Turkish Journal of Agricultural and Natural Sciences
Special Issue: 2, 2014

TÜRK
TARIM ve DOĞA BİLİMLERİ
DERGİSİ

TURKISH
JOURNAL of AGRICULTURAL
and NATURAL SCIENCES

www.turkjans.com

Determination of Optimum Harvest Date of Sweet Cherry cv. Lapins Grown in Isparta

[a]Özgür Çalhan*, Cemile Ebru Onursal, Atakan Güneyli, İsa Eren, İsmail Demirtaş
[a]Fruit Research Station, Eğirdir, Isparta, Turkey
*Corresponding author: ozgur_calhan@hotmail.com

Abstract

In terms of agricultural exports, cherry is an important product for Turkey. Export is possible with the high quality production, harvest at the right time and properly storing. Quality cherries to market is one of the most important step that determination of the optimal harvest date and harvesting on these dates. Fruits are encountered with the loss of quality and products if they are not harvested an exact date. This study was conducted to evaluate physical measurements of fruit quality as a maturity index for estimating optimum harvest date (OHD) of Lapins cherries. For this purpose, the days after full blossom (DAFB) was determined as 19.04.2012. Cherry fruits, began after 22 DAFB, were harvested at certain periods. Fruit samples were picked from 22 to 85 DAFB. Skin color, fruit width and length, fruit weight, fruit firmness, total soluble solids (TSS), titratable acidity (TA), respiration rate, maturity index (TSS/TA ratio) were analyzed in picked fruits. As a result of the analysis, as DAFB was increased, fruit weight, fruit width and length were increased. Fruit growth was slowed down in the days after OHD. With the start of the changes in fruit color L*, b* and h° color value were rapidly decreased, while a* value was increased. This color changes was slowed down in the days after OHD. Respiration rate in small fruit stage was very high, while respiration rate was slow gradually during growth. OHD of Lapins cherry variety was determined as 64 DAFB.

Keywords: Sweet cherry, Lapins, Optimum harvest date, fruit maturity

Introduction

Sweet cherries (*Prunus avium* L.) are highly perishable non-climacteric fruits. With a high respiration rate, their shelf life is very short and can be seen in the browning and drying of the stems, the darkening of the fruit color, shriveling, and development of decay (Alonso and Alique, 2006).

Maturity at harvest is an important factor affecting quality perception and the rate of change of quality during postharvest handling. Variability in the maturity of sweet cherries is related to several factors, including crop load, fruit to leaf ratio, location on the tree and exposure to light. Maturity indices can be determined in many ways, including estimation of the duration of development; measurement of size, weight, or density; physical attributes such as color, firmness and moisture or solids content; other chemical attributes such as starch, sugar, or acid content; or morphological evaluation (Shewfelt, 2009). Soluble solids content (SSC), titratable acidity (TA), SSC/TA ratio, skin color, and firmness have all been used as indices for cherry fruit maturity, but skin color has long been accepted as the best indicator for the appropriate harvest maturity of sweet cherries (Drake and Elfving, 2002).

Lapins is a self-fertile cultivar from the PARC breeding program. Lapins is a dark-colored sweet cherry cultivar that matures 7 to 15 d later than Bing. Lapins is of commercial interest because of its large size, very firm and resistance to rain cracking, but sensitive to wind marking. The tree has a very upright growth habit and is very productive with fruit growing in tight clusters making late season fungicide coverage difficult and increasing the potential for fruit disease infection. Fruit is mahogany and flesh is red when ripe, but the fruit colors early and is not a good indicator of ripeness. Its SSC when ripe is similar to Bing (Drake and Elfving, 2002; Long et al., 2005).

Generally, two different systems for predicting OHD are possible, (1) calculation models or OHD equations which are using number of days after full bloom and meteorological variables during the growing season, and (2) direct measurement of certain physiological fruit parameters and quality characteristics during a given period until harvest. Optimum harvest date equations (1) are simple and unexpensive tools, but it is necessary to establish long term records of meteorological and phenological data and at optimum harvest dates. The optimum harvest date equations give a general

impression of the ripening situation in normal years and for standard conditions only. Direct measurements of fruit characteristics (2) in certain intervals some weeks before the estimated harvest date are more reliable for single orchards or specific cultivars, but they need much more time and labour. The main purpose for developing such a method was to enable the growers or store managers to apply the maturity tests themselves in their orchards or storehouses. Therefore it was necessary to create a reliable, cheap and simple method for OHD determination (Streif, 1996).

This study was conducted to evaluate OHD equations and physical measurements of fruit quality as a maturity index for estimating proper harvest time of Lapins cherries.

Materials and Methods

Fruit from the sweet cherry cv. Lapins was harvested during 16 different dates (between 11.05.2012 and 20.07.2012) from research station orchard in Eğirdir (Isparta) district, in southwestern Turkey. Full bloom date of Lapins is at 19.04.2012.

Fruit with the pedicel was harvested from 7 trees, transferred to the postharvest laboratory. The fruit were inspected and culls (split, diseased or damaged fruit) were discarded. For each sampling date, harvested fruits were separated three replicate which the following analytical determinations were performed.

Quality parameters

Fruits weight was measured to each 10 fruits (5 group, 50 total fruits) by an electronic balance to an accuracy of 0.01 g. Results were expressed as gram (g).

Fruit width and length was measured to 21 fruits by electronic micrometer. Results were expressed as millimeter (mm).

Flesh firmness was defined as the maximum load required to push the 6 mm dia. probe into the fruit firmness one side of each fruit, to a depth of 6 mm with fruit texture analyzer (Guss FTA Type GS14, Strand, South Africa). The results were expressed in Newton (N). Firmness was measured between 15.6.2012 and 13.7.2012.

The fruit color variables L* (brightness or lightness; 0 = black, 100 = white), a* (−a* = greenness, +a* = redness) and b* (−b* = blueness, +b* = yellowness), hue angle and chroma were measured using a colorimeter (CR400, Minolta Co., Japan). The hue angle is expressed in degrees and is a measure of color that, for example, from 0 to 120° spans from red to orange to yellow to green.

Total soluble solids concentration (TSS) was determined in the juice from ten fruits from each replicate with a temperature compensated digital refractometer (HI 96801, Hanna, U.K.) previously calibrated with distilled water and results expressed as °Brix. Titratable acidity (TA) was estimated by juice titration with 0.1 N NaOH to the titration end point of pH 8.1, monitored with a pH meter (HI 110, Hanna, U.K.) and expressed as malic acid content (mg/100 mL). Maturity index was measured TSS/TA ratio. TSS, TA and TSS/TA was measured between 15.6.2012 and 13.7.2012.

The respiration rate of fruit was measured with a gas chromatography (Agilent 6840) with equipment column TCD. Approximately 200 g from each replicated was enclosed for 1 h in a 0.3 L glass jar. A 10 mL gas sample was withdrawn from the headspace for respiration rate determination. The respiration rate (measured as CO_2 production) was expressed as mL/kg/h.

This research was based on completely randomized design with three replications. For examining of relationships among parameters, correlation coefficients were calculated by pearson correlation test in JMP7 software.

Results

Fruit size (weight, width and length) increased during fruit growth and development (Fig. 1 and 2). Time of picked influenced fruit size of Lapins sweet cherries. Fruit size increased with the advance of the picked time, particularly later the veraison time (breaker green colour). 10 fruit weight increased from 17.10 g to 107.22 g depending on example dates, and this value was 93.73 g at optimum harvest date. After the optimum harvest time in the increase rate of 10 fruit weight reduced. At the same time, fruit width and length increased during fruit growth and development. Fruit width and length increased from 15.43 mm and 16.80 mm to 26.39 mm and 24.04 mm, respectively. Fruit width and length was 26.91 mm and 24.97 mm at optimum harvest date.

Fruit firmness is also a very important both preharvest and postharvest quality factor. Fruit firmness decreased with longer picked date. Late-picked fruits were less firm than fruit early picked (Fig. 3). Firmness of early picked fruits (15.6.2012) was 15.43 N while firmness of late picked fruits was 7.75 N. Firmness of determination date as optimum harvest date was 11.55±1.47 N. Decreased in fruit firmness after late harvest date (25.06.2012) declined.

As would be expected, a delay in picked date resulted in increased TSS. Therefore, TSS/TA values were increased during fruit growth and development (Fig. 3). This increased of TSS/TA values over picked dates has been observed in other studies (Drake and Elfving, 2002; Crisosto et al. 2003).

Table 1. Correlations among the variables during the fruit growth and development. The correlation coefficients significant at *=p ≤ 0.05, **= p ≤ 0.01, ***= p ≤ 0.001 error level, NS= not significant.

	10 Fruits weight	Firmness	Respiration rate	SSC	TA	SSC/TA	Width	Length	Color (h)	Color (a*)	Color (b*)	Color (C*)	Color (L*)
DAFB	0,96 ***	-0,89 **	-0,95 ***	0,87 **	-0,64 NS	0,92 ***	0,86 **	0,86 ***	-0,89 ***	0,72 **	-0,88 ***	-0,77 ***	-0,90 ***
10 Fruits weight		-0,90 **	-0,93 ***	0,86 **	-0,61 NS	0,89 **	0,96 ***	0,96 ***	-0,96 ***	0,68 **	-0,99 ***	-0,94 ***	-0,98 ***
Firmness			0,89 **	-0,83 **	0,48 NS	-0,83 **	-0,77 *	-0,74 *	0,70 *	0,91 ***	0,94 ***	0,94 ***	0,93 ***
Respiration rate				-0,87 **	0,26 NS	-0,81 **	-0,97 ***	-0,96 ***	0,96 ***	-0,83 ***	0,89 ***	0,80 ***	0,89 ***
SSC					-0,42 NS	0,97 ***	0,62 NS	0,57 NS	-0,37 NS	-0,88 **	-0,81 **	-0,88 **	-0,80 **
TA						-0,62 NS	-0,45 NS	-0,50 NS	0,19 NS	0,59 NS	0,52 NS	0,58 NS	0,52 NS
SSC/TA							0,64 NS	0,60 NS	-0,35 NS	-0,91 ***	-0,83 **	-0,90 **	-0,81 **
Width								1,00 ***	-0,96 ***	0,46 NS	-0,96 ***	-0,85 **	-0,97 ***
Length									-0,96 ***	0,46 NS	-0,96 ***	-0,85 **	-0,97 ***
Color (h)										-0,86 ***	0,94 ***	0,78 ***	0,96 ***
Color (a*)											-0,65 **	-0,37 NS	-0,72 **
Color (b*)												0,93 ***	0,99 ***
Color (C*)													0,87 ***

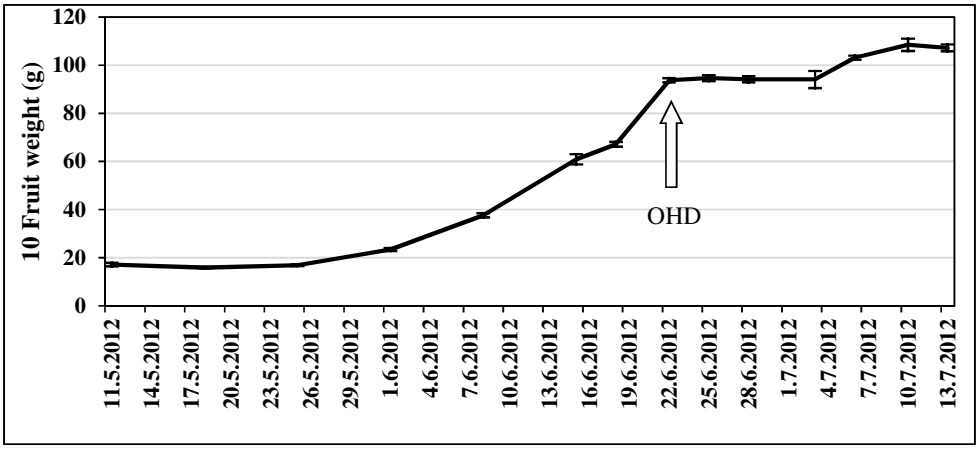

Fig. 1. Effects of different picked dates on 10 fruit weight (g) of sweet cherry cv. Lapins fruits. Vertical bars represent standard error of the means.

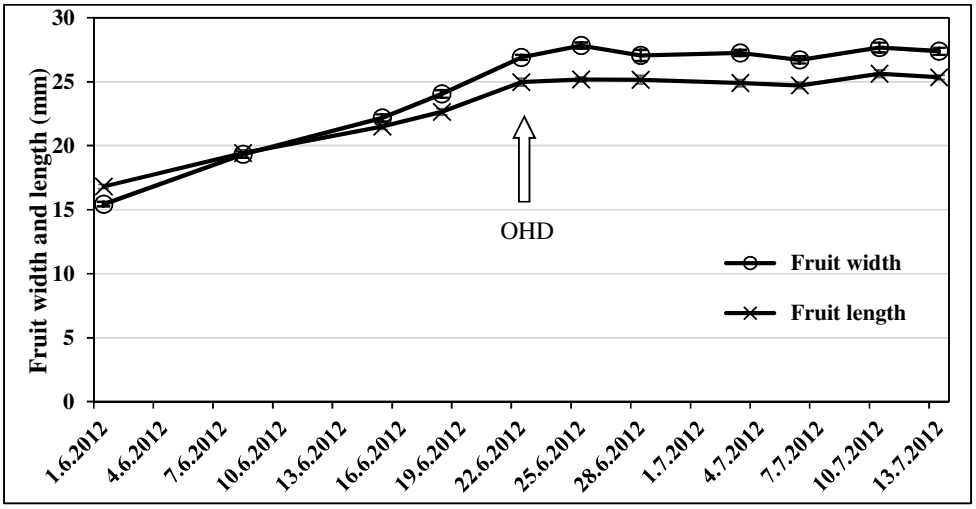

Fig. 2. Effects of different picked dates on fruit width and length (mm) of sweet cherry cv. Lapins fruits. Vertical bars represent standard error of the means.

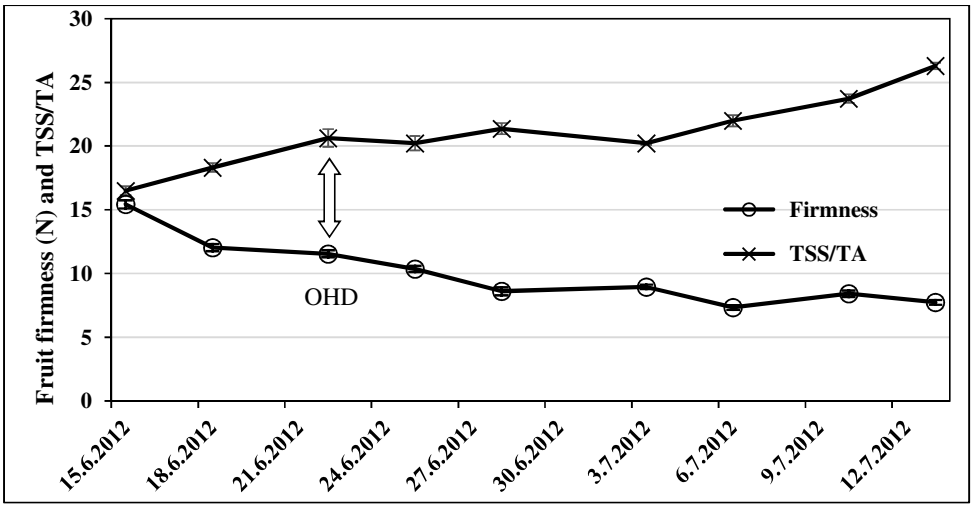

Fig. 3. Effects of different picked dates on fruit firmness (N) and TSS/TA of sweet cherry cv. Lapins fruits. Vertical bars represent standard error of the means.

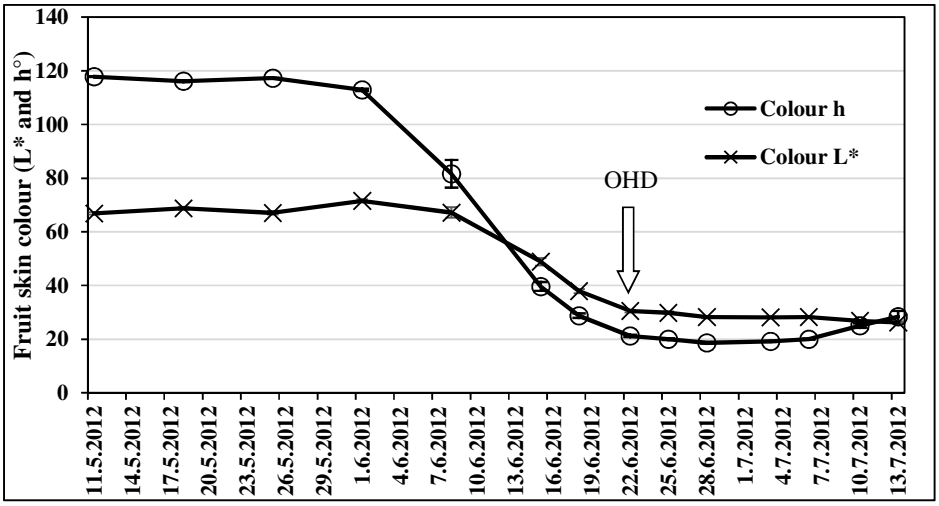

Fig. 4. Effects of different picked dates on skin colour (L* and h°) of sweet cherry cv. Lapins fruits. Vertical bars represent standard error of the means.

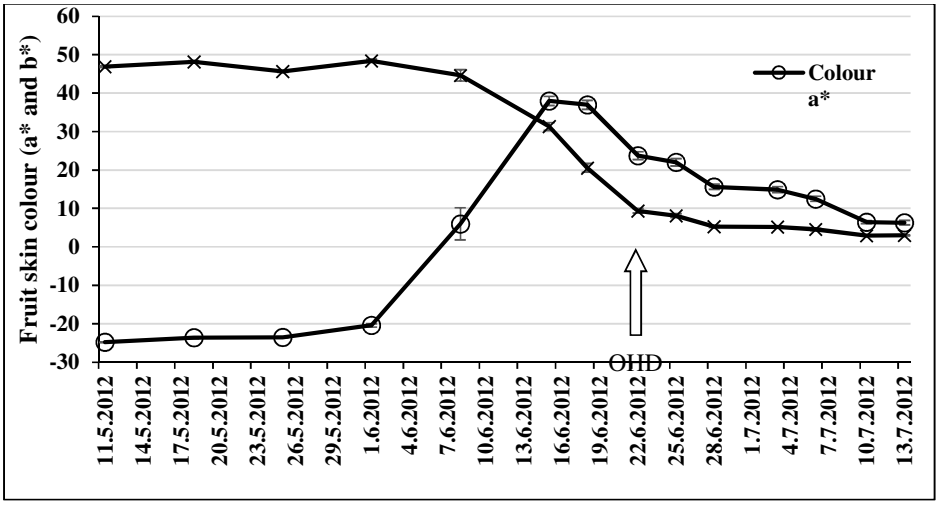

Fig. 5. Effects of different picked dates on skin colour (a* and b*) of sweet cherry cv. Lapins fruits. Vertical bars represent standard error of the means.

The increase in SSC/TA during the maturation/ripening period resulted from the higher increase in SSC than the increase in TA (Crisosto et al. 2003). The TSS/TA balance is responsible for the fruit's flavor and is one of the main indicator of the quality of the fruits (Alonso and Alique, 2006).

Consumers decided to buy cherries according to skin color; the darker the skin color the higher the percentage of consumers that would buy them. L*, b* and h colour values were increased, and a* colour value first increased and then decreased during fruit growth and development (Fig. 4 and 5). Effect of harvest date on color values were statistically significant differences ($P<0.001$). Decreasing fruit colour hue values indicates change in fruit colour from green to yellow to red. It has been well known that decrease in fruit colour hue values resulted from chlorophyll decomposition during maturation. The highest a* value obtained early and optimum harvest date.

Young fruits were high respiration rate, while respiration rate decreased with the growth and development of fruits (data not shown). Decrease of respiration rate after the optimum harvest time is reduced and then respiration rate was stable. Respiration rate value in small fruit periods were 85.36 mL/kg/h, but this value decreased 22.44 mL/kg/h in optimum harvest date. Then, respiration rate values varied between 14.40 and 18.95 mL/kg/h, generally, these values did not change too much. This is similar to previous findings, which showed that cherry cultivars respiration rates were generally decreased during growth

and develop (Toivonen et al., 2004; Alonso and Alique, 2006).

In correlation calculations, it was determined that the DAFB was positively correlated with 10 fruits weight, TSS/TA, width and length and a* value, and was negatively correlated with firmness, respiration rate, TSS, TA, h value for Lapins fruits (Table 1). The highest significant correlation coefficients could be observed for DAFB, 10 fruit weight, skin colour values width and length other criteria. However, TA was not related mostly of the all studied criteria.

Conclusion

All findings have shown that determination date as optimum harvest date of sweet cherry cv. Lapins was 22.06.2012 and was 64th days after full bloom. Determination of optimum harvest date could use as maturity criteria for example DAFB, fruit size (weight, width and length), and fruit colour. In this study, early, optimum and late harvest date of sweet cherry cv. Lapins were determined as 18.06.2012, 22.06.2012, 25.06.2012, respectively.

Change in most analyses criteria after optimum harvest date decreased. The increase in fruit size (weight, width and length), decrease in firmness, change in skin colour, after optimum harvest date slowed.

References

Alonso, J. and Alique, R., 2006. Sweet cherries (Chapter 20) In: *Handbook of fruits and fruit processing.* ed. Hui, Y.H., Blackwell Publishing, USA, pp: 359-367.

Crisosto C.H., Crisosto, G.M., Metheney, P. 2003. Consumer acceptance of 'Brooks' and 'Bing' cherries is mainly dependent on fruit SSC and visual skin color. *Postharvest Biology and Technology,* 28, 159-167.

Drake, S. R., and Elfving, D.C. 2002. Indicators of maturity and storage quality of Lapins' sweet cherry. *HortTechnology*, 12 (4), 687-690.

Long, L. Núñez-Elisea, E.R. and Cahn, H. 2005. Evaluation of sweet cherry cultivars and advanced selections adapted to the Pacific Northwest USA. V International Cherry Symposium 795, pp. 255-260.

Shewfelt, RL. 2009. *Measuring quality and maturity. postharvest handling: A systems approach*, Elsevier Inc., pp: 461-481.

Streif, J. 1996. Optimum harvest date for different apple cultivars in the 'Bodensee' area. In Cost, Vol. 94, pp. 15-20.

Toivonen, P.M.A., Kappel, F., Stan, S., McKenzie, D-L. and Hocking, R., 2004. firmness, respiration, and weight loss of 'Bing', 'Lapins' and 'Sweetheart' cherries in relation to fruit maturity and susceptibility to surface pitting. *Hortscience* 39(5):1066–1069.