HortFlora Research Spectrum, 3(1): 73-76 (March 2014) ISSN : 2250-2823

RAIN-INDUCED FRUIT CRACKING IN SWEET CHERRY (*Prunus avium* L.) CULTIVARS

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ABSTRACT : Survey of cherry orchards in Srinagar and Shopion districts of Kashmir revealed that rain-induced fruit cracking varied with cultivars and Misri recorded highest loss (>50%) of fruit due to cracking followed by Awal Number, Double and Makhmali. The relative susceptibility of different cultivars has also been confirmed in the laboratory by dipping of ripened fruits in water for 48 hours. To test the efficiency of certain chemicals in reducing the rain-induced fruit cracking in sweet cherries ripened fruits were dipped in aqueous solutions of $CaCl_2$ (0.5 and 1.0%), NAA (10 and 20 ppm) and GA_3 (25 and 50 ppm) for a period of 48 hours at room temperature and cracking of fruits was observed accordingly. Distilled water without any chemical was served as control. Cultivars responded differently to various chemical treatments. GA_3 (50-100 ppm) was found most effective in controlling the rain-induced fruit cracking in Awal Number, while as $CaCl_2$ at 1.0% gave better results with Makhmali, Double and Misri cultivars. Preharvest foliar spray of GA_3 (100 ppm) and $CaCl_2$ (1.0%) also confirmed their superiority in controlling the fruit cracking in "Awal number" and other cultivars, respectively as compared to other treatments.

Keywords : *Fruit cracking, cherry, $CaCl_2$, NAA, GA_3.*

Cherry is one of the most important fruits of temperate zones all over the world. It is also grown in the Kashmir valley and especially liked by the people due to its attractive colour and high caloric values. Being a non climacteric, its fruit must be remained on the tree for ripening. However, rain-induced fruit cracking at ripening stage is a serious constraint for its production and productivity all over the world (Lane *et al.,* 11). More than half of the fruit borne by crack susceptible cultivars may be lost due to untimely rain near harvest (Davenport *et al.,* 5; Singh and Singh, 15, Khan *et al.,* 9). In the Kashmir valley cherries are harvested during the months of April and May, depending upon the cultivars and prevailed climatic conditions. This is the period of the year in the valley when most of the precipitation occurrs. A heavy loss of cherry due to rain-induced cracking has been a frequent phenomenon in Kashmir; however, there is no précised report available on this aspect. The prevailing theories of fruit cracking have been based on direct water absorption through the fruit skin causing volume increase of the fruit and thus cracking (Davenport *et al.* 5). Any treatment that will decrease the rate of absorption of water or will increase the capacity of fruit tissues to stretch without rupturing should reduce the susceptibility to cracking. Spray application of Ca salts (Meheriuk *et al.,* 12; Bhat *et al.,* 3), boron (Anaris, 1) and hormones like GA_3 and NAA (Anon, 2) have been found effective in reducing rain-induced cracking in sweet cherry cultivars. However, one major problem with interpreting these reports is the variability in response from country to country, season to season and even orchard to orchard. Keeping the above facts in mind, the present investigation was planned to assess the extent of losses due to rain-induced cracking in sweet cherry cultivars and evaluate the potential of certain chemicals as possible control measure.

Received : 20-12-2013 *Accepted : 28-01-2014*

MATERIALS AND METHODS

The present investigation was carried out in the Plant Physiology section, Division of PHT, SKUAST-K, Shalimar during 2007-09. Four commercially important cultivars of cherry, namely "Awal Number", "Makhmali", "Double" and "Mishri", grown in the Kashmir valley were selected for the study. To assess the degree of fruit cracking on the tree survey of two major cherry growing areas of the valley i.e. Srinagar and Shopian, was made during the two consecutive years (2007 and 2008) at the time when fruits were ready to harvest. Each cultivar at each site was taken in four replicates with two trees as one sample unit making of total eight trees per cultivar per site. Three limbs on each tree were choosen randomly to count the number of cracked fruits over intact one and per cent cracked fruits were calculated. Freshly harvested intact fruits were collected and brought to the laboratory for judging their cracking potential by dipping in water for a period of 48 hours. In order to evaluate the efficacy of certain chemicals in protecting the fruits from cracking they were immerged in aqueous solutions of different chemicals comprised of $CaCl_2$ (0.5% and 1.0%), NAA

Table 1 : Effect of chemical solutions on fruit cracking in sweet cherry cultivars (sinking studies).

Treatments	Cracking index (%)							
	Awal number		Makhmali		Double		Misri	
	2007	2008	2007	2008	2007	2008	2007	2008
Control-DW	40.0	32.45	26.7	20.16	22.5	27.42	85.0	73.22
$CaCl_2$-0.5%	25.0	25.22	10.0	13.14	5.0	6.54	5.0	9.87
$CaCl_2$-1.0%	20.0	21.34	7.5	9.25	5.0	4.33	12.0	5.75
NAA-10 ppm	20.0	7.82	17.5	11.55	12.0	12.78	55.0	45.88
NAA-20 ppm	12.0	6.23	12.0	15.23	17.5	10.45	60.0	39.35
GA_3-50 ppm	5.0	12.33	10.0	9.68	7.5	7.95	80.0	15.20
GA_3-100 ppm	2.0	13.26	20.0	6.33	12.5	8.12	75.0	18.36
CD (*P*=0.05)	2.06	1.79	2.77	2.12	1.03	1.73	3.01	2.13

Table 2: Effect of pre-harvest application of certain chemicals on fruit cracking in sweet cherry cultivars.

Treatments	Cracking index (%)							
	Awal number		Makhmali		Double		Misri	
	2008	2009	2008	2009	2008	2009	2008	2009
Control-DW	18.6	29.8	19.8	15.4	17.00	32.8	47.30	28.6
$CaCl_2$-0.5%	13.5	10.5	12.5	13.8	6.28	6.0	15.28	13.9
$CaCl_2$-1.0%	12.8	10.8	11.8	13.5	4.65	6.0	11.57	14.9
NAA-10 ppm	17.2	18.3	16.5	14.1	10.55	30.2	18.74	25.3
NAA-20 ppm	17.5	16.5	18.3	13.8	9.14	19.8	14.35	22.6
GA_3-50 ppm	5.5	5.8	18.5	12.5	8.55	05.4	24.88	14.1
GA_3-100 ppm	4.6	5.0	17.8	11.2	7.22	12.9	25.20	17.2
CD (*P*=0.05)	1.56	1.36	2.01	2.20	2.13	1.99	2.56	2.23

(10 ppm and 20 ppm) and GA_3 (50 ppm and 100 ppm) and remained them at room temperature for a period of 48 hours. Each treatment was replicated five times with 50 fruits in each sample. Cracking score, as per cent cracked fruits was recorded in each treatment. Similar treatments were also applied by spraying them to ripened fruits 'on tree' to test their efficacy in the field. The spray studies were performed in two consecutive seasons 2006 and 2007 in the Srinagar area only. Analysis of variance of the data was calculated to see the significance of differences among the treatments (Gomez and Gomez, 8).

RESULTS AND DISCUSSION

Survey of cherry orchards in Srinagar and Shopion area (Fig 1) revealed that extent of 'on tree' fruit cracking was varied from year to year at both the location but without any definite trend. Cherry cultivars also differed in their cruelty of cracking although the pattern of average fruit cracking with regard to cultivars was roughly comparable in both the years at both the sites with maximum malevolence in 'Misri', followed by 'Awal Number', 'Double' and 'Makhmali'. Variability in rain-induced fruit cracking among cherry cultivars has also been reported by Roser (14) and Lane *et al.* (11). The dissimilarity in fruit cracking among the cultivars may be attributed to the differences in their flesh composition especially soluble sugars and/or skin characteristics (Christensen, 4; Glenn and Poovaiah 6). It is evident from the data that the severity of fruit cracking was more in Srinagar region as compared to Shopion which could be attributed to the distinction in climatic conditions chiefly temperatures between the two as the average temperature of Srinagar district is generally higher than Shopion. Higher temperature might have resulted in more water absorption and thus splitting of fruits.

Sinking of fruits in water (Table 1) caused a noteworthy amount of fruits to be cracked and degree of fruit cracking with regard to cultivars was resembling the results of 'on tree' fruit cracking i.e. 'Misri' showed the highest percentage of cracked fruits (85.0 and 75.22%) followed by 'Awal number' (40.0% and 32.45%), 'Double' (22.5% and 27.4%) and 'Makhmali' (26.7% and 20.26%) in two consecutive years (2007 and 2008), respectively. Tumbling of fruits in aqueous solutions of various chemicals, however, resulted in a lessened fraction of cracked fruits as compared to

water dipped fruits, and different cultivars responded in a diverse way to various chemical solutions. Cultivar 'Awal Number' exhibited better results with hormonal treatments in both the years, however, with varied response, as compared to calcium chloride salt, while as 'Makhmali', 'Double' and 'Misri' gave better results with $CaCl_2$ against the less effective role of hormones. Between the two hormones tested, GA_3 proved better as compared to NAA. Though, no definite trends with regard to the level of hormones could be drawn but higher levels seem better than lower ones. However, higher concentration of $CaCl_2$ (1.0%) visibly proved finer treatments in suppressing the fruit cracking of cherry as compared to its lower level (0.5%). It has been clearly shown in immersion studies that calcium reduces the rate of cracking in sweet cherries by solubilizing the cell wall materials and reducing the rate of water uptake in cells (Glenn and Poovaiah, 7). Reduced cracking due to calcium has also been explained by the direct reduction in the rate of water absorption caused by the increase in the osmotic concentration of the water in contact with the treated fruits (Christensen, 4). Application of gibberellic acid appeared to thicken the cuticle and the redial epidermal walls and thus reduced fruit cracking (Anon. 2; Anaris, 1). Pre-harvest spray of NAA has also been reported to reduce the field cracking and cracking index and increase the firmness of two cherry varieties (Anon. 2). Reduced fruit cracking due to spray is also in line of Mishra *et al.* (13) as reported in litchi.

Data on effect of pre-harvest application (at ripening) of various treatments on fruit cracking (Table 2) pointed out somewhat a lesser degree of cruelty in case of control but with similar pattern of diversity among the cultivars. As in case of plummeting studies, cultivars also responded distinctly to various spray treatments e.g., hormonal treatments found more effective in controlling the fruit cracking in 'Awal Number' while as $CaCl_2$ provided evidence of more effectiveness with other cultivars. Data also indicate that GA_3 showed an added advantage in comparison to NAA. In general, all the treatment showed better outcome with their enhanced doses of treatments. Spray applications of calcium salts to fruit in the field are known to reduce fruit cracking (Anon, 2; Bhat *et al.,* 3; Lang and Flore, 10). It has also clued-up that cherry cultivars differ in their susceptibility to cracking and application of chemicals prior to the rain such as gibberellic acid can help in toughen the skin and reduce cracking in cherries (Anon.2; Anaris 1). Pre-harvest application of lower concentrations of NAA (10-25 ppm) was found effective in reducing cracking in fruits (Singh and Singh, 15; Anon., 2).

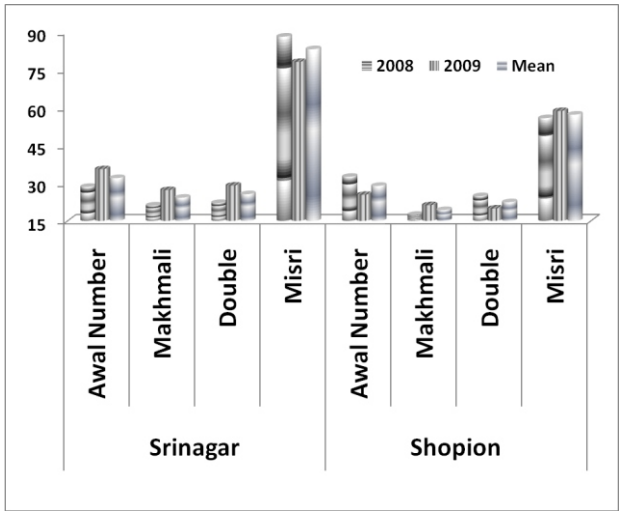

Figure 1 : Severity of rain-induced fruit cracking (%) in sweet cherry cultivars.

It can be concluded that susceptibility of rain-induced fruit cracking (or potential of fruits to crack in response to continuous bathe with water) sweet cherry is cultivar specific and "Misri" is at risk as it proved most vulnerable to rain-induced cracking. Severity of fruit cracking can be reduced by spraying 1.0 % aqueous solution of $CaCl_2$ to the ripening fruits just before harvest.

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Citation : Khan F.A., Rather A.H. and Ahsan, H. (2014). Rain induced fruit cracking in sweet cherry (*Pranus avium* L.) cultivars. *HortFlora Res. Spectrum,* 3(1). 73-76.