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DEZVOLTAREA PLANTELOR DE AGRIŞ ÎN FUNCŢIE DE SOI ŞI SCHIMBĂRILE CLIMATICE

DEVELOPMENT OF GOOSEBERRY PLANTS ACCORDING TO VARIETIES AND CLIMATE CHANGE

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Abstract

At present, the world's research is focused on selecting new varieties of fruit-bearing shrubs, including gooseberries, that are resistant to changing climate conditions each year, taking into account their productivity, production quality and market requirements. The paper presents the results of the study conducted during the years 2010-2020 in the Central area of the Republic of Moldova regarding the development periods of gooseberry plants. The influence on the development of the phenological phases, the obtaining of the fruit production according to the variety and the annual climatic conditions were analyzed. The researches were carried out in the Experimental Field of the laboratory "Fruit Shrubs", Public Institution Scientific and Practical Institute of Horticulture and Food Technoloigies in the gooseberry plantation established in 2007 with a planting distance of 1.5 x 1.0 m under irrigation conditions. The study included the varieties: 'Smena', 'Sadko', 'Colobok', 'Captivator', 'Severni capitain'. The analysis of the results obtained from the researches carried out regarding the influence of the changing climatic conditions on the development of the phenological phases of the gooseberry plants allowed to establish that the earliest budding of the gooseberry plants took place on 27.02. (2020) and the latest on 30.03 (2018), the difference between them was 32 days. The earliest flowering of gooseberry was recorded on 03.04.2016 and the latest 26.04.2013, the difference was 23 days. The ripening of the gooseberry fruits was registered the earliest on 17.06.2015, and the latest on 12.07 (2011). The duration between the budding and flowering periods varied between 21 days (2014) and 48 days (2019). The duration between the flowering and ripening period of gooseberry berries varied between 59 days (2014) and 92 days (2014). Under the influence of the properties characteristic of the variety, the average fruit harvest obtained varied between 6.7 t/ha ('Smena' cv.) - 18.6 t/ha ('Captivator' cv.). Under the influence of the climatic conditions of the year, the average fruit harvest obtained varied between 7.4 t/ha (2019) and 22.3 t/ha (2010). The difference between the minimum gooseberry harvests obtained depending on the variety and the year conditions was 9.5% and the maximum yields 16.6%.

Cuvinte cheie: agriș, fenologie, durata faze, producţie, soiuri, Republica Moldova.
Key words: gooseberry, phenology, phase duration, production, varieties, Republic of Moldova

1. Introduction

Fruit bushes have ecological plasticity, safe adaptation to growing conditions and environmental extremes (Kazakov et al., 2009; Panfilova et al., 2021). The normal development of plants at each development phase requires the favorable combination of the average or total amount of heat and humidity (Semencenko P., 1975; Cepoiu et al. 1996). In the great diversity of pedoclimatic conditions, there are no "universal varieties", but varieties with high ecological plasticity, which grow profitably on very extensive territories on all continents (Cepoiu at al., 1996). The adaptation reactions of plants to the negative action of abiotic stress factors are closely related to the phytohormonal system, which influences plant resistance and productivity (Toma et al., 2002). The level of adaptation of plants to the conditions of an area depends not only on the biological requirements of the species, but also on the variety (Kashin, 2002). Under the influence of drought, low temperatures and diseases, plants can undergo changes, temporary or permanent disturbances, which depend on the duration and period of action according to the degree of resistance of the variety (Kvashin and Volkov, 1998). As a result of the research, it was found that gooseberry plants are able to absorb water and keep it in the leaves in increased quantities, and in critical periods, at high temperatures and low air humidity, they sweat intensively, thus protecting the leaves from overheating and ensuring them vitality (Semenchenko, 1975, 1979; Chira, 2000).

2. Material and methods

The researches regarding the influence of the variety on the obtained harvest and the weight of the fruits of the gooseberry plants (*Ribes grossularia* L.) were carried out during the years 2010-2020 in the

Experimental Field of the Fruit Shrubs laboratory at the Technological-Experimental Station, Codru of PI Scientific and Practical Institute of Horticulture and Food Technologies. The plantation was established in 2007 with a planting distance of 1.5 x 1.0 m and the varieties: 'Smena', 'Sadko', 'Colobok', 'Captivator', 'Severni capitain'. The observations and researches regarding the development of gooseberry plants and the fruit production obtained depending on the variety and climatic conditions were carried out during the exploitation period of the gooseberry plantation according to the methods recommended for shrub crops (Cociu and Oprea, 1989).

3. Results and discussions

Gooseberry is a little picky and can be grown at high altitudes, beyond the limit at which trees succeed (Chira, 2000). The research and observations carried out during the years 2010-2020 regarding the unfolding of the phenological phases of gooseberry plant development during the vegetation period, allowed us to obtain the results, which were entered in table 1.

According to the data included in table 1, it was determined that the unfolding of the phenological phases of gooseberry plant development with the earliest budding took place starting from 27.02. (year 2020), and the longest delay occurred in 2018 (30.03), respectively with a difference of 32 days between them. The earliest flowering of the gooseberry was recorded on 03.04. (year 2016), and the latest on 26.04. (year 2013), with a difference of 23 days between them. Depending on the variety, the beginning of flowering started with a difference of 5-7 days between them.

The earliest ripening of gooseberry fruits was recorded on 17.06 (2015), and the latest on 12.07. (year 2011). The unfolding of the phenological phases of gooseberry growth and fruiting is influenced by the climatic conditions and the specific characteristics of each variety. Gooseberry is an early growing species. Budding takes place when positive temperatures are recorded, which usually coincides with the beginning or middle of March, with some deviations (Fig.1.a).

Gooseberry flowering starts when positive temperatures higher than 10ºC are established, which usually takes place in mid-April and lasts for 8-15 days depending on the variety and climatic conditions (Fig.1.b), after which the growth of the fruits begins (Fig.1.c).

The variation of climatic conditions during the research period (years 2010-2020) influenced the unfolding of the phenological phases of gooseberry plant development. The vegetation period of 2011 was manifested with lower temperatures than in the previous year, a fact that led to retention and a delay in the development of the phenological phases of plant development by 10-14 days. The duration between the budding and flowering phases of gooseberry in 2010 was 22 days, and in 2011 it reached 30 days, the difference being 8 days delay in the occurrence of the mentioned phenophases in the current year. In 2012, the duration between the phases reached 36 days, and the difference being 14 days delay in the occurrence of the mentioned phenophases compared to 2010.

The duration between the flowering and ripening phases of gooseberry fruits in 2012 was 64 days compared to 2010 when it was 23 days less. In 2013 it reached 30 days, and in 2014 it reached 21 days, while in 2015 and 2016 it reached 34 days. In 2016, 31 days passed from budding to flowering, and 72 days passed from flowering to fruit ripening.

The duration between the budding and flowering phases of gooseberry in 2016, budding took place on 06.03. it took 34 days to flower, and flowering started on 03.04.2016. At the end of March, there were frosts above minus 5°C, a phenomenon that practically never happened in gooseberries, it affected the first young leaves, which were just starting to unfold, and the plants further on were not affected by this frost (Fig. 2).

The climatic conditions during the vegetation period of 2017 manifested themselves with lower temperatures than in previous years starting from the third decade of April, which led to a delay in the phenological phases of gooseberry plant development, and the rains from late May to early June and low temperatures at night delayed plant development.

In 2017, the vegetation period started earlier, similar to 2016, and budding took place on 08.03. until flowering lasted 32 days and flowering started on 09.04.2017. There were frosts at the end of April, and on 19-21.04. wet snow fell with a layer of 50 cm, which (Fig. 3) affected plants with large leaves, tied fruits and partially the amount of the harvest, breaking some branches under the weight of the snow.

The climatic conditions during the vegetation period of 2018 manifested themselves with lower temperatures than in previous years starting from the third decade of April, which led to a delay in the phenological phases of gooseberry plant development, and the rains from late May to early June and low nighttime temperatures delayed plant development. The observations made during the phenological phases of the gooseberry during the vegetation period, 2018, allowed us to establish that the low temperatures held back the budding that took place on 29.03.2018. At the end of April, high summer temperatures were established, which accelerated the flowering of the gooseberry plants.

During 2019, the spring was colder and rainier, and in such conditions, from budding to flowering lasted 48 days. The ripening of gooseberry fruits in 2019 took place over 65 days after flowering, starting

on 29.06. At the end of April, high summer temperatures were established, which accelerated the flowering of the gooseberry plants.

The climatic conditions in the winter of 2020 year were manifested with positive temperatures and no precipitation, and at the beginning of the vegetation period, in the spring, lower temperatures were established than in previous years, being positive during the day and negative at night, which restrained the plants developing. The late spring frosts of -4 -6º C, and in some places even of -11º C during the flowering period affected the harvest of early species, including gooseberry.

The year 2020, although it started with dry conditions, and temperatures much higher than usual, and in spring lower, with a difference in temperatures between day and night, and with spring frosts did not act on the plants to such an extent as to affect the fruit yield of varieties resistant to powdery mildew. And in varieties sensitive to powdery mildew, the fruits were affected and therefore the harvest was compromised.

The ripening of gooseberry fruits in the rather complicated conditions of 2020 year began in the period from 01.07. at 'Smena', 'Sadko' varieties and was held until 20.07. to 'Colobok', 'Captivator' and 'Severnai captain' varieties. The ripening of gooseberry fruits takes 2-3 weeks, and the beginning of this phase can take place between the end of June and the beginning of July.

The fruiting period of the most fruitful gooseberry plants occurs between years 5-10, when high fruit yields of 3-7 kg/bush are obtained. Gooseberry harvesting can be carried out in different phases of fruit maturity: green, semi-green and ripe (Fig. 4.a, b, c), which have different destinations.

The duration of the phenological phases is influenced by the climatic conditions established in the given period, but it is also determined by the properties of the variety. The results obtained regarding the duration between the phenological phases of gooseberry plant development (budding - flowering and flowering - fruit ripening) are shown in figure 5.

According to the data included in fig.5 the duration of the period between budding and flowering varies between 21–48 days, and between flowering and ripening of gooseberry fruits is 59–92 days. The longest duration between the budding and flowering phases of gooseberry was established in 2019, when it reached 48 days, and in 2020 – 42 days, with a difference of 6 days delay, and the shortest duration of 21 days was registered during 2014.

The duration between the budding and flowering phases of gooseberry in 2010 was 22 days, in 2011 it reached 30 days, the difference being 8 days delay in the occurrence of the mentioned phenophases in 2010, and in 2012 this period reached 37 days, in 2013 it reached 30 days, in 2014 it reached 21 days, and in 2015 it reached 34 days. The duration between the flowering and ripening phases of gooseberry fruits in 2012 was 64 days, and compared to 2010, the duration between the flowering and fruit ripening phases was 23 days less. Fruit ripening took place earlier in 2012 (29.06) and later in 2011 (12.07).

The variety occupies a central place in increasing productivity, being an independent and absolutely determined factor. An intensive gooseberry variety must combine in itself a whole series of qualities such as: the reaction to adapt to the conditions of the cultivation environment, in case it does not adapt well, the accumulated energy is spent on adaptation, but not on the formation of the crop, weak resistance to diseases and pests can affect more than 1/3 of the harvest, the rapid entry into the fruit, self-fertility, which guarantees obtaining the harvest in unfavorable conditions for flowering, fruit quality, resistance to cold, drought, and finally, the harvest (Zotova and Inozemcev, 1987; Sergeeva, 1975).

The productivity of the gooseberry is largely determined by the particularities of the variety, which are influenced by a number of factors, including the ecological ones, in particular, the climatic conditions of the year, the culture maintenance technology, resistance to diseases, etc.

Although the level of resistance, specific to each species, variety or even plant, is a hereditary character, genetically controlled, in optimal conditions it is latent, unrealized and manifests itself only in extreme stressful conditions (Ştefârţă et al, 2001)..

At the present moment, the researches of scientists in the world are oriented towards the selection of new gooseberry varieties, resistant to the changing climate conditions, taking into account the market requirements as well. The analysis and assessment of the quality of gooseberries based on the harvest was included in the research, and the results obtained were included in figure 6.

The analysis of data included in fig. 6 regarding the average fruit yield obtained under the influence of the characteristic properties of each variety studied allowed us to establish that it varied between 6.7 t/ha for the 'Smena' variety and 18.6 t/ha for the 'Captivator' variety. The characteristic properties of the variety influenced the average fruit yield obtained, which varied between 6.7 t/ha ('Smena' variety) - 18.6 t/ha ('Captivator' variety), with a difference between the obtained yields of 36.0%. The climatic conditions of the year influenced the average fruit harvest obtained, which varied between 7.4 t/ha (year 2019) and 22.3 t/ha (year 2010), with a difference between the obtained harvests of 33.2%.

In addition to the other factors that annually influence the phenological phases of plant development, there are also climatic conditions, which can delay their period and duration, as well as the quantity and quality of the production obtained. Climatic conditions of the year, which may include:

prolonged drought during various growing seasons, a warm winter, colder temperatures and late spring frosts, torrential rains, hail, favorable conditions for the development of diseases and pests can affect plant development and yield both from the current year, as well as from next year. The analysis of the research results regarding gooseberry productivity under the influence of the changing climatic conditions of the year allowed us to appreciate the harvest, and the data obtained are included in figure 7.

According to the data included in figure 7 the lowest average of gooseberry harvests obtained during the driest research years (2018-2020), which varied between 7.4-7.8 t/ha. The highest harvests were obtained in the most favorable climatic conditions during the years 2010, 2014, 2013 with respective values of 22.3; 17.5 and 16.5 t/ha.

The comparative analysis of gooseberry harvests obtained during the research period is included in fig. 8. According to the data included in figure 8, depending on the variety, the minimum and maximum harvest varies between 6.7 and 18.6 t/ha; depending on the climate conditions between 7.4 and 22.3 t/ha, and the percentage difference between the minimum gooseberry harvests obtained depending on the variety and the climatic conditions of the year is 9.5%, and the maximum harvests – 16.6%. The variety influences the fruit harvest up to 64%, the climatic conditions up to 66.8%, and the difference between the minimum and maximum harvests up to 42.8%.

4. Conclusions

The analysis of the results obtained from the research carried out between the years 2010 and 2020 regarding the influence of climatic conditions changing's and the variety on the development and productivity of gooseberry plants allowed us to establish that:

- the earliest budding of gooseberry plants took place on 27.02. in 2020, and the latest on 30.03 in 2018, with a difference of 32 days between them;
- the earliest flowering of the gooseberry was recorded on 03.04 in 2016, and the latest on 26.04. in 2013, with a difference of 23 days between them;
- the earliest ripening of gooseberry fruits was recorded at 17.06 in 2015, and the latest at 12.07 in 2011;
- the duration of the period between budding and flowering varied between 21 days (year 2014) – 48 days (year 2019);
- the duration of the period between flowering and ripening of gooseberry fruits varied between 59 days (year 2014) - 92 days (year 2014);
- the characteristic properties of the variety influenced the average fruit yield obtained, which varied between 6.7 t/ha ('Smena' variety) - 18.6 t/ha ('Captivator' variety);
- the climatic conditions of the year influenced the average fruit harvest obtained, which varied between 7.4 t/ha (year 2019) and 22.3 t/ha (year 2010);
- the difference between the average harvests obtained respectively depending on the variety and climatic conditions varies between 9.5% and 16.6%.

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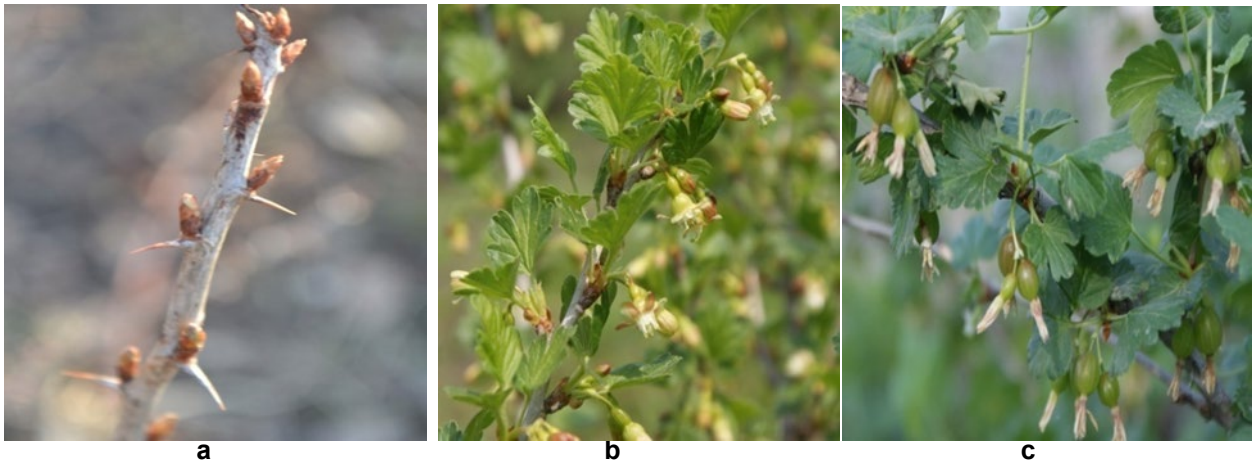
Tables and Figures

Table 1. The period of development of gooseberry plant phenophases

Phenophases	Years											Average duration between phases (days)
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	
Budding	15.03	24.03	21.03	14.03	10.03	16.03	06.03	08.03	30.03	07.03	27.02	
Flowering	06.04	06.04	22.04	26.04	12.04	19.04	03.04	09.04	25.04	24.04	09.04	33
Ripening	28.06	12.07	29.06	04.07	01.07	17.06	19.06	21.06	29.06	29.06	01.07	75



a **b** **c**

Fig. 1. The phenological phases of gooseberry plant development: a) budding; b) flowering; c) fruit growth

Fig. 2. Affecting gooseberry buds in the process of opening by spring frosts (year 2016)

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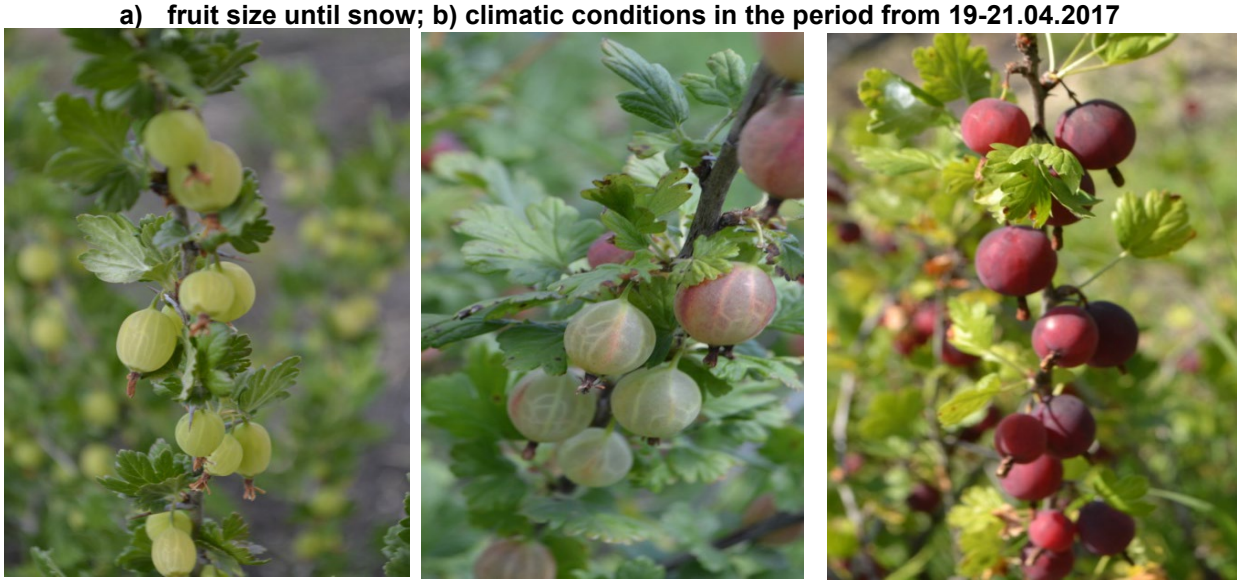
a b

Fig. 3. Gooseberry fruit growth period in April:
a) fruit size until snow; b) climatic conditions in the period from 19-21.04.2017



a b c

Fig. 4. Gooseberry fruit harvesting phases: a) green; b) semi-green; c) ripe

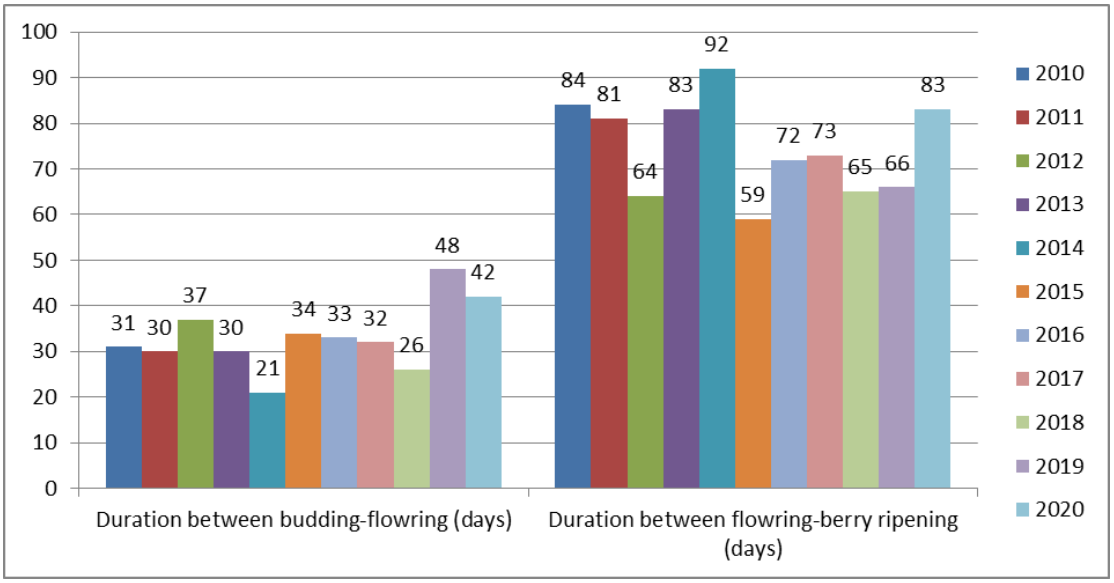


Fig. 5. The duration of the phenological phases of gooseberry plant development

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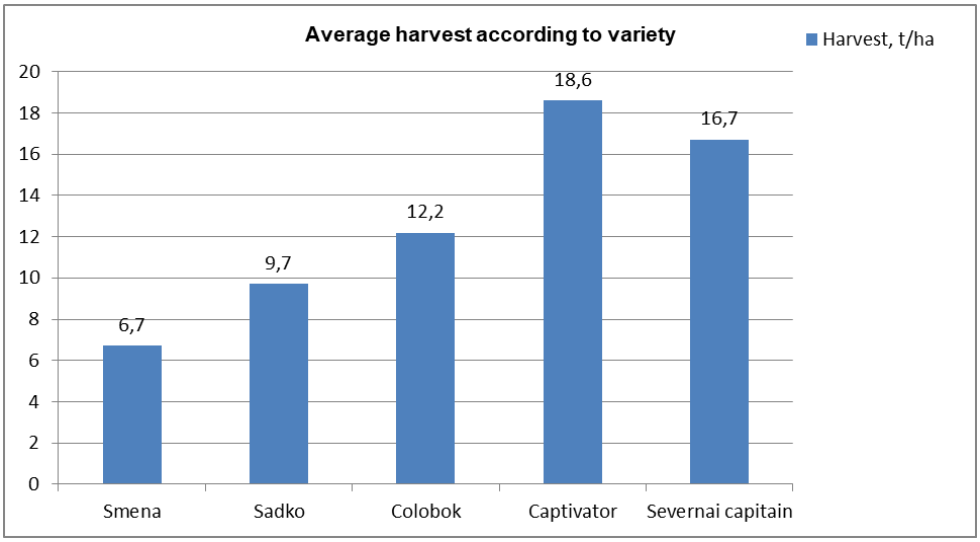

Fig. 6. Productivity of gooseberry plants depending on the variety, t/ha

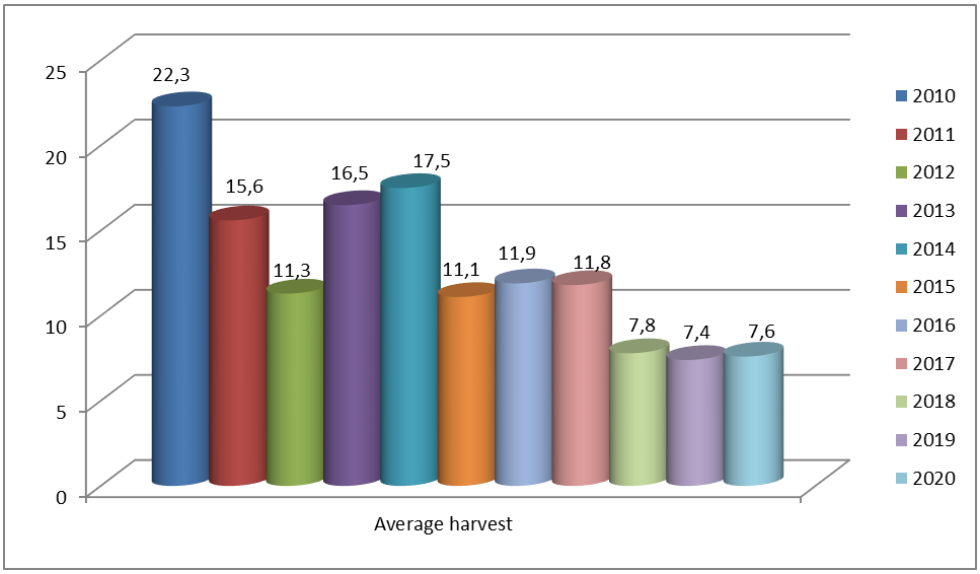

Fig. 7. The average production of gooseberries obtained during the years 2010-2020 depending on the climatic conditions of the year, t/ha.

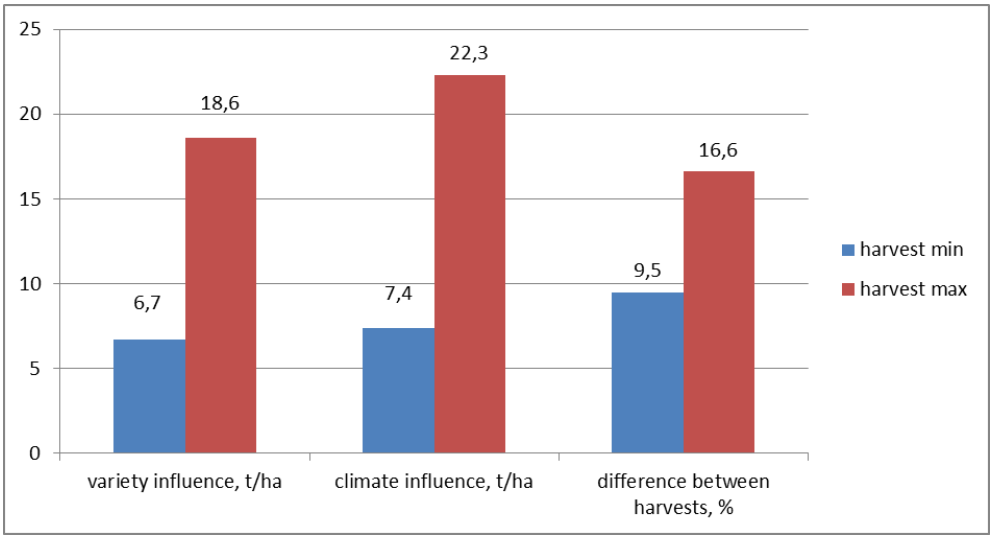

Fig. 8. The average production of gooseberries obtained according to the climatic conditions of the year