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Resistance to fungal diseases of interspecific currant hybrids of *Eucoreosma* section

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Abstract. Interspecific hybridisation in genus *Ribes* is one of the most effective methods fordeveloping resistant cultivars. Plants of *R. nigrum* x *R. pauciflorum*, *R. nigrum* x *R. ussuriense*, *R. nigrum* x *R. Janczewskii* (F_1) were obtained directly after interspecific hybridization of currant. Hybrids of *R. nigrum* × *R. americanum* and *R. americanum* x *R. nigrum* (F_1 - F_3) were obtained after interspecific hybridization and embryo rescue *in vitro*. Fertile plants were found in all crosses. 20.0–52.3% of hybrids in F_1 were resistant to powdery mildew. In crosses of *R. nigrum* x *R. pauciflorum, R. nigrum* x *R. Janczewskii* 2–5% of plants were undamaged by Septoria leaf spot. Plant fertility of hybrids *R. nigrum* × *R. americanum* and *R. americanum* x *R. nigrum* was very low in F_1 and increased in F_2 and F_3. There were resistant plants in all families of hybrids obtained by reciprocal crosses, but resistance level of hybrids with *R. americanum* cytoplasm was considerably higher. The resistance to fungal diseases of some hybrids in F_3 generation was higher than *R. nigrum* and equal to *R. americanum.*

Key words: currant species, fungal diseases, interspecific hybrids

INTRODUCTION

Sensitivity to powdery mildew (*Sphaerotheca mors-uvae)*, Septoria leaf spot (*Mycosphaerella ribis)* and anthracnose *(Pseudopeziza ribis)* is a major problem for commercial currant growing (Trajkovski, 1996, Rousseau & Roy, 2002, Kniazev & Ogolcova, 2004).

Research has shown that *Ribes pauciflorum*, *R. ussuriense*, *R. Janczewskii* may be useful as donors or sources of fungal disease resistance (Ogolcova, 1992; Kniazev & Ogolcova, 2004). It was shown that *R. americanum* resistance to Septoria leaf spot is controlled by oligogene (Keep, 1975). Distant hybridisation between different species provides qualitatively new information for currant breeding (Brennan, 1996).

The aim of this work was to create interspecific hybrids between blackcurrant cultivars and wild species *R. americanum, R. pauciflorum*, *R. ussuriense*, and *R. Janczewskii,* to evaluate resistance to fungal diseases of the interspecific hybrids, and investigate the possibilities for using wild currant species of *Eucoreosma* section as resistance donors to powdery mildew, Septoria leaf spot and antrachnose in blackcurrant breeding.

MATERIALS AND METHODS

The work was performed at the Department of Genetics and Biotechnology of Orchard Plants in the Lithuanian Institute of Horticulture in 1989–2005. The following cultivars of *R. nigrum* were used for crossing: 'Vakariai', 'Beloruskaya sladkaya', 'Minaj Shmyriov', 'Zagadka', 'Laimiai', 'Ben Tirran', and wild species of section *Eucoreosma* of genus *Ribes* (Table 1).

Table 1. Characteristics of wild species of section *Eucoreosma* of genus *Ribes.*

Species	Spreading region	Donor or source of characters*
R. americanum	West coast of North America (in forests from North Scotia to Virginia)	Late flowering, resistance to powdery mildew, Septoria leaf spot, anthracnose.
R. pauciflorum	East Siberia and North East China	Length of trusses, resistance to Septoria leaf spot, anthracnose and powdery mildew (only in field conditions).
R. ussuriense	East Siberia (coasts of Amur river)	Adaptivity, resistance to powdery mildew and Septoria leaf spot.
R. Janczewskii	Mountains of West Pamir (1500-2000m above sea lewel)	Late flowering, resistance to powdery mildew (only in field conditions).

* (Keep, 1975; Ogolcova, 1992; Kniazev & Ogolcova, 2004)

For crossing combinations 100–250 flowers were emasculated. Because seeds collected in crossings combinations with *R. americanum* were unable to germinate, isolated embryos of F_1 were grown on White (White, 1943) nutrition media, modified for isolated currant embryos (Stanys et al., 1994). Embryos were maintained in the culture room at 21–25°C temperature and 50 μmol $m^{-2}s^{-1}$ PPF with a 16-h photoperiod using cool white fluorescent light. Seeds collected in other crossing combinations were stratified and then seeded in a greenhouse (Shiksnianas et al., 2005). F_2 hybrids in reciprocal crossing combinations *R. americanum* with *R. nigrum* were obtained from the most fertile plants selected from hybrid families after open pollination. Families of F_3 hybrids were obtained from plants selected according to complex valuable agronomical traits after open pollination of F_2.

Two-year-old hybrids from the greenhouse were planted outside in breeding trials at distances of 3×1 m and have been grown without fungicides.

Resistance to powdery mildew was evaluated in the greenhouse. Damage by Septoria leaf spot and anthracnose was evaluated against a natural infection background in the field conditions during the first and second cropping season. The extent of leaf damage caused by fungal diseases was evaluated on a 0 to 5 scale (0 denoting undamaged leaves, and 5 denoting 100% of leaf surface).

Data were analysed by analysis of variance (ANOVA) and grouped by the Duncan test; standard errors were calculated.

RESULTS AND DISCUSSION

All plants of *Ribes nigrum* were damaged by Septoria leaf spot and antrachnose and only 20.1% of plants were undamaged by powdery mildew (Table 2). Interspecific hybrids suffered different damage by fungal diseases. The percent of hybrids'

resistance to powdery mildew in the F_1 generation of interspecific crossings depended on the combination. All interspecific crossing combinations produced both sensitive and resistant hybrids except combination *R.americanum* x *R.nigrum,* where all hybrids $F_1 - F_2$ were undamaged. Average damage was respectively from 0 to 2.0 score. In crossing combinations *R. nigrum* x *R, pauciflorum* and *R. nigrum* x *R. ussuriense,* 43.3–52.3% of the plants were not damaged.

Very few plants undamaged by Septoria leaf spot were obtained in combinations of *R. nigrum* x *R. pauciflorum* and *R. nigrum* x *R. Janczewskii.* In the combination of *R. nigrum* x *R. pauciflorum,* 2 percent of plants had no damage. Other plants of that combination were damaged -on average by a 0.8 score. In crossings *R. nigrum* x *R. Janczewskii* 5 percent were not damaged by Septoria leaf spot plants and average damage in this combination was low, only 0.1%. About 40% of hybrids between *R. americanum* and *R. nigrum* were undamaged independent from crossings direction. All hybrids of F_1 *R. nigrum* x *R. ussuriense* were damaged by Septoria leaf spot, but the average damage was low – scoring about 0.3 (Table 2).

Table 2. Performance of interspecific currant hybrids to fungal diseases.

Crossing combination	Number of plants	Powdery mildew		Septoria leaf spot		Anthracnose	
		Average damage (score)	Undamaged plants (%)*	Average damage (score)	Undamaged plants (%)*	Average damage (score)	Undamaged plants (%)
R. nigrum x R. nigrum	348	1.8±0.91	20.1e	3.0±0.20	0.0e	2.9±0.66	0
R. nigrum x *R. americanum* F_1	11	0.6±0.36	17.3e	1.2±0.38	45.5a	1.3±0.33	18.2cd
R. nigrum x *R. americanum* F_2	33	0.6±0.30	54.5b	0.8±0.21	15.1c	1.7±0.32	12.1d
R. nigrum x *R. americanum* F_3	186	1.0±0.31	60.9b	1.2±0.25	12.1c	1.1±020	18.9cd
R. americanum x *R. nigrum* F_1	12	0	100a	0.3±0.08	41.7a	0.1±0.00	58.3b
R. americanum x *R. nigrum* F_2	21	0	100a	1.1±0.17	28.6b	0.2±0.07	80.9a
R. americanum x *R. nigrum* F_3	235	0.7±0.16	59.6b	1.2±0.17	32.4b	1.4±0.20	25.8c
R. nigrum x R. pauciflorum F_1	44	1.0±0.1	52.3b	0.8±0.30	2.0d	2.2±0.32	0e
R. nigrum x R. ussuriense F_1	60	1.2±0.79	43.3c	0.3±0.01	0.0e	3.5±0.01	0e
R. nigrum x R.Janczewskii F_1	160	2.0±1.08	20.0e	0.1±0.01	5.0d	1.9±0.14	0e

*Means marked with the same letter do not differ significantly ($P \leq 0.01$)

There were resistant hybrids in both families obtained by reciprocal crosses between *R. americanum* and *R. nigrum,* but the resistance level of hybrids with *R. americanum* cytoplasm was considerably higher. Similar results were obtained by Keep (1975). All plants in other interspecific crossing combinations were damaged by

anthracnose (Tables 2). Our results disagree with the findings of Ogolcova (1992) where *R. pauciflorum* was proposed for use as a donor resistance to antracnose.

Developed interspecific *R. nigrum* and *R. americanum* hybrids are recommended in further breeding for resistance to powdery mildew, Septoria leaf spot and anthracnose. Interspecific hybrids *R. nigrum x R. pauciflorum* and *R. nigrum x R. Janczewskii* are suitable for breeding of blackcurrants resistant to powdery mildew and Septoria leaf spot.

CONCLUSIONS

1. Crosses of black currants with *Eucoreosma* section wild currant species allows development of plants absolutely resistant to fungal diseases. Plants resistant to a complex of diseases caused by *Sphaerotheca mors-uvae, Pseudopeziza ribis* and *Mycosphaerella ribis* were developed in crosses *R. nigrum* and *R. americanum.* In F_1-F_2 generations the resistance level of hybrids with *R. americanum* cytoplasm was considerably higher.

2. Hybrids resistant to *Sphaerotheca mors-uvae* and *Mycosphaerella ribis* were selected in the combinations *R. nigrum x R. pauciflorum* and *R. nigrum x R. Janczewskii.*

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