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EVALUATION OF OLD APPLE VARIETIES GROWN IN THE NORTH-EASTERN PART OF ROMANIA

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Abstract

Old apple cultivars, either originating from Romania or of foreign origin but grown widely in this region, were examined to provide a characterisation of the varieties. The aim of the thesis was to observe and evaluate the phenological, and morphological traits of the old apple cultivars using the following methods as: observation of flowering phenology traits and the classification of the cultivars into flowering time groups; characterisation of the gene bank collection and the determination of diversity using morphological markers; preparation of a number-coded characterisation based on the morphological and biological traits laid down in the UPOV guidelines. Identified and collected material provides the initial genetic source for variety improvement. Using the observations and determinations made, we identified the potential genitors for different useful characteristics that we used in controlled intra and interspecific hybridizing. Researchers constant concern refers to preserving, coplotting, periodically reorganizing and assessing the biological and agrochemical characteristics of each genotype, the exchange of biological material into the restricted manner and the assessment of the potential genitors for some useful characteristics used in genetic breeding programs.

Key words*: Malus, varieties, evaluation, diversity.*

INTRODUCTION

In the last years fruit consumption is becoming more and more varied and this trend leads to the necessity for a more various fruit assortment available on the market. This could be achieved in two ways: by re-introducing old varieties into cultivation, but also by using them as crossing partners in the development of new cultivars.
Despite the fact that the apple is the third cultivated species worldwide after citrus fruits and bananas, global apple production involves only a few dozen cultivars. This is understood as in the last decades the role of local cultivars has become completely insignificant.
Apple is a specie that is always vulnerable to natural disasters, pathogens or different pests. Eliminating this vulnerability can only be done when the maintenance and uninterrupted enrichment of the germoplasm field is achieved (Corneanu G. et al., 2020; Volk, G.M. et al., 2005; Bignami, C., et al., 2003).
In the limit situations, like climate change or appearance of new pathogen species, there could be reached an ecological catastrophe and this restricted range of cultivars could endanger the reliability and profitability of apple production as we know it.
In this scenario, the old apple cultivars have a highly significant value from biodiversity the point of view due to the good resistance or excellent inner quality, while others satisfy special consumer demands (Hammer K. et al., 2003).
Old varieties are a rich source of genetic source with a highly significant role in breeding, and some have very positive characteristics, which is very important in cultivation (Routson' K. J. et al., 2009).
The aim of the present study is to provide useful information for gene bank analysis and to achieve better knowledge of cultivar traits, which could be useful for scientists and growers.

MATERIALS AND METHODS

During 2019-2022 there was performed a study in an apple orchard that involved 12 old apple varieties, traditionally grown (table 1) located in Solca and Cacica villages, Suceava, North-East

of Romania (Figure 1). The total number of analysed trees was 162.
Orchard was established during 1850-1900 and since then trees were constantly renewed.
Planting distances are 8 x 6 m. The average age of all trees in research was 40 years. Trees have been held under non-irrigated extensive cultural practice.
The aim of research was to observe and evaluate the phenological and morphological traits of the old apple cultivars using the following observation of flowering phenology traits and the classification of the cultivars into flowering time groups.

Figure 1. Location of the experience

Table 1. The list of studied varieties and location

Variety's name/ Abreviation	Location	Nr. of trees
'Trauben' (T)	Solca village - own orchard	4
'Bănățesc' (B)	Solca village - own orchard	2
'Domnesc' (D)	Solca village - own orchard	130
'Belle Fleur Jaune' (BFJ)	Solca village - own orchard	3
'Belle de Boskoop' (BB)	Solca village - own orchard	4
'Renet de Canada' (RC)	Solca village - own orchard	2
'London Pepping' (LP)	Solca village - own orchard	2
'Parmen auriu' (PA)	Solca village - own orchard	4
'Renet de Landsberg' (RL)	Solca village - own orchard	2
'Jonathan' (JO)	Solca village - own orchard	5
'Gravenstein' (G)	Cacica village	2
'Papirovka' (P)	Solca village - own orchard	2
TOTAL		162

Observations on flowering phenology were carried out in the years 2019–2022. Data were recorded every two days during the flowering period. The beginning of flowering, the peak flowering period and the end of flowering were determined by subjective observations (as laid down in the UPOV guidelines).
The first phase of the study consisted of data collection and centralization of information.
The second phase consisted of observations and data systematization.
There were used UPOV descriptors for apple (Batelja Lodeta Kristina et al., 2019).
The orchard (4.75 ha) is located on a plot of land with a profile and soil type of the black soil class. The cernisoil class includes soils where the diagnostic horizon is A, relatively soft, rich in calcium humus, almost exclusively or predominantly humic of a dark color that also penetrates the underlying horizon.

RESULTS AND DISCUSSIONS

Phenological traits

Data on flowering phenology were recorded every two days during the flowering period. The beginning of flowering, the peak flowering period and the end of flowering were determined by subjective observations.
In addition to subjective observations, measured data were also recorded, based on the analysis of 30 flowers and fruits from each cultivar. The samples required for the analyses were collected randomly, collecting no more than one sample from each inflorescence or shoot. Flowering times were determined for all 12 old apple cultivars.

Table 2. Flowering time groups and varieties distribution

Flowering period	Variety
Very early	Gravenstein Papirovka
Early	Renet de Landsberg
Medium	Bănățesc Belle Fleur Jaune
Late	Domnesc Belle de Boskoop Renet de Canada London Pepping Parmen Auriu Jonathan
Very late	Trauben

According to data registered in the orchard the flowering times were divided into five flowering time groups on the basis of the beginning of flowering period. The groups are: very early, early, medium, late, and very late (Table 2).

The fruit traits linked with phenology are the times of harvest and eating maturity. As required by the UPOV guidelines (2005), the harvest maturity was scored using five categories and the eating maturity using nine, ranging from very early to very late.

Morphological traits

In Table 3 there were recorded data relating to the average morphological traits and their state of expression, according to UPOV (2005) guidelines'.

Table 3. Average morphological traits and their state of expression

Variable	Variety											
	T	B	D	BFJ	BB	RC	LP	PA	RL	JO	G	P
Average fruit weigh (g)	94.8	73.3	170.3	152.1	140.2	116.9	109.8	112.0	119.1	111.1	139.8	84.3
Average fruit heigh (mm)	62.2	57.2	76.9	74.4	56.8	57.8	56.9	57.2	54.9	56.0	64.3	58.4
Average fruit diameter (mm)	70.3	59.0	83.8	69.2	73.2	65.5	68.3	64.3	68.1	67.1	72.8	62.5
Fruit shape	3.1	4	4.2	2.1	4.1	4.2	3	3.3	3.1	2	3.3	2
Ground colour	2	2	4	2	3	3	4	2	2	3	2	2
Over colou	1	2	3	1	3	1	5	1	1	3	1	1
Presence o stripes	1	2	3	1	1	1	1	4	1	3	3	1
Colour of flesh	2	4	2	2	3	3	2	3	2	2	2	1
Taste	2	2	2	2	1	2	2	2	2	2	2	2
Flesh firmess	4	3	4	2	4	4	4	3	3	4	4	3

The analyses were performed between 2019 and 2022, and observations were made on each cultivar. It is important not to average the categories determined over a number of years; the category characteristic of each individual variety is taken as that which occurs most frequently in the separate annual classifications. Figure 2 shows fruits exterior characteristics (fruit size and shape, colour and presence of stripes).

Analyzing the results for these old apple varieties, we can say that fruit genetic traits are very important in today's breeding programmes for new cultivars, like fruit weight, shape, skin colour and flesh taste, stand out in explaining the variability (Ficzek, G. et al., 2017; Urrestarazu, J. et al., 2017).

Therefore, the conclusion that could be made is that these apple varieties present a good gene pool for these traits in breeding programs for new competitive commercial apple varieties. The above mentioned characteristics are defined by the market and consumers and play a major role in future breeding programmes.

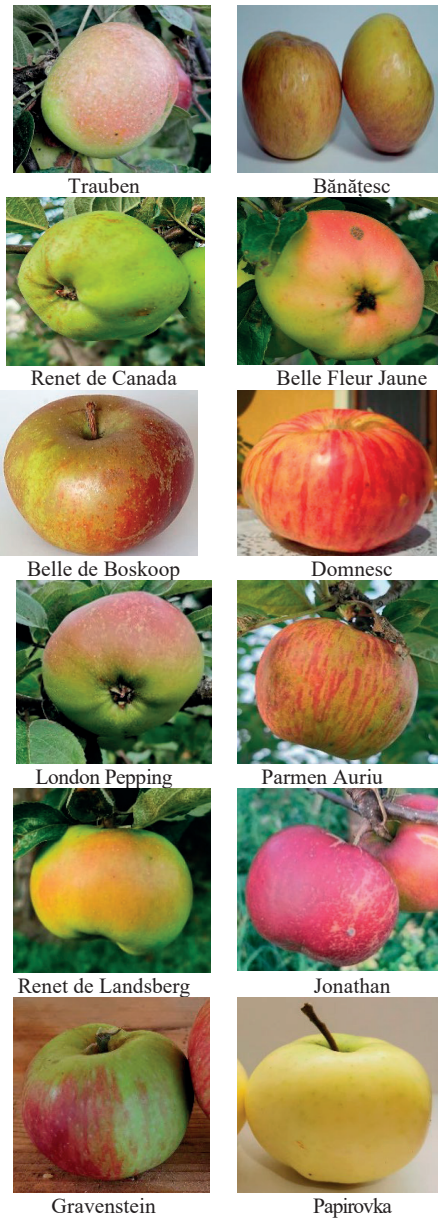

Figure 2. Fruits exterior characteristics

In addition to phenological and morphological descriptions, it is also advisable to carry out a series of genotypic analysis. The determination of the genetic fingerprints of the cultivars is of importance not only for the identification of gene bank accessions, but also to check the

trueness-to-type of reproductive materials in nurseries. Well-chosen genetic markers can also be used to detect specific characteristics related to resistance, fertilisation, growth and fruit quality parameters (Hemmat M.S.K.B. et al., 2003; Kiprijanovski M. et al., 2020).
Lespinasse, since 2009 consider that a new European organization must be promoted to develop pre-competitive research on pome fruit genomics and molecular breeding, aiming finding solutions to the general and specific needs of the different pedo-climatic conditions of the European basins of production.

CONCLUSIONS

According to results of this research, it can be concluded that investigated apple varieties, are valuable sources of desirable genetic characteristics including important morphological and nutritional characteristics of the fruits.
The material presents valuable growing, yielding and fruit quality characteristics which make them valuable and useful in many aspects.
The apple cultivars were divided into five flowering time groups on the basis of the beginning of flowering period: very early, early, medium, late, and very late.
The results will contribute to the long-term conservation and sustainability in the cultivation of apple varieties, as well as to promote the value of conservation and the importance in the use of germplasm sources in apple.
Additional genetic fingerprinting of apple cultivars is needed. Until such work is undertaken, these genotypes should be conserved and analyzed for useful traits.
The results on this direction of research could be used in order to answer the new challenges concerning the drastic reduction of pesticides, the consequences of the climate changes and the need for better fruit quality and food safety.

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