Cold tolerance of Latvian local sweet cherries selected for agroforestry system

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Introduction

The climate in Latvia is influenced both by maritime and continental air intrusions. The cherries in continental regions (CR) used to be under the threat of prolonged low temperatures but in the maritime regions (MR) – of temperature fluctuations.
The research aimed to evaluate the cold tolerance of local sweet cherry accessions from different Latvia regions, which were selected for agroforestry system (vigorous, healthy and productive).

Materials and Methods

The samples of flower buds (FB), spurs, and annual and biannual shoots (AS and BS) were collected and evaluated visually in the natural conditions and after artificial freezing at -20, -25 and -30 °C during the winter-dormancy (February) and at -10, -15 and -20 °C at the end of winter-dormancy (March). The freezing was done in climate chamber MKFT 240 (BINDER). After the samples were kept at 4 °C for 24 h for thawing and incubation. The shoots and spurs were evaluated by estimation of cross-section browning on a scale from 0 (light colour) to 5 (all brown). The flower buds were cut and evaluated visually, the percentage of damaged FB was calculated. The analysis of relative electrolyte leakage (REL) was done for annual shoots (Pagter et al., 2008), which indicates the level of cell membrane damages or dormancy status.

Results 1

During endodormancy, FB resisted the freezing at -20 and -25 ° C, but suffered at -30°C (Table 2). The browning of spurs increased after all freezing treatments, but of the BS – after freezing at -25°C. The brown colour appeared in pit tissues (0.5 - 1 points); but in several cases – in cambium and sapwood (1.5 – 3 points).
During ecodormancy, the tissue browning was less both in the shoots and spurs. FB of all accessions tolerated well the freezing at -15°C, but -20°C was lethal.

Tab. 2. The effect of origin on cold-tolerance of sweet cherries

Origin	February, endodormancy				March, ecodormancy		
	damaged FB at -30 °C (%)	spur browning (points)		AS REL at -30 °C (%)	spur browning (points)		AS REL in natural conditions (%)
		in natural conditions	at -25 °C		in natural conditions	at -20 °C	
Continental	62[a]	0.22[a]	0.89[a]	10.40[a]	0.38[a]	0.72[a]	10.65[a]
Maritime	92[b]	0.89[b]	1.61[b]	12.91[b]	0.55[ab]	1.16[ab]	14.10[b]
Estonia, Russia (control)	48[a]	0.50[ab]	0.88[a]	10.95[ab]	0.62[b]	1.81[b]	13.89[b]
p-value	<0.01	<0.01	<0.01	0.03	<0.01	0.02	0.02

Tab. 1 Origin and basic fruit characteristics of sweet cherry accessions

Accession	Location of origin	Latitude	Longitude	Fruit size	Fruit skin color
Smiltenes 9	Smiltene, Latvia CR	57.42 N	25.89 E	small	black
Karzdabas 2	Karzdaba, Latvia CR	56.99 N	26.19 E	small	yellow
Karzdabas 4	Karzdaba, Latvia CR	56.99 N	26.19 E	medium	dark red
Muizhas 2	Muižciems, Latvia MR	56.77 N	22.47 E	small	yellow
Muizhas 4	Muižciems, Latvia MR	56.77 N	22.47 E	small	dark red
Agrais Hedelfingens	Aizpute, Latvia MR	56.72 N	21.61 E	medium	dark red
Meelika	Polli, Estonia	58.11 N	25.55 E	small	black
Bryanskaya Rozovaya	Bryansk, Russia	53.19 N	34.18 E	small	yellow

Muizhas 4'

Results 2

During endodormancy, MR accessions, 'Karzdabas 4' and 'Meelika' showed an increase in REL at -30°C compared to natural conditions. REL of 'Smiltenes 9', 'Karzdabas 2' and 'Bryanskaya Rozovaya' remained relatively stable or decreased at -30°C, indicating the stability of cell membranes and acclimation to cold. At -30 °C, cold tolerance of FB still was high for 'Karzdabas 4', medium - for 'Smiltenes 9 ', 'Meelika' and 'Bryanskaya Rozovaya' and low for 'Agrais Hedelfingens', 'Muizhas 2', 'Muizhas 4' and 'Karzdabas 2' with significant diferences between CR and MR accessions.
During ecodormancy, all CR accessions showed lower REL in natural conditions than MR and control accessions (Fig.1).

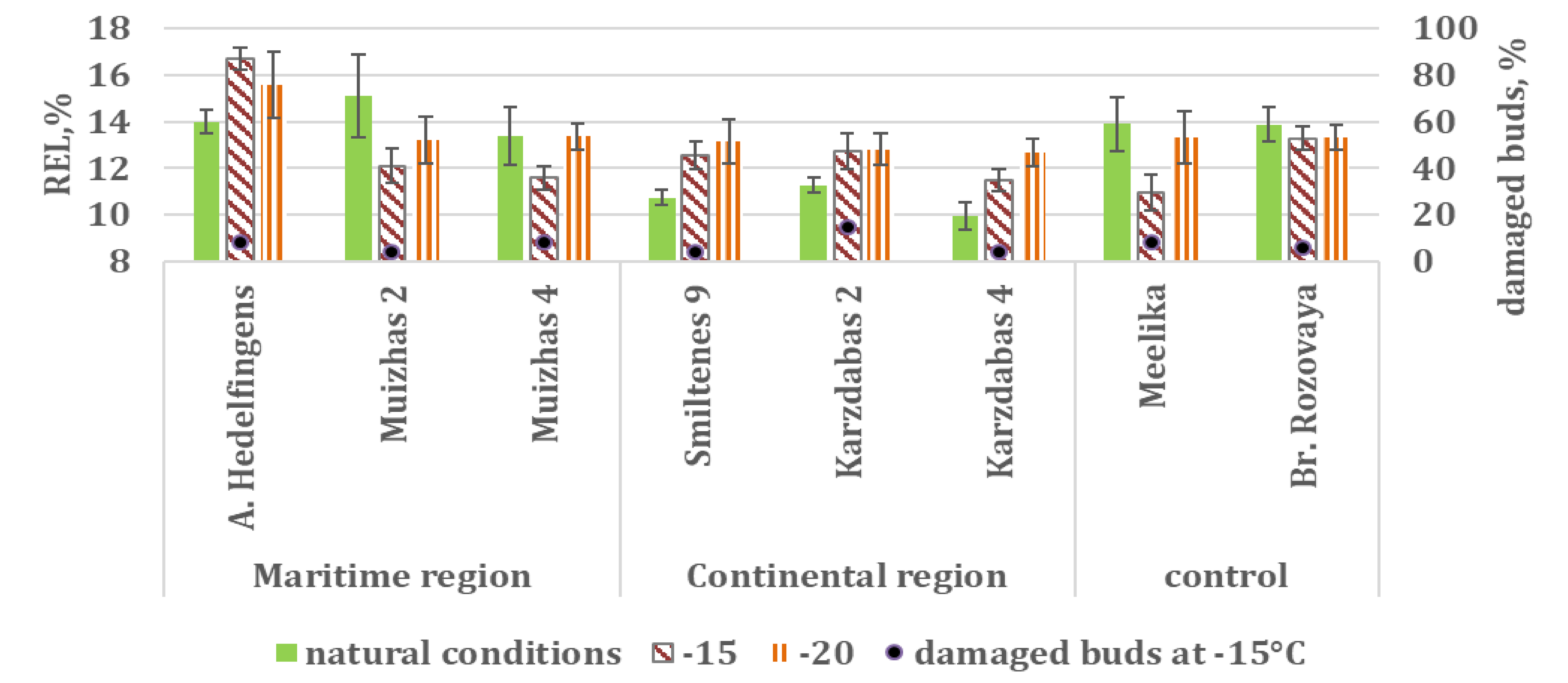
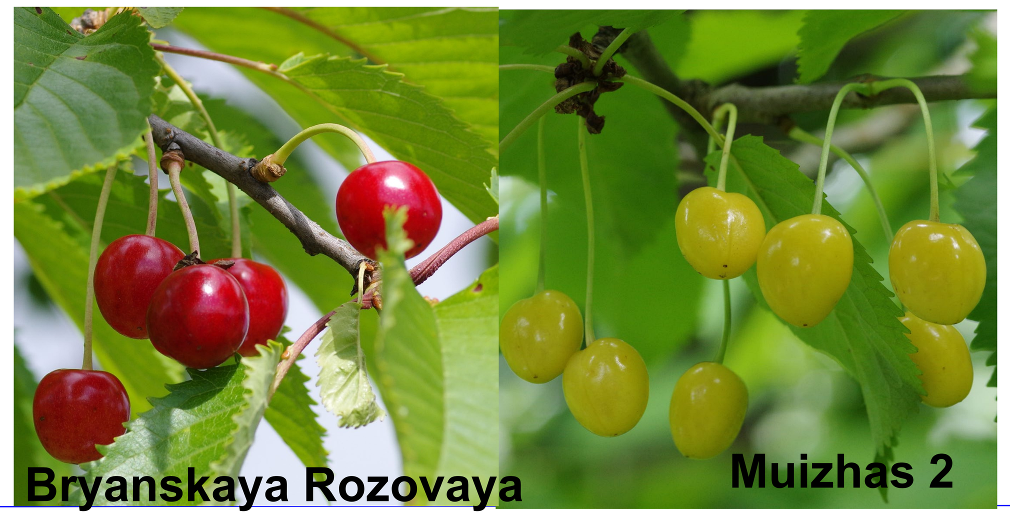


Fig. 1 The effect of freezing on REL of ecodormant annual shoots and flower buds

Freezing caused an increase of REL of CR accessions whereas MR and control accessions showed a decrease of REL at -15 or -20°C. Sweet cherry accessions from Latvian CR responded to cold by less browning of the spurs than the control cultivars and accessions from MR. The FB cold tolerance did not differ between the accessions.



Bryanskaya Rozovaya Muizhas 2

Conclusions

During winter endocormancy, the cold tolerance of Latvian CR sweet cherry accessions generally did not differ from control cultivars but was higher than of sweet cherries from MR.
At the end of winter dormancy, sweet cherry accessions showed similar cold-tolerance, which was achieved by slower de-acclimation of CR accessions and soon re-acclimation to freezing of MR accessions and control cultivars.

References: M. Pagter et al. (2008). Physiol. Plant. 134: 473–485.
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