4)

Fungal leaf spotting, apparently caused by a *Phoma* sp., was recorded on all varieties The varieties Mother, Northern Greening and Winston Red Sport were the most affected. The spotting also occurred on fruits, notably of Early Victoria.

Canker (Table 4)

Canker infection of trunk or branches was recorded on several varieties though its occurrence was sporadic.

Rosy apple aphid (Table 5)

Rosy apple aphid infestation was patchy and varied sporadically from year to year. None occurred on Double Red Wealthy or Goldrush. Notably high levels of infestation and damage were recorded on Discovery, E11/20, Egremont Russet, Greensleeves and Vanda.

Leaf hopper (Table 6)

Leafhopper damage occurred on all varieties. Herrings Pippin and Lord Lambourne stood out as having consistently higher levels.

Rust mite and leaf midge (Table 6)

All varieties were infested and damaged, though not severely so, by rust mite and leaf midge. Leaf midge infestation was closely associated with the presence of young

growing leaves in the shoot tips. Varieties that had ceased to grow in late summer had lower levels.

Crop growth and cropping (Table 7)

Detailed records of fruit set, yield and plant growth were not taken. However, counts of the number of fruitlets present per tree and a rough visual assessment of tree size in June 2000 confirmed obvious differences in crop load and tree growth. The varieties E11/20, Falstaff, Judeline and Saturn set good numbers of fruit in both 1999 and 2000. Prima set a high number of fruit in 2000 but few fruits in 1999. The varieties E11/20, Florina, Judeline and Prima made particularly good growth. Antonoulka, Early Victoria, Red Charles Ross and Wealthy were comparatively weak.

Discussion

Selection of varieties of low susceptibility to scab and mildew and the avoidance, if possible, of varieties of high susceptibility to rosy apple aphid is vital for successful organic apple production in the UK. The incidence of scab, mildew and rosy apple aphid over the first three seasons of growth of the different varieties of apple in this trial are good preliminary indicators of the relative susceptibility of the varieties to these key pests and diseases. E11/20, Edward VII, Florina, Judeline, Lord Lambourne, Red Fortune, Red Free and Saturn had a low or very low incidence of both diseases in all three years. Apart from E11/20, they did not appear unduly susceptible to rosy apple aphid, though the patchy and sporadic distribution of this pest in the experiment makes the drawing of firm conclusions about the susceptibility of the varieties to this pest difficult. Minor diseases, such as sooty blotch and leaf spots, become much more important in organic production than in conventional production because synthetic, broad-spectrum fungicides are not used. Early Victoria appeared to be relatively susceptible to both diseases.

Caution has to be exercised in drawing firm conclusions about the relative susceptibility of apple varieties to pests and diseases from this single experiment over only three growing seasons. For this reason, it is recommended that the work is continued for a further three seasons and that the planting of a further experiment, testing a more optimal range of varieties, is considered.

Acknowledgements

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Table 1. Assessment methods for pests and diseases.

Pest/disease	Assessment method per tree
First assessment (22-23 June 1998)	
Apple leaf midge	Nos. of infested leaves in terminal of each of 2 shoots
Rust mite	Nos. of mites on each of 2 leaves scored into categories:- 0 = 0, 1 = ≤ 5, 2 = 6-25, 3=26-100, 4 = >100 mites per leaf
Spider mite	Nos. mites on each of 2 leaves
Leaf hopper	Severity score* of damage to leaves
Mildew	Nos. out of 5 youngest leaves infected in one shoot recorded
Scab	Presence of scab on one shoot and on whole tree recorded
Other diseases	Presence or absence on tree recorded
Second assessment (1-2 October 1998)	
Apple leaf midge	Nos. infested leaves in terminal of each of 2 shoots
Mites	Leaf bronzing damage scored:- 0 = none, 1 = trace, 2 = slight, 3 = moderate, 4 = severe
Leaf hopper	Severity score* of damage to leaves
Other pests	Presence or absence on tree recorded
Mildew	Nos. out of 5 youngest leaves infected in one shoot
Scab	Presence of scab on one shoot and on whole tree
Other diseases	Record presence or absence on tree
Third assessment (22 June – 7 July 1999)	
Primary mildew	Nos. of mildewed shoots and blossoms
Leaf mildew	Nos. of leaves out of 5 youngest infected in one shoot
Mildew	Severity score*
Leaf scab	Presence/absence on each tree
Fruit scab	Presence/absence on each tree
Other diseases	Presence/absence on each tree
Fourth assessment (16 July 1999)	
Mite bronzing	Severity score* of leaf bronzing damage on terminal, middle and basal leaves on each of two shoots per tree
Fifth assessment (27-28 September 1999)	
Leaf scab	Presence/absence
Fruit scab	Severity score*
Sooty blotch and fly speck	Severity score*
Mildew	Severity score*
Fruit mildew russet	Severity score
Leaf spot	Severity score*
Canker	Presence/absencem on each tree
Pests	Presence/absence of pests or their damage on each tree
Sixth assessment (14 June 2000)	
Leaf scab	Severity score*
Fruit scab	Severity score*
Primary mildew	Number of mildewed shoots and blossoms
Mildew	Severity score*
Canker	Presence/absence on each tree
Rosy apple aphid	Number of colonies on each tree
Seventh assessment (27 September- 2 October 2000)	
Leaf scab	Severity score*
Leaf spot on leaves	Severity score*
Leaf mildew	Severity score*
Fruit scab	Severity score*
Fruit mildew russet	Severity score*
Sooty blotch	Severity score*
Leaf spot on fruits	Severity score*
Rosy apple aphid	Severity score*

* 0= none, 1= trace, 2 = slight, 3 = moderate, 4 = severe, 5 = very severe

Table 2. Incidence of scab infection on leaves and fruits in June-July and September-October in 1998, 1999 and 2000.

Variety	Scab infection on leaves						Scab infection on fruits			
	Number trees out of 8 with infection		Presence/ absence		Mean score (0-5 scale)		Mean score (0-5 scale)			
	Jun 1998	Oct 1998	Jun 1999	Sept 1999	Jun 2000	Sep 2000	Jun 1999	Sep 1999	Jun 2000	Sep 2000
A567/19	2	1	+	-	0.0	0.0	0.3	0.0	0.0	0.0
A931/15	2	0	-	-	0.0	0.0	0.0	0.0	0.1	0.1
A93/16	0	1	-	-	0.0	0.0	0.0	0.0	0.0	0.0
Antonoulka	0	0	-	-	0.0	0.0	0.0	0.0	0.0	*
Boscoop	2	2	+	-	0.9	1.0	0.0	0.0	0.4	0.7
Ceeval	2	0	-	-	0.1	0.5	0.0	0.0	0.4	0.6
Delorina	1	3	+	-	0.0	0.0	0.3	0.0	0.0	0.0
Discovery	1	2	-	-	0.0	0.0	0.0	*	0.0	*
Double R.Wealthy	1	0	-	-	0.3	0.9	0.1	0.0	1.3	0.4
E11/20	0	2	-	-	0.0	0.1	0.0	0.0	0.0	0.0
E83/4	1	0	-	-	0.1	0.3	0.0	0.0	0.4	0.4
E210/198	3	4	+	-	3.9	2.6	0.0	0.0	2.0	2.7
Early Victoria	0	1	-	+	0.1	0.1	0.0	*	0.1	0.0
Edward VII	1	1	+	+	0.0	0.0	0.0	0.0	0.0	0.0
Egremont Russet	0	0	+	+	1.3	0.6	0.0	0.0	0.4	0.3
Falstaff	0	1	-	+	0.3	0.4	0.1	0.0	0.6	0.1
Fiesta	2	4	+	+	2.5	1.9	0.6	1.3	1.9	2.0
Florina	1	1	-	-	0.0	0.0	0.0	0.0	0.0	0.0
Freedom	0	0	-	-	0.0	0.0	0.0	0.0	0.0	0.0
Goldrush	0	2	-	+	0.0	0.0	0.0	0.0	0.0	0.0
Greensleeves	0	1	-	-	0.1	1.0	0.0	*	0.6	*
Herrings Pippin	0	1	+	-	0.5	0.8	0.0	*	0.1	0.3
Judeline	1	2	-	-	0.0	0.0	0.0	0.0	0.0	0.1
King of Pippins	1	2	-	-	0.0	0.0	0.0	0.0	0.1	0.0
Liberty	0	1	-	-	0.1	0.1	0.0	0.0	0.4	0.1
Lord Lambourne	0	0	-	-	0.0	0.4	0.1	0.0	0.0	0.0
Mother	0	1	+	-	0.0	0.0	0.0	0.0	0.0	0.0
Northern Greening	0	0	+	-	0.9	1.8	0.5	1.2	1.3	3.1
Prima	0	0	-	-	0.0	0.0	0.0	0.0	0.0	0.0
Princess	2	3	-	+	0.0	0.0	0.0	0.0	0.0	0.0
Priscilla	0	0	-	-	0.0	0.0	0.0	0.0	0.0	0.0
Red Charles Ross	1	1	-	-	0.9	0.4	0.0	0.0	0.3	0.0
Red Ellison	1	0	-	-	0.0	0.1	0.0	0.0	0.0	0.5
Red Fortune	0	2	-	-	0.0	0.0	0.0	*	0.1	*
Redfree	0	0	-	-	0.0	0.0	0.0	*	0.0	0.0
Regent	1	2	+	-	3.3	2.0	0.9	0.8	2.6	2.9
Saturn	0	0	-	-	0.0	0.0	0.0	0.0	0.0	0.0
Sir Prize	0	3	-	+	0.0	0.0	0.0	0.0	0.0	0.0
Vanda	0	0	-	-	0.0	0.0	0.0	0.0	0.0	0.0
Wealthy	0	0	-	+	0.0	0.1	0.0	0.0	0.3	0.2
Winston R. Sport	2	3	-	+	2.3	2.3	0.1	0.3	1.4	3.0
Wyken Pippin	1	2	-	+	0.0	0.0	0.0	0.0	0.0	0.0

Note: + = present, - = absent, * = missing value because no fruit was present

Table 3. Incidence of primary and secondary mildew infections in June – July and September – October 1998, 1999 and 2000.

	Primary mildew		Secondary mildew infection on leaves							Mildew russet on mature fruits	
	Mean number of infections per tree		Mean number out of 5 of leaves in shoot terminals infected			Mean score (0-5 scale)				Mean score (0-5 scale)	
Variety	June 1999	Jun 2000	June 1998	Oct 1998	June 1999	June 1999	Sep 1999	Jun 2000	Sep 2000	Sep 1999	Sep 2000
A567/19	10.4	18.9	3.8	2.5	5.0	5.0	4.6	3.6	4.4	4.0	4.2
A931/15	0.3	0.9	2.6	1.5	4.3	3.1	2.1	2.5	1.5	0	0.0
A93/16	2.4	3.4	2.6	3.5	4.1	4.1	2.7	3.0	2.7	0.3	0.0
Antonoulka	0.9	0.6	3.4	2.8	4.8	4.4	3.4	3.1	2.5	0	*
Belle de Boscoop	2.3	2.7	2.6	0.3	4.7	3.6	3.3	2.5	2.4	0.4	0.0
Ceeval	2.4	6.8	3.8	1.8	3.3	3.1	2.1	1.9	1.3	0	0.0
Delorina	9.5	14.1	4.1	4.0	5.0	5.0	4.3	4.2	4.1	0.8	0.6
Discovery	0.0	0.0	2.6	2.3	0.4	0.4	0.9	0.8	1.0	*	*
Double R. Wealthy	0.4	0.1	4.5	3.3	4.3	3.1	1.9	2.5	1.4	0	0.0
E11/20	0.8	0.8	2.9	2.1	0.9	1.3	1.6	0.9	0.8	0	0.0
E83/4	2.4	1.8	3.4	3.1	4.1	3.6	3.3	2.4	2.0	1.0	0.0
E210/198	2.1	2.0	3.1	1.5	4.4	3.3	3.1	2.0	2.0	0	0.0
Early Victoria	0.4	1.6	3.9	4.0	2.1	2.0	2.7	1.4	1.4	*	0.0
Edward VII	0.0	0.6	3.8	3.6	0.6	0.8	1.1	0.9	0.9	0.3	0.0
Egremont russet	4.0	6.8	2.5	1.3	3.6	3.5	2.6	2.1	1.9	0	0.0
Falstaff	1.9	1.0	2.7	0.6	3.6	2.9	2.4	1.9	1.4	0	0.0
Fiesta	0.9	1.4	3.5	2.1	4.8	3.9	2.9	2.8	2.6	0.2	0.6
Florina	0.3	0.3	2.3	1.9	3.8	2.1	1.6	2.3	1.5	0.5	0.0
Freedom	8.8	15.8	1.4	1.9	5.0	5.0	4.0	3.3	3.7	2.5	1.3
Goldrush	7.9	7.9	2.8	1.0	5.0	5.0	4.4	4.8	4.0	0	0.0
Greensleeves	1.1	3.5	3.4	1.8	0.8	1.0	2.6	1.0	1.3	*	*
Herrings Pippin	0.3	2.5	3.6	3.0	2.9	1.9	1.6	1.9	1.5	*	0.0
Judeline	0.9	0.3	3.8	2.9	4.6	2.9	2.0	1.5	2.0	0.4	0.0
King of Pippins	2.6	11.6	2.9	3.4	3.9	3.8	3.8	3.0	3.8	0	0.0
Liberty	2.4	3.5	4.1	4.0	5.0	4.5	2.9	3.5	2.9	0.8	0.3
Lord Lambourne	0.0	0.3	2.3	2.1	0.9	0.8	1.0	0.8	0.5	0	0.3
Mother	0.5	1.4	3.4	1.4	3.5	3.1	3.1	2.8	2.3	0	0.0
Northern Greening	1.1	7.4	4.0	3.0	4.8	4.4	3.8	3.8	2.9	0.2	0.0
Prima	0.5	0.3	3.8	2.6	2.8	1.6	1.4	0.9	1.0	2	0.0
Princess	7.1	18.0	3.3	4.4	5.0	4.6	4.3	3.8	3.6	0	0.0
Priscilla	6.8	11.9	4.3	3.3	5.0	4.9	3.8	3.9	3.0	0.1	0.5
Red Charles Ross	0.0	0.0	4.3	1.5	4.1	3.4	1.9	2.4	1.1	1.0	0.0
Red Ellison	0.0	1.1	3.3	2.3	1.5	1.4	0.6	1.0	1.0	0	0.3
Red Fortune	0.4	0.4	2.8	0.8	4.3	3.3	1.8	2.1	1.6	*	*
Redfree	0.4	2.4	3.4	2.0	2.6	2.4	1.7	1.7	1.9	*	0.0
Regent	0.1	0.0	3.9	2.0	4.6	3.1	3.1	2.4	1.3	0	0.7
Saturn	0.8	1.4	4.1	3.0	3.0	1.9	1.9	2.1	1.4	0.8	0.9
Sir Prize	5.0	9.6	3.1	3.1	5.0	5.0	3.6	4.2	2.7	1.6	0.0
Vanda	4.6	5.9	3.3	2.5	4.9	4.7	3.0	2.8	2.6	0	0.0
Wealthy	0.0	0.0	3.3	0	4.6	2.9	1.8	2.4	1.5	0	0.0
Winston R. Sport	1.1	3.4	4.3	3.0	3.3	2.9	3.1	2.6	3.2	1.1	0.7
Wyken Pippin	2.5	8.3	3.3	1.4	4.8	4.0	3.3	3.5	3.8	0	0.0

Table 4. Incidence of sooty blotch, leaf spot and canker.

	Sooty blotch on mature fruits		Leaf spot on leaves		Leaf spot on mature fruits	Canker on trunk or branches	
	mean score (0-5 scale)		mean score (0-5 scale)		mean score (0-5 scale)	presence/absence	
Variety	Sep 1999	Sep 2000	Sep 1999	Sep 2000	Sep 2000	Jun 2000	Sep 1999
A567/19	1.1	0.9	1.3	0.8	0.0	-	-
A931/15	0.7	0.8	1.3	0.8	0.0	+	-
A93/16	0.7	1.5	1.1	1.1	0.0	-	-
Antonoulka	0.0	*	2.4	1.9	*	-	-
Boscoop	0.0	0.8	2.6	1.4	0.2	+	-
Ceeval	0.0	0.2	0.6	0.6	0.2	+	+
Delorina	1.5	0.9	0.9	0.6	0.1	-	-
Discovery	*	*	1.0	1.0	*	-	-
Double Red Wealthy	1.3	0.8	0.9	1.4	0.0	-	-
E11/20	0.0	0.4	0.9	1.0	0.0	-	-
E83/4	0.0	0.8	0.9	2.3	0.1	+	+
E210/198	0.5	1.4	1.0	1.1	0.0	-	-
Early Victoria	*	3.0	1.1	1.6	2.0	-	-
Edward VII	0.1	1.1	0.8	1.0	0.1	-	-
Egremont Russet	0.0	0.0	1.3	0.9	0.0	-	-
Falstaff	2.3	1.6	1.6	1.8	0.6	-	+
Fiesta	0.1	0.8	1.3	1.0	0.2	-	-
Florina	0.4	1.8	0.8	0.6	0.0	+	-
Freedom	0.8	0.7	2.1	0.9	0.0	+	+
Goldrush	3.3	1.9	1.3	0.3	0.1	+	+
Greensleeves	*	*	0.4	1.3	*	-	-
Herrings Pippin	*	0.3	0.3	1.0	0.0	-	-
Judeline	1.4	0.5	0.9	1.0	0.4	-	-
King of Pippins	0.0	0.0	1.0	1.1	0.0	-	-
Liberty	0.6	0.4	1.0	1.9	0.6	-	-
Lord Lambourne	0.1	0.3	0.8	0.8	0.3	-	-
Mother	0.0	0.8	3.1	2.9	0.2	-	-
Northern Greening	1.7	1.1	2.1	1.6	0.1	-	+
Prima	0.0	0.6	0.4	1.0	0.5	+	-
Princess	0.0	0.0	1.5	0.6	0.0	-	+
Priscilla	0.6	1.0	0.8	0.9	0.1	-	-
Red Charles Ross	0.0	0.0	1.0	0.7	0.0	+	-
Red Ellison	0.0	0.8	0.6	0.5	0.0	-	-
Red Fortune	*	*	1.5	0.8	*	-	-
Redfree	*	0.0	1.4	2.1	0.0	-	-
Regent	0.8	1.3	0.9	1.1	0.0	+	+
Saturn	1.0	0.6	1.9	2.0	0.1	-	-
Sir Prize	2.0	1.1	1.9	1.1	0.3	-	-
Vanda	0.6	0.8	1.1	1.0	0.2	+	+
Wealthy	0.5	0.4	1.4	1.5	0.0	-	-
Winston Red Sport	0.6	1.2	3.4	2.6	0.3	+	+
Wyken Pippin	0.3	0.8	1.5	0.8	0.3	+	-

Table 5. Incidence of infestation and damage by rosy apple aphid.

	Number trees out of 8 infested		Mean number of colonies per tree	Damage severity Mean score (0-5 scale)
	Jun 1998	Jun 1999	Jun 2000	Sep 2000
A567/19	2	2	0.5	1.6
A931/15	0	0	0.6	0.9
A93/16	0	0	0.0	1.3
Antonoulka	0	0	0.0	1.0
Boscoop	0	0	1.0	1.7
Ceeval	0	0	1.5	1.9
Delorina	0	0	0.0	1.5
Discovery	0	1	6.3	2.3
Double Red Wealthy	0	0	0.0	0.0
E11/20	0	1	1.1	3.3
E83/4	0	0	0.3	1.9
E210/198	1	0	1.4	0.7
Early Victoria	0	1	0.4	1.4
Edward VII	0	0	0.4	1.0
Egremont Russet	0	0	2.8	3.3
Falstaff	0	0	0.3	0.5
Fiesta	0	1	0.3	1.0
Florina	0	0	2.4	1.1
Freedom	1	0	0.1	0.7
Goldrush	0	0	0.0	0.0
Greensleeves	0	0	4.1	1.5
Herrings Pippin	0	0	0.0	0.4
Judeline	0	0	0.1	0.4
King of Pippins	1	1	0.0	1.3
Liberty	0	0	0.0	0.9
Lord Lambourne	1	1	0.6	1.0
Mother	0	0	0.0	1.6
Northern Greening	1	1	0.0	2.3
Prima	0	0	1.1	2.9
Princess	0	0	0.0	2.4
Priscilla	0	0	0.0	0.6
Red Charles Ross	0	1	0.6	1.3
Red Ellison	0	0	0.5	0.4
Red Fortune	0	1	0.1	0.8
Redfree	0	0	0.4	1.1
Regent	0	0	0.4	0.4
Saturn	0	0	0.0	2.1
Sir Prize	0	0	1.6	2.6
Vanda	0	1	5.1	2.6
Wealthy	0	0	1.1	1.1
Winston Red Sport	0	0	0.9	0.9
Wyken Pippin	0	0	0.3	0.8

Table 6. Incidence of leaf hopper damage, rust mite and leaf damage and leaf midge damage.

	Leaf hoppers		Rust mite			Leaf midge	
	Mean score (0-5 scale)		Nos. mites Mean score (0-5 scale)	Bronzing Mean score (0-5 scale)		Mean nos. of leaves infested in 2 shoot terminals	
	Jun 1998	Oct 1998	Jun 1998	Oct 1998	Jul 1999	Jun 1998	Oct 1998
A567/19	1.5	2.4	0.9	1.1	1.0	0	8.4
A931/15	1.9	1.9	1.9	1.3	1.5	2.4	9.4
A93/16	1.5	2.4	2.3	1.1	1.4	1.0	8.5
Antonoulka	1.9	2.6	1.5	1.0	1.6	2.3	8.1
Boscoop	2.0	1.8	1.8	1.5	2.4	0.9	9.4
Ceeval	1.3	1.8	1.5	1.5	1.3	0.4	9.4
Delorina	0.9	1.8	1.3	0.6	1.6	1.1	7.6
Discovery	1.5	2.1	1.0	2.0	2.0	0.4	9.8
Double R. Wealthy	1.4	1.9	1.0	1.9	1.5	0.6	5.5
E11/20	1.7	2.0	0.8	1.9	0.9	0.3	9.4
E83/4	2.3	2.1	2.0	1.6	1.7	0.5	10.0
E210/198	1.5	2.0	0.8	1.6	1.7	1.6	9.5
Early Victoria	1.1	2.3	0.3	1.1	1.0	0.6	10.0
Edward VII	1.5	2.9	2.7	1.5	0.5	0.8	9.3
Egremont Russet	1.8	2.3	1.4	1.4	2.0	0.6	9.3
Falstaff	1.1	1.9	1.3	1.3	1.3	0	10.1
Fiesta	2.5	2.5	1.8	1.5	1.5	1.0	9.9
Florina	1.4	2.9	1.3	1.0	2.1	2.0	9.9
Freedom	2.1	2.1	1.7	1.3	1.8	0.1	9.8
Goldrush	1.9	2.5	1.7	1.1	1.0	1.4	9.9
Greensleeves	1.6	1.5	1.3	1.4	1.4	0	10.0
Herrings Pippin	2.9	2.9	3.1	0.8	1.9	1.8	8.6
Judeline	1.4	2.3	1.7	1.3	0.4	0.3	9.6
King of Pippins	2.6	2.6	2.0	1.0	2.3	0.4	9.8
Liberty	1.4	2.3	1.6	1.6	1.7	0.5	9.9
Lord Lambourne	2.9	3.4	2.3	1.6	1.7	0.5	9.8
Mother	1.1	1.3	0.7	1.0	1.7	0.5	9.6
Northern Greening	1.6	1.8	1.7	1.6	0.9	1.1	8.4
Prima	1.8	2.8	2.2	2.0	1.8	1.1	9.4
Princess	1.1	2.3	2.5	1.9	1.3	1.1	9.5
Priscilla	1.6	2.5	0.7	1.3	2.2	1.4	9.3
Red Charles Ross	1.6	2.8	1.8	1.8	1.4	0.5	9.9
Red Ellison	1.6	2.3	1.3	1.3	1.2	1.0	7.8
Red Fortune	1.6	2.4	2.0	1.0	1.4	0.9	9.5
Redfree	1.4	1.9	1.7	1.9	1.3	1.3	8.6
Regent	1.1	1.8	2.1	1.4	2.3	0.8	9.8
Saturn	1.5	2.3	1.7	1.5	2.1	0.3	8.0
Sir Prize	1.8	2.4	1.6	0.8	1.6	0.9	9.5
Vanda	1.5	1.6	0.1	0.6	2.5	1.9	10.0
Wealthy	2.0	1.8	1.0	1.4	2.6	0	7.9
Winston Red Sport	2.0	2.4	1.9	1.9	0.8	0.3	9.6
Wyken Pippin	1.6	1.6	1.5	0.9	0.8	0	10.0

Table 7. Crop growth records

Variety	Mean number fruitlets per tree		Tree growth
			Mean score (0-5 scale)
	June 1999	June 2000	June 2000
A567/19	9.1	17.1	2.8
A931/15	2.8	13.5	3.2
A93/16	21.6	11.4	2.6
Antonoulka	8.0	0.8	1.8
Boscoop	4.1	8.0	3.6
Ceeval	7.8	20.0	2.9
Delorina	2.4	22.5	2.6
Discovery	11.5	7.8	3.1
Double Red Wealthy	13.6	26.0	2.6
E11/20	22.6	55.0	4.1
E83/4	3.8	26.3	3.5
E210/198	4.5	21.1	2.7
Early Victoria	9.1	17.3	2.0
Edward VII	5.5	16.3	2.9
Egremont Russet	11.3	16.4	3.6
Falstaff	35.9	48.9	3.4
Fiesta	19.9	38.9	3.0
Florina	10.8	30.9	4.1
Freedom	10.6	7.8	2.5
Goldrush	14.4	67.8	3.6
Greensleeves	19.6	23.6	3.2
Herrings Pippin	3.5	29.1	3.3
Judeline	48.1	84.4	5.0
King of Pippins	8.0	6.5	3.0
Liberty	19.1	46.0	3.7
Lord Lambourne	18.4	26.4	3.0
Mother	0.9	6.4	3.3
Northern Greening	7.8	5.9	2.5
Prima	7.5	113.1	5.0
Princess	22.3	17.9	3.7
Priscilla	17.9	29.0	3.4
Red Charles Ross	4.1	17.9	2.1
Red Ellison	16.3	27.5	3.6
Red Fortune	11.1	21.9	3.1
Redfree	15.0	48.3	3.1
Regent	9.3	20.6	2.6
Saturn	21.0	55.3	3.5
Sir Prize	11.3	8.9	3.3
Vanda	8.1	29.1	3.1
Wealthy	9.3	25.0	2.2
Winston Red Sport	10.8	31.3	2.7
Wyken Pippin	9.2	4.3	2.8