

EVALUATION OF *PYRUS* AND QUINCE ROOTSTOCKS FOR HIGH DENSITY PEAR ORCHARDS

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High density planting systems are a prerequisite to economise the use of land and labour costs of orchards. Dwarfing rootstocks controlling the vigour of the scion cultivars form the basis for such orchards.

In the Netherlands there are no breeding programs for fruit tree rootstocks. Rootstock research is limited to and focussed on testing rootstocks selected in other countries. For the Dutch pear growers the main selection criteria for new rootstocks are: 1) control of tree size; 2) production; 3) fruit size; 4) fruit quality; 5) production efficiency; 6) frost resistance. Additional criteria for Dutch fruit tree nurseries exporting trees to other countries are: 1) compatibility with scion cultivars; 2) suitability for growth in calcareous soils; 3) easy propagation. In all trials rootstock performance is compared to quince MC, the most commonly used rootstocks for pears in the Netherlands.

Recently, a number of pear (*Pyrus communis*) and quince (*Cydonia oblonga*) rootstocks have been tested with ‘Conference’ and ‘Doyenné du Comice’ as the scion cultivars.

Generally, the production efficiency of the *Pyrus* rootstocks was much less than for quince MC. Another disadvantage of the evaluated *Pyrus* rootstocks was their high sensitivity towards pear decline. Several rootstocks were rejected after examination of the graft union because of suspected compatibility problems. Of the tested quince rootstocks C 132 shows promise because of its control of tree growth in combination with good fruit size and Eline® because of its reduction of fruit russeting in ‘Conference’.

Key words: *Cydonia oblonga*, graft compatibility, high density orchard, *Pyrus communis*.

Introduction. High density planting systems are the starting point of modern orchards. Small trees that come into production in the second year after planting are a prerequisite to achieve regular yields of high quality fruits and to economise the use of land and labour costs for pruning and picking. Dwarfing rootstocks controlling the vigour of the scion cultivars and inducing precociousness form the basis for such high density orchards (Wertheim and Webster, 2005).

European pears are predominantly grown on rootstocks of Quince (*Cydonia oblonga*). In the Netherlands the majority of pears are grown on quince MC, but

quince MA and quince Adams are also used. 'Conference' is the most important cultivar. Grown in high density planting systems yearly yields of 60 to 70 tons/ha are feasible.

To obtain this production level a good control of shoot growth, flower bud development, and fruit set is required. Although quince MC has been used successfully for many decades in the Netherlands, there are several reasons to look for alternative rootstocks.

Until 2001, the growth retardant chlormequat (CCC) was amply used to reduce shoot growth and stimulate flower bud development. The loss of CCC has renewed the interest in rootstocks more dwarfing than quince MC. Besides dwarfing of the scion cultivar other desired traits of new rootstocks for pears are: 1) precociousness, to ensure early productions starting in the second year after planting; 2) fruit size, for 'Conference' pears the proportion of pears with a diameter >65 mm should be as large as possible; 3) disease resistance, especially towards fire blight and pear decline; 4) compatible with scion cultivars; 5) frost resistance; 6) easy propagation; 7) suitability for growth on calcareous soils (absence of lime-induced chlorosis). In addition, new rootstocks may also be used to meet the changes in market demands for 'Conference' pears like larger and less russeted fruits.

Since there is no breeding program for pear rootstocks in the Netherlands, the research on pear rootstocks is limited to testing rootstocks selected in other countries. The main selection criteria for the Dutch pear industry are: 1) tree size; 2) production; 3) production efficiency; 4) fruit size distribution. Additional criteria for nurseries exporting fruit trees to other countries are: 1) compatibility with as many modern scion cultivars as possible; 2) suitability for growth in different soils; 3) easy propagation.

During the past decades a large number of rootstocks were collected by Wertheim (1998). The results of evaluation trials with several of these rootstocks have already been published (Wertheim, 2002; Wertheim, Vercammen, 2000). This paper contains the results of three more recent trials with the cultivars 'Conference' and 'Doyenné du Comice' grafted on a number of other Quince and *Pyrus* rootstocks.

Materials and methods. Plant material. All trials were planted in the experimental orchard of the fruit research station at Randwijk (5.707° East, 51.937° North) in fresh soil consisting of river clay with 30% silt. Trees were planted at a distance of 3.5 x 1.5 m and were trained as spindle trees according to local commercial practice. Growth of the trees was not regulated by chemical growth regulators, root pruning or girdling of the trunks. No gibberellins were applied to stimulate fruit set. Contrary to common practice the rootstocks were not protected by a layer of compost during the winter in order to evaluate the frost resistance of the different rootstocks.

During a period of at least 5 years the growth and production of the trees was monitored by:

- Annual or biannual measurement of the girth of the trunk at 30 cm above the graft union
- Annual shoot growth on a scale from 1 (no shoot growth) to 9 (very vigorous growth)

- Annual flower intensity on a scale from 1 (no flowers) to 9 (very rich flowering)
- Annual fruit production (number of fruits and kg fruits per tree)
- Analysis of mineral content of leaves and fruits (once for each trial 3 to 5 years after planting)
- Fruit size distribution (at least once for each trial 4 to 5 years after planting)
- Calculation of production efficiency (number of fruits/cm² trunk cross sectional area)

Trial 1. (code 044 - Ra99107). Trees were planted on April 8th, 1998. The statistical design of the trial was a split plot with the scion cultivar being the whole plot and the rootstocks the sub plots. Plots were replicated 8 times and contained one tree of each treatment. In this trial the growth of ‘Conference’ and ‘Doyenné du Comice’ budded at 10 or 25 cm height was compared for the quince rootstocks MC, C132, and the *Pyrus* rootstock BP10030 (Trajkovski, Andersson, 1990). Rootstocks were obtained from Naktuinbouw (Netherlands Inspection Service for Horticulture) (MC), HRI East Malling, UK (C132), Eliteplantstation Balsgård, Sweden (BP10030) and Fleuren Nurseries, Netherlands (Eline[®]). MC, C132 and BP10030 were virus free. The virus-status of Eline[®] was unknown.

Trial 2 (code 044 - Ra00105). Trees were planted on March 30th, 2000. The statistical design of the trial was a split plot with the scion cultivar being the whole plot and the rootstocks the sub plots. Plots were replicated 10 times and contained one tree of each treatment. The growth of ‘Conference’ and ‘Doyenné du Comice’ grafted on quince MC was compared with trees grafted on quince Sobu and the *Pyrus* species Delbuena, Dolacom, Gieser Wildeman and Pyrodwarf. Plant material of Delbuena, Dolacom and Gieser Wildeman was considered to be virus-free as they were grown from seed. MC and Sobu were obtained as virus-free material. The virus status of Pyrodwarf was unknown.

Trial 3 (code 044 - Ra01101). Trees were planted on March 13th, 2001. The statistical design of the trial was a split plot with the scion cultivar being the whole plot and the rootstocks the sub plots. Each plot was replicated 6 times and consisted of 3 trees per treatment. In this trial the growth of ‘Conference’ and ‘Doyenné du Comice’ grafted on Quince MC was compared with trees grafted on the Quinces Adams, S 3, MC Peters, MH (=QR 193-16), ME and the *pyrus* Gieser Wildeman. The virus status of S 3 and MH was unknown, all other rootstocks were assumed to be virus-free as they were obtained from virus-free stock plants or grown from seed (Gieser Wildeman).

Statistical analysis. The data were analysed using the Genstat statistical program (release 8.1). In trial 1, the results of the trials with ‘Conference’ and ‘Doyenné du Comice’ were analysed separately because of the difference in the duration of the trials. If possible, the data of all other trials were analysed using the analysis of variance for a split plot. In case of significant differences ($p < 0.05$), LSD values were calculated and used for comparing treatment means in pairs.

Results. **Trial 1** (044 - Ra99107). As no significant effect of budding height was observed on growth and production the data of both budding heights were taken together. *Pyrus* BP10030 gave the lowest shoot growth index and the smallest increase in trunk circumference (Table 1). With ‘Conference’ the

growth was very weak. Quinces C.132 and Eline® gave comparable to slightly more growth in both ‘Conference’ and ‘Doyenné du Comice’.

Table 1. Average growth parameters of ‘Conference’ and ‘Doyenné du Comice’

1 lentelė. ‘Conference’ ir ‘Doyenné du Comice’ veislių augimo rodiklių vidurkiai

Rootstock Poskiepis	Growth index* Augimo indeksas		Increase of trunk circumference Kamieno apimties padidėjimas, cm	
	‘Conference’ 2001–2005	‘Doy. du Comice’ 2001–2004	‘Conference’ Spring 1999 – autumn 2005 1999 m. pavasaris– 2005 m. ruduo	‘Doy. du Comice’ Spring 1999 – autumn 2004 1999 m. pavasaris– 2004 m. ruduo
MC	4.7 b	5.9 b	12.6 b	14.7 b
BP10030	2.4 a	4.2 a	7.9 a	12.0 a
C.132	5.0 bc	6.2 b	13.6 b	15.9 bc
Eline®	5.4 c	6.0 b	13.7 b	16.4 c
F-test	p<0.001	p<0.001	p<0.001	p<0.001
LSD _{05/R₀₅}	0.6	0.6	1.6	1.8

*on scale 1 (no growth) to 9 (very strong growth) / skalėje nuo 1 (jokio augimo) iki 9 (labai intensyvus augimas)

The cumulative production of ‘Conference’ on BP10030 was only 45% of that on quince MC (Table 2). On quince C.132 ‘Conference’ produced slightly less and on quince Eline® slightly more than on quince MC, but these differences were not statistically significant. From 2000 to 2005 ‘Conference’ produced the largest number of fruits on quince MC and quince Eline®, about 20% less fruits on quince C.132 and approx. 50% less on BP10030. Despite the low number of fruits, the average fruit weight was lowest on BP10030. On the quince rootstocks the average fruit weight was the highest for the rootstock with the lowest number of fruits. Production efficiency (number of fruits per cm² TCSA) was highest on quince Eline®, but not statistically different from that on quince MC.

Cumulative production and total number of fruits of ‘Doyenné du Comice’ was similar for all 4 rootstocks, but with an average production of only 32 kg and 125 fruits per tree much lower than the 87 kg and 500 fruits per tree for ‘Conference’ on the tested quince rootstocks (Table 3). Average fruit weight of ‘Doyenné du Comice’ was highest on C.132 and least on Eline®. Production efficiency was highest for BP10030.

The fruits harvested in 2003, 2004 and 2005 were graded in size. Table 4 shows that C.132 gave the highest percentages of fruit with a diameter >65 mm. However due to the large variation between the observations of trees these differences were not statistically different in this trial.

Table 2. Cumulative production of ‘Conference’ in 2000–2005

2 lentelė. ‘Conference’ derėjimo rodikliai 2000–2005 m.

Rootstock Poskiepis	Yield, kg/tree Derlius, kg/vaism.	Amount of fruits, pcs/tree Vaisių kiekis, vnt./vaism.	Fruit weight Vaisių masė, g	Production efficiency, fruits/cm ² of TCSA* Produktyvumas, vaisiai/cm ² KSP
MC	87.0 b	503 c	193 b	19.0 bc
BP10030	39.7 a	266 a	176 a	17.4 ab
C.132	81.4 b	433 b	212 c	15.5 a
Eline®	92.3 b	563 c	186 ab	20.5 c
F-test	p<0.001	p<0.001	p<0.001	p<0.05
LSD ₀₅ /R ₀₅	12.2	68	12	3.0

*Total number of fruits per tree in 2000–2005 per cm² of trunk cross sectional area (TCSA) in autumn of 2005 / Bendras vaisių skaičius 2000–2005 m. vienam kamieno skerspjūvio ploto (KSP) cm² 2005 rudenį

Table 3. Cumulative production of ‘Doyenné du Comice’ in 2000–2005

3 lentelė. ‘Doyenné du Comice’ derėjimo rodikliai 2000–2005 m.

Rootstock Poskiepis	Yield, kg/tree Derlius, kg/vaism.	Amount of fruits, pcs/tree Vaisių kiekis, vnt./vaism.	Fruit weight Vaisių masė, g	Production efficiency, fruits/cm ² of TCSA* Produktyvumas, vaisiai/cm ² KSP
MC	34.2	133	287 ab	4.4 ab
BP10030	31.6	128	299 b	5.5 b
C.132	31.2	112	304 b	3.4 a
Eline®	31.6	129	268 a	4.3 a
F-test	ns	ns	p<0.05	p<0.01
LSD ₀₅ /R ₀₅			26	1.1

*Total number of fruits per tree in 2000–2005 per cm² of trunk cross sectional area (TCSA) in autumn of 2005 / Bendras vaisių skaičius 2000–2005 m. vienam kamieno skerspjūvio ploto (KSP) cm² 2005 rudenį

Leaf appearance of both ‘Conference’ and ‘Doyenné du Comice’ grafted onto BP10030 was not as healthy as on any of the other rootstocks. Many leaves were pale green to yellowish. Mineral analysis of the leaves during the summer of 2002 revealed lower contents of K, Mg and Ca in ‘Conference’ and Mg and Ca in ‘Doyenné du Comice’ (Table 5).

Flowering of ‘Conference’ was quite regular and good over the years 2000 to 2005. Average flower intensity over this period was between 5.5 and 6.2. Flowering of ‘Doyenné du Comice’ was less regular. Average flower intensity from 2000 to 2005 varied between 3.5 and 5.3, with the lowest observed in 2001 (1.0 to 3.4) and the highest in 2005 (7.3 tot 7.8). In both cultivars rootstock BP 10030 resulted in the highest flower intensities.

Table 4. Fruit size of ‘Conference’, % of total fruit yield

4 lentelė. ‘Conference’ vaisių dydis, % bendro vaisių kiekio

Rootstock Poskiepis	2003		2004		2005	
	>55 mm	>65 mm	>55 mm	>65 mm	>55 mm	>65 mm
MC	91 b	52 c	89	33	89	48
BP10030	50 a	6 a	-	-	-	-
C.132	94 b	54 c	92	40	94	62
Eline®	88 b	42 c	93	40	86	40
F-test	p<0.001	p<0.001	ns	ns	ns	ns
LSD ₀₅ /R ₀₅	16	17				

Table 5. Mineral analysis of leaves harvested on August 26th, 2002

5 lentelė. Mineralinių elementų kiekis lapuose, nuskintuose 2002 m. rugpjūčio 26 d.

Rootstock Poskiepis	N	P	K	Mg	Ca	Fe	Mn	Zn	B	Cu
	%					mg kg ⁻¹ of dry weight mg kg ⁻¹ sausojoje medžiagoje				
‘Conference’										
MC	2.12	0.19	1.21	0.24	1.76	75.8	75.0	58.2	22.2	6.5
C132	2.14	0.23	1.55	0.18	1.74	77.2	56.8	56.8	24.8	7.0
BP10030	2.10	0.18	0.99	0.14	1.22	68.0	85.5	68.2	24.5	6.0
Eline®	2.05	0.18	1.28	0.22	1.72	68.8	73.2	51.5	22.8	4.4
F-test	ns	ns	*	***	***	ns	*	ns	ns	ns
LSD ₀₅ /R ₀₅			0.4	0.03	0.18		19.0			
‘Doyenné du Comice’										
MC	1.83	0.17	1.36	0.30	1.81	64.0	80.2	69.0	22.5	5.8
C132	1.89	0.17	1.46	0.22	1.59	72.2	65.8	62.8	24.5	4.7
BP10030	1.77	0.17	1.32	0.14	1.14	62.2	72.8	57.5	25.0	4.9
Eline®	1.87	0.18	1.42	0.26	1.76	70.5	69.5	64.5	22.5	5.8
F-test	*	*	ns	***	***	*	~	ns	~	**
LSD ₀₅ /R ₀₅	0.08	0.01		0.04	0.20	9.1	10.4		2.2	0.6

~ towards significant difference / artima esminiam skirtumui

At the end of the trial the graft unions of ‘Conference’ and ‘Doyenné du Comice’ grafted on BP10030 were examined. The bark was removed and longitudinal sections were made of the graft unions. Figure 1 shows the longitudinal sections of the graft unions of both scion cultivars grafted onto BP10030. As can be seen in this figure, compatibility between BP10030 looks good and ‘Conference’ is very poor, while that between Sobu and ‘Doyenné du Comice’ seems to be much better. However, also in the latter combination a clear separation line between the wood of the scion

and the rootstock is visible indicating both tissues are also not fully compatible.

Trial 2 (044 - Ra00105). Table 6 shows that with ‘Conference’ rootstock Sobu gave the weakest growth. Differences in growth between all other combinations were quite small. With ‘Doyenné du Comice’ growth index and increase in trunk diameter were similar for all rootstocks used in the trial.

Table 6. Average growth parameters of ‘Conference’ and ‘Doyenné du Comice’

6 lentelė. ‘Conference’ ir ‘Doyenné du Comice’ augimo rodiklių vidurkiai

Rootstock Poskiepis	Growth index* in 2000–2004 Augimo indeksas 2000–2004 m.		Increase of trunk circumference in spring 2000–autumn 2005 Kamieno apimties padidėjimas 2000 m. pavasari–2005 m. rudenį, cm	
	‘Conference’	‘Doy. du Comice’	‘Conference’	‘Doy. du Comice’
MC	3.6 ab	5.0	8.6 b	11.6
Delbuena	4.3 bc	6.2	8.5 b	13.5
Dolacom	5.1 c	5.0	11.3 b	13.0
Gieser W.	5.6 c	6.1	11.9 bc	12.7
Pyrodwarf	5.7 c	5.5	12.8 c	14.3
Sobu	2.5 a	4.9	5.4 a	11.9
F-test	p<0.001	n.s.	p<0.001	n.s.
LSD ₀₅ /R ₀₅	1.1		2.8	

*on scale 1 (no growth) to 9 (very strong growth). n.s = not significant / skalėje nuo 1 (jokio augimo) iki 9 (labai intensyvus augimas); n.s. = nereikšminga

Table 7 summarises the production of ‘Conference’ and ‘Doyenné du Comice’ grown on four different *Pyrus* cultivars and quince Sobu as a rootstocks in comparison with the standard rootstock quince MC. Production was highest on quince MC and did not differ significantly between the 4 *Pyrus* rootstocks and quince Sobu. Despite the lower fruit numbers, average fruit weights on Dolacom and Gieser Wildeman were lower than on MC and Pyrodwarf.

With ‘Doyenné du Comice’ quince Sobu was second best with respect to production and production efficiency.

‘Conference’ trees on Sobu did not look as healthy as on the other rootstocks and growth of the cultivar was much weaker than that of ‘Doyenné du Comice’ on the same rootstocks, indicating some kind of incompatibility between ‘Conference’ and Sobu. At the end of the trial a longitudinal sections were made of the graft unions of both scion cultivars grafted onto Sobu. Figure 2 shows the longitudinal sections of the graft unions between Sobu and both cultivars. As can be clearly seen in this figure, part of the wood at the union is black, which indicates compatibility between Sobu and ‘Conference’ is very poor. The union between Sobu and ‘Doyenné du Comice’ looks much healthier. However, also in the latter combination a clear separation line between the wood of the scion and the rootstock is visible, indicating that also in this case both tissues are not fully compatible.

Table 7. Cumulative production of ‘Conference’ and ‘Doyenné du Comice’, 2001–2004

7 lentelė. ‘Conference’ ir ‘Doyenné du Comice’ derėjimas 2001–2004 m.

Rootstock Poskiepis	Yield, kg/tree Derlius, kg/vaism.	Amount of fruits, pcs/tree Vaisių kiekis, vnt./vaism.	Fruit weight Vaisių masė, g	Production efficiency, fruits/cm ² of TCSA [*] Produktyvumas, vaisiai/cm ² KSP
‘Conference’				
MC	28.9	172	190	10.2 e
Delbuena	16.4	114	160	6.4 d
Dolacomì	17.3	118	153	4.6 bc
Gieser W.	18.6	138	139	5.3 cd
Pyrodwarf	17.3	123	175	4.3 bc
Sobu	16.3	109	151	10.6 e
‘Doyenné du comice’				
MC	24.3	98	263	4.1 bc
Delbuena	11.5	44	270	1.4 a
Dolacomì	8.1	36	232	1.1 a
Gieser W.	9.5	33	259	1.2 a
Pyrodwarf	8.6	30	263	0.9 a
Sobu	17.0	69	243	3.2 b
Average of ‘Conference’ & ‘Doyenné du comice’ / ‘Conference’ ir ‘Doyenné du comice’ vidurkis				
MC	26.6 b	135 b	227 b	
Delbuena	13.8 a	80 a	212 ab	
Dolacomì	12.6 a	77 a	194 a	
Gieser W.	13.8 a	85 a	197 a	
Pyrodwarf	13.1 a	77 a	224 b	
Sobu	17.4 a	91 a	204 ab	
F-test	p<0.001	p<0.001	p<0.05	p<0.01
LSD _{05/R₀₅}	5.6	31	25	1.5

*Total number of fruits per tree in 2001-2004 per cm² of trunk cross sectional area (TCSA) in autumn of 2004 / Bendras vaisių skaičius 2001–2004 m. vienam kamieno skerspjūvio ploto (KSP) cm² 2004 rudenį

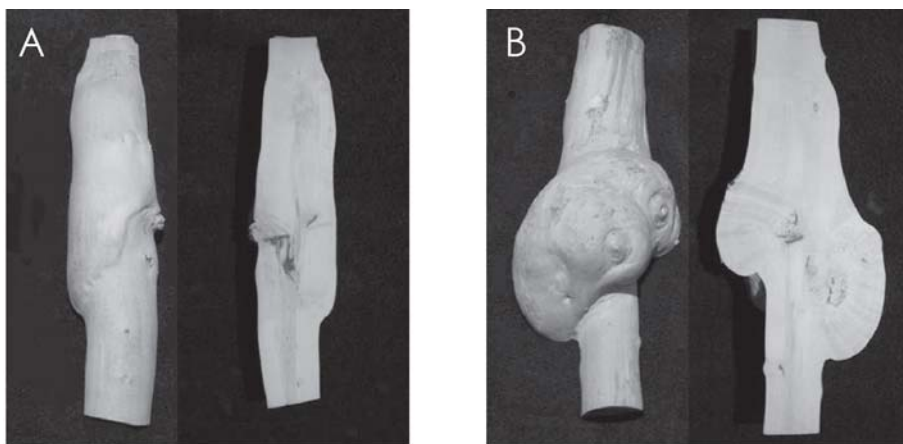


Fig. 1. Longitudinal sections of graft unions of 8-year old trees of 'Conference' (A) and 'Doyenné du Comice' (B) grafted on rootstock BP10030

1 p a v. Aštuonmečių 'Conference' (A) ir 'Doyenné du Comice' (B) veislių vaismedžių su BP10030 poskiepiu išilginis skiepijimo vietos pjūvis

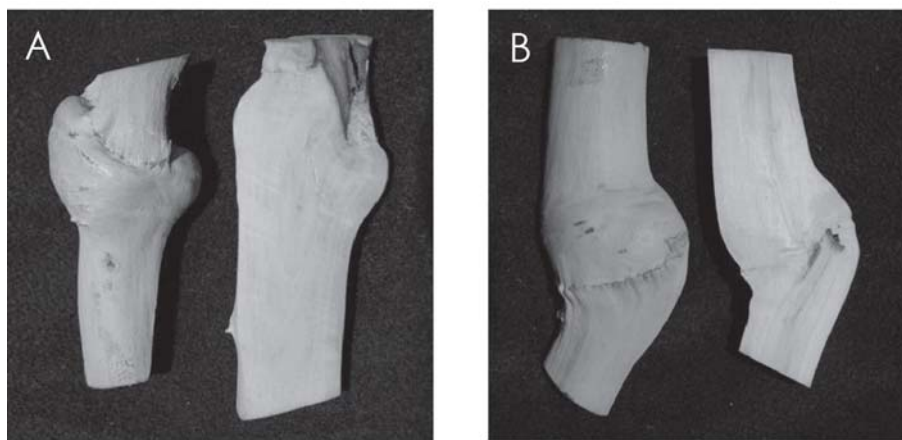


Fig. 2. Longitudinal sections of graft unions of 8-year old trees Conference (A) and Doyenné du Comice (B) grafted on rootstock Sobu

2 p a v. Aštuonmečių 'Conference' (A) ir 'Doyenné du Comice' (B) veislių vaismedžių su Sobu poskiepiu išilginis skiepijimo vietos pjūvis

Average flower intensities over the trial period were between 4.4 and 5.4 for 'Conference' and 3.4 and 4.9 for 'Doyenné du Comice'. In both cultivars the lowest flower intensities were noted for trees grown on Gieser Wildeman and the highest for trees grown on quince MC.

Trial 3 (044 - Ra01101). In Table 8 the growth and production of 'Conference' and 'Doyenné du Comice' on quince MC is presented together with that on 5 other quinces (Adams, MC Peters, MH (= QR 193-16), ME, and S 3) and on the pyrus Gieser Wildeman. Both scion cultivars showed similar patterns in growth.

Compared to growth on quince MC a significantly higher growth index and a larger increase in trunk circumference was noted on both Gieser Wildeman and S 3. On MC Peters the growth index and increase in trunk circumference equalled those on MC. On Adams growth index of ‘Conference’ equalled that on MC, while that of ‘Doyenné du Comice’ was slightly higher. No differences were observed in the increases in trunk circumferences of both scion cultivars on MC and Adams. With the exception of a smaller increase in trunk circumference of ‘Doyenné du Comice’, growth of both scion cultivars on MC Peters equalled that on MC. Significantly lower growth indexes were observed in both scion cultivars on quinces MH and ME. Increases in trunk circumferences were also smaller on these rootstocks, but these differences were only statistically significant in ‘Doyenné du Comice’.

Table 8. Average growth index and increase in trunk circumference

8 lentelė. Vidutinis augimo indeksas ir kamieno apimties padidėjimas

Rootstock Poskiepis	Growth index* in 2002–2005 Augimo indeksas 2002–2005 m.		Increase of trunk circumference in spring 2001–autumn 2005 Kamieno apimties padidėjimas 2001 m. pavasari–2005 m. rudenį, cm	
	‘Conference’	‘Doy. du Comice’	‘Conference’	‘Doy. du Comice’
MC	4.6 cde	4.3 bcd	8.2 ab	10.4 c
Adams	5.0 def	5.1 ef	9.0 b	10.9 c
S 3	6.0 g	5.9 g	12.1 d	14.0 e
Gieser W.	5.5 fg	6.8 h	10.3 c	14.8 e
MC Peters	4.4 bcd	4.3 bc	8.1 ab	9.0 b
MH	3.8 ab	3.4 a	7.7 a	7.9 ab
ME	3.2 a	2.9 a	7.5 a	7.8 ab
F-test	p<0.001	p<0.001	p<0.001	p<0.001
LSD ₀₅ /R ₀₅	0.6	0.6	1.2	1.2

*on scale 1 (no growth) to 9 (very strong growth) / skalėje nuo 1 (jokio augimo) iki 9 (labai intensyvus augimas)

The average growth on Gieser Wildeman presented in Table 7 was somewhat reduced by the occurrence of pear decline in some years in several observation trees. In any year trees on Gieser Wildeman without any visual symptoms of pear decline showed a much stronger growth than on MC.

Contrary to an earlier experiment at the former location of the research station in Wilhelminadorp (Wertheim, 2002), growth on S 3 was stronger than on MC. The most probable explanation for the weaker growth in Wilhelminadorp was the use of virus-infected S 3. The growth on virus-free S 3 in the experiment in Randwijk indicates that this rootstock is too vigorous for Dutch high density orchards.

Cumulative productions of ‘Conference’ and ‘Doyenné du Comice’ are shown in Table 9. ‘Conference’ produced the highest number of fruits on the MC, Adams and MC Peters. On S 3, Gieser Wildeman and MH trees produced about 100 fruits less. On ME trees produced only one third of the number of fruits as compared to trees on MC. ‘Conference’ trees produced similar kg fruits on MC, Adams and MC

Peters. On S 3 and MH trees produced about 15 kg less. Trees on Gieser Wildeman and ME produced about 26 and 34 kg less, respectively, than on MC. Average fruit weight was only significantly reduced for ‘Conference’ grown on Gieser Wildeman. Production efficiency was highest for ‘Conference’ on MC. Trees on Adams and MC Peters had slightly lower production efficiency, but the difference to MC was not statistically significant. Significant lower efficiencies compared to MC were noted for ‘Conference’ on MH (-17%), ME (-46%), and S 3 (-52%) and Gieser Wildeman (-54%).

Table 9. Production parameters of ‘Conference’ and ‘Doyenné du Comice’, 2002–2005

9 lentelė. ‘Conference’ ir ‘Doyenné du Comice’ derėjimo rodikliai 2002–2005 m.

Rootstock Poskiepis	Yield, kg/tree Derlius, kg/vaism.	Amount of fruits, pcs/tree Vaisių kiekis, vnt./vaism.	Fruit weight Vaisių masė, g	Production efficiency, fruits/cm ² of TCSA Produktyvumas, vaisiai/cm ² KSP
‘Conference’				
MC	329 h	54.8 g	177 b	18.9 f
Adams	327 h	55.5 g	176 b	17.0 ef
S 3	211 g	38.4 ef	190 b	9.0 d
Gieser W.	215 g	27.1 c	134 a	8.6 d
MC Peters	293 h	52.0 g	188 b	16.9 ef
MH	222 g	40.0 ef	188 b	15.8 e
ME	109 def	19.6 b	187 b	10.3 d
‘Doyenné du comice’				
MC	90 cde	28.4 cd	324 ef	4.8 bc
Adams	135 f	38.0 ef	294 d	5.6 c
S 3	79 cd	24.9 bc	317 def	2.9 b
Gieser W.	25 a	6.1 a	247 c	0.7 a
MC Peters	119 ef	35.0 de	301 de	6.2 c
MH	66 bc	19.9 b	330 f	4.7 bc
ME	37 ab	12.4 a	362 g	3.3 b
F-test	P<0.001	P<0.05	P<0.05	P<0.001
LSD ₀₅ /R ₀₅	40	7.0	26	2.1

*Total number of fruits per tree in 2002–2005 per cm² of trunk cross sectional area (TCSA) in autumn of 2005 / Bendras vaisių skaičius 2002–2005 m. vienam kamieno skerspjūvio ploto (KSP) cm² 2005 rudenį

Compared to ‘Conference’ fruit production of ‘Doyenné du Comice’ was lower for all rootstock. The highest number of fruits and kg/tree were produced on Adams, MC Peters and MC, the lowest numbers on Gieser Wildeman and ME. Average fruit size was highest on ME and lowest on Gieser Wildeman. Production efficiency was highest on MC Peters followed by Adams, MC and MH. Gieser Wildeman gave by far the lowest production efficiency.

Flower intensity over the trial period was generally good and averaged between 4.9 and 6.4 in ‘Conference’ and 3.6 and 6.0 in ‘Doyenné du Comice’ . In both cultivars the lowest flower intensities were observed for trees grown on pyrus Gieser Wildeman or quince ME, the highest flower intensities for trees grown on the quinces MC, Adams and MC Peters.

Discussion. ‘Conference’ and ‘Doyenné du Comice’ trees raised from the same batch of rootstocks and scion buds and at the same nursery in the Netherlands were also planted in 1999 in a trial at East Malling Research in England (Johnson et al., 2005). Compared to the Dutch trial production of ‘Conference’ in the UK was lower and the percentage of fruits having a diameter of 65 mm or more was much lower for trees grown on rootstocks MC and C132. With ‘Conference’ the *Pyrus* rootstock BIP10030 was less productive. In the trial in England this was not yet noticeable in 2003 (Johnson et al., 2005), but became very clear in 2004 (Johnson, personal communication, 2006). The observed tendency of C132 increasing fruit size of ‘Conference’ in the Dutch trial confirmed by the results of the trial in England. The negative effect of leaf appearance of ‘Conference’ grafted on BP10030 together with the decreased productivity warrants further attention and may possibly be the result of a cultivar – specific incompatibility. Although such negative effects were not observed with cultivar ‘Doyenné du Comice’, the formation of a very thickened graft union may possibly affect graft compatibility in the future and thus necessitates further research.

An interesting observation was the reduction of russeting of ‘Conference’ when grown on rootstock Eline®. This may be of interest when the market demands fruits with less russeting, which may be of interest for market demanding less russeted pears.

Frost resistance is expected to be another advantage of both Eline® and C132 as they were originate from areas with much more severe winters. However, lack of severe winter frosts during the trial period made it not possible to evaluate this characteristic.

Pyrus rootstocks are attractive from the point of view of better compatibility, frost hardiness and tolerance to lime-induced chlorosis than most quince rootstocks. However, all *Pyrus* rootstocks evaluated so far resulted in stronger growth, a lower production efficiency and general smaller fruit size than quince MC. In addition, another negative aspect of *Pyrus* rootstocks is their observed sensitivity to pear decline. Of the tested quinces the weakest growth and highest production efficiency was observed for ‘Conference’ and ‘Doyenné du Comice’ grown on Sobu. However, based on the anatomy of the graft union and the poor leaf quality the dwarfing by this rootstock seems to be caused by incompatibility, especially with ‘Conference’. Large variation was observed in vigour between the 10 replicate trees of the trial, indicating variability in the establishment of a successful graft union. As virus free plant material of Sobu was used, it is unlikely that viruses were the reason for the differences in growth between the trees. Quinces MH, Eline®, and C132 were the best performing rootstocks of the trials and their control of tree vigour and production efficiency was quite similar to quince MC. Specific characteristics like slightly more dwarfing (MH), bigger fruit size (C 132) and expected greater frost resistance

(C 132, Eline®), less russeted fruits with 'Conference' (Eline®) may favour their choice above the currently most used quince rootstocks MC and Adams, depending on the desired planting system, scion cultivar and market demands for fruit size and russeting. A larger demonstration trial is in preparation to compare this growth and production of 'Conference' with these three rootstocks in comparison with MC and Adams at different locations in the Netherlands and to further optimise cultivation practises.

Gauta
2006 05 05
Parengta spausdinti
2006 08 03

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SODININKYSTĖ IR DARŽININKYSTĖ. MOKSLO DARBAI. 2006. 25(3). 13–26.

KRIAUŠIŲ IR SVARAINIŲ POSKIEPIŲ TINKAMUMAS INTENSYVIEMS KRIAUŠIŲ SODAMS

F. Maas

Santrauka

Siekiant ekonomiškai išnaudoti žemę ir taupyti darbo sąnaudas soduose, būtina taikyti tankaus sodinimo sistemas. Tokių sodų pagrindas yra žemaūgiai poskiepiai, kontroliuojantys vaismedžių augimą.

Olandijoje nėra vaismedžių poskiepių selekcijos programų. Poskiepių tyrimai – tik kitose šalyse sukurtų poskiepių patikrinimas. Olandijos kriaušių augintojams pagrindiniai naujų poskiepių selekcijos kriterijai yra šie: 1) vaismedžio dydžio kontrolė; 2) produkcija; 3) vaisių dydis; 4) vaisių kokybė; 5) produktyvumas; 6) atsparumas šalčiams. Papildomi

kriterijai Olandijos medelynams, eksportuojantiems vaismedžius į kitas šalis, yra šie: 1) poskiepių suderinamumas su skiepijamomis veislėmis; 2) tinkamumas auginti kalkinguose dirvožemiuose; 3) nesudėtingas dauginimas. Visuose bandymuose poskiepių charakteristikos lyginamos su svarainiu MC, Olandijoje kriaušėms dažniausiai naudojamu poskiepiu.

Neseniai keletas kriausių (*Pyrus communis*) ir svarainių (*Cydonia oblonga*) poskiepių buvo patikrinti su 'Conference' ir 'Doyenné du Comice' veislėmis.

Paprastai kriausių poskiepių produktyvumas yra daug mažesnis negu svarainių MC. Kitas įvertintų kriausių poskiepių trūkumas buvo jų didelis jautrumas kriausių nykimo fitoplazmai. Patikrinus skiepijimo vietą, keletas poskiepių buvo atmesta dėl įtariamų suderinamumo problemų. Iš patikrintųjų svarainių poskiepių daug vilčių teikia C132 (riboja vaismedžių augimą ir užtikrina gerą vaisių dydį) ir Eline® (sumažina 'Conference' veislės kriausių vaisių grūdėtumą).

Reikšminiai žodžiai: *Cydonia oblonga*, intensyvus sodas, *Pyrus communis*, suderinamumas.