

MAPPING OF TRADITIONAL AND REGIONAL VARIETIES OF APPLE TREES AND PEAR TREES IN KROMĚŘÍŽ AREA

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Abstract

In the present work, the current state and representation of traditional and regional fruit varieties of apple trees and pear trees in the form of high-trunk were surveyed in the territory of southeastern Kroměříž district in the region of the Litenčice Hills. The research was carried out during the years 2009–2013. The variety, the age of the tree, the growth characteristics (tree height, trunk thickness, crown diameter and dryness) and health status were evaluated. The record of 972 old fruit trees of apple and pear trees were registered in selected municipalities. Pomological determination was made on 840 trees, of which 700 were apple trees and 140 were pear trees. In total, 104 varieties of apples and 44 varieties of pears were found. The most common apple varieties were 'Baumannova reneta' and 'Panenské české' and the most common pear varieties were 'Boscova' and 'Hardy'. Out of the total number of fruit trees recorded, 274 were nominated for conservation in respective genepools, of which 57 were pear trees and 217 were apple trees. The main criteria for this selection were the overall condition of the tree and its perspective, the quality of the fruit, the variety and its importance. The results of this work will be used to restore and settle the existing orchards and alley in the region. The identified species and variety composition will be used for newly established thickets in the extensive farming system and involvement in the territorial system of ecological stability of the studied area.

Keywords: traditional varieties, regional varieties, pear, apple, mapping, Kroměříž district

INTRODUCTION

Fruit trees belong to the most impressive elements in the landscape. Their importance in ecology, economy, breeding, aesthetics, culture, history and society is mentioned most often.

Significance and value of semi-cultural forms, regional and elderly grown varieties is often emphasized with their gradual loss.

In the last sixty years, the visage of the landscape has been unprecedentedly changed in Czech Republic as well as in the world as a result of the deflection from former traditional ways of fruit growing and agricultural activity in general. Present agricultural production is focused on cultivation of narrow spectrum of crops on large fields with no landscape-forming elements like thickets, boundaries, field alleys, high-rise orchards. In recent studies, almost 90 % reduction of mentioned planting types around towns was found compared to the conditions before intensification of agriculture (Holubec *et al.*, 2012). Maxted *et al.* (2006) has argued that landrace diversity is the most highly threatened component of biodiversity today, and there is only little knowledge of how much diversity actually exists. Food and Agriculture Organization of the United Nations (FAO, 2010) highlights on almost 95 % loss of varieties, which were grown in the early 20th century. Nowadays, genetic erosion is accelerated like never before in the past by a change in farming practice in the countryside and in the life of people in the country. For this reason, it is necessary to protect and conserve genetic resources worldwide (Cinca, 2009).

The re-use of fruit trees of old and regional varieties in the restoration of landscape features is a direct way for man to connect broken links with surrounding nature, the state of which has a multifaceted impact on the quality of our lives. Genius loci represents the traces of the past in our present time, and fruit trees in the Moravian landscape are though one of the elements of this characteristic (Salašová, 1999).

Creation of cultural landscape and its maintenance should be of the first interest of society. Ambition for intensive production and for maximum effect from every agricultural activity cause in many cases worse life conditions and disrupt natural equilibrium of ecosystems.

A prerequisite for a targeted search for a missing gene pool of fruit trees is the inventory of growing trees especially in old orchards, fruit nurseries, parish gardens, open-air museums, valuable sources of valuable information are old experts and witnesses.

There is an unclear line between regional varieties and old cultivars. Boček (2008) perceives the aspect of time in the term “traditional variety” and the aspect of space in the term “regional variety”. Tetera *et al.* (2006) shows that the traditional varieties are all that reach the age of several decades since its outset or dissemination. The time limit can then vary considerably depending on the individual concept. Hans Thomas Bosch use very interesting distribution according to Boček (2008), which divides the varieties by age into 3 categories, the historical (originated before 1870), classic (originated between 1870–1950) and modern (originated after 1950). Proskowetz (1925) indicates that regional varieties are farming varieties of cultivated crops that have undergone a century-old, collaborative selection and excellent natural conditions. It is therefore necessary for a regional variety to be first cultivated in the same landscape and to stabilize its characteristics. Vaněk (1935) describes that a large number of varieties have originated randomly and only a few have been cultivated by deliberate breeding, and for some significant features and characteristics they have been cultivated in the region or eventually spread to other areas.

Tetera (2006) describes and classifies varieties according to their origin, distribution, use and meaning under the designation: Cultural varieties, Local seedlings, Local varieties, Old varieties, New varieties, Significant varieties, Vanish varieties and Collection varieties. Each variety may belong to different designations at the same time. For example, the local variety ‘Jadernička moravská’ is an old and also significant variety, and the ‘Golden Delicious’ market variety is considered to be a Cultural, Old variety, and from the point of view of origin it is a local random seedling.

MATERIALS AND METHODS

Specification of the subject of mapping

The fruit trees in the cadastral areas of selected municipalities of the surveyed region in orchards or alleys with a number of old high-rise fruit trees, and stand-alone solitaires in private gardens, in the thickets along the fields were observed. The variety survey was focused on apple and pear trees.

Surveyed area

The surveyed area is located in the southwestern part of the Kroměříž district and includes the cadastral areas of the villages Honětice, Hoštice, Kunkovice, Lhota u Pačlavic, Litenčice, Morkovice,

Nítkovice, Pornice, Prasklice, Strabenice, Troubky, Uhřice, Zdislavice and Bojanovice (Fig. 1). The municipalities were selected because of their close relative location – the adjoining cadastral area, which forms, apart from Bojanovice, one unit situated in the western part of the district. The selection was also made with a view of the continuity of further mapping. The motivation for the survey was also the rich fruit history of the region and the very good conditions for fruit trees growing.

From the geomorphological point of view, the region belongs to the Litenčice Hills with an altitude in the range from 228 to 277 m above sea level, where the erosion-denudation hilly to highlands relief of the Central Moravian Carpathians prevails. The flat surface of the Litenčice Hills was created on miocene sediments and on a low-resistant flysch.

It is an agricultural landscape with predominantly long, moderate slopes and small forests in the highest parts.

As regards soil in this part of the district, Pararendzina Cambizem was formed on the marl and slopes of carbonate flysch slate as a dominant component in the association with brownfields. In the flatter parts of the Litenčice Hills there is a chernozem on the loess.

The surveyed area belongs in the temperate climate. The average annual air temperatures in the lower parts of the Litenčice Hills are up to 8 °C, at their peaks below 7 °C. The precipitation is slightly above normal with an average rainfall of about 703 mm. A rich history of agricultural activities on the breeding and selection of quality varieties of agricultural crops was found in the studied area. Nowadays, in relation to

the problem solved, the negative phenomenon of unbearably large plowed areas of fields open to wind and water erosion appears.

Methodology of exploration of old and regional varieties

In the first stage, the method of registration is the basic ground survey and the recording of places with old and regional varieties of apple and pear fruit. Data about the history of growing and processing of fruit in municipalities was carried out based on a questionnaire and direct contact with local people. The historical-ethnographic method according to Tetera (2003) was used to find out the existence and frequency of fruit names in the studied region.

The main points of the survey were:

- collection and the professional pomological determination of the fruits from the selected trees
- Pomological characteristics of trees in selected localities with a focus on regional varieties.
- Measurement of growth characters: trunk diameter, tree height and crown width.
- Evaluation of tree health status by nine-point scale (1 – critical, 9 – excellent).
- Evaluation of the variety composition of the studied areas and design of perspective trees of suitable varieties for professional treatment.

Pomological characteristics are based on available literature Boček (1954), Černík *et al.* (1961), Kohout (1960) and Tetera (2006) and further on consultations with experts Ing. Václav Tetera, CSc., Prof. Ing. Vojtěch Řezníček, CSc. from the experience of solver of the survey from the conducted mapping in municipalities Rusava, Fulnek.



1: Area of interest (red point near to Kroměříž).

Data source: orthophoto map – © ČÚZK, www.cuzk.cz

RESULTS AND DISCUSSION

A number of fruit varieties have been originated in the Czech Republic, what is supported by records from the beginning of the cultural development of this territory. According to current pomology studies, 200–400 preserved original regional varieties of fruit trees are estimated in Czech Republic (Holubec, 1996; Holubec *et al.*, 2012).

Holubec (2012) evaluates the range of regional varieties found in the Czech Republic over the last 20 years. Regions with a higher probability of occurrence of regional varieties, especially mountain areas, national parks and protected landscape areas (Šumava, Krkonoše, Orlické Mountains, Podyjí, White Carpathians) were mapped out preferably. The estimated age of selected trees was 150–200 years. The regional varieties of apples 'Velňák', 'Kanefl', 'Stražinec' and pear 'Václavka', 'Neznámka', 'Knigger' were recorded. The most valuable varieties were suggested for *ex situ* and *in situ* conservation. Interesting local varieties were designed for *in-situ* conservation on the territory of national parks and protected landscape areas. Selected regional varieties are also kept *ex situ* by VŠÚO Holovousy and Mendel University in Brno. Part of the varieties is recommended for on-farm conservation at local fruit growers.

Not much data regarding occurrence of old and local fruit varieties in the studied region can be found. The older records include the following: The Czech Department of Agricultural Council for the Moravian Margrave (Rozkošný, 1905) proposes in the normal selection of fruit varieties 19 apple varieties and 22 pear tree varieties suitable for the Kroměříž region. Suchý (1907) describes 22 apple varieties and 22 varieties of pear trees selected for cultivation in Zdounecko region. In mentioned selections (1905, 1907 and current mapping) the following are the same: apple trees in the varieties: 'Landsberská reneta', 'Ontario', 'Krasokvět žlutý', 'Croncelské', 'Boskoopské', 'Baumannova reneta', 'Blenheimská reneta', 'Boikovo', 'Gdánský hranáč', 'Panenské české', 'Parména zlatá zimní', 'Strýmka' and pear trees in the varieties: 'Hardyho', 'Charneuská', 'Pastornice', 'Špínka', 'Boscova', 'Avranšská', 'Křivice'.

Bleša (1965) studied the occurrence of local varieties. He describes three varieties of apple trees found in the Kroměříž region – 'Kysňatka', 'Špiška', 'Chřibská reneta'. Tetera (2006) mentions the local variety 'Kysňatka' originating in Roštín in the Kroměříž region.

In the mapped area, extensive fruit orchards and alleys are now widely used. Coherent plantings of

apple and pear high-rise trees were recorded in the municipalities of Hoštice, Litenčice, Morkovice, Nítkovice, Troubky, Zdislavice and Bojanovice. Fruit trees are also recorded in tree-lines and individually in gardens. Recorded trees do not include all apple trees and pear trees in the form of high-rise trees in the studied municipalities. The inventory provides an overview of the most frequently represented varieties and should be a recommendation for a selection of varieties in the restoration of plantations.

In the noticed records during the period 2009–2013, 972 of old apple and pear trees were recorded in selected municipalities. Pomological determination was made on 840 trees, of which 700 were apple trees and 140 were pear trees. In total, 104 varieties of apples and 44 varieties of pears were found. The most frequently occurred varieties are shown in Fig. 2. for apple trees and in Fig. 3. for pear trees.

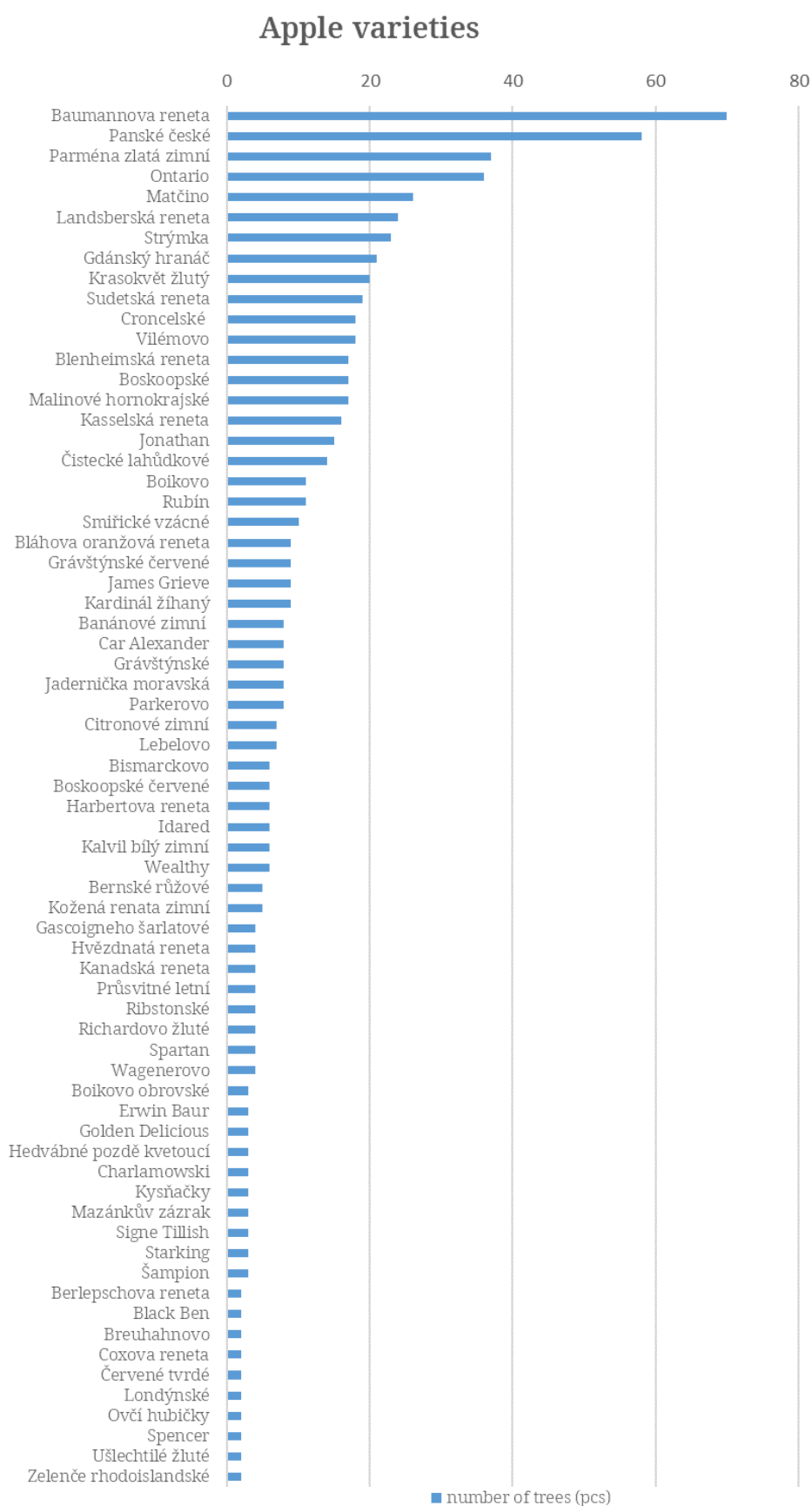
Several interesting seedlings, considering the fruit quality, were recorded and described in the survey. These were predominantly the bearer rootstocks in the municipalities Zdislavice, Hoštice, Uhřice and Kroměříž. Two seedlings were deliberately planted, and quality monitored for 40 years in the garden of Mr. Šušlík from Vážany u Kroměříže.

Neglect of basic care can be observed in trees and vegetation in general in the monitored area. Nevertheless, some of the trees can be considered as perspective, mainly thanks to the professionally made pruning at the time of planting. Corresponding distribution of scaffold branches prevents the crown breaking under the weight of the fruit at the later age of the trees and the subsequent settlement of the breaks by wood-carving pathogens (mushrooms, insects, etc.).

Of the total number of fruit trees recorded, were 57 pear trees, 217 apple trees nominated to a conservation of the gene pool. The main criteria for this selection were the overall state of the tree and its perspective, the fruit quality, the variety and its importance.

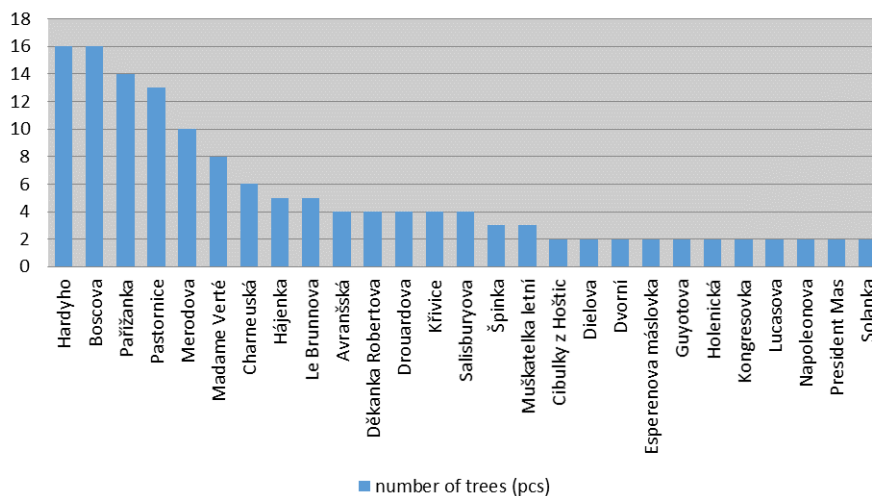
The highest number of trees proposed to a conservation of the gene pool was for these varieties:

- apple trees: 'Vilémovo', 'Baumannova reneta', 'Landsberská reneta', 'Panenské české', 'Parména zlatá zimní', 'Kasselská reneta', 'Blenheimská reneta', 'Matčino', 'Gdánský hranáč', 'Jonathan', 'Krasokvět žlutý', 'Strýmka';
- pear trees: 'Hardyho', 'Avranšská', 'Merodova', 'Boscova lahvice', 'Charneuská', 'Le Brunnova', 'Muškatelka letní'.



2: Incidence of the most frequently found apple varieties in the mapped area

Pear varieties



3: Incidence of the most frequently found pear varieties in the mapped area



4: Fruits of apple tree 'Vilémovo'



5: Fruits of pear 'Avranšská'

The gene pool varieties of the apple tree 'Vilémovo' (Fig. 4.) and the pear tree 'Avranšská' (Fig. 5.) were the most common in comparison with the overall frequency of occurrence of the varieties.

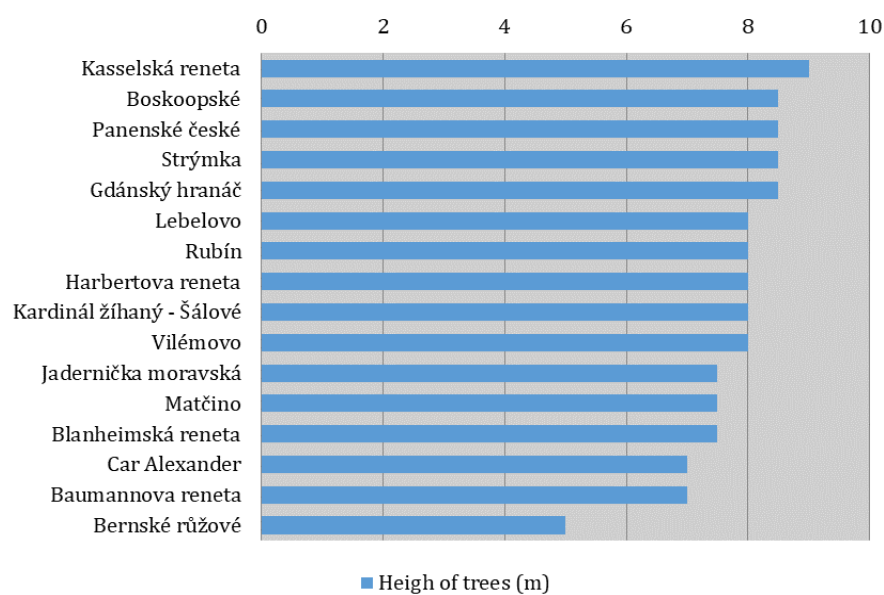
The highest trees belonged to apple varieties 'Gdánský hranáč' from Litenčice and 'Kasselská reneta' from Nítkovice, both 11 meters high. 'Panenské české' from Nítkovice, 'Strýmka' from Hoštice and 'Vilémovo' from Zdislavice were 10 meters high and 'Blenheimská reneta' from Nítkovice, 'Boskoopské' from Prasklice, 'Harbertova reneta' from Nítkovice, 'Hedvábné pozdě kvetoucí' from Nítkovice and 'Kardinál žiháný' from Zdislavice was 9 meters high. Among the pear trees were the highest 'Muškatelka letní' (18 m) from Honětice, 'Charneuská' (13 m) from Litenčice, 'Cibulky z Hoštic' (12 m), 'Salisburyova' (11 m), 'Špinka' (11 m) from Zdislavice, 'Výrostkova hruška z Hoštic' (11 m) 'Avranšská' (10 m) from Hoštice, 'Guyotova' (10 m) from Zdislavice and 'Le Brunnova' (10 m) from Zdislavice.

Figures 6. and 7. show the highest average height of tree trunk for varieties from the total number of individually recorded varieties.

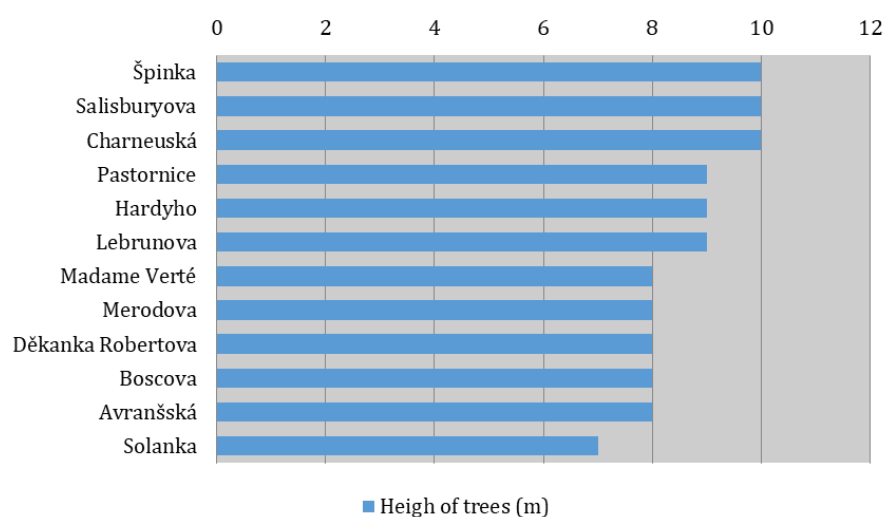
The smallest trees were recorded in apple varieties 'Bernské růžové' (4 m), 'Boikovo' (4 m) and pear tree variety 'Pařížanka' (5 m).

Trees with the largest diameter of the trunk were found in apple varieties 'Kasselská reneta' (70 cm) from Nítkovice, 'Boskoopské' (70 cm) from Prasklice, 'Panenské české' (70 cm) from Nítkovice and 'Blenheimská reneta' from Nítkovice; and in pear varieties 'Muškatelka letní' (80 cm), 'Cibulky z Hoštic' (80 cm), 'Špinka' (80 cm), 'Výrostkova hruška z Hoštic' (80 cm), 'Charneuská' (70 cm), 'Merodova' (70 cm).

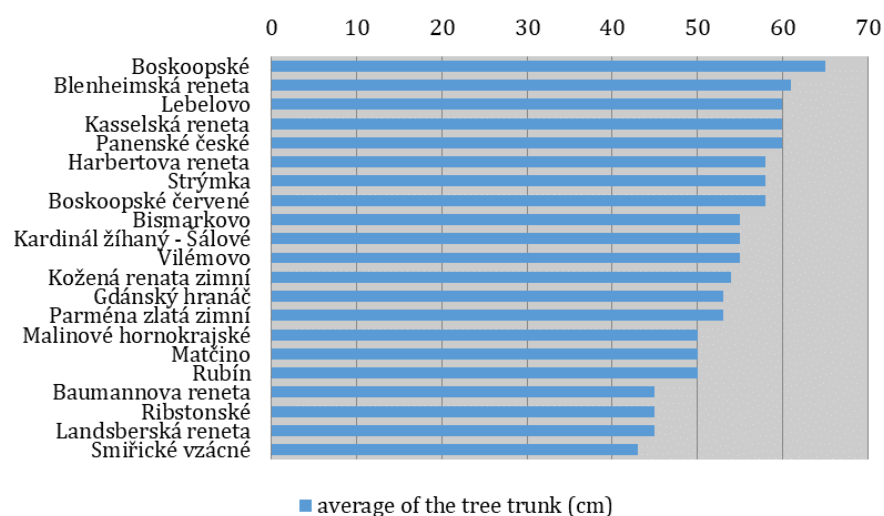
The average trunk thicknesses (Fig. 8. and 9.) were the largest for the apple trees 'Boskoopské' (65 cm), 'Blenheimská reneta' (61 cm), 'Kasselská reneta' (60 cm), 'Panenské české' (60 cm) and for the pear trees 'Cibulky z Hoštic' (70 cm), 'Špinka' (70 cm), 'Muškatelka letní' (60 cm).



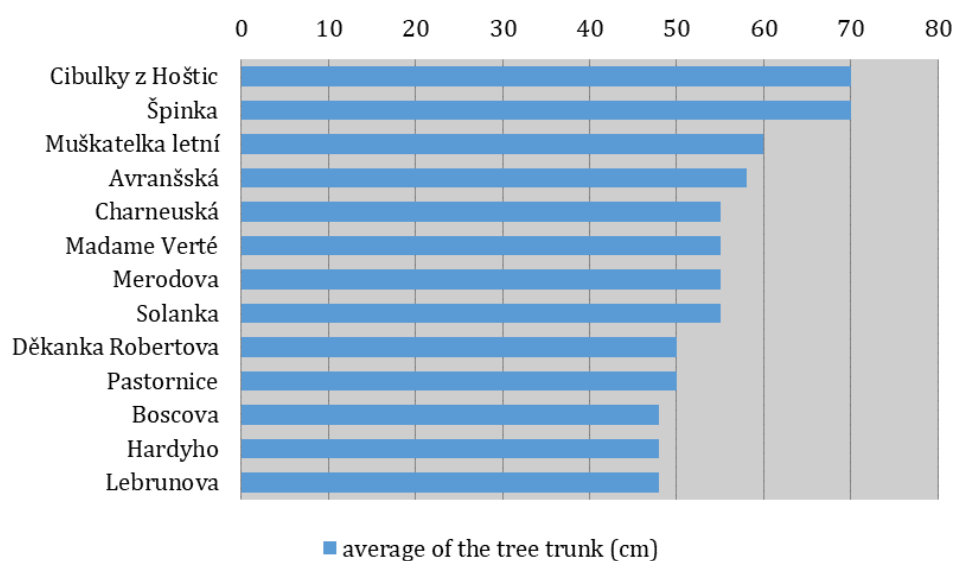
6: Apple tree varieties with the highest average height of tree trunk in the mapped area



7: Pear tree varieties with the highest average height of tree trunk in the mapped area



8: Apple tree varieties with the largest average trunk thickness in the mapped area



9: Pear tree varieties with the largest average trunk thickness in the mapped area

The value of the thickness is significantly related to the tree height. Significant influence on trunk dimensions has rootstock and grafting method. Information about rootstock is not available. According to the found fruits on the rootstocks, they are usually seedlings of old and regional varieties such as 'Panenské české', 'Croncelské', 'Jadernička moravská' and 'Strýmka'. Grabbing was practiced mostly in the height of a trunk shape – a crown.

The value of the determined tree health status, evaluated according to the nine-point scale (value in brackets), was the highest for apple varieties 'Jadernička moravská' and 'Strýmka' – grade 8, 'Bernské růžové', 'Citronové zimní' a 'Gdánský hranáč' – 7,5. The varieties of 'Baumannova reneta', 'Bláhovo oranžové', 'Boskoopské červené', 'Croncelské', 'Harbertova reneta', 'Hvězdnatá reneta', 'Jonathan', 'Landsberská reneta', 'Malinové hornokrajské', 'Panenské české', 'Parkerovo' a 'Ribstonské' were rated with 7th grade. The 'Hájenka' and 'Madame Verté' reached the value 8 and 'Boscova', 'Charneuská', 'Pařížanka', 'Solanka' and 'Muškateľka letní' had the same value – 7,5.

The health status of trees is significantly related to the age of the trees. The trees evaluated in this selection corresponded to the age range of 60–80 years. The health status of the seedlings found was mostly excellent, which corresponds to their usually lower age. The highest age of trees, estimated at one hundred years or more, was found in the following varieties of apple trees: 'Panenské české' from Zdislavice and Nítkovice, 'Blenheimská reneta' from Nítkovice and Litenčice, 'Boskoopské' from Prasklice, 'Hedvábné pozdě kvetoucí' from Nítkovice, 'Kasselská reneta' from Hoštice and Litenčice, 'Vilémovo' from Nítkovice, 'Gdánský hranáč' from Litenčice, 'Lebelovo' from Litenčice, 'Parména zlatá zimní' from Litenčice and Nítkovice, 'Bismarkovo' from Litenčice, 'Car Alexander' from Litenčice; and pear trees: 'Výrostkova hruška z Hoštic' (up to 150 years), 'Cibulky z Hoštic', 'Muškateľka letní' from Honětice, 'Špínka' from Zdislavice, 'Merodova' from Strabenice.

Furthermore, the statistic influence of the variety, age and location on tree height, trunk diameter, health status was observed. For the complexity of the statistical evaluation, the statistical influence

I: Statistical analysis of recorded data – apple trees

Apple trees	Tree height	Trunk diameter	Crown diameter	Health status	Crown dryness
Variety	NS	**	NS	NS	NS
Age	***	***	***	***	***
Locality/Municipality	NS	NS	NS	NS	NS

Legend: NS – no statistical significance, * statistical significance, ** high statistical significance, *** very high statistical significance, * $\alpha = 0,05$, ** $\alpha = 0,01$, *** $\alpha = 0,001$ or lower than these values

of the variety, age and locality on the average and the dryness of the crown is also presented.

Tab. I shows that the tree height and the diameter of the crown is not statistically significant influenced by variety or locality. On the contrary, the age had very high statistical significance on the height and crown diameter. The trunk diameter was significantly influenced by the age of the tree ($\alpha = 0,001$) and the variety ($\alpha = 0,01$), however the locality had no significant influence. The health status and crown dryness were statistically very significantly influenced by the age of the tree. The interaction between the variety and the locality did not have a statistically significant effect on the health status and the prosperity of the crown.

The statistical analysis in Tab. II. shows that tree height and trunk diameter were statistically very highly influenced by tree age and significantly influenced by variety. Locality Tree height and trunk diameter were not significantly influenced by locality. The crown diameter was statistically very highly influenced by the age of the tree. The interaction of the variety and the locality had no statistically significant influence on the crown average. The interaction of variety, age and locality had no statistically significant effect on the health status of the tree. The crown dryness was significantly influenced by the locality. The interaction of the variety and age had no significantly effect on the crown dryness.

II: Statistical analysis of recorded data – pear trees

Pear trees	Tree height	Trunk diameter	Crown diameter	Health status	Crown dryness
Variety	*	*	NS	NS	NS
Age	***	***	***	NS	NS
Locality/Municipality	NS	NS	NS	NS	*

Legend: NS – no statistical significance, * statistical significance, ** high statistical significance, *** very high statistical significance, * $\alpha = 0,05$, ** $\alpha = 0,01$, *** $\alpha = 0,001$ or lower than these values

CONCLUSION

In this survey, 972 old fruit trees of apple trees and pear trees were observed in the studied area. Pomological determination was performed on 840 trees, of which 700 were apple trees and 140 were pear trees. In total, 104 varieties of apples and 44 varieties of pears were found. The most common apple varieties were 'Baumannova reneta' and 'Panenské české' and the most common pear trees were 'Boscova' and 'Hardyho'. Out of the total number of fruit trees recorded, 274 were nominated to a conservation of the gene pool, of which 57 were pear trees and 217 were apple trees. The results point to the importance of regional and previously grown varieties. Their properties, such as resilience and modesty, are suitable for an extensive, naturally close cultivation in which modern varieties often fail. Current methods of cultivation of newer varieties do not meet the principles of sustainable agriculture and yields are heavily dependent on additional inputs of fertilisers and pesticides.

Regional varieties are rarely used in breeding, but their great significance is very important and very well known to professional breeders. Many of the traditional varieties exhibit high frost resistance, resistance to pathogens and pests, their plasticity, but also fertility and fruit quality have been proven for centuries. It is very important to keep all varieties, because they can carry important genes, even though they have lost market significance.

The best way to preserve old varieties for future generations is to support their cultivation by planting in landscape and in private gardens and by protecting localities, where they occurred, for example, salvaging old orchards (Boček, 2008).

The mapping, recording and eventual return of quality ecotypes of previously grown and local varieties to the landscape is an important step in saving their unique properties usable in many ways to improve the appearance of the landscape, increase the biodiversity of its surroundings and, last but not least, breeding and food production by processing their fruits. All of this could lead to an economic increase in the area of their cultivation.

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