Plum phenology in Troyan region and the influence of climatic factors on phenophases

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Abstract

Phenological observations are a good way to determine the response of plants to climatic factors to identify climate change in recent years. The study was carried out on the territory of RIMSA Troyan including plum cultivars, such as "Katinka", "Tegera", "Čačanska lepotica", "Hanita", "Stanley", "Jojo", 'Elena' in connection with the climatic conditions in the period of 2014-2018.

The blossoming and ripening periods are determined, and the changes in the course of phenophases depending on the climatic factors of the respective vegetation period. It was found that "Jojo" cultivar blooms earlier in 2015 and 2017, while "Elena" blooms earlier in 2016 and 2018. In most years, the blossoming duration for each variety was 10-12 days.

The climate phenology research can be used in the establishment of plantation in the choice of suitable cultivars for the specific climatic conditions. This allows to avoid the risks of climate abnormalities that are common in a given region that compromise the crops.

Keywords: plum; cultivar; climate; phenology; observations

INTRODUCTION

Phenology, which is the annual recurring biological events, provides a critical signal of climate variability and the impact of changes on orchard plants. In the course of scientific research, it is clear that plant phenology responses to climate change factors are specific to location and species. The extent to which plants are affected by changes in temperature and precipitation, their internal adaptive capacity, determines the potential for sustainable ecological stability and food security (Fitchett et al., 2015).

Changes in the occurrence of phenophases in spring are most often formed by the rise in temperature. Discovering autumn changes is more difficult because the events that define it are less and more difficult to determine (such as leaf coloring and environmental factors). Nonetheless, the common pattern demonstrates the advancement of spring processes and autumn delays, which shortens the winter period of rest but increases the vegetation period and accelerates the onset of the initial phase of plant growth in the spring.

Various changes in air temperature in the late 1980s have led to acute plant phenology responses in many regions of the world, but have not yet had so much impact on fruit bearing processes. However, further climate change factors is likely to increase the effect on plants so that their impact in the future is relevant to yields (Chmielewski et al., 2004).

The same idea is expressed by Chmielewski & Rötzer (2001), who believe that phenological observations are the best quantitative dimensions for the response of plants to climate factors. Increasing the temperature caused by the greenhouse effect is manifested by changes in daily, annual and yearly

temperatures, a model that can cause phenological changes in plants (Cosmulescu & Baciu, 2002; Lu, et al., 2006).

Kazandjiev & Malasheva (2016) reported that during the first years of the new century a number of extreme weather events were observed which did not have their analogues in the period 1961-1990. Moreover, a large number of the agro-climatic indicators used in the previous studies for the requirements of the crops are derived from a completely different variety of the species used in our country and under substantially different conditions of cultivation of orchards.

Based on the idea that phenological observations most clearly determine the response of plants to climatic conditions, we set ourselves the goal to follow some climate factors and to find their impact on the blossoming phenophases and fruit ripening in plum varieties in the region of Troyan.

MATERIAL AND METHODS

The reserches were carried out with "Katinka", "Tegera", "Čačanska lepotica", "Hanita", "Stanley", "Jojo", 'Elena' plum cultivars, grown in the climatic conditions of the region of Troyan where the altitude is 420 m, the terrain is slightly inclined, the soil is light gray forest, acidic, nutrient-poor. After 10 years of trees, which is the period of the study, the soil surface is maintained not treated in the row, between rows is processed once in vegetation, under non-irrigated conditions. Each cultivar is a variant represented by 15 trees.

The phenophases of blossoming and ripening of fruits were studied, according to the generally accepted methodology for studying the plant resources of orchard plants (Nedev et al., 1979).

The weather data - temperatures and precipitation for 2014-2018 - were analyzed in the survey area and compared with the basic results over a 30-year period (1965-2005).

RESULTS AND DISCUSSION

Climatic factors for the past 5 years included in the survey show some fluctuations. The average monthly temperature was about 2 °C in 2015, 2017 and 2018, while in 2016 it was 7.5 °C in terms of the average monthly temperatures for the spring months, at an average February temperature of 2.3 °C for a basic 30-year period (1965-2005). It is a significantly higher temperature sum for the period under review. This is confirmed by Chmielewski et al. (2004).

The average monthly temperature for March 2015 and 2018 was 5 °C, approaching the base of 5.7 °C, as for the remaining years of the study they were 7.4 °C and 8 °C, which exceeded it. Figure 1

The April average temperature for a period of 30 years was 11 °C, and in 2014, 2015, 2017 it was

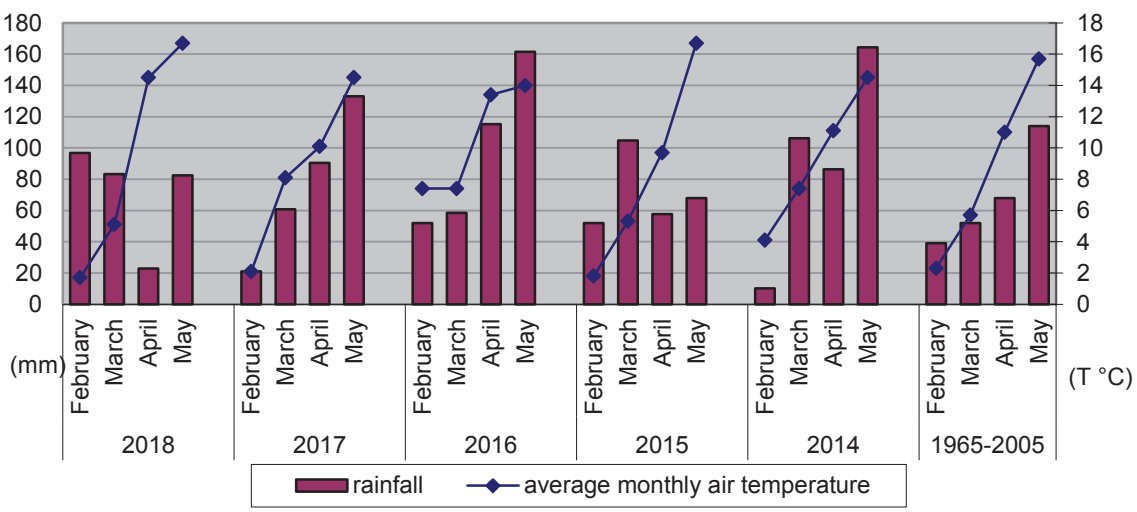

Figure 1. Changes in climatic factors over the last 5 years (2014-2018) and thirty years basic periods (1965-2005)

close, and 2016 and 2018 was significantly higher, respectively 13.4 °C and 14.5 °C.

In May, during the survey period, the average monthly temperature varied from 14 °C (2016) to 16.7 °C (2015 and 2018). For the base period it was 15.7 °C, which was within the variability for the years surveyed. Similar results are presented by Popki (2017) for the period 2009-2016.

The data analysis shows a certain increase in the average monthly temperatures during the last 5 years. The blossoming phenophases and ripening period of plum cultivars have been studied in this aspect.

Some variation was found during the years of the survey in terms of blossoming, both among various cultivars and in individual years.

The earliest beginning of blossoming was recorded in 2014 and 2017 (29. 03), and the latest in 2015 (10. 04) (Figure 2). The delay in blossoming in all observed cultivars in 2015 is influenced by the relatively lower temperatures in March and April, which are respectively 5.3 °C; 9.7 °C (Figure 1) and are significantly lower than the other years of the study. The precipitation in March (104 mm) and in April (58 mm) in 2015 also affected the blossoming in all cultivars.

During the years of the study, the earliest initial phase of blossoming was observed in "Tegera", "Elena" and "Jojo" and at the latest in "Čačanska lepotica". Some differences were found in the blossoming of different cultivars due primarily to temperature fluctuations.

The blossoming of individual cultivars lasts for 10-12 days, which is in direct connection with climatic conditions (Stefanova et al., 2017).

The significant part of the annual precipitation for the survey period is in the spring months included in the study (Figure 1). It affected the blossoming, both because of the low temperatures and pollination and fertilization.

The earliest fruit ripening period is found in "Katinka", in most cases it starts in the second ten

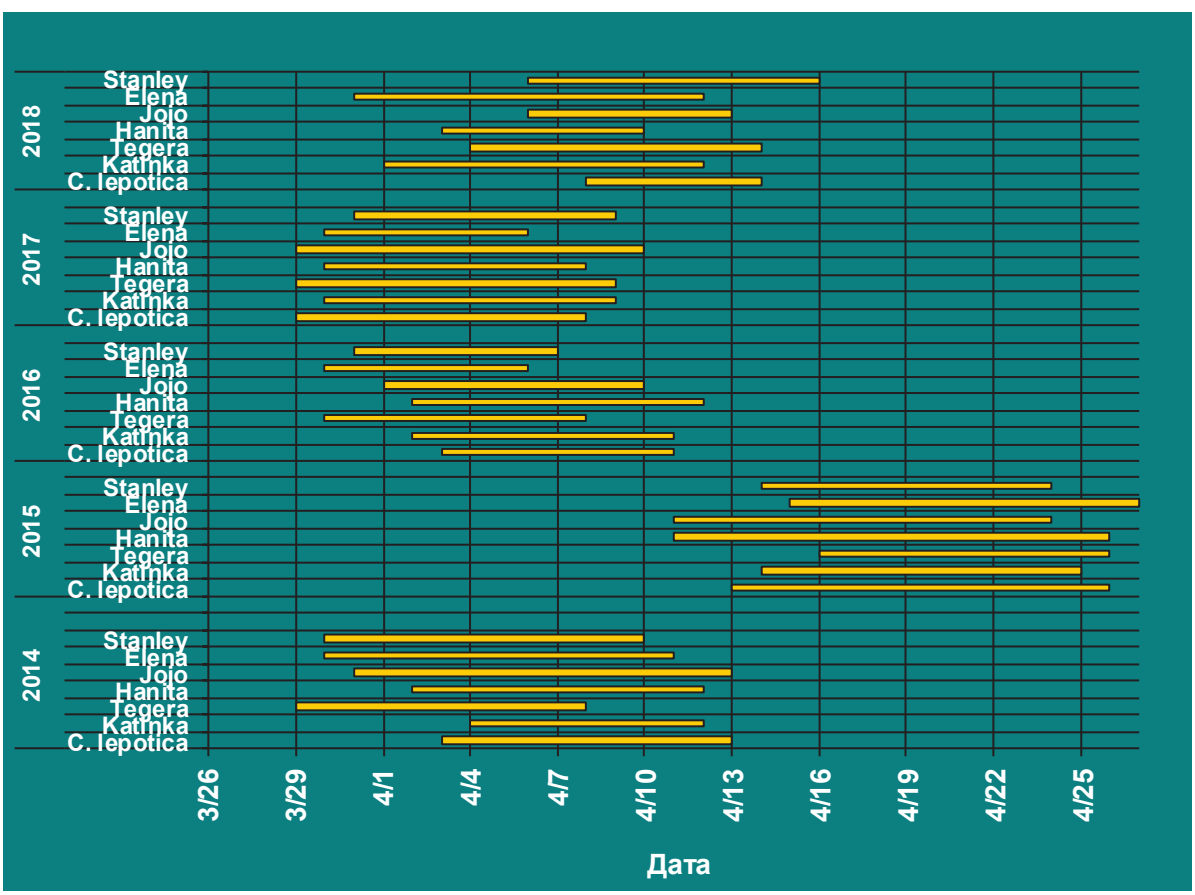

Figure 2. Blossoming periods of plum cultivars (2014 - 2018)

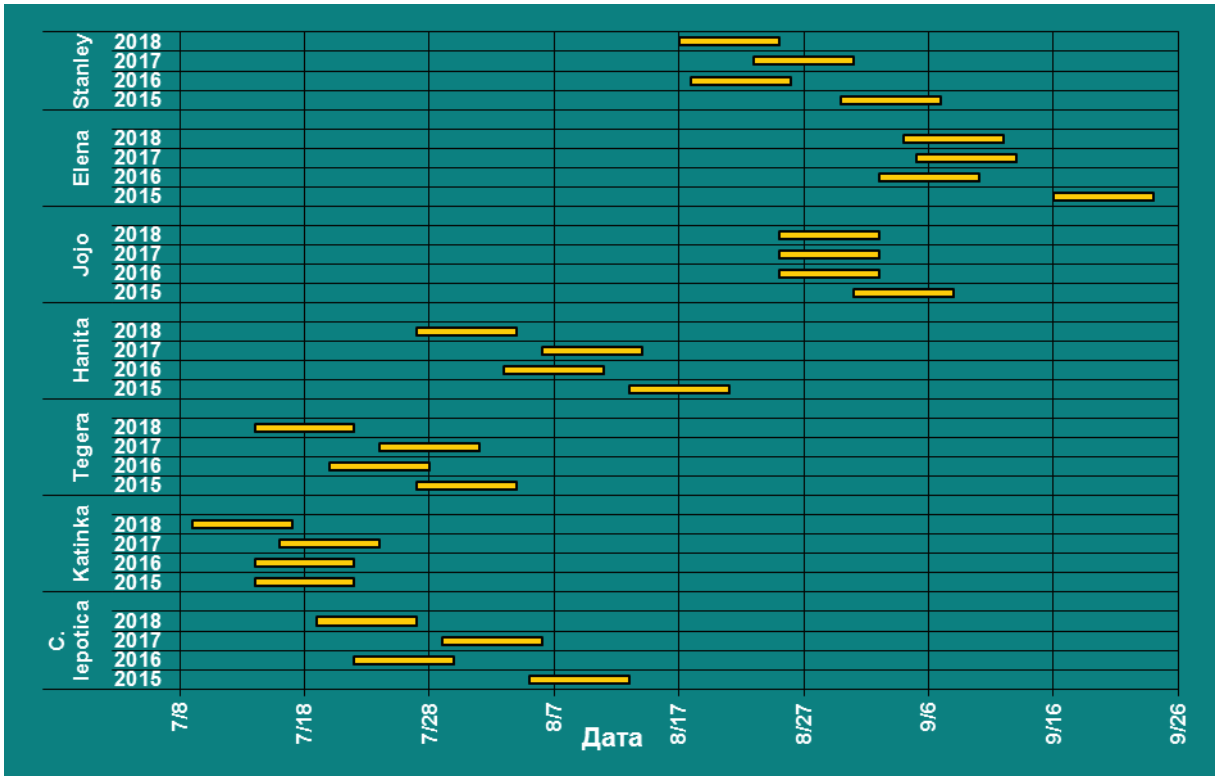

Figure 3. Ripening periods of plum cultivars (2014 - 2018)

days of July, while the latest ripening period is at the beginning of September for 'Elena' (Figure 3). All cultivars reached their ripening stage earlier in 2018 with about 10-15 days, due to temperature fluctuations and cumulative temperatures during that period.

CONCLUSIONS

Some of the years of the 2014-2018 survey show an increase in average monthly temperatures for the spring months compared to a 30 year base period (1965-2005).

"Elena" and "Jojo" cultivars flowering early, while "Čačanska lepotica" flowering later. The earliest beginning of blossoming was recorded in 2014 and 2017 (29. 03.), and the latest one in 2015 (10. 04.). The delay in blossoming in all observed cultivars in 2015 was influenced by the relatively lower average monthly temperatures in March and April, respectively, of 5.3 °C; 9.7 °C. The temperatures in April had the greatest impact on the blossoming periods.

These cultivars cover a harvest period from the middle of July to the first ten days of September, as fruit of "Katinka" cultivar ripen first, while the fruit of "Elena" has the latest ripening period.

The phenology research can be used in making planting choices and selecting cultivars suitable to specific climatic conditions. This allows to avoid the risks of climate abnormalities that are common in a given region.

REFERENCES

Chmielewski, F. M., Müller, A., & Bruns, E. (2004). Climate changes and trends in phenology of fruit trees and field crops in Germany, 1961–2000. *Agricultural and Forest Meteorology*, *121*(1-2), 69-78.

Chmielewski, F. M., & Rötzer, T. (2001). Response of tree phenology to climate change across Europe. *Agricultural and Forest Meteorology*, *108*(2), 101-112.

Cosmulescu, S., & Baciu, A. (2002). Climatic factors effect on flowering of fruit tree species. *Journal of Environmental Protection and Ecology*, *3*(4), 856-862.

Fitchett, J. M., Grab, S. W., & Thompson, D. I. (2015). Plant phenology and climate change: Progress in meth-

odological approaches and application. *Progress in Physical Geography*, *39*(4), 460-482.

Kazandzhiev, V. & Malasheva, **P.** (2016). Agro-meteorological conditions and the creation of sustainable fruit-growing in Bulgaria. *3rd National Congress on Physical Sciences,* 2016, Sofia Section: Physics of Earth, Atmosphere and Space. http://phys.uni-sofia.bg/upb/conference/3kongres/disk/html/pdf/S0653.pdf

Nedev N., Grigorov, Y., Baev, H., Serafimov, S., Strandzhev, A., Kavardzhikov, L., Lazarov, K., Nikolov, N., Djuvinov, V., Popova, L., Slavov, N., Iliev, P., Stoyanov, D., Kunev, I., Krinkov, H., Vishanska, Y., & Topchiyska, M. (1979). Methodology for the Study of Plant Resources in Orchard Plants. Plovdiv (Bg).

Lu, P., Yu, Q., Liu, J., & Lee, X. (2006). Advance of tree-flowering dates in response to urban climate change. *Agricultural and Forest Meteorology*, *138*(1-4), 120-131.

Popski, G. (2017). Problems of sustainable productionof plum fruit inmountain regions. *Diertation for awarding the educational and scientific degree* Ph D (Bg).

Stefanova, B., Popski, G., & Minev, **I.** (2017). Influence of some soil and climate factors of the region of Troyan over the yield and quality of plum fruits of "Katinka", "Tegera", "Elena" cultivars, in natural grass establishment. *Journal of agricultural, food and environmental sciences (JAFES), 71*(2), 142-148.