Scientia Horticulturae 184 (2015) 169–170

Contents lists available at ScienceDirect

Scientia Horticulturae

journal homepage: www.elsevier.com/locate/scihorti

Short communication

On the mechanisms of the sweet cherry (*Prunus avium* L.) fruit cracking: Swelling or shrinking?

Kouman S. Koumanov*

Department of Meliorations and Land Survey, Faculty of Viticulture and Horticulture, Agricultural University, 12 Mendeleev Str., Plovdiv 4000, Bulgaria

ARTICLE INFO

Article history:
Received 15 December 2014
Received in revised form 4 January 2015
Accepted 7 January 2015

Keywords:
Prunus avium L. (sweet cherry)
Fruit cracking mechanisms
Fruit skin shrinking
Cooling irrigation

ABSTRACT

This short communication brings to the attention of the scientific community a new hypothesis about the mechanism of the sweet cherry fruit cracking, which is a problem in most producing areas of the world and causes significant economic losses. It is commonly accepted that fruit crack after rainfalls because of the fruit-flesh swelling due to osmotic imbibition of water by cells. The proposed hypothesis attributes this phenomenon to fruit skin shrinking after its rapid cooling, caused by a rainfall or by sharp drop of the ambient temperature. If the proposed mechanism is correct, the cracking prevention measures should be thoroughly revised. Paradoxically, the expensive rain-preventing covers may be replaced by cheaper systems for cooling overhead (micro)sprinkling, which to be operated in the days with an unfavorable forecast. All related chemical treatments would not make sense anymore as well.

Dear researchers involved in solving the problem of cherry-fruit cracking, I am addressing you in "letter" format because the phenomenon has always been remote to my scientific interests. Taking advantage of the opportunity offered by the Scientia Horticulturae journal, I dare bring to your attention one hypothesis about the cherry-fruit cracking mechanism. I do not have experimental proofs at this moment, but I encourage skilled researchers with adequate state-of-the-art instrumentation to test the hypothesis presented here.

Cherry fruit crack when the tensile stress in the fruit skin exceeds its strength. It is commonly accepted that this happens because of the swelling of the fruit flesh due to cell expansion after osmotic imbibition of water (Balbontín et al., 2013; Christensen, 1996; Measham, 2011; Sekse, 1998, 1995; Simon, 2006). The discrepancy between scientists, if any, concerns only the mechanism of this water imbibition and particularly the water pathways. By now, no convincing explanation of this event has been offered. Nevertheless, alternative mechanisms of stress induction in the fruit skin have not been considered so far; probably because cracking is predominantly associated with rainfalls, though it may happen in dry conditions as well (Measham, 2011; Sekse, 1995).

Amazingly, nobody has ever considered alternative explanations of the stress induction in the fruit skin. For instance, the same effect may be caused by skin shrinking instead of flesh swelling. It is well known that in sunny days skin temperature of the exposed fruit may raise well above 40 °C (Tarara et al., 2008) exceeding the air temperature by about 12 °C (Smart and Sinclair, 1976). The process of temperature increase is slow and accompanied by heat transfer inwards to the fruit core. This heating unavoidably leads to an increase in the fruit volume, the rates of expansion in bot skin and flesh being comparable. Moreover, because of the higher temperatures at the fruit surface, the skin relaxation probably outstrips the flesh expansion, thus avoiding the appearance of any stress in the skin. On the opposite, eventual rain drops on such "overheated" fruit can rapidly decrease the skin temperature by probably more than ten degrees Celsius, while flesh cooling lacks far behind because of the slower heat transfer from the inside outwards. Thus, the fruit skin shrinking should be significant and almost instant, while the expanded flesh volume should remain virtually unchanged. As a result, the fruit skin is probably subjected to much more severe stress than that induced by the eventual osmotic water imbibition. The mechanism should probably be the same in the case of sharp drop of the ambient temperature, which could explain the "dry" fruit cracking as well.

If this is the mechanism of the cherry-fruit cracking, then the cracking prevention measures should be revised, too. "Keep fruit cool" would become the new paradigm. Paradoxically, the expensive rain-preventing covers might be replaced by cheaper systems for cooling overhead (micro)sprinkling, which to be operated in the days with a rainy forecast or when sharp drops in the ambient

* Tel.: +359 32696599; fax: +359 32670808.
E-mail address: kskoumanov@hotmail.com

http://dx.doi.org/10.1016/j.scienta.2015.01.002
0304-4238/

temperatures are expected. All related chemical treatments would not make sense anymore as well.

Acknowledgment

I thank the COST Action FA 1104 “Sustainable Production of High-Quality Cherries for the European Market”, which provided me with the opportunity to meet researchers of different scientific fields and particularly to get acquainted with the problems of the sweet cherry fruit cracking.

References

Balbontín, C., Ayala, H., Bastías, R.M., Tapia, G., Ellena, M., Torres, C., Yuri, J.A., Quero-García, J., Ríos, J.C., Silva, H., 2013. Cracking in sweet cherries: A comprehensive review from a physiological, molecular, and genomic perspective. Chil. J. Agric. Res. 73 (1), 66–72.

Christensen, J.V., 1996. Rain-induced cracking of sweet cherries: Its causes and prevention. In: Webster, A.D., Looney, N.E. (Eds.), Cherries: Crop Physiology, Production and Uses. CAB International, London, UK, pp. 297–327.

Measham, P., (Ph.D. thesis) 2011. Rain-Induced Fruit Cracking in Sweet Cherry (*Prunus avium* L.). School of Agricultural Science, University of Tasmania, 170 pp.

Sekse, L., 1998. Fruit cracking mechanisms in sweet cherries (*Prunus avium* L.) – a review. Acta Hortic. (ISHS) 468, 637–648.

Sekse, L., 1995. Cuticular fractioning in fruits of sweet cherry (*Prunus avium* L.) resulting from changing soil water content. J. Hortic. Sci. 70 (4), 631–635.

Simon, G., 2006. Review on rain induced fruit cracking of sweet cherries (*Prunus avium* L.), its causes and the possibilities of prevention. Int. J. Hortic. Sci. 12 (3), 27–35.

Smart, R.E., Sinclair, T.R., 1976. Solar heating of grape berries and other spherical fruits. Agric. Meteorol. 17 (4), 241–259.

Tarara, J.M., Lee, J., Spayd, S.E., Scagel, C.F., 2008. Berry temperature and solar radiation alter acylation, proportion, and concentration of anthocyanin in merlot grapes. Am. J. Enol. Vitic. 59 (3), 235–247.