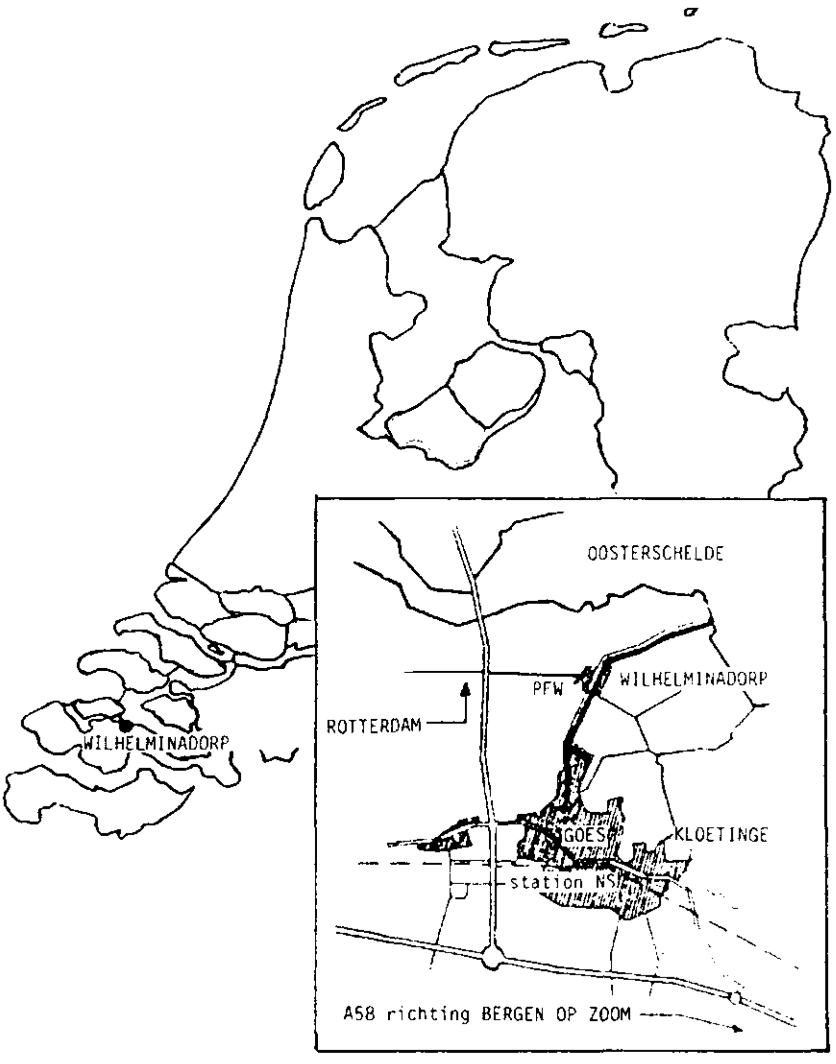
RESEARCH STATION FOR FRUIT GROWING

BRUGSTRAAT 51, 4475 AN WILHELMINADORP, THE NETHERLANDS

Price Dfl. 12.50



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C O N T E N T S

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Economic comparison of Q

REMARKS ON THE BRANDS OF PESTICIDES AND HERBICIDES

The dosages mentioned for pesticides and herbicides in this report refer to the commercial products. Trade names of products have been used for the sake of convenience, but this makes it unavoidable that in some cases similar products on the market under other trade names are not mentioned. No endorsement of named products is intended. A list of the commercial products mentioned in this report and their active ingredients is given on page 76.

Some of the experiments described in this report are being carried out with chemicals and/or concentrations not yet legally approved.

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TOP FRUIT

VIRUS RESEARCH AND CLONAL SELECTION IN FRUIT TREES

S.J. Wertheim and J.L. Baarends

Pear clones

In the spring of 1975 a trial was planted with 4 cultivars on Quince C rootstock, viz. Conference, Doyenné du Comice, Bonne Louise d'Avranches and large-fruited Précoce de Trévoux mutants. Several clones of each variety were planted; 5, 7, 5 and 4 respectively. After the budding of rootstocks in the fruit-tree nursery on 27th July 1973, half of the rootstocks (not with all clones) were infected with a virus complex. This was done on 25th August 1973 by the budding of 2 chips per rootstock from an infected pear tree. According to data from the Plant Protection Service at Wageningen the virus complex consisted of 5 viruses: Quince stunt, Quince sooty ring spot, Rubbery wood, Vein yellows, and Ring pattern mosaic.

With Conference and Doyenné du Comice the treatments given in Table 1 were replicated 6 times with 3 trees per plot. With the other two cultivars, not mentioned further here, 4 replicates of 2 trees each occurred. Planting distance was 3.86 x 1.52 m. The trees were grubbed after the harvest of 1984.

Some production data are given in Table 1. For Conference, accumulated from 1976 to 1984; for Comice from 1976 to 1983, because 1984 was a complete off-year. The figures for Conference show that virus infection decreased tree production considerably. This was due to the effect on growth (smaller tree heads) since the production per m^3 tree volume was not affected negatively. Clone T.173 cropped more than the standard M.202, the clone distributed in The Netherlands. However T.173 gave smaller and smoother pears than M.202. The latter clone gives the wanted bronze-coloured fruits. T.310, too, yielded more than M.202, but again the fruit skin was less russeted.

Virus lowered fruit size significantly, and of the clones, M.202 gave the largest pears.

With Doyenné du Comice, too, virus infection lowered tree productivity in all clones. Again, this was due to a smaller tree volume, for per m^3 of tree volume diseased trees cropped equally well compared with healthy ones. Clone M.204, the standard one, proved to be a very good one, both in productivity as in external fruit quality. M.204 yielded large, smooth-skinned pears. The French clone equalled M.204 in both aspects. T.58 was the only bronze-fruited clone. This is an undesirable character for this cultivar (in contrast to Conference). All clones gave large pears and virus infection decreased fruit size also in all clones.

Table 1. Results of virus infection and clonal comparison with pear.

Clone	Virus infection*	Kg/tree	Tree volume m^3 end of 1984	Kg/m^3 tree volume
Conference 1976 till 1984				
T.173	-	134.5 a	1.54 b	90.1 ab
T.173	+	85.4 b	0.89 c	111.3 a
M.202	-	129.7 a	1.99 a	66.3 b
M.202	+	98.2 b	1.48 b	67.3 b
T.310	-	143.8 a	1.54 b	100.1 a
Italy 69	-	125.6 a	1.71 b	75.5 b
France 69	-	129.2 a	1.75 b	74.4 b
LSD		15.3	0.24	19.3
Doyenné du Comice 1976 till 1983				
T.45	-	71.3 cde	1.89 a	38.0 bc
T.45	+	64.0 ef	1.65 abc	39.4 bc
T.58	-	60.4 ef	1.81 ab	34.7 c
T.58	+	54.7 f	1.59 abc	35.4 c
B.363	-	84.1 abc	1.89 a	44.5 abc
B.363	+	68.7 de	1.50 bc	46.6 ab
M.204	-	87.5 a	1.90 a	46.5 ab
M.204	+	68.9 de	1.37 c	50.9 a
Italy 69	-	78.2 abcd	1.91 a	41.4 abc
Italy 69	+	67.6 de	1.47 bc	46.7 ab
France 69	-	85.2 ab	1.80 ab	48.2 ab
France 69	+	73.8 bcde	1.65 abc	45.7 ab
Cauwenberghe	?	78.9 abcd	1.78 ab	44.6 abc
LSD		9.3	0.24	6.7

* See text; - = no virus, + = virus infected, ? = virus status unknown.
Values per variety in one column followed by the same letter(s) do not differ significantly (P = 0.05).

Mutants and clones of Jonagold apple

"Wilmuta", a red coloured Jonagold mutation

In 1980 a red Jonagold mutation was found within the Belgian number 2361. It obtained as a code number 2361-15-1, and was later named "Wilmuta". Breeders' rights have been applied for. The fruit colour of "Wilmuta" is conspicuously an even red, albeit that non-coloured sectors often do occur. Hence, "Wilmuta" probably is a chimaere. Similar mutations have been found, both in Wilhelminadorp, and on commercial holdings.

In 1984 the first crop was obtained from Wilmuta trees on M.27, planted spring 1983. Colour grading data in 1984 are given in Table 2, compared with those of normal Jonagold on M.27 that served as controls. Table 2 shows that there were no differences between the red coloured areas between the two types. However, colour intensity did differ, "Wilmuta" fruits having a deeper red colour. These latter differences were statistically significant (P = 0.05). The fruits of "Wilmuta" often showed small less-coloured stripes (chimaeres).

Table 2. Fruit-colour data of Jonagold and Wilmuta. Picking date 24 October 1984.

% red blushed area	Jonagold		Wilmuta	
	%	colour intensity*	%	colour intensity*
0-10%	0.6	0.0	0.4	0.0
11-20%	3.2	0.0	3.4	0.9
21-33%	11.5	0.8	9.5	3.0
34-50%	35.2	10.3	32.1	15.5
51-75%	46.5	12.1	49.7	33.5
75-100%	3.0	0	4.9	3.5
		23.2		56.4

* % intensively coloured fruits in each blushed area.

Within the trees of "Wilmuta" some reverse mutations with regard to fruit colour have been found. Therefore, it will be necessary to test "Wilmuta" further for a few years to establish its stability.

For some other details on Jonagold mutants see p.35.

Jonagold origins

In the spring of 1977 3 sources of normal Jonagold were planted in the experimental gardens at Wilhelminadorp and Horst. One source came from Geneva (USA), a second one from the experimental garden at Glabbeek (Belgium). A third source was supplied by Mr. Gilles from the Gorsem Research Station in Belgium. The latter was supplied in the form of three different top grafts, numbered 2291, 2311, and 2381. These 3 numbers proved to be virus free, after testing in Gorsem and Wageningen. The USA and the Glabbeek source were not virus tested and were probably contaminated with various latent viruses.

All sources tested in this experiment are normal Jonagold types. Table 3 summarizes some results obtained in the period 1978 till 1984. The first column shows that the virus free numbers yielded more than the non-tested ones. Number 2311 gave the highest yield, albeit not significantly different from the other two numbers. The mean fruit weights in column 2 show that no significant differences between the sources were obtained.

Table 3. Results comparison of Jonagold sources accumulated for 1978 till 1984.

Source	Kg/tree	Mean fruit weight (g)	Colour index	% in kg of intensively coloured plants
Gorsem 2291	141 abc	198 a	336 a	17.0 a
Gorsem 2311	168 c	199 a	347 a	21.6 b
Gorsem 2381	160 bc	185 a	339 a	17.3 a
Glabbeek	129 abc	181 a	332 a	16.2 a
USA	121 a	179 a	343 a	15.8 a

Values within the same column followed by the same letter(s) do not differ significantly (P = 0.05).

Fruits were annually graded for colour. The standard was the percentage of the fruit surface that was red coloured (0-25, 26-50, 51-75, and more than 75).

By multiplying the weight percentages of these 4 grades by 1, 3, 5, or 7 respectively a colour index was obtained. The higher the index the better the colour of the lot. The third column of Table 3 gives the colour indices, which show that no differences existed. However, when colour intensity (column 4) was also taken into account, number 2311 was the best.

From these results number 2311 should get preference over all others. However, a final conclusion can only be made when the data of Horst are also considered, the more so because there, number 2311 lagged somewhat behind in fruit colour.

ROOTSTOCKS AND INTERSTEMS FOR POME AND STONE FRUITS

S.J. Wertheim

Apple

Rootstock-interstem combinations to avoid using tree supports

In the spring of 1981 a trial was planted on MM.106 rootstock with M.9 as an interstem and Golden Delicious and James Grieve as scion cultivars. The aim was to study whether such trees can be trained without a stake. For the same reason deep planting was included in the trial. Deep planting meant that the lower union is at soil level, whereas with normal planting this is 15 cm above the ground. The trial (Table 4) has 6 replicates with 3 trees per plot.

Table 4. Results of a comparison of trees with or without a stake, normally or deeply planted (see text).

Planting depth	Stake	Kg/tree 1982-1984		
		James Grieve	Golden Delicious	Average
Normal	+	23.0 a	35.4 a	29.2 a
Normal	-	23.9 a	31.4 ab	27.7 a
Deep	+	22.0 a	29.9 a	25.9 ab
Deep	-	20.8 a	26.1 b	23.4 b

Values within the same column followed by the same letter(s) do not differ significantly (P = 0.05).

Cropping started in 1982. The accumulated yields per tree for the years 1982 till 1984 are given in Table 4. It appears that with James Grieve productions did not differ significantly. The same holds when the data are calculated for support or planting depths alone. With Golden Delicious significant differences in yield did occur. Deep planting yielded significantly less than normal planting (27.8 vs. 33.8 kg/tree). The difference between trees with or without a stake failed to reach significance (32.7 vs. 28.8 kg).

When the two cultivars were taken together, only the difference between normal and deep planting was significant.

Especially with Golden Delicious a number of trees without a stake are standing at such an angle that it is feared that they will topple over in a strong wind when loaded with fruit.

In a second trial, planted in the spring of 1980, with Cox's Orange Pippin, the treatments mentioned in Table 5 are being compared. The aim is the same as in the afore-mentioned trial. The trial has 6 replicates with 2 to 3 trees per plot. The planting distance is 3.50 x 1.80 m. In the previous Annual Report (1983: p. 29) some results were mentioned.

Tabel 5. Results of a comparison of rootstock-interstem combinations with Cox's Orange Pippin planted with or without a stake.

Rootstock	Interstem	Kg/tree 1981-1984	
		+ stake	- stake
MM.106	MM.106	75.7 a	65.8 c
MM.106	Zoete Aagt	73.6 ab	70.8 ab
MM.106	M.9	57.8 d	49.1 ef
MM.106	M.27	46.5 ef	36.7 g
MM.106	3426	16.9 h	18.3*h
M.9	Zoete Aagt	41.7 fg	-
M.9	MM.106	52.8 de	-

- Missing treatment.
* Trees provided with stake at planting time.
Values in both columns followed by the same letter(s) do not differ significantly (P = 0.05).

All trees with the interstem 3426 already got a pole at planting, because the trees were slack. On the other dwarfing interstems at the moment 5 (M.27) or 1 (M.9) support-less trees have already been provided with a pole to prevent tree loss, because these had toppled over. Some of the remaining trees on these interstems are also standing more or less at an angle. So, also in this trial it appears that the rootstock-interstam combinations under trial are no substitute for tree supports.

Trees on MM.106 with M.27 or M.9 interstem do have comparable sizes to those directly on M.9. The interstem 3426 is too dwarfing, resulting in very small trees, too small fruits, and a lot of root suckering. Trees on MM.106 (interstem) are too vigorous.

Table 5 shows that trees without a stake yielded less than those with a stake. Averaged over all relevant treatments trees with a stake gave 69.0 kg per tree, which was significantly more than the yield of stake less trees (61.9 kg). This is a consequence of the smaller tree volumes of the latter trees. Apparently, lack of support weakens growth. The other yield differences in Table 5 also more or less reflect differences in tree sizes.

Interstem for increasing production

Some apple cultivars form sylleptic shoots in the fruit-tree nursery that are inserted too low. Such side shoots are removed at planting in the orchard. When an interstem is used these shoots can be maintained, which is favourable for early production.

In the spring of 1978 a trial was planted with Winston - a low-feathering cultivar - on M.9 with or without various interstems (Table 6) of 40 cm length. The trial has 6 replicates with 3 trees per plot planted at 3.47 x 1.62 m.

The trees developed uniformly. At the end of 1982 there were no significant differences in tree volume. However, the trees without an interstem lagged behind a bit in m^2 tree-crown projection. The accumulated productions given in Table 6 reflect tree size. Differences between interstem trees were small, but trees on Winston interstem were less productive than those on Bellefleur or Golden Delicious. The high production of interstem trees compared to trees directly on M.9, prove that use of an interstem is favourable for low--feathering cultivars. Fruit size was not affected by the interstems.

Table 6. Results interstem trial with Winston on M.9.

Interstem	1979-1984	
	kg/tree	mean fruit weight (g)
None	73.0 a	132
Zoete Aagt	82.8 bc	133
Bellefleur	87.9 c	132
Golden Delicious	86.8 c	130
Rode Boskoop*	84.3 bc	135
Winston	78.1 ab	134

* Schmitz Hübsch
Values followed by the same letter(s) do not differ significantly (P = 0.05).

<u>Plum</u>

Rootstocks

In the spring of 1981 a trial was planted in which the English rootstock Pixy is being compared with the standard rootstock St. Julien A with 2 cultivars: Opal and Reine Claude d'Oullins. Five to 6 replicates occur with 2 to 3 trees per plot, with the trees planted at 4 x 3 m.

The trees on Pixy grew less vigorously than those on St. Julien A, but Pixy should not be considered as a very dwarfing rootstock. The first crop was obtained in 1983. Table 7 shows the yields and fruit weights from 1983 and 1984. The latter is of importance, because English observations show that fruits from trees on Pixy may be small. The data in Table 7 confirm that plums from Pixy are somewhat smaller than from St. Julien A.

Table 7. Results of plum-rootstock trial.

Rootstock	Kg/tree			Mean fruit weight (g)		
	1983	1984	Total	1983	1984	Total
Opal						
Pixy	3.7	4.9	8.5 a	23.2	36.7	28.9 a
St. Julien A	3.3	19.7	23.1 b	32.0	34.9	34.4 b
Reine Claude d'Oullins						
Pixy	1.8	6.3	8.1 a	43.5	50.5	48.5 a
St. Julien A	0.0*	4.9	5.0 a	50.0	58.9	59.1 b

* 0.03 kg.
Values within the same column followed by the same letter do not differ significantly (P = 0.05).

Opal yielded less on Pixy, which is certainly partly due to the smaller trees. With Reine Claude d'Oullins yields were equal in spite of this.

The overall picture is that Pixy is a real improvement with regard to growth vigour. However, it has to be awaited how productivity and fruit quality will develope further.

RESEARCH ON TOP FRUIT

S.J. Wertheim and P.S. Wagenmakers

Planting system trial with slender and North-Holland spindle

In spring 1978, a trial was planted with Rode Boskoop on M.9, in which slender spindles and North-Holland spindles are being compared, each in five planting systems. In each system winter pruning is compared with winter pruning plus additional summer pruning. Table 8 gives the various treatments for both spindles in order of increasing plant density.

Table 8. Planting systems, density and distance in order of increasing density.

Planting system	Trees/ha	Planting distance
Slender spindle		
Single row	2667	3.00x1.25
Three-row bed	2959	3.00+(2x0.75)x2.25
Six-row bed	3012	3.00+(5x1.17)x2.25
Full field	3559	2.25x1.25
Three-row bed	3788	2.75+(2x0.89)x1.75
North-Holland spindle		
Three-row bed	2959	3.00+(2x0.75)x2.25
Single row	3196	2.50x1.25
Three-row bed	3788	2.75+(2x0.89)x1.75
Six-row bed	3921	2.75+(5x1.20)x1.75
Full field	4566	1.75x1.25

After the high yields in the previous year, 1984 has been an off-year. Yields per ha were considerably low, but didn't deviate from the accumulated yields in the period 1979-1984. As in the previous years, the differences between trees with and without additional summer pruning were very small, so the results were averaged. The slender spindle reached a significantly higher production per tree compared with the North-Holland spindle. Obviously, the larger tree volume is responsible for this outcome.

The optimal plant density for the slender spindle was reached at a lower density compared to that for the North-Holland spindle. With 3500 trees/ha the slender spindle had the same production level as the North-Holland spindle with 4500 trees/ha.

In general, there was an increase in production with plant density, but the planting system had an effect. The narrow three-row bed and the six-row bed with North-Holland spindles had the same production level as the single row, in spite of having more than 500 trees extra. Yet, this was still not the optimal density, for the full-field system had a significantly higher production per ha. With the slender spindle a comparable situation occurred. There, at high density, the narrow three-row bed had a lower yield than the full-field system. Possibly, 3500 trees/ha was the optimal density for the slender spindle, but it cannot be ruled out that a full-field system with a higher density is more productive.

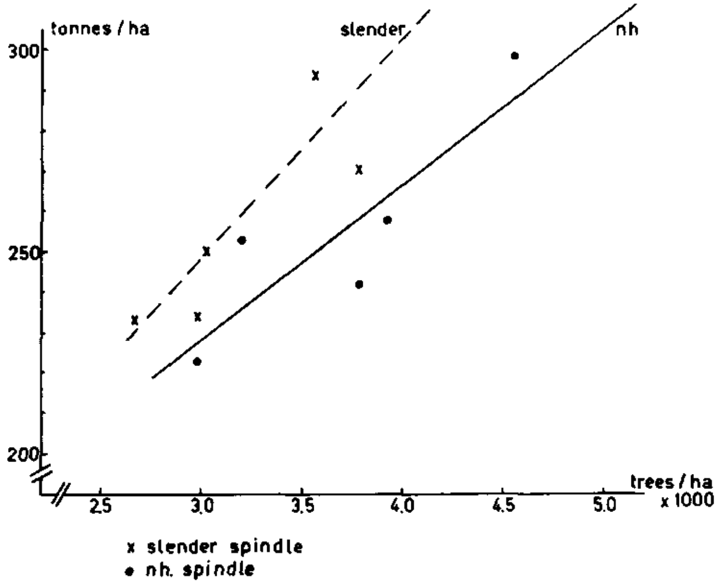

Fig. 1. Production in tonnes/ha, accumulated for 1979-1984 (averaged for winter plus summer pruning).
Slender spindle : y = 47.8x + 104 (r = 0.85).
North-Holland spindle: y = 38.4x + 113 (r = 0.87).

International planting-system trial

Within the framework of the Working Group "High Density Plantings" of the International Society for Horticultural Science (ISHS), a planting system trial with Golden Delicious and Gloster was planted in spring 1981. All systems and densities are mentioned in Table 9. The systems are single row, double row, three-row bed and full field. The systems 1, 2, 3 and 5 are on M.9 rootstock, system 4 is on M.27. The tree shape is a slender spindle, except for system 3 (North-Holland spindle) and 4q ("mini-bush").

As in the previous years, the production was good in 1984. Yields per ha increased with density, but not in a linear way. The full-field system yielded less well, which may be due to the use of M.27, but the plant density may also have been too high.

With the same densities, the double row and three-row bed did not yield more than the single row. The mini-bush had a smaller tree volume than the slender spindle. Nevertheless, the production per tree was almost the same in the case of Golden Delicious. For Gloster, the production of the mini-bush was remarkably lower.

Fruit weight in the full-field system was 25-50 g lower than in the other systems, due to either M.27 or the high density. The difference in fruit weight between slender spindle and mini-bush was small.

Table 9. Production per tree (1984) and per ha (1982-1984) and fruit weight (1984) at Wilhelminadorp.

Planting system	Planting distance	Density (trees/ ha)	Kg/ tree	Ton- nes/ ha	Fruit weight (g)
Golden Delicious					
1. Single row	3.00x1.25	2667	20.9	103	149
2. Double row	3.00+1.45x1.68	2675	18.5	90	139
3. Three-row bed	3.00+(2x0.90)x1.75	3571	15.9	112	135
5. Single row	2.75x1.02	3565	17.2	119	143
4p. Full field	1.50x0.75	8889	7.7	142	110
4q. Full field, mini	1.50x0.75	8889	7.2	127	109
Gloster					
1. Single row	3.25x1.50	2051	21.4	85	185
2. Double row	3.25+1.70x1.96	2061	22.0	88	198
3. Three-row bed	3.25+(2x1.10)x2.00	2752	18.5	95	210
5. Single row	3.00x1.21	5714	18.4	97	202
4p. Full field	1.75x1.00	5714	9.4	110	161
4q. Full field, mini	1.75x1.00	3565	6.6	84	172

Planting system with apple: arrangement and tree height

In this trial, the factors density, arrangement and heigth are being compared in four places, one of which in Denmark. The trees were planted in 1983. The cultivar is Elstar on M.9 rootstock. At three densities (Table 10), the effects of arrangements and tree height on productivity and fruit quality will be assessed. The reason is that light distribution might be a limiting factor at high densities. Therefore, square arrangements (1:1) that theoretically have a better interception than rectangular plantings (2:1 and 3:1) are being compared, each for three tree heights (2.25, 1.87 and 1.50 m).

Table 10. Production and mean fruit weigh for Elstar in 1984.

Trees/ha	Tonnes/ha					Mean fruit weight (g)
	Wilhel- minadorp	Numans- dorp	Werk- hoven	Aarslev (Denmark)	Mean	
2000	14.5	20.6	10.8	20.6	16.2 a	178 a
2667	19.3	28.3	14.0	29.1	22.0 b	177 a
4000	28.4	38.7	21.7	38.8	31.8 c	174 a

Values within the same column followed by the same letter do not differ significantly (P = 0.05).

In 1984, the first production year, the effect of tree height and arrangement was negligible, because differences in tree sizes were very small. Production increased linearly with plant density. The increase was 8 tonnes/ha per 1000 trees. Fruit weight decreased slightly with densitiy. Results are given in Tabel 10, averaged for arrangements and heigths.

There were marked differences between the places. Numansdorp and Aarslev (Denmark) had most vigorous growth, accompanied by good production. This may be explained by differences in soil quality. Fruit weight was rather low in Aarslev, possibly because the growing season is much shorter than in The Netherlands.

Planting system with pear

In spring 1981, a planting system trial with the cultivars Conference and Doyenné du Comice, both on Quince C rootstock, was planted. The treatments are single row, three-row bed and five-row bed, each in three densities (Table 11).

Table 11. Production per ha, accumulated for 1982-1984 and fruit weight (1984) for 2 cultivars, averaged for three planting systems.

Trees/ha	Tonnes/ha		Fruit weight (g)	
	Conference	D. du Comice	Conference	D. du Comice
2000	40.3 a	24.6 a	148	254
2667	43.4 a	25.7 a	142	246
4000	56.7 b	51.6 b	133	195

Values within the same column followed by the same letter(s) do not differ significantly (P = 0.05).

A higher plant density led to more production per ha. The influence of the planting system per density was not statistically significant. For this reason, results are given per density.

Mean fruit weight decreased with higher plant density. Particularly the fruit weight of Doyenné du Comice seemed to be higher in the bed systems. This was more pronounced in 1983 than in 1984. A lower number of flower buds and fruits in the beds is possibly the reason for the higher fruit weight. Light distribution in the beds might have been limiting for flower-bud formation.

In 1984, the objects with 4000 trees/ha were sprayed for the second year with chloromequat (CCC), the objects with 2667 trees/ha were sprayed for the first time, because the alloted space had been filled up.

Growth promotion after replanting

After replanting apple trees in soil previously planted with apple, growth can be inadequate. To investigate whether growth can be improved in such a situation, a trial was planted with 3 apple cultivars: James Grieve, Jonagold and Golden Delicious. This was done in the spring of 1980 on a site where apple trees had been grubbed the previous winter.

Main treatments were deep rotary tillage of the soil to 90 cm depth and trickle irrigation. Subtreatments were the planting of one or two-year-old trees on M.9 or one-year-old trees on M.26. The planting distance was 3.42 x 1.50 m and the trial has 4 replications with 3 to 9 trees per plot. With Jonagold some treatments are missing (Table 12).

Table 12 shows that water improved cropping with James Grieve. Water treatments yielded significantly more than non-watered treatments (52.8 vs 45.3 kg/tree). Deep rotary tillage too, had a significantly positive effect (50.4 vs 47.7 kg/tree). Between the other treatments differences were not significant. Fruit weight did not differ either.

With Golden Delicious trickle irrigation also increased yield significantly (77.2 vs 69.3 kg/tree). Here, rotary tillage had no advantage over no soil treatment (72.3 vs 74.2 kg/tree). With this cultivar M.26 lagged behind in production, in spite of having larger trees! The production per tree on M.26 was 68.4 kg, which was significantly less than on M.9: 75.5 kg (one-yeaer-old trees) or 76.0 (two-year-old trees). Fruit weights did not differ much between the treatments.

With Jonagold irrigation, too, increased cropping significantly (72.2 vs 67.4 kg/tree). Freezing had no effect (68.8 vs 70.9 kg). Fruits were equally large in all treatments.

In conclusion, it may be said that trickle irrigation was the most important growth-promoting factor. Averaged over all 3 cultivars, this treatment yielded significantly more than unwatered controls (67.2 vs 61.7 kg/tree, undoubtedly a consequence of a larger tree volume). Soil treatment did show an effect when all cultivars were taken together. So, even with a shallow soil, as in the current trial, mixing top soil with sub soil to enlarge the rooting zone has no clear effects.

Table 12. Results of growth-promoting trial.

Deep rotary tillage	Water	Plant material* rootstock	Kg/tree 1981-1984		
			James	G. Delicious	Jonagold
-	-	1 M.9	42.8 a	72.3 abc	68.3 a
-	-	2 M.9	46.6 ab	77.8 abc	
-	-	1 M.26	44.6 a	60.5 a	
+	-	1 M.9	46.7 ab	73.8 abc	66.6 a
+	-	2 M.9	47.2 ab	71.3 abc	
+	-	1 M.26	44.1 a	64.4 ab	
-	+	1 M.9	50.2 ab	82.7 c	73.5 a
-	+	2 M.9	51.0 ab	80.7 c	
-	+	1 M.26	51.2 ab	75.4 abc	
+	+	1 M.9	52.5 ab	73.2 abc	71.0 a
+	+	2 M.9	56.7 b	78.1 bc	
+	+	1 M.26	55.4 b	73.2 abc	

* See text.
Values within the same column followed by the same letter(s) do not differ significantly (P = 0.05).

Plum pruning

In the spring of 1981 a trial was planted with the cultivars Opal, Reine Claude d'Oullins, and Victoria, all on St. Julien A rootstock to study the effect of summer pruning in combination with a higher plant density. The planting distance was 4 x 3 m or 4 x 1.5 m. Pruning is done entirely in the winter or predominantly in the summer (with a light correction in the winter). Summer pruning is carried out in July-August and included the removal of superfluous shoots, and the cutting back of extension shoots to 20 cm stumps and side shoots to 15 cm stumps. Because this was considered a weakening method, a smaller planting distance (4 x 1.5 m) was planted next to a normal distance (4 x 3 m). The trial is made in 4 replications per cultivar with 5 trees per plot, of which the 3 middle ones are for observations.

Trees started to bear fruit in 1982, except for Reine Claude d'Oullins which cropped for the first time in 1984. Table 13 summarizes the first crops. Decreasing tree volume by heavy summer pruning lowered productivity per tree, but per ha, because tree density is increased, the reverse was true with Opal and Victoria. Summer pruning reduced fruit size somewhat with Victoria.

With all cultivars the summer pruned trees at 4 x 1.5 m are most manageable.

Table 13. Results plum pruning trial.

Cultivar	Pruning time	Planting distance	Kg/tree 1982	1983	1984	Total	Ton/ha 1982-1984	Mean fruit weight (g) 1984
Opal	winter	4x3	0.07	3.02	21.38	24.5 a	20.4	32.1
	summer	4x3	0.40	2.68	20.33	23.4 a	19.5	31.3
	summer	4x1.5	0.21	3.33	10.50	14.0 b	23.3	31.1
Oullins	winter	4x3	-	-	3.88	3.9 a	3.2	56.3
	summer	4x3	-	-	4.98	5.0 a	4.2	57.5
	summer	4x1.5	-	-	2.10	2.1 a	3.5	51.0
Victoria	winter	4x3	1.55	5.95	18.85	26.4 a	22.0	50.1
	summer	4x3	1.08	5.91	16.83	23.8 a	19.8	47.3
	summer	4x1.5	0.80	5.08	8.65	14.5 b	24.2	43.4

Values per cultivar followed by the same letter do not differ significantly ($P = 0.05$).

REGULATION OF FRUIT SET, FRUIT GROWTH, FRUIT DROP, AND VEGETATIVE GROWTH

S.J. Wertheim

Growth inhibition with pear

In a trial with five-year-old trees of Doyenné du Comice on Quince A rootstock various growth retardants were compared. The standard recommendation of chloromequat (treatment 2, Table 14) was compared with a higher concentrated more frequent programme (treatment 3) and with 2 Alar-treatments (4 and 5). The new retardants paclobutrazol (PP333) and El 500 were included as well (treatments 6 and 9). Finally, chloromequat was combined with Alar (treatments 7 and 8), because the current chloromequat treatments often reduce growth insufficiently. Untreated trees (treatment 1) served as a control. The trial was set up in 10 fold with 1 tree per plot.

The main data on growth and cropping are given in Table 15. The trees flowered well - with 150 to 200 clusters per tree on average - but fruit set was low. Both GA-inhibiting compounds, PP333 and EL 500, thinned, especially the former. PP333 further reduced fruit size. All other treatments did not affect fruit set or fruit growth.

All retardants reduced growth, chloromequat and Alar through reduction of both the shoot number and shoot lengths, PP333 and EL 500 only through length. For growth control chloromequat and Alar combinations warrant further study.

Table 14. Treatments of growth-retardant trial with Doyenné du Comice in 1984 (+ = treatment, - = no treatment).

Treatment	Application date						
	24/4[1]	14/5[2]	28/5	5/6	12/6	18/6	25/6
1. Untreated	-	-	-	-	-	-	-
2. Cycocel Extra 0.25%	-	+	+	-	-	-	-
3. Cycocel Extra 0.40/0.30%	-	+	+[3]	-	+[3]	-	-
4. Alar-64 0.20%	-	+	+	-	-	-	-
5. Alar-64 0.10%	-	+	+	-	-	-	-
6. PP333 0.50/0.25%	+	-	+[4]	+[4]	+[4]	+[4]	-
7. Treatment 2+5[5]	-	+	+	-	-	-	-
8. Cycocel E/Alar-64	-	+[6]	+[6]	-	+[7]	-	+[7]
9. EL 500 0.05%	+	-	+	+	+	+	-

1) Mouse-ear stage. 2) End of flowering. 3) 0.30%. 4) 0.25%. 5) Mixed sprays. 6) 0.25% Cycocel. 7) 0.10% Alar-64.

Table 15. Results growth-retardant trial with Doyenné du Comice.

Treat-ment (see Table 14)	Fruits/ tree	Fruits/ 100 flower clusters	Kg/ tree	Mean fruit weight (g)	Growth/ tree (m)	Shoots/ tree	Mean shoot length (cm)
1	19.3	10.9 a	5.4	294 a	15.1	30.8 a	51.a
2	19.6	11.8 a	5.1	268 a	6.1	24.8 ab	27 bc
3	20.6	10.4 a	5.4	278 a	6.2	25.2 ab	25 bc
4	18.3	10.7 a	4.9	282 a	5.5	18.5 ab	31 bc
5	18.3	9.1 a	5.1	284 a	10.9	30.0 a	37 bc
6	0.9	0.6 b	0.2	169 b	4.1	14.3 ab	30 bc
7	14.4	9.7 a	4.0	286 a	3.3	14.5 ab	23 c
8	22.8	14.2 a	5.7	262 a	3.3	12.5 b	27 bc
9	7.7	3.5 b	2.0	277 a	11.8	31.7 a	38 b
LSD		4.0		30		12.4	9

Values within the same column followed by the same letter(s) do not differ significantly (P = 0.05).

In a second trial also with Doyenné du Comice PP333 is being compared with chloromequat (Annual Report 1983: 36-37). Treatments and some results are given in Table 16. Chloromequat was applied on 14th and 28th May, 1 and 3 weeks after full bloom respectively. Each time 0.40% Cycocel Extra was used. PP333 was sprayed on 28th May and 18th June, always with 500 ppm active ingredient.

Treated trees in general flowered less than untreated ones. Partly, this was caused by the smaller tree volumes that arose from the treatments in preceding years, and partly it was a direct effect. For example, the trees from treatment 'PP333 1982' flowered scarcely in reaction to vigorous growth in 1983 (Table 12, Annual Report 1983, p. 36).

Spraying with PP333 in 1984 had a thinning effect. For all these reasons treated trees produced considerably less than untreated ones. The differences were such that all treatments led to losses in production when all years are accumulated, albeit not significantly. PP333, when sprayed subsequently for 2 or 3 years, reduced fruit size. Possibly, this is caused by the small, cupped leaves that arose from the treatment. One treatment is not included in Table 16 viz. the spraying of PP333 from 1982 till 1985, because the last treatment has not yet been carried out.

Table 16. Results growth-retardant trial with Doyenné du Comice.

Treatment inhibitor	Year	Flower clusters/ tree	Fruits/ 100 flower clusters*	Kg/ boom	Mean fruit weight (g)**	Kg/ tree 1982-1984
Untreated		561.2	7.5 a	11.0	257 a	41.8 a
Chloromequat	1982-'84	427.7	4.3 ab	4.5	240 ab	37.0 a
PP333	1982	265.1	6.0 ab	4.2	244 ab	34.3 a
PP333	1982-'83	546.8	7.0 a	4.2	209 ab	33.6 a
PP333	1982-'84	379.6	1.8 b	3.0	195 b	31.6 a
LSD			3.5		38	8.2

* Corrected for differences in flower clusters per tree.
** Ditto for fruit numbers.
Values within the same column followed by the same letter(s) do not differ significantly (P = 0.05).

Fruit set pear

With Doyenné du Comice one spray with GA4+7 at the beginning of flowering may enhance fruit set. Unfortunately, the initial increase in fruit set is often offset by enhanced June drop. The next trial was aimed at reduction of such a June drop to maintain the GA4+7-effect. For this purpose both aminooxy acetic acid (AOA) and Alar were studied. Both compounds inhibit ethylene production and may therefore reduce fruit drop, ethylene being a promoter of fruit abscission. With Alar the growth inhibiting effect may further add to this effect by reducing competition between shoots and fruitlets.

The trial mentioned in Table 17 was carried out on five-year-old trees on Quince A rootstock. The treatments were replicated 10 times with 1 tree per plot.

Fruit set was light and was not affected by AOA or Alar. GA4+7 had a slight negative effect on final fruit set. For all GA4+7 treatments the number of fruits per 100 flower clusters was 10.1 as against 13.7 for treatments without GA4+7 (LSD = 1.2). Because GA4+7 increased initial fruit set, extra June drop was apparently such that it was stronger than normal. Neither AOA nor Alar were able to maintain the extra initial fruit set induced by GA4+7.

None of the compounds used affected fruit size.

Chemical thinning with apple

On six-year-old Elstar trees on M.9 two concentrations of Amid Thin (0.025 and 0.075%) and carbaryl (0.05 and 0.15% AArupsin) were compared. Combinations of these were also studied. All thinning treatments were also combined with an anti-fruit russeting programme, consisting of 4 sprays of GA4+7 (0.10% Berelex A4/A7) from petal fall every 10 days. The latter treatment also occurred separately. These treatments were studied, because it is known that with Golden Delicious GA4+7 may act as a thinner and may affect the action of "real" thinners as well. That was the reason that lower concentrations of these chemicals were included. Perhaps such concentrations plus GA4+7 may lead to adequate thinning. The same might apply for Amid Thin and carbaryl combinations. Unthinned and hand thinned trees served as controls. The 18 treatments were replicated 10 times with 1 tree per plot.

Table 17. Results fruit-set trial with Doyenné du Comice (+ = treatment; - = no treatment).

Treatment chemical	Date				Fruits/ 100 flower clusters	Kg/ tree	Mean fruit weight (g)
	2/5*	14/4 **	21/5	28/5			
1. Untreated	-	-	-	-	14.4 ab	6.6	267
2. Berelex A4/A7 0.17%	+	-	-	-	9.6 ab	5.2	262
3. AOA 125 ppm	-	-	+	-	12.7 ab	5.8	276
4. AOA 250 ppm	-	-	+	-	15.6 b	6.8	260
5. AOA 500 ppm	-	-	+	-	13.3 ab	5.5	267
6. Treatment 2+3	+	-	+	-	10.0 ab	4.4	271
7. Treatments 2+4	+	-	+	-	13.2 ab	5.5	274
8. Treatments 2+5	+	-	+	-	10.7 ab	4.8	279
9. Alar-64 0.20%	-	+	-	+	12.5 ab	5.1	273
10. Treatments 2+9	+	+	-	+	6.7 a	3.0	268
LSD					4.8		

* 50% open flowers.
** End of flowering.
Values followed by the same letter(s) do not differ significantly (P = 0.05).

Amid Thin was applied on 25th May (7 days after full bloom) and carbaryl on 19th June (circa 12 mm fruit diameter). The 4 GA4+7 sprays were applied on 25th May, 4th, 13th, and 22nd June.

Fruit set was moderate, so hand thinning was light (49.2 fruitlets per tree). There were no significant differences in the numbers of fruits per 100 flower clusters nor in fruit weights between the 18 treatments.

However, the data were also calculated group wise. Then it appeared that averaged over all Amid-Thin treatments, 0.025% Amid Thin had significantly more fruits per 100 clusters than 0.075% (37.7 vs 33.3). This did not hold for 0.05 and 0.15% AArupsin (35.8 vs 32.9), nor for treatments with or without GA4+7 (34.9 vs 37.4).

For all Amid-Thin treatments 0.15% carbaryl did thin:

Fruits per 100 flower clusters

0.15% carb.	0.05% carb. + GA4+7	0.15% carb. + GA4+7	0.05% carb.	control	GA4+7
28.5 b	33.8 ab	34.6 ab	35.3 ab	38.9 a	41.5 a

(LSD = 6.8)

No significant differences were found for Amid Thin and GA4+7 combinations when calculated over all carbaryl treatments. However, over all GA4+7 treatments Amid Thin and carbaryl combinations did show some differences:

Fruits per 100 flower clusters

0.075% AT + 0.15% carb.	0.075% AT + 0.05% carb.	0.025% AT + 0.15% carb.	0.15% carb.	0.025% AT + 0.05% carb.	0.075% AT	0.05% carb.	Control	0.025% AT
30.5 b	31.7 b	31.7 b	35.4 ab	37.5 ab	37.7 ab	38.3 ab	38.8 ab	42.7 a

(LSD = 6.7)

So, the thinning action of Amid Thin was enhanced by carbaryl, although not always significantly.

In fruit weights only two significant differences occurred. Over all Amid--Thin treatments 0.15% AArupsin gave larger apples:

Mean fruit weight (g)

0.15% carb. + GA4+7	GA4+7	Control	0.05% carb. + GA4+7	0.05% carb.	0.15% carb.
177 a	178	178 a	179 a	181 a	192 b

(LSD = 8)

Further, over all thinning treatments GA4+7 gave, surprisingly, smaller apples; 178 g versus 185 g for non GA-treatments.

Pollination

Pollen germination

Germination of pollen was assessed for certain cultivars. Pollen grains were brought for 24 hours in a 15% sucrose solution, and after that counts were made of grains with and without pollen tubes. This was done three times for each cultivar.

The apple Sweet Caroline had an average germination of 75% and the new Dutch pear cultivars IVT 68011-1 and P 408, 65 and 48% respectively. Hence, all these cultivars are diploid.

Results with plum pollen were very variable. The cultivars Anna Späth, Bleue de Belgique, Monsieur Hâtif, Opal, and Sanctus Hubertus gave the following percentages on 4th May: 25, 39, 23, 50, and 14 but on 8th May 66, 3, 63, 0, and 67. From both observations it may be concluded that these cultivars are all diploids, but it is puzzling why the germination percentages diverged so much.

Cross pollination

Apple

With apple many hand crossings were made to fill gaps in the pollination table of the Variety list. Attention was mainly focussed upon new cultivars. Table 18 summarizes the results obtained with Elan and Vista Bella (100 flowers per crossing and for open-pollinated controls). It appears that Elan had good pollen for 3 of the 4 tested cultivars. Only, the result on Schone van Boskoop was poor, but this often occurs after pollination of a triploid. Vista Bella pollen was good for 3 other summer apples and some of these pollinated Vista Bella successfully as well.

Fifteen other crossings were carried out, but not mentioned here. Results are included in the earlier mentioned Variety List for Fruit Crops 1985.

Table 18. Results of hand crossings with apple. Open pollination in brackets.

Female parent	Pollinator	Fruits/ 100 flowers	Good seeds/ fruit
Elan	x Cox's Orange Pippin	46 (69)	5.3 (6.1)
Elan	x Elstar	63 (69)	6.2 (6.1)
Elan	x Lombarts Calville	67 (69)	6.6 (6.1)
Elan	x Smoothee	34 (26)	7.1 (5.6)
Alkmene	x Elan	42 (45)	5.7 (6.2)
Boskoop	x Elan	4 (19)	1.3 (1.3)
Smoothee	x Elan	38 (2)	4.5 (3.0)
Summerred	x Elan	50 (70)	5.6 (6.1)
Vista Bella	x Alkmene	59 (71)	6.5 (6.5)
Vista Bella	x Benoni	54 (71)	4.7 (6.5)
Vista Bella	x Summerred	55 (71)	4.8 (6.5)
Alkmene	x Vista Bella	68 (45)	5.6 (6.2)
Discovery	x Vista Bella	61 (44)	6.1 (5.3)
James Grieve	x Vista Bella	82 (78)	6.5 (6.4)
Summerred	x Vista Bella	76 (77)	4.5 (5.8)

Sweet cherry

Because 6 new cultivars of sweet cherry were to be included in the 1985 Variety List for Fruit Crops, some crossings were made in 1984 to establish their pollination values. The standard cultivar Early Rivers was included as well (Table 19). Table 19 shows that a number of combinations can be made. However, not all return crossings were made. Besides, flowering periods should match. The reader is referred to the above-mentioned Variety List.

Table 19. Results of hand corssing with sweet cherry in percentage set flowers counted 12th July 1984.

Female parent	Pollinator						
	Open*	Castor	Corum	E.Rivers	FRM**	Pollux	Venus
Anna Bella	17	8	4	15	13	8	13
Castor	29	-	63	31	46	21	50
Early Rivers	42	50	42	0	42	29	33
FRM**	58	38	29	25	-	46	-
Pollux	13	50	38	48	46	-	42
Venus	4	17	25	46	29	33	-

* Open pollinated.
** Frühe Rote Meckenheimer.
\- = not carried out.

Effect of honey bees

In a commercial planting with 19 rows of Cox's Orange Pippin, each with 118 trees, the effect of honey bees was studied. In every third row James Grieve pollinators occurred. The rows run North-east/South-west and on the South-west side of the Cox, Golden Delicious rows occurred and on the other side Winston rows. The total acreage of the parcel was 2 ha, surrounded by arable land. At flowering time 4 beehives were placed in the middel of the Cox block. It was thought that by doing so a fruit-set gradient should arise from the centre to the edges. Going from the hives trees were marked on 8 wind directions in all rows. From these, fruits were counted after June drop and seeds were counted from a sample of 10 apples.

There was no effect of the bees on fruit set. Close to the hives (within 35 m) the number of fruits per 100 clusters amounted to 214.2 and further away (48 to 65 m) 215.4. These values hold for Cox trees not bordering a James Grieve pollinator. Similarly, no differences in seed set were observed.

Cox trees bordering a James Grieve had significantly more apples (256.2) as against 220.1 for trees not next to a pollinator. This also applied for the number of good seeds per fruit (2.93 vs 2.76). Finally, it appeared that Cox rows next to Golden Delicious had more fruits than those next to Winston.

So, except for these effects that can also be explained without bees, the benefit of bees could not be established in this manner.

UNUSUAL FRUIT CROPS

S.J. Wertheim and J. Dijkstra

Quinces (Cydonia oblonga)

The quinces cropped poorly due to adverse weather conditions during flowering. Only the cultivars Lescovacs, Rea's Mammoth and Vranja cropped reasonably well. Fruit numbers per bush (and kg) were: 63.7, 19.7, and 14.0 (6.8, 5.1 and 3.2). All other cultivars hardly gave any fruit.

Medlar (Mespilus germanica)

Several cultivars planted in the spring of 1982 cropped in 1983 and 1984. An unnamed cultivar from the General Netherlands Inspection Service for Arboricultural Produce (NAKB) yielded most: 146 and 211 fruits per tree respectively. The fruits were not large: 28 and 26 g. Only 2 of 6 cultivars present are large fruited ones, namely Macrocarpa and Sultan. The former on hawthorn rootstock gave 63 and 73 medlars respectively, with a mean fruit weight of 71 and 63 g. Sultan cropped poorly: 3 and 12 fruits per tree respectively, the fruits weighed 77 and 44 g.

Hazelnut (Corylus species)

The bushes planted in spring 1981 cropped well in spite of poor weather during flowering. Table 20 gives some results of the trial planted in 3 replicates with 2 bushes per plot. The bushes - single stemmed - were planted at 4.5 x 2 m. Gunslebert, so far, is the most productive cultivar. Theoretically, it yielded 1.1 (1983) to 2.7 (1984) tonnes per ha. In 1983 it appeared that empty shells fall before filled ones. These were gathered separately before the good nuts. In that year the percentage of empty nuts varied from 2 (Gunslebert) to even 38% (Ségorbe). In 1984 empty nuts were still found in the normal crop, after the early drop of empty ones had been removed.

Now the percentage varied from 3 (Gunslebert) to 11% (Louis Berger).

Table 20. Production in g per bush of hazelnut cultivars.

Cultivar	1983	1984
Corford	75	600
Gunslebert	996	2417
Impératrice Eugénie	43	1383
Longue d'Espagne	77	683
Louis Berger	166	483
Merveille de Bollwiller	317	967
Pearson's Prolific	81	933
Ségorbe	235	1450

Nut weight was assessed in 1983, as an average of 3 gathering dates (23th September, 4th, and 13th October). Pearson's Prolific gave the smallest nuts (2.5 g), Merveille de Bollwiller the largest (4.9 g). Louis Berger (4.4 g), Longue d'Espagne (4.6 g), and Gunslebert (4.5 g) also gave large nuts.

Gathering was made on 23rd September and especially on 4th October for Gunslebert, Louis Berger, and to a lesser extent for Merveille de Bollwiller. With all other cultivars main gathering was done on 23rd September, so these are earlier. On 13th October only Merveille de Bollwiller still necessitated some gathering (6% of the nuts).

By the culture with 'one trunk' as followed in the current trial, removal of root suckers is needed. The tendency to sucker varies per cultivar. Louis Berger gave the least problems (1.8), Pearson's Prolific the most (4.0). These figures refer to a scale of 1 (= no suckering) to 5 (= many suckers).

Elderberry (Sambucus nigra)

Bushes planted in the spring of 1981 cropped well again in 1984. The trial (Table 21) has 3 replicates with 3 bushes per plot at 4.5 x 1.8 m. Production in 1983 was mentioned wrongly in the Annual Report of 1983 (p. 43). Therefore, Table 21 mentions the yields for both 1983 and 1984, together with other 1984 data.

Table 21. Results comparison elderberry cultivars.

Cultivar	Kg/bush		Refractometer value	Colour value	Stalk percentage*
	1983	1984			
Allesøe	18.3	25.6	9.2	233	4.5 +
Donau	1.1	6.2	11.0	334	24.0 +
Hamburg	2.2	5.0	7.7	180	10.1 +
Haschberg	18.2	16.0	8.7	166	9.6 -
Korsør	13.7	15.6	5.0	191	5.0 +
Sambu	2.7	9.5	7.0	250	16.4 -
743	8.3	20.4	9.0	179	11.0 +
15-65	5.5	14.7	7.6	166	2.6 -

* Berries detach easily (+) or difficultly (-).

Allesøe, Haschberg, Korsør, and 743 were very productive. The first gave 22 (1983) to 32 (1984) tonnes per ha. Sugar content of the juice was lower in 1984 than in 1983, probably due to the poor summer weather. Only the refractometer values of Allesøe and Donau were reasonable.

The colour value - determined with a spectrofotometer at 530 mm - is an important quality parameter. This value should be over 130, and the higher the better. All cultivars met this standard, but great differences existed.

Another important feature is the stalk content. This could be as low as possible. Further, the berries should be easily detachable from the stalk. Both features are also mentioned in Table 21.

From the cultivars mentioned Sambu had a bad aroma and Donau a bitter taste, at least in 1984.

Concluding, Allesøe and Korsør came out as the best cultivars in all aspects. In 1983 Korsør was picked on 31st August and 15th September and Allesøe on 15th and 29th September. In 1984, ripening was later. First pick of both cultivars took place on 28th September and the second one on 17th October, at which date more Allesøe had to be picked. Allesøe is thus a later ripening cultivar than Korsør.

Chinese gooseberry or kiwi (*Actinidia chinensis*)

Yields were disappointing due to a fungal disease, probably *Botrytis cinerea*, on the old fruit stalks. Through that many young shoots died leaving only a few shoots for fruiting.

The fruits were harvested on 16th November, having 6.2% soluble solids content. The yield of cultivars Bruno and Monty was about 3.9 and 2.7 kg per bush respectively. Again cultivar Hayward had a very low yield (1.4 kg per bush).

After 2 months of storage at 1°C the soluble solids content was 10 to 11% for Bruno and Monty and 12% for Hayward.

Siberian gooseberry (*Actinidia arguta*)

The cultivar Ananaskaja yielded well with 4.5 kg per bush and an average fruit weight of 9.5 g. Fruits were harvested from 10th till 22nd October and still had a good quality after 4 to 6 weeks storage at 1°C. Soluble solids content then was 15 to 18%.

The fruits mostly grow at the ends of short shoots, therefore pruning differs from the pruning of the Chinese gooseberry.

Roseships (*Rosa* species)

In the third year the selections V and VII of *Rosa oxydon* and selection II of *Rosa blanda* again gave high yields (Table 22). *Rosa villosa* "Pomifera" gave the biggest fruits.

Table 22. Results of a trial with Rosa species and cultivars (Plant distance 4.3x2 m).

	Kg/bush		Average fruit weight (g) 1983/'84	Harvest date 1983/'84
	1983	1984		
Rosa blanda II	1.6	4.2	2.7	8 September
Rosa oxydon V	1.2	4.0	3.0	8 September
Rosa oxydon VII	1.6	5.9	3.1	8 September
Rosa majalis	0.6	2.0	1.7	26 September
Rosa villosa "Pomifera"	0.8	2.6	4.3	20 September
Rosa villosa "Carpathia"	0.2	0.8	3.5	20 September
Rosa villosa "Duplex"	0.1	0.6	4.2	26 September

RESEARCH IN THE FRUIT-TREE NURSERY

S.J. Wertheim

Branching treatments

Apple

In an experiment with Elstar and Gloster on M.9, budded in August 1983, the effect of trickle irrigation and branching agents was studied (Table 23). Trees were planted at 100x30 cm. Water was applied from 6th June, twice a day. In total 2 l per plant was given, which proved too much. Therefore, on 27th June this was reduced to 1 l per day, also given in two doses. Trickle irrigation was ended on 9th July, because water ran off to adjacent plots through the furrows made by the cultivator. So, the water treatment failed. Branching agents were applied at 50 cm plant height (29th June). Table 23 only gives the results of Elstar, since with Gloster no significant results were obtained.

M&B 25,105 reduced tree height, but AA 4111 did not. As stated before, the chemicals had no significant effect on side-shoot formation with Gloster, but with Elstar there was a stimulative effect.

This poor result, especially with GLoster, is possibly due to the low concentration of AA 4111. In other trials a double concentration gave better results. Also, the poor weather conditions of 1984 may have been involved. Tree quality in general was less than in the previous years. That water failed to give results is partly due to the wet growing season and partly to the water flowing to non-irrigated plots. This may also have caused the lack of effect of combinations of water and branching agents.

In a second trial with Schone van Boskoop on M.9, AA 4111 was compared with one of the components, benzyladenine (BA). AA 4111 containes BA and GA4+7. The treatments mentioned in Table 24 were compared in 10 replications with 1 tree per plot. Both compounds were sprayed at 60 cm plant height (28th June). The results of this trial are given in Table 24.

Table 23. Results trial with trickle irrigation and branching agents with Elstar in the nursery.

Treatment	Tree height (cm)	Side shoots/tree > 10 cm	Side shoots/tree ⩾ 15 cm ↑ 40 cm**	Total side shoot length (cm)	Mean shoot length (cm)
1. Untreated	144.4 a	6.0 a	5.2 a	221 a	26.4
2. Water	143.1 a	7.8 ab	6.3 ab	276 a	27.0
3. AA 4111 28 ml/l*	143.3 a	8.8 b	8.1 b	381 b	37.8
4. Treatment 2+3	143.2 a	9.5 b	8.7 b	393 b	40.3
5. M&B 25,105 1 ml/l	136.1 b	8.4 b	7.2 ab	374 b	37.4
6. Treatment 2+5	138.1 b	8.7 b	7.1 ab	330 ab	32.9
LSD	4.7	2.0	2.0	77	

* + 0.1% Citowett wetter.
** Standard for extra quality trees (↑ 40 cm = higher than 40 cm above soil level).
Values within the same column followed by the same letter(s) do not differ significantly (P = 0.05).

Table 24. Results of trial with branching agents with Schone van Boskoop.

Treatment*	Tree length (cm)	Side shoots/tree > 10 cm	Side shoots/tree ⩾ 15 cm ↑ 40 cm**	Total side shoot length (cm)	Mean shoot length (cm)
1. Untreated	149.7 a	2.7 a	1.3 a	92 a	14.5
2. AA 4111 14 ml/l	141.1 b	4.0 a	2.5 a	153 ab	17.2
3. AA 4111 28 ml/l	139.2 b	4.5 a	3.1 a	169 ab	19.1
4. AA 4111 56 ml/l	130.7 c	6.7 b	3.9 a	207 b	22.1
5. BA 250 ppm	144.6 ab	3.7 a	2.6 a	145 ab	21.6
6. BA 500 ppm	145.1 ab	4.1 a	2.6 a	140 ab	20.0
7. BA 1000 ppm	142.1 b	6.5 ab	4.1 a	216 b	21.6
LSD	5.3	1.9	1.4	56	

* Chemical Plus 0.1% Citowett-wetter.
** See Table 23.
Values within the same column followed by the same letter(s) do not differ significantly (P = 0.05).

AA 4111 reduced tree length, the more so the higher the concentration. BA only diminished height in the highest concentration. Over all concentrations BA-treated trees were significantly longer than AA 4111-treated ones. None of the treatments affected tree diameter, measured at 10 cm above the union (data not given).

The number of shoots longer than 10 cm was only enlarged with the highest concentrations of both chemicals. The effect on still longer, well situated shoots was not significant. Of all treatments, 1000 ppm AA 4111 or BA, were the only ones to give reasonable results on side-shoot formation. Side shoots were formed below the point where the shoot tip was at application time.

Pear

With Conference and Doyenné du Comice, budded on Quince C in August 1982, branching agents were compared. With Conference the treatments given in Table 25 were involved. With Doyenné du Comice treatments 8, 9, and 10 were lacking.

Table 25. Results of trial with branching agents with Conference.

Treatment*	Tree length (cm)	Side shoots/tree		Total side shoot length (cm)	Mean shoot length (cm)
		> 10 cm	⩾ 15 cm ↑ 40 cm**		
1. Untreated	137.7 a	2.4 ab	1.0 a	87 ab	14.0
2. AA 4111 7 ml/l	124.5 b	3.8 ab	2.6 ab	130 abc	17.7
3. AA 4111 14 ml/l	119.9 b	3.9 ab	2.8 ab	151 bc	19.6
4. AA 4111 28 ml/l	110.9 c	4.9 b	3.3 b	171 c	21.6
5. BA 125 ppm	130.8 ab	1.6 a	1.1 a	54 a	19.8
6. BA 250 ppm	138.0 a	2.8 ab	1.5 ab	97 abc	16.2
7. BA 500 ppm	131.5 ab	1.9 a	0.8 a	73 ab	11.1
8. GA4+7 125 ppm	130.2 ab	2.2 a	1.7 ab	79 ab	11.7
9. GA4+7 250 ppm	133.1 ab	2.2 a	1.5 ab	76 ab	21.0
10. GA4+7 500 ppm	121.9 b	3.7 ab	2.6 ab	113 abc	21.8
LSD	8.5	1.8	1.3	57	

* Chemicals plus 0.1% Citowett-wetter.
** See Table 23.
Values within the same column followed by the same letter(s) do not differ significantly (P = 0.05).

Treatments were applied on 26th June when tree length was 55 cm (Conference) or 60 cm (Doyenné du Comice). The treatments had only a little effect on the latter cultivar. Only the highest BA concentration had a slight positive effect on the total number of side shoots, but not on well-developed ones. No other effects were observed, so that data for Comice are not given.

With Conference results are summarized in Table 25. AA 4111 reduced tree height, the more so the higher the concentration. Neither BA nor GA4+7 exerted much effect. The highest GA-concentration caused some growth reduction. None of the treatments induced an increase in total shoot number or in shoots longer than 10 cm. Only the highest concentration of AA 4111 had a positive effect on the number of well-situated shoots longer than 15 cm. These treatments warrants further study.

Improvement branching after heading back

Apple trees that do not develop well in the first year in the nursery are left for another year. These are normally headed back at 80-90 cm (apple) or 60-70 (pear). Another method is to head back at 50 cm and to allow one shoot to develop. Because of its vigour such a shoot gives a branched tree, at least in cases of easily feathering cultivars. The question arose whether this holds for non-feathering cultivars and what the effect of branching agents is.

On the apple Schone van Boskoop on M.9 and Conference pear on Quince C this was studied in 1984. Treatments of both trials, given in Table 26, were replicated 10 times with 1 tree per plot. Spraying was done on 8th June, when the extension shoot averaged 15 cm. This was done to develop side shoots at a proper height.

Table 26. Results trial with the branching agent AA 4111 after deep heading back (see text).

Height of heading (cm)	AA 4111 ml/l	Tree length (cm)	Side shoots/tree		Total side shoot length (cm)	Mean shoot length (cm)
			> 10 cm	≥ 15 cm ↑ 40 cm*		
Schone van Boskoop						
1. 90	-	162.7 a	5.3 a	4.8 a	265 a	27.4
2. 50	-	163.7 a	1.0 b	1.0 bc	43 b	28.1
3. 50	14	144.1 b	1.6 bc	1.5 bc	62 bc	22.6
4. 50	28	126.2 c	2.4 bc	2.4 cd	98 bc	35.8
5. 50	56	121.6 c	3.0 c	3.0 d	11 c	35.9
LSD		10.1	1.2	1.1	51	
Conference						
1. 70		166.2 a	5.5 a	4.9 a	345 a	52.2
2. 50		145.3 ab	5.3 a	4.1 a	203 b	27.0
3. 50	7	151.3 a	5.0 a	4.2 a	175 b	21.1
4. 50	14	142.3 ab	4.8 a	3.8 a	188 b	29.1
5. 50	28	121.6 b	4.3	3.1 a	164 b	26.7
LSD		18.7			62	

* See Table 23
Values per cultivar within the same column followed by the same letter(s) do not differ significantly (P = 0.05).

AA 4111 caused damage - burned shoot-tips and brown lesions in the leaves - and the more so the higher the concentration. Apparently it is risky to spray such a young shoot. This damage led to growth inhibition, especially in treatments 4 and 5 with apple (Table 26).

Table 26 shows that heading back to 50 cm in the case of Schone van Boskoop gave poor results with regard to side-shoot formation. AA 4111 gave more shoots, but the treatments did not reach the level of the standard.

With Conference, too, the standard treatment was the best. Therefore, deep heading back in the case of non-feathering cultivars is not a good practice, whether or not AA 4111 is used later on.

Defoliation

Early grubbing in the nursery necessitates hand removal of leaves or spraying with copperoxychloride, which is not very effective. In 1983 copperchelate was successfully tested (Annual Report 1983, p. 33) and research was continued in 1984.

On the apple cultivars Cox's Orange Pippin and Jonagold on M.9 and Conference and Doyenné du Comice on Quince C the treatments given in Table 27 were compared in 10 replicates with 3 trees per plot. The apple trees had grown for one year in the nursery, the pear trees for two years. With apple the first treatment was on 15th October and for treatments 3, 7, and 8, the second one was on 23th October. For pears the dates were 16th and 24th October. The results are given in Table 27, and also in De Fruitteelt 74(1984)50:1314-1315.

Table 27. Results defoliation trial with apple and pear.

Treatment	Leaves/tree at dates			
	Cox's O.P. 1/11	Jonagold 8/11	Conference 6/11	D. du Comice 6/11
1. Untreated	79.6 a	114.4 a	124.4 a	340.4 a
2. Hand defoliation	0.0 d	0.0 f	0.0 d	0.0 c
3. 2x0.2% copperoxychloride	55.8 a	93.2 ab	106.7 a	249.2 a
4. 1x1% copperoxychloride	63.6 a	71.5 b	98.0 a	253.4 a
5. 1x1% MC*	3.0 b	25.3 c	12.3 b	61.7 b
6. 1x2% MC	1.4 bc	12.8 de	10.6 bc	32.1 b
7. 2x1% MC	3.6 b	17.1 d	5.8 bc	40.1 b
8. 2x2% MC	0.9 c	8.2 e	2.9 c	16.7 b
9. 1x4% MC	0.3 cd	8.8 e	2.7 c	21.0 b

* Trade product with 9% copperchelate.
Values within the same column followed by the same letter(s) do not differ significantly (P = 0.05).

Copperchelate was more effective than copperoxychloride. This is favourable for the environment. It appeared that those cultivars that easily shed their leaves (Cox, Conference) were more easily defoliated than those that retain their leaves longer (Jonagold, Doyenné du Comice).

In a second series of trials one-year-old table grafts of Elan, Jonagold, and Schone van Boskoop on M.9 were sprayed on 19th November. After this treatment with copperchelate, defoliation was much less rapid. Possibly, the (colder) weather, or the (older) leaf age were involved.

The trees will be checked in the orchard for possible side effects.

EVALUATION TOP-FRUIT CULTIVARS

FRUIT CULTIVAR TRIALS WITH POME FRUITS

P.D. Goddrie

Apple

In the spring of 1984, 32 new cultivars were set out for the first screening trials.

In taste experiments with Elstar fruits in 1982 and 1983, no differences in taste could be found between fruits from several growing sites in the orchard, between fruits of several trees and between fruits from several sectors in the tree (Annual Report 1983: 12). In January 1984 a similar experiment was carried out with Jonagold fruits. In contrast with Elstar, differences in taste were found between fruits of several trees and between fruits from several growing sites in the orchard. As with Elstar no differences in taste were found between fruits from several sectors in the tree.

In 1984 many taste experiments were carried out. Summarizing 12 experiments with taste panels at the research station gives the following results:

- bad scores were obtained for the eating quality of Nico and Jerseymac;
- bad to rather bad scores were obtained for the eating quality of Vista Bella, Sterappel and Priscilla;
- moderate scores were obtained for the eating quality of Rakrag, Julyred, Mantet, Discovery, Summerred, Akane, Paulared, Zaailing Schiedam and Prima;
- rather good to good scores were obtained for the eating quality of Scarlet Benoni, Merton Knave, Delcorf, Katja, James Grieve, Jupiter, Cox's Orange Pippin and Hatsuaki;
- good scores were obtained for the eating quality of State Fair, Alkmene, Elan, Fantazja and Elstar.

One should realize that it is difficult to compare early-ripening apple cultivars at the right moment. With such summer cultivars the optimal consumption period is very short. Therefore, it is possible that at a certain moment some cultivars have not yet reached their true ripening stage, whilst others have already passed that moment. Tasting summer cultivars a few days too late can result in low scores for eating quality. Therefore, more taste experiments with such cultivars are needed to get a good impression of the eating quality.

In taste experiments at Geldermalsen on December 1 the appreciation of the eating quality of the rather sweet apple cultivars Gala and Red Delicious was examined. Gloster and Elstar served as standard cultivars. In another 5 trials at the same venue, Suntan, Kent, Jester and Greensleeves were compared with the Dutch standard cultivars Cox's Orange Pippin, Elstar, Rode Boskoop and Golden Delicious.

For these experiments fruits from 3 experimental orchards were used, and in total 900 people took part in these experiments. The results have not yet been statistically analysed. The preliminary impression is that Gala was fairly well appreciated; this was not so for Red Delicious. Suntan scored fairly well; Kent and Greensleeves were moderately appreciated, whilst Jester was rejected. Good scores were obtained with Elstar, Golden Delicious and Cox's Orange Pippin; the scores for Rode Boskoop were only moderate and those for Gloster were bad.

The same cultivars were tested on December 3 to 5 at the research station. The results of those trials, mentioned in Table 28, were quite similar to those obtained at Geldermalsen.

Table 28. The average appreciation for some apple cultivars in December 1984 (1 = very bad taste; 10 = excellent taste).

Trial 1		Trial 2		Trial 3	
Cultivar	Taste	Cultivar	Taste	Cultivar	Taste
Elstar	6.8 a	Elstar	7.4 a	Cox's O.P.	6.5 a
Gala	6.4 a	Greensleeves	5.6 b	Golden Delicious	6.3 a
Red Delicious	4.7 b	Rode Boskoop	4.5 c	Suntan	5.6 b
Gloster	4.1 b	Jester	3.8 d	Kent	4.8 c

Values within the same column followed by the same letter do not differ significantly (P = 0.05).

Because of a wet and dark harvesting period the amount of red blush on Jonagold fruits was disappointing. In Table 29 2 figures about the amount of red blush with standard Jonagold and the colour mutation New Jonagold are given. In Table 30 the presence of sectorial chimaeres in both types are mentioned. Although it seems that there is hardly any difference in the amount of red blush between fruits of standard and New Jonagold, it was found that the colour of New Jonagold has to be considered somewhat better than that of standard Jonagold. The reason is that the blushed fruits of New Jonagold have a more intense and deeper red blush than the blushed fruits of standard Jonagold.

Table 29. The amount of red blush of New Jonagold and comparable standard Jonagold (%).

Amount of red blush (%)	New Jonagold	Standard Jonagold
0-10	45.2	33.9
11-20	26.5	30.4
21-33	12.1	14.9
34-50	12.7	9.5
51-75	3.5	11.3
76-100	0	0

Table 30. The presence of sectorial chimaeres with New Jonagold and comparable standard Jonagold (%).

Fruits with	New Jonagold	Standard Jonagold
no stripes	29.6	97.4
1 stripe	19.3	2.6
2-4 stripes	38.9	0
5 or more stripes	12.2	0

Pear

Again attention was paid to the shelf-life of Condo fruits.

Condo and Conference fruits from the 1983 growing season, both picked on 19 or 26 September were stored in cool storage and CA-storage. At the end of March it appeared again that the shelf-life of Condo fruits is very short; after 10-12 days at about 18°C fruits had completely broken down. The shelf-life of Conference fruits was only somewhat better. No influence of storage conditions was noticed. Another part of the same fruits were stored till half of June. Now it appeared that Condo fruits from the first picking date had a somewhat shorter shelf-life than those from the second picking date. Nevertheless, after 13 days fruits from both picking dates had completely broken down. No differences of the storage conditions could be noticed.

Condo and Conference fruits from the 1984 growing season were picked 4 times at weekly intervals. All the fruits were stored together at a temperature of +0°C. Weighing the fruits at the several picking dates indicated that the average fruit weight of both Conference and Condo increased by 10-13 g weekly. About the middle of November 1/3 of the stored fruits were placed at about 18°C. Results of this part of the trial are given in Table 31. As can be seen in that Table the internal breakdown of Condo started earlier than that of Conference. Later picking of Conference resulted in more serious internal breakdown. The trial will be continued in early 1985.

Since spring 1981, 23 new pear selections of the Institute for Horticultural

Plant Breeding (IVT) at Wageningen have been tested on a limited scale in the experimental orchards at Geldermalsen, Oosthuizen and Wilhelminadorp. Summarizing the results so far have led to the decision to start a second-screening trial with 10 selections in 4 regional experimental orchards; the trial will be planted in the spring of 1987.

At the end of the 1984 growing season Général Leclerc, planted in 1978, was removed from the cultivar trials. This cultivar gave very low yields and a very high amount of secondary flowering, which is a dangerous characteristic because of fire blight problems.

Table 31. The amount of Condo and Conference fruits with symptoms of internal breakdown on several days after removal from storage (%).

Cultivar	Picking date	Fruits with internal breakdown-symptoms after placing at ± 18°C during:			
		5 days	7 days	9 days	12 days
Conference	18 Sept.	0	0	0	25
	25 Sept.	0	0	8	33
	2 Oct.	0	0	8	50
	10 Oct.	0	0	12	64
Condo	25 Sept.	0	46	77	92
	2 Oct.	0	46	69	77
	10 Oct.	0	62	92	100
	16 Oct.	0	47	87	100

FRUIT CULTIVAR TRIALS WITH STONE FRUITS

P.D. Goddrie

Plum

Because of a lot of rain during the harvesting period the fruit quality of many plum cultivars was badly influenced. Especially 4 French Reine-Claude Verte selections suffered heavily; almost all fruits were cracked and rotten.

The Swedisch cultivars Gilbert, Herman and Ive, plantedin 1980, gave reasonably good yields. These blue cultivars have a fairly good eating quality. Till now Ive is the most productive one.

Sour cherry

Quite a lot of observations were made in the trial with 10 sour cherry cultivars, planted in the spring of 1980. Till now the yield of Elmer is the highest one, being 106% above that of the standard Rheinische Schattenmorelle 226. Kelleriis 16 yielded so far 38% and Morel P2 8% more than the standard cultivar. Lower productions were reached with Schattenmorelle Boscha 22 (-3%), Stevnsbaer (-10%), Meteor, Scharö and Vitova (-15% each) and Schwäbische Weinweichsel (-43%).

The susceptibility for fruit cracking was also investigated. This was done using a method described by Vittrup Christensen, Denmark. Following this method

Stevnsbaer proved to be very susceptible, followed by Elmer and Vitova. Meteor, Scharö and Schwäbische Weinweichsel were much less susceptible. A second investigation next year has to be done to be sure of the exactitude of these statements about fruit cracking.

Measurements of average fruit weight, fruit volume, average stone weight, and stone volume indicated again that Elmer is a big-sized cultivar, in contrast with the very small fruits of Stevnsbaer.

SECOND-SCREENING TRIALS WITH APPLE AND PEAR CULTIVARS

P.D. Goddrie

At the end of the 1984 growing season the second-screening trial with apple cultivars, planted in the spring of 1979 in 6 regional experimental orchards was terminated.

The preliminary results are as follows:

- Honeygold: autumn cultivar; biennial bearing; moderate eating quality;
- Empire: Red Delicious-type with rather small fruits and moderate eating quality;
- Goldjon: rather small fruits; dense tree and consequently problems with fruit colour; moderate eating quality;
- IVT 5544-146: resembles Jonagold for fruit appearance, but eating quality much lower; difficult tree habit; very late flowering;
- Akane: very attractive fruits; no premature fruit drop; very weak growth on M.9; moderate eating quality;
- Gravenstein and Red Gravenstein: triploid cultivars; biennial bearing; fairly good eating quality; short shelf life;
- Prima: scab resistent; very susceptible to fruit tree canker; dense tree and consequently problems with fruit colour; moderate eating quality;
- Gala: weak growth on M.9; susceptible to fruit tree canker; reasonably good eating quality; attractive fruit colour;
- Summerred: summer cultivar which is already planted on a limited scale in practice.

Summarizing this trial it can be said that Summerred deserves some place in practice as a summer cultivar. Probably Gala deserves some attention because of its fairly good eating quality and attractive fruit appearance. The remaining cultivars do not seem worth planting in practice.

At the end of 1984 results of the apple trial 85.0.5 and pear trial 83.1.1 were not yet available.

SMALL FRUIT SECTION

CULTURE EXPERIMENTS WITH STRAWBERRIES

J. Dijkstra and A.A. van Oosten

Soil temperature of strawberries grown in a heated and illuminated glasshouse

In continuation of research at the Research Stations for Fruit Growing and for Glasshouse Crops a trial with soil temperatures was carried out by the regional advisory service in Gelderland in cooperation with the Research Station for Fruit Growing. Tubilene tubes were dug in at a depth of 20 cm. By means of these tubes soil temperature in January and February was raised by 4°C. In this experiment the cultivar Riva was used. A rise in the soil temperature in January led to a reduction of yield (Table 32). In the heated soil plants grew better at first, but stayed behind afterwards. An increase of soil temperature only in February had nearly no influence on the yield.

It must be noticed that in the unheated plots soil temperature was already relatively high (11°C) due to a mild winter. The results correspond with the results obtained in a trial at the Research Station for Glasshouse Crops in 1983.

Table 32. Influence of soil temperature on yield of strawberries in a heated and illuminated glasshouse.

	Soil temperature (°C) in the period of*		Kg/m^2	Mean harvest date
	5 Jan. - 2 Feb.	2 Feb. - 26 Feb.		
1	11.4	13.6	3.82	22 April
2	11.2	17.0	3.89	21 April
3	15.4	14.2	3.56	21 April
4	15.8	17.6	3.60	20 April
5	14.7	17.1	3.69	21 April

* In treatments 1 up to and including 4 besides tubes at a depth of 20 cm in the soil also heating tubes at the surface.

Utilization of rest heat

Strawberry trials in the Project Utilization of Rest Heat at the Research Station for Arable Farming and Field Production of Vegetables at Lelystad were continued with the cultivars Karina, Tenira and Tioga. Treatments are: no extra heating of the soil (0), heating with water with temperatures of 12°C in the winter and 25°C in the summer (F) and heating with water with a temperature of 30°C all the year around (C). The plants were partly covered with perforated plastic during the spring. Heating as well as plastic advanced the harvest period. The influence of a plastic cover was somewhat greater than of soil heating. In treatment C with Tenira and Tioga there was clearly an interaction between the plastic cover and soil heating. In this treatment plastic advanced the harvest period by 14 to 16 days, in the F- and 0-treatments with plastic the harvest period was only advanced by 6 to 9 days. With Karina the plastic cover always advanced the harvest period by 11 to 12 days.

The influence of soil heat on yield differed for each cultivar. With Karina, heating as well as plastic cover was harmful, with Tioga there were no clear differences and with Tenira soil heating had a positive influence, that was somewhat reduced by a plastic cover. As in 1983 there was a tendency that forcing measures influenced fruit size negatively.

With the everbearing cultivars Ostara and Rapella, planted in spring, there was no clear influence of soil heat on yield, but fruit size decreased.

Soil heat as well as a plastic cover had a very favourable influence on runner production with plants planted in autumn (Table 33).

Planting dates of everbearing cultivars

As in 1983 at the Experimental Station at Horst and the Research Station at Wilhelminadorp (PFW), with cultivars Ostara and Rapella planting on the production field in autumn was compared with spring planting with and without a growing period of 3 to 4 weeks in pots in a plastic tunnel. In autumn it was was planted in the second week of October, in spring on 18th April. At Horst plant distance was 110x45 cm, at Wilhelminadorp (90+60)x50 cm. In contrast with 1983 the potted plants could be planted in good time and now gave the highest yields with the biggest fruits (Table 34). The differences in yield between plants directly planted on the production field and the potted plants are somewhat increased by the bad weather conditions in the autumn of 1984. Through that, specially in Wilhelminadorp, the delayed production of the plants planted directly on the field in autumn and spring did not show to full advantage.

The conclusion is that from a point of view of production potted plants are preferable.

Tabel 33. Influence of rest heat on runnering of strawberry plants (number of runners per mother plant)*.

	C+	C-	Average< >	F+	F-	Average< >	O+	O-	Average< >
Tioga**	17.5	10.6	14.1	7.4	4.1	5.8	5.2	3.1	4.2
Tenira***	32.1	16.7	24.4	12.9	15.8	14.4	7.5	5.5	6.5
Bogota***	14.7	11.8	13.3	7.6	4.5	6.1	3.8	2.0	2.9

* For explanation of C, F and O see text.
** Grubbed on 2 August.
*** Grubbed on 28 August.

Table 34. Results of trials with planting dates of everbearing cultivars.

	Kg/m^2*		Average fruit weight (g)		Percentage fruit rot		Mean harvest date	
	Horst	PFW	Horst	PFW	Horst	PFW	Horst	PFW
Ostara								
Autumn planting	0.95	1.27	8.9	14.6	5	8	27/8	20/8
Spring planting	1.11	1.25	11.0	14.4	2	7	27/8	24/8
Spring, forced plant	1.54	1.91	11.6	15.0	10	12	22/8	15/8
Rapella								
Autumn planting	1.46	1.39	15.9	17.8	0	7	1/9	26/8
Spring planting	1.11	1.26	13.9	17.9	1	6	31/8	27/8
Spring, forced plant	1.63	2.15	16.6	18.5	5	8	29/8	18/8

* First quality only.

Influence of GA3 and GA4/7 on runner production of everbearing cultivars

In springtime spraying 100 and 200 ppm GA3 and 100 ppm GA4/7 4 weeks after planting and 100 ppm GA3 4 and 6 weeks after planting had no clear effect on runnering. The enormous variability in the number of runnerplants per mother plant was striking. Specially mother plants treated with GA3 had very long-drawn leaf stalks and light green leaves. Although runner production of everbearing cultivars sometimes is unsatisfactory, in this trial, with cold stored and potted mother plants high numbers of runners were obtained.

CULTIVAR TESTING OF STRAWBERRIES

A.A. van Oosten and J. Dijkstra

First screening

Everbearing cultivars

Screening of new everbearing selections of the Institute for Horticultural Plant Breeding (IVT) was continued. One selection was rejected because of low productivity and a disappointing appearance of the fruits, one because of high susceptibility for *Verticillium* wilt. Again the older selection IVT 75326 was as productive as Ostara and Rapella but showed no advantages in respect to these cultivars. IVT 79191 is interesting. This selection is high yielding and has big bright-red fruits; its taste is only moderate. It will be judged again.

At the same time a number of American and French cultivars was judged. None of these cultivars was satisfactory due low production, small fruits or insufficient fruit quality. These cultivars can be described briefly as follows:

- Appelever, low productivity, fruits of irregular shape and bad taste.
- Brightin, reasonably good growth, productivity sufficient to good, ugly fruits with seeds totally on top of the fruit skin and often a poor fruit set. Bad taste.
- Hecker, compact growth with very long fruit stalks. Productivity good with rather small fruits, very firm, bright-red with a moderate taste.
- Marastar, compact growth with long fruit stalks. Productivity only moderate. Fruit colour dark red, dull with seeds on the top of the fruit skin, vulnerable with a moderate taste.
- Profusion, compact growth with weak vulnerable fruits that have a moderate appearance and a bad taste.
- Superbe Remontante Delbard, vigorous growth with long fruit stalks with a lot of small flowers. Productive but too many small fruits. Fruit shape irrigular, firm, dark red with a good taste.

National cultivar trials in the open

Early ripening cultivars

At Breda, Horst, Kesteren and Wilhelminadorp 3 early ripening IVT-selections were compared with Karina and Karola. Karina was the earliest ripening cultivar followed by Karola. However at all sites results with Karola were unsatisfactory due to a disappointing production and bad fruit quality. Fruits of Karola often cracked at the calyx, which resulted in a lot of fruit rot. In the open Karola certainly is no improvement on Karina. One of the IVT-selections was rejected. In 1985 the other 2 and some new selections will be compared with Karina, Gorella and Elvira.

Cultivars suitable for processing

The IVT selections 77020 and 77057 seem to be suitable for processing (easy decapping, moderate fruit size) and were compared with Confitura, Induka and Senga Sengana. Both selections were very productive; decapping was somewhat more difficult than with Senga Sengana and Confitura but comparable with Induka. Fruits were processed at the Sprenger Institute at Wageningen and the processed products were judged as good. The trial will be continued in 1985.

Cold stored waiting-field plants (for a late harvest)

At Breda and Nibbixwoud the trial with cultivars and planting dates was continued. Yields at Breda were considerable higher than at Nibbixwoud (Table 35). This was partly caused by the higher plant density in Breda (4.6 plants/m^2, (90+42)x27 cm). In Nibbixwoud plant density was 3.2 plants/m^2, (120+60)x35 cm. Probably there was also the influence of a dry August in the Nibbixwoud area.

Table 35. Production (kg/m^2, 1st and 2nd quality) in trials with planting dates of cold stored waiting bed plants (for a late harvest).

	Breda			Nibbixwoud		
	8 May	12 June	6 July	14 May	18 June	10 July
Gorella	2.10	1.65	1.40	1.24	-	-
Elvira	2.67	1.93	1.52	1.08	0.90	0.73
Korona	2.70	1.65	1.57	1.56	0.95	0.76
Elsanta	3.37	1.86	1.77	1.69	1.26	0.66
Valeta	2.23	2.05	1.44	1.33	1.05	0.63
IVT 77050	2.85	1.45	1.31	1.46	1.34	0.53
IVT 77191	2.20	1.64	1.24	1.75	0.79	0.69
Average	2.59	1.75	1.46	1.44	1.05	0.67

At both sites yields decreased with later planting dates. With Elsanta, IVT 77050 and, somewhat less, Valeta, quite a lot of plants fell out, probably due to Verticillium wilt. In spite of this Elsanta was very productive and had a good fruit quality. There were no big differences in productivity between the other cultivars, even though the order of the cultivars changed somewhat for the various planting dates.

Production of IVT 77050 was satisfactory but fruit quality was disappointing due to moderate firmness and variegated colour. Therefore this selection was rejected. Production of IVT 77191 was reasonable; fruits were rather grooved but firm and had a nice bright-red colour. This selection will be judged again in 1985.

CULTURE EXPERIMENTS WITH RASPBERRIES AND CURRANTS

J. Dijkstra and A.A. van Oosten

Raspberry

Removal of young canes

With raspberries mostly all new young canes are removed at the end of April or the beginning of May. With a number of cultivars a large number of new canes develops afterwards, of which a high percentage is too short (< 150 cm) at the end of the growing season. Some years ago it was established with cultivar Schönemann that late selective removal of young canes (end of May - beginning of June), up to 10 to 12 canes per meter row, resulted in nearly no development of new canes and a better growth of the remaining ones. This saved labour in autumn and winter and gave a higher fruiting potential for the next year (due to a sufficient number of stronger canes).

In 1984 early removal of all new growth (beginning of May) was compared with thinning the canes at that same moment and with late thinning (beginning of June). With Malling Promise early thinning indeed resulted in a far lower number of too short shoots at the end of the season. Also with Spica early thinning gave fewer short shoots, while the number of long shoots increased considerably. With Jochems Roem and Malling Delight with regards to removal of all canes, early thinning resulted in the same number of canes but the number of very long canes (> 250 cm) increased. With Schönemann and Glen Clova early thinning resulted in a considerable increase of the total number of canes, compared with complete removal of the young canes.

With all cultivars late thinning resulted in a sufficient number of (strong) canes per meter row (10-13). With Malling Delight, Malling Promise and Jochems Roem the number of very long canes increased further.

Except for Spica unfortunately there was a tendency that compared with the early removal of all young shoots, early thinning resulted in a decrease in production of about 15-20%. With late thinning decrease of production was less. The question is whether this production decrease will be compensated for by a higher yield in the following years, due to stronger canes. The trial will be continued with cultivars Malling Promise and Glen Clova.

Growing autumn-bearing raspberries

Plastic tunnels were placed in March on the plots that had to be covered. The number of canes was partly thinned to 16 per meter row, for the next there was no thinning. With Heritage, no thinning resulted in 26 fruiting canes per meter row, and with Baron de Wavre, the number of fruiting canes then was 20.

Growing the raspberries in tunnels resulted in advancing the harvest period by 3.5 weeks (Table 36), through which there was a good connection between the harvest periods of the normal-bearing raspberries and the autumn-bearing raspberries. Bad weather conditions in autumn led to lower production and more fruit rot on the plots in the open. Keeping more than 16 canes per meter row did not result in a higher yield.

Tabel 36. Results with autumn-bearing raspberries in 1984.

	Kg/m^2	1st quality (%)	Fruit rot (%)	Average fruit weight (g)	Mean harvest date
Heritage - in the open	1.95	83	7.6	3.0	1/10
Heritage - in tunnels	2.42	83	0.9	2.8	6/9
Baron de Wavre - in the open	0.87	77	4.1	4.4	25/10
Baron de Wavre - in tunnels	1.39	84	3.1	4.6	12/10
Heritage - 16 canes/m row	2.16	85	4.3	3.0	18/9
Heritage - 26 canes/m row	2.20	80	4.3	2.8	19/9
Baron de Wavre - 15 canes/m row	1.24	80	3.9	4.5	18/10
Baron de Wavre - 20 canes/m row	1.03	83	3.3	4.5	20/10

Black currant

Plant distance

In a plant-distance trial with the cultivars Black Reward, Tenah and Westra again high yields were obtained (Table 37). With Tenah and Westra, the planting of cuttings at an in-row distance of 25 cm resulted in the highest yield. Of the plots started with one-year-old bushes, with Tenah a plant distance of 75 cm gave the highest yield, and with Black Reward and Westra, 50 cm seems best.

Table 37. Results black currant plant-distance trial (planted in spring 1982).

Plant distances (m)	Kg/m^2		Average berry weight		Berries per string	
	1983	1984	1983	1984	1983	1984
Tenah						
cuttings 2.75x0.25	1.04	2.73	1.2	1.1	6.9	8.2
bushes 2.75x0.50	0.95	2.28	1.2	1.2	6.3	7.5
bushes 2.75x0.75	0.89	2.52	1.2	1.2	7.0	7.2
bushes 2.75x1.00	0.80	2.43	1.2	1.2	7.5	7.9
bushes 2.75x1.25	0.65	1.77	1.2	1.2	8.0	9.0
Black Reward						
cuttings 2.75x0.25	0.57	1.28	1.2	1.1	5.7	4.8
bushes 2.75x0.50	0.74	1.44	1.4	1.1	5.1	4.3
bushes 2.75x0.75	0.60	1.22	1.4	1.2	5.1	5.1
bushes 2.75x1.00	0.36	1.11	1.3	1.2	5.0	5.0
bushes 2.75x1.25	0.32	0.82	1.4	1.2	4.8	4.9
Westra						
cuttings 2.75x0.25	0.67	1.14	0.9	0.8	5.3	4.9
bushes 2.75x0.50	0.62	0.78	1.0	0.9	4.4	4.4
bushes 2.75x0.75	0.50	0.62	1.0	0.9	4.3	4.8
bushes 2.75x1.00	0.40	0.46	1.0	1.0	4.6	4.8

Pollination

In cooperation with the National Advisory Service for Beekeeping an attempt was made to find out the influence of bees on fruit-set and yield. Beehives were placed in the middle of a big black currant field and yield was measured on bushes in concentric rings with distances of about 15 m. In this way no influence of bees on yield or fruit set could be proved.

Red currant

Pruning trial

With Rotet, planted in spring 1983, the influence of summer pruning on production and quality was investigated. Though differences are small, an early start (May) and a selective method of summer pruning tends to give a higher production than late summer pruning (beginning of July).

Comparison of virus tested and non virus tested plants

In the first year differences in production were only small. Cultivars are Jonkheer van Tets, Stanza, Rosetta and Rotet. It was striking that great differences in the size of plant material had nearly disappeared after 1 growing season when the bushes were cut back completely at planting time.

CULTIVAR TESTING OF RASPBERRIES, BLACKBERRIES, GOOSEBERRIES AND CURRANTS

A.A. van Oosten

Raspberry

First screening

A trial with cultivars Gradina, Payallup Large and Haida was started in the spring. Also some plants of the old and nearly vanished cultivar Preussen were planted to judge fruit quality. Plants of Preussen were discovered in the Southern part of the German Federal Republic and nurseries are interested in this cultivar.

Cultivar trial

A new cultivar trial was planted. It includes the early ripening cultivars Glen Clova (standard) and Glen Prosen, the mid-season cultivars Rode Radboud (standard), Glen Moy, Glen Isla and Magnific Delbard and the late ripening cultivars Schönemann (standard), Leo, Joy and the selections Westveer and Toorenaar.

Cultivar test with growers

In 1981, 6 cultivars were planted with growers on 10 sites. Of the early ripening cultivars Glen Clova performed better than Malling Delight (fruits too soft) and Spica (fruits too small). However with Glen Clova more and more cane diseases were found. Of the late ripening cultivars Schönemann is preferred to Phyllis King (harvesting of the fruits is difficult).

Cultivar trial autumn-bearing raspberries (see also p. 46).

Again, in the fourth year, Heritage was very productive with 1.8 kg/m^2. The average fruit weight was 2.9 g and the mean harvest date was 4th September. Due to a late spring and a cold, wet autumn the late ripening cultivar Baron de Wavre was less productive (0.9 kg/m^2). The average fruit weight was 4.5 g, and the mean harvest date was 19th October. Certainly in unfavourable years Baron de Wavre is unsuitable under Dutch circumstances.

Blackberry

First screening

Of the new American cultivar, Hull Thornless, the first fruits were harvested. Ripening time was about the same as with Black Satin, but the total ripening period was shorter. Fruits are firmer and sweeter than those of Black Satin. Productivity cannot be judged after 1 year.

Ripening of cultivar Wilson's Frühe was early and fruits were a nice, shiny black with a reasonably good taste. Unfortunately the plants were not healthy and had to be pulled up.

The raspberry x blackberry hybrid Marion was also pulled up. Fruits are much like those of Loganberry but this cultivar is preferred.

Thorned and thornless Boysenberries were planted.

Cultivar trial

Productions differed less than in previous years. Thornless Evergreen, in previous years by far the least productive cultivar, now had a production nearly equal to the other cultivars. Himalaya and Ashton Cross were again equal in production but now fruits of Ashton Cross were bigger and the ripening period was nearly 1 week later.

Cultivar trial with growers

In 1981, 4 cultivars were planted with 5 growers. Black Satin and Bedford Giant are not considered to be improvements on the standard cultivars Thornfree and Thornless Evergreen. Due to a very early ripening time and nice, big fruits, there could only be some interest for Bedford Giant. The fact that fruits of Black Satin are too soft and therefore have to be harvested twice a week is not acceptable to the growers.

Gooseberry

First screening

Misstek turned out to be synonymous with Achilles and was pulled out. Invicta, a new English cultivar was productive with big, yellow fruits. Also the first fruits of Weisse Neckartal were big.

Cultivar trial

In the third harvest year production of most cultivars was satisfactory (Table 38). Whinham's Industry type A is the true Whinham's Industry. The B type is probably an unknown cultivar that is far less satisfactory.

Production of Golda and Rosko stays behind because growth in the first years was slow due to weak planting material. However fruit quality of these cultivars is good.

Table 38. Results of a gooseberry cultivar trial.

	Kg/m^2 (1st quality)		Average fruit weight (g)	Mean harvest date
	1984	1982-'84 (average)		
Whinham's Industry A	2.85	1.70	13.1	24/7
Whinham's Industry B	1.42	0.99	8.9	17/7
Achilles	2.54	1.37	15.6	2/8
Rosko	1.57	1.08	12.6	28/7
Goudbal	1.21	0.72	12.1	17/7
Golda	1.60	0.91	11.8	29/7

Cultivar trial with growers

The new cultivars Golda and Rosko got good judgements for production as well as for fruit qulaity. Goudbal is praised for its high fruit quality.

Red currant

First screening

Of 10 Italian selections, planted in 1980, 3 have been kept for further trials in the open. These 3 selections have a reasonable fruit quality and have an early flowering or ripening time. The other selections were abandonned for not being an improvement on the standard cultivars. Five selections will be tested with growers in a glasshouse.

The French cultivar Groseille Raisin Industria is very much like Heinemann's Rote Spätlese and ripens in the same period, but fruit quality is better and plants seem more healthy.

Some other French cultivars are also much like Heinemann's Rote Spätlese and have no favourable qualities.

The German cultivar Mulka attracts attention by its very late flowering and ripening time and the dark red-brown berries. Selection Klay has very nice strings with big good coloured berries.

Selection in Rondom

For the first time in this trial a branch with malformed leaves was found in a healthy clone. Also a branch with fasciation was found in the same clone (G2). Differences in production between 'healthy' and 'not healthy' clones were undiminished. On average, 'healthy' clones produced 4.4 kg/m^2, and 'not healthy' ones only 0.8 kg/m^2. Average berry weight of the 'not healthy' clones is less and these clones have less berries per string than the 'healthy' clones. In the 4th year after grafting no transmission of symptoms was visible.

The Rondom selection from Wemeldinge was far more productive with bigger berries and more berries per string than the standard Rondom. Differences in flowering were less than in previous years.

Cultivar trial with growers

In this trial the results of previous trials were confirmed. Rolan and Rovada gave good results, but at 2 fields in the province of Noord-Holland these cultivars as well as Stanza proved to be susceptable to Verticillium albo-atrum (Bangertse ziekte). Rosetta and Rotet seem less susceptable and Rondom seems hardly susceptable.

White current

First screening

Based on a first screening the following cultivars are to be considered for further trials: Witte Parel, Primus, Blanka, Witte van Huisman, Zitavia, Weisse aus Jüterbog and Werdavia.
The French cultivar Amber Delbard was pulled out. This cultivar flowers and ripens very late with long strings, but the bushes seem unhealthy and the berries become prematurely ripe.

Cultivar trial

The production of a clone with acute leaf margin serration of cultivar Witte Parel was somewhat higher than of a clone with a more round leaf margin serration. However the fruit quality (berry weight, number of berries per string) of the latter was better. Therefore this clone is preferred.

Black currant

First screening

Burga and Black Giant Missouri (a black currant x gooseberry hybrid (?)) were planted. Strata turned out to be synonymous with Strato.

Cultivar trial

Productions in the trial were exceptional high (Table 39). Nine out of 14 cultivars produced over 1 kg/m^2.
Preliminary remarks over certain cultivars:
- Black Down is high yielding but fruits are quite soft and the branches have a limpy growing habit.
- Of Silgo the big berries attract attention.
- Growth of M.59-3 is very strong and this cultivar is susceptable to American Gooseberry Mildew (*Sphearotheca mors-uvae*).
- Phoenix has big berries that taste very good.
- Tsema, Ben Lomond, Phoenix and Black Reward are suitable for mechanical harvesting as well as hand picking.

Table 39. Results of a black current cultivar trial (averages 1983-'84).

	Kg/m^2		Average berry weight (g)	Date first flowers	Harvest date
	1983	1984			
Tsema	0.59	2.08	1.12	29/4	23/7
Silgo	0.39	1.53	1.63	30/4	23/7
Ben Lomond	0.44	1.94	1.17	1/5	24/7
Meitgo	0.39	1.19	0.93	2/5	26/7
M59-3	0.22	1.97	1.13	2/5	26/7
Black Down	0.73	1.81	0.98	29/5	28/7
Phoenix	0.44	1.38	1.17	8/5	30/7
Green's Black	0.67	0.59	0.79	29/4	31/7
Baldwin	0.58	0.90	0.73	27/4	31/7
IVT-69010	0.30	1.03	1.08	2/5	31/7
Black Reward	0.42	1.27	1.26	2/5	1/8
IVT-69002	0.31	0.72	1.23	12/5	3/8
Westra	0.51	0.74	0.95	29/4	5/8
Ben Moore	0.41	0.94	1.19	8/5	5/8

Cultivars for a mechanical harvest

In Rilland the judgement of 10 cultivars and selections for suitability for mechanical harvest was continued. Machine harvesting of all cultivars and selections was reasonable to good. Ben Lomond performed best and Meitgo was pulled out, being too susceptable to American Gooseberry Mildew.

Cultivar trial with growers

Again in 1984 Tenah, Phoenix as well as Black Reward turned out to be suitable for hand picking and marketing for the fresh market in 500 g punnets.

ECONOMICS

ECONOMIC COMPARISON OF QUINCE A AND QUINCE C WITH CONFERENCE AND DOYENNE DU COMICE

J. Goedegebure

For a number of years Quince A has been widely used as a rootstock in Dutch pear growing. In recent years however growers showed an increasing interest in Quince C. The reasons are a higher and earlier production and the possibility of growing smaller trees which offers perspectives for intensification of pear plantings. Disadvantages of Quince C are the smaller fruit size and the greater susceptibility to winter frost, which may affect the price of young pear trees.

Since 1972 a number of rootstock trials with Quince A and Quince C with the varieties Conference and Doyenné du Comice have been conducted in several places in the Netherlands. Although these trials are not yet finished it was decided to make a preliminary economic analysis of the results.

From the trials it appeared that from the 3rd up to the 10th growing season the yields per tree of Quince C for Conference as well as for Doyenné du Comice exceeded those of Quince A (Tables 40 and 41). The average fruit weight of Quince C fruits was lower, which of course also affects the fruit size and consequently the growers' price.

Table 40. Results of Conference on Quince A and Quince C.

Growing season	Yield per tree (kg)		Mean fruit weight (gr)		Tons per ha		Price per kg (cts)	
	A	C	A	C	A	C	A	C
3	1.9	2.7	176	179	2.6	5.0	124	126
4	3.5	6.7	152	156	4.8	12.7	115	117
5	8.3	14.1	173	164	11.3	26.7	123	120
6	17.9	21.5	171	159	24.6	40.6	122	118
7	20.0	21.3	167	148	27.4	40.2	121	114
8	27.3	26.2	182	161	37.4	49.5	127	119
9	22.5	23.8	178	157	30.8	44.9	125	117

The average planting density in the trials was 1370 trees per ha with a distance of 3.75 by 1.75 meters.

Because of a smaller tree volume of trees on Quince C, the corresponding planting distance for Quince C was put at 3.40 by 1.40 meters, resulting in 1890 trees per ha.

Table 41. Results of Doyenné du Comice on Quince A and Quince C.

Growing season	Yields per tree (kg)		Mean fruit weight (gr)		Tons per ha		Price per kg (cts)	
	A	C	A	C	A	C	A	C
3	0.6	3.5	223	236	0.9	6.7	124	123
4	1.7	6.8	252	239	2.3	12.9	122	123
5	3.0	6.8	259	250	4.1	12.9	121	122
6	7.0	10.7	254	245	9.7	20.3	121	122
7	6.3	10.6	254	242	8.7	20.0	121	122
8	17.7	20.4	270	242	24.3	38.6	120	122
9	17.0	19.2	280	253	23.3	36.4	120	122

Up to the 10th growing season sufficient yield ata were available. For the following years it is assumed that the yield will remain at the same level. The average growers' price has been derived from data from fruit auctions in the province of Zeeland. The lifetime of the orchards has been put at 25 years. Because for Quince C there is less certainty on this point, the results of Quince C are also calculated for a lifetime of 18 years.

For comparing the results four parameters have been computed i.e. the planting costs, the net-present value of the gross-margins obtained during the lifetime of the orchards, the annuity of the net-present value and the pay-back period (Tables 42 and 43).

Table 42. Economic results of Conference on Quince A and Quince C (Dfl. per ha).

Rootstock	A	C	C
Trees/ha	1370	1890	1890
Lifetime	25	25	18
Planting costs	13,540	18,620	18,620
Net-present value	234,970	332,330	251,190
Annuity of n.p.v.	16,670	23,580	21,490
Pay-back period (years)	5.2	4.4	4.4

Table 43. Economic results of Doyenné du Comice on Quince A and Quince C (Dfl./ha).

Rootstock	A	C	C
Trees/ha	1370	1890	1890
Lifetime	25	25	18
Planting costs	13,540	18,620	18,620
Net-present value	140,350	261,430	192,480
Annuity of n.p.v.	9,960	18,550	16,470
Pay-back period (years)	7.0	4.5	4.5

Because of the higer density the planting costs of orchards on Quince C are substantially higher than for Quince A. For Conference as well as for Doyenné du Comice the highest net-present value is obtained from orchards on Quince C with a lifetime of 25 years.

Because the net-present value can only serve as a reliable parameter for orchards with a similar lifetime, the annuity of the net-present value has also been calculated. When comparing on the basis of this parameter it appears that Quince C with a lifetime of 25 years offers the best results for both varieties, followed by orchards on Quince C with a lifetime of 18 years. The results of Quince A orchards are much lower.

The time needed to earn back all expenditures of the first years (pay-back period) provides an indication of the risk of the investments. The shorter the pay-back period, the lower the risks involved. Of both rootstocks Quince C shows the shortest pay-back period in spite of the fact that the planting costs are considerably higher.

THE DEVELOPMENT OF FRUIT GROWING IN THE PROVINCE OF ZEELAND (1974-1990)

J. Goedegebure and M.L. Joosse*

In the province of Zeeland discussions are being held with the purpose of reaching an amalgamation of the four important fruit auctions in that region.

As a lead for the discussions the need was felt to have a quantitative prognosis of the developments in the regional fruit industry.

The study was done within the framework of a national study into the competitive position of the most important fruit growing regions in the Netherlands. Between the national research and the regional study for Zeeland a certain analogy exists. The regional study therefore has to be seen as a part of the national research.

The acreage of apples and pears in Zeeland diminished regularly between 1974 and 1983, although it decreased less rapidly than the acreage in the Netherlands as a whole. In 1983 the fruit acreage in Zeeland amounted to 88% of the acreage in 1974. For the Netherlands as a whole this figure was 73%. Apple decreased stronger than pear. The number of fruit holdings is showing the same tendency (Table 44).

Table 44. Development of the acreage and the number of holdings in the Netherlands and Zeeland from 1974-1983.

Year	Fruit acreage				Number of holdings			
	Netherlands		Zeeland		Netherlands		Zeeland	
	ha	%	ha	%	ha	%	ha	%
1974	31504	100	4780	100	9945	100	1044	100
1977	28382	90	4570	96	8283	83	936	90
1980	24736	79	4360	91	6964	70	823	79
1983	23147	73	4211	88	6358	64	755	72

Source: C.B.S.

Because of the introduction of new varieties important changes have taken place in the variety pattern (Table 45). In Zeeland in 1982 the new varieties accounted for 14% of the total apple acreage. The introduction of the new varieties has been achieved at the cost of Golden Delicious of which the share decreased by 11%. Concerning pears the main development is the rise of the share of Conference (30% in 1974, 39% in 1982).

For apples Zeeland is showing a favourable age structure and planting density in comparison with the national figures. For pears the share of young orchards is relatively low and there are only slight differences in comparison with the national figures.

The commercial production of apples in Zeeland today amounts to 68 million kg and of pears to 28 million kg. Per ha this means an average production of 26.7 resp. 19.3 tons, which is equal to or slightly higher than the national average.

* The research was done by a working group with the following members: Drs A. Boers and B. Mouris of the Horticultural Department of the Agricultural Economics Research Institute, M.L. Joosse of the Research Station for Fruit growing and J. Ruissen of the local Advisory Service. Leader of the project was J. Goedegebure.

Table 45. The variety pattern of apples and pears in the Netherlands and Zeeland from 1974 to 1983.

	Netherlands				Zeeland			
	1974		1982		1974		1982	
	ha	%	ha	%	ha	%	ha	%
Golden Delicious	7025	32	3981	25	1013	34	593	23
Cox's Orange Pippin	4279	20	2676	17	736	24	520	20
Boskoop	4851	22	3381	21	398	13	372	14
J. Grieve	1785	8	1252	8	206	7	205	8
Winston	605	3	576	4	303	10	269	10
New varieties*	-	-	1771	11	-	-	328	14
Others	3360	15	2347	14	366	12	281	11
Total	21905	100	15984	100	3022	100	2568	100
Conference	1811	26	1934	35	490	30	574	39
D. du Comice	1342	19	1213	22	378	23	371	25
B. Hardy	760	11	430	8	276	17	183	12
Cooking pears	625	9	712	13	52	3	77	5
Others	2558	35	1275	22	423	27	263	19
Total	7096	100	5564	100	1619	100	1468	100

Source: C.B.S.

* Jonagold, Karmijn de Sonnaville, Elstar, Gloster, Summerred, Alkmene, Discovery.

For apples as well as for pears it is expected that the acreage in Zeeland will stabilize and in 1990 will have the same level as in 1983 (Table 46). Further important changes are expected concerning the varieties. The new apple varieties will show a rising share and reach a level of about 38% of the total acreage in 1990. The share of Golden Delicious, Cox's Orange Pippin and Winston will decrease. For pears a further rise of the share of Conference up to 48% in 1990 is expected.

Because of increasing replacement activities a decrease in the average orchard age is expected as well as a rise in the average planting density. The number of holdings will decrease slowly which is compensated however by an increase in the average size of the holdings.

Because of improving growing techniques and a further intensification of the orchards a rise in the average production per ha is foreseen.

Total commercial production in Zeeland in 1990 is estimated at 72 million kg of apples and 30 million kg of pears. In comparison with 1982 this means an increase of 5%. In conformity with the developments of the acreage the production share of the new apple varieties and of Conference will increase.

An important part of the orchards with new varieties will still be young in 1990. By reaching full production in the beginning of the nineties production will rise additionally by 3 to 4 million kg of apples.

Table 46. Acreage and commercial production of apples and pears in Zeeland in 1990.

Variety	Acreage		Commercial production	
	ha	%	million/kg	%
Golden Delicious	400	15	13.7	19
Cox's Orange Pippin	450	17	11.8	16
Boskoop	250	10	7.2	10
James Grieve	185	7	4.9	7
Winston	125	5	4.0	6
New varieties*	1000	38	25.4	35
Others	210	8	5.0	7
Total	2620	100	72.1	100
Conference	720	48	15.4	52
Doyenné du Comice	370	25	6.7	22
Beurré Hardy	120	8	2.4	8
Cooking pears	90	6	1.5	5
Others	200	13	3.8	13
Total	1500	100	29.8	100

* Jonagold, Elstar, Karmijn de Sonnaville, Gloster, Summerred, Discovery, Alkmene

THE RELATION BETWEEN PRODUCTION LEVEL AND FRUIT SIZE OF APPLES AND THE INFLUENCE ON PROFITABILITY

M.L. Joosse

The growers' price for apples largely depends on the size of the fruits. By means of different growing measures the fruit size can be influenced by the grower. An important factor in this respect is the production level.

In this research the influence of the production level on fruit size and its impact on profitability has been investigated for three varieties viz. Golden Delicious, Cox's Orange Pippin and Boskoop.

Data were obtained from normal producing orchards with a planting density of 1100 trees per ha (Cox's Orange Pippin), 1300 trees per ha (Golden Delicious) and 1600 trees per ha (Boskoop). All orchards had reached full production and varied in age from 7 to 11 years.

It appeared that for the 3 varieties a negative relation existed between yield per tree and average fruitweight. For Golden Delicious a change in yield of 1 kg per tree induced a change in average fruitweight of 1.17 grams. For Cox's Orange Pippin the comparative figure was 1.11 grams and for Boskoop, 2.98 grams. Whereas Golden Delicious and Cox's Orange Pippin reacted almost equally, the reaction of Boskoop to a change in yield per tree was much stronger.

Also the relation between average fruitweight and fruit size appeared to be negative in the sense that with a higher average fruitweight the percentage of small fruits decreases.

This relationship, established by means of regression analyses, made it possible to calculate the fruit size pattern at different levels of production. An example is given in Table 47. It appears that at a higher production level the percentage of small fruits increases; however, due to the higher production, in absolute terms there is also an increase of the larger fruits.

Table 47. Fruit size in kg/ha and %.

Variety	Fruit size (Ø)	Kg	%	Kg	%	Δ kg
Golden Delicious	total	40000	100	50000	100	10000
	< 70 mm	13640	34	21420	43	7780
	> 70 mm	26360	66	28580	57	2220
Cox's Orange Pippin	total	30000	100	40000	100	10000
	< 65 mm	9220	31	15760	39	6540
	> 65 mm	20780	69	24240	61	3460
Boskoop	total	40000	100	50000	100	10000
	< 85 mm	13710	34	24400	49	10690
	> 85 mm	26290	66	25600	51	- 690

In order to measure the effect on profitability insight has to exist into the relation between fruit size and growers' price. The relationship was investigated for class I and class II with fruit sizes augmenting by 10 mm. Differences in marketing period were taken into consideration. Data were supplied by the auctions of Geldermalsen and Utrecht over the years 1979/'80 to 1982/'83.

The results are summarized in Table 48 from which can be seen that fruit prices for both class I and class II rise when fruit size increases. Only for Boskoop is there one exception; fruits over 85 mm receive a lower price than fruits of 75-85. Because orchards don't produce class I or class II exclusively, prices based on a ratio of 60% class I and 40% class II are given also. All further calculations will be based on this ratio.

Table 48. Fruit prices per kg (1979/'80 - 1982/'83) (Dfl./kg)

Variety	Fruit size (mm) (Ø)	Class I	Class II	Class I (60%) Class II (40%)
Golden Delicious	60-70	0.62	0.53	0.58
	70-80	0.98	0.74	0.88
	80-90	1.08	0.85	0.99
Cox's Orange Pippin	50-60	0.38	0.38	0.38
	60-70	0.91	0.81	0.87
	70-80	1.62	1.40	1.53
	80-90	1.63	1.41	1.54
Boskoop	65-75	0.89	0.76	0.84
	75-85	1.48	1.17	1.36
	85-95	1.35	1.09	1.25

For the three varieties mentioned gross-margins at different production levels were calculated. The differences in gross-margin in comparison with the gross-margin of the normal production are given in Table 49. It shows that under the present fruit price conditions, in spite of the smaller fruit size, a higher production leads to higher gross-margins and consequently to a better profitability.

Table 49. Difference in gross-margin in comparison with the normal production level (Dfl./ha) (60% class I, 40% class II).

Variety	Production (tons/ha)	Difference in gross-margin
Golden Delicious	30	- 2850
	35	- 1350
	40	0
	45	1270
	50	2440
Cox's Orange Pippin	20	- 5020
	25	- 2310
	30	0
	35	1920
	40	3440
Boskoop	35	- 4060
	40	0
	45	3720
	50	7400

The results are of course strongly dependent on the price differences between fruit sizes. To calculate the influence of increasing price differences between larger and smaller fruits, gross-margins have been established with price differences increased by 10% to 200% compared with the present differences. The general price level is assumed to remain stable (Table 50). In some cases this would theoretically lead to negative prices for the smaller fruit sizes. For the calculations these negative prices have been put at zero.

Table 50. Calculated fruit prices with increasing price differences (Dfl./kg) (60% class I, 40% class II).

Variety	Fruit size (mm) (Ø)	Increase in %			
		10%	50%	100%	200%
Golden Delicious	60–70	0.56	0.47	0.37	0.16
	70–80	0.89	0.92	0.97	1.06
	80–90	1.00	1.08	1.18	1.37
Cox's Orange Pippin	50–60	0.31	0.03	-0.31	-1.00
	60–70	0.84	0.77	0.67	0.47
	70–80	1.57	1.77	1.99	2.46
	80–90	1.58	1.79	2.01	2.49
Boskoop	65–75	0.79	0.62	0.40	-0.08
	75–85	1.36	1.40	1.44	1.53
	85–95	1.24	1.23	1.19	1.20

From Table 51 it can be seen that in the case of Golden Delicious price differences have to increase by 200% before the highest production (50 tons per ha) offers poorer results. In this case the highest gross-margin is achieved with a production of 45 tons per ha.

Table 51. Differences in gross-margin in comparison with the normal production level with increasing price differences (Dfl./ha) (60% class I, 40% class II).

Variety	Production (Tons/ha)	Increase in % 10%	50%	100%	200%
Golden Delicious	30	-2736	-2392	-2022	-1270
	35	-1288	-1088	- 883	- 430
	40	0	0	0	0
	45	1188	935	662	81
	50	2261	1706	1099	- 201
Cox's O.P.	20	-4815	-4226	-4012	-3682
	25	-2187	-1809	-1629	-1324
	30	0	0	0	0
	35	1757	1211	892	299
	40	3077	1819	1037	- 424
Boskoop	35	-4038	-3980	-3910	-3819
	40	0	0	0	0
	45	3657	3451	3206	2775
	50	7262	6815	6264	5300

Also for Cox's Orange Pippin the price differences have to increase by 200% before a production of 40 tons per ha becomes inferior to a production of 35 tons which then offers the highest gross-margin.

For Boskoop the highest production always gives the best results, even when the present price differences are increased by 200%. This is mainly due to the fact that the largest fruits of Boskoop receive a lower price than the medium sized fruits.

It applies to all varieties that an increase in price differences of 200% is hardly a realistic proposition. This means that the general conclusion can be that reducing production in order to improve fruit size within the given limits is unattractive from an economic point of view.

It will be obvious that manipulation of the production level will have its limits. Increasing production to such an extent that other quality problems arise or biennial bearing is induced, is of course irresponsible. When these limits are kept in mind however it is clear that for the profitability of fruit growing the production level is of vital importance.

SOIL MANAGEMENT

P. Delver

Soil management, potassium fertilization and trickle irrigation

In 1976 an experiment was started with Cox's Orange Pippin and Rode Boskoop apples on rootstock M.9 planted in 1975. Until 1983, four combinations of weed control on the tree strips and modes of mowing grass in the alleys were practised: herbicide treatment without tillage (C) or rotary tillage (M) combined with mulching grass along the tree-rows (CC, MC) or grass left on the grass alleys (CM, MM). Super imposed on the soil management blocks was trickle irrigation applied in different periods with or without potassium fertilization.

To observe after-effects, potassium fertilization and differences in weed control and mowing method were discontinued in 1983 and since then only herbicides have been used and grass is mulched on the tree strips (CC). Only differences in periods in which the trees receive trickle water are maintained.

Differences in yield between the soil management systems have always been small, in significant and inconsistent. This was due to several factors: generally good availability of moisture, further improved by irrigation; difficult, therefore incomplete performance of soil tillage under the trees because of the low position of branches; soil management blocks coinciding with different positions in wind shelter brought about by hedges.

Yields in kg per tree in 1984 for the treatments CC, CM, MC and MM were 39.8, 42.2, 39.4 and 37.6 for Rode Boskoop, respectively. For Cox's Orange Pippin: 20.6, 20.8, 19.4 and 18.5 kg, respectively. The differences may point to a slight lead in production in plots were in 1976-1982 chemical weed control was practised (CC, CM).

INFLUENCE OF NITROGEN FERTILIZATION ON YIELD AND QUALITIY OF FRUIT CROPS

P. Delver

Mineral nitrogen in the herbicide strip as a basis for fertilizer recommendations

The results of an investigation conducted in 1978-1980, on the usefulness of the "N-mineral" method of soil testing were reported in the Annual Report for 1983, p. 40. Also, a detailed report on the findings was written (Institute for Soil Fertility, Haren, Report 8-84). "N-min" is the total quantity of soluble nitrogen in kg N per ha in the ± 0-80 cm rooted soil layer of tree strips, determined late February - early March.

Although the practicability for fruit crops seems less convincing than for arable crops, the following fertilizer recommendations were set up.

Orchard conditions have to be distinguished inducing relatively high, or low nitrogen fertilizer demand. A high demand exists when the expected production is high; in high density plantings; when moisture supply and growth are moderate; when the cultivar is not very susceptible to bitter pit, breakdown and unsatisfactory colouring of the fruits. For such conditions a spring dressing is proposed calculated from 140- 1xNmin in kg N per ha.

On the other hand, a low nitrogen demand is induced by a (still) low productivity or in off-years in a biennial bearing planting; in wide plantings; when shoot growth is vigorous; when the cultivar is susceptible to storage losses and prone to difficult colouring of the fruits. In such cases the spring dressing can be calculated from 80- 1xNmin in kg N per ha. Apart from these considerations it is supposed that certain conditions may necessitate additional top-dressings, such as a too bright leaf colour or leaching of nutrients by excessive rainfall in spring.

FACTORS AFFECTING THE RELATIONSHIP BETWEEN POTASSIUM IN SOIL AND CROP

P. Delver

Soil management, potassium fertilization and trickle irrigation

In the field experiment mentioned in the foregoing, with Cox's Orange Pippin and Rode Boskoop apples planted in 1975, heavy annual dressings of potassium sulphate, 300 kg K_2O per ha were given over 7 years. The last dressing was given in 1982. Leaf analysis in 1983 for both cultivars still showed considerable differences in K-contents with an increase in non-irrigated dressed plots of 0.53% and 0.52% K for Cox's Orange Pippin and Rode Boskoop, respectively. Since the trickle water, drawn from 8-10 m deep wells, contains some potassium, irrigation applied in dry periods between 1 May and 15 September also caused a marked increase in leaf-K contents: on plots not fertilized with potassium, 0.24% and 0.19% higher values for the two cultivars, respectively.

K-fertilization also resulted in higer yields in 1983. On plots with and without K dressings, totalling 2250 kg K_2O per ha over 7 years, Cox's yields per tree were 17.8 and 21.5 kg respectively. For Rode Boskoop it was 37.6 and 40.7 kg per tree, respectively. The results so far have shown that with K-contents in the leaves within the range of 1.1-1.5% K for Rode Boskoop and 1.4-1.8% K for Cox's Orange Pippin a positive influence of K-fertilization on yield can still be expected.

BITTER PIT IN APPLE

P. Delver

Storage experiments

Cox's Orange Pippin fruits of the 1983 crop in the soil management experiment mentioned in the foregoing were stored until 23rd January. Losses due to bitter pit and breakdown were rather serious, therefore pronounced treatment influences could be observed. Total loss to bitter pit and breakdown on plots non-fertilized and fertilized with potassium amounted to 10.0% and 27.0%, respectively. With and without trickle irrigation: 24.6% and 13.1%, respectively.

Trickling in this experiment is practised in one or more of three periods: I under dry conditions between 1st May and 15th June, II from 15th June - 1st August and III from 1st August - 15th September. Storage losses were particularly aggravated by trickling early. With and without irrigation in period I resulted in 28.5% and 18.9% loss to bitter pit plus breakdown, respectively. Soil management differences maintained over 1976-1982 possibly had an after-effect on keepability: rotary tillage and herbicide treatment under the trees resulted in 16.0% and 25.0% bitter pit plus breakdown, respectively.

Rode Boskoop of the 1983 crop was also stored, until 20th January, but due to the high cropping level, 30 kg per tree approximately, only minor storage losses were observed. Nevertheless, total incidence of rot, scald, bitter pit and breakdown amounted to 3.2 and 4.5% for the two modes of weed control, respectively. This too, could point to an after-effect of former differences in soil management. Needless to add that in respect of the aim to investigate treatment influences on keepability no calcium sprayings were carried out in this experiment.

Due to lack of man-power the 1984 fruits of the 96 plots of each of the two cultivars in this large experiment could not be stored. Also, the 1985 crop will not be stored.

In the scope of international cooperation in research on the efficiency of trickle irrigation methods an experiment was conducted in guard rows of the above-mentioned trial field. This experiment was started in 1981 and is referred to as the "Agrimed"-experiment.

Amongst the 7 treatments there are 3 in which the same daily quantities of water are given through one dripper per two trees (8 l/hr), one dripper per tree (4 l/hr) or two per tree (2x2 l/hr). In this order the efficiency of dripping increased as was expressed by slightly higher average weights per fruit. Also, K-contents in the leaves increased and so did storage losses due to bitter pit and breakdown. As an average result of storage experiments with the 1983 yield of three cultivars in the guard rows, viz James Grieve, Cox's Orange Pippin and Karmijn de Sonnaville, losses due to bitter pit plus breakdown were 8.8%, 12.1%, 13.9% and 15.0% for non-irrigated trees and trickle irrigated trees in the order mentioned above. Spot in Jonathan in the same experiment also increased the more efficiently trickling was carried out. In the same order losses due to spot were 6.6%, 9.2%, 11.0% and 15.6%. The unfavourable effect of irrigation on keepability is at least partly due to enhanced uptake of potassium from trickle water. The effect can partly be reversed by adding fertilizer without potassium to the water.

TRICKLE IRRIGATION

P. Delver

The spring of 1984 was dull, wet and cold. Only July and particularly August had many warm, sunny days but September again had very dull, wet and cold weather. On the whole, 1984 was not a season to expect pronounced trickle-irrigation effects.

Soil management, potassium fertilization and trickle irrigation

In this trial field irrigation is applied in combinations of three periods as was mentioned in the report on storage experiments. Trickling is done in dry periods only and through one dripper per tree centred between the trees. Observations in former years on ground-water fluctuations have shown that high daily quantities of water e.g. 20 l per tree (with a plant density of 1800 trees per ha, equivalent to 3.6 mm), induce a rise in the ground-water table of 10-20 cm. With an original level of 130 cm below surface a rise to 120-110 cm could improve capillary water supply on non-irrigated plots. Therefore a somewhat more "saving" watering policy was followed in recent years. However it is not the aim of this experiment to obtaine optimum irrigation effects but to distinguish critical periods in the need for watering.

Due to dull cold weather until August only little water was given during the first two periods. Table 52 gives a review of water quantities applied in the course of the years.

Table 52. Water quantities in l per tree per day averaged over approx. 45 days per period along with total quantities in mm per period and per season.

	Trickle periods						Total (mm)
	I 1/5-15/6		II 15/6-1/8		III 1/8-±15/9		
	l	mm	l	mm	l	mm	
1977	4.8	39	14.5	117	5.1	41	198
1978	4.6	37	3.8	31	4.6	37	105
1979	0	0	9.6	78	13.1	106	184
1980	8.1	66	3.3	27	10.5	85	177
1981	0	0	12.4	100	10.7	94	194
1982	4.0	32	8.5	69	15.1	161	262
1983	1.3	11	12.0	97	12.0	97	205
1984	1.3	11	5.1	41	9.8	79	131
Average	3.0	24	8.7	70	10.1	88	182

In spite of the small need for additional water supplies, also in 1984 irrigation resulted in slightly improved yields. This may also have been an after-effect of cumulated extra growth in former years. Table 53 shows that on average on potassium-fertilized plots trickle-irrigation in periods II+III gave the best results with an average 10% and 6% higher yield for Cox's Orange Pippin and Rode Boskoop, respectively, compared with non-irrigated trees. The combined effect of potassium fertilization and irrigation however is considerably better with an average 19% and 12% higher yield on fertilized plots irrigated in periods II and III, for the two cultivars respectively, compared with non-fertilized, non-irrigated plots.

International cooperation on trickle irrigation research

In the "Agrimed" experiment the influence of different positions and numbers of drippers on the efficiency of irrigation is being investigated. The experiment is situated in guard rows of the soil management experiment and comprises four apple cultivars on M.9 planted in 1975. Equal water quantities per tree are given through one dripper per 2 trees (8 l/hr), one per tree (4 l/hr) or two per tree (2x2 l/hr). In part of the plots rainfall is intercepted by plastic frames to create dry soil conditions. In 1984 irrigation had an irregular non-significant effect on yield with sometimes a tendency to diminish the number of fruits per tree resulting in somewhat increased fruit weights.

Table 53. Yield data in the experiment on trickle irrigation (= +) in three different periods.

Potassium fertilization 1976-1982	Irrigation period			Yield in kg per tree			
	I	II	III	Cox's Orange Pippin		Rode Boskoop	
				1984	1976-1984	1984	1976-1984
-	-	-	-	16	117	37	198
+	-	-	-	21	127	39	208
-	+	+	+	20	130	38	210
+	+	+	+	22	140	43	224
+	+	-	-	21	131	41	209
+	+	+	-	20	133	40	211
+	-	+	+	21	140	40	219
+	-	+	-	17	127	41	220

Efficiency of trickle irrigation in young trees

An experiment was started in 1983 with Gloster apples on M.9 planted in February 1981. Equal quantities of water per tree are given through one 4 l/hr dripper per tree near the trunk or one centred between 2 trees or two 2 l/hr drippers on both sides of the trunk. In 1983 shoot growth in the last-named treatment was best. This points to a relatively efficient water use when water is distributed over large numbers of tricklers. However, in 1984, probably due to diminished flower intensity, yield was somewhat lower here, compared with other treatments.

A similar pilot experiment was started in 1983 in guard rows Elstar apple on M.9 of an international trial on planting systems in the experimental garden at Numansdorp. The trees were planted in December 1982. Here, 2 quantities of daily watering, 4 or 8 l per tree, were applied through one 4 l/hr dripper at 10 cm from the trunk or through 2 x 2 l/hr drippers per tree at 20 cm on both sides of the trunk. In the guard rows 2 types of trees were planted: branched and non-branched. With a 1st yield of 8.5 kg and 4.7 kg per tree in 1984, respectively, the branched plant material proved itself far superior to unbranched material. The former trees however are more susceptible to drought as was concluded from the more pronounced positive effects of irrigation on shoot production in 1983. In 1984, branched trees showed an average 12% higher production brought about by irrigation whereas an adverse effect, with 6% lower production, was found in the unbranched trees. There were no significant differences between quantities of water used and modes of trickling.

Fertilizers added to trickle water ("fertigation")

A pilot experiment was started in 1983 in guard rows of an international experiment on planting systems with Golden Delicious on M.9, densely planted in February 1981. Trickle irrigation with equal daily quantities of water 4-6 l per tree in 1984, was applied through 1 or 2 drippers per tree, with or without the addition of dissolved fertilizer 18-18-18. On the basis of 3500 trees per ha, 148 mm of water was given and in the fertigated treatments, the fertilizer consumption was equivalent to 102 kg N, P_2O_5 and K_2O per ha. No fertilizers were broadcast. As in 1983, the effect of fertigation was shown by a darker leaf colour compared with trees trickled with non-treated water.

In 1984 there were no significant differences in yield but the data showed a tendency of somewhat lower yields per tree in most of the irrigated treatments. This could have resulted from diminished flower intensity induced by enhanced growth in 1983. However, as in 1983, the highest yield was obtained from fertigated trees with 2 drippers (2 x 2 l/hr) on each side of the trunk.

In 1984 a new experiment on fertigation was started in the experimental garden at Numansdorp, on a site where in the preceding year apple trees on M.9 were grubbed. Well-branched trees, four varieties on M.9, were planted in December 1983 with potting compost in the planting-hole. The varieties were: Cox's Orange Pippin, Jonagold, Karmijn de Sonnaville and Golden Delicious.

"Kristallon-lila", a soluble fertilizer containing 19% N, 6% P_2O_5 and 6% K_2O was applied in different ways and periods through 4 l/hr and 2x2 l/hr tricklers as indicated for treatments 3-7 in Table 54. Trickling was done in dry periods between 11th May and 4th September, daily for 1 hour (4 l/tree) with tricklers at 10-15 cm from the trunk. Fertigation was done daily in low concentrations (E.C.) rise approx. 0.4-0.5 S) except for treatment 6 where fertilizer was applied in high concentrations (E.C. 5-7 mS) once every 8-10 days. In treatments 8 and 9 calciumnitrate and potassiumnitrate were used, respectively.

In the course of the spring marked growth responses came to the fore as is demonstrated in Table 54. They may have been accentuated by the following factors: replanting apple on M.9 after apple on M.9; no broadcast fertilization; use of heavy, branched, therefore drought-susceptible planting material; leaching of nitrogen by excessive rain in January, March and May 1984; potting compost in the planting hole without the use of organic mulch around the stem. From the growth response of the 4 varieties the following conclusions may be drawn.

On the basis of equal nitrogen consumption, 19-6-6 has given better results than calcium- or potassiumnitrate (treatments 3, 8 and 9). Distribution of enriched water through two instead of one trickler per tree improves fertigation efficiency (3 and 7). In the course of the summer, treatment 7 showed unusual dark-green leaf colours.

Accumulation of slats followed by a slight check of growth in the last stage of shoot growth may have played a role. Finally, daily addition in low, constant concentration of the fertilizer is more effective than interrupted fertigation in high concentration. Treatments 4 and 5 showed that to a certain extent shoot growth can be regulated by confining fertigation to certain periods only.

Experiments in Wageningen and Geldermalsen

In a high-density orchard with Lombarts Calville apples trees on M.9, planted in 1981 on river clay at the experimental garden of the Institute for Mechanisation, Labour and Buildings near Wageningen, the effect of overhead-sprinkling is compared with trickle irrigation. Due to biennial bearing with productions per tree between 0 and 7 kg (4000 trees per ha) an analysis of treatment effects in 1984 could not be made.

Also in the experimental garden on river clay at Geldermalsen overhead sprinkling at rates of 15 or 30 mm per time is compared with trickle irrigation. The drippers are positioned inbetween the trees, one per tree or one per two trees on the basis of equal daily water use. The apple trees, var. Cox's Orange Pippin, Karmijn de Sonnaville and Golden Delicious were planted in 1980. In 1984, response to watering was positive for all varieties. Overhead sprinkling and trickle-irrigation resulted in 22% and 18% higher productions, respectively, for Cox's Orange Pippin: 23% and 7% for Karmijn de Sonnaville and 10% and 6% for Golden Delicious, respectively. Due to reduced flowering intensity, overhead sprinkling (30 mm per time) combined with spring-frost control by sprinkling resulted in a slight reduction in yield compared with sprinkling without frost control.

Table 54. Treatments and some experimental results in the new experiment on fertigation at Numansdorp. Data averaged over 4 varieties of apple on M.9. Number of trees per ha 2400.

Treat- ment no.	Trick- ling	Fertigation fertilizer	Fertigation period	Con- sump- tion (kg N/ha)	% growing shoots 24/7	Leaf weight (g) ***	Leaf size ****	Shoot length (m/ tree)
1	-	-	-	0	8	0.33	5.3	2.8
2	+	-	-	0	11	0.31	5.0	3.7
3	+	19-6-6	11/5-4/9	55	61	0.37	6.8	6.4
4	+	19-6-6	11/5-13/7	30	51	0.37	6.7	5.9
5	+	19-6-6	7/8-4/9	20	14	0.32	5.2	3.8
6	+	19-6-6**	11/5-4/9	55	46	0.37	6.2	5.3
7	++*	19-6-6	11/5-4/9	55	75	0.40	7.3	6.5
8	+	Ca-nitrate	11/5-4/9	55	37	0.33	6.4	5.2
9	+	K-nitrate	11/5-4/9	55	39	0.35	6.2	4.5

* With 2 2 l/hr tricklers on each side of the tree.
** Once every 8-10 days in high concentrations.
*** Spur leaf, fresh weight per leaf.
**** Vigour markings 31/7.

FERTILIZER RECOMMENDATIONS BASED ON LEAF ANALYSIS

P. Delver

Only little progress was made on this project aiming at interpreting leaf-analytical data for apple and pear in terms of fertilizer demand. A number of samples was analysed in order to better evaluate the influence of bearing level and time of sampling on the nutrient content of basal leaves of current year shoots.

PREDICTING THE STORABILITY BY MEANS OF FRUIT ANALYSIS

J. Oele

Improvements in predicting the storability by means of fruit analysis

The size of the sampling error

In the course of 1984 analysis results became available from an investigation of the effects of three different sub-sampling methods on the results of fruit analysis. The already known differences between the method used at Oosterbeek and the method used in England (and in Wilhelminadorp) were defined more clearly. For the prediction of storability only the differences in the elements calcium and phosphorus were important.

Fruit analysis results from the climate chamber pot experiment conducted by the physiology department were used to find an explanation for the large differences in calcium content between individual fruits of equal fruit weight. No correlation was found between calcium content and position on the tree, number of leaves around the fruit or the length of shoot belonging to the fruit.

Changes in mineral concentrations during the growing season

In 1984, for further determination of these changes, fruit samples which had been gathered in 1983 for this purpose, were analysed. It involved samples from 4 test plots of Cox's Orange Pippin, 5 of Schone van Boskoop and 1 plot of each of the cultivars Gloster, Jonagold, Karmijn de Sonnaville and James Grieve. In the case of Cox's Orange Pippin and Schone van Boskoop the changes in mineral concentrations were not significantly different from results obtained in previous years.

In 1984 the periodic fruit sampling for this investigation was repeated on the same test plots that were used in 1983. Fruit weight and dry matter content for 1984 were lower than normal during the whole season. The very high calcium content found early in the summer decreased in the first half of August more than in previous years. However, probably as a result of the continuing lag in fruit weight, calcium concentration has been fairly high up to the end of the season. As potassium content in 1984 was not very different from that of other years, the K/Ca ratio in 1984 was significantly lower than normal.

As a result of the above average decrease in calcium concentration found in August 1984 we can expect the estimations of calcium concentration at picking time, for use in assessing storability, have given too high a value, especially when fruit sampling was early.

The effect of spraying with calcium on the calcium concentration in apples

Investigations in 1983 on 15 plots containing Schone van Boskoop and Karmijn de Sonnaville showed no correlation between calcium concentration, time, number or kind of calcium sprayings. In some cases however when calcium was sprayed just before sampling, a relatively high calcium concentration was found. In a trial at the experimental garden at Horst, among other things the effect of Calcium spraying on bitter pit is being studied. Calcium concentrations of fruits sprayed 11x with $CaCl_2$ was 0.7 mg Ca. 100 g^{-1} higher than the calcium concentration of unsprayed plants.

Investigations into the mineral concentrations in varieties other than Cox's Orange Pippin and Schone van Boskoop

For this purpose fruit samples were analysed from the storage trials with new varieties listed below:

Jonagold (n = 10)
Jonagold (n = 32)
Karmijn de Sonnaville (n = 4)
Karmijn de Sonnaville (n = 16)
Elstar (n = 6)
Gloster (n = 3)

In all these trials the correlation between mineral concentrations and the various storage disorders was established.

Early fruit analysis

For the second year in succession, in the second week of July, fruit samples were picked for analysis of mineral composition. The cultivars Cox's Orange Pippin and Schone van Boskoop were used on 24 plots. The analysis of both years is given in Table 55. Table 55 indicates that with both cultivars fruit weight in the second week of July was significantly lower than at the same time in 1983.

Table 55. Mean fruit weight, % dry matter and mineral concentrations in the 2nd week of July (n = 12)*.

	Mean fruit weight (g)	% dry matter	$mg \cdot 100\ g^{-1}$					
			N	P	K	Mg	Ca	K/Ca
Cox's 1983	26.2 b	12.9 a	127 a	15.2 a	164 a	10.6 a	12.7 a	13.4 b
Cox's 1984	20.8 a	13.0 a	132 a	17.0 b	177 b	11.2 a	17.3 b	10.4 a
Boskoop 1983	50.6 b	12.6 a	113	15.6 a	158 a	9.5 a	12.3 a	12.6 b
Boskoop 1984	33.8 a	13.1 b	118	15.6 a	160 a	9.5 a	17.6 b	9.2 a

* Concentrations are, when necessary, corrected due to the influence of different fruit weights.
Figures within the same column followed by the same letter do not differ significantly ($P = 0.05$).

In particular the calcium concentrations, but also the potassium and phosphorus concentration in Cox's Orange Pippin and dry matter concentration in Schone van Boskoop were higher in 1984 than in 1983. An explanation for these differences can probably be given by the totally different weather conditions in the period between blossoming and fruit sampling; in 1983 the weather during this period ws warm and dry whereas 1984 was cold and dull.

INVESTIGATIONS INTO FACTORS UNDERLYING THE RELATIONSHIP BETWEEN THE VEGETATIVE AND GENERATIVE DEVELOPMENT OF FRUIT TREES

J. Tromp

Growth regulators

In 1982, one-year-old trees of Cox's Orange Pippin were sprayed either "early" (a few weeks after full bloom) or "late" (shortly after growth had ceased) with GA3 and GA4+7 (500 ppm), alone or in combination with PP333 (1000 ppm). To assess a possible after-effect of the various treatments, all trees remained untreated in 1983. In the spring of this year flowers were counted and shoot growth (from 1983) was estimated. With respect to flower-bud formation there was no after-effect: the percentage of flower clusters (arising from the total number of vegetative and flower buds) was almost the same in the various groups. However, shoot growth was stimulated in all treatments where PP333 was sprayed early in 1982; the late application had no effect or even reduced growth somewhat. In the actual experimental year (1982) the various sprayings did not affect shoot growth.

In 2 new pot experiments with Cox's Orange Pippin, one with one-year-old and the other one with two-year-old trees, the growth inhibitors Alar and PP333 (1800 and 1000 ppm respectively) were sprayed alone or combined with GA4 and GA7 (500 ppm). The experiment with one-year-old trees also included the factor "position" (horizontal versus vertical). In both experiments the attention was again focused on shoot growth and flowering.

Using three-year-old Cox's Orange Pippin trees under controlled conditions an experiment is done to find out whether there is an interaction between the effects of temperature and the growth regulators GA4+7 and Alar on shoot growth and flower-bud formation. Four temperature treatments were applied, i.e. A. day/night temperature $24^{o}/19^{o}C$ throughout, B. $17^{o}/12^{o}C$ throughout, C. $24^{o}/19^{o}C$ until 6 weeks after flowering, thereafter $17^{o}/12^{o}C$ and, reversely. D. at first $17^{o}/12^{o}C$, thereafter $24^{o}/19^{o}C$. GA4+7 (500 ppm) and Alar (1800 ppm) were applied at flowering. All trees were deblossomed.

PRE-HARVEST PHYSIOLOGY OF FRUITS IN RELATION TO FRUIT QUALITY

Effect of temperature in the period preceding bloom on apple-tree behaviour

The experiment done in 1983 on the effect of temperature in the period preceding bloom on fruit set, fruit growth and mineral composition of the fruits (Annual Report 1983, p. 47) was repeated with three-year-old trees of the same cultivar (Cox's Orange Pippin). To recap, starting at the rest stage day/night temperature was gradually raised to $19^{o}/14^{o}C$, but the rate of increase varied greatly (4 treatments). During flowering and the rest of the season, the temperature was $19^{o}/14^{o}C$ throughout. Pollination was done by hand. The results fit in with those of the preceding experiment. When the temperature was raised rapidly to $19^{o}C$, fruit set (calculated with regard to the number of flowers, and recorded 54 days after full bloom) was about 17% as against only 7% when the temperature increase was extended over a much longer period. There were no marked differences in mean fruit weight and in the number of seeds per fruit.

In both experiments during the flowering period all open flowers were counted each day. The applied temperature regime affected the "rate of flowering", although the results of the 2 experiments did not agree completely. It is striking that the flowering period was prolonged somewhat when an initial rapid bud development was interrupted by keeping the trees at a reduced temperature for 2 weeks.

With respect to the effect of the various pre-bloom temperature regimes on the mineral composition of the fruits the data of the 1983-experiment did not show any differences for the levels of K, Mg and N (expressed as mg/fruit). However, the Ca level might have been reduced slightly in the treatment where bud development was slow in the period preceding bloom.

Flowering observations of the 1983-experiment showed that flower-bud formation was not affected by the rate of bud development in early spring.

Water relations in the tree

Alder and poplar are used frequently as windbreaks round Dutch orchards of apple and pear. As a consequence, broadly speaking, the 4 species are exposed to the same environmental conditions. It may be questioned how far these species differ with respect to their response to drought conditions. For that reason estimations on water potential, osmotic potential and conductance were done on leaves of the apple Golden Delicious, the pear Général Leclerc, the poplar Vereecken and the black alder. A few data are given.

- Water potential of alder and poplar (-14 to -16 bar) were higher than that of apple (-18 to -20 bar) and pear (-18 to -24 bar) throughout the season.
- The relationship between hydrostatic potential and drought level (cut-of leaves used) showed that in the same range of water loss the hydrostatic potential in apple and pear decreased less rapidly than in alder and poplar.
- The relationship between leaf conductance and water potential (cut-off leaves used) made clear that pear leaves closed their stomata at a markedly lower potential than alder and poplar; apple occupied the position in-between. However, in view of the potentials that usually are found under field conditions, in the orchard, stomata will rarely close due to low water potentials.

Similar estimations were done on leaves of the early apple cultivar Discovery and the much later cultivar Schone van Boskoop. The aim is to find out whether the genetic differences between the 2 cultivars are reflected in differences in water relations and as a consequence in carbon assimilation.

ENDOGENOUS GROWTH REGULATORS AND TREE BEHAVIOUR

Abscisic acid in fruit bourses of apple

The last few years, rather frequently throughout the year fruit bourses were sampled from always the same Cox's Orange Pippin orchard. Abscisic acid (ABA) analyses showed that roughly speaking the ABA level in bourses was highest in spring. The lowest values were found in the period July-August. Thereafter the level tended to increase. Furthermore, in general the ABA level in bourses without fruits exceeded that in bourses bearing fruits.

So far ABA was estimated gas-chromatografically. Most likely in future work the EIA (Enzyme-Immuno-Assay) method will be used.

TESTING OF CROP PROTECTION CHEMICALS IN FRUIT GROWING

H.A.Th. van der Scheer

Apple

Within the framework of the working group "Improvement of spraying techniques in fruit growing", research into the effect of spraying with a type of nozzle that dispenses 100 l liquid spray - containing only 50% or 75% of the usual amount of the spray chemical - per ha is being continued. This type of nozzle was compared with that of standard nozzles, which dispense 150 l liquid spray, containing the usual amount of the spray chemical per ha or only 50% of that amount. In all plots the control of scab was adequate, but in plots sprayed with 100 l liquid spray containing 50% of the usual amount of the spray chemical, the adequacy came to the lower limit. In these plots some scab appeared on the leaves, but not on the fruits. The latter occurred in unsprayed plots. On the other hand, in the plots sprayed with 100 l liquid spray containing 50% of the usual amount of the spray chemical, control of the sumemr fruit tortrix moth and the fruit-tree red-spider mite was significantly less good than in the other sprayed plots. But, a good control was achieved when this amount of spray chemical was applied in 150 l spray liquid per ha. Thus, spraying by means of the tested nozzles, it is possible to economize the amount of spray chemical and water.

Because of a case in practice, a trial was carried out in cooperation with the soil fertility section on Cox's Orange Pippin to test the phytotoxic effects of spraying with a spray liquid containing nitrate of potash or sulphate of ammonia. Each tree was sprayed once at the end of May, the middle of June, or the middle of July. It appeared that only a high volume (1500 l per ha) spray with a liquid containing 10 or 20 g per l sulphate of ammonia damaged the newly unrolled leaves. Lower dosages caused no damage. Also, this holds for spraying with a liquid containing nitrate of potash, 31.6 g per l being the highest dosage tested, and a low volume (150 l per ha) spray with a liquid containing 5 g per l sulphate of ammonia or 8 g per l nitrate of potash. None of the treatments effected the fruit finish, the yield, or the average fruit weight. In this trial no crop protection chemical was added to the spray liquid.

Pear

In 1982 it appeared that a number of sprays with 2 kg Insegar in 1500 l water per ha for the control of pear psyllids damaged the leaves and fruit of Beurré Hardy. This year two sprays with only 0.6 kg in 1500 l water per ha, applied with an interval of 10 days in May for the control of the summer fruit tortrix moth were also damaging to this cultivar. The leaves were mis-shapen, and dull-coloured with brown and black patches; the fruits were less shiny.

Strawberry

For a couple of years a significant amount of fruit rot caused by the fungus Gnomonia comari has occurred in a number of strawberry plantations. It concerns mainly fields with a more-year culture of strawberry plants, because the pathogen overwinters on the leaves and produces in the following spring a lot of spores which will spread during (artificial) rainfall. In the field no control of the disease was achieved by application of several fungicides like Benlate and Rovral, which in low dosages prohibited the growth of the pathogen on a culture medium. Besides, the amount of fruit rot in the untreated plots was rather low, despite the presence of quite a lot of leaves which were attacked in the preceeding year.

In cooperation with Mr. J. de Bruijn (Experimental Garden, Breda) different dosages of 4 fungicides, applied to nutrient liquid in small buckets in which 5 artificially infested strawberry plants were grown, were tested for the control of crown rot caused by Phytophthora cactorum. In the 5 trials which were run 3 out of the 4 tested fungicides gave adequate control, namely AAterra, Aliette, and Ridomil 5G. In a next series of trials, the effect on red stele, caused by Phytophthora fragariae, will be tested.

SUPERVISED CONTROL OF SCAB AND POWDERY MILDEW ON APPLE

H.A.Th. van der Scheer

The research on the effect of powdery mildew, caused by Podosphaera leucotricha, on fruit production and average fruit weight was continued. During the past year the amount of mildew on the trees in the trial field increased. In 1984 the incidence (expressed as a mean percentage of diseased leaves on long shoots) on individual trees varied from 4-68% on Cox's Orange Pippin, from 1-73% on Golden Delicious and from 3-74% on Karmijn de Sonnaville. In 1984 the production was negatively affected for the first time. The fruits will still be judged for size and russeting.

As in preceding years a linear correlation was found between secondary mildew (S) - expressed as percentage diseased leaves on long shoots - and primary mildew in the next year (P) - expressed as number of emerging, diseased buds per tree. This correlation is shown in Table 56. Primary mildew on Golden Delicious was again negligible in 1984.

Table 56. Correlation between secondary mildew (S) in 1983 and primary mildew (P) in 1984.

Cultivar	Regression	Correl. coeff.
Cox's Orange Pippin	$P = 0.958S - 1.262$	0.70
Karmijn de Sonnaville	$P = 1.191S - 8.810$	0.91

The level of resistance of cultivars in a mixed plantation is an important factor concerning the possibility of reducing the number of sprays for the control of scab and powdery mildew. Therefore in the spring of 1983 trees of 30 different cultivars were planted in blocks and for the first time in 1984 sprays for the control of scab and/or mildew were omitted in some of these blocks. From the literature it was known that some of the cultivars were considered to be resistant to one or both diseases. All cultivars current in

The Netherlands are included in the trial too. In 1984 both diseases spread over the trial field. Excluding Prima, all the scab resistant cultivars remained free from scab. Also the trees of the cultivars Discovery and Lombarts Calville did not show scab. No cultivar remained free from powdery mildew.

The possibility of diminishing the number of sprays for the control of scab and mildew on apple is being tested on a plot of 0.5-1 ha on each of 4 holdings. On 3 of these holdings both diseases were hardly present. Therefore spraying for the control of the two diseases was omitted after mid July, but later on sprays were applied for the control of fruit rot. No scab on the fruits was seen and leaf attack by scab or mildew still hardly present at picking time. But, on the fourth holding 4 per cent of the shoots on Golden Delicious trees had scabbed leaves in the beginning of July. Therefore spraying for the control of scab was continued at fortnightly intervals. At picking time the disease incidence on the leaves had hardly increased and only 1 fruit out of 500 Odin apples was scabbed. This cultivar had the same disease incidence on the leaves as Golden Delicious at picking time.

BIOLOGY AND CONTROL OF NECTRIA GALLIGENA IN ORCHARDS

H.A.Th. van der Scheer

Research on the effect of sprays with Topsin M in autumn and winter in combination with the painting of the cankers with copper naphtenate on canker incidence, fruit production and occurrence of fruit rot caused by *Nectria galligena* was continued. The results in 1984 resemble those of last year.

Pruning cuts are entrances for spores of pathogenic fungi. To prevent infection, pruning shears with spraying devices have been develloped. In March 1984 4 types of such pruning shears were tested on shoots of a stoolbed of apple rootstock M.2. The spray liquid contained 0.2% Topsin M vloeibaar. Cankered prunings, hanging above the stoolbed, served as inoculum source. Additionally all pruning cuts were smeared with a spore suspension of *Nectria galligena* 1 day after the cutting. In December the pruned shoots were judged for the presence of spores of the pathogen. The latter was present on circa 40% of the unsprayed shoots. Cutting with the adapted "Felco" pruning shears (pneumatic as well as non pneumatic) reduced the attack by about 65%. A pair of pruning shears with an experimental spraying device even attained a 90% reduction, but a fourth one was not satisfactory.

BIOLOGY AND CONTROL OF SECONDARY (OR OCCASIONALLY APPEARING) DISEASES ON FRUIT CROPS

H.A.Th. van der Scheer

Apple

In the autumn of 1983 a trial was ended in which the effect of crown gall on growth and production of Golden Delicious on rootstock M.9 v.v. was investigated as well as the effect of removal of the galls before planting in the spring of 1977. At the start the trees were selected for equal weight and number of branches per replicate of the treatments, but afterwards it appeared that galled trees on average had a somewhat smaller stem diameter. This arreage was not made up for during the experiments. The removal of the galls and/or roots resulted in a less good shoot growth in the first year, but the effect did not extend to later years. The growth of galled trees was less good than that of healthy ones in each of the years. Presumably, this is connected with the differences in stem diameter which existed at the start of the trial. The removal of the galls resulted in a less good growth of the trees in the first year, but thereafter the growth of these trees became better than that of galled trees. Healthy trees made the biggest progress and had the highest production. Thus it is important that maiden trees are free from crown galls. If they do have galls, than the removal does not effect the fruit production despite the better growth of the trees from which the galls were removed. In this trial no effect of the treatments on the average fruit weight was seen.

Strawberry

In March 1984 some 15 plants of each of a number of strawberry cultivars and selections were delivered by the small fruit breeding section of the Institute for Horticultural Plant Breeding in order to test their susceptibility to Alternaria alternata leaf spot. The opportunity was also taken to test their susceptibility to among others Gnomonia comari leaf blotch. The result of the tests is shown in Table 57. The plants of some of the cultivars remained free from A. alternata, but none of the cultivars had plants which all remained free from G. comari.

Table 57. Susceptibility (0-3) of strawberry cultivars and selections to 2 pathogens.

Cultivar/Selection	Alternaria alternata	Gnomonia comari
Bogota	0	2
Confitura	0	1
Elsanta	0	1
Elvira	0	1
Gariguette	0	2
Gorella	0	2
Induka	0	2
IVT 74112	0	2
IVT 75247	2	2
Karina	0	1
Karola	0	2
Korona	0	3
Ostara	0	2
Rabunda	2	1
Rapella	0	1
Red Gauntlet	1	3
Senga Sengana	0	1
Sivetta	3	2
Tago	2	2
Tamella	2	2
Tenira	1	1
Tioga	0	1
Valeta	2	1

0 = not susceptible; 1 = slightly susceptible; 2 = moderately susceptible; 3 = very susceptible.

The susceptibility to A. alternata was tested by inoculating the potted plants with a spore suspension and keeping them during the incubation period in a misty environment to be sure that the infection would take place. A more handy method appeared to be the inoculation of leaf disks (Ø 18 mm) and keeping these in moist petri dishes. Two days after the inoculation of susceptible leaf disks small black speckles appeared. After another one or two days the colour of the inoculated disks turned from green into brown-black.

BIOLOGY AND CONTROL OF SECONDARY (OR OCCASIONALLY APPEARING) PESTS ON FRUIT CROPS

H.A.Th. van der Scheer

In 1984 all the effort was directed to the biology and control of pear psyllids, which are in fact no longer a secondary pest of pear trees in The Netherlands. In cooperation with the Research Institute for Plant Protection and the Experimental Orchard De Schuilenburg the population development of pear psyllids and their predators was observed in some orchards. Both Psylla pyri and P. pyricola were (in some orchard numerously) present. But predacious bugs were come across in only low numbers in April and then again in August/September. In between the (many) sprays with endosulfan and azinfos-methyl (the latter for the control of summer fruit tortrix moth) will certainly have contributed to the absence of these predators. Due to this absence the negative effect of synthetic pyrethroids on predacious bugs, described in the literature, could not be demonstrated.

In September the effect of a spray with 0.15% Luxan Captan 83% spuitpoeder and with 0.1% Topsin M sp.pdr. on adults of the predacious bug Anthocoris nemoralis was tested. For that shoots on trees of the cultivar Doyenné du Comice, infested with eggs and larvae of pear psyllids, were sprayed until driven off with one of the fungicides and then enveloped with gauze cages in each of which 6 bugs were placed. No harmful effect was seen 6 days later.

The effect of insecticides on pear psyllids was tested in the same way: using shoots on trees of the same cultivar and gauze cages. A spray with 0.2% Asepta Tetranyx, 0.15% Luxan Endosulfan 50% spuitpoeder, or 0.075% Ultracid was more adequate than in a spray with 0.1% Luxan Carbaryl 50% spuitpoeder for the control of adult pear psyllids. No control was achieved by a spray with 0.1% Dipterex spuitpoeder or 0.15% Luxan Azinfos spuitpoeder. A spray with 0.1% Dimilin spuitpoeder 25% was only effective on eggs deposited before the application. Eggs deposited after the spray application developed well and L5-larvae were found in the end. Two new insecticides, tested under code, were both very effective for the control of larvae, and one of them for the control of adults too.

After picking time the population of pear psylla can increase very rapidly because of migration. It was tested to see if a spray with 2700 g Tiodan spuitpoeder Conc. plus 4.5 l Asepta Tetranyx in 1800 l water per ha is effective at that time. The spray was applied on 29th November and the population sampled before and after that date. From the result (Table 58) is concluded that the spray was barely effective.

Table 58. Effect on a pear psylla population of a spray with endosulfan plus amitraz applied on 29th November 1984.

Date of observation	Number of larvae per m shoot		% shoots taken by larvae	Number of *P. pyri* in a beating sample		
	alive	dead		♀	♂	larva
28-11-1984	17.9	0	80	395	420	62
3-12-1984	7.3	2.7	70	135	114	40

L I S T O F C H E M I C A L S, mentioned in this report

Trade name	Common name of chemical
FUNGICIDES AND BACTERICIDES	
Benlate	50% benomyl
Luxan Captan 83% spuitpoeder	83% captan
Rovral	50% iprodion
Topsin M sp.pdr.	70% thiofanate-methyl
Topsin M vloeibaar	500 g/l thiofanate-methyl
INSECTICIDES AND ACARICIDES	
Apollo	50% bisclofenterine
Asepta Tetranyx	190 g/l amitraz
Dimilin spuitpoeder	25% diflubenzuron
Dipterex spuitpoeder	80% trichloorfon
Insegar	25% phenoxycarb
Luxan Azinfos spuitpoeder	25% azinfos-methyl
Luxan Carbaryl 50% spuitpoeder	50% carbaryl
Luxan Endosulfan 50% spuitpoeder	50% endosulfan
MK-936	18 g/l avermectin B1
Plictran 25 W	25% cyhexatin
Thiodan spuitpoeder Conc.	50% endosulfan
Ultracid	40% methidathion
GROWTH REGULATORS AND CHEMICAL THINNERS	
AA 4111	1.8% gibberellin A4+A7, 1.8% N-(phenylmethyl)-1H-purine-6-amine
AArupsin	50% carbaryl
Alar-64	64% daminozide
Amid Thin	8.4% α-naphthylacetamid
Berelex A4/A7 (GA4+7)	0.89% gibberellin A4+A7 and 0.06% gibberellin A13
BA-middel	1.3% benzylademine
Cycocel Extra (CCC)	40% chloromequat

EL 500	50% α-isopropyl- -(4-trifluoromethoxyphenyl)-5-pyrimidine methanol
M&B 25,105	690 g/l n-propyl-3-t-butylphenoxyacetate
MC koperchelaat (CU-EDTA)	9% copperchelate
Koperoxychloride	60% copperoxychloride
PP333	250 g/l paclobutrazol

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