Thesis of PhD dissertation

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Growth regulation of some annual ornamentals by retardants, biostimulators and mechanically

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1. BACKGROUND OF THE WORK, OBJECTIVES

Ornamental plant production is one of the most diverse areas of the horticultural sector. One of the most dynamic agricultural sectors, especially for potted ornamental crop production, has grown worldwide in the international market (MEGERSA et al. 2018).Climate change and global warming, which have intensified in recent years, are rearranging the current order of the sector, and the formation of new production areas is typical. Globalization also affects the ornamental plant sector (TILLY-MÁNDY and STEINER 2013a). One of the great challenges of our time, in addition to climate problems, is to deal with the newer and newer challenges of urbanization, to meet the increasingly urban needs of society, all in a way that keeps in mind the increasingly challenging environmental and climate protection problems and solutions.

An essential feature of our public spaces is that the wave of planting is taking on increasing proportions. The car parks of the newly established shopping centers and the communal areas of the mass-built residential centers are already dotted with plant beds. The range of species and varieties used in the public areas of Hungary is slowly changing, Hungarian-bred, weather-tolerant varieties are often planted (TILLY-MÁNDY and STEINER 2013b). However, most of the herbaceous ornamental plants currently in use are plants bred and produced in Western Europe, so that the humid continental, often oceanic climate dominates in the breeding and maintenance of the varieties. Buying seedlings from Western Europe, as many domestic gardeners agree, is cost-effective, simple; the seedlings are completely uniform, healthy. The droughty summer, the often extremely high temperatures, and the weeks of July-August destroy the unevenly irrigated annual and perennial beds planted with plants that do not tolerate the Hungarian climate.

However, most ornamental plants tolerant of the Hungarian climate are not always suitable for use as occasional potted ornamental plants or in green walls or vertical walls, as their habitus and large size do not allow this, although among Hungarian-bred ornamental plants and several Western European varieties. also characterized by drought tolerance, heat stress tolerance. Therefore, due to their size, these varieties are in many cases not suitable for use in alternative urban use and educational technologies, but can be made suitable for this task by several methods.

By using certain dwarfing methods, the cultivation of possible new species as potted crops, or even the possibility of alternative urban rearing, can be solved on outdoor green walls and plant poles by reducing their size and making their habitus more bushy.

In the ornamental plant sector, auxins, gibberellins, cytokines and other growth regulators, mainly retardants, are essential for the production of quality goods. These retardants are commercially available and a wide variety is available. Their application promotes the proper market appearance of ornamental plants (SAJJAD et al. 2017).

A new method used to induce pollutants could be dwarfing based on mechanical contact of seedlings. The programmed (targeted) modification of plant architecture is based on a physiological process that can be described by the concept of mechanical "thigmomorphogenesis".

This mechanical dwarfing technology is still used in a relatively small area, both in Hungary and worldwide. The technology is not yet fully developed, but important advances have been made in recent years.

If successful technologies are emerging in the field of dwarfing, which could be used to solve the novel use of drought-tolerant plants, even here it may be important whether plants used in urban environments can retain their ornamental value due to increasing drought and temperature. Therefore, in addition to dwarfing, it is an important task to strengthen the plant organism and prepare it for cultivation in the urban environment. In ornamental crop production, the issue of sustainability needs to be addressed for the whole life cycle (DOMINGUEZ et al. 2017).

Demand for biostimulators of biological origin has increased enormously in recent years due to their natural origin, which does not require occupational health and safety, and plants treated with biological biostimulators may be suitable for urban planting, as they are more resistant to high UV radiation, extreme summer heat as well. For this reason, the cultivation and breeding of several taxa can be solved with biostimulators for use in urban public areas.

Biological biostimulators and retardants may also be suitable to support alternative forms of ornamental plant cultivation. Plant cultivation and use in vertical systems has come into the spotlight in recent years.

By writing my dissertation I want to achieve the following goals:

• Reviewing and processing the domestic and foreign literature, as a result of which the comparison and combination of seedling cultivation technologies, and then, after drawing the appropriate conclusions, creating the possibility of applicability in practical life.
• Investigation of the effect of commercially available retardants by morphological, histological and physiological methods on annual ornamental plant varieties.
• Investigation of the effect of biostimulators by morphological, histological and physiological methods on annual ornamental plant varieties.
• Investigation of the effect of thigmomorphogenesis as a method of mechanical seedling amplification by morphological, histological and physiological methods on annual ornamental plant varieties.
• Selection of annual ornamental plant varieties that may be suitable as potted, occasional ornamental plants using appropriate retardants or biostimulators.
• My goal is to find varieties among the Hungarian and foreign annual ornamental plant varieties used for modeling the methods, which, as a model plant, are included in the measurements with appropriate results and can thus be recommended for alternative use in the city.
• Selecting a biostimulator that is able to improve the health of plants before planting without burdening the environment.
• Research and presentation of alternative cultivation possibilities of Hungarian-bred annual ornamental plant varieties.

2. MATHERIALS AND METHODS

My series of measurements took place between 2010 and 2020, in several locations and ways. I performed morphological surveys on the parameters of plants grown in the open field, then the laboratory measurements were performed at the Department of Ornamental Crops and Dendrology of Szent István University, the

Department of Botany, the Herb Garden of Eötvös Loránd University and the Faculty of Agricultural and Food Technology of Debrecen.

2.1. Setting up experiments

In studies with retardants, the tested cultures were grown from seed in greenhouse conditions at each growing season. Herds were divided into 20-25 treatment groups according to the retardant and one control group in the experiments. A total of 50 ml / m2 of retardants per treatment was used in the experiment. Retardants were applied to the crop by hand sprayer. The first treatment was performed two days after firing and then continued at 10-12 day intervals until the varieties were 100% flowering.
The use of biostimulators started immediately after sowing and they were treated twice a week. The application rate is 200 ml / plant by irrigation, 25 ml / plant as a spray. The pot size used was 7x7x8 cm. The layout is a randomized complete block.
In 2019, the phytoserum treatments were supplemented with a mechanical disturbing effect, thus trying another dwarf-seedling strengthening program. At the end of the experimental series in 2020, we combined the treatments with retardants (Regalis, CCC, Cultar) with the biostimulators (phytoserum, treatments with Ferbanat L, treated with different concentrations.) The measurements were supplemented with mechanical disturbance.

2.2. Species and verieties

Table 1: Characteristics of the varieties used

Species	**Variety**
Matthiola incana (L.) R.Br.	’Cinderella Purple’ (MI CP)
***Tagetes patula* L.**	’Csemő’ (TP-1)
	’Vénusz’ (TP-19)
	’Orion’ (TP-31)
	’Robuszta kén’ (TP-15)
***Ocimum basilicum* L.**	’Zöldgömb’(O-1)
	’Bíborfelhő’ (O-4)
	’Rokokó’ (O-8)
Celosia argantea L. var. plumosa	’Arrabona’ (CP-2)
	’Bikavér’ (CP-6)

2.3. Retardants

In our experiments, the retardants listed in the table below were measured (Table 2):

Table 2: Ingredients

Name	Ingredient	Concentration of ingredient
Alar 85	daminozide	85%
CCC/ Cycocel 460 (CCC)	2-Chloroethyltrimethylammonium chloride or chloroquat chloride	460 g/l
Caramba SL (CAR)	metconazole	60 g/l
Cultar 25 SC (SL) (CUL)	paclobutrazol	250 g/l
Regalis WG (REG)	prohaxadione-calcium	10 g/l
Toprex (TPX)	paclobutrazol	125 g/l
	difenoconazole	250 g/l

2.4. Biostimulators

2.4.1. Ferbanat L (FL)

Ferbanat L is a complex of microhumatates, macronutrients, active salts of organic acids, fulvic acid, amino acids, vitamins, phytohormones, soil microflora and trace elements. When applied, the root system develops at a faster rate, a larger root mass is formed, and the number of branches is more than in the case of an untreated plant. It can be applied by spraying and watering. It was marketed in Hungary as Bistep.

2.4.2. Phytoserum (PHYS)

Phytoserum is a 42-47% w / w solution with a Brix value of 6-9%. Its total sugar content is 38 g / l. The pH of the phytoserum varies between 5.43 and 5.69. The inaccurate labeling of the data is due to the fact that the properties of the phytoserum are still under measurement, its properties have not yet been stabilized.

2.5. Mechanical dwarf machine

Under the guidance of Prof. Miklós Gábor Fári, on behalf of the University of Debrecen, László Bereczki and Tamás Kertész prepared a prototype of the first Hungarian mechanical dwarf machine in 2009/2010, with which Krisztina Lénárt, a horticultural engineering student, carried out preliminary research (LÉNÁRT 2010).

The main parts of the machine: frame structure, profile rail (HIWIN), endless ball carriage structure (HIWIN), cross member with switch stops, limit switches, span mechanism, wire rope with discs, DC 12V drive motor, protective covers, current converter adapter, TD-02 type timer switch, caress sheets (KERTÉSZ and BERECKI 2020).

2.6. Morphological data collection

• Plant height was measured from the surface of the support medium between the highest point of the plant (cm).

• The number of leaves was measured only on the leaves on the primary branches (pcs).

• Plant diameter is the largest diameter of the plant (cm).

2.7. Treatments during morphological examinations

During the measurements, the following treatments were applied to the annual ornamental plant varieties (Table 3):

Table 3: Treatment of morphological parameters

treatments
Reduction of 6 treatments used in preliminary experiments to 3 treatments in one culture period
Setting up a concentration line of the most effective dwarfing retardants
Comparative study of retardants in the experiment
Investigation of the combined effect of retardants in the experiment
Investigation of the effect of retardants in terms of order of application
Investigation of the combined effect of retardants and biostimulators
Investigation of the effect of biostimulators
Application of phytosterum in individuals of annual ornamental plant varieties in combination with mechanical stimulation
Comparative study of the two applied biostimulators
Plant individuals grown under natural light and receiving only tap water

2.8. Physiological and histological examinations

The laboratory measurements were performed in the laboratory of the Corvinus University of Budapest, Faculty of Horticulture, Department of Ornamental Crops and Dendrology, in the laboratory of the Faculty of Agriculture and Food Technology of the University of Debrecen.

2.8.1. Measurement of peroxidase enzyme activity

By measuring peroxidase enzyme activity, we wanted to obtain more information about plant stress caused by retardants and biostimulators.

2.8.2. Chlorophyll content tests

Chlorophyll content is a major indicator of plant vitality. The chlorophyll content studies performed during our series of measurements provided information on the extent to which the retardants and biostimulators used during the treatments affected the amount of chlorophyll in the foliage.

2.8.3.Histological examinations

By performing histological examinations, our aim was to investigate the effect of the retardants and biostimulators used on plant tissue and cells. The parameters listed below were measured:

-ratio of columnar to spongy parenchyma

-trichoma size shape

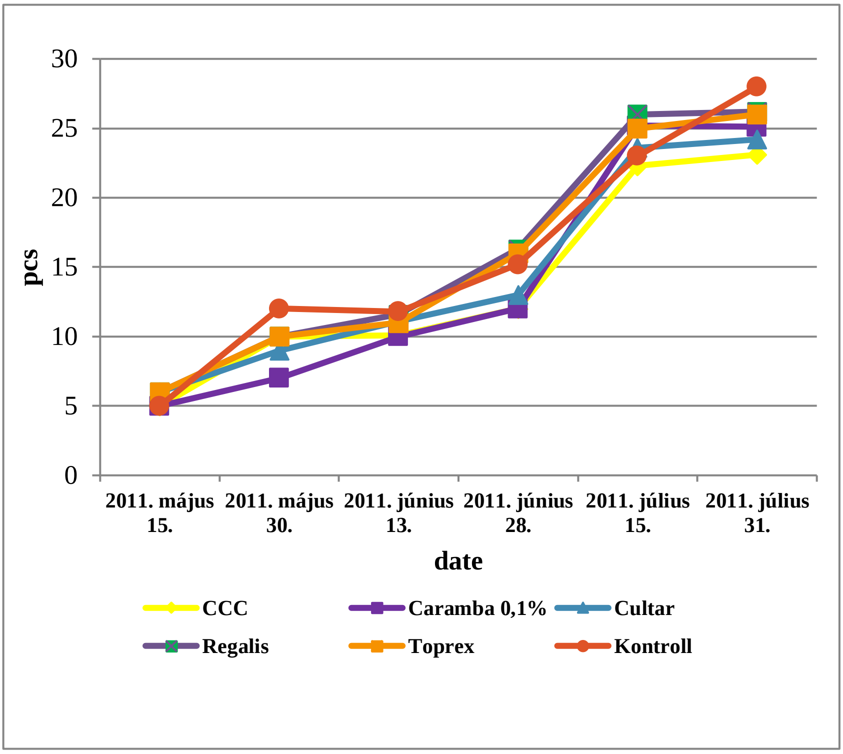
cell size

-intercellular ratio

- proportion of stem tissue structure

3. RESULTS

Between 2011 and 2020, I studied dwarf and strengthening seedling cultivation technologies with perennial and annual ornamental plants. My goal was to use a variety and retardant in the right concentration, which can be used to create a technology suitable for market cultivation in the field of occasional potted ornamental plant production or urban plant application. My further goal was to compare chemical, mechanical, dwarfing procedures and to strengthen them with biostimulators.



1. Figure: Effect of retardants *Matthiola incana* (L.) R.Br. 'Cinderella Purple' variety for leaf number with 3 treatments (Eger, 2011)

Based on the preliminary examinations carried out in 2010, we determined that it is necessary to reduce the number of treatments used. Starting in 2011, the six treatments were reduced to three treatments, which produced similar results to the control group in *Matthiola incana* (L.) R.Br. 'Cinderella Purple' (Fig. 1) .The number of treatments higher than three resulted in a deformed, dwarf growth. In 2011, *Matthiola incana* (L.) R.Br. responded well to the 2010 treatments. Measurements were performed with 'Cinderella Purple' cultivars with CCC, Caramba, Cultar, Toprex and Regalis retardants.

In 2012, *Matthiola incana* (L.) R.Br. Further measurements were performed with 'Cinderella Purple' cultivar. The results reflected

the results achieved in 2011. A 0.25% solution of Regalis and a 0.1% solution of Toprex resulted in dwarf but commercially available plant specimens. To summarize the results of the 2012 measurements, it can be said that *Matthiola incana* (L.) R.Br. Treatment with 'Cinderella Purple' cultivars with retardants is effective. A
lso in 2012, plants treated with 0.1% Toprex and 0.25% Regalis became marketable habitus. Other concentrations are not suitable for further measurements according to *Matthiola incana* (L.) R.Br. 'Cinderella Purple'. The combined application of Toprex and Regalis is a strong stress factor for the plant body, in addition, an additive effect can be felt, which results in small plants, and the additive effect also prevented the plant from flowering. Evaluating the chlorophyll content of the treatments, I found that the chlorophyll content of the leaves of the control group was higher than that of the treated groups. These retardants reduced the chlorophyll content in plant tissue.

The use of the Ferbanat L biostimulator had a positive effect on the plant. We found that Ferbanat L treatments applied at lower concentrations resulted in higher plant heights than the 0.3% concentration used as the highest treatment concentration. Measurements were continued with the biostimulator in 2020 (Figure 2).

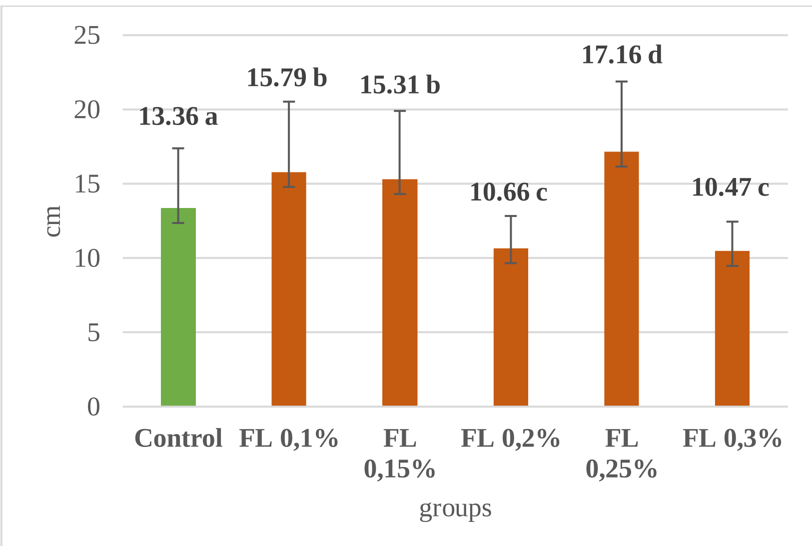


Figure 2: Effect of ferbanate L (FL) on *Matthiola incana* (L.) R.Br. 'Cinderella Purple' plant height (Eger, 2012)

In 2013, *Matthiola incana* (L.) R.Br. Retardants and Ferbanat L biostimulator were used simultaneously on 'Cinderella Purple' cultivar. We found that all retardants had an effect on the average height of the treated plants. The groups treated with retardants only were statistically significantly lower than those treated with Ferbanat L-. The effect of Ferbanat L is clearly significant even with retardant use. From a commercial point of view, plants treated with Ferbanat L biostimulator are suitable.

In 2014 and 2010 and 2011, *Matthiola incana* (L.) R.Br. The results of the groups treated with 'Cinderella Purple' Toprex were also considered as measurement results for further evaluation. The effects of Toprex were further investigated in *Matthiola incana* (L.) R.Br. 'Cinderella Purple' plants.

As a result of histological examinations, it can be said that there is no significant difference in the treated groups compared to the control group, except for the Regalis-treated group, the ratio is lower than the control result, ie the ratio of spongy parenchyma was almost everywhere in the control group. Leaf thickness did not yield significant results compared to either the control group (228.1080 μm) or the relative proportions of the other groups.

In the cell size assay, only the 0.1% and Regalis 0.25% solution groups (12.97 μm) showed a significant difference from the mean leaf thickness of the control group (20.686 μm). The number of trichomas decreased as a result of the treatments. Another change in the Regalis 0.25% group was that the shape of the trichomas also changed: compared to the control and the treated group, the trichomas became flatter. The chlorophyll content of the control group is the lowest (1.2912 µg), ie the agent used in all treated groups is effective in terms of chlorophyll content.

In 2015, measurements were performed with Alar, Regalis, and Toprex, and as a result of their combined treatment, with *Matthiola incana* (L.) R.Br. 'Cinderella Purple'. The number and sequence of treatments were also measured. It can be said that the results of the treated groups differed statistically from the results of the control groups. The order of treatments was not an influencing factor. There was no significant difference in height and leaf length between the results of the control group treated with tap water and illuminated and the results of the group receiving only natural light, and there was a significant difference in plant diameter. It can be stated that the group treated with tap water and lighting produced better results than the group that did not receive lighting.

In 2018, at the conclusion of the series of measurements between 2010 and 2015, *Matthiola inacan* (L.) R.Br. The cultivar ‘Cinderella Purple’ was found to be suitable for treatment with retardants as an occasional potted ornamental plant, so from 2018 new species and treatments were included in further measurements. Our goal was to make these varieties cultivable for other applications. *Celosia argantea* L. *var. plumosa* ‘Arrabona’, *Tagetes patula* L. ‘Csemő’ and *Ocimum basilicum* L. ‘Bíborfelhő’ cultivars were treated with fermented, protein-free alfalfa whey, which was evaluated as a biostimulator. Phytoserum had an effect on each of the treated varieties. The measured parameters became higher than the values of the control group. The Osmocote-treated group produced lower values in most cases, even than the control group. The tendency to branch increased in direct proportion to the percentage of concentration used. The method of application (irrigation and spraying) was not relevant for the varieties. The highest measured values were found at concentrations of 0.5%, 1% and 2.5%. Overall, however, a concentration of 1% was the most appropriate for the treatment of the variety. In the case of *Tagetes patula* L. ‘Seedling’, the method of application is also irrelevant. The plants were healthy, bushy with strong stems and foliage. The results for the 0.5% and 1% groups yielded the highest values for the variety. Examining the method of application, the combined effect was very pronounced in *Ocimum basilicum* L. ‘Bíborfelhő’ variety. Concentrations of 0.5%, 1%, and 2.5% were the most effective in the variety, but leaf number and, in this context, fresh leaf weight values were outstanding at the 10% concentration. The habitus of the plants changed greatly. The leaves became larger in size and brighter than those in the control group (Fig. 3). In 2018, *Celosia argantea* L. *var. plumosa* ‘Arrabona’ variety was anatomically evaluated and measured by measuring chlorophyll content. Chlorophyll content was measured and histological examinations were performed on *Ocimum basilicum* L. ‘Bíborfelhő’ variety. The leaf area size achieved in the control group represented the lowest leaf area value among the measured groups. Each of the phytoserum-treated groups produced significantly higher results on the leaf surface of the control group than *Ocimum basilicum* L.

‘Bíborfelhő’ cultivar. The chlorophyll content of the leaves increased at all concentrations used during the application of the phytoserum. It was mostly increased by the use of 2.5% concentration, this value was significantly different from the chlorophyll content of the control group. Compared to the control group, the treated groups had stronger cell walls and were characterized by more orderly, thicker cell-walled epidermal cells. Secondary vascular tissue is mainly higher than the control group at a concentration treated with a 10% solution of phytoserum and consists of strong, thick cells. It can be stated that the use of phytoserum together with the increase of the concentration had a thickening effect on the cell wall, the formation of secondary solidifying tissue elements was characteristic of both *Celosia argantea* L. *var. plumosa* ‘Arrabona’ for both *Ocimum basilicum* L. ‘Bíborfelhő’.

Figure 3: Effect of phytoserum on *Ocimum basilicum* L. ‘Bíborfelhő’ variety (Debrecen, 2018) Legend: OSM = Osmocote

In 2019, the phytoserum treatments were supplemented with a mechanical disturbing effect, thus trying another dwarf-seedling strengthening program. Phytoserum-treated groups produced higher fresh and dry leaf weight values than phytoserum-untreated groups. Groups that received both phytoserum and mechanical stimulation treatment had significantly higher dry leaf mass values than those that received phytoserum alone or mechanical stimulation alone. Plants that did not receive treatment produced statistically lower leaf weights. Phytoserum also has an outstanding effect in this series of measurements, as shown by the results of 2018.

In 2020, we performed synthesizer-repetitive measurements of cultivars treated in previous years, thus shading and confirming our results so far (Figure 4).

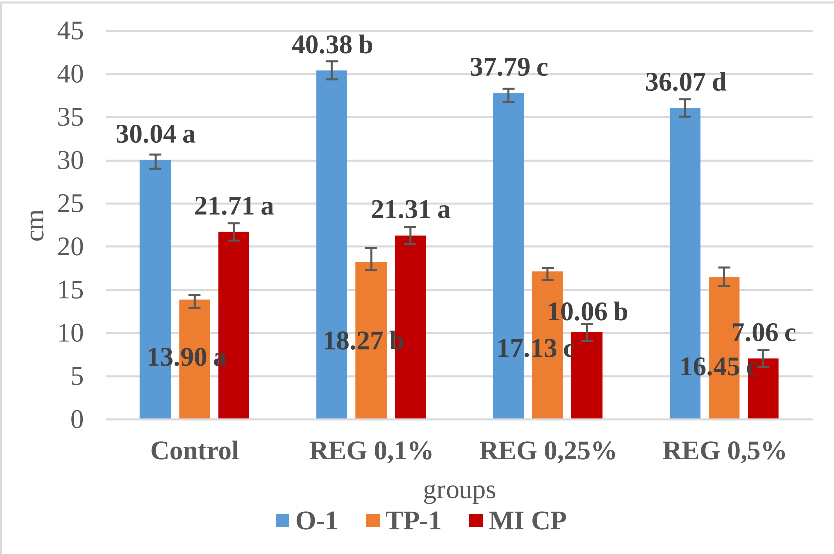


Figure 4: Effect of Regalis on plant height (Budapest, 2020) Legend: O-1: *Ocimum basilicum* L. 'Green sphere'; TP-1: *Tagetes patula* L. 'Csemő' MI CP: *Matthiola incana* (L.) R.Br. 'Cinderella Purple'; REG: Regalis

4. NEW SCIENTIFIC RESULTS

• I presented the effect and use of commercially available retardants in the cultivation of seedlings of annual ornamental plants.

• A *Matthiola incana* (L.) R.Br. 'Cinderella Purple' variety is suitable for dwarfing with retardants. Treatment of the variety with 0.25% Regalis is suitable for sale as an occasional potted plant, and Toprex and Cultar retardants can also be used effectively to dwarf the variety. I found that *Matthiola incana* (L.)

R.Br. ‘Cinderella Purple’ responds to the combined use of the retardants used with an additive effect.

• I was the first to measure thigmomorphogenesis and the combined effect of biostimulators. We have successfully applied the mechanical dwarfing method based on the theory of thigmomorfogenesis in the seedling cultivation of annual ornamental plants.

• Phytoserums as industrial by-products were first evaluated by *Matthiola incana* (L.) R.Br. 'Cinderella Purple', *Tagetes patula* L. 'Baby', Tagetes patula L. 'Orion', Ocimum basilicum L. 'Green sphere', *Ocimum basilicum* L. 'Bíborfelhő', *Ocimum basilicum* L. 'Green Rococo', Celosia argantea L. Castle. plumosa ‘Arrabona’, *Celosia argantea* L. *var. plumosa* ‘Bull Blood’ varieties. Eco-friendly phytosterum can be used as a biostimulator in the cultivation of these annual seedlings. The appropriate application concentration of phytoserum was between 1-2.5%.

5. CONCLUSIONS AND RECOMMENDATIONS

Evaluation of the morphological results of the effect of retardants

• Retardants have an effect on plant growth and development, an effect on the regulation of the growth of ornamental plants, as found by MILLER (2017). A *Matthiola incana* (L.) R.Br. The cultivar ‘Cinderella Purple’ is a suitable model plant for retardant testing and responds statistically significantly to treatments with retardants.

• Regalis, Toprex, and Cultar resulted in statistically significant differences compared to the control and other treated groups. Prohexadione calcium is a highly safe retardant for plants with higher growth vigor, and our results are consistent with those of LORDAN et al. (2019).

• Regalis was suitable for *Matthiola incana* (L.) R.Br. For use on ‘Cinderella Purple’ as it has resulted in reduced height, leaf length and increased leaf numbers. Related to this result is the result of BANON (2001) that plant size (in Nerium oleander L. individuals) decreases, but the plant itself will have a denser habitus with higher leaf counts as a result of the use of retardants.

• Regalis retardant *Matthiola incana* (L.) R.Br. For the use of ‘Cinderella Purple’, it is recommended to use concentrations of 0.25% and 0.5%, resulting in reduced size, increased number of leaves and no reduced diameter. These two concentrations are suitable for growing occasional potted ornamental plants. and KOCH et al. (2011) in the treatment of ornamental variants of *Helianthus annuus* L. also mention Regalis treatment at a concentration of 0.25% as a concentration that already has a more significant dwarfing effect.

• The combined effect of retardants does not cause adequate results, the average height of the treated individuals becomes extremely dwarfed, almost invaluable.

Evaluation of histological results of the effect of retardants

• In terms of cell size, the plants treated with Regalis showed the best results. All treated groups produced smaller cell sizes than those seen in the control group.

• Leaf thickness was increased in several cases by retardant use.

• The finding of WALLIS et al. (2020) is consistent with the finding in the research that prohexadione calcium increases chlorophyll content. It should be mentioned. that Caramba also had a stimulating effect on green body formation, as the chlorophyll content was higher in the Caramba-treated group than in the group treated with Toprex alone. Thus, gibberellin synthesis inhibitors may have an effect on chlorophyll content and cells, as was established by HALEVY et al. In 1966.

• During the application of Regalis, the size and shape of the trichomas changed: they became smaller, flatter and thus fit more tightly to the leaf surface. This finding correlates with the measurements of REEKIE et al. (2005) that prohexadione-calcium treatment in strawberries resulted in several morphological changes in the treated plants.

Physiological evaluation of the effect of retardants

• The combined use of retardants results in an additive effect on *Matthiola incana* (L.) R.Br. In the case of 'Cinderella Purple', which is not favorable, the results of the peroxidase enzyme activity measurement show that the plants do not initially show (1 hour measurement) symptoms of stress (compared to the control group), but do not disappear even 24 hours after treatment. stress effect.

• Peroxidase enzyme activity was increased by treatment with retardants, which is consistent with the finding of BEKHETA et al. (2009) that prohexadione calcium increases peroxidase enzyme activity.

• Ferbanat L treatment reduced peroxidase enzyme activity in the plant at all concentrations used, ie the effect of the treatments was reduced 24 hours after treatment.

Morphological results related to phytoserum and Ferbanat L biostimulators

• Overall, biostimulators had an effect on each of the treated varieties. The measured parameters became higher than the values of the control group.

• Ferbanat L treatment had a positive effect in all cases, which is related to the finding of DOMENICO (2019) and ZULFIGAR et al. (2019) regarding wormhumus, which is one of the main components of Ferbanat L. However, the combined effect of Ferbanat L and Cultar has a stronger retardant effect. The effect of Ferbanat L is clearly significant even with retardant use, perhaps there may be a synergistic effect between them, as examined by PAN and ZHAO (1994). From a commercial point of view, plants treated with Ferbanat L biostimulator are suitable.

• *Matthiola incana* (L.) R.Br. was not suitable when co-administered with Ferbanat L retardants. To increase the plant diameter of 'Cinderella Purple' cultivar, the effect of the retardant suppressed the effect of the biostimulator. *Matthiola incana* (L.) R.Br. In the 'Cinderella Purple' variety, the phytoserum was outstandingly effective in combination with a 0.25% solution of Regalis.

• A *Matthiola incana* (L.) R.Br. 'Cinderella Purple' cultivar responded adequately to phytosera treatment. The group treated with a 1% solution of phytosera achieved statistically significantly higher plant heights than the control group.

• The use of Ferbanat L in higher concentrations (0.2% -0.3%) shows more effective results against *Matthiola incana* (L.) R.Br. 'Cinderella Purple' variety in terms of leaf count parameter than lower concentrations.

• In the case of *Ocimum basilicum* L. 'Bíborfelhő', all applied concentrations of phytoserum were higher in the rootstock and produced leaf mass than in the control group.

Histological and physiological results related to Ferbanat L biostimulators

• It can be stated that the use of phytoserum together with the increase of the concentration had a thickening effect on the cell wall, the formation of secondary solidifying tissue elements is characteristic of both *Celosia argantea* L. *var. plumosa* 'Arrabona' and *Ocimum basilicum* L. 'Bíborfelhő'.

• Although it was found that treatments with the Ferbanat L biostimulator showed higher values in 1 case after 1 and 6 hours after treatment than in the control group, a decrease in POD enzyme levels was observed in each of the treated groups 24 hours after treatment, which suggests that the effect of Ferbanat L does not cause long-term and high stress effects in treated plants.

• Chlorophyll content increased in *Ocimum basilicum* L. 'Bíborfelhő' variety as a result of phytoserum. The 2.5% concentration significantly increased the chlorophyll content.

• Similar to *Ocimum basilicum* L. 'Bíborfelhő', lower concentrations resulted in higher values. Mechanical stimulation and phytoserum increase leaf mass and dry matter content (*Ocimum basilicum* L. 'Bíborfelhő' variety, *Celosia argantea* L. *var. plumosa* 'Arrabona' variety).

• Individuals of *Ocimum basilicum* L. 'Bíborfelhő' treated with phytoserum had a significant increase in leaf surface area compared to the control group.

Results on thygmomorphogenesis

• Mechanical stress increases leaf formation in all cultivars used. With mechanical disturbance, ornamental plants suitable for sale on the market can be grown, as described by JAFFE (1973), SCHNELLE et al. (1997) and BÖRNKE (2018).

• *Matthiola incana* (L.) R.Br. In 'Cinderella Purple', mechanical stimulation increases both leaf count and proportional leaf count. Complementing the treatment with a 1% solution of phytosera, it can also be seen that the number of leaves increased.

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