

RESEARCH ARTICLE

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Phenological Stages and Climatic Adaptation of the Hazelnut Cultivar, Visoka

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Abstract

The present study aims at achieving a better understanding of the impact of temperatures and, more in general, climate conditions impact on the phenological stages of the hazelnut cultivar Visoka. A deeper knowledge of the impact of climate conditions helps in a better crop management thus resulting in a better quality of the production and higher yields.

On this purpose, an observation was conducted in three different areas of Albania where currently this hazelnut cultivar is cultivated. These three geographic areas, namely Pogradec, Mat and Ballsh are situated in different latitudes and present different climate conditions among them. The observation took place for three consecutive years. The study confirms that the hazelnut plants' phenophases are significantly influenced by the minimum temperatures reached and the average temperatures during the cold season. It was observed that the mentioned hazelnut cultivar delays the flowering process according to the temperatures of the area. In a sort of self-defence mechanism, cultivar Visoka postpones the flowering process thus avoids the damaging of the new flowers in the colder areas.

The results show that an alteration of the average temperatures with -6.7°C delays the flowering process by 36 days while an alteration of -7°C delays the flowering process by 42 days.

Keywords: hazelnut; phenological stages; climatic adaptation.

1. Introduction

Limiting factor in regionalization of hazelnut in different climatic areas are low temperatures (below -10°C), at the time of flowering. However, the time of flowering of hazelnut depends on the climatic conditions of the area where it is cultivated. This is confirmed by other researchers, and from the results of this study.

Knowledge of plant-weather relationships can improve crop management, resulting in higher quality and more stable crop yields. The annual spring phenophases in mid-latitudes is largely a response to temperature, and reflects the thermal conditions of previous months (Crepinsek et al., 2011) [1].

The timing of phenological events is clearly correlated with different climatic factors including air

temperature, soil temperature, precipitation, solar radiation, evapotranspiration, day length, snow cover, etc. (Wielgolaski, 1999) [2]. In mid-and high latitudes, with a vegetation rest in winter and an active growing period in spring-summer time, plant phenology is mainly driven by temperature and photoperiod (Crepinsek 2006)[3].

European hazelnut (*Corylus avellana* L.) is characterized by early bloom of catkins that start to shed pollen, depending on the variety, from the end of December to mid February; while female flowers become receptive from the beginning of January towards the end of February (Piseta et. al., 2010) [4]. Winter low temperatures might lead to ice formation in the conductive tissue blocking water flux to developing floral tissues (Piseta et. al., 2010).

Phenological observations are essential for many aspects in practical agriculture. The date can be used to define the growing season length in a region. The

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dates are also necessary to evaluate the risk of frost damage and to make forecasts of plant development and harvest dates. In agrometeorological studies phenological date are used to analyze crop-weather relationships and to describe or model the phytoclimate.(F. Chmielewski, 2003) [5].

The starting dates of phenophase may be differ with district of growth and latitude because of temperature and daylength.(F. E. Wielgolaski, 1999) [2].

2. Material and Methods

The survey of the development of the female and male flowers was made in three areas with different climatic and soil conditions. Observations were made primarily for the flowering and fruit set stages. These are the more delicate phenophases, when cultivation of hazelnut may be risked:

a-Visoke of the Mallakaster, where is located the main block of hazelnuts (in altitude up to 150 m above sea level and is characterized by mild winters and without risks to the flowering stage).

b-Alarup (Pogradec), in altitude 850 m above sea level and where there may be risk in hazelnut cultivation.

c-Burrel (Derjan), in altitude up to 721m,where production of hazelnut may be compromised by the cold of winter.

-In each area were determined 4 plants. In these plants were made observations

-In each plant were defined 4 second branches in the four horizontal directions.

-During the period November - May were made observations every 10 days, while from May to November in every 20 days.

During these surveys were defined:

- Start of pollen release
- Opening of female flowers
- End of the pollination stage
- Fruit set stage
- The time of nut maturation

These observations were followed for three years.

3. Results and Discussion

Results on table 1 show that in Visoka cultivar, the male flowers appear in the beginning of July and are ready for the pollination of female flowers the in the beginning of January (5-6 January). The female flowers bloom in the beginning of January, (in our case, from 8-10 January). As it seems, there is a protandry changes of 4-5 days . The maturation of the male flowers takes place gradually and lasts until January 22, which means that pollination can continue for 40 days.

The flowering period of female flowers lasts about two weeks. Their ability to pollinate lasts for 1 month. Pollination ends with wilting and drying of the petals. Fruit laying begins on April 16, ie about 10 weeks after the start of pollination.

Table 1. Phenological dates of hazelnut in Visoka.

Years	Plants	Male flowers			Female flowers			Fruit set	Nut maturation
		Opening flowers	Start of pollen opening	End of flowering	Appear of flowers	Start of pollination	End of pollination		
2011	A	-	5-8/I	11-13/2	8- 20/I	8-I	10-2	15/4	2-10/8
	B	-	5-10/I	11-13/2	9- 2I/I	9-I	12-2	17/4	
	C	-	5-12/I	11-13/2	10-22/I	10-I	12-2	15/4	
	D	-	5-12/I	10-15/2	8-22/I	8-I	12-2	16/4	
2012	A	2-7/7	6-14/I	11-15/2	10-22/2	10/I	12/2	16/4	10-15/8
	B	5-7/7	5-14/I	11-15/2	10-22/2	10/I	12/2	16/4	
	C	2-7/7	6-14/I	11-15/2	9-22/2	10/I	10/2	16.4	
	D	3-7/7	6-13/I	11-15/2	10-22/2	10/I	12/2	15/4	
2013	A	7-10/7	6-12/I	11-15/2	10-22/I	10/I	10/2	16/4	12/8
	B	7-10/7	6-13/I	12-16/2	10-22/I	10/I	10/2	16/4	
	C	8-10/7	6-12/I	13-16/2	10-22/I	10/I	10/2	16/4	
	D	7-10/7	6-12/I	13-16/2	10-22/1	10/I	10/2	16/3	

Table 2 shows that in Alarup the altitude has risen above sea level (about 850 m). The phenophases of flowering are in about a month later than in Visoka. Male flowers appear on July 21st. Pollination begins on 21 February, about 40 days later than in Visoka.

Likewise the female flowers appear on February 18, about 38 days later, while fruit set begins in the end of April, i.e. about 2 weeks later. Apparently the pollination period in the cold zone is shorter. In our case about two weeks shorter than in Visoka.

Table 2. Phenological dates of hazelnut in Alarup

Years	Plants	Male flowers			Female flowers			Fruit set	Nut maturation
		Opening flowers	Start of pollen opening	End of flowering	Appear of flowers	Start of pollination	End of pollination		
2012	A	21/07	21/2- 25/2	20 -30/3	23-25/2	23/2	16-3	3/5-10/5	30/8
	B	21/07	21.2-28/2	21 -24/3	23-25/2	23/2	16/3	3/5-10/5	
	C	21/07	22/2-28/2	21-24/3	24-25/2	24/2	16/3	3/5-10/5	
	D	21/07	21/2-28/2	20-25/3	24-25/2	24/2	17/3	3/5-8/5	
2013	A	19/07	20-27/2	15-19//3	23-25/2	23/2	16/3	30/4-10/5	30/8
	B	19/07	20-27/2	15-20/3	24-25/2	23/2	17/3	30/4-10/5	
	C	19/07	21-27/2	15-20/3	24-25/2	24/2	22/3	30/4-10/5	
	D	19/07	21-27/2	15-20/3	24-25/2	24/2	22/3	30/4-10/5	

Table 3 shows the progress of flowering phenophases in Mat (Macukull). The plot was planted in 2011. Since there were plenty of two-year-old seedlings the plants bloomed and fruited in the first year after planting. This gave us the opportunity to make observations from the second year of planting. From the table it appears that the phenophases of flowering (male and female flowers) are about 1 month later than in Visoka and about 1 week before in

Alarup. The male flowers bloom on 10-15/7 and the pollen becomes ready to pollinate the female flowers on 12/2, while the female flowers emerge on 14/2 and the pollination ends on 12-15 / 3. As can be seen in the table, the onset of pollen release in Macukull occurs about 6 days faster than in Alarup. The female flowers are ready to accept the pollen 3-4 days faster, and the fruit set start about 5-6 days faster than in Alarup.

Table 3. Phenological dates of hazelnut in Mat (Macukull).

Years	Plants	Male flowers			Female flowers			Fruit set	Nut maturation
		Opening flowers	Start of pollen opening	End of flowering	Appear of flowers	Start of pollination	End of pollination		
2012	A	10/7	12-17/2	15/3	14/2	14/2	15/3	25-30/4	15/8
	B	10/7	12-17/2	15/3	14/2	14/2	15/3		
	C	10/7	12-17/2	15/3	14/2	14/2	15/3		
	D	10/7	12-17/2	15/3	14/2	14/2	15/3		
2013	A	15/7	11-15/2	14/3	14/2	14/2	14/3	25-30/4	
	B	15/7	12-15/2	12/3	14/2	14/2	12/3		
	C	15/7	12-15/2	12/3	14/2	14/2	14/3		
	D	15/7	12-15/2	13/3	14/2	14/2	12/3		

Table 4 . Occurrence of flowering phenophases by zones in 2011-2013

No	Zones	Opening male flowers			Appear of female flowers			Start of pollination			End of pollination		
		2011	2012	2013	2011	2012	2013	2011	2012	2013	2011	2012	2013
1	Mallakastër	5/I	6/I	6/I	8/I	9/I	10/I	8./I	9.I	10/1	12/2	12/2	12/2
2	Mat	-	12/2	12/2	-	14/2	14/2	-	14/2	14/2	-	8/3	8/3
3	Alarup		21/2	20/2		24/2	24/2		23/2	23/2		16/3	16/3

The above results clearly shows the changes in the start dates of pollen release and pollination. The onset of pollen release in Mat (Macukull) occurs 37 days later than in Visoka, while in Alarup this change is 44 days. The onset of pollination in Alarup occurs 40 days later than in Visoka and 4-5 days later than in Mat. The end of flowering follows almost the same pattern. This, as will be seen below, depends on the temperatures of January and February. Such changes in the flowering dates of male and female flowers and consequently of pollination and fruit set are also reported by other researchers (Crepinsek et al 2011, Wielgolaski 1999, Crepinsek et al 2006). Crepinsek et al 2011 have found that increasing the temperature by 10c causes an acceleration of leaf opening by 2.5-3.9 days, accelerates male flowers by 7-8.8 days and female flowers by 6.3-8.9 days.

4. Conclusions

The onset of pollen release in Mat (Macukull) occurs 37 days later than in Visoka, while in Alarup this difference is 44 days. The onset of pollination in Alarup occurs 40 days later than in Visoka and 4-5 days later than in Mat.

These differences are related to the temperatures of January and February. The starting dates of phenophase differ with growth region and latitude because of temperature and daylength.

Phenological observations are essential for practical aspects in agriculture and can be used to define the growing season length in a region.

5. References

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