RELATIONSHIP BETWEEN AIR TEMPERATURE, BEGINNING OF VEGETATION AND BLOOMING PERIOD OF SEVERAL APRICOT CULTIVARS IN THE LOWER SILESIA AREA

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ABSTRACT: One year old trees of twelve apricot cvs. were planted on the Somo seedling, in April 1996. Becouse of weather conditions relationship between air temperature and the blooming period was investigate in the Lower Silesia area only in 2000-2004. Length of period from the 1st of January to the white flower bud, for eleven estimated cultivars was significantly correlated with sum of air temperatures above +4°C up to the half of March or above +5°C up to the beginning of white flower bud phase. The earliest blossoming cvs were sensitive even to the sum temperature above 0°C whereas the intermediate and the latest ones were more insensible to temperature changes.The term of full of blooming of the latest blossoming cvs, depended on the year, was noted about 2-8 days after early ones.

Key words: apricot, cultivar, phenology, blooming, air temperature

INTRODUCTION

Temperature during winter and early spring season are the major factors affected the blooming of apricot tree (Szalay and Szabo 1999, Krejzova 2000). Flower buds can be often frozen during winter frost periods, flowers and young fruit can be also injured in frost days in April and as the results of this, no yield will be obtained (Jakubowski 1988, Krska 1993). The problem how to avoid or minimise the risk connected with weather conditions is still important to be solved in many countries, because that is the only possibility to increase interest of apricot production.

MATERIALS AND METHODS

One year old trees of several apricot cultivars were planted on the Somo seedling, in spacing 5 x 4 m (500 trees/ha). The experiment was established in Fruit Experimental Station which belongs to Agricultural University of Wroclaw. First part of the experiment was carried out by randomized block design, in five replications with four trees on each plot. 'Harcot', 'Morden 604', 'Early Orange', 'Moorpark' and 'Somo' cvs. were planted in April 1996. In the same time collection of apricot trees was also established with following cultivars: 'Velkopavlovicka LE 12/2', 'Velkopavlovicka LE 19/2', 'Karola', 'Veecot', 'Ungarische beste', 'Bergeron' and 'Hargrand'. All agrotechnical methods used in whole experiment were carried out like in apricot commercial orchard and plant protection according to current recommendation of Orchard Protection Programme.

Beginning of vegetation and blooming period of 12 apricot cultivars were observed on each tree separately, from 1997 to 2004. The estimation was based on the visual observation average five times a year. Terms of appearance and length of following phenological phases were studied:

- white flower bud – appearance of white or pink colour of bud,
- first flowers – appearance of first several opened flowers,
- the beginning of blooming - blossoming of the first 10% flowers,
- full of blooming – blossoming of 50-75% flowers,
- the end of blooming – petals falling and blooming of the latest 5-10 % flowers,

Mean daily air temperature was noted in Agricultural University Meteorological Station in Wroclaw-Swojec.

The aim of the present studies was the estimation of blossoming possibility of 12 apricot cultivars in the Lower Silesia area weather conditions, in 1997-2004. Relationship between air temperature and phenology of the beginning of vegetation and blooming period was evaluated on the base on the linear correlation coefficients, with the confidence level $\alpha = 0,05$.

RESULT AND DISCUSSION

Investigation of the phenology of blooming period all apricot cultivars was possible only in 2000-2004 (tab. 1 and 2). In 1999, flower buds were frozen. It was caused by the winter frost in the third decade of January when the temperature was very low after warmer period earlier noted. The year before, in 1998, flowers were injured in frost days in early spring. Not only in Poland but also in other countries, weather conditions in winter and early spring are the major factors determining blooming and yield of apricot (Jakubowski 1988, Krska 1993, Szalay and Szabo 1999). However during last five years (2000-2004) there were suittable conditions for apricot tree in the Lower Silesia area. The term of some phenological phases appearance were strong effected by temperature but it also depended on cultivars. The earliest blooming group of cultivars started vegetation period very early, about 19th of March, after warm temperature in February 2002 while the latest ones - 23-24 th of March. In 2003 it was noted on 17th and 19-20 th of April, respectively. In the last mentioned year, the beginning of apricot trees vegetation was one month later because it was result of low temperatures during winter and early spring.

Near Potsdam, Blasse and Hofmann (1993) found that mean daily air temperature from the 1st of January to the end of March affected the beginning of blooming period of 'Marena' cv. Sum of air temperatures above +4°C were relevant for the opening of flowers. The study of relationship between sum of air temperature within 1st of January – 15th of March and the beginning of apricot vegetation near Wroclaw showed similar tendency and in additional, it was found that linear correlation coefficients between the beginning of vegetation and the beginning of blooming period were

significant for eleven cultivars (tab. 3 and 4). Length of period from the 1st of January to the white flower bud phase, for eleven estimated cultivars was significantly correlated with sum of air temperatures above +4°C up to the half of March or above +5°C up to the beginning of white flower bud phase. It was also found that the earliest blooming cultivars were sensitive even to the sum temperature above 0°C whereas the intermediate and particulary the latest blossoming ones were more insensible to temperature changes.

It was not found significant correlation between term of the beginning of blooming and length of period from the beginning to the end of blooming the (tab. 5) which was describe by Szalay and Szabo (1999). This relationship was showed by Blasse and Hofmann (1993) on plum tress but not found on apricot cultivar. Szalay and Szabo (1999) indicated also that blooming period followed faster when the weather conditions was warmer. Similar results were observed near Wroclaw on the some intermediate and all the latest blossoming cultivars. The increase of mean temperature during blooming period significantly decrease its length.

The term of full blooming of the latest group of blossoming cultivars, was noted about 2-8 days after early ones (tab. 2). Later blossoming give more chance for possibility to obtain regular yielding and it can reduce the risk connected with weather conditions. The result of this study indicated that proper choosing of cultivars is the most important factor in difficult Polish climate conditions for successful apricot production.

LITERATURE

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Table 1. Mean air temperatures during winter and spring period in 1997-2004

Mean decade and monthly air temperature (°C)		1997	1998	1999	2000	2001	2002	2003	2004
	I	-8,5	5,6	3,7	1,1	2,6	-3,7	-7,2	-5,4
January	II	-3,9	2,9	1,9	-0,5	-1,5	-2,3	0,7	1,8
	III	-0,7	-2,7	-0,6	-1,2	1,1	7,6	1,7	-5,1
Mean		**-4,3**	**1,8**	**1,6**	**-0,2**	**0,7**	**0,8**	**-1,5**	**-2,9**
	I	1,1	-0,7	0,3	6,6	2,2	7,5	-3,0	7,3
February	II	2,3	7,8	**-2,4**	2,1	2,6	3,8	-5,5	-0,9
	III	7,1	8,3	2,8	2,9	-0,9	3,4	-0,5	-0,6
Mean		**3,2**	**4,9**	**0,0**	**3,9**	**1,4**	**5,0**	**-3,2**	**2,0**
	I	5,5	5,4	6,2	5,2	2,6	5,3	0,9	-0,4
March	II	3,8	**1,5**	1,7	2,9	5,8	7,2	4,2	8,4
	III	3,3	3,8	8,5	6,9	2,1	4,3	5,8	5,6
Mean		**4,2**	**3,6**	**5,6**	**5,0**	**3,4**	**5,6**	**3,7**	**4,6**
	I	5,8	10,9	10,8	6,9	9,4	4,7	2,8	7,7
April	II	3,6	7,6	7,8	12,3	4,9	10,3	8,4	9,8
	III	9,5	14,3	11,7	17,5	10,0	11,9	13,7	11,9
Mean		**6,3**	**10,9**	**10,1**	**12,2**	**8,1**	**9,0**	**8,3**	**9,8**

Table 2. Term of beginning and length of their period for several apricot cvs in 2000-2004.

Phenological phase	Term of the phase beginning (day/month/year)		Length of period (days)		
	The earliest	The latest	The shortest	The longest	Mean
The earliest blooming cvs: 'Early Orange', 'Morden 604', 'Veecot'					
White flower bud	19.03.02	17.04.03	1	3	2,0
Full of blooming	**22-23.03.02**	**20-21.04.03**	**4**	**11**	**7,5**
The end of blooming	30.03-1.04.02	25-27.04.03	-	-	-
The intermediate blooming cvs: 'Harcot', 'Karola', 'Moorpark', 'Velkopavlovicka LE12/2', 'Velkopavlovicka LE19/2', 'Hargrand'					
White flower bud	20-21.03.02	18-20.04.03	1	4	2,5
Full of blooming	**23-28.03.02**	**22-23.04.03**	**3**	**13**	**8,0**
The end of blooming	1-8.04.02	25-27.04.03	-	-	-
The latest blooming: 'Somo', 'Bergeron', 'Ungarische Beste'					
White flower bud	23-24.03.02	19-20.04.03	1	3	2,0
Full of blooming	**28-30. 03.02**	**22-23.04.03**	**4**	**11**	**7,5**
The end of blooming	6-9.04.02	27.04.03	-	-	-

Table 3. Linear correlation coefficients between air temperature and the beginning of vegetation of several apricot cvs in 2000-2004

Parameters of mean daily temperature	Length of period from the 1st of January to the beginning of white flower bud phase (days)											
	Cultivars											
	'Early Orange'	'Morden 604'	'Veecot'	'Harcot'	'Karola'	'Moorpark'	'Velkopa-vlovicka LE12/2'	'Velkopa-vlovicka LE19/2'	'Hargrand'	'Somo'	'Bergeron'	'Ungarische Beste'
Sum of temperatures within 1st January-15 th March:												
>0°	-0,891	-0,912	-0,883	NS	NS	NS	NS	NS	NS	NS	NS	NS
>2°	-0,896	-0,913	-0,885	NS	NS	NS	NS	NS	NS	NS	NS	NS
>4°	-0,940	-0,949	-0,929	-0,919	-0,900	-0,913	-0,894	-0,903	-0,916	-0,909	-0,896	NS
>6°C	-0,954	-0,960	-0,944	-0,935	-0,918	-0,932	-0,914	-0,924	-0,933	-0,929	-0,916	-0,895
Number of days within 1st January-15 th March:												
>0°	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
>2°	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
>4°	-0,909	-0,920	-0,893	-0,880	NS	NS	NS	NS	NS	NS	NS	NS
>6°C	-0,932	-0,938	-0,918	-0,907	-0,890	-0,903	-0,883	-0,894	-0,905	-0,900	-0,888	NS
Sum of temperatures within 1st January-beginning of white flower bud phase:												
>4°	-0,926	-0,944	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
>5°	-0,975	-0,990	-0,971	-0,934	NS	-0,930	NS	-0,918	-0,944	-0,945	-0,899	-0,883
>6°	-0,985	-0,974	-0,959	-0,923	-0,882	-0,929	NS	-0,916	-0,937	-0,951	-0,905	-0,882
>7°C	NS	NS	-0,976	-0,989	-0,880	-0,915	-0,888	-0,902	0,954	-0,946	NS	NS
Number of days within 1st January-beginning of white flower bud phase:												
>4°	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
>5°	-0,920	-0,938	-0,882	NS	NS	NS	NS	NS	NS	NS	NS	NS
>6°	-0,896	-0,892	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
>7°C	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

NS - not significant α =0,05

Table 4. Linear correlation coefficients between the beginning of blooming period and the beginning of vegetation of several apricot cvs in 2000-2004

Parameter	Length of period from the 1st of January to the beginning of blooming phase (days)											
	Cultivars											
	'Early Orange'	'Morden 604'	'Veecot'	'Harcot'	'Karola'	'Moorpark'	'Velkopa-vlovicka LE12/2'	'Velkopa-vlovicka LE19/2'	'Hargrand'	'Somo'	'Bergeron'	'Ungarische Beste'
Length of period from the 1st of January to the beginning of white flower bud phase (days)	0,999	0,996	0,993	0,999	1,000	0,993	0,991	0,988	NS	0,989	0,991	0,993

NS - not significant α =0,05

Table 5. Linear correlation coefficients between air temperature or others factors and the length of period from the beginning to the end of blooming of
several apricot cvs in 2000-2004

Parameters	Length of period from the beginning to the end of blooming (days)											
	Cultivars											
	'Early Orange'	'Morden 604'	'Veecot'	'Harcot'	'Karola'	'Moorpark'	'Velkopa-vlovicka LE12/2'	'Velkopa-vlovicka LE19/2'	'Hargrand'	'Somo'	'Bergeron'	'Ungarische Beste'
Length of period from the 1st of January to the beginning of blooming (days)	NS	NS	NS	-0,947	NS	NS	NS	NS	NS	NS	NS	NS
Length of full blooming period (days)	0,985	0,962	0,969	0,907	0,925	0,990	0,886	0,988	0,984	0,986	0,975	0,983
Mean temperature from the beginning to the end of blooming period (°C)	NS	NS	NS	NS	-0,893	-0,882	NS	-0,968	-0,956	-0,955	-0,931	-0,885

NS - not significant α =0,05