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Evaluation of blackcurrant cultivars and perspective hybrids in Lithuania

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Abstract. A cooperative blackcurrant breeding project between Sweden, Russia, Latvia and Lithuania studied yield, resistance to fungal diseases and pest, biochemical composition of berries of 20 new blackcurrant cultivars and hybrids at the Lithuanian Institute of Horticulture in 2004-2008. The blackcurrants were cultivated without plant protection against either diseases or pests. Yield, damage by fungal diseases and pest and biochemical composition was investigated. The hybrids BRi 9504-5, BRi 9568-1A, BRi 9508-3A and BRi 9508-3B were selected as possible cultivars.

Key words: blackcurrant, cultivar, hybrid, yield, diseases, pest, biochemical composition

INTRODUCTION

Blackcurrants are an important crop of small fruit production. European blackcurrant production totalled around 186,000 tonnes in 2004, with Poland by far the largest producer at just over 70% of the EU total (Brennan et al., 2008).

There are at present around 15 currant (*Ribes)* breeding programmes worldwide. The release and commercial success of a new cultivar of blackcurrant increasingly depends on an effective combination of agronomic and fruit quality traits (Brennan et al., 2008). 'Öjebyn', 'Titania', 'Ben Lomond', 'Ben Alder', 'Ben Tirran' are now widely grown in European blackcurrant plantations. The others in the European market are the recently released cultivars: 'Ben Hope', 'Ben Gairn', 'Tiben' and 'Tisel' (Pluta & Zurawicz, 2008; Zurawicz & Pluta, 2008). 'Gagatai', 'Vyčiai', 'Laimiai' and 'Joniniai' from Lithuania are interesting cultivars as they are high yielding, have a high sugar/acid ratio and satisfactory colour content. They have begun to be planted in the Baltic and Scandinavian countries (Kampus & Pedersen, 2005; Pluta et al., 2007; Pedersen, 2008).

The aim of this work was to evaluate new blackcurrant cultivars and hybrids with regard to yield, biochemical composition and resistance to the most important fungal diseases and pests.

MATERIALS AND METHODS

Blackcurrant cultivars and hybrids were evaluated at the Lithuanian Institute of Horticulture in 2004-2008. Blackcurrant hybrids and cultivars – BRi 9316-1 ('Ben Gairn' x 'Minaj Smyriov'), BRi 9502-1A ('Lentiaj' x 'Intercontinental'), BRi 9504-4A (65-59-5 x 'Storklas'), BRi 9504-5 (65-59-5 x 'Storklas'), BRi 9508-1A ('Gagatai' x 'Intercontinental'), BRi 9508-2A ('Gagatai' x 'Intercontinental'), BRi 9508-2B ('Gagatai' x 'Intercontinental'), BRi 9508-3A ('Gagatai' x 'Intercontinental'), BRi 9508-3B ('Gagatai' x 'Intercontinental') and BRi 9508-3C ('Gagatai' x 'Intercontinental') were bred at the Lithuanian Institute of Horticulture, BRi 9538-1 ('Veloj' x 'Triton') and BRi 9568-1A ('Delikates' x 'Pilot Aleksandr Mamkin') were bred at the N.I. Vavilov Institute of Plant Industry (Russia). 'Binar' (Russia), 'Intercontinental' (Sweden), 'Jadrenaja' (Russia), 'Polar' (Sweden), 'Poezija' (Russia), 'Storklas' (Sweden), 'and Veloj' (Russia)were evaluated with the standard cultivar 'Gagatai' (Lithuania). The experiment was repeated in Latvia and Sweden.

Cultivars and hybrids were planted in spring 2004. Bushes were in plots of 3x1.5 m in four replicates of one bush each. Plantation management was as recommended for commercial orchards but without plant protection against diseases and pest.

In the trial the following characteristics of blackcurrant hybrids and cultivars were established: yield (kg/bush); damage by fungal diseases and pests (scores where 0 – no disease and pest symptoms detected on leaves or branches up to 5 –more than 75% damaged leaves and buds). Soluble solids in blackcurrant berries were analysed by the digital refractometer ATAGO, ascorbic acid – by titration with 2.6-dichlorophenolindophenol sodium salt solution, titratable acidity, expressed as citric acid - by titration with 0.1 M NaOH solutions. Total amounts of anthocyanins were analysed spectrophotometrically at a wave length of λ 544 nm.

All data were subjected to analysis of variance. The significance of differences between the cultivars and hybrids was evaluated using the LSD test at $P \leq 0.05$.

RESULTS AND DISCUSSION

Blackcurrant breeders throughout the world hope to improve the yield of hybrids (Brennan et al., 2008). The hybrids BRi 9508-3A (1.62 kg/bush) and BRi 9508-3B (1.50 kg/bush) produced a higher yield in the first year of cropping (Table 1). In the second year of cropping hybrids BRi 9508-3B (3.62 kg/bush) and BRi 9508-3C (3.42 kg/bush) produced higher yields, while bushes of hybrids BRi 9502-1A (3.03 kg/bush), BRi 9504-5 (3.08 kg/bush), BRi 9508-2A (3.01 kg/bush), BRi 9508-2B (3.01 kg/bush) and 'Gagatai' (3.28 kg/bush) bore fewer berries. In the third year of cropping hybrids BRi 9504-5 (4.15 kg/bush) and BRi 9568-1A (3.83 kg/bush) produced higher yields, while BRi 9316-1 (0.51 kg/bush) and BRi 9508-3C (0.69 kg/bush) produced lower yields. Hybrids BRi 9508-3A (2.26 kg/bush) and 'Veloj'(2.13 kg/bush) produced higher yields in the fourth year of cropping. Hybrids BRi 9504-5 (2.47 kg/bush), BRi 9568-1A (2.36 kg/bush), BRi 9508-3A (2.35 kg/bush) and BRi 9508-3B (2.30 kg/bush) produced a higher yield throughout the four years.

Table 1. Blackcurrant cultivars and hybrids yield, kg/bush.

Hybrids and cultivars	Yield kg/bush				
	2005	2006	2007	2008	Mean (2005–2008)
BRi 9316-1	0.31	2.10	0.51	0.86	0.94
BRi 9502-1A	1.08	3.03	1.43	1.51	1.76
BRi 9504-4A	0.78	2.88	1.77	1.40	1.70
BRi 9504-5	0.96	3.08	4.15	1.71	2.47
BRi 9508-1A	0.51	2.16	3.06	1.23	1.74
BRi 9508-2A	0.96	3.01	2.41	1.28	1.92
BRi 9508-2B	1.36	3.01	1.51	0.37	1.56
BRi 9508-3A	1.62	2.85	2.67	2.26	2.35
BRi 9508-3B	1.50	3.62	2.78	1.30	2.30
BRi 9508-3C	0.40	3.42	0.69	1.12	1.41
BRi 9538-1	0.25	2.23	1.55	0.74	1.19
BRi 9568-1A	0.82	2.76	3.83	2.03	2.36
'Binar'	0.66	2.14	2.06	1.05	1.47
'Gagatai'	0.29	3.28	1.68	1.16	1.60
'Intercontinental'	1.38	2.76	2.12	0.73	1.74
'Jadrenaja'	0.09	1.57	1.88	0.98	1.13
'Polar'	0.62	1.98	1.10	1.47	1.29
'Poezija'	0.44	2.65	2.30	1.40	1.69
'Storklas'	0.08	1.95	0.97	0.56	0.89
'Veloj'	0.34	2.56	2.31	2.13	1.83
Average	0.46	2.65	2.04	1.27	1.67
LSD_{05}	0.72	1.02	1.60	1.01	0.75

In blackcurrant breeding attention is paid not only to the processing of berries, but to their potential in the fresh market as well. Berries for consumption are expected to be of large size, good looking with good taste and aroma (Trajkovski et al., 2000). The weight of 100 berries was the highest for the hybrids BRi 9508-3C (230g) and BRi 9504-5 (206g), while lowest for 'Poezija' (0.96g) in the first cropping year (Table 2). In the second and third cropping year the weight of 100 berries was highest for hybrid BRi 9508-3B and cultivar 'Jadrenaja'. In the fourth cropping year the weight of 100 berries was highest for the hybrid BRi 9502-1A (178.3g) and cultivar 'Jadrenaja' (182g). During the investigation period the biggest berries were in the cultivars 'Jadrenaja' (3.42g) and BRi 9508-3C (2.98g). 'Jadrenaja' has also been reported elsewhere to be a cultivar with a large berry (Ogolcova et al., 2000).

Table 2. Berry weight of blackcurrant cultivars and hybrids.

Hybrids and cultivars	Weight of 100 berries, g					Largest berry weight, g Average (2005–2008)
	2005	2006	2007	2008	Mean (2005–2008)	
BRi 9316-1	103.3	126.8	96.3	106.7	108.2	1.75
BRi 9502-1A	163.3	169.6	152.3	178.3	165.9	2.63
BRi 9504-4A	194.3	145.0	138.6	140.0	154.4	2.48
BRi 9504-5	206.0	169.6	147.3	152.6	168.9	2.59
BRi 9508-1A	150.3	129.4	113.0	111.3	126.0	1.81
BRi 9508-2A	185.7	164.2	133.0	106.6	147.3	2.33
BRi 9508-2B	148.6	140.6	118.6	108.6	129.1	2.03
BRi 9508-3A	190.3	175.2	145.0	128.3	159.7	2.60
BRi 9508-3B	173.3	223.8	159.3	138.3	173.6	2.53
BRi 9508-3C	230.0	192.6	148.3	147.6	179.6	2.98
BRi 9538-1	106.3	113.0	107.0	0.93	81.8	1.77
BRi 9568-1A	121.7	115.0	92.7	79.7	102.2	1.65
'Binar'	122.0	0.92	100.0	96.3	79.8	1.43
'Gagatai'	146.3	126.4	98.3	83.6	113.6	1.84
'Intercontinental'	170.7	142.4	155.6	134.3	150.7	2.18
'Jadrenaja'	193.3	223.8	220.6	182.3	205.0	3.42
'Polar'	128.3	106.2	125.0	107.0	116.6	1.81
'Poezija'	0.96	103.0	102.3	111.3	79.3	1.57
'Storklas'	130.7	110.6	129.7	0.82	92.9	1.86
'Veloj'	176.0	156.0	132.0	122.0	146.5	2.38
Average	156.8	146.3	130.7	120.5	134.1	2.18
LSD_{05}	41.1	26.8	21.1	35.7	41.5	0.44

New cultivars should be not only productive but also demonstrate resistance to the main pests and diseases (Broniarek-Niemec et al., 2000; Pluta & Zurawicz, 2008). Tested blackcurrant genotypes demonstrated different field resistance to the main fungal diseases and pests. Mean resistance to anthracnose (*Drepanopeziza ribis* Kleb.) of blackcurrant cultivars and hybrids was a score of 2.67 (Table 3). The highest resistance to this fungal disease was in the hybrids BRi 9504-4A (1.89) and BRi 9538-1 (1.82). Six hybrids BRi 9316-1 (2.63), BRi 9504-5 (2.55), BRi 9508-1A (2.30), BRi 9508-3C (2.20), BRi 9568-1A (2.20) and BRi 9508-2A (2.0) was more resistant in comparison with the trial mean.

Average resistance to leaf spot (*Mycosphaerella ribis* Lind.) of blackcurrant cultivars and hybrids ranged from scores of 2.2-3.57. Hybrids BRi 9508-2B (2.23) and BRi 9568-1A (2.20) demonstrated the highest resistance to leaf spot, while BRi 9538-1 (3.47) and 'Polar' (3.57 were moderately susceptible.

The hybrids 'Binar', 'Intercontinental' and 'Poezija' were almost free from gall mite (*Cecidophyopsis ribis* Westw.). The same result has been recorded previously by Russian scientists (Ogolcova et al., 2000). Four hybrids BRi 9316-1 (score of 0.11), BRi 9504-4A (0.15), BRi 9504-5 (0.06) and BRi 9508-2B (0.16) were all slightly infested by gall mite. On the other hand all the investigated cultivars and hybrids were only minimally damaged by the gall mite (mean score of 0.59), except for the bushes of 'Storklas' (3.44).

Table 3. Resistance to leaf diseases and pests of blackcurrant cultivars and hybrids.

Hybrids and cultivars	Resistance to leaf diseases and pest, scores		
	Anthracnose (2006—2008)	Leaf spot (2006–2008)	Gall mite (2007–2008)
BRi 9316-1	2.63	2.46	0.11
BRi 9502-1A	2.93	2.73	0.36
BRi 9504-4A	1.89	2.60	0.15
BRi 9504-5	2.55	2.40	0.06
BRi 9508-1A	2.30	3.00	1.38
BRi 9508-2A	2.00	2.80	0.26
BRi 9508-2B	3.28	2.23	0.16
BRi 9508-3A	2.85	2.38	0.26
BRi 9508-3B	2.96	3.04	0.69
BRi 9508-3C	2.20	3.30	0.85
BRi 9538-1	1.82	3.47	0.32
BRi 9568-1A	2.20	2.20	1.24
'Binar'	3.24	2.70	0.00
'Gagatai'	2.03	2.40	0.36
'Intercontinental'	3.71	2.50	0.00
'Jadrenaja'	3.11	2.57	0.51
'Polar'	3.35	3.57	1.32
'Poezija'	3.00	2.59	0.00
'Storklas'	2.45	2.83	3.44
'Veloj'	2.94	2.34	0.33
Average	2.67	2.70	0.59
LSD_{05}	0.60	0.69	0.41

Blackcurrant berries are mainly used for processing, so particular attention ispaid to the improvement of the quality of processed berries, notably juice colour, ascorbic acid content, dry matter and soluble solids (Šikšnianas et al., 2005; Siksnianas et al., 2006). The soluble solids content in berries ranged from 12.6 to 17.7% (Table 4). Significant differences in this parameter were observed between BRi 9508-3B and 'Poezija'. The highest dry matter was found in the cultivars 'Intercontinental' (28.9%), 'Storklas' (27.7%) and hybrid BRi 9316-1 (27.5%), while significantly lower in the hybrids BRi 9508-3C (18.0%), BRi 9508-3B (18.3%) and cultivar 'Jadrenaja' (18.4%). Hybrids BRi 9504-4A (121mg 100 g^{-1}), BRi 9538-1 (129mg 100 g^{-1}), BRi 9508-3C (132mg 100 g^{-1}), BRi 9504-5 (151 mg 100 g^{-1}), cultivars 'Jadrenaja' (124 mg 100 g^{-1}) and 'Binar' (132 mg 100 g^{-1}) contained significantly more ascorbic acid than the other investigated cultivars and hybrids. A lower ascorbic acid content was found in the hybrid BRi 9508-3B (67 mg 100 g^{-1}). The highest titratable acidity was found in the hybrids BRi 9502-1A (3.55%), BRi 9504-5 (3.65%), and the cultivars 'Binar' (3.57%) and 'Storklas' (3.87%), while acidity wassignificantly lower in the cultivar 'Gagatai' (2.34%). The largest variability was observed in anthocyanin content. The richest in anthocyanins were the berries harvested from the hybrids BRi 9316-1 (488.4mg 100 g^{-1}), BRi 9508-1A (410.7mg 100 g^{-1}), BRi 9508-2B (465.3mg 100 g^{-1}), BRi 9508-3B (497.9mg 100 g^{-1}), BRi 9568-1A (455.9mg 100 g^{-1}) and cultivar 'Gagatai' (442.2mg 100 g^{-1}), while BRi 9502-1A (204.8mg 100 g^{-1}) and 'Intercontinental' (241.6mg 100 g^{-1}) had the lowest content of anthocyanins.

Table 4. Biochemical composition of blackcurrant cultivars and hybrids.

Hybrids and cultivars	Soluble solids (%)	Ascorbic acid (mg 100 g^{-1})	Titratable acidity (%)	Anthocyanins (mg 100 g^{-1})	Dry matter (%)
BRi 9316-1	15.8	106	2.53	488.4	27.5
BRi 9502-1A	14.5	109	3.55	204.8	18.9
BRi 9504-4A	14.6	121	2.93	339.3	26.4
BRi 9504-5	13.5	151	3.65	265.7	19.8
BRi 9508-1A	13.8	121	2.61	410.7	22.1
BRi 9508-2A	14.3	99	3.36	286.8	20.0
BRi 9508-2B	15.5	74	2.85	465.3	21.6
BRi 9508-3A	15.2	72	2.50	286.8	20.0
BRi 9508-3B	12.6	67	2.68	497.9	18.3
BRi 9508-3C	13.7	132	2.93	258.4	18.0
BRi 9538-1	15.4	129	3.47	355.0	23.3
BRi 9568-1A	15.9	116	2.82	455.9	24.4
'Binar'	16.8	132	3.57	365.5	25.9
'Gagatai'	16.2	111	2.34	442.2	22.0
'Intercontinental'	15.8	111	3.28	241.6	28.9
'Jadrenaja'	14.0	124	2.63	357.1	18.4
'Polar'	16.4	97	3.01	347.7	24.8
'Poezija'	17.7	111	3.30	381.3	24.7
'Storklas'	14.6	83	3.87	360.3	27.7
'Veloj'	14.6	109	2.68	291.0	21.6
Average	15.0	108.7	3.02	355.1	22.7
LSD_{05}	0.089	3.011	0.048	10.29	0.301

CONCLUSIONS

1. Advanced hybrids BRi 9504-5, BRi 9568-1A, BRi 9508-3A and BRi 9508-3B can be selected as the best examples among the tested hybrids.

2. The following blackcurrant hybrids were identified as having particular beneficial characteristics: BRi 9504-5, BRi 9508-3A, BRi 9508-3B and BRi 9568-1A – for yield; BRi 9508-3C and BRi 9508-3B – for biggest berries; BRi 9504-4A and BRi 9538-1 – resistance to anthracnose; BRi 9508-2B and BRi 9568-1A – resistance to leaf spot; BRi 9316-1, BRi 9504-4A, BRi 9504-5 and BRi 9508-2B – resistance to gall mite; and BRi 9316-1, BRi 9504-5, BRi 9538-1 and BRi 9568-1A – for biochemical characteristics.

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