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INFLUENCE OF THE METEOROLOGICAL CONDITIONS ON FRUIT CRACKING IN TWO SWEET CHERRY CULTIVARS GRAFTED ON TEN (10) DIFFERENT ROOTSTOCKS

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KEY WORDS: sweet cherry, Prunus avium, precipitation, rootstocks, fruit cracking

ABSTRACT

The studies were conducted in 2004-2006 in the 8-10-year-old plantation in the experimental field of the Agricultural University in the town of Plovdiv. On the basis of the concrete meteorological conditions during the time of the 20-day period before fruit-picking, the fruit cracking in the sweet cherry cultivars 'Bigarreau burlat' and 'Stella', grafted on 10 rootstocks, was studied. It was established that the precipitation in the last ten days before fruit-picking has the strongest influence on fruit cracking, whereas that of the preceding period(no matter that its quantity was greater)was of no significant importance. The influence of the rootstocks on cracking is not one way - i.e. a certain rootstock in some years induces heavier cracking than the remaining variants, and in other years – it is less heavy. This could be due to variations of the mean fruit mass of the trees on the examined rootstocks in the separate years, or to other factors.

INTRODUCTION

The cracking of the sweet cherry fruit inflicts serious losses on the producers in many of the regions where this crop is being cultivated (Balmer, 1996; Siegler, 1999). Taking into account the importance of this problem, the research workers from different countries have started their research work for its solving as early as the 30s of the 20th century (Sekse, 2008). Advancement in this activity has been registered after the introduction of the so called "cracking index" in the 50s of the previous century (Verner, 1957) and after the thorough studies of the different aspects of the sweet cherry fruit cracking, conducted in Denmark in the 70s (Christensen, 1972a, 1972b, 1973).

The main reason for the fruit cracking is connected with the frequent precipitation during the time of the fruit growth and ripening (Popatanasova et al., 2005; Greco et al., 2008; Vercammen et al., 2008). As a result of the purposeful scientific work it has been established that other factors, such as the biological characteristics of the cultivar – the thickness of the fruit skin, the size and density of the stomata on it (Georgiev, 2001; Sekse, 2008), the air temperature and humidity and the presence of wind (Georgiev, 2001; Sotirov, 2008), the maintenance system of the soil (Pansaers, 1976), the crown thickness etc., also influence fruit-cracking.

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There are very few studies in the literature available to us, referring to fruit-cracking depending on the rootstock. In this connection, some authors have observed the established influence of a certain rootstock (Granger and Frensham, 1991; Popatanasova and Sotirov, 2005; Simon et al., 2004), whereas in other studies no differences between the rootstocks have been proved (Vercammen et al., 2006).

Taking all this into consideration, we set the objective to study the influence of 10 rootstocks on the fruit-cracking of two cultivars under natural conditions (based on the concrete meteorological conditions).

MATERIALS AND METHODS

The studies were conducted during the period 2004 – 2006 in the experimental field of the Fruit-growing Department at the Agricultural University in the town of Plovdiv. The fruit of 8-10-year-old trees of the sweet cherry cultivars 'Bigarreau burlat' and 'Stella', grafted on the rootstocks P 1 (seedling of *P. mahaleb* L. selected in Bulgaria), Gisela 5, Gisela 4, Gisela 12, Gi 497/8, Weiroot 10, Weiroot 13, Weiroot 53, Weiroot 72 and Weiroot 158 were used, which were planted at distances of 6,0 – 4,5 m using a randomized block design. The trees (6 in number per variant) were trained as free-growing crowns; they were grown under the conditions of herbicide fallow and were gravity irrigated. The specific meteorological conditions (quantity of precipitation, mean 24-hour air temperature and relative air humidity) were registered during the time of the 20-day period preceding the crop-gathering. In the time of fruit-picking fruit were gathered (60 in number per tree for the cultivar-rootstock combinations, from the four cardinal points) and the percentage of cracking was calculated. The data obtained were statistically processed by the Anova method, using Student's test.

RESULTS AND DISCUSSION

During the 20-day period preceding the fruit-picking of 'Bigarreau Burlat' in the year 2004, the total precipitation of 32 mm was observed (Table 1). For the last 10 days of this period precipitation was low – 13,3 mm (Table 2), but as it was almost on a daily basis (Table 2 and Figure 1), it caused fruit-cracking. The fruit of the trees on Weiroot 53, Weiroot 158, Gi 497/8, P 1 and Gisela 12 suffered the most severe damages (between 12% and 15%), these on Gisela 4, Weiroot 10 and Weiroot 72 suffered the least severe damages (about 5% - 8%), whereas the remaining variants occupied an intermediate position (Table 3).

In the year 2005 during the 20-day period before picking the fruit of the cultivar 'Bigarreau burlat', a greater quantity of precipitation was observed (45 mm) in comparison with that form the same time in the previous year. Irrespective of this, fruit-cracking in the year 2005 in all variants decreases many times and was about 1% - 2% (Table 3). The reason for the lower fruit-cracking in the year 2005 is, according to us, probably due to the fact that the precipitation (nonetheless that it is great for the total 20-day period), fell mainly in the middle of this period, whereas in the last 8 days there was almost no precipitation (Figure 1). The weaker cracking in the year 2005 was positively influenced also by the higher mean 24-hour air temperature (Table 2), at which the rain drops fallen on the fruit evaporated more rapidly and didn't cause damages.

In the year 2006, in the time of the 20-day period preceding the harvesting of the cultivar 'Bigarreau Burlat', an insignificant quantity of precipitation fell (only 8,1 mm), which allowed to lower the fruit-cracking in all variants to under 1% (Table 3).

In the cultivar ‘Stella’ what makes an impression is that during the 20-day pre-harvesting period in the years 2004 and 2005 the precipitation is frequent (Table 1 and Figure 1), and its quantity in the two years is great and almost equal – 56,4 mm and 58,4 mm respectively (Table 1). This causes fruit-cracking which is especially clearly manifested in the year 2004 and in the separate variants it is between 25% and 45% (Table 3). The cracking is the highest (between 40% and 45%) in the trees on Gisela 5, Gisela 12 and P1, and it is the lowest (about 25% - 27%) in these on Gisela 4, Weiroot 53 and Weiroot 158. In the year 2005 the fruit-cracking is lower and in the separate variants it varies between 3% and 8, 62%. The cause for the different degree of cracking of the fruit of the cultivar ‘Stella’ in the years 2004 and 2005 (irrespective of the fact that in every one of these years the total precipitation for the 20-day pre-harvesting period was almost equal) can be explained, together with that for the cultivar ‘Bigarreau burlat’, with the precipitation quantity in the last ten-day period before harvesting. In this connection, for the last 10 days immediately before harvesting, for the year 2004 – 48,9 mm were reported, whereas for the year 2005 – it was only 13,1 mm (Table 2). The year 2006 is also indicative, when during the last 10 days before harvesting the precipitation fallen was 16,2 mm (approximately the same as that in the same term of the year 2005), and irrespective of the fact that the year 2006 was a lot dryer during the whole 20-day pre-harvesting period, cracking in both years was almost equal (Table 3). Based on the data obtained we can make the conclusion that the precipitation quantity in the last ten–day period before harvesting influences very significantly fruit-cracking. In this connection other authors (Granger, 2005; Popatanasova et al., 2005; Greco et al., 2008; Vercammen et al., 2008) also report that the precipitation in the time of growing in size and ripening of the fruit causes fruit-cracking, but they don’t specify the term in which precipitation causes the most severe damages. The conclusion drawn by us is logical, especially taking into consideration also the observations made under an electronic microscope, which register very thoroughly that the cracking on the cuticle occurs mainly in the third stage of fruit growing (Sekse, 2008).

As far as the rootstocks are concerned, their influence on fruit-cracking in our study is especially well outlined in the cultivar ‘Stella’ (in the three years), whereas in ‘Bigarreau Burlat’ – only in the year 2004 (Table 3). What makes an impression, however, is that this influence is not one-way – i.e. the separate rootstocks (for example Gisela 5) in some of the years induce higher fruit-cracking than the remaining variants, whereas in other years – considerably lower. This could be due to the variations in the mean fruit mass of the trees on the examined rootstocks in the separate years (data are not presented). In a given year, usually in the variants with larger fruit, higher cracking is also observed. It is possible, however, for other factors, such as fruit dry matter content, sugars etc., to influence cracking. According to us, additional, even more efficient studies are needed, including ones of the above-mentioned factors, in order to obtain more exact information about the influence of rootstocks on fruit-cracking (on the basis of the specific meteorological conditions). In this connection, according to Sekse’s (2008) topical opinion, it was observed that in the last years, although valuable contributions have been added to the issue of fruit-cracking in the sweet cherry, it still remains a complicated phenomenon.

CONCLUSIONS

Fruit-cracking in the sweet cherry cultivars ‘Bigarreau burlat’ and ‘Stella’ varies during the years of examining predominantly according to the quantity and density of the precipitation in the pre-harvesting period.

The precipitation in the last ten days or so before harvesting has the greatest influence on cracking, whereas that fallen before this time (no matter that its quantity is greater), is of no significant importance.

The influence of rootstocks on cracking is not one-way – i.e. a given rootstock in some years induces higher cracking than the remaining variants, whereas in other years - considerably lower. This could be due to the variations of the mean fruit mass during the separate years in the trees on the examined rootstocks or to other factors. In a given year, higher cracking is usually observed in the variants with larger fruit. However, it is possible for other factors to influence fruit-cracking too. In order to obtain more exact information about the influence of rootstocks on fruit-cracking (on the basis of the specific meteorological conditions), additional and even more detailed research is needed.

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Table 1.

Meteorological conditions during the time of the 20-day period before harvesting in two sweet cherry cultivars

	Quantity of precipitation, mm	Number of days with precipitation	Mean 24-hour air temperature, °C	Relative air humidity, %
'Bigarreau burlat'				
2004	32,0	11	16,1	70
2005	45,0	9	16,8	70
2006	8,1	6	15,2	65
'Stella'				
2004	56,4	11	17,2	77
2005	58,4	10	18,7	71
2006	18,8	9	19,1	63

Table 2.

Meteorological conditions during the time of the 10-day period before harvesting in two sweet cherry cultivars

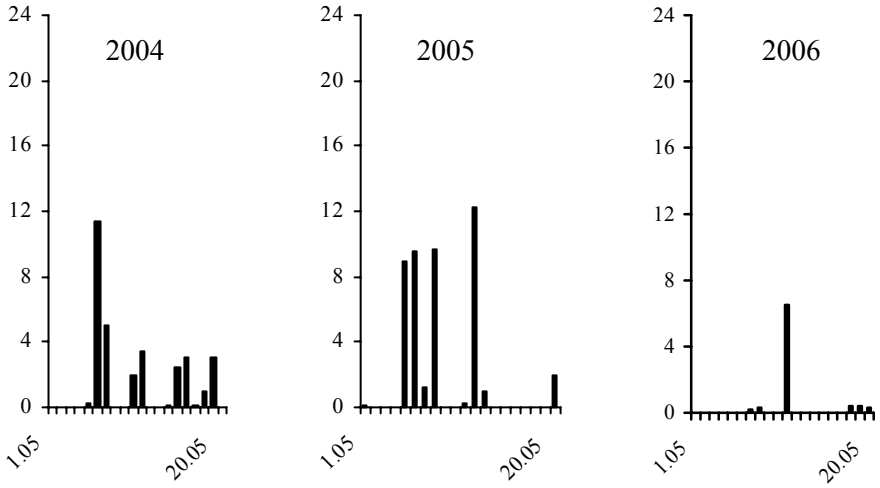
	Quantity of precipitation, mm	Number of days with precipitation	Mean 24-hour air temperature, °C	Relative air humidity, %
'Bigarreau burlat'				
2004	13,3	7	15,6	67
2005	15,4	4	17,1	73
2006	7,6	4	17,3	65
'Stella'				
2004	48,9	7	18,8	82
2005	13,1	4	17,1	74
2006	16,2	6	17,4	62

Table 3.

Fruit cracking in the cherry cultivars 'Bigarreau burlat' and 'Stella' depending on the rootstock

Rootstocks	'Bigarreau burlat'			'Stella'		
	2004	2005	2006	2004	2005	2006
P 1	12,73	1,69	0,53	39,52	3,07	6,06
Gisela 5	10,42	2,06	0,26	45,18	8,62	2,14
Gisela 4	5,19	1,52	0,28	25,10	3,40	2,97
Gisela 12	12,10	1,97	0,49	40,72	6,20	5,20
Gi 497/8	13,27	2,09	0,69	37,62	6,77	5,05
Weiroot 10	8,36	1,76	0,40	33,86	4,20	6,16
Weiroot 13	10,06	1,24	0,59	39,23	5,65	6,50
Weiroot 53	14,90	2,15	0,30	27,04	4,88	6,92
Weiroot 72	7,68	0,88	0,36	36,09	7,10	7,24
Weiroot158	13,56	1,50	0,48	26,78	4,07	6,70
LSD - 5%	4,09	NS	NS	13,20	4,31	3,19

'Bigarreau Burlat'



'Stella'

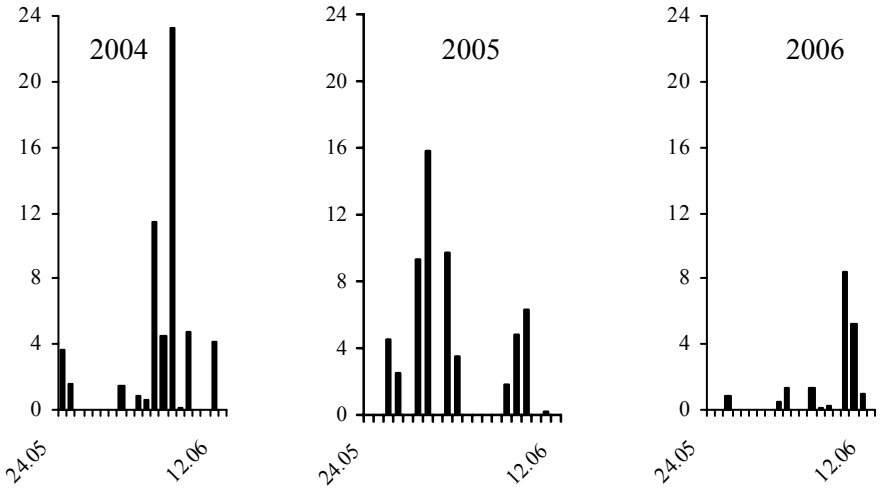


Figure 1. Quantity of precipitation (mm) during the time of the 20-day period before picking of the fruit of two sweet cherry cultivars