Small fruit breeding tendencies in Lithuania

A. Sasnauskas, R. Rugienius, I. Mažeikienė, V. Bendokas, V. Stanys

Institute of Horticulture, LAMMC
Kaunas st. 30, Babtai, LT-54333, Kaunas dist.

4 January 2019
TABLE OF CONTENT

- INTRODUCTION
- Conventional breeding
- Interspecific hybridization
- In vitro techniques
- Molecular markers
- Preservation of genetic resources
- New small fruit cultivars
- CONCLUSIONS
Main facts about Lithuania

- **Population:** ~3 000 000
- **Area:** 65 300 sq. M
- **Bordering countries:** Russia (Southwest), Poland (South), Belarus (East), Latvia (North), Baltic Sea (West).
- **Ethnicities:** Lithuanians 85,08%, Poles 6,65%, Russians 5,88%, Others 2,39%
- **Native languages:** Lithuanian [official] 85%
- **Languages spoken:** Lithuanian [official] 96%
- **Climate:** average winter temperature: –5°C (lowest –27°C), average summer temperature: +17°C (highest +35 °C).
- **The agricultural sector** now employs only some 12 percent of the population.
INTRODUCTION

Most popular small fruits

- Blackcurrant
- Raspberry
- Strawberry
Conventional breeding

Ribes breeding program

- fruit quality
- amount of biologically valuable materials
- resistance to fungal diseases
- winter hardiness
- resistance to pest and virus

Raspberry breeding program

- well adapted
- tasty
- winter hardiness
- quality
- productivity

Strawberry breeding program

- tasty
- quality
- winter hardiness
Interspecific hybridization

In interspecific crosses many *Ribes* species were used: *R. americanum*, *R. sanguineum*, *R. dikuscha*, *R. aureum*, *R. nigrum ssp. sibiricum*, *R. uva-crispa*, *R. sanguineum*, *R. ussuriense*, *R. janczewski*, *R. pauciflorum*.

Interspecific hybrids between *R. ideasus* and *R. occidentalis*.

Interspecific hybridization using 10 *Fragaria* species and forms with different genomic constitution and ploidy level were performed.
In vitro techniques (1)

- Method of isolated embryo was used to increase germination of *Ribes* interspecific hybrids *in vitro*.
- Polyploidization in *in vitro* was used in order to restore fertility of interspecific hybrids, or restore homozygous state of target genes.
- Tetraploid blackcurrant C₁ and C₂ genotypes were induced and currently are studied in field collections.
Methods of screening for cold hardiness in strawberry seedlings under controlled conditions were developed.

Results of cold acclimation and freezing treatments of *Rosacea* family plants *in vitro* show that for maximal cold hardiness acclimation for 56 days or longer is required. The hybrid *F. orientalis* x *F. vesca* and hybrids *F. ananassa* x *F. virginiana* showed highest viability after the freezing.

The expression of dehydrin proteins in *Rosaceae* during cold acclimation were studied. A novel XERO2 - like dehydrin, which is expressed during cold acclimation in *F. vesca*, was identified.
Molecular markers

- Markers for Ce and P genes, responsible for blackcurrant resistance to gall mite, are used in breeding programs. It was established, that species *R. sanguineum*, *R. americanum*, *R. aureum*, *R. nigrum* spp. *sibiricum* may be used as donors for resistance to gall mite.
- PCR based markers for *Rpf1* gene were developed and used for screening strawberries for red stele resistance.
- The genetic diversity of all our blackcurrant, raspberry and strawberry cultivars and hybrid clones developed mostly was evaluated using SSR and AFLP markers.
- This enable to select most promising donors for further studies or breeding, easily identify cultivars and distinguish them between many cultivars.
Preservation of genetic resources

- *In vitro* culture techniques, including storage under growth limiting conditions and cryopreservation, provide storage alternatives for protecting valuable germplasm.

- Vitrification, vitrification method with aluminium plates, incapsulation/dehydratation, incapsulation/vitrification methods were evaluated in the cryopreservation studies of *Rosacea* and other plants.

- Cryopreservation technologies of different explants including meristems, buds, embryos and suspension cells was evaluated.
Blackcurrant breeding (1)  International program between Sweden-Latvia-Lithuania

‘Ritmo’

‘Domino’

‘Viktor’

‘Karina’
Blackcurrant breeding (in DUS testing) (2)

‘Didikai’

- Early season cultivar.
- Pedigree: ‘Kriviai’ × ‘Saniuta’.
- Berries are with very good taste and big size.
- Bushes are medium high, resistant to cold.
- Enough resistance to fungal diseases, resistant to gall mite.
- Distinguished by a high level of self-pollinating (77%).
- Suitable for organic horticulture.

Blackcurrant breeding achievements (in DUS testing) (3) ‘Aldoniai’

- Middle season cultivar.
- Pedigree: ‘Vakariai’ × Nr. 70-88-9.
- Berries are with good taste and big size.
- Bushes are high, resistant to cold, blossom resistant to spring frosts.
- Enough resistance to fungal diseases, resistant to gall mite.
- Distinguished by a high level of self-pollinating (77%).
- Suitable for organic horticulture.
'Mistika‘ – F₂ seedling of ‘Norna’. Plant height 1.4 m, 14.1 stems per bush, average yield 3.3 t ha⁻¹. Average fruit weight 2.4 g, fruit very attractive, very tasty, has high sugar content. Picking time lasts from 07-02 to 07-25.

‘Vizija‘ – F₂ seedling of ‘Norna’. Plant height 1.5 m, has 24.6 stems per bush. Average yield 3.5 t ha⁻¹. Average fruit weight 2.3 g, fruit very attractive, very tasty, has high ascorbic acid content. Picking time lasts from 07-09 to 07-28.
Wild strawberry breeding (5)

‘Dena’

‘Meda’

‘Redita’

‘Elina’

All of them are remontant - producing berries from June to October, with production peaking in mid-summer. They produce high yields of rather big berries with excellent aroma of wild strawberry. ‘Dena’ distinguished by early fruiting, ‘Meda’ – by high yield (up to 4 t/ha), ‘Redita’ by big size (over 3 g), berries of oblong shape and easy picking, ‘Elina’ by nice white aromatic berries. All of them are tolerant to drought and cold. Propagated by seeds.
Conclusions

- Over 30 small fruit cultivars were released as products of small fruit breeding programmes in Lithuania.

- Interspecific breeding, employment of *in vitro* methods, usage of molecular markers allows to introduce resistance to biotic and abiotic stress into cultivars, and enables to fasten breeding process.

- Cryopreservation of genetic resources was started; new methods are being developed.
Thank you for the attention