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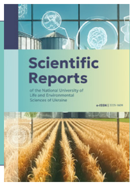

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The effect of growth regulators on the morphological and anatomical characteristics and yield of the tea-hybrid rose variety 'Aqua'

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Abstract. Roses occupy a leading position among cut flowers, and the use of growth regulators activates metabolism, increases plant resistance, yield and decorative qualities of flowers. The aim was to determine the effect of various growth regulators on the development, yield formation and decorative parameters of the 'Aqua' rose variety under conditions of low-volume hydroponics in Venlo-type glass greenhouses. Kendal+, Ferti Set, Regoplant, Isabion, Gilea and Yara Vita preparations were used for the tests. The object of the study was the 'Aqua' hybrid tea rose, originally bred by the Dutch breeding company Sint Petrus Johannes Schreurs. The experiment was carried out under production conditions at the LLC 'Askania-Flora' greenhouse farm in 2023. Three foliar treatments of plants with growth-regulating substances were carried out: the first – a week after planting them in a permanent place in the greenhouse, the second – during the first budding, the third – at the beginning of mass flowering. The control variant was not sprayed with growth regulators. The research showed that the preparations Gilea and Isabion accelerated the formation of flower stalks and the timing of bending, as well as promoted faster budding and flower development. It was found that the use of Isabion increased the yield of the 'Aqua' rose variety to 267 pieces/m^2 (38.1 pieces/plant), which was 11% higher than the control (241 pieces/m^2). Under the action of Gilea, the vase life of cut flowers reached 15 days compared to 10 days in the control. It was found that under the action of Yara Vita, the yield reached 259 pcs/m^2 (37.0 pcs/plant), which exceeded the control by 8%. A positive effect of the growth regulators Yara Vita, Gilea and Isabion on rose productivity, overall yield and the main decorative indicators of the flower was found. The results obtained should be taken into account when planting rose seedlings in Venlo-type glass winter greenhouses for better regulation of growth processes and increased overall yield

Keywords: stimulating effect; greenhouse; plant growth regulators; bud height; productivity

Introduction

Growing cut flowers is one of the uses of greenhouse facilities, which occupies a small but stable segment of the agricultural market in Ukraine. Among the flowers grown for sale in floriculture farms, roses occupy a special place, as they are in high demand among the population. This poses a priority task for producers – to preserve the decorative qualities of flower products. At the same time, modern market requirements stipulate not only high quality and attractive appearance of flowers, but also the ability to store them for a long time after cutting, which necessitates the improvement of agricultural technologies. In particular, the use of growth regulators that can influence the physiological processes of plants, increase their resistance to stress factors and contribute to the production of products with high decorative and commercial characteristics is relevant.

Similar to the action of growth regulators, nutrients play an important role in the formation of above-ground plant mass and determine the intensity of physiological processes. V. Gamayunova & A. Panfilova (2020) found that fertiliser application significantly increases biomass accumulation in spring barley plants, indicating a close relationship between mineral nutrition and growth processes in cultivated plants. Researchers D.N. Jaber & S.A. Mashkoor (2025) determined that spraying roses with gibberellic acid and methyl jasmonate affects the qualitative characteristics of flowers and the duration of rose flowering. Vase life and flower stalk diameter increase when plants are sprayed with a combination of gibberellic acid at a concentration of 75 and 150 mg/l with methyl jasmonate at a concentration of 200 mg/l, and the diameter of the flower increases when treated with gibberellic acid at a concentration of 75 mg/l with 100 mg/l methyl jasmonate. An increase in the number of petals is observed when spraying with gibberellic acid at a concentration of 150 mg L^{-1} with 100 mg L^{-1} methyl jasmonate, while higher concentrations of both preparations lead to the opposite process. O.A. Ukrainets & V.V. Polishchuk (2024) studied the effect of different concentrations of indolyl-3-butyric and naphthylacetic acids on the process of rhizogenesis during vegetative propagation of roses. Analysis of the results showed that the use of naphthylacetic acid has a significant effect on increasing the number of primary roots on cuttings at all concentrations studied.

A study by M.A. Rasyid (2025) on the effect of concentrations (500 ppm, 1,000 ppm and 1,500 ppm) of indole-3-butyric acid on the growth rate of cuttings and the appearance of buds on roses (*Rosa centifolia* L.) found that auxin concentrations are ineffective for root growth activity and rose yield through propagation by cuttings. D. Anjelita *et al*. (2025) conducted and determined the effect of various auxin-containing preparations on the growth dynamics of rose stem cuttings. The experimental variants included three growth regulators: a commercial synthetic preparation containing 6 mg of naphthaleneacetic acid; bean sprout extract containing 6 mg of indole-3-acetic acid; and garlic extract containing 6 mg of indole-3-acetic acid. The results showed that naphthaleneacetic acid significantly increases plant height, and garlic extract combined with natural indole-3-acetic acid has a positive effect on the emergence of new shoots on cuttings. M. Zavhorodnii *et al*. (2024) found that S-heterylsuccinates affect the microclonal propagation of the Lada variety of Damask rose (*Rosa damascena* Mill.). Adding this compound to the nutrient medium increases the number and length of roots in rose plants by 12%. Scientists C. Cheng *et al*. (2021) found that the opening activity of rose flowers (*Rosa hybrida*) was increased by ethylene, which specifically activated the endoreduplication of parenchyma cells at the base of the petals, leading to asymmetric growth of the petal base and, consequently, to typical flower opening. M. Thakur & R. Kumar (2020) concluded that growth regulators significantly affect yield characteristics. The number and weight of fresh flowers per plant were significantly higher with the application of diphenylurea and kinetin compared to the control and increased the yield of fresh flowers by 56.0 and 41.6%, respectively.

According to M.H. Naeemi *et al*. (2022), improving the quality of rose flowers mainly depends on natural and chemical compounds. The growth regulators methyl jasmonate (MeJA) and brassinosteroids (BR) significantly activate protective mechanisms in plants and maintain the quality of cut flowers by increasing the level and activity of superoxide dismutase and catalase. G.A. Abdel-Wahed *et al*. (2024) investigated the effect of seaweed extract on improving the growth and flowering characteristics of *R. gallica* and *R. Chinensis*. The results showed that this preparation at a concentration of 400 ppm significantly reduces the incidence of root rot and wilting in rose plants, leading to an improvement in all growth and flowering parameters, as well as an increase in the content of photosynthetic pigments, total carbohydrates, nitrogen, phosphorus and potassium. Synthetic retardants are the main inhibitors used in floriculture. They have the ability to limit shoot growth without significantly reducing the number of leaves and leaf surface area, resulting in a compact plant habit and stable flower stalks even when light intensity is insufficient. Scientist K. Sharma (2023) summarised the results of studies on the use of growth regulators on rose crops. The author noted that such preparations contributed to increased yields, improved decorative characteristics and prolonged the shelf life of cut flowers. It was emphasised that their effectiveness depended on the type of preparation, growing conditions and plant development stages.

According to M. Yaquby *et al*. (2020), the effectiveness of growth regulators also depends on the effectiveness of other agrotechnical measures, external conditions, the condition and age of plants, and the need for strict adherence to doses, timing, and application technologies. This highlights the need for further study of growth-regulating substances on rose crops in order to increase the adaptive potential of plants and increase crop yield and quality. There is also limited information on the effect of exogenous application of growth regulators on the growth, development and physiology of hybrid tea roses in winter greenhouse conditions.

The aim of this study was to determine how effectively plant growth regulators affect the growth, development, decorative qualities, productivity and yield of rose varieties when grown in small-volume hydroponics in modern Venlo-type glass greenhouses.

Materials and Methods

The effect of growth regulators on physiological processes, flowering dynamics, productivity and decorative qualities of flowers was studied on plants of the 'Aqua' tea-hybrid rose variety bred by the Dutch breeding company Sint Petrus Johannes Schreurs. The experimental work was carried out at the greenhouse facility of LLC "Ascania-Flora" during 2023 in a modern Venlo-type winter greenhouse using a computerised climate control system. The research was conducted in accordance with the ethical standards set out in the Convention on Biological Diversity (1992). The 'Aqua' rose seedlings were planted in their permanent growing location in the greenhouse on 11 April 2023. The planting pattern was two rows. The rose seedlings were placed in mineral wool cubes (Grodan Plantop Rosa NG 2.0, size 100 × 100 × 65 mm). The plants were placed on mineral wool mats (Grodan Vitaflor NG 2.0, size 1000 × 235 × 75 mm). At the time of planting, the length of the shoots was 20-22 cm. Seven plants were placed per 1 m^2. The substrate volume was 2.2 litres per plant.

At the beginning of cultivation, the air temperature was maintained at 8-20°C, and the air humidity was 65-75%. During the summer months, the air temperature ranged from 25 to 30°C. The length of daylight hours was of great importance for the optimal growth and development of roses. As the level of solar energy decreased or when there was high cloud cover, a plant lighting system was turned on in the greenhouse to ensure the necessary length of daylight hours and level of light energy, which promotes the active process of photosynthesis. During the winter, lighting was provided at a level of 10,000-12,000 lux. The electric lighting mode was set for 20 hours a day, from 4 a.m. to midnight. The dark phase of photosynthesis lasted four hours. In spring, with the increase in the intensity of solar radiation and the length of daylight hours, the operating time of the electric lighting system was reduced to 16, 14, 10, etc. hours. With the transition from summer to autumn, the duration of lighting during the day was gradually increased again.

An important microclimatic parameter in growing roses in a greenhouse was the level of carbon dioxide. On average, its content in the air was maintained within 800-1,200 ppm, and on clear sunny days – up to 1,500 ppm. Watering was carried out according to the programme in automatic mode. The interval between waterings was 1-1.5 hours. The amount of nutrient solution was 2.5-6 l/m^2. In closed ground conditions, the root system of the rose was rather weak, so the standard electrical conductivity value was within the range of EC = 1.2-2.2 mS/cm. In winter, the concentration of the nutrient solution was increased due to lower water consumption, and in summer it was reduced. Plant care consisted of removing suckers from the leaf axils and pruning. Before pruning, the buds were removed. The first pruning was carried out 15-20 days after planting the seedlings. Flowers were cut daily in the morning in the half-open bud phase, when the sepals were already bent back and the coloured petals were visible from above.

Six plant growth regulators were used in the study: Kendal+, Gilea, Regoplant, Ferti Set, Isabion and Yara Vita. All preparations differ in origin and basic composition. Kendal+ is a biological complex of macroelements of oligosaccharides and phytoalexins; Gilea is succinic acid, an environmentally friendly growth biostimulant; Regoplant is a growth biostimulant from a line of multicomponent preparations, a fermented product of fungal microorganisms and ginseng root extract; Ferti Set – a combination of alginic acid, carbohydrates, betaine, phytohormones and microelements; Isabion – a set of amino acids of animal origin, macro- and microelements; Yara Vita – a balanced combination of macro- and microelements and bioactive compounds extracted from the unique *Ascophyllum nodosum* algae.

The plants were sprayed with growth regulator solutions three times: the first time – 7 days after placing the seedlings in their permanent place in the greenhouse, the second time – during the first budding, and the third time – at the beginning of mass flowering. The control variant was not sprayed with growth regulators. The concentrations recommended by the manufacturers were used to treat the plants: Kendal+ at a concentration of 25 ml per 10 l of working solution for spraying; Gilea – 200 mg/l; Regoplant – 25 ml per 10 l; Ferti Set – 0.5 l/100 l, Isabion – 10 ml/1 l of water, and Yara Vita – 20 ml of fertiliser per 5 l of water.

Results and Discussion

The results of the studies showed that growth regulators had different effects on the dynamics of growth processes and phenological indicators of the 'Aqua' rose variety. Differences were observed in the timing of the first break, the speed of bud emergence, and the duration of flower development. The use of certain preparations accelerated the formation of generative organs, while others showed almost no difference from the control variant (Table 1).

Table 1. *Phenological observations of rose development under the influence of plant growth regulators*

Variant	Planting date	Date of first stem breaking	Duration of period, days	
			Bending to bud appearance	Flower development
No treatment (C)	11.04.23	29.04	17	21
Yara Vita		26.04	17	21
Regoplant		27.04	16	20
Gilea		26.04	15	19
Isabion		26.04	15	19
Kendal+		29.04	17	21
Ferti Set		28.04	15	19

Note: C – control

Source: developed by the authors

An important task after planting roses in a permanent place in a greenhouse is to create a powerful assimilation apparatus. This is achieved by forming productive skeletal shoots that develop from the axillary buds of the shoot's covering scales. To increase the assimilation surface, shoot bending was used. The first bends were made when buds began to appear on the shoots. Before bending, the bud was removed. The operation was carried out in the afternoon, when the turgor in the plant cells was reduced.

In the variants where Yara Vita, Gilea and Isabion preparations were used, the first bending was carried out on 26 April, 15 days after planting the seedlings. On 27 April, bending was carried out on roses treated with Regoplant, and on 28 April, on plants treated with Ferti Set. The Kendal+ preparation did not affect the growth of rose shoots, and in this variant, the break was carried out simultaneously with the plants of the control variant. To ensure a gradual, rather than simultaneous, awakening of the buds on the plants, the operation was carried out every other day in the afternoon, when the turgor in the plant cells was reduced. Proper execution of the first pruning is one of the components of success in increasing the flowering period. The fastest appearance of the second bud was observed when using the growth regulators Gilea, Isabion and Ferti Set. The period from breaking to bud formation lasted 15 days. Full opening of the flower was observed after another 4 days, and the total duration of its development was 19 days. The longest period from bending to bud appearance was observed in the variants with the use of Yara Vita, Kendal+ and in the control. Under these conditions, the duration of the period from planting seedlings to full flower formation was 21 days.

Yield allows to determine the feasibility of using growth regulators in production and is the main indicator of effectiveness. The first cuts of rose flower stalks using the preparations Gilea and Isabion were obtained in the third decade of May. However, their effect on plants in the last two months (October-November) was insignificant. It can be assumed that the stimulating effect of growth regulators decreased and plant metabolism slowed down. Determination of the total yield of the 'Aqua' rose variety revealed that the growth regulators Isabion, Gilea and Yara Vita had a significant impact on this indicator (Table 2).

Table 2. *Rose yield depending on plant growth regulator*

Variant	Total yield, pcs/m²	Productivity	
		pcs/plant	% to control
No treatment (C)	241	34.4	-
Yara Vita	259	37.0	+8
Regoplant	252	36.1	+5
Gilea	261	37.3	+8
Isabion	267	38.1	+11
Kendal+	248	35.4	+3
Ferti Set	250	35.7	+4
$LSD_{0.5}$	15.4	2.3	-

Note: C – control

Source: developed by the authors

The growth regulator Isabion had the highest stimulating effect on the total number of flower stalks and exceeded the control indicator by 26 pieces/m², making it the most effective among the options studied. The preparations Gilea and Yara Vita also demonstrated a significant increase in the total yield, creating an increase of 20 and 18 pieces/m² over the control. A positive effect on the increase in flowering shoots was also noted with the use of the growth regulators Kendal+, Regoplant and Ferti Set. However, their effect was weaker and did not differ significantly from the control option.

The productivity indicator of a single plant is particularly valuable in the production of flower and decorative products, as it allows to predict the yield per area, compare the impact of microclimatic factors, agrotechnical measures, green operations, etc. on a single plant. Tracking productivity at the level of an individual plant makes it possible to determine the uniformity of bushes, lack of nutrition or the impact of stress, which is especially important when growing flowers, where each plant must be aesthetically attractive. In the current study, a significant increase in productivity was obtained with the use of the Isabion preparation – 38.1 pcs/m², which is 3.7 pcs/m² higher than the control indicator and amounts to 11%. The use of Gilea and Yara Vita preparations increased the formation of flower stalks on the plant by 2.9 and 2.6 pcs/m², which exceeded the control variant by 8%.

An increase in productivity by 3-4 flower stalks is of practical importance. Since the plant density is 7 plants per 1 m², this gives 21-32 additional marketable cuttings per m², which significantly increases profits. The other variants showed a tendency to increase productivity, but the difference from the control was within the margin of error. The growth regulator Kendal+ had the weakest effect on the productivity of a single plant – 3%.

According to a study by K. Sharma (2023), the application of naphthylacetic acid at a concentration of 25 mg/l increased the length of shoots and flower yield on Damask rose plants. Also, according to B. Muradi *et al*. (2023), cytokinins are used to enhance cell division and tissue differentiation, and they cause active shoot formation in vivo. In addition, scientists A. Porcher *et al*. (2021) claim that cytokinin preparations cause rose bud growth not only in light but also in darkness, which explains the active formation of flower stalks in early spring when using isabion, which contains amino acids in combination with auxin-like and cytokinin-like forms. During studies of the decorative qualities of 'Aqua' rose flowers, it was found that the growth regulators used significantly affected a number of important indicators. In particular, they changed the height of the bud, the diameter of the open flower, the number of petals and the shelf life of cut flowers in a vase (Table 3).

Table 3. *Decorative indicators of rose flowers of the 'Aqua' variety under the influence of growth regulators*

Variant	Bud height, cm	Diameter of open flower, cm	Number of petals, pcs.	Vase life, days
No treatment (C)	6.7	9.6	43.6	10
Yara Vita	7.3	10.9	51.4	14
Regoplant	6.9	10.2	48.8	12
Gilea	7.4	11.2	50.7	15
Isabion	7.1	10.7	47.4	12
Kendal+	6.5	9.7	45.2	10
Ferti Set	7.0	10.3	50.3	11
LSD_{05}	0.6	1.0	5.6	-

Note: C – control
Source: developed by the authors

The product Gilea had a significant effect on bud height. The diameter of the open flower significantly exceeded the control variant when using Gilea, Yara Vita and Isabion – by 17, 14 and 11%, respectively. The double-floweredness (number of petals) was significantly influenced by Yara Vita, Gilea and Ferti Set. Under their influence, double-floweredness increased by 7.8, 7.1 and 6.7 petals, respectively. The vase life of the flower stalk in the cut was most prolonged by the preparation Gilea – by 5 days compared to the plants in the control variant. The main component of this growth regulator is succinic acid. This result coincides with the data of S. Kazaz *et al*. (2019), who evaluated the effect of various organic acids on the storage of cut roses. Succinic acid (SUA) at a concentration of 100 mg/l significantly prolonged the vase life of flowers to 13.07 days compared to 8.53 days in the control. In general, Gilea and Yara Vita demonstrated the most comprehensive effect on decorative characteristics. These preparations simultaneously ensured an increase in flower size, an increase in the number of petals, and a significant prolongation of vase life, which makes them promising for use in industrial rose cultivation.

Studies conducted by A. Alzuhairi & A. Al-Sheikly (2022) and A. Zahid *et al*. (2022) confirm the data obtained in the current study on a significant improvement in rose flowering parameters as a result of treatment with plant growth regulators. Spraying with gibberellic acid (200 mg/l) accelerated the appearance of flowering buds, increased their number, increased the length of the pedicel, the diameter of the flower and the shelf life of the cut flower. The study by L. Hong *et al*. (2021) analysed the morphogenesis of rose flowers under the influence of growth regulators during the induction of flowering of vegetative shoots *in vitro*, which reveals the mechanism of action of some growth-regulating substances. Flower development goes through three stages: apical meristem of the shoot → floral meristem → flower bud. During the transition to the floral meristem, the levels of cytokinins, auxins, and gibberellins increase, indicating their key role in triggering flowering. It has been proven that a combination of gibberellic acid – 0.5 mg/l, 1-naphthylacetic acid – 0.1 mg/l and 6-benzylaminopurine – 2.5-3.0 mg/l induces flower meristem *in vitro*, which subsequently develops into a flower bud. The most common method of applying gibberellic acid preparations is spraying the entire plant or its individual parts, or applying drops of suspension to buds and floral primordia. Under the influence of gibberellins on rose plants, R. Gupta & S. Chakrabarty (2013) observed elongation of shoots, increased terry and brightness of colour, increased size of inflorescences and accelerated flowering times. In the current study, an increase in shoot height and acceleration of bud formation were similarly noted, in particular with the use of the preparations Gilea and Isabion, which confirms the stimulating effect of gibberellins on the generative development of plants. Scientists N. Zieslin & R. Ben-Zaken (1992) found that gibberellin preparations stimulate the growth of structures that had formed prior to treatment. Thus, to increase the size of inflorescences, enhance their colour and terry, treatment is carried out when all elements of the flower are fully formed, and to change the flowering time, when all parts of the flower are formed but the buds are still green. The results obtained in the current study confirm this conclusion: the maximum effect was observed when the treatment was carried out in the phase of complete flower formation, which manifested itself in a reduction of the "bending-bud appearance" period to 15 days. According to I. Havris *et al*. (2019), the products Bionur and Bud accelerated the development of rose flower stalks, reduced the duration of the bud emergence and flower development periods, and also affected plant productivity and the decorative properties of the flower. In the current experiment, similar patterns were observed: the preparations Isabion and Gilea contributed to faster development of flower stalks and an increase in decorative indicators (flower diameter, number of petals, vase life), which is consistent with the literature data. Thus, the results of the current study confirm the conclusions of previous authors and demonstrate a similar effect of gibberellin preparations on the growth, development and decorative properties of roses, although the degree of effectiveness of individual agents (Gilea, Isabion, Yara Vita) was more pronounced in greenhouse conditions of small-volume hydroponics.

Auxin-like substances are used in the vegetative propagation of roses and other flowers to intensify the rhizogenesis of cuttings (Oliynyk, 2017). The most widely used substances for this purpose are heteroauxin, β-indolylbutyric and α-naphthylacetic acids, as well as vitamins B1 and C. For the treatment of cuttings, aqueous solutions of preparations are prepared, as well as powders and, based on powders, pastes. The concentrations of different substances vary for different crops. S. Ghosh *et al.* (2017) determined the effect of plant growth regulators on stem cuttings of Damask rose (*Rosa damascena* Mill.). It was found that the use of such preparations increased the survival rate and shortened the germination period of cuttings. A similar trend was observed in the current study: the use of auxin-based preparations ensured faster root system formation, which had a positive effect on the further development of plants and an increase in the number of flower stalks.

Thus, the results of the observations confirm the conclusions of S. Ghosh *et al*. (2017) about the stimulating effect of auxins on the process of rhizogenesis and rooting of cuttings, which is an important stage for the successful vegetative propagation of roses.

The results obtained indicate that the use of growth regulators had a significant effect on both the phenological indicators and the productivity and decorative characteristics of the 'Aqua' rose variety. The highest efficiency was achieved with the preparations Gilea, Isabion and Yara Vita, which contributed to an increase in yield, an increase in flower size and number of petals, as well as a significant prolongation of the vase life of cut products. Other preparations had a less pronounced but still positive effect compared to the control. Thus, the use of growth regulators can be considered a promising direction for optimising rose cultivation technology in low-volume hydroponics. The set of data obtained formed the basis for formulating generalised conclusions of the study.

Conclusions

After planting the 'Aqua' rose seedlings, the main task of agricultural technology was to form bushes with productive skeletal shoots developing from axillary buds. The assimilation surface was created by bending the shoots in the afternoon, after removing the buds, when the turgor of the cells was reduced. The use of growth regulators accelerated the first bending. The most effective preparations were Gilea, Isabion and Yara Vita – bending was carried out 15 days after planting.

Observation of the phenological phases of growth and development of rose plants showed that the shortest period from breaking to bud appearance (15 days) was observed in the variants with the use of Gilea, Isabion and Ferti Set. Complete flower formation in these variants took 19 days. The longest period between breaking and bud appearance was observed with the use of Yara Vita and Kendal+ – 21 days. The first flower cuttings were obtained in the third decade of May with the use of Gilea and Isabion. The growth regulator Isabion had the greatest effect on the yield and productivity of rose flower stalks per m^2 – +26 pieces (38.1 pieces/m^2, +11% from the control), Gilea – +20 pieces, Yara Vita – +18 pieces. The weakest effect was from the use of Kendal+ (+3%). A noticeable effect of growth regulators was also noted on the decorative qualities of the flower. The height of the bud increased significantly with the use of the growth regulator Gilea. The diameter of the flower increased by 17% (Gilea), 14% (Yara Vita), 11% (Isabion) compared to the control. The number of petals increased with the use of Yara Vita (+7.8), Gilea (+7.1) and Ferti Set (+6.7). Vase life increased by 5 days (Gilea) and 4 days (Yara Vita).

Thus, the greatest stimulating effect on growth and phenological parameters, productivity and decorative characteristics was shown by the plant growth regulators Gilea and Isabion , as well as, to some extent, Yara Vita. Other preparations (Kendal+, Regoplant, Ferti Set) had a weaker or local effect. The use of growth-regulating substances allows to shorten the period of shoot development and budding, increase the yield and decorative properties of roses, and extend the life of cut flowers.

Based on the results obtained, it is promising to study the mechanisms of action of growth regulators on roses in different phenological phases. In particular, it is advisable to evaluate the long-term effects of growth stimulants on plant metabolism in the late period (October-November), since previous observations have shown a decrease in the stimulating effect during this period. Investigate the interaction of various growth-regulating substances with each other and with growing conditions (temperature, lighting, nutrition) to create practical protocols for improving the productivity and quality of flowers. These areas will deepen the understanding of the role of stimulants in regulating rose growth and flowering and optimise production technologies for commercial greenhouses.

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Conflict of Interest

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Вплив застосування рістрегулюючих речовин на морфо-анатомічні показники та урожайність троянди чайно-гібридного типу сорту ‘Аква’

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Анотація. Троянда посідає провідне місце серед квітів на зріз, а застосування регуляторів росту забезпечує активацію метаболізму, підвищує стійкість рослин, урожайність та декоративність квіток. Мета полягала у визначенні дії різних регуляторів росту на процеси розвитку, формування врожаю та декоративні параметри троянди сорту ‘Аква’ за умов малооб’ємної гідропоніки у скляних теплицях типу Venlo. Для випробувань використано препарати Кендал+, Ферті Сет, Регоплант, Ізабіон, Гілею та Яра Віта. Об’єктом дослідження були рослини чайно-гібридної троянди сорту ‘Аква’, оригінатором якої є нідерландська селекційна компанія Sint Petrus Johannes Schreurs. Експеримент реалізовано у виробничих умовах тепличного господарства ТОВ «Асканія-Флора» впродовж 2023 року. Здійснено триразову позакореневу обробку рослин розчинами рістрегулюючих речовин: перше – через тиждень після висаджування їх на постійне місце в теплицю, друге – в період першої бутонізації, третє – на початку масового цвітіння. Контрольний варіант регуляторами росту не обприскували. В результаті досліджень встановлено, що препарати Гілея та Ізабіон прискорювали формування квітконосів і терміни проведення залому, а також сприяли швидшій появі бутонів та розвитку квітки. Виявлено, що застосування Ізабіону підвищило урожайність троянди сорту

‘Аква’ до 267 шт./м² (38,1 шт./рослину), що на 11 % перевищувало контроль (241 шт./м²). За дії Гілеї вазостійкість зрізаних квіток досягала 15 діб проти 10 діб у контролі. З’ясовано, що за дії Яра Віта урожайність досягала 259 шт./м² (37,0 шт./рослину), що перевищувало контроль на 8 %. Виявлено позитивний вплив рістрегулюючих речовин Яра Віта, Гілея та Ізабіон на продуктивність троянди, загальну урожайність і основні декоративні показники квітки. Одержані результати варто враховувати під час висаджування саджанців троянди у скляних зимових теплицях типу Venlo для кращого регулювання ростових процесів і підвищення загальної врожайності

Ключові слова: стимулююча дія; теплиця; регулятори росту рослин; висота бутона; продуктивність