

## Preliminary evaluation of 10 highbush blueberry cultivars

### Første vurdering af 10 sorter af storfrugtet blåbær

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#### Summary

Ten cultivars: 'Ama', 'Berkeley', 'Bluecrop', 'Bluejay', 'Blueray', 'Goldtraube 71', 'Meader', 'Northland', 'Patriot' and 'Spartan' were planted in holes filled up with peat on a sandy loam. The plants were fertigated. Plant vigor was generally very poor. 'Spartan', 'Meader', 'Bluejay' and 'Patriot' were discarded within the first four years due to poor vitality. Flowering started first in May with 'Northland', latest was 'Berkeley'. Harvest

started late in July with 'Northland'. The latest varieties, 'Ama' and 'Berkeley' were harvested from the beginning of August. The number of pickings was 5-6 on average. The highest yielding varieties were 'Bluecrop', 'Blueray' and 'Berkeley'. These varieties were also judged to have the best blueberry flavour, and 'Bluecrop' and 'Blueray' were given the highest points for overall impression of taste.

**Key words:** *Vaccinium corymbosum*, cultivars, flowering, yield, sweetness, acidity, blueberry flavour, taste.

#### Resumé

Ti sorter af storfrugtet blåbær: 'Ama', 'Berkeley', 'Bluecrop', 'Bluejay', 'Blueray', 'Goldtraube 71', 'Meader', 'Northland', 'Patriot' og 'Spartan', blev plantet med grov ukalket spagnum i plante-hullet på en lerjord. Planterne blev gødevandet. Planternes trivsel har generelt været ringe. 'Spartan', 'Meader', 'Bluejay' og 'Patriot' blev kasseret inden for de første fire år, da flere planter var gået ud. Blomstringen startede først i maj med sorten 'Northland'. De øvrige sorter begyndte blomstringen midt i maj. Plukningen startede med

'Northland' sidst i juli. De seneste sorter 'Ama' og 'Berkeley' blev plukket første gang først i august. Alle sorter blev plukket over en gang om ugen i gennemsnit 5-6 gange. Blåbær er længe om at komme i god bæring, fuld produktion er således ikke opnået i de fire første år efter plantning. De mest produktive sorter har været 'Bluecrop', 'Blueray' og 'Berkeley'. Disse sorter blev ved den sensoriske afprøvning vurderet som meget aromatiske, og 'Bluecrop' og 'Blueray' blev bedømt som de mest tiltalende ved den totale vurdering af smagsindtryk.

**Nøgleord:** *Vaccinium corymbosum*, sorter, blomstring, udbytte, sødhed, surhed, blåbær aroma, smag.

## Introduction

Denmark has not yet a commercial production of highbush blueberry *Vaccinium corymbosum*. In 1977 Dalbro (2) concluded that if such a production was to be successful in Denmark, it would be necessary to find cultivars with a high resistance to diseases. At that time it was not possible to establish a commercial culture successfully because of problems with diseases in particular *Fusicoccum* canker caused by *Godronia cassandrae*, and the interest in the blueberry culture died.

However, during the last five years interest in the culture has been renewed. Since blueberry thrives on soils with a low pH (3.5-5.5) and a high content of organic matter, the areas where this culture can be grown in Denmark are very limited. The existence of more than 30 cultivars has necessitated an evaluation of cultivars under Danish conditions.

## Material and methods

Cultivars which have done well in Holland, Germany and in Denmark (unpublished) have been chosen for this experiment: 'Ama', 'Berkeley', 'Bluecrop', 'Blueray', 'Goldtraube 71', 'Northland', 'Bluejay', 'Meader', 'Patriot' and 'Spartan'. The four latter were discharged after max. three years due to poor vitality.

Two year old plants were planted in holes, 40 cm in diameter and 40 cm deep, in pure peat. The soil was a sandy loam with a clay content of 10-15%. Planting was done in autumn 1986 or spring 1987 at a distance of 1.5×3.0 m. 12 plants of each variety were randomized in 4 blocks.

Plants were fertigated. Daily supplies of water were about 5 mm. Fertilizer content: 99 ppm N, 104 ppm K, 21 ppm Mg, 28 ppm S and 0,01 ppm P, pH=6.

Hard pruning was done in winter 88/89 to encourage new growth.

The flowering periods were registered in 1988-90. In 1990 yield was reduced due to six frosty nights in the flowering period (from 5 to 10 May).

Fruits were hand picked once a week in the ripening period. Yield and size of fruits were registered.

The quality of fully ripe fruits was determined in 1987, 1989 and 1990. Acidity was determined as mg citric acid per 100 g fruit and sweetness as refractometer reading. In 1990 a trained panel of eight judges made a sensory evaluation of the fruits of six varieties. The panel evaluated 36 samples (6 varieties × 2-5 dates × 2 replicates). The samples were randomized within each replicate and served in a different sequence on different dates. A category scale points 0-10 (0=none, 10=most) was used to describe the following parameters: 1. Sweetness 2. Acidity 3. Blueberry flavour. Overall impression of taste was evaluated with points from 0 to 8 (0=none, 8=best).

Results have been statistically analysed by the General Linear Model (GLM) procedure and comparison of means have been done with Duncan's multiple range test.

## Results and discussion

### Bush growth

The vigour has generally been very poor for most cultivars and the production of new canes from bases has been unsatisfactory. This can to some extent be due to allowing young bushes to set fruit. The flowers should have been stripped off plants the first year or two in the field (7). Blueberry likes constant soil moisture (3). In some critically warm periods the water supply might have been insufficient in this experiment.

**Table 1.** Date of flowering and length of flowering period, aver. 1988-90.  
*Tidspunkt for begyndende blomstring og blomstringens varighed, gns. 1988-90.*

Cultivar <i>Sort</i>	Date for 10% open flowers <i>Dato for 10 pct. åbne blomster</i>	Period, days <i>Varighed, dage</i>
'Northland'	5/5 a	25 a
'Ama'	10/5 b	27 a
'Bluecrop'	13/5 c	21 b
'Goldtraube'	14/5 c	20 b
'Blueray'	14/5 c	20 b
'Berkeley'	14/5 c	20 b

Means with the same letter are not significantly different.

*Sorter med samme bogstav kan ikke adskilles med statistisk sikkerhed.*

Finally some growth depression may be due to the non-optimal soil. Recently it has been demonstrated that good growth requires planting on virgin land (1).

#### Resistance against diseases

No symptoms of *Fusicoccum* canker were observed on any of the cultivars.

#### Season of flowering

The flowering started first-mid May, Table 1. The

date for 10% open flowers varied significantly from one year to another.

The flowering period was relatively long, 20-27 days, in accordance with registrations from Poland (16). Early flowering varieties had a significantly longer period of flowering than the rest of the varieties. The difference in date of flowering from 'Northland' to the other varieties is probably too long to ensure satisfactory cross pollination, and cross pollination is known to be profitable for blueberry production (7, 8).

**Table 2.** Picking date and number of pickings, 1988-90. *Plukketid og antal plukninger, 1988-90.*

Cultivar Sort	Year År	Date for first picking Dato for første plukning	Number of pickings Antal plukninger
'Northland'	1988	1/8	5
	1989	27/7	5
	1990	<u>19/7</u>	<u>4</u>
	aver. gns.	26/7	5
'Bluecrop'	1988	3/8	7
	1989	27/7	5
	1990	<u>27/7</u>	<u>4</u>
	aver. gns.	29/7	5
'Goldtraube'	1988	3/8	7
	1989	27/7	5
	1990	<u>27/7</u>	<u>4</u>
	aver. gns.	29/7	5
'Ama'	1988	3/8	7
	1989	27/7	5
	1990	<u>2/8</u>	<u>3</u>
	aver. gns.	1/8	5
'Blueray'	1988	3/8	8
	1989	27/7	5
	1990	<u>27/7</u>	<u>4</u>
	aver. gns.	29/7	6
'Berkeley'	1989	11/8	7
	1989	27/7	5
	1990	<u>27/7</u>	<u>4</u>
	aver. gns.	1/8	5

**Table 3.** Fruitproduction, 1987-90.  
*Frugproduktion, 1987-90.*

Cultivar <i>Sort</i>	g/plant <i>g/busk</i>				Total <i>ialt</i>
	1987	1988	1989	1990	
'Bluecrop'	538 c	1.117 a	429 a	535 a	2.619
'Blueray'	907 a	876 ab	307 ab	400 a	2.490
'Berkeley'	757 ab	870 ab	111 cd	486 a	2.224
'Goldtraube'	425 cd	709 bc	219 bc	177 a	1.530
'Ama'	42 f	578 bcd	213 bc	301 a	1.134
'Northland'	486 cd	307 d	34 d	178 a	1.005
'Patriot'	598 bc	249 d	13 d	—	—
'Bluejay'	342 de	338 cd	22 d	—	—
'Spartan'	192 fe	—	—	—	—
'Meader'	172 fe	—	—	—	—
aver. <i>gns.</i>	446 b	630 a	169 d	346 c	

### Season of harvest

The harvest lasted from late July to early September, Table 2. Order of varieties are in accordance with Dutch and American results (13,19). The date of first picking varied from 7-15 days from one year to another.

Depending on variety and region, the number of pickings in America will normally vary from three to seven (one picking per week), (8). In this experiment there was a variation from an average of 7 pickings in 1988 to 4 in 1990.

### Fruit yield

The average production of fruit varied significantly from year to year, Table 3. The production of fruit was lowest in 1989 after a severe pruning and highest in 1988 the year after planting. The highest yielding cultivars have been 'Bluecrop', 'Blueray' and 'Berkeley', Table 3. These varieties in many experiments are shown to be among the highest yielding cultivars (9, 12 15, 18, 20, 21).

The very unstable yield situation indicates that full production has not yet been reached. Results from Germany, Italy and America have shown that a stable fruit production will be obtained 5-7 years after planting (9, 13, 20, 21). At Årslev it might take a longer time to reach full production, since plant growth seems to be extremely slow.

### Size of fruits

'Bluecrop' and 'Berkeley' had the largest fruits and 'Ama' and 'Northland' had the smallest fruits,

Table 4. Generally the fruits in this experiment were about 15-20% smaller than in other countries (9, 15, 16, 19) except for 'Ama', which had nearly the same weight (9, 16).

**Table 4.** Size of fruits, aver. 1987-90.  
*Frugstørrelse, gns. 1987-90.*

Cultivar <i>Sort</i>	g/100 fruits <i>g/100 stk.</i>
'Bluecrop'	172 a
'Berkeley'	158 b
'Goldtraube'	147 bc
'Blueray'	146 c
'Ama'	113 d
'Northland'	87 e

### Chemical analysis and sensory evaluation of fruits

Both the content of sugar and of citric acid depended on the cultivar, Table 5. The sugar level is in accordance with results by *Sapers et al.* (17) and a little higher than analysis by *Oblak* (14). The level of citric acid was a little higher than results by *Sapers et al.* (17) and a little lower than results by *Oblak* (14). The results from the tasting panel, Table 6, are except for 'Ama' in good accordance with the results of the chemical analysis.

Overall impression of taste is a complex evaluation. It includes all measurable and nonmesura-

**Table 5.** Content of sugar and citric acid in fruits 1987, 89, 90.

*Indhold af sukker og citronsyre i frugter 1987, 89, 90.*

Cultivar Sort	Sugar Sukker g/100 g	Citric acid Citronsyre mg/g
'Ama'	13.0 a	0.99 a
'Northland'	12.3 b	1.53 d
'Blueray'	10.9 c	1.05 d
'Berkeley'	11.3 c	1.38 d
'Bluecrop'	11.1 c	1.05 c
'Goldtraube'	11.1 c	0.98 b

ble parameters of taste. Highest character has been given to 'Bluecrop' followed by 'Blueray', the least appetizing variety was 'Ama'. It seems that the blueberry flavour is the most important individual parameter in the total evaluation of taste, since the best correlation between the total impression of taste and individual parameters was obtained for the flavour component (correlation coefficient=0,74).

## Description of the cultivars

### 'Ama'

*V. corymbosum* x *V. angustifolium*, introduced in 1983. The flowering starts early May and the first picking is early in August. In Holland and Germany 'Ama' is a very productive cultivar (10, 19). At Årslev 'Ama' had a good vegetative growth but seemed to be slow in producing a good fruit production. Fruits are small, they have a high content of sugar and acid and the blueberry flavour is very poor.

References: 10, 19.

### 'Berkeley'

'Stanley' x ('Jersey' x 'Pioneer') introduced in 1949. The flowering starts mid in May and the picking starts the same time as 'Ama': early in August. 'Berkeley' is one of the most productive cultivars. Fruits are large. The acid content is low and the blueberry flavour is good.

References: 7, 9, 10, 12, 15, 18, 19, 20, 21.

### 'Bluecrop'

('Jersey' x 'Pioneer') x ('Stanley' x 'June') introduced in 1952. 'Bluecrop' is the most widely grown blueberry cultivar in the world (6). The

**Table 6.** Sensory evaluation of fruits, 1990.

*Sensorisk vurdering af frugter, 1990.*

Cultivar Sort	Sweetness Sødhed 0-10
'Northland'	7.8 a
'Berkeley'	7.5 a
'Blueray'	6.6 b
'Goldtraube'	6.3 b
'Bluecrop'	6.2 b
'Ama'	6.1 b

Cultivar Sort	Acidity Surhed 0-10
'Bluecrop'	5.7 a
'Goldtraube'	5.5 ab
'Blueray'	5.4 ab
'Ama'	5.0 b
'Berkeley'	3.7 c
'Northland'	3.3 c

Cultivar Sort	Blueberry flavour Blåbær aroma 1-10
'Bluecrop'	6.9 a
'Blueray'	6.5 a
'Berkeley'	5.8 b
'Goldtraube'	5.6 bc
'Northland'	5.6 bc
'Ama'	5.0 c

Cultivar Sort	Overall impression of taste Total vurdering af smag 0-8
'Bluecrop'	5.8 a
'Blueray'	5.3 ab
'Goldtraube'	5.1 bc
'Berkeley'	5.0 bc
'Northland'	4.6 cd
'Ama'	4.3 d

flowering starts mid in May and the first picking is late in July. 'Bluecrop' is one of the most productive cultivars. The fruits are very large and have a very good blueberry flavour.

References: 4, 6, 7, 9, 10, 12, 13, 15, 18, 19, 20, 21.

#### 'Blueray'

('Jersey' x 'Pioneer') x ('Stanley' x 'June') introduced in 1955. The flowering starts the same time as 'Berkeley': mid in May. The picking is from late in July. The productivity is very good. The fruit size is medium and the fruits have a very good blueberry flavour.

References: 5, 7, 9, 10, 12, 13, 15, 18, 19, 20, 21.

#### 'Goldtraube 71'

Clone of 'Blauweis Goldtraube', introduced in 1969. The flowering starts the same time as 'Berkeley': mid in May. The first picking is late in July. In Holland 'Goldtraube 71' has a relatively short ripening period (17), but in Denmark this cultivar like the rest has a long ripening season. In Holland, Poland and Italy the productivity is very good (6, 10, 17), but in Denmark the productivity is medium – poor. The fruit size is medium and the blueberry flavour is medium.

References: 9, 10, 12, 19.

#### 'Northland'

'Berkeley' x (lowbush x 'Pioneer' seedling) introduced in 1968. The flowering period starts early in May. The first picking is late in July. 'Northland' is a halfhigh blueberry cultivar originating from Michigan. Here it has a short period of ripening (9) but in Denmark the period of ripening is long. 'Northland' is in Michigan among the most productive cultivars (11, 16) but in Denmark productivity is very poor. The fruits are sweet and the blueberry flavour is very poor.

References: 11, 13, 18.

### Conclusion

Blueberry comes only slowly into bearing. Full production had not achieved four years after planting. No *Fusicoccum* canker was observed in any of the cultivars. 'Bluecrop', 'Blueray' and 'Berkeley' have been the highest yielding cultivars meaning that these cultivars are best suited for the conditions in this experiment. For these varieties fruit size were good. 'Bluecrop' and 'Blueray' were the most aromatic and best tasting cultivars.

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