

## European Network for Blackcurrant (*Ribes nigrum* L.) Cultivar Evaluation

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### Abstract

According the COST 863 Action - "Euroberry research: from genomic to sustainable production, quality and health" a European network for blackcurrant (*Ribes nigrum* L.) cultivar evaluation was organized. Lithuania, Latvia, Estonia, Norway, Denmark and Romania have participated in this Network. The objective of studies was to investigate the influence of geographic and climatic conditions on plant performance, berry quality and resistance to pest and diseases. A common protocol for evaluation and descriptors for blackcurrants were developed. Plant maintenance and cultivation was performed according to the local technologies and requirements of each partner (country). Phenological, morphological, productivity, berry quality and plant resistance to pest and disease characteristics were evaluated in the period 2005-2009.

### INTRODUCTION

Blackcurrants (*R. nigrum* L.) have traditionally been cultivated in the Baltic, Scandinavian and some west and central European countries for processing and fresh market. The high content of minerals and ascorbic acid in the berries has been well known for many years (Heiberg et al., 1992). The breeding objectives for new cultivars of *Ribes* are increasingly aligned with the commercial requirements of the relevant industry, and fruit quality parameters are now of equal importance to many agronomic traits (Brenan et al., 2008).

The aim of studies was to evaluate phenological, morphological, production potential, berry quality and disease resistance characteristics of blackcurrant cultivars in various climatic and geographical conditions.

### MATERIALS AND METHODS

Within the framework of the European network for blackcurrant cultivar evaluation, trials were planted in 6 countries. The research was carried out in Lithuania (LT), Latvia (LV), Estonia (EE), Norway (N), Denmark (DK) and Romania (RO) in 2005-2009. Blackcurrant cultivars 'Almiai', 'Gagatai' (Lithuania), 'Ben Alder', 'Ben Gairn', 'Ben Hope' (Scotland), 'Ruben', 'Tiben' (Poland), 'Intercontinental' and 'Polar'

(Sweden) were evaluated with standard cultivar 'Titania' (Sweden). Bushes were planted in a density of 3.0-4.5×1.0-1.5 m in three-five replications. Plant maintenance was performed according to local technologies and requirements of each partner country.

For each cultivar the following parameters were evaluated according to the protocol of evaluation within the COST 863 Action, using scale from 1 to 9 (1 denotes a low, weak or undesirable expression and 9 a high, strong or desirable expression of the trait): plant data - ripening time, vigour, habit, number of basal shoots, number of strigs per node, time of beginning of flowering; fruit data - firmness, uniformity of ripening, strigs length; chemical compounds in fruits - soluble solids (Brix, %) - by refractometer (AOAC, 1990a), ascorbic acid (mg 100g<sup>-1</sup>) - by titration with 2,6-dichlorophenol-indophenol sodium salt solution (AOAC, 1990b), anthocyanins (mg 100 g<sup>-1</sup>) - expressed by cyd-3-rut spectrophotometrically at 544 nm (Wrolstad, 1976); productivity - yield (kg/bush) and weight of 100 berries (g); susceptibility to pest and diseases - gall mite (*Cecidophyopsis ribis* West.), leaf spot (*Septoria ribis* Desm.) and anthracnose (*Drepanopeziza ribis* Kleb.). Finally, a General Value (decision upon possibility for the market) was given for each cultivar by considering the data and observations for the mentioned parameters.

## RESULTS AND DISCUSSION

### Plant Data

The studied cultivars of blackcurrant showed a variable performance, as average results from years of investigation and countries. In particular, the earliest flowering time was observed on bushes of cultivars 'Intercontinental' and 'Polar' (Table 1). Two other cultivars, 'Ben Gairn' and 'Ben Hope', began to flower latest in a comparison with other investigated cultivars. In the tested countries, berries of cultivar 'Polar' ripened earliest, while berries of cultivar 'Ben Hope' latest. More than two strigs per node had only cultivars 'Ben Hope', 'Gagatai', 'Tiben' and control cultivar 'Titania'. According to the data in Table 2 bushes of 'Titania' were the most vigorous in all countries. On the other hand, the shortest bushes had cultivar 'Polar'. The compact bush habit distinguished the cultivar 'Ruben'. Bushes of Scottish cultivars 'Ben Gairn' and 'Ben Hope' produced less basal shoots than other tested cultivars.

### Fruit Data

In Lithuania, Latvia, Estonia, Norway and Romania the control cultivar 'Titania' received highest scores for the fruit firmness (Table 3). Very firm berries were observed on bushes of cultivar 'Tiben' in Romania and 'Ruben' in Estonia. The uniformity of fruit ripening was good, except for 'Ben Alder', 'Gagatai', 'Polar' and 'Titania'. Short length of strigs had cultivar 'Ben Gairn', while 'Almiai' and 'Polar' produced the longest berry strigs.

### Productivity

The evaluated blackcurrant cultivars showed different results depending on country. In particular, the fruit yield of control cultivar 'Titania' ranged between 4.5 kg/bush in Norway and 0.3 kg/bush in Romania. Cultivars 'Almiai', 'Ben Alder', 'Ruben' and 'Tiben' produced highest yields during cropping years (Table 4). 'Tiben' and 'Ben Alder' had high yields, which was also found by other scientists (Pedersen, 2008). Bushes of cultivars 'Ben Gairn', 'Ben Hope' and 'Polar' were generally the least productive in all investigated countries.

Fruit size assessed as a weight of 100 berries is the most important trait for the dessert type of blackcurrant cultivars. According to investigation period the largest berries were observed in the cultivars 'Almiai', 'Gagatai', 'Intercontinental', 'Polar' and 'Titania' (Table 4).

### **Chemical Compounds in Berries**

The highest amount of soluble solids was measured in the berries of 'Ben Alder', 'Ben Gairn', 'Intercontinental', 'Ruben' and 'Titania' (Table 5).

Blackcurrants accumulated from 73 ('Titania') up to 251 mg 100 g<sup>-1</sup> ('Ben Hope') of ascorbic acid. Berries of 'Almiai', 'Ben Hope', 'Ruben' and 'Tiben' had the highest amount of ascorbic acid.

The berries of cultivars 'Ben Gairn', 'Ben Hope', 'Ruben' and 'Tiben' accumulated the highest amount of anthocyanins (Table 5). The highest content of bioactive chemical components of berries was found in 'Ruben' and 'Tiben' by Pluta and co-authors (Pluta et al., 2007). Slightly smaller amount of anthocyanins accumulated the berries of cultivars 'Ben Alder', 'Almiai' and 'Gagatai'. During the years of investigations the least amount of anthocyanins was recorded in the berries of cultivar 'Intercontinental'.

### **Susceptibility to Pest and Diseases**

The tested blackcurrant cultivars showed different level of field resistance to the main fungal diseases and pests.

Cultivars 'Ruben', 'Tiben', 'Ben Hope' and 'Ben Gairn' were almost free from gall mite (Table 6). 'Polar' was moderately susceptible to this pest in Lithuania and Estonia.

Average plant susceptibility to the *Drepanopeziza ribis* causing agent of anthracnose of tested blackcurrant cultivars ranged from 1 to 6 (in 1-9 ranking scale). Cultivars 'Ruben' and 'Tiben' showed the highest level of resistance to this pathogen, while control cultivar 'Titania' was moderately susceptible. The highest resistance to the *Septoria ribis*, caused leaf spot was observed on plants of cultivar 'Ruben'. Similar results were recorded previously by Polish scientists (Pluta and Zurawicz, 2002, 2008; Pluta et al., 2007).

### **CONCLUSIONS**

Cultivar 'Titania' distinguished for the parameter of berry firmness, 'Ben Hope', 'Gagatai', 'Tiben' and 'Titania' - for two strigs per node and 'Ruben' - for the compactness of the plant growth and habit.

Cultivars 'Almiai', 'Ben Alder', 'Ruben' and 'Tiben' produced higher yields in comparison with standard cultivar 'Titania. However, cultivars 'Almiai', 'Gagatai', 'Intercontinental', 'Polar' and 'Titania' are distinguished for largest berries.

The accumulated amount of soluble solids was highest in the berries of cultivars 'Ben Alder', 'Ben Gairn', 'Intercontinental', 'Ruben' and 'Titania', while the amount of ascorbic acid was highest in the berries of cultivars 'Almiai', 'Ben Hope', 'Ruben' and 'Tiben'. Anthocyanin content was highest in cultivars 'Ben Gairn', 'Ben Hope', 'Ruben' and 'Tiben'.

Cultivars 'Ruben', 'Tiben', 'Ben Hope' and 'Ben Gairn' showed the highest resistance to gall mite, 'Ruben' and 'Tiben' - to anthracnose and 'Ruben' - to leaf spot.

Based on these results, the General Value assessment of cultivars 'Almiai', 'Ben Alder' and 'Ben Hope' were ranked highest, and these could be recommended for commercial production in the investigated region.

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**Tables**

**Table 1. Ripening and flowering time and number of strigs of blackcurrant cultivars tested in different countries (average for 2005-2009).**

Cultivars	Time of beginning of flowering (scores)					Ripening time (scores)					Number strigs per node (scores)							
	LT	LV	EE	N	DK	RO	LT	LV	EE	N	DK	RO	LT	LV	EE	N	DK	RO
Almiai	4	4	5	5	5	5	4	5	5	5	5	1	1	1	1	1	1	1
Ben Alder	5	5	5	5	5	7	4	6	7	5	7	1	1	1	1	1	1	1
Ben Gairn	7	9	5	5	5	5	7	8	5	3	5	1	1	1	1	1	1	1
Ben Hope	7	8	5	5	5	5	7	7	7	7	7	1	1	1	1	2	1	1
Gagatai	5	5	5	3	3	5	7	6	5	5	5	2	2	1	1	2	2	2
Intercontinental	3	3	5	3	3	5	5	5	3	3	3	1	1	1	1	1	1	1
Polar	3	2	5	3	3	5	4	3	3	3	3	1	1	1	1	1	1	1
Ruben	5	6	5	5	5	5	4	4	6	5	6	5	1	1	1	1	1	1
Tiben	5	5	5	5	5	3	5	3	5	3	5	5	2	2	2	2	1	1
Titania (control)	5	4	5	5	5	7	5	5	7	5	4	7	1	1	1	1	2	1
Average	5	5	5	4	5	5	5	5	6	5	4	5	6	1	1	1	2	1

**Table 2. Vigor, habit and number of basal shoots of blackcurrant cultivars tested in different countries (average for 2005-2009).**

Cultivars	Vigor (scores)					Habit (scores)					Number of basal shoots (scores)							
	LT	LV	EE	N	DK	RO	LT	LV	EE	N	DK	RO	LT	LV	EE	N	DK	RO
Almiai	5	5	5	3	3	3	5	5	3	3	7	4	3	3	5	5	5	5
Ben Alder	6	5	5	3	3	5	5	5	5	5	5	5	3	3	5	3	5	5
Ben Gairn	5	5	5	3	3	3	5	5	3	7	3	4	4	4	3	7	3	3
Ben Hope	5	5	5	4	5	5	5	5	3	7	3	3	3	3	5	5	5	3
Gagatai	5	6	5	7	7	3	5	6	3	5	5	5	3	3	5	7	7	7
Intercontinental	5	5	5	3	3	5	3	3	5	5	5	5	5	5	5	3	3	3
Polar	4	5	3	3	3	5	6	5	5	5	5	4	3	3	5	3	3	3
Ruben	5	5	5	5	5	6	4	4	3	5	5	4	3	3	5	7	3	3
Tiben	5	5	5	5	5	6	5	5	3	5	7	5	5	5	3	7	7	7
Titania (control)	7	7	7	7	7	7	5	5	5	3	4	7	5	5	5	7	3	3
Average	5	5	5	5	5	5	5	5	4	4	6	5	4	4	5	4	6	4

Table 3. Firmness, uniformity of ripening and strigs length of blackcurrant cultivars tested in different countries (average for 2005-2009).

Cultivars	Firmness (scores)				Uniformity of ripening (scores)				Strigs length (scores)										
	LT	LV	EE	N	DK	RO	LT	LV	EE	N	DK	RO	LT	LV	EE	N	DK	RO	
Almiai	6	5	7	7	5	5	1	1	1	1	1	1	6	6	6	5	5	5	5
Ben Alder	5	5	7	7	6	6	1	1	1	1	2	1	6	7	3	5	3	3	3
Ben Gaim	7		7	7	7	7	1			1	1	1	3		3	3		3	3
Ben Hope	6		7	4	4	7	1			1	1	1	5		5	5		5	5
Gagatai	5	5	7	4	4	4	1	1	1	1	2	2	6	6	6	3	3	3	3
Intercontinental	5	5	7	5	5	5	1	1	1	1	1	1	5	5	3	3	5	5	5
Polar	5	4	5	5	5	5	1	1	1	1	2	2	6	6	3	3	5	5	5
Ruben	6		9	9	4	5	1			1	1	1	5		7		3	5	5
Tiben	5		5	7	7	9	1			1	1	1	5		5	3	3	5	5
Titania (control)	6	6	7	7	5	7	1	1	1	2	2	2	5	6	5	5	3	5	5
Average	6	5	7	6	5	7	1	1	1	1	1	1	5	6	4	5	3	5	5

Table 4. Yield and weight of berries of blackcurrant cultivars tested in different countries (average for 2005-2009).

Cultivars	Yield (kg/bush)				Weight of 100 berries (g)								
	LT	LV	EE	N	DK	RO	LT	LV	EE	N	DK	RO	
Almiai	3.5	1.8			4.1		124	100	80			112	
Ben Alder	3.3	2.5		3.5	4.0		105	82	150	91	55		
Ben Gaim	1.0			1.2	1.7	0.1	118			85	77	79	
Ben Hope	1.2			2.6	3.4	0.2	90			110	78	82	
Gagatai	2.2	1.2		2.9			126	111	140			85	
Intercontinental	2.0	2.3	1.4	2.6			144	128	140	205			
Polar	1.5	1.3	1.5	2.8			114	99	160	105			
Ruben	2.9				2.8	1.8	98		130			85	90
Tiben	2.5			4.2	2.6	2.5	64			140	79	85	
Titania (control)	2.7	2.1	1.1	4.5	1.7	0.3	88	104	100	135	93	101	
Average	2.3	1.9	1.3	3.1	2.9	1.0	107	104	129	124	83	87	

Table 5. Chemical composition of blackcurrant cultivars tested in different countries (average for 2005-2009).

Cultivars	Soluble solids (Brix, %)						Ascorbic acid (mg 100 g <sup>-1</sup> )						Anthocyanins (mg 100 g <sup>-1</sup> )					
	LT	LV	EE	N	DK	RO	LT	LV	EE	N	DK	RO	LT	LV	EE	DK		
Almiai	13	13	16		13	130	163	156			121	258	162	182	346			
Ben Alder	16	14	16	16	13	119	160	160			99	355	263	172	341			
Ben Gaim	15			14	15	110			140	94	348			369				
Ben Hope	13			13	13	251			189	134	339			295				
Gagatai	14	15	15	15	13	121	152	115		91	301	188	164	303				
Intercontinental	15	18	16	13		110	111	174			125	130	95					
Polar	13	11	17	15		97	114	144			215	223	218					
Ruben	15		16		13	179		239		154	490		187	338				
Tiben	13			13	14	209			145	167	645			200				
Titania (control)	15	15	18	17	13	115	123	148	145	73	175	171	183	216				
Average	14	14	16	14	13	144	119	162	155	117	325	190	172	301				

Table 6. Susceptibility to pest and diseases of blackcurrant cultivars tested in different countries (average for 2005-2009).

Cultivars	Gall mite (scores)						Antracnose (scores)						Leaf spot (scores)					
	LT	LV	EE	N	DK	RO	LT	LV	EE	N	DK	RO	LT	LV	EE	N	DK	RO
Almiai	1	2	2		1		2	3	3		1		3	3	4		1	
Ben Alder	2	3	1	1	1		5	5	3	1	1		3	3	3	7	1	
Ben Gaim	1	1	1	1	1	1	2	1		1	1	3	3	3	3	3	1	1
Ben Hope	1	1	1	1	1	1	2	1		1	1	5	3	2		3	3	3
Gagatai	1	3	3		1		2	3	1		1		3	3	1			1
Intercontinental	3	3	2	1			3	3	1	1			3	2	1	5		
Polar	2	1	7	1			5	6	1	1			3	2	1	5		
Ruben	1	1	1	1	1	1	3	1	1		1	1	2	1	1		1	1
Tiben	1			1	1	1	3			1	1	1	3			3	1	1
Titania (control)	1	1	2	1	1	1	3	3	4	1	1	1	3	3	4	3	1	1
Average	2	2	3	1	1	1	3	3	2	1	1	2	3	2	2	4	1	1

