

## Chilling Requirements of Cherries Grown Under Subtropical Conditions of Adana

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**Abstract:** The chilling requirements of different cherry cultivars and the chilling durations of two different cherry growing areas (Pozanti at 1100 m and Adana at 50 m elevations) were investigated. Results depicted that Lapins and Larian gave the lowest (400-450 hours and 94 chill units) chilling requirement. They were followed by Nafrina with 500-550 hours and 120 chill units. Kordia found to be the highest chilling requiring cherry cultivar (700-750 hours and 150 chill units). While, the others were moderate in chilling response. Calculating total growing degree hours, the highest chilling requiring cherry cultivar Kordia needed the least GDH values (14.000 GDH), the others were around 14.00-16.000 GDH. Calculating the hours below 45°F, Pozantı (1100 m elevation) gave 3 or 4 times higher chilling accumulation comparing subtropical conditions of Adana (50 m elevation). However, the chill unit values of Adana and Pozanti were quite similar to each other according to the Richardson's chill units (except 2001-2002-winter period). In comparison of cherry cultivars for dormancy breaking initiation of the buds, Kordia, Larian, Nafrina and Sunburst showed an apical dominancy effect and this effect was the strongest in Sunburst whereas the lightest in Summit. Top cut cuttings of these four cherry cultivars broke dormancy earlier in lateral buds than apical buds. Bud breaks rates of apical and lateral buds in Lapins, Summit and 0900 Ziraat were quite similar to each other.

**Key words:** Cherry • Chilling requirement • Bud break • Subtropical conditions

### INTRODUCTION

Cherry (*Prunus avium* L.) is originated to South Caucasia, Caspian Sea and North Anatolia [1]. Cherry is mainly grown in Marmara, Aegean, Black Sea and Mediterranean regions in Turkey. Turkey produces 417.905 tons of cherry among 2.102.651 tons of world cherry production. USA (287.305 tons), Iran (255.500 tons) and Italy (115.476 tons) are the other big cherry producing countries [2]. Temperate zone fruits especially stone fruits are extended to the different climatic areas. Cherry growing in Turkey begins from 500-600 m elevations up to 2000 m at Taurus Mountains. However, with the breeding of low chilling cherry cultivars, cherry growing has been tended to the milder even subtropical climatic conditions in the country.

Early or late ripening cherries are sold with much higher prices than mid-season cherries. Cherry season is usually around 30-40 days. Harvesting dates are extended

with the higher elevations. Cherry harvesting dates in Turkey could be earlier than a European country such as 15<sup>th</sup> April or later than mid-season cherries extending to August [3, 4, 5]. Cherry ripening months are generally May, June and July considering the cultivars and the elevation. However, Turkey exports cherries when the cherry prices are the lowest in Europe, in mid-season. So, new strategies and goals are needed to be planned in cherry growing [6]. Cherry growing in the subtropics gives us a chance to get very early harvesting to enter early cherry market in Europe. For this aim, we have to select low chilling cherry cultivars suitable for low chilling ecological conditions [7].

Küden and Kaska [8] stated that, insufficient chilling under subtropical conditions causes severe effects such as late flowering, less bud-break, bud drop, bare shoots. Horvath *et al.* [9], investigated the rest mechanism in buds. They stated that, it is a complex event, environmental factors especially air temperature is

effecting bud break besides internal factors. Imrak [10] found that ABA accumulation during the rest period was higher in high elevations comparing subtropical conditions. Luedeling *et al.* [11] investigated the effects of climate changes in California depending on global warming that causes changes in chilling durations.

Spain has early cherry cultivars such as Cristobalina and Precoc de Bernard. Early Van Compact is a mid-early Canadian cultivar whereas Nafrina (Na-1) is an early German cherry cultivar. Early cherry harvesting in Turkey is beginning at 500 m elevations of Taurus Mountains with wild *Prunus avium* L. trees. Fruit size of these cherry cultivars is about 2 g. Early cherry cultivars ripen in May in highlands (in Pozantı at Taurus Mountains) are small cultivars, early cultivars of Spain are 7 or 9 g. Cristobalina has about 4 g of fruit size; it could be used instead of wild *Prunus avium* fruits.

Küden *et al.* [4] stated that, some areas in Turkey, which have 500-800 hours of chilling durations such as Tokat and Amasya microclimatic areas, Hatay, Gaziantep, Osmaniye, Adana and Ceyhan plains are suitable areas for early cherry growing. For this aim, cherry growing studies have begun at the Cukurova University in Adana since 1990. Stella and Noir de Guben cherry cultivars gave promising results in the first studies under subtropical conditions. Küden [12], determined the chilling requirements of Aksehir Napoleon, Corum, Durano di Cesena, Karabodur, Malatya Dalbastı, Noir de Guben, Stella, Van and Vista according to the Richardson's chill units and standard method (calculation of total hours below 45°F). Considering the results, Stella (218 CU and 597 hours) was found to be the lowest chilling requiring cultivar. Küden [12] stated that, it is very important to get low chilling cultivars to grow cherries under subtropical conditions. Chilling requirements of 11 cherry cultivars on Gisela-5 rootstock were determined using standard and chill unit methods. Considering the results, while Regina was found to be the highest (581 hours) chilling requiring cultivar, Lapins was found to be the lowest (440 hours) [13].

Therefore, the present study was mainly aimed to know the chilling requirements of the cherry cultivars and also calculate the chilling duration of cherry growing areas of Turkey to take precautions during mild winter periods. In this study, determination of chilling requirements of cherry cultivars and chilling durations of two different cherry growing areas (Pozantı at 1100 m and Adana at 50 m elevations) were aimed.

## MATERIALS AND METHODS

This study was carried out between 2001-2002 and 2004-2005 winter periods at Cukurova University in two different ecological conditions. The experiments were carried out for two aims:

- The calculation of chilling requirements of the experimented cherry cultivars in Turkey. This experiment was carried out at Pozantı Agricultural Research and Application Center (POZMER) at 1100 m elevations in Taurus Mountains. Kordia (Attica) (S<sub>3</sub>S<sub>6</sub>), Lapins (S<sub>1</sub>S<sub>4</sub>), Larian (S<sub>4</sub>S<sub>6</sub>), Nafrina (S<sub>3</sub>S<sub>6</sub>), Noir de Guben (S<sub>1</sub>S<sub>5</sub>), Summit (S<sub>1</sub>S<sub>2</sub>), Sunburst (S<sub>3</sub>S<sub>4</sub>) and 0900-Ziraat (S<sub>3</sub>S<sub>12</sub>) were the experimental cherry cultivars. Also, chilling durations of Adana and Pozantı were determined.
- Cherry cultivars were compared for dormancy breaking initiation of the apical and lateral buds. In every cutting time, group of the cuttings were taken with and without apical buds to compare for dormancy breaking time and percentage. Chilling requirements of the cherries were calculated from daily maximum and minimum temperatures using Richardson's chill units [14] by using a computer program prepared by Miller and Küden in 1989 and developed by Efe in 1998.

In determination of chilling requirements of cherry cultivars, cuttings were taken from the orchard in every two days and put in a water tank to observe bud-breaking dates in a controlled room of  $\pm 24^{\circ}\text{C}$ . In the cuttings, 50% of the green tip stage of the buds seen in 21 days considered as dormancy breaking [8, 15]. Richardson's chill unit model was used to calculate chill units of the cultivars and also for chilling durations of the regions. Growing degree hours (GDH) value of the experimented cherry cultivars was also calculated from dormancy breaking dates until to full bloom dates.

## RESULTS AND DISCUSSION

The chilling requirements and growing degree hours of the cherry cultivars planted at POZMER Research Center were given in Table 1. Considering the results, Lapins and Larian were found to be the lowest (400-450 hours and 94 chill units) chilling requiring cultivars. They were followed by Nafrina with 500-550 hours and 120 chill units. Kordia found to be the highest

Table 1: Chilling requirements and growing degree hours of some cherry cultivars

Cherry Cultivars	Hours Below 45°F	Chill Unit (CU)	Growing Degree Hours (GDH)
Kordia	700-750	150	14.000
Lapins (SC)	400-450	94	15.500-16.000
Larian	450	94	15.500-16.000
Nafrina	500-550	120	15.000-15.500
Noir de Guben	600-650	110	14.000-14.500
Summit	650	125	15.000
Sunburst	650-700	141	14.000-14.500
0900 Ziraat	600-650	134	15.500-16.000

Table 2: Chilling Durations in Pozanti and Adana

Years	ADANA		POZANTI	
	Hours Below 45°F	Chill Unit (CU)	Hours Below 45°F	Chill Unit (CU)
2001-2002	534	423	2033	815
2002-2003	751	546	1592	509
2003-2004	581	416	2133	527
2004-2005	636	493	1816	419

Table 3: Comparison of apical and lateral buds for breaking dormancy.

Cultivars	Type of Cutting	Dates of Bud Break	Bud Break Rates (%)	Duration (days)	Dates of Cutting	Bud Break Rates (%)	Duration (days)
Kordia	Api.buds	30.12	25	21	13.01	60	17
	Lat.buds	30.12	79	17	13.01	100	13
Lapins	Api.buds	09.12	50	21	16.12	100	15
	Lat.buds	09.12	50	21	16.12	100	15
Larian	Api.buds	09.12	69	21	16.12	100	15
	Lat.buds	09.12	75	21	16.12	100	15
Nafrina	Api.buds	16.12	30	21	23.12	52	13
	Lat.buds	16.12	51	21	23.12	100	13
Summit	Api.buds	23.12	59	21	30.12	100	17
	Lat.buds	23.12	58	21	30.12	100	17
Sunburst	Api.buds	30.12	13	21	06.01	65	17
	Lat.buds	30.12	88	20	06.01	100	17
0900- Ziraat	Api.buds	23.12	46	21	30.12	78	20
	Lat.buds	23.12	41	21	30.12	85	20

(700-750 hours and 150 chill units) chilling requiring cherry cultivar, the others were in between. These results were suitable to the results of Küden [12] who found the chilling requirements of Noir de Guben around 700 hours below 45°F.

Calculating total growing degree hours, the highest chilling requiring cherry cultivar Kordia needed the least GDH values (14.000 GDH), the others were around 14.00-16.000 GDH (Table 1).

The chilling durations of Adana and Pozanti were given in Table 2. Calculating the hours below 45°F, Pozanti (1100 m elevation) gave 3 or 4 times higher chilling accumulation comparing subtropical conditions of Adana (50 m elevation). However, the chill unit values of

Adana and Pozanti were quite similar to each other according to the Richardson's chill units, except 2001-2002 winter periods.

This shows that ecological conditions of Adana such as day and night temperatures, rainfall during autumn and winter periods were very effective on the chilling accumulation and dormancy break. This effective chilling accumulation contributes us to understand how high chilling requiring cultivars could grow in Adana under subtropical climatic conditions. These results are in accordance with the results of Kuden and Kaska [8, 16] and Küden [12]. In comparison of cherry cultivars for dormancy breaking initiation of the buds, Kordia, Larian, Nafrina and Sunburst showed an apical dominancy effect



Fig. 1: Comparison of apical and lateral buds for breaking dormancy

and this effect was the strongest in Sunburst whereas the lightest in Summit. Top cut cuttings of these four cherry cultivars broke dormancy earlier in lateral buds than apical buds (Table 3).

Bud break rate of apical and lateral buds in Lapins, Summit and 0900 Ziraat were quite similar to each other. This result was suitable to the results of Kuden and Imrak [17]. They stated that in Pozanti usually basal and lateral buds of peaches broke dormancy earlier than apical buds. Higher ABA accumulations in apical buds might cause this kind of effect.

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