The effect of the drug Zircon on the decorative qualities of large-flowered eustoma plants in pot

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Abstract. The article presents the results of the study of the growth stimulator Zircon concentreation influence on the decorative qualities of large-flowered eustoma of White Kyoto F1 and Flamenco pink F1 hybrids. In the experiment, the drug concentration was studied from 0.25 to 5.0%. The drug foliar application affected the height of the plant, the number of leaves and their size, the passage of phenological phases by plants and the duration of flowering. The most effective was the use of Zircon with a solution concentration of 2.5%.

1 Introduction

The tasks of urban improvement come down to creating healthy, expedient and favorable living conditions for the population.

In solving these problems, external landscaping, functional and spatial structure and subject equipment of open areas, landscape design are becoming increasingly important.

In recent years, large-flowered eustoma (Eustoma grandiflorum), a beautiful flowering plant from the gentian family, has entered the assortment of flower plants, which has become one of the main cutting crops, an accent plant in many floral compositions. Eustoma is known for its beautiful almond-shaped leaves of a bluish hue, a long stem, flowers similar to a rose (simple or double), color variations and a long life (14 days) after cutting [7, 10, 15].

In Krasnodar, large-flowered eustoma is rarely used in the design of plots, although with the right selection of varieties for pot culture and care, it is possible to achieve prolonged flowering during summer and autumn.

Thanks to breeders, a large number of varieties and hybrids of new series of large-flowered eustoma enter the world market every year, characterized by beautiful coloring, flower shape, flowering time, resistance to diseases and pests [16, 17].

Denmark is a well–known producer of potted plants. Tromborg is the world's largest producer of eustoma large-flowered pot culture, accounting for about 70% of sales of this crop on the European market. The breeding center for ornamental crops (Sakata, Japan), with which the company Tromborg cooperates, is engaged in breeding low compact forms, in which the peduncles are cut off for the entire length of the shoot. In this center, a lot of breeding work is carried out with the genus Eustoma representatives (about 150 varieties

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are tested, no more than 15 are grown on a commercial scale – with simple flowers and about the same number of terry varieties) [4, 8].

Holland Agro Connection BV (Netherlands) exports varieties and hybrids of large-flowered eustoma [11].

Currently, valuable eustoms varieties have been created for decorative and economic characteristics. Breeders have always sought to obtain plants with strong branches, simple and double inflorescences of various colors, as well as varieties resistant to wind, rain and fusarium – the main disease of eustoma [5, 9, 13].

In recent decades, numerous physiologically active substances (FAV) have been widely used in the practice of floriculture for open and protected soils as growth stimulators, which are used to increase the ornamental plants' biometric indicators, the effects on flowering time, plant resistance to extreme environmental conditions [6, 9, 12, 14]. One of the most commonly used growth stimulants (active substances (DV) isolated from vegetable raw materials Ehinacea purpurea L. is the drug Zircon (DV is a mixture of hydroxycinnamic acids (PCC)). This drug is both a growth regulator, an immune-modulator and an anti-stressor [15]. However, there is no information about the results of its use on the eustoma, which substantiates the relevance of our research.

2 Materials and methods

The objects of the research were two hybrids of large-flowered eustoma (producer Sakata): Flamenco Pink F1 and White Kyoto F1.

The choice of hybrids is justified by the following advantages that distinguish them from other representatives of cultivars: the possibility of obtaining early flowering products; having a shorter period from the emergence of seedlings to the budding phase - the beginning of flowering; continuous flowering from mid-July to frost.

The subject of research was the the drug Zircon use regulation. The preparation was used for soaking seeds before sowing and watering plants, once a week, with a solution of various concentrations: 1 – control (water), 2 – Zircon (0.25% solution), 3 – Zircon (0.5% solution), 4 – Zircon (1.0% solution), 5 – Zircon (2.5% solution), 6 – Zircon (5.0% solution).

The repetition of the experiment is threefold. The methods used in our research are vegetative, field and statistical.

Before planting eustoma seedlings [1], the indicators of its aboveground system were evaluated: the plants height, the leaves number, the leaf blade size. The leaf area was determined by the contour method on millimeter paper. For evaluation, 10 typical plants of each variant of the experiment were taken.

During the growing season, the following records and observations were carried out: 1) Phenological observations. The dates of the main phenological phases onset of eustoma plants were noted: the emergence of seedlings, 1 and 3 pairs of real leaves, budding, the beginning and end of flowering. The timing of technological techniques (sowing, picking, transshipment) was also noted. 2) Biometric observations. During the period of mass flowering, the height of plants, the length of the peduncle, the leaf blade length and width were noted. The records were carried out on 5 plants of each variant of the experiment. 3) The decorative qualities of plants were evaluated by the number of peduncles, flowers, and their sizes on the same plants that were taken for biometric observations. To assess the reliability of differences in some plant characteristics, methods of mathematical statistics using computers were applied [3].

The method of varietal evaluation of leading flower crops by V. N. Bylov [2] served us as a basis for the method of complex evaluation of large-flowered eustoma varieties.

3 The results and the discussion

To conduct research to assess the growth, development and reproduction of eustoma plants in connection with the economic value of the Eustoma grandiflorum species is of importance.

The determination of the leaf area is of fundamental significance, since the leaves are directly related to processes such as evapotranspiration, radiation capture and CO_2 fixation [9, 10].

Before placing potted seedlings on a plot in the open ground, we carried out observations of the indicators of the vegetative organs of the eustoma (Table 1).

Table 1 – Eustoma hybrids seedlings quality before placing pots in the open ground, 17.05.2021.

№	Experiment option	Plant height, cm	Leaves number, pc.	Leaf length, cm	Leaf width, cm	Leaf area, cm^2
White Kyoto F1						
1	Control (water)	16.0	12	5.0	2.5	9.4
2	Zircon (0,25 % solution)	16.4	12	5.1	2.6	9.9
3	Zircon (0,5 % solution)	19.0	14	5.2	2.9	11.3
4	Zircon (1,0 % solution)	19.6	16	5.4	3.0	12.2
5	Zircon (2,5 % solution)	20.1	16	5.5	3.2	13.2
6	Zircon (5,0 % solution)	17.0	14	5.1	2.7	10.3
LSD $_{05}$		1.68				
Flamenco Pink F1						
1	Control (water))	15.8	12	4.8	2.2	7.9
2	Zircon (0,25 % solution)	16.2	12	4.9	2.4	8.8
3	Zircon (0,5 % solution)	18.8	14	5.0	2.6	9.8
4	Zircon (1,0 % solution)	19.3	16	5.1	2.8	10.7
5	Zircon (2,5 % solution)	19.8	16	5.3	2.9	11.6
6	Zircon (5,0 % solution)	16.6	14	4.9	2.4	8.8
LSD $_{05}$		1.63				

The data in Table 1 indicate that the growth regulator Zircon introduction when growing the seedlings of the studied eustoma hybrids is effective. Of the concentrations recommended by literary sources used on different plants [10, 12, 15, 16], a 2.5% solution of the drug proved more effective for eustoma. Plants of this variant of the experiment had higher biometric indicators characterizing the qualitative characteristics of seedlings, exceeding the indicators of the control variant of the experiment by 10.0-46.8%. In terms of growth, the seedlings of the control and the variant with the use of 0.25% solution of the drug lagged significantly behind. The largest concentration of the stimulant - 5.00% somewhat restrained the growth of seedlings, whose quality indicators were lower in comparison with experimental plants of other variants using the drug by 5.06-16.6%.

Large-flowered eustoma is grown for cutting because of the abundance and duration of flowering and the long life of flower products after cutting. Foliage plays an important role

in the formation of vegetative and generative organs of the plant. The measurement of leaf area is of fundamental importance for plants, because leaves are directly related to various physiological processes [5, 10, 15]. The area of the leaf surface of eustoma plants depends on the size of the linear dimensions of the leaves. The largest leaf area was observed in the two studied eustoma hybrids at a drug concentration of 2.5% – respectively, 13.2 cm^2 in the White Kyoto F1 hybrid and 11.6 cm^2 in the Flamenco pink F1 hybrid.

The smallest leaf area in the experiment was noted in the control variant and when using the drug in the lowest concentration of the solution, respectively, 9.4-9.9 and 7.9-8.8 cm^2.

Thus, the growth processes of eustoma seedlings were conditioned by varietal characteristics and the concentration of the drug Zircon solution.

The potted seedlings of large-flowered Eustoma grown by us were brought to the open site on May 18, 2021.

The first inflorescences on eustoma plants appeared in the second decade of June (Table 2). The formation of new inflorescences in the studied plants took place during the entire vegetation period of the plants, from June 11 to November 27 before the onset of the first negative temperatures, after which the plants were cut off with the three internodes on the stems and put in a cool room for the winter.

Table 2 – Passage of phenological phases by large-flowered eustoma plants in the second half of the growing season, 2021.

№	Experiment option	Peduncle appearance	Budding	Flowering	
				beginning	ending
White Kyoto F1					
1	Control (water)	03.07.	08.07.	12.07.	27.11.
2	Zircon (0,25 % solution)	01.07.	06.07.	10.07.	27.11.
3	Zircon (0,5 % solution)	29.06.	05.07.	09.07.	27.11.
4	Zircon (1,0 % solution)	25.06.	02.07.	07.07.	27.11.
5	Zircon (2,5 % solution)	23.06.	01.07.	05.07.	27.11.
6	Zircon (5,0 % solution)	01.07.	06.07	10.07.	27.11.
Flamenco Pink F1					
1	Control (water)	19.06.	25.06.	29.06.	27.11.
2	Zircon (0,25 % solution)	18.06.	24.06.	28.06.	27.11.
3	Zircon (0,5 % solution)	17.06.	22.06.	26.06.	27.11.
4	Zircon (1,0 % solution)	13.06.	18.06.	22.06.	27.11.
5	Zircon (2,5 % solution)	11.06.	16.06.	20.06.	27.11.
6	Zircon (5,0 % solution)	17.06.	23.06.	28.06.	27.11.

The hybrid Flamenco pink F1 eustoma belongs to the first flowering group, whose representatives bloom in the third decade of June, 10-12 days earlier than other Eustoma grandiflorum series.

Plants of the hybrid White Kyoto F1 belong to the second group of flowering (medium term) and bloom in the first decade of July.

The peduncle appearance and the budding phase onset in the studied plants were noted at different termes according to the experiment options. The shortest period from planting

seedlings to the beginning of flowering in Flamenco pink F1 plants is 155-165 days, in White Kyoto F1 plants it is longer – 170-179 days. Our observations showed that 2.5% concentration of the drug Zircon activated the flowering processes in both hybrids in the experiment. Flamenco pink F1 eustoma plants were the first to bloom on June 20 and 22 in the 4th and 5th options of the experiment. In the same options of the experiment the plants of the White Kyoto F1 hybrid also bloomed first – on July 5 and 7. The plants of the studied hybrids developed the slowest in the control experiment options. Their flowering phase began 10-13 days later than the plants of the 4th and 5th experiment options. In these hybrids, as confirmed by the data given earlier, the seedlings were characterized by the smallest leaf sizes.

Experiment options with the 0.25% and 5.0% concentration of the drug Zircon showed similar results according to generative phases onset terms. The phases of the appearance of the peduncle, budding and the beginning of flowering occurred in these experiment options 1-2 days earlier than in the control plants. The variant with a 0.5% concentration of the drug occupied an intermediate position in the experiment.

Eustoma plants are characterized by branching – the formation of peduncles, starting from the 8th pair of leaves. The peduncles of the eustoma are shoots that appear from buds located in the axils of the leaves. The flowering period of eustoma plants is of great importance, because with proper care of plants, it can last up to 4 months.

According to the results of our research, the plants of the White Kyoto F1 hybrid had a shorter flowering period, the plants of the Flamenco pink F1 hybrid bloomed longer. The longest flowering period turned out to be in the 4th and 5th experiment options - 1-2 days earlier than in the control plants. The option with a 0.5% concentration of the drug occupied an intermediate position in the experiment.

Flower stalks on Flamenco pink F1 plants appeared in 06.11-19.2021, and on White Kyoto F1 plants – 06.23-07.03.2021. The largest number of flower stalks on one stem (6.1-6.6 pcs.) were in plants of the studied hybrids of the 4th and 5th experiment options. In all other options the number of peduncles on one stem was approximately the same – on average, 5.3 pcs.

The plants of the Flamenco pink F1 hybrid in all experiment options had larger flowers compared to the White Kyoto F1 plants, which is a characteristic feature of the hybrid. The indicator "Flower diameter" in the studied hybrids differed in the context of the experimental options. The largest flowers were in the 5th experiment option, the diameter of which, on average, was 5.6-6.8 cm. The results of exposure to the drug Zircon at a concentration of 2.5% exceeded the data of the control experiment option by 24.4-30.7% in terms of flower size. The data of the other experiment options differed in average indicators.

4 Conclusion

The use of the drug Zircon for soaking eustoma seeds and applying them to the soil in irrigation proved to be effective.

The most effective for eustoma is the 2.5% drug solution. Flowering plants in potted culture in the experiment option with the 2.5% concentration of Zircon solution had higher indicators and exceeded the data of the control options in biometric indicators. Based on the results obtained, we offer the producers of large-flowered eustoma to use hybrids White Kyoto F1 and Flamenco pink F1 in the design of interiors and flower beds as a pot culture. To obtain potted eustoma products with high decorative qualities, we recommend using the drug Zircon in the 2.5% concentration when fertilizing plants.

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