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GENE POOL OF LESS WIDELY SPREAD FRUIT TREE SPECIES

V. Řezníček, P. Salaš

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Abstract

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Within the gene pool collected at the Department of Breeding and Propagation of Garden Plants of the Faculty of Horticulture, Mendel University of Agriculture and Forestry in Brno, in Lednice we established experimental plots with some selected less known tree species - quince (*Cydonia oblonga* Mill.), sea buckthorn (*Hippophäe rhamnoides* L.), Cornelian cherry (*Cornus mas* L.) and honeysuckle (*Lonicera caerulea subsp. edulis Turcy*. ex Freyn.). The experimental plots were established in successive steps according to the availability of planting material and using conventional methods of cultivation. Evaluations are focused on selected growth parameters, phenology and commercial use of the fruit.

The evaluations of the crown of quince showed differences in the size and shape. The variety Hemus had the largest crown volume (5.70 m^3); the variety Blanár gave the highest harvest yields. The sea buckthorn varieties Polmix, Dar Katuni and Novosť Altaja produced the longest increments. The average weight of the fruit of the variety Leicora was 0.74 g. The varieties of Cornelian cherry also differed in the growth parameters; the highest shrubs were those of the variety Vyšegorodskij, which also produced the largest fruit – the average weight of the fruit was 4.85 g. The initial growth of selected varieties and genotypes of honeysuckle is different when compared to the fruit-bearing shrubs. Harvest data are in direct proportion to the size of the shrub. Fruit harvest began in mid-May and vegetation ended on 15 October.

unconventional fruit species, quince, sea buckthorn, Cornelian cherry, honeysuckle, bilberries of Kamchatka

The importance of the less widely spread fruit tree species is considerable and irreplaceable. In terms of the growth conditions, the majority of these species are not very demanding and they grow even on extreme sites. They bear fruit, which has a high biological value and favourably effects human health, virtually every year. The fruit can be consumed as fresh fruit, but it can also be successfully processed in various ways as preserves. The effect of these species on the environment is significant, because their many bio-climatic, sanitary, soil-conserving, water-conservation and generally environmental functions have a favourable impact especially at the present time when interests and endeavours are concentrated on an ecologically balanced and stabilised environment.

In the gene pool collected at the Department of Breeding and Propagation of Garden Plants of the Faculty of Horticulture, Mendel University of Agriculture and Forestry Brno, in Lednice, situated in the experimental and demonstration buildings of the School Farm Žabčice, we evaluated selected growth parameters and economic properties of the following species:

- quince (*Cydonia oblonga* Mill.)
- sea buckthorn (*Hippophäe rhamnoides* L.)
- Cornelian cherry (*Cornus mas* L.)
- honeysuckle (*Lonicera caerulea subsp. edulis* Turcy. ex Freyn.).

Quince (*Cydonia oblonga* Mill.)

It is still not a widely cultivated species. In the past it used to be grown very frequently for its fruit and to the present day it can be found in older gardens and parks. Although it is very demanding in terms of climatic conditions, it can be cultivated in the warmer regions of the Czech Republic together with other thermophile species (apricots, peaches, almond, vine). In regions favourable for its cultivation it is a modest fruit, it does not suffer largely from diseases and pests. Because it is a late-flowering species, fertility is regular and annual. The disadvantage is that the fruit is not very suitable for direct consumption and requires technological processing before it is fit to be eaten. The fruit may well be a supplemental component of canned products – preserves, jam, marmalades and other products.

It is grown as a shrub or small tree with an irregular globular, or even wide-branched crown. The leaves are large, dark green, long and oval, ended off in a small apex, on the backside greyish, covered in felt. The annual shoots are grey-green to grey-brown and the surface is covered with a whitish felt. The flower buds are larger, oval-shaped and blunt. Quince flowers after it is foliaged, generally in late May. The flowers are usually pink with darker veins and are very often frequented by bees. Very rarely we can see parthenocarpic fruit without pollination.

The size of the fruit, as well as the shape, differs, from globular, widely bottle- or ball-shaped, to slightly irregular. KLIMENKO (1993) divides the species of cultural forms according to their weight into: small (less than 100 g), medium (100–250 g), large (250–400 g) and very large (400–1000 g). The weight of the fruit of the wild plants ranges from 20 to 60 g. The stalk is very short and thick and the skin is yellow-green covered in grey felt. During ripening the felt disappears and the fruit turns lemon yellow. The skin of some species remains permanently green. The flesh is tough, very aromatic, slightly bitter, and very frequently sclereids appear. The shape and size of the core differs, the ovary has five capsules and in the capsule are as many as 8 light or dark red-brown seeds, bound together by mucus secreted by the epidermis of the seeds. JANTRA (1996) drew attention to the difference in the fruit quality based on the shape; the apple-shaped fruit is harder, drier and more aromatic that the pear-shaped fruit, which is juicier, less granular, finer and softer. The fruit contains 124.0 $g.kg^{-1}$ of sugar, 16.0 $mg.kg^{-1}$ of fibre, 3.7 $g.kg^{-1}$ of ash and 100 $mg.kg^{-1}$ of vitamin C – ascorbic acid (KOPEC, 1998).

The plant flourishes on warm and adequately humid soil. Most convenient are sites in an altitude of not more than 250 m, average annual temperature 7–10 °C and sum of precipitation not more than 600 mm. It requires light loamy-sandy soil (DLOUHÁ et al., 1995).

In terms of energy, the vitamin content and nutritional value the fruit is superior to most of the other pomaceous fruit. It is used to make marmalade, fruit jelly, preserves, cider and wine, but also aromatic mustard, paste, fruitcakes and quince cheese; it is an ingredient of various meaty meals and fillings and it can be dried and candied.

In pomology the vegetatively propagated types of quince are used as dwarfing stock for selected pear varieties. The most widely spread variety is Champion, or the less frequently occurring varieties Bereczkeho and Portugalska.

Cornelian cherry (*Cornus mas* L.)

The Cornelian cherry is used both as an ornamental and commercial plant. In early spring at the time of flowering, when a large amount of superficial pollen is produced, it is very important for bees. The fruit – berries are eaten either as fresh fruit or they are processed in various ways.

It is a thermophilic fruit tree species; the wood, or also at the time of flowering, it is frost-resistant. It flourishes on sunny and drier flat or sloping sites and is very demanding in terms of temperature and light. The most suitable soil is sandy to loamy-sandy with alkali reaction.

The shrubs grow to a height of 4 m, the leaves are opposite, elliptic, dark green, with a protruding venation. It blossoms out on short lateral sprigs before foliage appears. The flowers are pendiculate, yellow, in umbellar bundles. The elongated stone fruits come out in various shades of red and have a hard two-seed elongated stone. In technological and market maturity the fruit is dark red; it ripens from late August to mid-September.

KLIMENKO (1990) reports that the biochemical content of the fruit is affected by environmental conditions and market maturity. The content of sugar ranges between 5.0 and 8.9%, the content of acids from 1.0 to 2.4% and of ascorbic acid from 68.6 to 99.8 mg%.

The biological value of the fruit is very high (DOLEJŠÍ, KOTT, ŠENK, 1991). In addition to the economic effect, the fruit can also be used to improve the environment. Two varieties of the fruit are known, i.e. Devín and Titus, which come from a selection of 11 localities of Vihorlat, Strážovská hornina and Moravské předhoří.

Sea buckthorn (*Hippophäe rhamnoides* L.)

The plant grows virtually all over Europe, also in west Asia and south Siberia. In the Czech Republic it is considered to be a less known species and is one of the youngest cultures. It is very often planted as an ornamental plant, it is useful for reinforcing sandy soils against erosion as it grows numerous root sprouts and produces generally vital stands. It is used on sites with extreme conditions; it is the least demanding woody species and is frost-resistant.

The spreading thorny shrubs grow up to a height of 2 m. The leaves are narrow, on the backside silver to silver-grey. It is a dioecious plant, the pistillate flowers are small and yellowish, the staminate flowers produce short catkins clustered around thorny lateral twigs; it blossoms in April and May. The colour of this stone fruit is orange and it ripens from August to early September. Harvesting is very difficult and it has not yet been technologically fully mastered, so manual harvesting is traditional. Flowering and fertility appear in the 3rd year after planting.

The biological value of the fruit, including its curative anti-infection effects, is very high. High is also the content of vitamin C (130–150 mg.kg^{-1}), provitamin A (9–12 mg%), vitamins of the B group, sugars, organic acids, tannins and other effective substances. Very popular is the consumption of fresh fruit with honey, but it can also be used for making preserves, syrup etc.

The shrub grows well on soils with a sufficient content of calcium; it also tolerates sites affected by excess amounts of pollution and it is a considerably long-age plant. The pistillate and staminate plants are planted together in a 1 : 6 ratio. Pistillate plants are planted on the windward side to increase the effect of pollination.

The improved varieties produce larger fruit with a higher content of sugar and lower content of tannins. They bear fruit regularly and have fewer thorns. The varieties are Dar Katuni, Olejová, Novosť Altaja, Polmix, Hergo, Leicora and Vitamínová. Wider distribution of the plant is dependent on undemanding and easy harvest and on simple pollination conditions.

Honeysuckle (*Lonicera caerulea subsp. edulis* Turcy. ex Freyn.)

In the area of fruit growing various taxons of *L. edulis* Turcz Ex Freyn. L., *L. kamtschatika* (Sevast.) Pojark, *Laltaica* Pall., *L. turczaninowii* Pojark., are cultivated, indicated under the common name "bilberries of Kamchatka". The reason why this fruit is becoming so popular is the interest of consumers in tasty, healthy and dietetic fruit.

It is a new modest fruit species, which provides edible and valuable small fruit exceedingly early to ripen. It forms a densely branching bush of medium growth, 1.5 to 2.0 m high. The bark is red-brown and peels off in long strips. Typical is the formation of epicormic shoots. Annual increments range around 0.2 m according to the growing capacity of the bush. The winter buds stick out and grow above each other. The leaves are deep green, lanceolate and in autumn they are coloured wine-red with antokyan.

Initial growth is dependent on the rapid development of flowers. The flowers are bisexual, tubular, yellow to yellow-green. They usually grow out in pairs; single flowers appear only sporadically. They provide good quality nectar and are much sought after by bees. Open flowers tolerate spring drops in temperatures to –8 °C. After they finish blossoming they ripen within 30–42 days. The berries are dark blue with a waxy coating, of various shape (most frequently they are cylindrical), they are 15–35 mm long, 9–18 mm wide and the weight ranges between 0.7 and 1.4 g. The fruit is slightly aromatic, tasty and attractive to look at. The earliest varieties mature in the second half of May, the medium-early varieties in early June and the late varieties in July. The seeds are small, flat and round. Differentiation of the floral buds takes place immediately after the fruit ripens. Very frequently recurring flowers appear which usually blossom in August and the fruits ripen in September. The end of the vegetation period when the plants shed their leaves takes place in mid-October. Dormancy is relatively short. It is a light-demanding plant and is very frost resistant. It requires a relatively small sum of temperature for growth in the spring and during ripening of the fruit. Suitable are more humid soils (but not waterlogged) with a sufficient content of humus. The optimal soil reaction is slightly acid to neutral.

The berries contain a considerable amount of nutrients; in addition to sugars and acids, they contain 30–70 mg.100g^{-1} of vitamin C, vitamins of group B, 640–700 mg% of rutin and mineral substances. Their scope of use is very broad, from fresh table fruit to various preserves. They are also used in popular healing methods to strengthen blood vessels, against spring fatigue etc.

Basing on the expected interest we can offer the "bilberries of Kamchatka", "honeysuckle" (without giving the variety). The perspective is focused on minimal varietal composition ensuring earliness of harvest, taste and size of fruit.

Experimental part

Experimental plots of the above fruit species in the School Farm Žabčice have been established in successive steps since 1994 to the present using conventional methods of planting (strip planting). Each variety (genotype) of the species under study

was planted out in 3 replications of 3 plants each. Cultural practice involves cutting, cultivation, nutrition and fertilisation, pest and disease control. The strip along the stems is cultivated on a regular basis with bare fallow between the rows.

In terms of growth factors we evaluated the crown volume, volume of the shrub (m^3), shape – habitus, phenological data – phenophase, damage due to low temperatures, harvest data, pomological features. The evaluations have been conducted on an annual basis since the establishment of the planting. The coefficient of variability was used to evaluate the crown volume.

The harvested fruit is subjected to laboratory determinations of the content of vitamin C, the refractometric dry matter, and the content of the respective elements in the fruit dry matter (P, K, Ca, Mg, Na). We evaluated 25 varieties and genotypes of quince – Adamsova, Aleša, Asenica, Blanár, BO-3, Brna, Buchlovická, Bzenecká, Hemus, Hruškovitá, Champion, Izobilnaja, Jurák, Kocúrova, Krymská, Krnovská, Leskovačka, Malinka, Mir, Muškátová, Otličnica, Pinter, Selena, Triumph and Úspěch.

Evaluations of sea buckthorn were focused on a set of 8 varieties and genotypes – Buchovický, Dar Katuni, Hergo, Leicora, Novosť Altaje, Olejová, Polmix and Vitamínová.

The group of Cornelian cherry contains 10 varieties and genotypes grown as shrubs. For planting we used grafts and rootstock of the Cornelian cherry seedling. We evaluated the following varieties: Elegenatní, Fruchtal, Jaltský, Lukjanovskij and Vyšegorodskij.

Plantings of honeysuckle include 30 varieties and genotypes – Altaj, Amfora, Amur, Bakcarskaja, Fialka, Goluboje vereteno, Jalská, Kamčadalka, Lebeduška, Leningradskyj velikan, Lipnická, Morena, Nymfa, Pavlovská, Roxana, Sinoglaska, Tomička, Valchova, Vasiljevská, Vasjuganská, Viola, Zoluška, L-KL-2, L-KL-5, L-KL-6, L-KL-7, L-KL-15, L-KL-20, L-KL-21, L-KL-35, and seedlings from the Lonicera hispida and Lonicera altaica expedition.

The varieties of the respective species were obtained within the framework of co-operation with our plant producers from abroad: Central Botanical Orchard im. N. N. Grisko Kiev; VIR Sankt Peterburg; Bundessortenamt Prüfstelle Wurzen; and others.

Achieved results

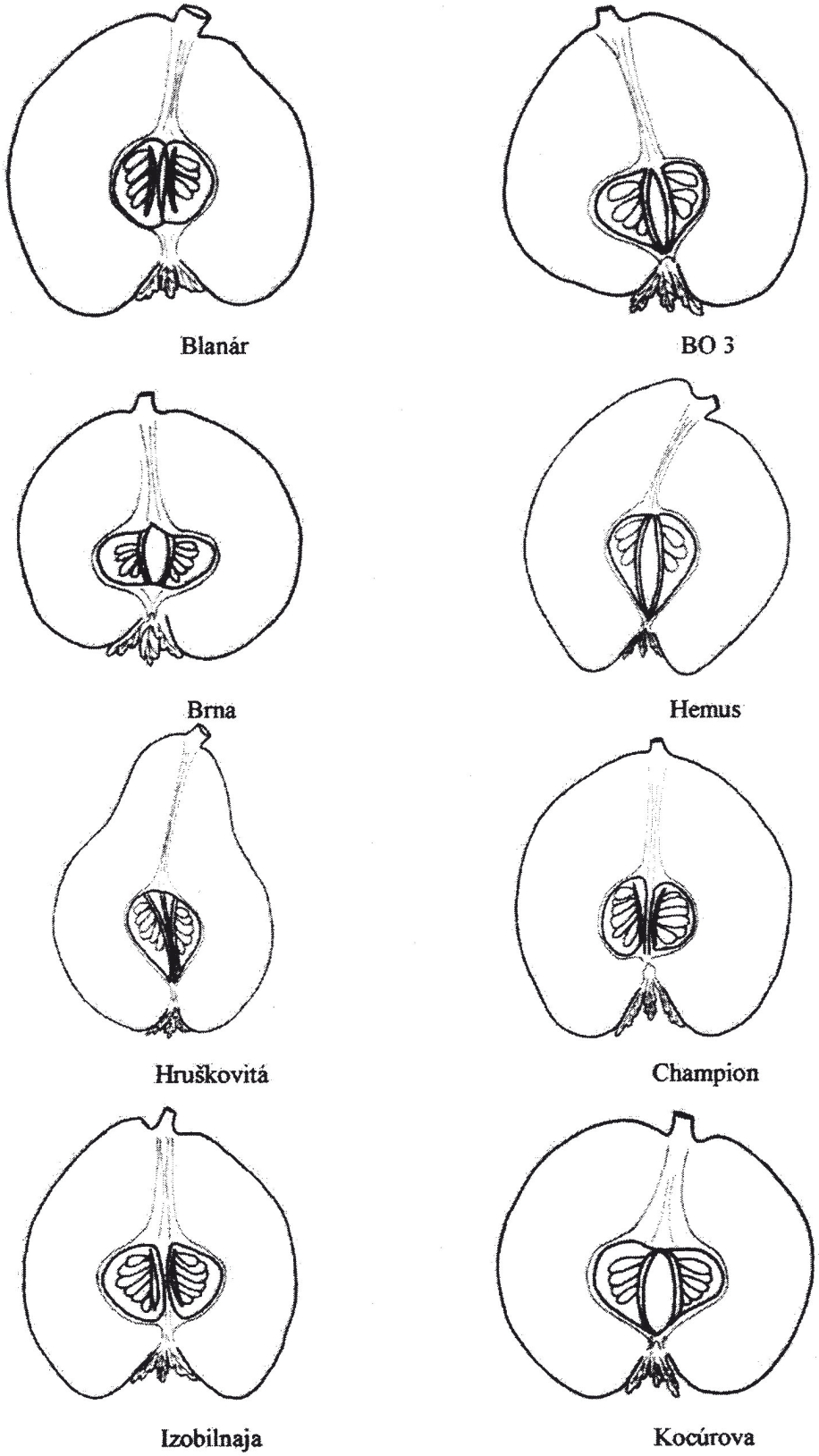
The evaluated parameters are very extensive and are presented in terms of their cultivation importance; only some are presented in tables or figures.

Quince

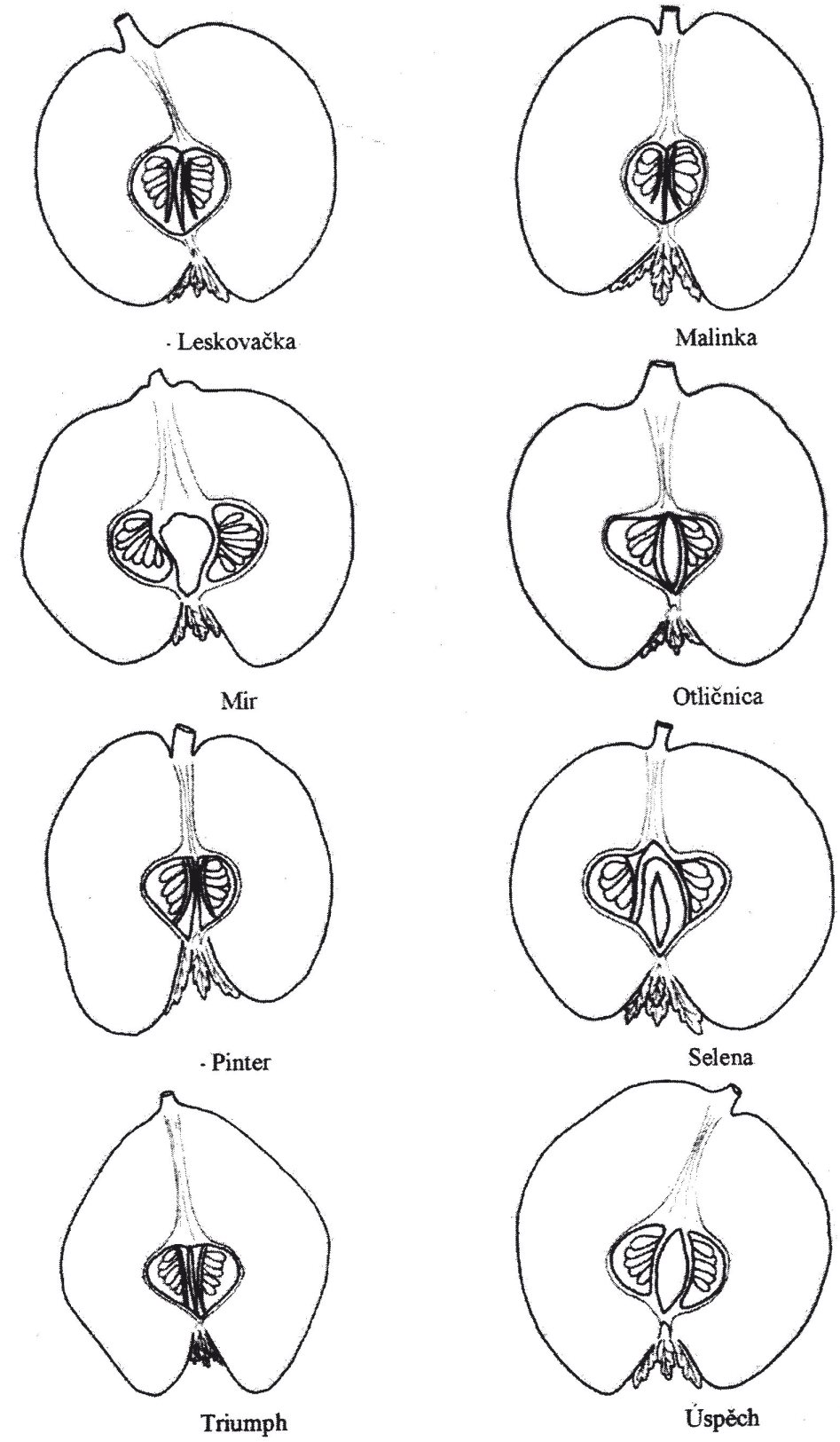
The results of evaluations of growth parameters of 25 varieties and genotypes showed differences in the size and shape of the crown. After five years of cultivation the following varieties had the largest crowns: Hemus – 5.70 m^3, Triumph – 5.56 m^3 and Blanár – 5.33 m^3. On the contrary the varieties Aleša, Mir and Malinka had the smallest crown volume, i.e. 2.30, 2.70 and 2.46 m^3, respectively. The highest variability among the respective years was observed in the varieties Úspěch – 11.01% and Asenica – 9.18%, and the lowest in Malinka – 2.24%. The shape of the crown was assessed in points from 1 to 9 and for the majority of varieties the results were positive (7-9); we estimated the formation of skeletal branches, their overgrowing and general appearance. In the studied period the varieties Triumph, Úspěch and Pinter showed perspective shapes (8.75, 8.30 and 8.23, respectively).

The varieties Adamsova, Asenická and Krymská were damaged by low temperatures. A very high degree of resistance against low temperatures was achieved in the varieties Blanár, Malinka, Pinter, Selena, Triumph and Úspěch.

Harvest data in the studied period varied among the varieties. The highest annual yields for the 3-year period were achieved in the varieties Blanár – 27.23 kg, Hemus – 26.67 kg and Triumph – 20.03 kg per tree. Fruit of the highest average weight was produced by the varieties Triumph (394.71 g), Hruškovitá (309.81 g) and Hemus (297.84 g). Pomological data focused on evaluations of the external and internal parameters characterise the respective varieties. Although the shape of the fruit was very variable, we can distinguish characteristic shapes – apple-shaped, pear-shaped etc. (Fig. 1, 2).



1: *Pomological evaluation of quince*



2: *Pomological evaluation of quince*

Sea buckthorn

The individual varieties differ in the growing capacity and shape of the shrub. The variety Polmix can be indicated as having a good growing capacity and dense branching. Contrary to this variety are Hergo and Buchlovický. The length of the increments of different age differs among the varieties. Long increments are characteristic for Polmix, Dar Katuni and Novosť Altaja. On the other hand, low values were revealed in the Hergo and Buchlovický varieties (Tab. I). The picking maturity, size of the fruit and also fertility based on the length of increments differs among the varieties. The variety Leicora produced fruit of the highest average weight (0.74 g), followed by Buchlovický (0.68 g) and Olejová (0.53 g). The variety Hergo produced the highest number of fruit per 10 mm of increment – 5.40; lower values were reported in the varieties Leicora and Buchlovický, i.e. 4.20. (Tab. I).

Cornelian cherry

The growth values differ among the varieties. The variety Jaltský has the highest shrub (1.35 m), followed by Vyšegorodskij (1.14 m) and Vydubeckij (1.10 m). Low shrubs are characteristic for Fruchtal (0.71 m), which also showed the highest number of increments (25.03) per shrub and shortest length of the shoots (0.12 m). In addition, this variety had the highest rating in points in the formation of the generative zone – floral buds and was followed by Vydubeckij and Lukjanovskij. The variety Vyšegorodskij produced the highest fruit harvest and the largest fruit; the 3.25 mm length and 17.10 mm width ranks this variety among the largest fruit. The weight of the fruit was 4.85 g.

Honeysuckle

The growth data characterise the properties of the individual varieties and genotypes. The initial growth of the planted out shrubs differs more than of shrubs at a later period of growth – the period of fruit-bearing. The growth of the variety Viola is very intense, the growth of the varieties Morena and Roxana is weak, while the other evaluated varieties can be characterised as having a medium growth capacity (Tab. III). In terms of the height of the plants explored in the following stage, the variety Altaj was the highest (0.88 m), and the variety Pavlovská and the genotype L-KL-5 were low (0.30 and 0.31 m, respectively).

In the past two years the phenological stage, beginning of flushing and formation of annual shoots was affected by the early onset of spring and increased temperatures. In most varieties the fruit-bearing period began between 9 and 14 May, and fruit bearing ended between 17 and 23 May. The beginning of secondary growth of annual shoots differed considerably and ranged between 15 and 27 June. Leaf shedding began in September and ended on 15 October.

Harvest data are in direct proportion to the size of the shrub. The harvest of 2-3-year-old plants not yet reaching the corresponding size was relatively low. The other data, the exceptionally high resistance against low temperatures and also against diseases and pests, make this species very valuable.

I: *Average values of growth parameters (sea buckthorn)*

Sequence	Variety-genotype	Total increment length (m) per shrub			Number of fruit (fruit. 10 mm^{-1} length of branch)	Weight of fruit (g.10 mm^{-1} of length of branch)	Weight of fruit (g. $fruit^{-1}$)
		3-year	2-year	one-year			
1	Buchlovický	2.85	5.36	9.70	4.20	2.85	0.68
2	Dar Katuni	3.40	11.70	14.50	4.10	0.63	0.30
3	Hergo	2.56	7.62	9.40	5.40	1.72	0.32
4	Leicora	3.10	9.45	10.70	4.20	3.10	0.74
5	Novosť Altaja	3.85	12.70	12.10	2.70	0.78	0.29
6	Olejová	3.20	10.30	11.85	3.80	2.01	0.53
7	Polmix	4.30	12.70	15.40	-	-	-
8	Vitamínová	3.40	11.10	9.80	3.10	1.11	0.36

II: *Average values of growth parameters (Cornelian cherry)*

Sequence	Variety-genotype	Total length of increment (m.shrub^{-1})	Number of shoots.shrub^{-1}	Average length of shoots (m.shrub^{-1})	Height of shrub (m)
1	Jaltský	3.80	19.90	0.19	1.35
2	Elegantní	2.75	16.58	0.70	0.94
3	Lukjanovskij	4.52	24.50	0.18	0.95
4	Vyšegorodskij	2.28	15.90	0.19	1.14
5	Vydubeckij	2.34	13.86	0.17	1.10
6	Fruchtal	2.73	25.03	0.11	0.71

III: *Average values of growth parameters (honeysuckle)*

Sequence	Variety-genotype	Height of shrub at end of vegetation (m)	Growing capacity of shrub
1	Fialka	0.77	medium growth
2	Goluboje vereteno	0.66	medium growth
3	Jaltská	0.84	medium growth
4	Kamčadalka	0.75	medium growth
5	Lipnická	0.72	medium growth
6	Morena	0.45	weak growth
7	Nymfa	0.80	medium growth
8	Roxana	0.46	weak growth
9	Sinaja Ptica	0.73	medium growth
10	Tomička	0.72	medium growth
11	Vasjuganská	0.77	medium growth
12	Viola	1.30	weak growth
13	Zoluška	0.70	medium growth
14	L. kamtschatica	0.92	medium growth
15	L-KL-21	0.63	medium growth

IV: *Laboratory assessment of refractometric dry matter (Rf°) in fruit of selected varieties and genotypes of* honeysuckle

Sequence	Variety-genotype	Refractometric dry matter (Rf°)
1	Fialka	8.33
2	Goluboje vereteno	9.70
3	Jaltská	10.72
4	Kamčadalka	9.70
5	Lipnická	9.10
6	Morena	10.35
7	Nymfa	10.92
8	Roxana	8.25
9	Sinaja Ptica	10.00
10	Tomička	11.13
11	Vasjuganská	10.80
12	Viola	10.47
13	Zoluška	9.45
14	L. kamtschatica	9.80
15	L-KL-21	10.30

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Address

Prof. Ing. Vojtěch Řezníček, CSc., Dr. Ing. Petr Salaš, Ústav šlechtění a množení zahradnických rostlin, Mendelova zemědělská a lesnická univerzita v Brně, Valtická 533, 691 44 Lednice, Česká republika