

The behaviour of plum varieties in the context of climate change in the Northern region of Moldova

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Abstract

The research was carried out with 6 plum cultivars as: 'Piteștean', 'Cacanska Najbolia', 'Empresso', 'Stanley', 'Blue Free' and 'President (C)', grafted on the rootstock *Prunus cerasifera* Mhr, planting distance 5.0x3.0 m, crown shape mixed pyramid with high volume. During the research, the diameter and growth of the trunk, the TCSA, the phenological phases of the fruiting organs during 2025 year, the morphological parameters of the fruit and seeds, the number of fruits, their average weight, the fruit yield per tree, per unit area, as well as per unit TCSA was studied. It was established that the studied cultivars had a favourable condition for growth and fruiting in the northern part of the country. Lower production, of 11.7 t/ha, was registered for the Blue Free variety, and higher production for the cultivars 'Piteștean' (25.4 t/ha) and 'Cacanska Najbolia' (27.6 t/ha). The other cultivars registered average values (18.3-21.7 t/ha), characteristic of intensive plum plantations. The ripening period for the studied cultivars was distributed over 45 days of harvesting. It has been established, that the biological characteristics of the variety, the climatic conditions and the age of the plantation have a direct influence on the number of fruits per tree, the average weight of plums, the fruit production per tree, per hectare and per unit of trunk cross-sectional area.

Keywords: diameter, flowering, fruit, maturation, production

Introduction

The plum is a fruit species with ancient traditions of cultivation in the Republic of Moldova, having a particularly important role in the life of the population due to its fruits, which served as a source of livelihood and income [1, 2, 10, 16].

The plum, being a temperate climate species, nevertheless ranks fourth, after the apple, pear and peach, in the respective area and is cultivated on all continents on an area of 2.6 million ha. The annual production of plums worldwide according to F.A.O. data amounts to 12.4 million tons.

In the Republic of Moldova, the area cultivated with plums in 2024 was 17.1 thousand ha, which represents 16.0% of the country's fruit-growing area, and the fruit production was 94.0 thousand tons, returning 5.5 t/ha, respectively 15.9% of the country's entire fruit production, occupying second place after the apple species [5].

When selecting plum cultivars for establishing orchards with the respective species, plum producers must pay attention to the general characteristics of the variety [4, 7, 8, 12], which include productivity, fruit quality, resistance to the main biotic and abiotic factors, as well as to some special ones, such as: fruit destination, resistance to transportation, handling and storage [7, 11, 14, 17].

It has been established that the best results in plum production in the conditions of the Republic of Moldova are obtained when using native and introduced plum cultivars, well adapted to the growing conditions, as well as cultivated for a long period on the territory of the country [3, 6, 10, 15, 16]. Currently, the recommended plum variety for various pedo-climatic zones in the country includes 29 cultivars, of which 15 are created within the Scientific-Practical Institute of Horticulture and Food Technologies, and the others come from various international breeding centres [11].

Material and Method

The research was carried out in the plum plantation of the enterprise SRL "Agrofields", in the northern part of the Republic of Moldova in 2025, where 6 cultivars of plum from the European assortment were taken as biological material: 'Piteștean', 'Cacanska Najbolia', 'Empresso', 'Stanley', 'Blue Free' and 'President'. The control variety was the President variety. The trees were planted in the spring of 2018 with plum trees in the

form of a rod. The trees were grafted onto the Mirobalan seedling rootstock, the planting distance was 5.0x3.0 m, and the crown shape was a naturally improved pyramid.

The variants on the field were structured in blocks according to the Latin square method. Each variant included 4 repetitions, and each repetition consisted of 8 trees.

In general, the weather conditions during 2025 were favourable for the growth and fruiting of plum trees.

Biological, stationary field and laboratory methods accepted for conducting experiments with plum culture were applied to the research objectives.

Research was conducted on the onset of the flowering and harvest maturity stages of the plum varieties studied. As part of the research, the diameter and trunk growth, the trunk cross section area (TCSA), the number of fruits, their average weight, fruit production per tree, per unit area, as well as the production TCSA were estimated.

The statistical processing of the main indicators was carried out by the method of one-factor analysis of dispersion using the ANOVA test and STATGRAPHICS 18.0 software packages.

Results and Discussion

The tree trunk is the organ through which the sap is transported from the root system to the tree crown and vice versa, having a primary influence on the growth and fruiting of plum trees. In sustainable fruit growing, there is a direct correlation between the development of the trunk and the productivity of the trees, which is reported by the mass of fruits recorded per 1 cm² of the trunk cross-section [5,6].

In the autumn of 2024, the trunk diameter of the cultivars studied varied from 87.8 mm for trees of the Piteștean variety to 113.4 mm for those of the Cacanska Najbolia variety, where maximum values were recorded. The 'Empresso', 'President', 'Stanley' and 'Blue Free' cultivars recorded average values characteristic of these cultivars, constituting 96.5; 86.8; 97.3 and, respectively, 103.9 mm (table 1).

At the end of the 2025 growing season, the trunk diameter of the trees in the studied strata increased, constituting 95.7-123.4 mm, i.e. an increase in the studied index by 8.0-10.0 mm, which was largely influenced by the plum production recorded in the tree crown, as well as the biological particularities of the variety.

Table 1. Development of trunk diameter in plum trees depending on the biological characteristics of the variety

Variety	Trunk diameter, mm		Trunk growth, 2025, mm	TCSA, 2025 year, cm ²
	autumn of 2024	autumn of 2025		
Piteștean	87.8	95.7	7.9	71.9
Cacanska Najbolia	113.4	123.4	10.0	119.5
Empresso	96.5	105.3	8.8	87.0
Stanley	97.3	106.4	9.1	88.9
Blue Free	103.9	113.5	9.0	101.1
President (C)	96.8	104.8	8.0	86.2
LSD 5%	4.3	4.7	-	-

The cross-sectional area of the trunk is directly correlated with the values recorded by the studied index. According to the cross-sectional area of the trunk, the cultivars studied in the seventh year of vegetation can be divided into four groups. The first group includes trees of the 'Piteștean' variety (71.9 cm²), the second group includes those of the 'Stanley' (88.9 cm²), 'Empresso' (87.0 cm²) and 'President' (86.2 cm²) cultivars, the third group includes the 'Blue Free' variety (101.1 cm²), and the fourth group includes trees of the 'Cacanska Najbolia' variety (119.5 cm²), where the largest trunk cross-sectional area was recorded.

Earlier flowering in the cultivars studied was recorded in the 'Cacanska Najbolia' (14.04), 'President' (15.04) and 'Blue Free' (16.04) cultivars (table 2). The flowering of the 'Empresso' variety trees began on 17.04.2025. The 'Piteștean' and 'Stanley' cultivars are characterized by a later flowering period, 19.04 and 20.04.2025, respectively. In practice, the flowering phenophases of the plum cultivars studied was triggered over a period of 7 days.

Full flowering in plum trees is considered when 100% of the flowers within the multi-year wood and annual branches have bloomed. In the cultivars studied, the full flowering period coincided with 20.04 – 25.04, that is, it lasted for 5 days, a period characteristic for plum cultivars with early and medium flowering.

The fall of the petals invokes the period when the fruits have just been formed and the basic tendency is to not allow their affection by abiotic and biotic factors. The fall of the petals in the plum cultivars studied in

the northern area of the country in 2025 took place in the period 23.04 – 29.04, starting with the cultivars 'Cacanska Najbolia', 'President', continuing with 'Blue Free', 'Empresso' and ending with those from 'Stanley' and 'Piteștean'.

Earlier ripening of the fruits is characterized by the Piteștean variety (25.07), followed by the following cultivars: Cacanska Najbolia (14.08), Espresso (24.08), Stanley (25.08), Blue Free (01.09) and President (08.09), i.e. these six cultivars were harvested on a 45-day sample.

Table 2. Influence of biological characteristics of plum cultivars on the phenophases of tree flowering and the beginning of harvesting in the northern part of the country, 2025

Variety	Date of onset of tree flowering phases				Beginning of the harvest
	Beginning flowering	Flowering 50%	Full bloom	Falling petals	
Piteștean	19.04	21.04	24.04	29.04	25.07
Cacanska Najbolia	14.04	17.04	20.04	23.04	14.08
Empresso	17.04	20.04	23.04	26.04	24.08
Stanley	20.04	22.04	25.04	29.04	25.08
Blue Free	16.04	19.04	22.04	26.04	01.09
President (C)	15.04	18.04	21.04	23.04	08.09

The study conducted on the period from flowering to fruit ripening demonstrates that an earlier period (98 days) was recorded for the earliest variety ('Piteștean') and is completed after a period of 149 days with the 'President' variety (fig. 1). The period from flowering to fruit ripening of the 'Cacanska Najbolia', 'Stanley' and 'Empresso' cultivars was 123; 128 and 130 days, respectively, and for the 'Blue Free' variety this period was 139 days.

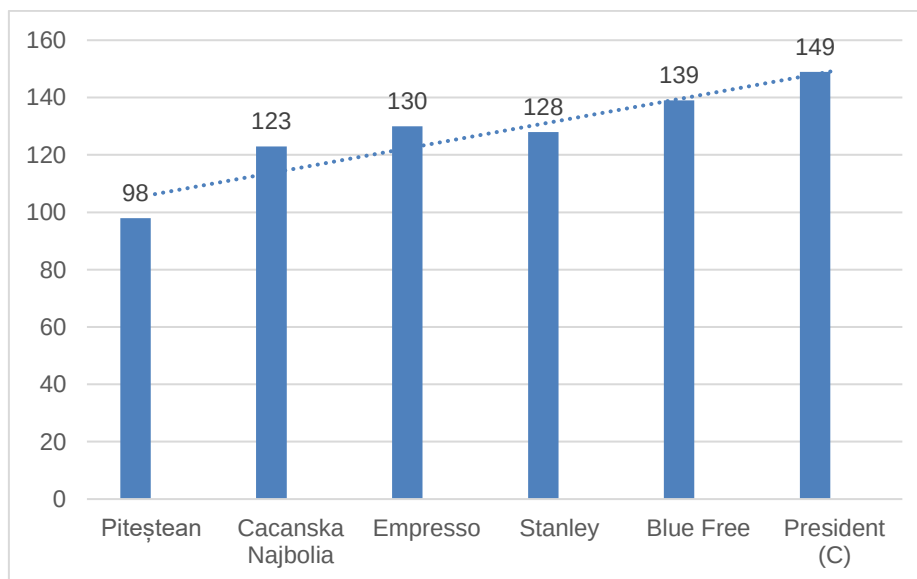


Figure 1. Influence of biological characteristics of plum cultivars on the period from the beginning of tree flowering to fruit harvest maturity, days, 2025

The climate changes that are recorded at a global level also leave their mark on the intensity of the phenophases of development of the plum crop.

If we compare the ripening period of plum fruits, we note that the cultivars studied according to the climatic conditions of 2025 can be divided into early (15.07-15.08) ('Cacanska Najbolia') and medium (15.08-15.09) ('Empresso', 'Stanley', 'Blue Free', 'President').

The height and large diameter of the plums are the characteristics that define the shape of the fruit. The differences between the height of the fruits depend on the biological characteristics of the variety. Lower values of the fruit height were recorded for the 'Piteștean' variety (47.9 mm), and the highest for the 'Stanley' and 'Empresso' cultivars, where the index under study was 55.2 and, respectively, 57.7 mm (fig. 2). For the

'Cacanska Najbolia', 'President' and 'Blue Free' cultivars, values of 51.1-53.1 mm were recorded. In general, all plum cultivars studied can be divided into 2 groups according to fruit height. That is, cultivars with fruit height up to 50 mm and greater than 50 mm.

The large and small diameters of the cultivars studied were influenced by the biological characteristics of the variety. If, for example, in the plum cultivars 'Stanley' and 'Piteștean', values of 35.3 and 36.0 mm were recorded for the large diameter, respectively, then in the other cultivars the diameter was larger, ranging from 40.2 mm for the 'Cacanska Najbolia' variety to 43.3 for the 'President' variety. According to the small diameter values, we record that all the cultivars studied: 'Piteștean', 'Cacanska Najbolia', 'Empresso', 'Stanley', 'Blue Free', 'President (C)' had values greater than 40 mm, only in the 'Piteștean' variety, the index studied was smaller, constituting 39.4 mm.

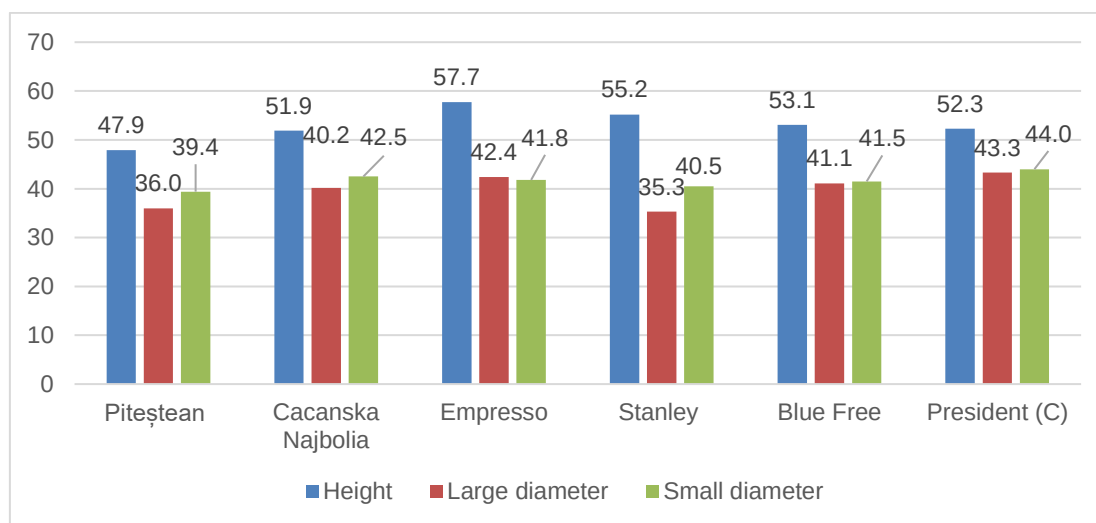


Figure 2. Morphological parameters of plum fruits depending on the biological characteristics of the variety, mm, 2025

The study conducted with plum fruits highlights that the biological peculiarities of the cultivars also influenced the share of the seed in the fruit (fig. 2).

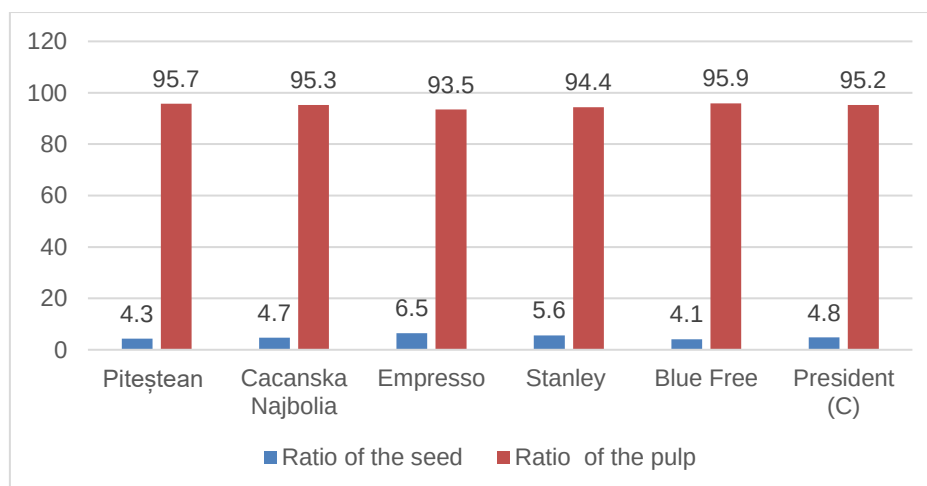


Figure 3. The seed/pulp ratio in plum fruits depending on the biological characteristics of the variety, %, 2025

According to the share of the seed in the fruit, the plum cultivars studied can be divided into 2 groups. The group of plum cultivars with the share of the seed in the fruit 4.0-5.0% includes the cultivars 'Blue Free' (4.1%), 'Piteștean' (4.3%), 'Cacanska Najbolia' (4.7%) and 'President (C)' (4.8%). The 'Empresso' and 'Stanley' cultivars recorded a higher share of the studied index, constituting 5.6% and 6.5%, respectively, i.e. being assigned to the second group (5.0 - 7.0%).

Depending on the share of the pulp in the fruit, the plum cultivars studied can be divided into 2 groups. The group of cultivars with a pulp content in the fruit of more than 95.0% includes the cultivars 'Blue Free' (95.9%), 'Piteștean' (95.7%), 'Cacanska Najbolia' (95.3%) and 'President (C)' (95.2%). For the cultivars 'Empresso' and 'Stanley', the index taken into study was 94.4% and, respectively, 93.5%, recording a pulp content in the fruit of less than 95.0%.

The cultivars studied tied different quantities of fruits in the spring of 2025, from 328 to 917 pcs./tree. Lower values of the studied index were recorded in the trees of the 'Blue Free' variety (328 pcs), and higher in the 'Piteștean' (917 pcs), 'Cacanska Najbolia' (826 pcs.) and 'Stanley' (759 pcs.) cultivars. The 'President' and 'Empresso Free' cultivars formed 468 and 533 fruits in the tree crown, respectively (table 3).

The large amount of fruit obtained in the crown of trees of the 'Cacanska Najbolia', 'Piteștean' cultivars is explained by the favourable climatic conditions during the flowering, pollination and fertilization period. The large amount of fruit in the crown of trees of the 'Stanley' variety is explained by higher self-compatibility, i.e. the variety being self-fertile binds a greater number of fruits compared to the 'President' (self-sterile) and 'Empresso' (partially self-fertile) cultivars, which require cross-pollination between them. The 'Blue Free' variety, although not self-fertile, in 2025 registered a lower degree of pollination.

The average weight of a fruit was correlated with the biological particularities of the variety studied and their quantity obtained in the crown of trees of different cultivars. A lower value of the average weight of a fruit was obtained in the trees of the 'Piteștean' variety (40.0 g), and a higher value in those of the 'Empresso' (57.2 g) and 'President' (58.5 g) cultivars. The 'Stanley', 'Cacanska Najbolia' and 'Blue Free' cultivars recorded average values of the studied index, constituting 42.8; 50.1, and, respectively, 54.0 g.

According to the average weight, the cultivars studied can be divided into two groups according to the size of the fruits: medium (40-50 g) the 'Piteștean' variety and large (50-60 g) the 'Stanley', 'Cacanska Najbolia', 'Blue Free', 'Empresso', 'President' cultivars 13.

Table 3. Plum plantation productivity and fruit weight depending on the biological characteristics of the variety, 2025

Variety	Quantity of fruit, pcs/tree	Average fruit weight, g	Productivity		Difference from control, t/ha
			kg/tree	t/ha	
Piteștean	917	40.0	36.7	24.5	+6.2
Cacanska Najbolia	826	50.1	41.4	27.6	+9.3
Empresso	533	57.2	30.5	20.4	+2.1
Stanley	759	42.8	32.5	21.7	+3.4
Blue Free	328	54.0	17.7	11.8	-6.5
President (C)	468	58.5	27.4	18.3	0.0
LSD 5%	36.2	2.2	1.7	1.2	-

The quantity of fruits and their average weight constitute the production recorded in a tree, which is in direct correlation with the value obtained per unit area. Lower fruit production was obtained in the case of the 'Blue Free' variety, 17.7 kg/tree and 11.8 t/ha, respectively. The 'President', 'Empresso' and 'Stanley' cultivars produced average yields of 27.4; 30.5 and 32.5 kg/tree, respectively, with production per unit area being 18.3; 20.4 and 21.7 t/ha, respectively. The 'Piteștean' and 'Cacanska Najbolia' cultivars produced the highest plum production both per tree and per production area, amounting to 36.7 and 41.4 kg/tree and 24.5 and 27.6 t/ha, respectively. The statistical data obtained demonstrate that a mathematical difference in the production of registered fruit is recorded within the cultivars studied.

Currently, in practical fruit growing, when studying cultivars, it is of interest how the productivity of trees obtained per unit area of the trunk cross-section develops. The data shown in Figure 4 highlight that the fruit production reported per 1 cm² of TCSA is related to the biological characteristics of the cultivars under study.

Thus, in 2025, lower values of the trunk cross-sectional area were recorded for trees of the 'Blue Free' variety (0.18 kg/cm²), and higher results were obtained for trees of the Piteștean variety (0.51 kg/cm²). Depending on the tree productivity obtained per unit of trunk cross-sectional area, the 'President', 'Empresso', 'Cacanska Najbolia' and 'Stanley' cultivars recorded average values of 0.32; 0.35; 0.35 and, respectively, 0.37 kg/cm².

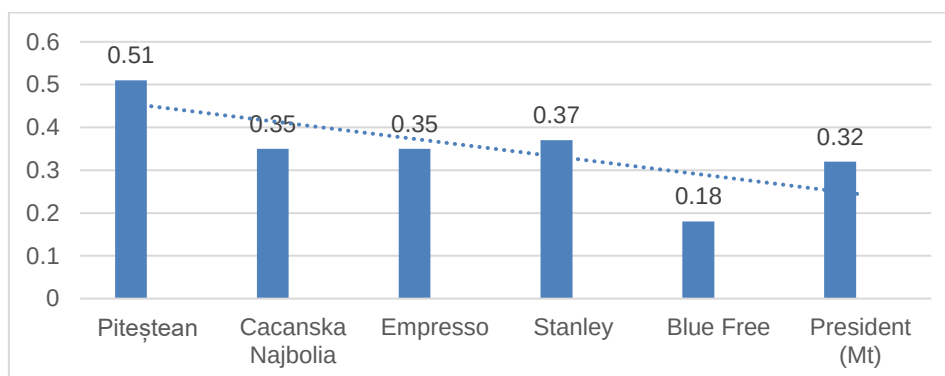


Figure 4. Influence of biological characteristics of plum cultivars on tree productivity obtained per unit area of TCSA, 2025

Finally, it can be mentioned that the biological characteristics of the variety, the climatic conditions and the age of the plantation have a direct influence on the number of fruits per tree, the average weight of plums, the fruit production per tree, per hectare and per unit of trunk cross-sectional area.

Conclusions

The biological characteristics of the studied cultivars and the fruit production recorded within the plantation had a direct influence on the development of the trunk diameter of plum trees and its cross-sectional area.

The climatic conditions were favourable for flowering, pollination and fertilization of flowers, which is also denoted by the large amount of fruit obtained in the crown of plum trees (468-917 pcs/tree) in the reference year, apart from the 'Blue Free' variety (328 pcs/tree).

The Piteștean variety recorded harvest maturity on 25.07, then followed at an interval of 21 days by the 'Cacanska Najbolia' variety (14.08), which subsequently continued staggered with the 'Espresso' (24.08), 'Stanley' (25.08), 'Blue Free' (01.09) and 'President' (08.09) cultivars. For a more rational efficiency of the use of labor during harvesting and a more staggered distribution of production, the period from late July to early August should be supplemented with 1-2 early plum cultivars.

Higher fruit production of the cultivars studied in 2025 per unit area was obtained for the 'Piteștean' variety 24.5 t/ha and 'Cacanska Najbolia' 27.6 t/ha, and the 'President', 'Espresso' and 'Stanley' cultivars formed average yields (18.3-21.7 t/ha), which are typical for intensive plum orchards without irrigation in the country. The 'Blue Free' variety recorded the lowest fruit production among the cultivars studied.

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