RESEARCH ARTICLE

Effect of climatic interference on the phenological stages of the Cherry tree Prunus cerasus in Tlemcen region. Algeria.

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ABSTRACT

The monitoring of the phenology of the two varieties of the cherry tree, the Black Bigarreau and the Sunburst, revealed that the climate of the region plays a very important role in the progress of the harvests, where the Black Bigarreau showed an earliness of 9 days between the year of 2018 and 2019. The Sunburst variety showed an earliness of only 6 days compared to the same years. This is explained by a time lag of flowering due to the fact that the climate-related interference linked to the thermal amplitudes of 2018 is greater than the one of 2019. Our study on the phenological stages of the two varieties of cherry allowed us to determine the duration of full blooms, important for pollination. Also, the climatic factor represented by the temperature influences the breaking of dormancy. It also has an effect on the setting of fruit as well as the precocity of ripening.

Keywords: *Cherry - Black Bigarreau- Sunburst - phenology - climate.*

INTRODUCTION

The cherry tree has a very important varietal range; some are early, mid-season, or late with very different fruit characteristics. The climate plays a vital role in determining these types enjoyed by our region; flowering date starts from mid-March. Hence we must understand the needs for temperature, rainfall, atmospheric humidity as well as a suitable wind speed in order to have effective pollination, good fruiting and subsequently a good yield (Ctifl, 1997).

Long records of flowering dates have proven to be extremely useful for reconstructing past phenology and predicting phenology in future climate scenarios. In Japan, for example, the flowering dates of cherry trees (Prunus jamasakura) have been recorded for centuries, and analyzes of these records have revealed that flowering of cherry trees currently occurs earlier than at any time during the seven to twelve years.

The impact of global warming and urbanization could undoubtedly have its influence on the phenological cycle of several rosaceous in the world (Primack, R. B., *et al.* 2009) (Aono, Y. & Omoto, Y. 1993) (Aono, Y. and Kazui, K. 2008). In the light of foregoing, our study was to know how the effect of climatic factors on the phenology of the cherry (Black Bigarreau and the Sunburst).

MATERIAL AND METHODS

The study of phenology of the cherry tree was carried out at the level of Tlemcen region, at 34.87 ° latitude and - 1.23 ° longitude with 800 m altitude (Figure 1).

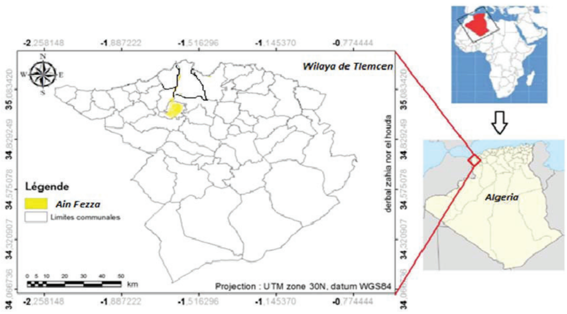

Figure 1. Geographical location of the experimental site

This station is being characterized by a sandy loam, non-calcareous soil, and a neutral pH (Zellam & Hamed. 2013). The orchard has an apiary (4 hives), which is not much for 7 hectares of cherry trees as well as many other crops at the farm. Irrigation water resources come from the water table led by a well of 100 m deep with a flow rate of 8-10 liters per second. The observations are carried out during the period of 2 years 2017-2018 and 2018 – 2019, affecting two varieties of the cherry tree (the Black Bigarreau and the Sunburst).

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RESULTS

Monitoring of phenological stages

The monitoring of the phenological stages represented in Table 1, shows a difference of 57 to 55 days for the fruiting of the Black Bigarreau and 58 to 55 days for the Sunburst in the two climatic years studied (2018 and 2019).

Table 1. Dates of phenologicals stages

	Black Bigarreau		Sunburst	
Phenological stage	2018	2019	2018	2019
Bud dormancy	18 February	19 February	19 February	21 February
Bud break	04 March	13 March	07 March	17 March
Blooming	04 March-03 April	14 March-14 April	08 March-05 April	17 March-14 April
Fruit set	03 April	14 April	05 April	14 April
Fruiting	30 May	08 June	02 June	08 June

Both varieties enter the stage of bud dormancy in February and last 15 to 23 days for the Black Bigarreau and 17 to 25 days for the Sunburst. The very first flowers bloomed for both varieties in 03/04/2018, 03/14/2019, 03/08/2018 and 03/17/2019. Flowering lasts 4 weeks for the Black Bigarreau and 28 days for the Sunburst. Fruiting, which begins with fruit set and ends with fruit ripening, is marked by an earliness of 9 days for the Black Bigarreau and 6 days for the Sunburst.

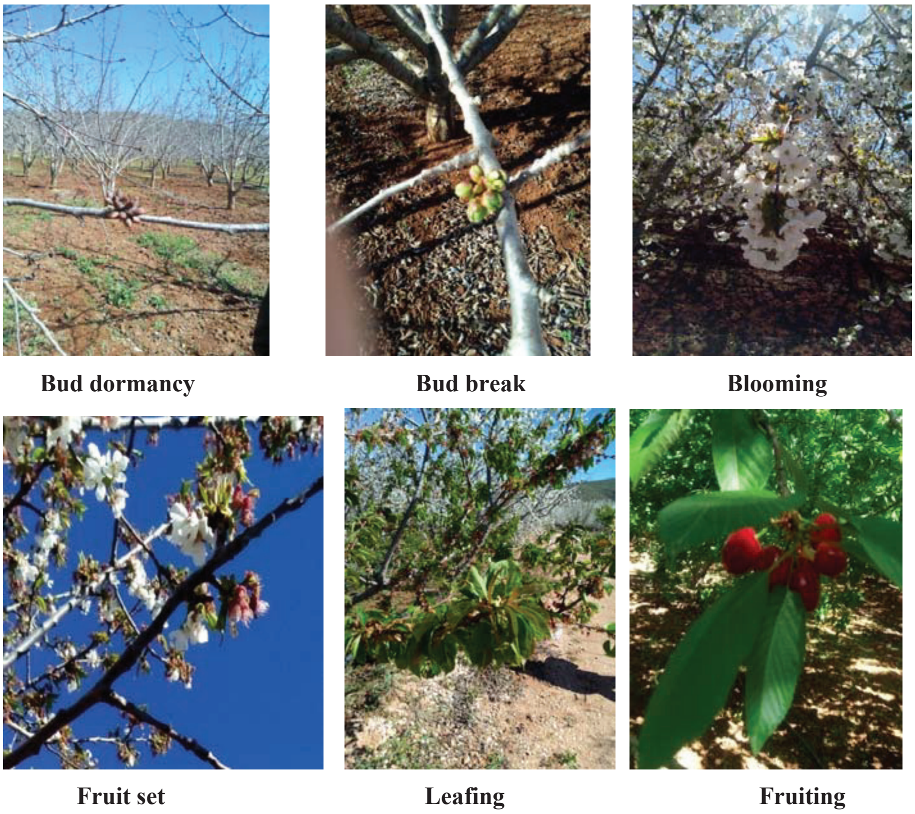

Figure 2. The phenological stages of the cherry tree (Hamed. 2019)

Climate data

The region of Tlemcen is classified in the semi-arid bioclimatic stage with a dry period that lasts 4 to 5 months. The average temperature of the year 2018 and 2019 is very close (17.6 and 17.9 °C). The highest temperature of the day of the year 2018 and 2019 is recorded in August (34.4°C and 33.3°C), on the other hand, the coldest averages were recorded in February (5°C and 4°C). For precipitation, it remains low (384.28 and 299.95 mm/year) compared to the needs of the crop 3000 to 5000 m^3. The humidity in turn, presents a high rate of 66.9% in 2018 and 61.8% in 2019. The wind speed, which plays a very important role in pollination, is evaluated at 8.8 and 9.1 km / h.

Table 2. Climate data of Tlemcen region for 2018 and 2019 (Fr.tutiempo.net)

					2018							
Month	J	F	M	A	Mai	June	July	At	S	O	N	D
T	11	10.5	14	14.9	17.4	21.9	25.6	27.1	24.1	18.7	14.1	11.6
TM	17.2	16.4	19.4	20.8	23.6	28.1	32.5	34.4	30.6	26.1	20.5	19.7
Tm	6	5	9.1	10.1	11.3	15	18.8	20.1	18.7	12.9	8.8	5.6
P	38.61	31.24	80.75	76.97	15.25	8.63	0	0.51	15.24	79.24	35.81	2.03
H	70.6	73.8	69.5	77.2	68.8	60.5	47.3	54.3	68.2	65.3	75	75.3
V	9.3	9.6	15.9	9.2	7.7	8.3	10.2	8.3	6.4	8.6	8.4	5.2
2019												
Month	**J**	**F**	**M**	**A**	**Mai**	**June**	**July**	**At**	**S**	**O**	**N**	**D**
T	9.9	10.6	13.4	15.5	20.1	22	25.9	26.7	23.6	19.4	14.5	12.8
TM	17.1	18.5	21.1	22.4	27.1	27.9	32.6	33.3	30.2	26.9	19.6	18.7
Tm	3.9	4	6.3	8.7	12.3	15.8	20	20.7	18.1	12.8	10.3	8.1
P	63.23	10.92	6.35	34.55	26.93	0.25	8.12	1.02	8.39	55.87	59.69	24.63
H	63.2	67.8	63.2	60.4	53.6	57.5	58	55.5	64.6	57.8	68.1	72
V	9.9	6.9	6.7	10.3	8	9.2	9.8	8	7.3	7.6	15.1	10.1

T : Temperature in c°, TM : Maximum Temperature in c°, Tm : minimum Temperature in c°, P : Precipitation in mm/year, H : Humidity in %, V : wind speed in Km/h. J : January, F : February, M : March, A : April, At :August, S :September, O :October, N :November, D :December.

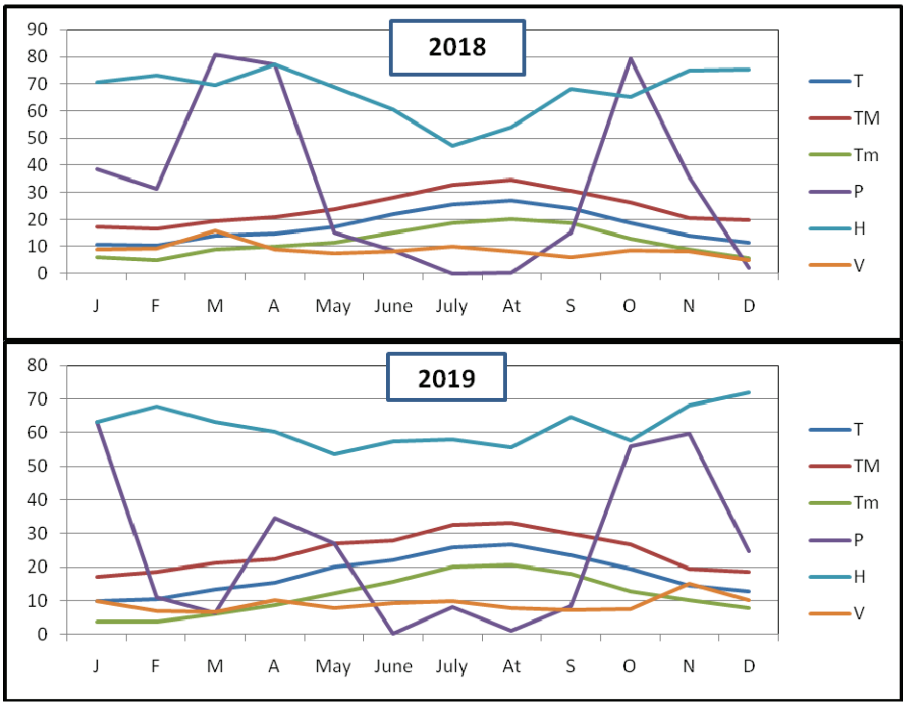

Figure 3. Climate data of Tlemcen region for 2018 and 2019

DISCUSSION

The results of climatic data provided by the Zenata meteorological station showed that there is a very small difference between the average temperatures during 2018 and 2019. Despite this, we observed dates of dormancy, flowering, fruit setting and staggered fruiting. According to Chmielewski & Rötzer (2001), an increase in temperature of 1 °C during the onset of the spring season leads to an advancement of the growth phases of about 7 days. The length of the growing season is an important measure in horticulture. Variations in the development cycle of fruit trees are caused by temperature fluctuations, starting with disruptions in the dates of the breaking of dormancy, which modify the budding and flowering phenology, and consequently affect vegetative development, maturity and fruit production (Legave, 2007). Breaking dormancy also experienced a longer period in 2019 compared to 2018 for both varieties, as well as an advancement of bud break of 9 days for Bigarreau noir and 10 days for Sunburst. The difficult elimination of dormancy appears to be linked to the lack of cold, especially since the first cold of autumn plays a role in intensifying dormancy. Physiologically, when dormancy is incomplete and disturbed, bud break is therefore deficient and widespread and a strong apical dominance characterizes the vegetative growth of trees (Oukabli, 2004). The maximum temperature in April (fruit set) is 20.8 to 22.4, which is within the norm for our climate. Temperatures above 25 °C are considered as threshold temperatures for the occurrence of fruit set problems in Prunus (Erez et al. 1998; 2000). After flowering, the maximum temperature in May month was evaluated at 23.6 °C in 2018 and 27.1 °C in 2019. This translates into a fruiting period that ranges from 55 to 57 days for the black Bigarreau and 55 to 58 days for the Sunburst. Several authors, notably Day et al. (2008), confirmed that high temperatures after flowering shortened fruit development time and accelerated fruit growth, thereby advancing the harvest date. Excessive heat (over 30 °C) impairs firmness (Claverie, 2005). For other climatic factors such as precipitation, humidity and wind, we have not found an influence on the shift in phenology, although they may have an effect on flower fall, pollination as well as on the quality of fruit. Also, there may be other factors limiting depending on the climatic conditions of the phenological site and the climatic station, for example, the exposure and the inclination (Schnelle 1955; Chen 1994), the underlying surface (Snyder et al. 2001), or the surrounding area (Rotzer 1996), may differ so that the temperature data does not exactly describe the phenological site. In addition, the age and height of a tree influence the phenology of its leaves (Seiwa 1999), and the genotype of the plant species can affect the timing of phenological stages. For example, Rötzer and Chmielewski (2001) found mean differences of six days at the start of leaf unfolding of two varieties of Fagus sylvatica as well as in the May shoot of two varieties of Picea abies. Other climatic parameters, such as air humidity, precipitation (Wielgolaski 2001), radiation (Cenci & Ceschia 2000), or even the thickness of the snowpack (Inouye et al. 2002), can have an influence on the phenological phase, and non-climatic parameters such as the soil moisture and the level of nutrients (Wielgolaski 2001) or CO2 (Jach & Ceulemans 1999; Sigurdsson 2001) can also modify the timing of the phenological phases.

CONCLUSION

Our study on the phenological stages of the two varieties of cherry allowed us to determine the duration of full blooms, important for pollination. Also, the climatic factor represented by the temperature influences the breaking of dormancy. It also has an effect on the setting of fruit as well as the precocity of ripening. Positive coefficients in the cooling phase indicate that higher temperatures during the given period delay flowering. It is also important to note that lower than average temperatures accelerate flowering, while negative coefficients reveal that warmer temperatures lead to earlier flowering dates. (Bénédicte & Mahendra. 2017)

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