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THE EFFECT OF PILARHANCE, SL GROWTH REGULATOR ON YIELD AND QUALITY OF SOUR CHERRY FRUITS

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Abstract

The research was carried out in the orchard of the "Ceteronis ST SRL" enterprise, founded in the spring of 2022, with trees of Erdi Botermo variety, grafted on Mahaleb cherry rootstock. The planting distance was 4 x 2 m, and the crown shape was a free-growing spindle. The soil between the rows and between the trees in a row was maintained as clean cultivation and irrigated. The following variants were investigated in the research plot: 1. Control (spraying with water); 2. Pilarhance, SL, 0.8 l/ha; 3. Pilarhance, SL, 1.3 l/ha. Two treatments were carried out during the growing season. During the reference period, it was established that the greatest intensity of growth processes in the tree crown and sour cherry fruits was recorded in the variant treated with Pilarhance, SL at a dose of 1.3 l/ha, applied twice by spraying. The first treatment should be carried out at the end of the flowering period, and the second during the period when the fruit color changes from green to yellow.

Key words*: growth regulator, leaf area, production, fruit setting, Prunus cerasus.*

INTRODUCTION

Along with the use of mineral and organic fertilizers and plant protection products, the application of plant growth regulators has recently become of great importance in agriculture (Neamțu & Irimie, 1991; Pește anu et al., 2000). Growth regulators are capable of causing various changes in plant growth and development in small quantities (Pește anu et al., 2023; Pește anu & Calestru, 2025).

Modern plant growth regulators can boost plant immunity, resistance to unfavorable growing conditions and stressful situations, accelerate fruiting, increase yields, and ensure the ecological safety of crops. All this makes plant growth regulators simply indispensable in the cultivation of agricultural crops (Buban, 1996).

When using growth regulators, it is necessary to take into account that each of them is designed to stimulate the growth, development, and increase the productivity of certain crops at the corresponding doses, times, and methods of application (Pește anu et al., 2018).

To the present time, hundreds of regulators of various chemical nature have been synthesized, possessing a wide spectrum of action on fruit plants (Kurlus et al., 2017; Neamțu & Irimie, 1991).

Many of them are already used in agriculture. There are six known groups of phytohormones: auxins, gibberellins, cytokinins, abscisic acid, ethylene, and brassinosteroids, which differ in their chemical nature and effect on plant physiological processes (Neamțu & Irimie, 1991).

Gibberellins are the most extensive class of natural growth stimulants. More than a hundred varieties are known. The main advantages of preparations based on them are high efficiency and safety. They are completely safe for humans, do not accumulate in plants, and have no post-effects (Kurlus et al., 2017; Pește anu et al., 2023).

Gibberellic acid has many physiological effects on plants. It significantly increases the number of flower buds and fruits, influences plant growth by promoting cell division in meristematic zones and their elongation, stimulates the production of enzymes, increases productivity and improves product quality, and reduces damage from diseases and fruit cracking (Пештяну, 2022).

Brassinosteroids are steroid phytohormones that support the normal function of the plant's defense system, especially in unfavorable conditions, such as soil salinization, low temperatures, frost, drought, and pathogen

infection (Chai et al., 2013; Mandava & Wang, 2016).
Brassinosteroids change enzyme activity and membrane potential, stimulate protein and nucleic acid synthesis, regulate plastid gene expression and fatty acid metabolism, and influence the plant's hormonal status, which is reflected in the whole plant in the form of enhanced growth and increased productivity (Mandava & Wang, 2016; Muradoglu et al., 2025)
The most common and studied is 24-epibrassinolide (EPB), a polyhydroxylated steroid compound that plays a significant role in regulating physiological processes. It is the main active ingredient in various preparations used in agriculture as an adaptive agent (Ahammed et al., 2020).
24-epibrassinolide is a plant growth regulator that acts through the hormonal system, influencing the activity and biosynthesis of oxidative cycle enzymes and hydrolytic enzymes (proteases), having a multifaceted effect on plants: it increases resistance to biotic and abiotic factors, enhances growth and shape-forming processes, increases yield, and improves its quality (Sun et al., 2020).
Combined growth regulators based on gibberellic acid and 24-epibrassinolide can promote crop growth and cell elongation, annual growth, and increase leaf surface area, reduce flower and fruit drop, promote fruit growth and increase productivity in orchards, and improve product quality (Buban, 1996; Kurlus et al., 2017).
Therefore, the aim of this research was to determine the effect of Pilarhance SL growth regulator on tree and fruit development of the Erdi Botermo sour cherry variety, grafted on Mahaleb cherry rootstock in an intensive sour cherry orchard, and to maintain a physiological balance between growth, fruiting, and obtaining consistent high-quality yields.

MATERIALS AND METHODS

The current research was carried out in the orchard of "Ceteronis ST SRL" during the growing season of 2025.
The experimental plot was located in the central part of the Republic of Moldova and had a favorable influence on the growth and fruiting of the sour cherry crop.
The region is characterized by warm weather and average humidity, with an active temperature sum of 3000-3100°C, where the thermohydrological coefficient is 0.6-0.8.
The average positive monthly temperature is maintained for 9 months (March-November). According to long-term data, late-spring frosts are observed until the first decade of May. Average daily air temperatures above 10°C are observed for 175-180 days. The average annual air temperature is 9.6°C. July is the warmest month of the year (21.4°C), and January is the coldest (-2.4°C).
Annual precipitation is 502.1 mm, with 342 mm falling during the growing season, of which approximately 75 mm falls in June. There is a difference in precipitation between dry and rainy months.
The weather conditions during the experiment were favorable for the growth and fruiting of sour cherry trees, except for the months when there was very little rainfall; however, growth processes were maintained with the aid of drip irrigation (Figure 1).



Figure 1. Climatic indicators recorded in the SRL "Ceteronis ST" orchard during the period during 01.03 - 30.06.2025 (iMetos meteorological station)

The orchard was established in 2022 with trees of the Erdi Botermo variety, grafted on Mahaleb cherry rootstock. The planting density was 4 x 2 m, and the crown shape was a free-growing spindle. The soil between rows and between the trees was maintained as clean cultivation by mechanical loosening and was irrigated.
The experiment was started in spring (April 25) according to the experimental design presented

in (Table 1). Sour cherry tree crowns of the control plants were sprayed with water.
Two treatments were carried out during the growing season with Pilarhance SL products at a dose of 0.8 and 1.3 l/ha. The first treatment was applied at the end of the flowering period (April 25, 2025), and the second during the fruit coloration period, when the fruit color changed from green to yellow (May 12, 2025).

Table 1. Experimental design for determining the effectiveness of Pilarhance SL growth regulator on sour cherry trees

Variants	Active substance	Method of application
Control	Spraying with water	The first treatment was performed at the end of the flowering period, and the second during the period when the fruit color changed from green to yellow
Pilarhance, SL, 0.8 l/ha	Gibberellic acid, 3.98 g/l+24-epibrassinolide, 0.02 g/l 750 g/kg	
Pilarhance, SL, 1.3 l/ha		

Every treatment included four replicates, and each replicate consisted of 8 trees.
The treatments were carried out with the help of a knapsack sprayer in the morning hours, in the absence of wind. The amount of solution per tree when treating with the studied preparations was 0.8 litres, based on the number of trees per unit area and the recommended amount of water of 1000 l/ha.
The studies were conducted under field and laboratory conditions according to the accepted methodology for conducting experiments with fruit crops and growth regulators (Моисейченко et al., 1994).
To determine the effect of the growth regulator at various doses on the leaf area of sour cherry trees, the method described by Balan V. et al. (2024) was used. This indicator has a direct effect on the photosynthesis process and, finally, on increasing crop yield and its quality.
The average and total length of annual growth was determined by measuring four model trees in each variant at the end of the growing season.
The fruit-setting rate was calculated as the ratio between the number of fruits set on the tree after petal fall and the total number of flowers on the tree, multiplied by 100%.
The sour cherry yield was determined at the stage of fully ripened fruits by determining fruit weight. The total yield from each tree was collected separately and weighed. Then, for each variant, the average yield per tree was determined, followed by conversion to yield per unit area.
The average fruit weight was determined in four repetitions for each variant by weighing 100 fruits picked consecutively from the tree, followed by division of the result by this number.
The firmness of the sour cherry fruits was assessed using a GY 1 penetrometer, which measures the resistance of the pulp to the penetration of a 3 mm^2 plunger. Ten fruits were selected for each variant to determine fruit firmness. In the equatorial region, on two opposite sides of the fruit (on the side exposed to the sun and the other from the shade), 10 firmness assessments were performed, and the average value was determined.
The total soluble solids content in sour cherry juice was determined using a ATA60N-20E digital refractometer.
Total acidity was determined by titration with a 0.1% NaOH solution using the TitroLine+ 5000 equipment.
The vitamin C content of the fruits was determined by the titrimetric method using 2,6-dichlorophenolindophenolate sodium.
The statistical processing of the main indicators was carried out using the one-factor analysis of dispersion using the ANOVA test and the STATGRAPHICS 18.0 software package.

RESULTS AND DISCUSSIONS

Among the main photometric characteristics of fruit plantations, leaf surface area and annual growth length are particularly important, as the productive potential of the orchard depends on these indicators.
The results (Table 2) demonstrate that the smallest leaf area per tree was recorded in the control, at 6.0 m^2/tree.
The use of the growth regulator Pilarhance, SL, at doses of 0.8 l/ha and 1.3 l/ha increased the leaf area compared with the control. In the variants treated with Pilarhance, SL, at a dose of 0.8 l/ha, the leaf area increased by 3.3% compared with the control.
When the trees were treated with the Pilarhance, SL growth regulator at a dose of 1.3 l/ha, the leaf surface area was 6.7 m^2/tree, which was 10.0% higher than in the control variant and 8.1%

higher than in the variant with Pilarhance, SL at a dose of 0.8 l/ha.

The difference between the variants treated with the Pilarhance, SL growth regulator at a doses of 0.8 l/ha and 1.3 l/ha was 0.5 m^2/tree, which is confirmed by mathematical data processing.

To obtain stable and high yields, fruit trees in the orchard crown should form 15-20 thousand m^2/ha of leaf surface.

The research conducted proves that the control variant had the smallest leaf surface area (7.5 thousand m^2/ha). While the leaf surface area in the Pilarhance SL variant at a dose of 0.8 l/ha increased by 0.3 thousand m^2/ha compared to the control, in the Pilarhance SL variant at a dose of 1.3 l/ha, this increase was 0.9 thousand m^2/ha, or 8.4 thousand m^2/ha.

Table 2. Effect of Pilarhance, SL growth regulator on leaf area and annual growth of Erdi Botermo sour cherry trees

Variants	Foliar surface area		Length of annual growth	
	m^2/tree	thousand m^2/ha	cm	m/tree
Control	6.0	7.5	49.3	17.3
Pilarhance, SL, 0.8 l/ha	6.2	7.8	51.8	18.1
Pilarhance, SL, 1.3 l/ha	6.7	8.4	55.2	19.3
LSD 5%	0.26	0.35	2.4	0.86

Another indicator influenced by the growth regulator under study was the annual growth. Abiotic stresses during the growing season, such as dry weather, high temperatures, insufficient soil moisture, and blocked mineral activity, increase the intensity of physiological processes in plants and reduce annual growth. Treating trees only with growth regulators can improve biochemical processes in plants and promote more uniform annual growth (Ahammed et al., 2020).

Studies on the average length of annual growth confirm that the growth regulator had different effects on the studied indicator.

The minimum average length of annual growth was observed in the control variant (49.3 cm), and the most developed shoots were observed in trees treated with the growth regulator Pilarhance, SL at a dose of 0.8 and 1.3 l/ha (51.8-55.2 cm).

When treating trees with Pilarhance, SL growth regulator at a dose of 0.8 l/ha, the average length of annual growth was 51.8 cm, which was 5.1% higher than in the control variant. This difference is also confirmed by statistical processing.

In the Pilarhance, SL variant at a dose of 1.3 l/ha, the average length of annual growth was the longest (55.2 cm). This indicator was 6.6% higher than in the Pilarhance, SL variant at a dose of 0.8 l/ha and 12.0% than in the control. The difference between these variants is also confirmed by statistical analysis.

The total length of annual growth is directly related to its average length on the tree, which changes under the influence of the studied growth regulators.

The shortest total length of annual growth during the study was observed in the control, and the longest in the Pilarhance, SL variant at a dose of 1.3 l/ha. If the total length of annual growth in the control variant was 17.3 m/tree, then in the Pilarhance, SL variant at a dose of 1.3 l/ha it was 19.3 m/tree, or 2.0 m/tree more. This is explained by the fact that treatment with a growth regulator based on gibberellic acid + 24-epibrassinolide improved the physiological processes occurring in the tree crown during shoot growth.

When treating with Pilarhance, SL at a dose of 0.8 l/ha, the total length of annual growth decreased by 1.2 m/tree compared to Pilarhance, SL at a dose of 1.3 l/ha, but increased by 0.8 m/tree compared to the control variant. The increase in the total length of annual growth is also confirmed by statistical analysis of the data.

Analysis of the experimental data allows us to conclude that the studied indicators are directly dependent on treatment with the growth regulator under study, but the highest values were recorded in the variant where the sour cherry trees were sprayed with the growth regulator Pilarhance, SL at a dose of 1.3 l/ha.

The results obtained prove that the number of flowers on the trees in the studied variants varied from 3319 units/tree in the Pilarhance, SL variant at a dose of 1.3 l/ha to 3364 units/tree in the control variant (Table 3). The difference between the number of flowers obtained in the experimental variants is insignificant and could not fundamentally have affected the results of the conducted research.

This increase in the number of fruits in the variant treated with the growth regulator Pilarhance, SL at a dose of 1.3 l/ha occurred due

to a slight increase in the percentage of fruit set compared to the other studied variants.
The lowest percentage of fruit set was recorded in the control variant (21.4%), followed by the Pilarhance, SL variant at a dose of 0.8 l/ha (22.2%), where the increase in the studied indicator was 0.8%.

Table 3. The effect of the growth regulator Pilarhance, SL on the number of fruits and their percentage of fruit set in Erdi Botermo sour cherry trees

Variants	Number of flowers, pcs./tree	Number of fruits, pcs./tree	Percentage of fruit set, %
Control	3364	720	21.4
Pilarhance, SL, 0.8 l/ha	3324	738	22.2
Pilarhance, SL, 1.3 l/ha	3319	780	23.5
LSD 5%	159	31.4	-

The highest percentage of fruit set (23.5%) was recorded in the variant treated with Pilarhance, SL at a dose of 1.3 l/ha, i.e., the increase was 1.3-2.1% compared to the previous variants.
The results obtained prove that trees treated with Pilarhance, SL at a dose of 1.3 l/ha had a higher percentage of fruit set compared to the other experimental variants.
Productivity is an indicator that demonstrates how all agrotechnical measures were carried out in the sour cherry orchard of the Erdi Botermo variety.
The conducted studies proved that the studied growth regulator Pilarhance, SL affected the average weight of fruits and yield as a whole, but in different ways.
During the research, the lowest fruit weight was observed in the control variant (5.45 g) (Table 4).

Table 4. The effect of the growth regulator Pilarhance, SL on the average weight and productivity of sour cherry trees of the Erdi Botermo variety

Variants	Average weight, g	Productivity		As a % of the control group
		kg/tree	t/ha	
Control	5.45	3.92	4.90	0.0
Pilarhance, SL, 0.8 l/ha	5.55	4.10	5.13	104.7
Pilarhance, SL, 1.3 l/ha	5.77	4.50	5.62	114.7
LSD 5%	0.24	0.19	0.25	-

When using the growth regulator Pilarhance, SL at a dose of 0.8 l/ha, the average fruit weight was insignificantly higher than the control variant, i.e., by 1.8%, and amounted to 5.55 g. The results show that the growth regulator Pilarhance, SL at a dose of 0.8 l/ha does not have such a significant effect on the average fruit weight as in the Pilarhance, SL – 1.3 l/ha variant, where this indicator was higher and amounted to 5.77 g, or 4.0% compared to the previous variant and 5.9% compared to the control variant. The change in the average fruit weight in the Pilarhance, SL – 1.3 l/ha variant occurred as a result of improved growth processes in the tree crown and increased plant resistance to unfavorable environmental conditions (frost, drought, diseases).
The control variant exhibited the lowest number of fruits and the lowest average weight per fruit. Accordingly, this variant also showed the lowest yield both per tree (3.92 kg/tree) and per unit area (4.9 t/ha).
When treating the variant with the growth regulator Pilarhance, SL at a dose of 0.8 l/ha, the fruit yield was higher than the control variant, but much lower than the Pilarhance, SL variant at a dose of 1.3 l/ha. The resulting yield in this variant was 5.22 kg per tree and 6.52 tons per hectare, representing an increase of 4.7% compared to the control variant.
In the case of the tested variant with Pilarhance, SL at a dose of 1.3 l/ha, a significant increase in the number of fruits (780 pieces/tree) and their average weight (5.77 g) was recorded, which led to a significant increase in yield both per tree (4.5 kg) and per unit area (5.62 t/ha).
The treatment doses had different effects on the yield obtained in the experimental variants. That is, the difference between the variants treated with the growth regulator Pilarhance, SL at doses of 0.8 and 1.3 l/ha was more significant, which is confirmed by statistical analysis.
The statistical analysis data on productivity indicate an insignificant difference between the control variant and the Pilarhance, SL variant at a dose of 0.8 l/ha, and a significant effect compared with the Pilarhance, SL variant at a dose of 1.3 l/ha. That is, if the difference in fruit yield obtained between the control and the variant treated with Pilarhance, SL at a dose of 1.3 l/ha reached 14.7%, then between the variant with Pilarhance, SL at a dose of 0.8 l/ha and the previous variant, this value was 10.0%.
The results obtained prove that among the experimental variants, the highest fruit yield was

recorded when Pilarhance, SL at a dose of 1.3 l/ha was applied compared to the other variants included in this study.

The observations (Table 5) show that the firmness of the sour cherry pulp of the Erdi Botermo variety at the time of harvest in the studied variants ranged from 0.38 to 0.46 kg/cm².

The firmness of Erdi Botermo sour cherry fruits changes under the influence of the growth regulator Pilarhance, SL, meaning that the corresponding preparations, whose active ingredient is gibberellic acid + 24-epibrassinolide, increase the firmness of sour cherries to some extent. While, in the control variant, fruit firmness was 0.38 kg/cm², in the variants treated with the growth regulator Pilarhance, SL, the corresponding indicator increased, reaching parameters of 0.41-0.46 kg/cm².

Comparing the variants treated with gibberellic acid + 24-epibrassinolide, it can be noted that the lowest fruit firmness was observed in the Pilarhance, SL variant at a dose of 0.8 l/ha - 0.41 kg/cm², i.e., an increase of 0.03 kg/cm² compared to the control variant. When the dose of the tested growth regulator Pilarhance, SL was increased to 1.3 l/ha, this indicator was 21.1% higher than in the control variant, reaching 0.46 kg/cm².

Table 5. The effect of the growth regulator Pilarhance, SL on the firmness of sour cherry fruits of the Erdi Botermo variety and their biochemical parameters

Variants	Firmness, kg/cm²	TSS, %	TA, %	Vitamin C, mg%,
Control	0.38	16.5	0.64	15.9
Pilarhance, SL, 0.8 l/ha	0.41	16.8	0.60	16.1
Pilarhance, SL, 1.3 l/ha	0.46	17.2	0.57	16.4

Studying the effect of the treatment dose on the studied parameter, it can be noted that increasing the dose of the Pilarhance, SL preparation from 0.8 to 1.3 l/ha increased fruit firmness by 0.05 kg/cm², meaning the sour cherry fruit peel becomes more elastic and the pulp firmer.

The content of soluble solids is a characteristic of the variety, and the value of this indicator can be used to determine the optimal harvest time. As the harvest period approaches, the intensity of soluble solids accumulation increases.

The conducted studies prove that the amount of soluble solids in the fruits of Erdi Botermo sour cherry variety was ranging between 16.5-17.2%. The lowest proportion of soluble solids content was recorded in the control – 16.5%. When using the growth regulator Pilarhance, SL, an increase in the studied indicator to 16.5-17.2% was noted. The growth regulator Pilarhance, SL increased the content of soluble solids in fruits by 0.3-0.7% compared to the control.

Studying the effect of the treatment dose on the amount of soluble solids in fruits, it can be noted that with an increase in the dose of the Pilarhance, SL preparation from 0.8 to 1.3 l/ha, the studied indicator increased. If the difference between the variants treated with the growth regulator Pilarhance, SL at doses of 0.8 and 1.3 l/ha was 0.4%, then between the control variant and the variant treated with Pilarhance, SL at a dose of 1.3 l/ha, the increase was 0.7%. Thus, treatment with the growth regulator Pilarhance, SL at a dose of 1.3 l/ha significantly influenced the increase in the amount of soluble solids in the fruits. The proportion of titratable acids in fruits is directly dependent on the amount of soluble solids. Simultaneously, as the amount of soluble solids in fruits decreases, the proportion of titratable acids increases, reaching its highest value in the control - 0.64%.

Applying the growth regulator Pilarhance, SL at a dose of 1.3 l/ha to the trees reduced the proportion of titratable acids in this variant to 0.57%, which is 0.07% less than in the control variant. In the variant treated with the growth regulator Pilarhance, SL at a dose of 0.8 l/ha, the studied indicator was 0.60%, which was 0.04% lower than the control variant.

Vitamin C is one of the main indicators of sour cherry fruit quality. The conducted studies prove that the lowest amount of vitamin C was recorded in the control variant, where its content was 15.9 mg%.

Treatment of the experimental variants with the growth regulator Pilarhance, SL increased the vitamin C content to 16.1-16.4 mg%, which is 0.2-0.5 mg% more compared to the control variant. The highest amount of vitamin C was observed in the Pilarhance, SL variant at a dose of 1.3 l/ha (16.4 mg%), which is 0.5 mg% more than the control variant and 0.3 mg% more than the Pilarhance, SL variant at a dose of 0.8 l/ha.

The results show that the application of the growth regulator Pilarhance, SL at a dose of 1.3 l/ha increased the firmness of fruits, while soluble solids, titratable acidity, and vitamin C content in this variant were more balanced in the sour cherry fruits compared to the other experimental variants.

CONCLUSIONS

The effectiveness of using the growth regulator Pilarhance, SL at a dose of 0.8 l/ha to stimulate growth processes and fruit development was insignificantly higher than the control variant, while with an increase in the dose to 1.3 l/ha, the studied indicator was much higher compared to the other tested variants.

The greatest intensity of growth processes in the tree crown and sour cherry fruit development was recorded in the variant with Pilarhance, SL at a dose of 1.3 l/ha, treated twice by spraying. The first treatment should be carried out at the end of the flowering period, and the second during the period when the fruit color changes from green to yellow.

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