

EFFECTS OF CLIMATIC CONDITIONS ON FRUIT QUALITY OF APPLE CULTIVARS ASSESSED BY PUBLIC SENSORY EVALUATIONS IN THE CZECH AND SLOVAK REPUBLICS 1999-2004

František Paprštejn¹, Jan Blažek¹
and Samuel Michalek²

¹Research and Breeding Institute of Pomology Holovously Ltd.
Holovously 1, 508 01 Hořice, CZECH REPUBLIC

²Central Control and Testing Institute in Agriculture (ÚKSÚP)
Topolčianska 28, 956 07 Veľké Ripňany, SLOVAK REPUBLIC

(Received July 13, 2005/Accepted November 8, 2005)

A B S T R A C T

Public sensory evaluations of the most important grown cultivars and promising new ones were regularly conducted from December to February in four places characterised by different mean annual temperatures and length of growing season. 'Rubín' and its mutants won the highest scores for 2000-2004 both in the category of taste and in the sum total of all the other sensory traits at almost every location. 'Rubinola' ('Rubin' x 'Prima'), which is scab resistant, performed almost as well as 'Rubin'. These leaders were mainly followed by 'Topaz', 'Angold' and a group consisting of 'Jonagold' and several of its mutants. In contrast, 'Golden Delicious', 'Gloster' and 'Melrose' performed well only at the warm and moderately warm locations. 'Braeburn' performed well only at the warm location. On the other hand, 'Fuji' and 'Pink Lady' performed only averagely at the warm location, and were barely acceptable in very warm years. Of the new cultivars, 'Meteor' was the best performer at the moderately warm location, and 'Stella' was the best performer at the cold location.

Key words: apple, cultivars, fruit quality, sensory evaluation, climatic conditions, Czech Republic, Slovak Republic

INTRODUCTION

Selection of the proper cultivar for particular climatic and soil conditions is a factor of primary importance (Steiner and Giuliani, 1995). The Czech

Republic and the Slovak Republic are countries with relatively very diverse climatic conditions that are utilised for commercial apple growing (Dvořák et al., 1976, Hričovský et al. 1990). Therefore some growing areas require a different selection of apple cultivars than others. Intensive research on the productivity of apple cultivars in different climatic and growing conditions of the Czech Republic was carried out more than twenty years ago (Paprštejn et al., 1983).

Later, thirty-one cultivars were ranked according to synthetic growth index based on the increase in trunk cross-sectional area, canopy volume and mean shoot length. Climatic conditions also had a great influence on vigour in apple trees. In warmer regions at lower altitudes, trees were generally more vigorous than those growing in cold regions at higher altitudes. Some cultivars responded differently to climatic conditions than others (Blažek and Varga, 2001).

In a subsequent study, the effect of climatic conditions on numerous cultivars were studied in relation to yield, yield efficiency, fruit size and some other fruit quality parameters. With most of these cultivars, climatic conditions significantly influenced productivity, fruit size, base color, russeting and some physiological disorders (Blažek and Hlušíčková, 2003).

In this study, the impact of different climatic conditions on fruit quality of the most important currently cultivated and promising apple cultivars was studied by public sensory evaluation of fruit taste and other fruit characteristics.

MATERIAL AND METHODS

This study was conducted from 1999 to 2004. The number of cultivars included into this study reflects the number of novelties that are currently being tested in the Czech Republic. Fruits were harvested from experimental orchards established on M 9 rootstock in four climatically different locations in the Czech and Slovak Republics:

1. Warm: altitude about 200 m, annual temperature above 9°C.
2. Moderately warm: altitude about 300 m, annual temperature above 8°C.
3. Moderately cold: altitude about 400 m, annual temperature above 7°C.
4. Cold: altitude about 500 m, annual temperature below 7°C.

Fruit samples of each cultivar were harvested at the estimated ripening stage and were stored in atmospheric cold storage at 1 to 3°C except at the cold location, where only “a very good cold cellar” was available.

Sensory evaluation sessions were organised separately at each location from the middle of December until the middle of February. Different but more or less stable groups of judges participated. The number of judges was constant for each location and session and ranged from about 25 to more than 150. The number of cultivars evaluated at each session ranged from 32 to 60. They were presented anonymously and in randomly chosen sequence.

During sensory evaluations, the following characteristics were individually recorded on a scale from 1 to 9: aroma, skin toughness, juiciness, texture, general taste, appearance and the ration of sugars to acids. The higher value the score, the better. Details on the methodology of these sensory evaluations are given by Vondráček and Hojek (1988). A total score was usually calculated by adding the scores for aroma, skin toughness, juiciness, texture, fruit appearance and twice the score for general taste. At the medium cold location, skin toughness was not included in the total score. At the warm location, two scores for taste were used: general and specific. At the cold location, judges rated only simple general taste.

In the final tables, only those cultivars were included which were evaluated at the given location in at least three years. Cultivars were arranged according to their mean rank for the total scores from individual years to ensure comparability. With the cold location, this ranking was based on general taste only.

RESULTS AND DISCUSSION

At the warm location, 'Topaz' had the best overall quality (Tab. 1). 'Rubín' and 'Bohemia' were almost as good. These three varieties were closely followed by a group of cultivars that did not differ significantly among themselves: 'Rubinola', 'Golden Delicious Smoothee', 'Melrose', 'Braeburn', 'Jonagold' and 'Jonagored'. Among the other cultivars, 'Fuji', 'Pink Lady' and 'Granny Smith' also performed well in very warm years with a long growing season (especially 2000), but not in "normal" years like 1999 or 2004.

Unlike at the other locations, at the warm location, all top cultivars got relatively high values of mean ranks, which indicate a greater variability of results from different years.

'Golden Delicious Smoothee' performed better than 'Golden Delicious Reinders'.

At the moderately warm location, 'Bohemia' performed by far the best (Tab. 2). It not only received the highest rank but also the highest total score, score for taste, and score for appearance. 'Meteor', a new cultivar with enhanced storage potential, came in second place. Also among the top ten were 'Gold Bohemia', 'Rubinola', 'Melrose Beaumon', 'Melrose', 'Gloster', 'Sir Prize' and 'Golden Delicious'. 'Topaz' generally scored high for taste, but lower for appearance and some other parameters.

At the cold location, 'Rubín' and its mutants, 'Bohemia' and 'Gold Bohemia', performed the best (Tab. 3) Also among the top ten were 'Rubinola', 'Jonagold', 'Topaz', 'Angold', 'Vanda', 'Delor' and 'Jarka'. Climatic conditions seem to be too cold for 'Golden Delicious', 'Melrose' and 'Gloster'.

'Rubín' and its mutant, 'Gold Bohemia', were by far the best in terms of taste (Tab. 4). 'Rubinola' came in third place, followed by 'Stella', a new scab-resistant cultivar derived from 'Golden Delicious'. Also among the top ten were 'Bohemia', 'Topaz', 'Auralia', 'Angold', 'Jonagold' and 'Rajka'.

Table 1. Results of cultivar tasting in warm climatic conditions

Cultivar	Mean rank	Total score	Score for taste
Topaz	5,2	48.7	14.6
Rubín	5,8	48.9	14.4
Bohemia	6,0	49.6	14.6
Rubinola	7.8	47.9	14.2
Golden Del. Smoothee	8.0	47.6	13.8
Melrose	9.5	46.4	13.9
Braeburn	9.6	47.7	14.2
Jonagold	9.6	46.7	14.2
Jonagored	9.8	48.0	14.0
Elise	12.2	46.9	13.8
Angold	13.3	46.0	12.6
Gala Must	13.5	45.7	12.9
Fuji	13.6	46.6	13.3
Aneta	14.5	46.8	13.2
Pinova	15.4	46.3	13.6
Pink Lady	15.5	46.1	13.3
Melodie	16.0	46.1	13.2
Granny Smith	17.0	45.7	13.0
Mutsu	17.5	46.5	13.7
Mondial Gala	18.7	45.7	12.9
Jonalord	19.0	45.1	13.0
Rosana	19.5	45.3	13.0
Resista	20.0	44.2	13.1
Svatava	20.2	44.9	13.2
Pilot	24.2	44.8	13.3
Gala	22.5	45.2	12.9
Rajka	22.5	44.4	12.7
Otava	23.5	44.6	13.1
Golden Del. Reinders	24.7	44.6	12.5
Royal Gala	24.7	44.3	12.8
Viktoria	26.5	42.3	11.8
Idared	26.8	44.0	12.2
Jarka	27.5	43.6	12.2
Domino	28.5	44.3	12.8
Šampion	29.0	42.3	11.6
Vesna	29.0	43.7	13.2
Selena	29.5	42.8	11.9
Florina	33.0	40.8	11.5
Dione	35.0	40.2	11.5

Table 2. Results of cultivar tasting in medium warm climatic conditions

Cultivar	Mean rank	Total score	Score for taste
Bohemia	2.3	46.6	7.1
Meteor	3.8	45.7	6.5
Gold Bohemia	5.0	44.9	6.9
Rubín	6.4	44.9	6.7
Rubinola	8.0	44.5	6.7
Melrose Beaumon	8.5	44.2	6.0
Melrose	9.5	43.9	6.0
Gloster	11.8	44.2	6.4
Sir Prize	12.2	43.9	6.6
Golden Delicious	13.6	43.5	6.6
King Jonagold	13.6	43.5	6.3
Angold	16.2	43.0	6.0
Rubinstep	16.3	43.1	6.2
Topaz	17.0	42.9	6.5
Elstar	19.0	42.9	6.6
Fiesta	23.8	41.9	6.0
Elista	25.0	42.2	6.4
Idared	27.4	41.6	5.9
Karmijn de Sonaville	28.0	40.8	6.2
Gala	29.0	41.4	6.1
Rajka	29.3	41.3	6.0
Jarka	30.2	41.3	6.0
Resista	31.0	41.0	5.9
Goldstar	31.5	40.9	6.0
Pinova	31.6	40.8	5.7
Florina	32.2	41.0	5.6
Mc Intosh Red	32.5	40.3	5.2
Rubimeg	32.5	40.8	5.6
Blaník	34.0	41.3	6.0
Rosana	34.0	40.9	5.7
Falstaff	35.9	40.4	6.0
Primadela	36.0	40.5	5.6
Selena	40.4	39.2	5.2
Orin	41.0	40.3	5.4
Fuji	41.7	39.2	5.2
Šampión Red	41.8	39.7	5.4
Ecolette	42.5	39.0	5.6
Braeburn	43.2	39.1	5.4
Šampión	45.5	39.1	5.5
Otava	46.0	38.8	5.7
Produkta	47.0	38.1	4.7
Relinda	48.0	37.1	4.6
Cox Orange	48.6	37.2	5.5
Baujade	49.0	34.2	4.6
Pilot	50.0	36.3	4.6

Table 3. Results of cultivar tasting in medium cold climatic conditions

Cultivar	Mean rank	Total score	Score for taste
Rubín	3.7	39.4	7.1
Bohemia	4.3	39.4	7.1
Gold Bohemia	5.2	38.5	7.0
Rubinola	6.6	38.2	6.9
Jonagold	7.2	38.1	6.9
Topaz	7.8	38.0	6.7
Angold	10.6	37.7	6.7
Vanda	10.8	38.7	6.5
Delor	12.8	37.0	6.7
Jarka	13.3	35.9	6.4
Melodie	14.8	36.2	6.2
Gala	15.0	35.6	6.6
Biogolden	15.5	36.0	6.4
Janalord	16.0	36.0	6.3
Jantar	17.3	35.3	6.5
Rosana	17.8	36.0	6.4
Rajka	19.4	35.7	6.3
Otava	19.8	35.8	6.3
Durit	20.5	36.2	6.3
Goldstar	20.8	36.7	6.4
Golden Delicious	21.3	35.9	6.5
Jonagored	22.0	36.1	6.3
Lotos	22.2	35.0	6.3
Sir Prize	23.5	36.5	6.2
Viktoria	23.5	34.7	6.3
Delvit	24.0	36.2	6.1
Šampion	24.0	34.9	6.0
Rubimeg	24.2	36.1	6.2
Aneta	24.4	35.1	6.1
Domino	24.8	35.0	6.4
Melrose	26.3	33.7	6.3
Dione	27.5	35.1	6.0
Denár	29.0	36.8	6.2
Idared	29.4	34.4	6.2
Dalila	31.5	33.9	5.8
Šampion Red	31.5	35.1	5.7
Karmína	32.0	33.9	5.9
Sparjon	32.0	33.9	6.1
Gloster	32.8	33.6	5.8
Rubinstep	33.0	35.1	6.1
Dolores	33.7	32.4	5.4
Doris	34.5	35.0	5.9
Produkta	35.8	33.3	5.7
Lord Lalbourne červený	36.7	31.6	5.7
Svatava	37.8	32.6	5.8
Desert	38.0	29.1	5.9
Florina	39.5	32.4	5.9
Selena	39.6	32.0	5.4
Patriot	40.5	30.0	5.6
Zvonkové	41.7	31.5	5.4
Jonalord	41.8	32.0	5.9
Mikra	41.8	31.7	5.3
Spartan	42.0	29.7	5.9

Table 4. Results of cultivar tasting in cold climatic conditions

Cultivar	Mean rank	Score for taste
Rubín	2.8	8.0
Gold Bohemia	3.8	7.9
Rubinola	4.6	7.8
Stella	4.7	7.5
Bohemia	4.8	7.8
Topaz	5.7	7.2
Auralia	7.0	7.3
Angold	9.6	7.0
Jonagold	9.7	7.0
Rajka	10.3	7.1
Jonagold (Wilmuta)	11.0	7.1
Karmijn de Sonaville	11.0	7.2
Jonagold (Jonika)	11.2	7.1
King Jonagold	11.2	7.1
Elstar	12.0	7.0
Elton	12.2	7.0
Viktorija	12.3	7.0
Rosana	12.6	6.8
Lipno	13.0	6.8
Sampión Red	14.0	6.9
Lindel	14.0	6.6
Jonagored	14.8	6.9
Arlet	15.0	6.9
Jarka	15.8	6.9
Rubinstep	16.0	6.8
Katka	16.2	6.8
Cox Orange (Holst.)	17.0	6.7
Otava	17.2	6.7
Regina	17.5	6.8
Elista	21.0	6.6
Sir Prize	21.0	6.7
Goldstar	23.5	6.5
Biogolden	24.5	6.3
Domino	25.5	6.5
Queen Cox	25.5	6.5
Golden Delicious	25.8	6.4
Rubimeg	26.0	6.3
Piglos	27.5	6.4
Deliga	29.0	6.2
Jantar	31.5	6.2
Ecolette	33.0	6.0
Elise	33.3	6.0
Dulcit	33.8	6.0
Pilot	34.0	5.5
Jonalord	35.2	5.8
Gala	40.0	5.7
Breaburn	42.0	5.8
Lordeta	4.5	5.6
Lodel	44.5	5.6
Produkta	45.5	5.2
RubINETTE	53.0	5.1

Acknowledgement. This research was sponsored by the Ministry of Education, Youth and Sport of the Czech Republic under project no. 25271121-01.

REFERENCES

- Blažek J., Varga A. 2001. Tree vigour of new apple cultivars grown in the Czech Republic and some factors influencing it. *HORT. SCI. (Prague)* 28 (4): 130-137.
- Blažek J., Hlušíčková I. 2003. Influence of climatic conditions on yields and fruit performance of new apple cultivars from the Czech Republic. *ACTA HORT.* 622: 433-448
- Dvořák J., Vondráček J., Kohout K., Blažek J. 1976. *Jablka*. Academia, Praha (Prague).
- Hričovský I., Bažant Z., Blažek J., Cifranič P., Čača Z., Horniak V., Klimpl B., Kopec K., Molnár J., Novotný M., Plíšek B., Staněk J., Vachůn Z. 1990. *Praktické ovocinárstvo*. Příroda, Bratislava.
- Paprštejn F., Blažek J., Havlíček Z. 1983. Productivity of commercial apple cultivars in relation to altitude, mean annual temperature and precipitation. *SBORNÍK UVTIZ – ZAHRADNICTVÍ* 10(2): 77-99.
- Steiner R., Giuliani G. 1995. Die richtige Sorte auf den richtigen Standort. *OBSTBAU WEINBAU* 32(11): 287-289.
- Vondráček J., Hojek S. 1988. Methodology of public organoleptic evaluation of apple cultivars. *ACTA HORT.* 224: 449-452.

WPLYW WARUNKÓW KLIMATYCZNYCH NA JAKOŚĆ OWOCÓW RÓŻNYCH ODMIAN JABŁONI OKREŚLANĄ ZA POMOCĄ KONSUMENCKIEJ OCENY SENSORYCZNEJ W CZECHACH I NA SŁOWACJI W LATACH 1999-2004

František Paprštejn, Jan Blažek
i Samuel Michalek

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

Oceny sensoryczne najważniejszych uprawianych odmian oraz nowych obiecujących odmian przeprowadzono regularnie od grudnia do lutego, w czterech miejscach charakteryzujących się różnymi temperaturami rocznymi i długością sezonu wegetacyjnego. Odmiana 'Rubin' i jej genetyczne mutanty uzyskały najwyższe oceny w latach 2000-2004 prawie w każdym miejscu, zarówno w kategorii smaku, jak i w ogólnej sumie wszystkich innych sensorycznych cech. 'Rubinola' ('Rubin' x 'Prima') charakteryzująca się odpornością na parcha, została oceniona podobnie i niewiele niżej niż 'Rubina'. Za tymi wiodącymi odmianami nadążają głównie 'Topaz', 'Angold' i „grupa” 'Jonagolda', reprezentowana przez jego mutanty. W przeciwieństwie do tej grupy, 'Golden Delicious', 'Gloster' i 'Melrose' uzyskały dobry wynik jedynie w średnio ciepłych lub bardzo ciepłych warunkach klimatycznych. Do tej listy można dołączyć odmianę 'Braeburn', jeżeli rośnie ona w najcieplejszych warunkach klimatycznych. Przeciwnie odmiany 'Fuji' i 'Pink Lady' rosnące w takim rejonie uzyskiwały jedynie średnie oceny i w szczególnie gorące lata były zaledwie akceptowalne. Pośród nowych badanych odmian, najbardziej interesujące były – 'Meteor' pochodząca ze średnio ciepłych warunków klimatycznych i 'Stella' z najchłodniejszych rejonów.

Słowa kluczowe: jabłka, odmiany, jakość owoców, ocena sensoryczna, warunki klimatyczne, Republika Czeska, Republika Słowacka