PROTECTION OF GENETIC RESOURCES OF POMOLOGICAL PLANTS AND SELECTION OF GENITORS WITH TRAITS VALUABLE FOR SUSTAINABLE FRUIT PRODUCTION

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THE IMPORTANCE OF GENETIC RESOURCES FOR APRICOT BREEDING IN SLOVAKIA

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A B S T R A C T

The Research Institute of Plant Production in Piestany oversees the Slovakian National Program for the Conservation of Plant Genetic Resources for Food and Agriculture. The Research Breeding Station Vesele at Piestany is responsible for collecting fruit and nut trees such as apricots, peaches, almonds and walnuts. There are a total of 646 accessions on the ten-hectare station, 319 of which are apricot accessions. In 1964, a breeding program was established to develop genetically improved apricot varieties. The parent genetic material included the cultivar 'Hungarian Best', cultivars from Slovakia, China, and Central Asia, and NJA hybrids. The chief qualities bred for were disease resistance, frost tolerance, extended blossoming period, extended ripening period, as well as fruit quality parameters such as flavor, firmness, skin color, flesh color, ease of transport, and suitability for processing. Ten new apricot varieties and one new apricot rootstock have been registered. 'Veselka' and 'Vesna' have high quality fruits. 'Veharda' and 'Vemina' are resistant to PPV. 'Veharda', 'Vemina', and 'Vesprima' are very good for processing.

Key words: plant genetic resources, fruit tree breeding, apricot breeding, varieties

INTRODUCTION

The Research Institute of Plant Production in Piestany has overseen the Slovakian National Program for the Conservation of Plant Genetic Resources for Food and Agriculture since the program was started in 1991 (Benedikova et al., 2003).

The Gene Bank at the Research Institute of Plant Production in Piestany was established in 1996 to ensure long-term, nationwide conservation of genetic resources. It specializes in preserving seed species in full viability without genetic deterioration. Off-site collections include seed gene banks, field gene banks, *in vitro* gene banks, and cryo-preserved gene banks. The Slovakian law No. 215/2001 "Conservation of Plant Genetic Resources for Food and Agriculture" defines the terms "field gene banks", "field collections", and "repositories" for vegetatively propagated species.

By the end of 2003, the National program included 26,742 registered accessions: 10,150 in the active collection and 2,645 in the base collection. The off-site collections include at least 17,000 accessions, not all of which have yet been registered. A total of 190 plant species are represented, chief among which are the cereals (26.1%), the legumes (19.7%), and the fruits (16.2%). The Research Breeding Station Vesele at Piestany is responsible for collecting fruit and nut trees such as apricots, peaches, almonds and walnuts. There are a total of 646 accessions in four collections on the ten-hectare station, 319 of which are apricot accessions.

Apricots are one of the few temperate fruits which is not affected by overproduction. Although acreage has been steadily increasing worldwide, apricot growing is especially challenging (Bassi, 2001). Apricot breeding programs have a long tradition in Europe and have achieved interesting results in some countries (Egea and Burgos, 2001; Pennone, 2001; Karayiannis and Mainou, 2001).

Apricots have long been grown in Slovakia, even though Slovakia lies on the northern edge of the profitable cultivation range. Apricots are a "high-risk" crop for Slovakian farmers. Apricot orchards are not long-lived. Flower buds are frequently injured by winter and spring frosts. The trees are especially susceptible to a host of viral, bacterial and fungal diseases. Slovakian breeders have tried to overcome some of these problems as part of their long-term hybridization program, and important part of which is the apricot genetic resources collection (Benedikova, 2001).

MATERIAL AND METHODS

Procedures carried out as part of the apricot conservation program include:

- Collection and conservation of species, germ-lines, breeding material, and wild forms native to Slovakia;
- Introduction of perspective varieties from elsewhere in the world for breeding purposes;
- Evaluation according to a standard descriptor list;
- Analysis of biological material; and
- Computerization of data.

Standard breeding techniques included self-pollination, open pollination, hand pollination, and crossing by emasculation. Cultivars from different regions such as China and Central Asia were carefully interbred with European cultivars. The chief properties bred for were disease resistance, frost tolerance, extended blossoming period, extended ripening period, as well as fruit quality parameters such as flavor, firmness, skin color, flesh color, and ease of storage, transport and processing. Of about 15,000 hybrid seedlings, the most interesting 250 seedlings were grafted onto *Prunus armeniaca* L. seedling (M-VA-2) rootstock and planted in trials to observe their performance in comparison to the standard cultivar, 'Hungarian Best'.

History of the Apricot Breeding Program		
Phase One	1962 to 1970	First hybridizations
Phase Two	1973 to 1987	Hybridization of promising hybrids, back crossing with cultivars such as 'Veecot', 'Sunglo', 'Goldcot', various NJA hybrids, 'Tirziu de Bucuresti', and 'Marculesti'.
Phase Three	1988 to 1996	Testing and selecting promising hybrids. Breeding with cultivars resistant to pathogens like PPV, *Monilinia* spp., *Gnomonia erythrostoma*, such as 'Stark Early Orange', 'Veecot', 'Goldcot', 'Hargrand', 'Screara', and 'Bergeron'.
Phase Four	1997 to present	Further breeding for resistance. Selecting and testing promising PPV-resistant hybrids.

RESULTS

The chief qualities bred for and the cultivars most often used in the program as donors of these properties were:

- disease resistance ('SEO', 'Dacia', and Chinese cultivars);
- frost tolerance (the Central Asian varieties 'Achrori', 'Arzami', and 'Zard');
- extended blossoming period ('Ananasova');
- extended ripening period ('Ruzova Skora', 'Kech Pchar', 'Vynoslivyj', and the NJA hybrids); and
- fruit quality ('Hungarian Best', 'Bergeron', 'Hargrand', and the Chinese cultivars).

'Hungarian Best' is generally a good cultivar for hybridization, contributing to fruit size and flavor, as well as to overall good health. Unfortunately, 'Hungarian Best' is not very frost tolerant. Frost tolerance and

fruit quality in F1 hybrids resulting from self-pollination of 'Hungarian Best' were never better than in 'Hungarian Best'.

'Rakovsky' was less suitable for hybridization, contributing poor taste especially if it is used as the female parent.

The Chinese cultivars had white or orange flesh, and contributed to fruit size, soft, juicy flesh, high sugar content, and resistance to fungal diseases especial when used as the male parent. Unfortunately, they also contributed to limited longevity, poor skeletal branch health, and to fruits with clingstone properties.

The Central Asian cultivars 'Achrori', 'Arzami', and 'Zard' were used separately or together in the pollen mixture. They contributed to high frost tolerance of flower buds, overall good health, fruit size, and shiny fruit surface. When combined with 'Hungarian Best', they produced some of the most promising hybrids with different ripening periods and variable fruit quality. 'Achrori' was tolerant to *Gnomonia* in Slovakia's climate.

When 'Hungarian Best' was crossed with Chinese cultivars, the F1 generation had large clingstone fruits with flesh and skin color ranging from yellow to deep orange, with a high sugar content. F1 trees were overall very healthy, but short-lived with unhealthy skeletal branches.

When 'Hungarian Best' was crossed with 'Julskij', the F1 generation had flower buds which were highly frost tolerant, but small, late ripening fruits with pale orange skin and poor flavor.

When 'Hungarian Best' was crossed with the Central Asian cultivars 'Achrori', 'Arzami', and 'Zard', the F1 generation had fruits which varied greatly in size and color. Stems and skeletal branches were very health with no sign of fungal diseases or gummosis. Some of the hybrids were auto-sterile.

Some promising cultivars are presented in the following tables:

VESELKA®	
Origin	'Vesna' x 'Vegama'
Growth	Smaller, low-density crown, spur type
Fruiting	Regular yields
Leaves	Dark green, very large, cordate
Blossoming	Early
Fertility	Self-fertile
Fruit	Ripens very early (July 10, twenty days before 'Hungarian Best'); very large fruit; weight 65 g; spherical; firm, easy to transport; dark orange skin with attractive dark red blush; light orange flesh; very good flavor; juicy; aromatic
Disease resistance	Good level of resistance to *Gnomonia erythrostoma*
Overall evaluation	Dessert cultivar, ripens very early, spur type growth, large, attractive fruit with very good flavor

VELITA®	
Origin	'Hungarian Best' x 'Achrori', 'Arzami', and 'Zard' (Central Asian cultivars)
Growth	Medium vigor, high-density, overhanging crown
Fruiting	Regular yields
Leaves	Light green, smaller, cordate
Blossoming	Late
Fertility	Self-fertile
Fruit	Ripens very early (July 7, twenty-three days before 'Hungarian Best'); large fruit; weight 56 g; flattened, elongated; light orange skin with dark red blush; firm, light orange flesh; good, well-balanced flavor; medium, light brown stone
Disease resistance	-----
Overall evaluation	Very early cultivar with large attractive fruit and regular yields

VEMINA®	
Origin	'Rakovsky' x 'Achrori', 'Arzami', and 'Zard' (Central Asian cultivars)
Growth	Smaller, low-density crown
Fruiting	Regular yields
Leaves	Dark green, smaller, very shiny
Blossoming	Late
Fertility	Self-fertile
Fruit	Ripens late (July 27, three days before 'Hungarian Best'); large fruit; weight 50 g; spherical; very firm, very easy to transport; dark orange skin with attractive dark red blush; very shiny; dark orange flesh; good flavor; juicy; aromatic; smaller brown stone
Disease resistance	Resistant to PPV
Overall evaluation	Universal apricot cultivar; mainly for processing; very attractive fruits; very good flavor

VESTAR®	
Origin	'Hungarian Best' x Chinese pollen mixture
Growth	Medium vigor, low-density, flat crown, spur type
Fruiting	Regular yields
Leaves	Very large, dark green, cordate
Blossoming	Mid-season, white blossoms
Fertility	Self-fertile
Fruit	Ripens late (July 30, same as 'Hungarian Best'); very large fruit; weight 55 g; spherical; dark orange skin with attractive red blush; dark orange flesh; very good, well-balanced flavor; juicy; aromatic; large, brown stone
Disease resistance	Good level of resistance to *Gnomonia erythrostoma*
Overall evaluation	Attractive dessert cultivar; low-density crown; very good transportability; large, attractive fruits; very good flavor

DISCUSSION

The driving forces behind the program to breed genetically improved apricot cultivars in Slovakia have been the demand for greater fruit variety on the one hand, and the demand for healthy and hardy trees on the other. The foreign cultivars used in the program contribute a wide range of desirable characteristics which can be combined with the best characteristics of local Slovakian cultivars to produce improved commercial varieties.

The Chinese cultivars were good donors of fruit quality and disease resistance. The fact that PPV resistance was transmitted to a considerable proportion of the hybrids is especially encouraging. However, the Chinese cultivars do not require a high number of chilling units to break dormancy in Slovakia's climate.

The Central Asian cultivars were good donors of frost tolerant blossoms and later ripening period, but unfortunately contributed to small fruit size, pale skin color, and poor flavor.

CONCLUSIONS

Since the apricot breeding program was established in 1964, ten new apricot varieties and one new apricot rootstock have been registered: 'Vesna', 'Vegama', 'Veharda', and 'Velbora' in 1991, 'Vesprima' and 'Barbora' in 1996, 'Vestar' in 1997, and 'Veselka', 'Vemina', and 'Velita' in 2000. 'Veselka' and 'Vesna' have high quality fruits. 'Veharda' and 'Vemina' are resistant to PPV. 'Veharda', 'Vemina', and 'Vesprima' are very good for processing.

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ZNACZENIE ZASOBÓW GENOWYCH DLA HODOWLI MORELI NA SŁOWACJI

D a n i e l a B e n e d i k o v a

S T R E S Z C Z E N I E

Utrzymanie zasobów genowych na Słowacji koordynuje RIPP Piestany, w ramach narodowego programu ochrony zasobów genowych roślin. Stacja hodowli Vesele w Piestanach odpowiada za utrzymanie kolekcji moreli, brzoskwini, migdała i orzecha włoskiego. Wszystkie kolekcje zawierają 646 taksonów, a sama kolekcja moreli 319 taksonów. Program hodowli moreli rozpoczęto w 1964 roku. Wyhodowano dotychczas 10 odmian i jedną podkładkę dla moreli. Główne cele hodowlane to: wysoka jakość owoców, uzyskanie wczesnych i późno dojrzewających odmian, przydatność dla przetwórstwa, odporność na choroby itp. Jakość potomstwa zależy w dużym stopniu od użytych w hodowli genotypów. W pracach hodowlanych wykorzystano między innymi odmiany ‘Hungarian Best’, ‘Chinese landraces’, lokalne odmiany słowackie, odmiany z centralnej Azji, mieszańce z New Jersey i inne.

Zarejestrowano następujące odmiany o wysokiej jakości owoców – ‘Veselka’, i ‘Vesna’; odporne na szarkę – ‘Veharda’ i ‘Vemina’ oraz przydatne dla przetwórstwa – ‘Veharda’, ‘Vemina’ i ‘Vesprima’.

Słowa kluczowe: zasoby genowe, hodowla drzew owocowych, hodowla moreli, odmiany