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Results with the 'Colt' and *Prunus avium* L. rootstocks for sour and sweet cherry

Resultater med 'Colt' og Prunus avium *L. grundstammer til sure og søde kirsebær*

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Summary

In a trial with the cherry rootstocks 'Colt' and *Prunus avium* seedlings, 'Colt' resulted in weaker growth and higher yields after the first six years. For sour cherries 'Nefris' and 'Stevnsbær' cl. Viki yield efficiency (kg/cm^2 of trunk area) was respectively up to 105% and 71% higher on 'Colt'. For the sweet cherry 'Sam' the yield efficiency was up to 129% higher and for 'Merton Marvel' it was up to 61% higher on 'Colt' compared to *P. avium*.

Winter temperatures down to –21°C gave no frost damage to any of the cultivars or rootstocks.

Key words: Cherry, rootstocks, yield efficiency, 'Colt', *Prunus avium*, vigour.

Resumé

En sammenligning af den nye kirsebærgrundstamme 'Colt' med frøplanter af *Prunus avium* begyndte i 1983. Der foreligger nu resultater for vækst og udbytte for de første seks år efter plantning i plantage. 'Colt' begyndte med lidt kraftigere vækst end *P. avium*, men efter seks år var træer på 'Colt' mindst for både surkirsebærsorterne 'Nefris' og 'Stevnsbær' cl. Viki og for sødkirsebærsorterne 'Merton Marvel' og 'Sam'.

'Colt' resulterede i betydeligt højere udbytter med både sur- og sødkirsebær. Specielt træernes udbytte-effektivitet (kg/cm^2 stammetværsnit) var højere på 'Colt' end på *P. avium*. For 'Nefris' var effektiviteten op til 105 pct. højere og for 'Stevnsbær' cl. Viki op til 71 pct. højere på 'Colt'. For sødkirsebærrene var 'Colt' også fordelagtig med op til 129 pct. højere effektivitet for 'Sam' og 61 pct. for 'Merton Marvel'.

Træer i dette forsøg var udsat for vintertemperaturer i vintrene 1984/85, 1985/86 og 1986/87 på henholdsvis –21°, –17° og –15°C, uden at synlige frostskader kunne erkendes.

Nøgleord: Kirsebær, grundstammer, 'Colt', *Prunus avium*, vækstkraft, udbytte, produktivitet.

Introduction

The rootstock cultivar 'Colt' originates from a cross between *Prunus avium* selection F299/2 and *P. pseudocerasus* done at East Malling Research Station in 1958 (10). *Pennell et al.* (7) reported

'Colt' to be very productive with less vigour than the standard 'F12/1' rootstock. The weaker growth of trees grafted on 'Colt' is reported by several authors (5,12,13,14,15,16,17). In the early years the vigour of 'Colt' resembles that of 'F12/1' (9) and later, when 'Colt' gives a high crop the growth becomes somewhat weaker than 'F12/1' (14,15). *Vogel* (11) reported problems with incompatibility for some sweet cherry cultivars, on the other hand 'Colt' had a better budtake than some of the new rootstock candidates from Weihenstephan and Gembloux (1) for three sour cherry cultivars.

There seems to be a higher risk of frost damage of 'Colt' rootstocks in the nursery, than of *Prunus avium* (6). *Vogel* (11) reported severe frost damage in sweet cherry on 'Colt' at winter temperatures of -17°C – -23°C, but *Zahn* (16) solved the problem by high working. *Cummins et al.* (2) tested a range of new rootstocks for tolerance to December freezing and found 'Colt' to be one of the most frost sensitive, with half of the tested branches dead at -20°C, while other rootstocks could stand temperatures down to -30°C.

Fruit production of sweet cherry on 'Colt' is reported to be higher or equal to 'F12/1' (3,4,6,7, 15), while there is very little information on sour cherry. However, *Perry* (8) found yields comparable to *P. avium* seedlings or lower with 'Montmorency' sour cherry.

There is no doubt about the higher cropping efficiency on 'Colt' than on *P. avium* rootstocks (5,7,8,15).

In Denmark *P. avium* seedling and 'F12/1' rootstocks are mainly used for sour cherry. It is the experience that the differences in vigour and yield are small between the two types. Therefore a comparison between 'Colt' and *P. avium* are of interest for Danish growers.

Materials and methods

In spring 1983 *P. avium* seedlings of Romanian origin and 'Colt' rootstocks were planted in the nursery. 'Nefris' and 'Stevnsbær' cl. Viki sour cherries were budded in August 1983, and 'Sam' and 'Merton Marvel' sweet cherries were grafted in spring 1984. The trees were planted in the orchard in December 1984 in a systematic single tree split-plot design with cultivars on main plots and rootstocks on sub-plots. The sour cherries were planted at 5 by 3.5 m with eight replicates, and the sweet cherries were planted at 5 by 4 m with seven replicates.

The trunk measurements were taken between the growing seasons and refers to spring in the mentioned years in the tables.

Due to spring frost the sweet cherries were not harvested in 1988 and the sour cherries had reduced yields. There was spring frost also in 1989 and 1990 resulting in some flower damage.

Table 1. Size of maiden trees measured as trunk diameter and height in autumn 1984 (mm).
Størrelsen af et-årige træer målt som stammediameter og højde i efteråret 1984 (mm).

Rootstock *Grundstamme*	Trunk diameter *Stammediameter*	Tree height *Træhøjde*
'Colt'	17.6	144
P. avium	18.1	168
LSD	ns.	22

Table 2. Trunk diameter (mm) for 'Nefris' and 'Stevnsbær' cl. Viki. 1985 is the first leaf in the orchard.
Stammediameter (mm) for 'Nefris' og 'Stevnsbær' cl. Viki.

Year	1985	1987	1988	1989	1990	1991
'Stevnsbær'						
'Colt'	23.7	54.4	70.9	89.8	94.4	105.1
P. avium	21.3	49.5	68.5	89.6	102.5	119.5
LSD	1.47	3.50	ns.	ns.	5.0	7.1
'Nefris'						
'Colt'	23.7	50.2	67.3	84.3	89.3	97.5
P. avium	22.6	49.5	64.8	85.5	101.3	115.9
LSD	ns.	ns.	ns.	ns.	5.0	7.1

Table 3. Trunk diameter (mm) for 'Sam' and 'Merton Marvel'. 1985 is the first leaf in the orchard.
Stammediameter (mm) for 'Sam' og 'Merton Marvel'.

Year	1985	1987	1988	1989	1990	1991
'Sam'						
'Colt'	18.6	50.0	70.0	94.5	109.6	127.1
P. avium	18.8	50.0	72.7	101.2	124.0	143.7
LSD	ns.	ns.	ns.	4.71	6.0	5.7
'Merton Marvel'						
'Colt'	19.0	48.4	64.7	85.9	100.6	116.9
P. avium	19.1	44.8	62.4	86.0	105.3	121.7
LSD	ns.	3.0	ns.	ns.	ns.	5.7

Results

The budtake in the nursery was the same for both rootstocks, when the trees for the trial were produced. For 'Colt' the mean was 72% and for *P. avium* it was 78%, but the difference was not significant. Although the percentage of well developed trees was low, there did not seem to be graft compatibility problems, as there were no such symptoms on the trees.

Growth in the nursery was a little more vigorous om *P. avium* than on 'Colt', when measured as tree height, Table 1. There were big differences in vigour between the four cultivars tested, and only 'Merton Marvel' gave significantly higher trees on *P. avium* than on 'Colt', while for 'Sam', 'Stevnsbær' cl. Viki, and 'Nefris' the difference was not significant.

Growth measured as trunk diameter in the orchard shows the interesting pattern for 'Stevnsbær' cl. Viki that 'Colt' gave significantly more growth than *P. avium*, Table 2, in the first years, while after six years *P. avium* was the most vigorous. For sour cherry 'Nefris', and sweet cherry 'Sam' 'Colt' gave the weakest growth after five years, while there was no difference in the first years, Table 2 and Table 3. For 'Merton Marvel' *P. avium* gave the weakest growth in the second year, but after six years 'Colt' gave the weakest growth, Table 3.

Tree height was less for 'Colt' than for *P. avium* with both sour and sweet cherries. There was no difference in tree diameter after either five or six years.

Yield is expressed in tons/ha, Table 4 and Table 5. For both sour cherry cultivars yield was recorded from the third year after planting. 'Colt' resulted in higher yields than *P. avium* in the first cropping years, but in the sixth year differences were not significant. However, the yield sum for the first six years showed a 32% increase for 'Colt' compared to *P. avium*. For 'Stevnsbær' cl. Viki the increase was even 40%. The sweet cherry yield was only recorded from the fifth year, due to

Table 4. Yield (tons/ha) for 'Nefris' and 'Stevnsbær' cl. Viki. 1985 is the first leaf in the orchard.
Udbytte (tons/ha) for 'Nefris' og 'Stevnsbær' cl. Viki.

Year	1987	1988	1989	1990	Sum	Relative
'Stevnsbær'						
'Colt'	2.1	3.0	14.1	18.6	37.7	140
P. avium	1.1	1.9	8.2	15.8	26.9	100
LSD	0.6	0.9	2.4	ns.	6.1	
'Nefris'						
'Colt'	2.4	3.4	13.2	23.2	42.3	123
P. avium	1.7	2.3	6.8	23.4	34.3	100
LSD	0.6	0.9	2.4	ns.	6.1	

Table 5. Yield (tons/ha) for 'Sam' and 'Merton Marvel'. 1985 is the first leaf in the orchard.
Udbytte (tons/ha) for 'Sam' og 'Merton Marvel'.

Year	1989	1990	Sum	Relative
'Sam'				
'Colt'	7.4	14.1	21.4	174
P. avium	3.7	8.5	12.3	100
LSD	1.0	1.9	2.5	
'Merton Marvel'				
'Colt'	4.5	3.3	7.9	111
P. avium	2.8	4.3	7.1	100
LSD	1.00	ns.	ns.	

spring frost damage, and 'Colt' showed an increase of 11% for 'Merton Marvel' and 74% for 'Sam', Table 5. For 'Sam' the increase in favour of 'Colt' was more than 70%, while there was less increase in the case of 'Merton Marvel'. It should be noted that more than half of the flowers on 'Merton Marvel' were damaged by frost in 1990, which influenced the yield.

Yield efficiency is calculated as kg/cm^2 of trunk cross sectional area in 1989 and 1990. For the two sour cherry cultivars yield efficiency was bigger in 1990 than the year before. In 1989 'Colt' resulted in nearly double the efficiency of *P. avium*, while the difference was about one third in favour of 'Colt' in 1990, Table 6. Both yield and yield efficiency were bigger for 'Nefris' than for 'Stevnsbær' cl. Viki, Table 3 and Table 6. Yield efficiency differences between the two rootstocks were even bigger for sweet cherry than for sour cherry, Table 6 and Table 7. For 'Sam' 'Colt' resulted in more than double the efficiency as *P. avium*, while the difference for 'Merton Marvel' was much less, but still in favour of 'Colt'.

Table 6. Rootstock efficiency for 'Nefris' and 'Stevnsbær' cl. Viki, kg/cm^2.
Grundstamme effektivitet for 'Nefris' og 'Stevnsbær' cl. Viki, kg/cm^2.

Year	1989		1990	
	kg/cm^2	relative	kg/cm^2	relative
'Stevnsbær'				
'Colt'	0.389	171	0.467	140
P. avium	0.227	100	0.333	100
LSD	0.070		0.081	
'Nefris'				
'Colt'	0.418	205	0.629	123
P. avium	0.204	100	0.510	100
LSD	0.070		0.081	

Table 7. Rootstock efficiency for 'Sam' and 'Merton Marvel', kg/cm^2.
Grundstamme effektivitet for 'Sam' og 'Merton Marvel', kg/cm^2.

Year	1989		1990	
	kg/cm^2	relative	kg/cm^2	relative
'Sam'				
'Colt'	0.211	229	0.300	213
P. avium	0.092	100	0.141	100
LSD	0.032		0.040	
'Merton Marvel'				
'Colt'	0.155	161	0.097	115
P. avium	0.296	100	0.084	100
LSD	0.032		ns.	

Discussion

The initial vigourous growth on 'Colt' and the later weakning effect is in accordance with the results found in England by *Pennell et al.* (7) and *Webster* (13) and in Norway by *Ystås* (15). The initial vigorous growth was also reported by *Perry* and *Cummins* (9) under Michigan, USA conditions.

'Colt' seems to fulfil the goal that a rootstock should start off with a vigorous growth, and produce a good sized nursery tree, which fills the allotted space quickly and then later becomes weaker with less need for tree training.

Ystås (15) found no reduction with 'Sam', but 'Ulster' and 'Van' grew less on 'Colt' compared to *P. avium* 'F12/1'. Under Italian conditions *Marangoni et al.* (5) found no significant vigour difference between 'Colt' and 'F12/1' measured as trunk area, canopy volume or total mass of the tree after seven years, when 'Durone Nero II' and 'Bigarreau Burlat' were the scion cultivars.

The present and referred results show that we get a weaker tree, but cultivar differences in the reduction should be expected, when 'Colt' is used as rootstock.

The higher yield and the even higher yield efficiency on 'Colt' demonstrated in this investigation is in accordance with *Marangoni et al.* (5), who found 'Colt' to possess double the yield efficiency compared to 'F12/1' when calculated on the tree volume. *Pennell et al.* (7) and *Ystås* (15) found significant increase in yield efficiency on 'Colt' compared to 'F12/1' on a trunk area basis.

There is still a need for information on the value of 'Colt' as rootstock for sour cherry. *Perry* (8) found a higher yield of 'Montmorency' on 'Colt' than on *P. avium* seedling rootstocks, but no significant increase in yield efficiency as is the case in this investigation. The higher yield efficiency found for 'Nefris' and 'Stevnsbær' cl. Viki on 'Colt' is in good agreement with results on sweet cherry (5,6,7,13,15).

The frost damage on 'Colt' rootstocks reported by *Vogel* (11) at temperatures between –17°C and –23°C and by *Cummins et al.* (2) at December temperatures of –15° and –20°C was not supported in this trial. These trees were exposed to –21°C in January 1985 about one month after planting, –15°C in December 1985, –17°C in January 1986 and –15°C in January and March 1987, all without any visible damage.

We had 'Colt' trees planted in spring 1979, which survived temperatures of –19°C in December 1981 and –24°C in January 1982.

The frost tolerance of 'Colt' has been rather good, and better than usually seen for pears and apples under the same temperature conditions. However, it should be noted that the *Prunus pseudocerasus* parentage of 'Colt' may induce more frost sensitive plants (6).

On the smaller and more open trees on the 'Colt' rootstock sweet cherries are much easier to pick, and presumeably less susceptible to cracking.

References

1. *Anonymous* 1988. Internationale onderstammenproef – zure kers: Lukkingspercentages in de boomkvekerij. Bezoekersgids Tuinbouw- stichting Aarchot (Rillaar), Belgium 1988, 8.
2. *Cummins, J. N.; Wilcox, W. F. & Forsline, P. L.* 1986. Tolerance of some new cherry rootstocks to December freezing and to Phytophthora root rots. Compact Fruit Tree 19, 90-96.
3. *Lichou, J.; Garcin, A. & Jay, M.* 1988. La conduite du cerisier: acquis et perspectives. Infos-Ctifl no 40, 21-23.
4. *Mansfield, R.* 1989. Benefits of tying sweet cherries. Compact Fruit Tree 22, 111-112.
5. *Marangoni, B.; Scudellari, D. & Martelli, S.* 1989. Valutazione di quattro portinnesti per il ciliegio dolce *(Prunus avium)*. Rivista di Frutticoltura 51 (8-9), 73-77.
6. *McVittie, Anne C.* 1984. Cherry rootstocks Cob and Colt. Rep. E. Malling Res. Stn for 1983, 193-196.
7. *Pennell, D.; Dood, P. B.; Webster, A. D. & Matthews, P.* 1983. The effects of species and hybrid rootstocks on the growth and cropping of Merton Glory and Merton Bigarreau sweet cherries (*Prunus avium* L.). J. Hort. Sci. 58, 51-61.
8. *Perry, R. L.* 1989. Rootstock evaluations for sweet and sour cherry. 119th Ann. Rep. Mich. Sta. Hort. Soc., 163-168.
9. *Perry, R. L. & Cummins, J. M.* 1990. First observations of new German and Belgian cherry rootstocks in North America. XXIII International Congress, Abstract 1761.
10. *Tydemann, H. M. & Garner, R. J.* 1966. Breeding and testing rootstocks for cherries. Rep. E. Malling Res. Stn for 1965, 130-134.
11. *Vogel. T.* 1990. Beurteilung der Süsskirschenunterlage 'Colt'. Obstbau 15, 19-20.
12. *Webster, A. D.* 1980. Dwarfing rootstocks for plums and cherries. Acta Hort. 114, 201-207.
13. *Webster, A. D.* 1984. The effects of fumigation and rootstock on the growth of young sweet cherry trees planted in land previous cropped with cherries. J. Hort. Sci. 59, 349-358.
14. *Webster, A. D. & Shepherd, Ursula M.* 1984. The effects of summer shoot tipping and rootstock on the growth, floral bud induction, yield and fruit quality of young sweet cherries. J. Hort. Sci. 59, 175-182.
15. *Ystås, J.* 1990. The effect of 'Colt' and 'F12/1' rootstocks on growth, cropping and fruit quality of 'Ulster', 'Van' and 'Sam' sweet cherries. XXIII International Congress, Abstract 4164.
16. *Zahn, F. G.* 1989. Süsskirschenführung 1989. Mitt. des Obstbauversuchsringes des Altes Landes. 44, 345-359.
17. *Zahn, F. G.* 1990. Die Spindel beim Steinobst. Obstbau 15, 293-304.

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