

## YIELDING AND HEALTHINESS OF SELECTED GRAPE CULTIVARS FOR PROCESSING IN CENTRAL POLAND

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### A B S T R A C T

This work presents the results concerning the yielding (time of ripening, weight of clusters and berries, fertility of vines, percent of soluble solids, taste of fruits), winter hardiness and susceptibility to fungal diseases (downy mildew, powdery mildew, grey mould and excoriose) of 25 selected cultivars for processing. The investigations were carried out in the grapevine collection of the Research Institute of Pomology and Floriculture in Skierniewice, Poland. This grapevine collection was established in 1992, and it is consisted of 234 taxons. Assessed genotypes differed considerably in terms of the examined traits. Berries ripened from the second half of August ('Reform') until the second week of October ('V 71141', 'Sibera'). In the years 2005-2009, vines of the hybrid 'V 64035' and cultivars 'Seyval' and 'Cayuga White' were most productive. Berries of 'Delaware' were characterized by having the highest level of soluble solids. Vines of interspecific hybrids were less susceptible to frost damage and fungal diseases than cultivars of *V. vinifera* ('Chasselas Dore', 'Ortega'). Interspecific hybrids 'Seyval', 'Bianca', 'Sibera', 'Marechal Foch', 'Rondo' and 'Regent' were distinguished as having the best yielding and highest quality of fruit from among the assessed cultivars, for commercial wine making. 'Aurore', 'Delaware', 'Cascade' and 'Golubok' were relatively reliable in yielding, and their grapes may be used for the production of juice and home wines.

**Key words:** collection, grapevine, wine and juice cultivars, field evaluation

### INTRODUCTION

The present grapevine acreage in Poland is estimated to be 300-400 ha. Most cultivars planted in vineyards

are grown for wine production. Wine introduced into the market may be produced from grapes of cultivars classified as wine cultivars in at least one EU country which has a national

register of cultivars. Fruit of other cultivars may serve to produce juice or home wine (not for sale).

The first aim of the collection of the Research Institute of Pomology and Floriculture in Skierniewice is to preserve biological diversity. The second aim is to create gene resources for potential breeding of cultivars adapted to the environment in Poland. There are great numbers of genotypes within the genus *Vitis* (assessed at 15-20 thousand) and there is intensive breeding of new cultivars in this collection, like many others. For this reason, the Skierniewice collection also aims to roughly estimate the functional value of new cultivars (Sękowski and Myśliwiec, 1996; Pospíšilová et al., 2005). Recommended cultivars should be characterized by high fertility, high quality of fruit, resistance to fungal diseases and, in countries where winters are cold, low susceptibility to frost damage (Elfving et al., 1985; Reisch et al., 1999; Plocher and Parke, 2001; Korbuly, 2002; Kozma 2002; Kriszten, 2002; Lisek 2004, 2005, 2007, 2009; Abuzov, 2009; Lott et al., 2010).

## MATERIAL AND METHODS

The field collection of grapevines where the research was conducted is located in the Pomological Orchard of the Institute of Pomology and Floriculture in Skierniewice. The grapevines are growing in podsolic soil graded Class IV. The soil is slightly acidic (pH 6.3) and contains 1.3% organic matter. The collection

consists of two parts: 1) the field part – with vines selected mostly from the collection of 234 genotypes, including all cultivars for processing, and 2) - the plastic tunnel with bushes of 23 stenothermal cultivars. In this work 25 cultivars of different origins from the field collection are assessed; 23 of which are considered interspecific hybrids and 2 ('Chasselas Dore' and 'Ortega') are *V. vinifera* (Tab. 1). Bushes of 19 cultivars grown on their own roots, were planted in 1992 and another 6 bushes ('Baco Noir', 'Leon Millot', 'Ortega', 'Regent', 'Rondo', 'Viktoria gyöngye') were planted in 2001. Each of the genotypes was represented by three vines, planted at a spacing of 2.5 × 1 m and trained according to the "low-head" method. One to three trunks, 20 cm in height, were formed on the vines. After winter pruning, 6-8 evenly spaced canes, each with 2-3 buds, were left on the vine (spur pruning). In July, shoots were pruned above the 10<sup>th</sup>-12<sup>th</sup> leaf, past the last cluster of grapes. Lateral branches of young shoots were cut back above the first or second leaf, counting from the base. Each season, one or two chemical treatment against fungal diseases was carried out, using agents containing copper, sulphur and mancozeb. In the years 2008-2009, vines were treated once with fungicide containing difenconazol.

This work presents results obtained during 2005-2009, including date of harvest, weight of bunches and berries, fertility of bushes, soluble solids content, susceptibility to

frost damage (assessment from the period 2002-2010) and fungal diseases: downy and powdery mildews, grey mould, excoriose and other dangers (assessment from the period 2002-2009). During the time when the research was being carried out, minimal winter temperatures reached:  $-25.4^{\circ}\text{C}$  (January 2003),  $-31.6^{\circ}\text{C}$  (January 2006),  $-23.0^{\circ}\text{C}$  (January 2009),  $-28.1^{\circ}\text{C}$  (January 2010).

Susceptibility to frost damage was assessed during pruning, in March. The assessment was noted in the following manner: 1 – lack of damage, 2 – frozen buds not exceeding 10%, 3 – 11%-50% of frozen buds, 4 – more than 50% of frozen buds and damage to the two-year old shoots, 5 – dead bushes.

Assessment of damages caused by downy *Plasmopara viticola* (Berk. et Curtis ex de Bary) Berl. et de Toni and powdery mildew *Uncinula necator* (Schw.) Burr. was conducted directly before harvest on each plot. A five-grade scale was used based on the following criteria: 1 – lack of damage, 2 – less than 20% of leaves and vines infested by mildew, 3 – 21%-50% of infested leaves and vines, 4 – heavily infested leaves and vines, together with slight (up to 10%) infestation of berries, 5 – heavily infested leaves, shoots (more than 50%) and berries (more than 10%).

Excoriose (*Phomopsis viticola* Sacc.) causes death to wood and buds. The occurrence of excoriose was assessed during the pruning period, which was the first two weeks of March. Again, a five-grade scale

was used: 1 – lack of damage, 2 – damage up to 20%, 3 – 21%-50%, 4 – 51%-100% of shoots internodes infested, 5 – death of skeletal parts of bushes and whole plants. Infestation was assessed on the basis of both, the colour of shoots, which changed from brown to grey, and the excoriose visible on cross-sections of older shoots.

Susceptibility to decay caused by grey mould *Botryotinia fuckeliana* (de Bary) Whetzel was assessed during harvest. A six-grade scale was used: 1 – lack of damage, 2 – damage up to 3%, 3 – 4%-10%, 4 – 11%-25%, 5 – 25%-60%, 6 – more than 50% of fruit infested.

## RESULTS AND DISCUSSION

Wine and juice cultivars selected from the collection differed substantially in their most important functional traits concerning yielding: time of harvest, weight of bunches and berries, and fertility of vines (Tab. 1). First to ripen were the grapes of the cultivar 'Reform'. They ripened at the beginning of the third decade of August, which confirms earlier reports (Sękowski and Myśliwiec, 1996; Lisek, 2005). Last to ripen were fruits of the cultivar 'Sibera' and hybrids 'V 64035' and 'V 71141'. They ripened at the end of the first decade of October. This confirms reports about the late ripening of fruit of those cultivars in southern Canada (Elfving et al., 1985). Hybrid 'V 64035' had the largest bunches and berries of all

Table 1. Country of breeding and yielding of selected wine and juice cultivars, from the field collection in 2005-2009, Skierniewice

Cultivar, colour of berry skin	Country of breeding	Time of ripening	Weight of cluster [g]	Weight of 100 berries [g]	Average yearly yield [kg/bush]	Soluble solids content [%]
Reform (B)	Hungary	21.08	122.0 b-e	286.3 j-l	1.5 a-e	19.5 g-j
Kristaly (B)	Hungary	1.09	137.8 c-g	265.8 h-j	1.36 ab	18.9 e-j
Iliczewskij Rannyj (N)	Ukraine	11.09	139.0 c-g	293.3 kl	1.49 a-e	15.1 a
Golubok (N)	Ukraine	14.09	110.5 a-d	184.3 c	1.24 a	18.3 d-h
Cascade (N)	France	15.09	132.0 c-g	207.8 c-e	1.82 b-f	19.4 f-j
Rondo (N)	Germany	16.09	150.5 e-h	250.0 g-i	2.23 fg	19.7 ij
Ortega*(B)	Germany	16.09	123.8 b-e	224.8 e-g	1.42 a-c	19.2 f-j
Zala gyöngye (B)	Hungary	16.09	169.5 g-i	248.8 g-i	1.63 a-e	18.0 d-f
Aurore (B)	France	17.09	100.5 a-c	186.3 c	1.91 ef	18.8 d-j
Marechal Foch (N)	France	17.09	86.0 ab	104.5 a	1.54 a-e	18.9 e-j
Chasselas Dore* (B)	Unknown	23.09	177.8 h-j	301.8 l	1.45 a-e	16.4 bc
Regent (N)	Germany	24.09	136.8 c-g	214.8 d-f	2.24 f-g	19.6 h-j
Viktoria gyöngye (B)	Hungary	26.09	138.5 c-g	204.0 c-e	1.38 a-c	18.9 e-j
Leon Millot (N)	France	26.09	81.8 a	94.0 a	1.44 a-d	19.3 f-j
Medina (N)	Hungary	26.09	140.8 d-h	198.8 c-e	1.37 a-c	19.1 f-j
Baco Noir (N)	France	28.09	81.9 a	104.3 a	1.27 a	18.1 d-f
Swenson Red (R)	USA	30.09	113.8 a-e	355.0 m	1.45 a-c	18.2 d-g
Delaware (R)	USA	1.10	90.0 ab	144.8 b	1.48 a-e	21.5 k
Bianca (B)	Hungary	2.10	124.8 b-f	219.3 d-f	2.11 fg	19.1 f-j
Refren (B)	Hungary	2.10	210.0 j	364.5 m	1.84 c-f	18.4 d-i
Seyval (B)	France	3.10	177.0 h-j	197.8 c-e	3.07 h	18.9 d-j
Cayuga White (B)	USA	5.10	203.8 ij	273.5 i-k	2.90 h	17.4 c-d
V 64035 (B)	Canada	6.10	267.8 k	509.8 n	3.08 h	15.4 ab
V 71141 (B-R)	Canada	8.10	163.5 fh	239.8 f-h	2.36 g	17.7 de
Sibera (B)	Germany	9.10	116.8 a-e	195.8 cd	1.90 d-f	19.8 j

Explanations: colour of berry skin: B (Blanc) – (yellow-green); R – (Rose); N (Noir) – (blue-black)

\**V. vinifera*

Averages followed by the same letter do not differ significantly at  $p = 0.05$  according to Duncan test

tested genotypes. Bunches, and grapes of least weight, were harvested from the bushes of the cultivars ‘Marechal Foch’, ‘Leon Millot’, ‘Baco Noir’ and ‘Delaware’. During the investigated period, bushes of hybrid ‘V 64035’, cultivars ‘Seyval’ and ‘Cayuga White’ proved to be

most fruitful. These results confirm earlier data on the high fertility of those cultivars in Canada, USA, and Poland (Sękowski and Myśliwiec, 1996; Elfving et al., 1985; Reisch et al., 1999; Plocher and Parke, 2001; Lisek, 2005). Berries of the cultivar ‘Delaware’ had the highest extract

content, which exceeded 21%. Fruits of hybrid 'V 64035' and cultivar 'Iliczewskij Rannyj' contained about 6% less of the extract. Grapes differed in taste and fragrance. Muscat flavor was perceptible in grapes of 'Medina' and 'Kristaly'. Various fruit fragrances were present in fruits of the following hybrids and cultivars: 'Marechal Foch' (sweet cherry), 'Golubok', 'Baco Noir', 'Leon Millot' (currant), 'Delaware', 'Cayuga White' (strawberry), 'V 64035' (citrus).

The most significant factors which caused plant yield and plant condition to worsen were: frost, pathogens causing fungal diseases, wasps and birds. Cultivars 'Aurore', 'Marechal Foch', 'Baco Noir', 'Swenson Red', and 'Delaware' proved to be most resistant to low winter temperatures (Tab. 2). Even when the temperature dropped to  $-31.6^{\circ}\text{C}$  in January 2006, no serious frost damage was observed on the wintering buds of those cultivars (Lisek, 2004, 2007). 'Seyval', 'Leon Millot', 'Refren' and 'Sibera' also had quite high resistance. The vines of 'Bianca', 'Rondo' and 'Regent' turned out to be far more susceptible (Lisek, 2009). Among all the tested cultivars, the least frost resistant proved to be 'Chasselas Dore'. Wintering buds on 'Chasselas Dore' bushes received more damage than the wintering buds on bushes of 'Ortega', also belonging to the *V. vinifera*.

Among fungal diseases, in conditions of limited chemical protection, downy and powdery mildew presented the greatest threat to the development of bushes. 'Aurore', 'Mare-

chal Foch', 'Leon Millot', 'Seyval', 'Baco Noir', 'Refren' and 'Regent' had the least degree of infection by pathogens. 'Rondo', 'Sibera' and 'Golubok' were susceptible mostly to fungi responsible for powdery mildew, while most susceptible to both kinds of mildew were 'Chasselas Dore' and 'Ortega'. Symptoms of excoriose were most visible on vines of 'Bianca', 'Medina' and 'V 64035'. No cultivar, however, was entirely resistant to infestation caused by the fungi *Phomopsis viticola*. Grey mould was a particularly problem for cultivars characterized by dense, large bunches ('Seyval', 'Cayuga White') and delicate berry skin ('Reform', 'Aurore') if the weather was rainy during the fruit ripening period. Damage caused by wasps was most extensive on bushes whose fruit ripen earliest: 'Reform' and 'Kristaly'. Birds preyed mostly on 'Marechal Foch', 'Leon Millot' and 'Baco Noir' whose berries are small and dark-skinned.

Our results confirmed reports from the USA, Canada, Germany, Hungary and Ukraine, that new hybrids may be an alternative to *V. vinifera* cultivars because they are more resistant to frost and fungal diseases, and have a high quality of fruits (Elfving et al., 1985; Reisch et al., 1999; Plocher and Parke, 2001; Korbuly, 2002; Kozma 2002; Kriszten, 2002; Lisek, 2005; Abuzov, 2009; Lott et al., 2010). While cultivating multiple hybrids in Poland, it is necessary to bear in mind that they will be more unreliable in yielding compared with their original place of

Table 2. Winter hardiness and healthiness of vines of chosen wine and juice grape cultivars in 2002-2009, Skierniewice

Cultivars in order of fruit ripening time	Winter hardiness (scale 1-5)	Susceptibility to downy mildew (scale 1-5)	Susceptibility to powdery mildew (scale 1-5)	Susceptibility to excoriosis (scale 1-5)	Susceptibility to grey mould (scale 1-6)
Reform	2-3	3	2	1.5	2
Kristaly	2	2.5	2.5	1.6	1.5
Iliczewskij Rannyj	2-3	2.5	2.5	1.5	1.1
Golubok	2	2	3	1.5	1.3
Cascade	2	1.5	1.8	1.8	1.1
Rondo	2-3	1.5	3	1.8	1.5
Ortega	3	3.8	4.3	1.5	1.8
Zala gyöngye	2-3	3	3	1.8	1.5
Aurore	1	1.1	1.2	1.2	1.7
Marechal Foch	1	1.2	1.2	1.5	1.1
Chasselas Dore*	3-4	3.8	3.5	1.5	1.8
Regent	3	1.3	1.5	2.0	1.1
Viktoria gyöngye	2-3	1.5	1.5	1.8	1.5
Leon Millot	1-2	1.1	1.2	1.2	1.1
Medina	3-4	1.5	3	2.5	1.3
Baco Noir	1	1.1	1.2	1.2	1.1
Swenson Red	1	1.5	2	1.5	1.5
Delaware	1	2	2.5	1.2	1.5
Bianca	2-3	1.5	2.5	2.5	1.3
Refren	1-2	1.1	1.3	2.0	1.8
Seyval	1-2	1.1	1.5	1.8	2
Cayuga White	2	2	2	1.8	2
V 64035	2	3	2.5	2.5	1.6
V 71141	2	1.5	1.5	1.5	1.3
Sibera	1-2	1.3	3	1.5	1.1

Explanations: susceptibility to frost damage (average in winters 2002/20003, 2005/2006, 2008/2009, and 2009/2010, with minimal temperature from  $-23^{\circ}\text{C}$  to  $-31.6^{\circ}\text{C}$  and fungal diseases (average in 2003-2009): 1 - resistant, 5-6 – susceptible

\**V. vinifera*

breeding and cultivation. For instance, the cultivar ‘Golubok’ proved less fertile and frost-resistant than when grown in Ukraine (Abuzov, 2009). There were differences in yielding and healthiness of particular cultivars presented in the results of this research investigation and in foreign research. These differences were a consequence of different cultivation settings, and show the necessity to assess cultivars in their local conditions.

## CONCLUSIONS

1. Genotypes of cultivars for processing, gathered in the collection in Skierniewice, differed in fruit ripening time – from the last two weeks of August (‘Reform’) till the second week of October (‘V 71141’, ‘Sibera’), in taste of fruit, weight of bunches and berries, fertility of bushes and their resistance to frost damage and fungal diseases.

2. Bushes of interspecific hybrids bred via crossing *V. vinifera* with other species such as *V. labrusca*, *V. riparia*, *V. rupestris*, *V. lincecumii*, *V. amurensis*, were less susceptible to frost damage and fungal diseases than *V. vinifera* cultivars.
3. 'Seyval', 'Bianca', 'Sibera', 'Marechal Foch', 'Rondo' and 'Regent' were most reliable among assessed cultivars, for commercial wine production in Poland.
4. 'Aurore', 'Delaware', 'Cascade' and 'Golubok' were relatively reliable in cultivation, and their grapes, in accordance with the binding law, may be used for production of juice and home wines.

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# PLONOWANIE I ZDROWOTNOŚĆ WYBRANYCH PRZEROBOWYCH ODMIAN WINOROŚLI W CENTRALNEJ POLSCE

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## STRESZCZENIE

W pracy przedstawiono wyniki dotyczące plonowania – terminu dojrzewania owoców, masy gron i jagód, plenności krzewów, zawartości ekstraktu, podatności krzewów na uszkodzenia mrozowe oraz choroby grzybowe – mączniaka rzekomego i prawdziwego winorośli, szarą pleśń oraz nekrozę korową, 25 wybranych, przerobowych odmian winorośli. Badania prowadzono w kolekcji winorośli Instytutu Sadownictwa i Kwiaciarstwa w Skierniewicach, założonej w 1992 roku, gromadzącej 234 taksony. Oceniane genotypy różniły się znacznie pod względem badanych cech. Winogrona dojrzewały od drugiej dekady sierpnia ('Reform') do końca pierwszej dekady października ('V 71141', 'Sibera'). W latach 2005-2009 najlepiej plonowały krzewy mieszańca 'V 64035' oraz odmian 'Seyval' i 'Cayuga White'. Jagody 'Delaware' charakteryzowały się najwyższą zawartością ekstraktu. Krzewy międzygatunkowych mieszańców były mniej podatne na uszkodzenia powodowane przez mróz i choroby grzybowe niż odmiany winorośli właściwej: 'Chasselas Dore' ('Chrupka Żłota') i 'Ortega'. Odmiany 'Seyval', 'Bianca', 'Sibera', 'Marechal Foch', 'Rondo' i 'Regent', należące do mieszańców międzygatunkowych, najlepiej plonowały i miały najlepszą jakość owoców, spośród ocenianych odmian winiarskich, których owoce mogą być wykorzystane do komercyjnej produkcji wina. Krzewy odmian 'Aurore' ('Aurora'), 'Delaware', 'Cascade' i 'Gołubok' były relatywnie niezawodne w plonowaniu i mogą dostarczać winogron do wyrobu soku i win domowych.

**Słowa kluczowe:** kolekcja, winorośl, odmiany przerobowe, ocena polowa