

New varieties of elderberry (*Sambucus nigra* L.)

Nye sorter af hyld (*Sambucus nigra* L.)

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Summary

Two experiments with new elderberry varieties have been carried out with the aim of obtaining a variety supplement for the elderberry orchards. The bush characteristics were evaluated with consideration of a yearly pruning in order to keep the plants as bushes with many strong and upright shoots. Fruit yield, optimal harvest time, umbel weight, fruit weight, percentage fruit in the umbels and juice yield by pressing have been deter-

mined.

The fruit quality was evaluated as the content of anthocyanin, titratable acid, soluble dry matter, and the flavour score of sweet juice.

By use of bush yield, anthocyanin content, number of upright shoots and the flavour score, four varieties were selected as valuable for elderberry orchards. The varieties were named 'Samidan', 'Samdal', 'Sampo' and 'Samyl'.

Key words: *Sambucus nigra*, 'Samidan', 'Samdal', 'Sampo', 'Samyl', elderberry, variety, quality.

Resumé

Der er udført to forsøg med fjorten nye hylde sorter, som er fremkommet ved forædling udført af professor S. Dalbro, Havebrugsinstituttet på Den kgl. Veterinær- og Landbohøjskole og af forsøgsleder A. Thuesen på Institut for Grønsager ved Havebrugscentret.

Sorternes buskegenskaber er blevet bedømt under hensyntagen til, at der foretages beskæring hvert år, hvorved planterne holdes i buskform med et passende antal frugtbærende skud. Høsttidspunkt, frugtudbyttet pr. busk, skærmvægt,

frugtvægt, procent frugter i skærmene og saftudbyttet ved presning er blevet bestemt.

Frugtkvaliteten er blevet vurderet på grundlag af indholdet af anthocyanin, titrerbar syre, opløseligt tørstof og smagskvaliteten af sødet hylde-saft.

Ved brug af udbytte, anthocyaninindhold, antal oprette skud og smagskarakteren blev udvalgt fire sorter, der er velegnede til erhvervsmæssig dyrkning. Disse sorter blev navngivet 'Samidan', 'Samdal', 'Sampo' og 'Samyl'.

Nøgleord: *Sambucus nigra*, hyld, kvalitet, sorter, 'Samdal', 'Samidan', 'Sampo', 'Samyl'.

Introduction

In Denmark three elderberry varieties 'Allesø', 'Korsør' and 'Sambu' have been recommended for commercial orchards. The fruit yield is highest for 'Allesø' and 'Korsør' but the content of anthocyanin in the fruits is low compared to the content in 'Sambu' (1, 4).

After a cross breeding carried out by professor S. Dalbro and a selection carried out by scientific officer A. Thuesen fourteen varieties of elderberry were selected at Pometet, Institute of Horticulture, The Royal Veterinary and Agricultural University, Copenhagen, and at the Institute of Vegetables, Horticultural Research Centre, Årsløv.

The aim has been to determine bush characteristics, fruit quality and fruit yield in order to evaluate the varieties for commercial orchards.

Materials and methods

Experiment 1

In the spring of 1983, two year old bushes of fourteen new varieties and of 'Sambu' were planted on sandy loam. The planting distance was 5×2 m with two bushes of each variety.

The fertilization amounted to 225 kg nitrogen, 20 kg phosphorous and 105 kg of potassium per ha. The PK-fertilizer and 50 p.c. of the nitrogen were applied in early spring and the remaining 50 p.c. nitrogen about 1 July.

Non tillage was established using Simazin and Kerb. The pruning method and pest control are described elsewhere (5).

Fruits were harvested and analysed in 1985 and 1986. At four harvest dates samples were picked and used for determination of umbel weight, percentage fruit in the umbels, fruit weight and analysed as described earlier (5).

Experiment 2

Two year old bushes were planted in the autumn of 1985. Eight bushes of each variety were planted at a distance of 5×2 m. Grass strips (4 m) were established. Fertilizing was carried out as described for experiment 1. Methods of pruning, weed control and pest control are described earlier (5).

Fruits were harvested and analysed in 1987 and 1988. At three harvest dates all the umbels from 2 bushes of each variety were picked. Samples of 20 umbels were used for determination of umbel

weight, percentage fruit in the umbel, fruit weight, and analysed as described earlier (5). Organoleptic evaluation (0 = without elderberry flavour, 10 = very strong elderberry flavour) of juice diluted with water (1:3) was carried out by eight trained panelists using an incomplete block design described by Cochran and Cox (2). A data analysis of the results from organoleptic evaluation was carried out as described by Giesbrecht (3).

The content of anthocyanin was expressed as mg/100 g cyanidin - 3 - glucoside and titratable acid as g/kg citric acid.

The juice processing was carried out by pressing of 300 g of blended and enzyme treated fruits in a Tincture Press by increasing of the pressure to 200 kg/cm² for one hour.

Bush vigour and leaf characteristics were determined at the beginning of harvest in 1988. Leaf weight was determined by weighing all the leaves from one shoot of each two bushes. After measurement of leaf length (L) and the greatest leaf width (W) of the third pair of blades, the proportion L/W was calculated.

Results

Experiment 1

A considerable variation in harvest date, fruit yield (1.4 to 10.9 kg/bush), umbel weight (25 to 127 g/umbel) and fruit weight (17 to 31 g/100 fruits) were found (Table 1). The percentage fruit in the umbels varied from 91 to 94 p.c.

The varieties were rather different with respect to the content of anthocyanin (286 to 638 mg/100 g), titratable acid (7 to 15 g/kg) and soluble dry matter (8 to 14 g/100 g) (Table 2).

Experiment 2

A considerable variation in harvest date, fruit yield (5.9–15.2 kg/bush), umbel weight (80–185 g/umbel) fruit weight (15–27 g/100 fruits) and juice yield were found (Table 3).

The varieties were rather different with respect to content of anthocyanin (366 to 759 mg/100 g), titratable acid from (7 to 13 g/kg), soluble matter (7 to 10 g/100 g) and scores for elderberry flavour (3.8 to 6.2) (Table 4).

The varieties were rather different with respect to bush vigour, number of shoots and leaf characteristics (Table 5).

Table 1. Harvest date, yield, umbel weight and fruit weight. Experiment 1, average of 2 years.
Høstdato, udbytte, klasevægt og frugtvægt. Forsøg 1, gennemsnit for 2 år.

Variety Sort	Harvest date Høst- dato	Yield* kg/bush Udbytte kg/busk	Umbel weight g/umbel Klasevægt g/klase	Fruit weight g/100 fruits Frugtvægt g/100 frugter
'Sambu'	9.17	6.1	82	17
'Samdal'	9.03	8.2	83	21
'Samidan'	9.04	6.9	73	20
'Sampo'	9.01	4.1	74	31
'Samyl'	9.08	7.4	64	20
'138'	9.18	6.3	57	24
'369'	9.17	7.7	109	19
'541'	9.13	7.0	56	21
'617'	9.12	1.4	25	25
'678'	9.16	7.3	87	26
'684'	9.17	7.3	85	22
'694'	9.17	8.9	95	31
'742'	9.12	3.2	70	30
'765'	9.11	7.7	89	21
'1565'	9.11	10.9	127	27
Average Gennemsnit		6.7	78	24
LSD		2.2	22	3

* With a planting distance of 5×2 m corresponds kg/bush with ton/ha.

Table 2. Content of anthocyanin, titratable acid and soluble dry matter. Experiment 1, average of 2 years.
Indhold af anthocyanin, titrerbar syre og opløseligt tørstof. Forsøg 1, gennemsnit for 2 år.

Variety Sort	Anthocyanin Anthocyanin mg/100 g	Titratable acid Titrerbar syre g/kg	Soluble DM Opl. tørstof g/100 g
'Sambu'	294	15	9
'Samdal'	542	8	11
'Samidan'	474	14	9
'Sampo'	500	12	10
'Samyl'	638	14	10
'138'	384	7	12
'369'	458	11	10
'541'	518	14	10
'617'	416	10	14
'678'	308	14	8
'684'	326	13	11
'694'	401	15	9
'742'	344	13	12
'765'	286	14	10
'1565'	324	15	9
Average Gennemsnit	414	13	10
LSD	111	2	1

Table 3. Harvest date, yield, umbel weight, fruit weight and juice yield. Experiment 2, average of 2 years. *Høstdato, udbytte, klasevægt, frugtvægt og saftudbytte. Forsøg 2, gennemsnit for 2 år.*

Variety Sort	Harvest date <i>Høst- dato</i>	Yield kg/bush <i>Udbytte kg/busk</i>	Umbel weight g/umbel <i>Klasevægt g/klase</i>	Fruit weight g/100 fruits <i>Frugtvægt g/100 frugter</i>	Juice yield W/W% <i>Saftudbytte W/W%</i>
'Sambu'	10.04	5.9	80	15	76
'Samdal'	9.18	13.6	139	18	80
'Samidan'	9.15	11.7	172	22	80
'Sampo'	9.14	14.2	149	23	82
'Samyl'	9.18	10.7	138	17	78
'138'	9.30	15.2	125	20	80
'369'	10.07	8.3	133	18	72
'541'	10.02	8.6	139	23	77
'617'	9.24	9.8	83	19	77
'678'	10.02	12.1	153	23	78
'684'	10.02	10.6	140	19	75
'694'	10.09	14.8	177	27	79
'742'	10.04	10.4	116	29	77
'765'	9.28	11.8	150	19	83
'1565'	10.04	12.6	185	23	80
Average <i>Gennemsnit</i>		11.4	139	21	79
LSD		2.9	24	3	2

Table 4. Content of anthocyanin, titratable acid, soluble dry matter and flavour. Experiment 2, average of 2 years. *Indhold af anthocyanin, titrerbar syre, opløseligt tørstof og point for smag. Forsøg 2, gennemsnit for 2 år.*

Variety Sort	Anthocyanin <i>Anthocyanin mg/100 g</i>	Titratable acid <i>Titrerbar syre g/kg</i>	Soluble DM <i>Opl. tørstof g/100 g</i>	Flavour of juice <i>Smag af saft point*</i>
'Sambu'	759	10	8	3.8
'Samdal'	497	9	8	4.2
'Samidan'	463	13	7	4.9
'Sampo'	491	11	7	5.6
'Samyl'	625	12	7	5.3
'138'	366	7	9	3.9
'369'	711	10	9	5.2
'541'	755	12	8	5.7
'617'	368	8	9	4.2
'678'	423	10	7	4.8
'684'	436	12	10	6.2
'694'	385	13	8	5.1
'742'	507	10	9	3.9
'765'	371	10	9	5.6
'1565'	413	11	8	4.7
Average <i>Gennemsnit</i>	504	11	8	4.9
LSD	88	1.5	1.0	0.8

* 0 = without elderberry flavour, 10 = very strong elderberry flavour.

Table 5. Characteristics of the elderberry bushes. Experiment 2. 1988.
Hyldeplanternes egenskaber. Forsøg 2. 1988.

Variety <i>Sort</i>	Vigour <i>Kraftighed</i>	Shoots <i>Skud</i>	Leaf weight (g) <i>Bladvægt (g)</i>	L/W <i>L/W</i>	Serratness <i>Takkethed</i>
'Sambu'	medium	few	10	2.2	fine
'Samdal'	medium	many	16	1.9	coarse
'Samidan'	low	few	12	2.3	fine
'Sampo'	medium	many	17	2.0	coarse
'Samyl'	medium	many	14	2.2	fine
'138'	medium	many	10	2.0	fine
'369'	medium	many	17	2.1	fine
'541'	medium	few	16	2.3	fine
'617'	medium	many	11	2.4	coarse
'678'	low	few	9	2.1	coarse
'684'	low	few	11	2.0	fine
'694'	low	few	10	2.0	fine
'742'	medium	many	9	2.3	fine
'765'	medium	many	16	1.9	fine
'1565'	low	few	11	2.1	fine
Average			10	2.1	
<i>Gennemsnit</i>					
LSD			5	0.1	

Discussion and conclusion

A high yield of fruit, ease of picking and pruning is very important for the economy of the elderberry orchard. To obtain this, rather low bushes with many (8–12) strong and upright shoots from the root or lower part of the bushes must be preferred. A high early yield per unit of area can be obtained by use of high planting density for slender bushes. The picking capacity increases by increase of the umbel weight. Broad bushes with many small and thin shoots are not very suitable from the picking and pruning points of view. Of the last mentioned reasons the varieties '138' and '617' could be rejected. All the other varieties were more slender with large variation in number, strength and thickness of the shoots.

A high content of anthocyanin is very important when the elderberry juice is used as a colour ingredient. Varieties with high contents of titratable acid and soluble dry matter are preferable but certain variation are acceptable. The flavour score expressing elderberry flavour must be high.

A large fruit weight is very impressive, especially in combination with a large umbel weight, but a high umbel weight is more important from a picking point of view.

In order to calculate ranges for rejection of varieties the lowest value of average bush yield (y) and the lowest average content of anthocyanin (a) were used together with the corresponding values of LSD (Table 1 to 4). Varieties within the values of the following ranges were deleted:

$$\text{Experiment 1: } y + \text{LSD}(y) \leq 3.6 \text{ kg/bush} \\ a + \text{LSD}(a) \leq 397 \text{ mg/100 g}$$

$$\text{Experiment 2: } y + \text{LSD}(y) \leq 8.8 \text{ kg/bush} \\ a + \text{LSD}(a) \leq 454 \text{ mg/100 g}$$

Because of too few upright shoots three varieties ('541', 'Samidan', '694') were deleted and only four varieties ('369', 'Samdal', 'Sampo', 'Samyl') remained from experiment 1. Four varieties ('Samdal', 'Sampo', 'Samyl', '742') remained from experiment 2. The juice of variety '742' was scored very low while juice of the remaining three varieties were scored rather high and not significant different (Table 4).

Large umbel weight, large fruits, high bush yield, very dense umbels, early maturing, and very small bushes with few shoots are characteri-

Table 6. Reasons for rejecting some varieties for industrial juice processing. *Årsager til at nogle sorter er uegnede til industriel saftfremstilling.*

Low yield <i>Lavt udbytte</i> experiment		Low anthocyanin content <i>Lavt anthocyaninindhold</i> experiment		Few shoots <i>Få skud</i> experiment	
1	2	1	2	1	2
'617'	'369'	'138'	'138'	'541'	'541'
'742'	'541'	'678'	'617'	'567*'	'567'
		'684'	'678'	'694'	'694'
		'541'	'684'		'684'
		'742'	'694'		'1565'
		'765'	'765'		
		'1565'	'1565'		

* '567' = 'Samidan'

stics of the variety 'Samidan'. The fruits have acceptable quality characteristics. Therefore and because of special suitability for the fresh market and home gardens, this variety must be of special value.

Reasons for rejecting of some varieties for industrial juice processing are summarized in Table 6.

Average values of the most important characteristics of the varieties and of 'Sambu' are presented in Table 7.

Variety descriptions

'Samidan'. Small bushes with few shoots, small leaves, high L/W, large umbels, and medium fruit size. Medium content of anthocyanin, high con-

tent of titratable acid and low content of dry matter. Very good juice flavour. Especially suitable for the fresh market and home gardens.

'Samdal'. Medium size bushes with many shoots, large leaves, low L/W, medium size umbels, and medium size fruits. High content of anthocyanin, low content of titratable acid and medium content of soluble dry matter. Very good juice flavour. Suitable for industrial juice processing.

'Sampo'. Medium size bushes with many shoots, large leaves, medium L/W, medium size umbels, and large fruits. Medium content of anthocyanin, medium content of titratable acid and low content of soluble solids. Very good juice flavour. Suitable for industrial juice processing.

Table 7. Average (experiment 1 and 2) of harvest date, bush yield, umbel weight, content of anthocyanin and flavour score of varieties suitable for commercial orchards.

Gennemsnit (forsøg 1 og 2) af høstdato, udbytte, skærmvægt, anthocyaninindhold og smagskarakter for sorter egnede til erhvervsmæssig dyrkning.

Variety <i>Sort</i>	Harvest date <i>Høst- dato</i>	Yield kg/bush <i>Udbytte kg/busk</i>	Umbel weight g/umbel <i>Klasevægt g/klase</i>	Anthocyanin mg/100 g <i>Anthocyanin mg/100 g</i>	Flavour score <i>Smag point</i>
'Sambu'	9.26	6	81	527	3.8
'Samidan'	9.10	9	123	469	4.9
'Samdal'	9.11	11	111	520	4.2
'Sampo'	9.8	9	112	496	5.6
'Samyl'	9.13	9	102	632	5.3

'Samyl'. Medium size bushes with many shoots, medium size leaves, medium L/W, medium size umbels, and small fruits. Very high content of anthocyanin, high content of titratable acid and low content of soluble dry matter. Excellent juice flavour. Suitable for industrial juice processing.

'138'. Medium size bushes with many shoots, small leaves, low L/W, large umbels, and medium size fruits. Low content of anthocyanin, low content of titratable acid and medium content of soluble dry matter. Unsatisfactory juice flavour.

'369'. Medium size bushes with many shoots, large leaves, medium L/W, large umbels, and small fruits. High content of anthocyanin, medium content of titratable acid and medium content of soluble dry matter. Very good juice flavour.

'541'. Medium size bushes with few shoots, large leaves, large L/W, small umbels, and medium size fruits. Very high content of anthocyanin, high content of titratable acid and low content of soluble dry matter. Excellent juice flavour.

'617'. Medium size very broad bushes with many shoots, small leaves, high L/W, very small umbels, and medium size fruits. Low content of anthocyanin, low content of titratable acid but high content of soluble dry matter. Very good juice flavour.

'678'. Small bushes with few shoots, small leaves, medium L/W, large umbels, and large fruits. Low content of anthocyanin, high content of titratable acid but low content of soluble dry matter. Very good juice flavour.

'684'. Small bushes with few shoots, small leaves, medium L/W, medium size umbels, and medium size fruits. Low content of anthocyanin, high content of titratable acid and medium content of soluble dry matter. Excellent juice flavour.

'694'. Small bushes with few shoots, small leaves, medium L/W, very large umbels, and large fruits. Low content of anthocyanin, high content of titratable acid and low content of soluble dry matter. Very good juice flavour.

'742'. Medium size bushes with many shoots, small leaves, large L/W, small umbels with large fruits. Medium content of anthocyanin, titratable acid and soluble dry matter. Unsatisfactory juice flavour.

'765'. Medium size bushes with many shoots, large leaves, low L/W, large umbels, and medium size fruits. Low content of anthocyanin, medium content of titratable acid and soluble dry matter. Excellent juice flavour.

'1565'. Small bushes with few shoots, small leaves, medium L/W, very large umbels and large fruits. Low content of anthocyanin, high content of titratable acid and low content of soluble dry matter. Very good juice flavour.

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