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Using pyrimidinecarboxylic acids as growth stimulants for *Rhododendron ledebourii* Pojark and *Rhododendron smirnowii* Trautv.

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Using pyrimidinecarboxylic acids as growth stimulants for *Rhododendron ledebourii* Pojark and *Rhododendron smirnowii* Trautv.

Abstract: Synthesised organic compounds of pyrimidinecarboxylic acids are characterised by high biological activity, even when their concentrations are low. These compounds, when applied to the seeds of *Rhododendron*, a genus of woody plants, with concentrations of 0.01, 0.05, and 0.1 %, stimulate the growth of the plants. The effect is more obvious 3 months after the start of the experiment, rather than 7 months after. Thus, *Rhododendron ledebourii* Pojark. seedlings grew by 13.3-33.5 %, and *Rhododendron smirnowii* Trautv. seedlings grew by 29.6-48.1 %. *Rhododendron ledebourii* and *Rhododendron smirnowii* seedlings demonstrated similar direct correlations: when the concentration of 2-benzylamino-4-methyl-pyrimidine-5-carboxylic acid and 4-methyl-2-morpholin-4-pyrimidine-5-carboxylic acid (for *Rhododendron ledebourii* seeds only) rose from 0.01 to 0.1 %, the height of the seedlings increased. It is suggested using 4-methyl-2-piperidin-1-yl-pyrimidine-5-carboxylic acid, 2-benzylamino-4-methyl-pyrimidine-5-carboxylic acid, and 4-methyl-2-morpholin-4-pyrimidine-5-carboxylic acid at concentrations of 0.01, 0.05, and 0.1 % as growth stimulants for the species of *Rhododendron* genus.

Key words: growth stimulants, synthesized organic compounds, pyrimidine carboxylic acids, *Rhododendron*

Uporaba pirimidin karboksilne kisline kot rastnega vzpodbujevalca za vrsti rododendrona, *Rhododendron ledebourii* Pojark in *Rhododendron smirnowii* Trautv.

Izvleček: Za sintetične organske spojine pirimidin karboksilnih kislin je značilna velika biološka aktivnost, tudi pri majhnih koncentracijah. Tretiranje semen rododendrona s temi spojinami v koncentracijah 0,01; 0,05 in 0,1 %, stimulira rast rastlin. Ta učinek je jasnejši 3 mesece po začetku poskusa kot po 7 mesecih. Sejanke vrste *Rhododendron ledebourii* Pojark. so rastle pri koncentracijah 13,3-33,5 %, sejanke vrste *Rhododendron smirnowii* Trautv. pa pri koncentracijah 29,6-48,1 % stimulanta. Sejanke obeh vrst so se na tretiranje odzvale podobno in sicer: kadar se je koncentracija 2-benzilamino-4-metil-pirimidin-5-karboksilne kisline in 4-metil-2-morfolin-4-pirimidin-5-karboksilne kisline (le za semena vrste *Rhododendron ledebourii*) dvignila iz 0,01 na 0,1 %, se je višina sejank povečala. Priporočamo uporabo 4-metil-2-piperidin-1-il-pirimidin-5-karboksilne kisline, 2-benzilamino-4-metil-pirimidin-5-karboksilne kisline in 4-metil-2-morfolin-4-pirimidin-5-karboksilne kisline v koncentracijah 0,01; 0,05 in 0,1 % kot rastne vzpodbujevalce za vrste iz rodu *Rhododendron*.

Ključne besede: rastni vzpodbujevalci, sintetične organske spojine, pirimidin karboksilne kisline, *Rhododendron*

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1 INTRODUCTION

Over the past few years, the cultivation of plants has been facing a number of challenges, including a dramatic increase in temperatures, lack of soil water, and the need for more resistant and hardy plants, which grow even under the harshest conditions. It is therefore vital to minimise the time required for the growth of planting material, which can be done using growth and germination stimulants, including synthesised chemical compounds Pentelkina, 2003; Vasin et al., 2008, 2009; Ostroshenko and Ostroshenko, 2011; Schuchka, 2006; Baranova, 2013a; Khodaei-Joghan et al., 2018; Nesterkina et al., 2019) and other original modes (Shibaeva et al., 2018).

It has been noted high biological activity of pyridines and pyrimidines. For example, 1, 4-dihydropyridines have received large attention because of their fundamental role in different biological processes (Goldmann and Stoltefuss, 1991; Litvinov, 1998; Balalaie et al., 2008). It has been reported about the wide biological activity of dihydropyridine derivatives (Ghoneim and Assy, 2015). But a promising area of the study, related to the growing need for the development of effective and safe drugs, is the synthesis of new heterocyclic systems, containing a pyrimidine fragment. Pyrimidine fragments and pyrimidine base are included in DNA. So pyrimidine derivatives show different biological activity. There is another mode for applying chemical compounds, containing pyrimidine fragments, for instance, as mutagens.

The composition of diethyleneimide-2-amidopyrimidyl phosphoric acid (phosphazine, phosphomid, syn. phosphemide - phospemidum) includes two ethylene imine groups connected to phosphorus and a pyrimidine base. Ethyleneimine causes mutations, the pyrimidine base is included in the chromosome during DNA synthesis, determining the specificity of the effect (Weisfeld, 2015). Laboratory seed germination and morphometric parameters of seedlings (length of roots and shoots, number of leaves) were studied after seed treatment with heterocyclic sulfur-containing compounds on the example of woody plants (Vostrikova et al., 2020) and agricultural crop (Vostrikova et al., 2021). As the composition of the phosphemide mutagen, pyrimidine-carboxylic acids contain a pyrimidine base. Sulfur (in the composition of alkylating compounds: diethyl- and dimethylsulfonate, ethylmethanesulfonate) enhances biological activity. It is known that mutagens in low concentration have stimulating effect for plant objects. A necessary working step is the determination of concentration ranges (Bome et al., 2017).

Over the last years, attempts have been made to synthesise new organic compounds, derivatives of pyrimidines (Dlugosz and Dus, 1996; Elkholy and Morsy, 2006; El-Gazzar et al., 2009; Marjani et al., 2011; Tkachenko et al., 2013, 2018; Azizian et al., 2014), which can be used as growth regulators. Such compounds should be more effective than the existing commercial formulations because of their different concentrations that may have either stimulating or inhibiting activity (Dlugosz and Dus, 1996; Gavrilov et al., 1988; Litvinov, 1998; Brown et al., 2004; Balalaie et al., 2008; Moiseeva et al., 2012a).

The effect of pyrimidine carboxylic acids on seed germination and plant height was studied using another annual flower – spreading marigold (*Tagetes patula* L.) (Vostrikova et al., 2012; Kalaev et al., 2013a). However, the effect of pyrimidinecarboxylic acids on the growth of other plants has not been studied yet.

Up to the present time, there have also been no studies considering the results of application of synthesised chemical compounds of pyrimidinecarboxylic acids to the seeds of woody plants, which grow much slower than annual plants. It is therefore of great importance to conduct a longitudinal study and measure the height of ornamental woody plants over long time intervals (eg. 3 and 7 months after the application of the growth regulator) in order to determine, whether the growth stimulating effect lasts or deteriorates over time.

Two ornamental woody plants, namely *Rhododendron ledebourii* Pojark. and *Rhododendron smirnowii* Trautv. were used. The long history of studying these species (Moiseeva et al., 2012b; Baranova, 2013b) at the B.M. Kozo-Polyansky Botanical Garden of Voronezh State University has demonstrated, that *Rhododendron ledebourii* is a winter-hardy, drought-resistant, and fruit-bearing shrub. *Rhododendron smirnowii* is also quite winter-hardy, though less drought-resistant. It also grows slower than *Rhododendron ledebourii* (Alexandrova, 2003; Vostrikova, 2011). It has been reported about the antioxidant activity in *Rhododendron* leaves, connections between this characteristic in maternal plant and the cytogenetic structures in the seedlings of the *Rhododendron* species (Vostrikova et al., 2022). Cytogenetic polymorphism of seed progeny of introduced plants has been studied on the example of *Rhododendron ledebourii* (Burmenko et al., 2018). It has been revealed the high seeds quality. So the representatives of the *Rhododendron* genus are valuable resource plant.

The aim of our research was to study the effect from pre-sowing seed treatment of the following woody plants: *Rhododendron ledebourii* and *Rhododendron smirnowii* by pyrimidine carboxylic acids.

2 MATERIALS AND METHODS

The research was conducted at the B.M. Kozo-Pol-

yansky Botanical Garden of Voronezh State University (geographic coordinates: 39°22' N, 51°40' E; 168.2 metres above sea level).

It has been focused on the effect of synthesised organic compounds of pyrimidinecarboxylic acids on the height of seedlings of *Rh. ledebourii,* and *Rh. smirnowii.* The following compounds were used: 4-methyl-2-piperidin-1-yl-pyrimidine-5-carboxylic acid, 2-benzylamino-4-methyl-pyrimidine-5-carboxylic acid, and 4-methyl-2-morpholin-4-pyrimidine-5-carboxylic acid synthesised at the Department of Organic Chemistry of Voronezh State University.

Prior to the sprouting process, the seeds of *Rh. ledebourii* and *Rh. smirnowii* were soaked in a water suspension of the above listed compounds with concentrations of 0.01 %, 0.05 %, and 0.1 % for 18 hours. The control group consisted of the same type of seeds soaked in tap water solution of a commonly used growth stimulator, Epibrassinolide (commercial fraction Epin Extra produced by NNPP NEST M, Russia), with the concentration of 0.05 % (in accordance with the instruction). In case of each of the studied concentrations of the acids, as well as the control group, the experiment was conducted three times using a set of 100 seeds. After soaking, the rhododendron seeds were placed in Petri dishes containing blotting paper, and germinated in the laboratory conditions at a constant temperature 22 °C. On the 21st day, the sprouts were planted in containers filled with high-moor peat and then kept in a greenhouse. The height of the seedlings of *Rhododendron ledebourii* was measured with a ruler, 3 and 7 months after the start of the experiment. Since *Rhododendron smirnowii* grows slower, the height of its seedlings was measured 7 months after the start of the experiment.

Sprouts are formed during the early stage of plant ontogenesis, which starts after the germination stage, i.e. when the seed coat develops, and finishes, when the first leaf of the hypocotyledonous stem (the shoot rising from the plumule) develops (Korovkin, 2007). After the first true leaves appear, young plants are considered seedlings (Korovkin, 2007).

The results were statistically processed using the STADIA software package. The procedures of data grouping and processing were described by A. P. Kulaichev (2006). The mean values were compared using Student's t-test. Coefficient of variation (Cv) was counted according to G. F. Lakin (1990). If Cv was below 10 %, it meant that the degree of variation was low, with Cv between 10 and 25 % it was medium, and when Cv was over 25 % - the degree of variation was high (Lakin, 1990). Average values of seedlings (plants) height were compared using Student's *t*-test. The seed germination in control and experimental variants were compared using Z-test for equality of frequencies. To estimate the influence of various concentrations of the chemical compounds on the height of the plants, one-way analysis of variance was used. The power of influence was calculated according to Snedecor (in %).

3 RESULTS AND DISCUSSION

The standard growth stimulant hasn't shown influence of the seed treatment on the height of *Rhododendron ledebourii* seedlings. It hasn't been revealed the significant difference between Control group and Epin group. That means special stimulant impact for sowing qualities in *Rhododendron* seeds or specific seeds reaction for the treatment. The seeds germination wasn't strongly increased (Table 1-3). But there were significant differences between control and experimental groups in this parameter (Table 1-3).

Suspensions of 2-benzylamino-4-methyl-pyrimidine-5-carboxylic acid at concentrations between 0.01 and 0.1 % proved to be more effective than other growth stimulators (Table 1). When suspensions of 4-methyl-2-morpholin-4-pyrimidine-5-carboxylic acid at concentrations of 0.05 and 0.1 % were used, the seedlings of *Rhododendron ledebourii* grew up to 55.6–116.7 % higher (Table 1).

Within 7 month after the start of the experiment all the studied compounds at any concentration proved to be effective for *Rhododendron ledebourii* (Table 2).

Within 7 month after the start of the experiment, the height of the *Rhododendron smirnowii* seedlings also increased (Table 5). The parameter "height of the seedlings" varied greatly for the control group of *Rhododendron ledebourii* 3 months after the start of the experiment. This is indicated by Cv = 44 %. For the experimental groups, Cv was medium (Table 1), which indicated that the reactions of individual seedlings to the compounds used were similar. 7 month after the start of the experiment, the degree of variation was medium in the control group, and even low in the experimental group. This might mean that older seedlings adapt better to experimental conditions. Changes of the seedlings growth are illustrated in Fig. 1-3.

For the seedlings of *Rhododendron smirnowii*, a medium coefficient of variation was observed (Table 3). Because of the slow growth and the small size, differences between experimental and control groups of *Rhododendron smirnowii* are not significant 3 month after the start of the experiment.

Table 1. The seedlings height of *Rhododendron ledebourii* seedlings 3 months after the seed were treated with the studied synthesized organic compounds

Concentration, %	Average height of the plants, cm	Min - max, cm	Cv, %	The seeds germination, %	Increase in the height of the plants, %
Control group	1.8 ± 0.2	1.0–3.0	44	72	–
Epin group	1.9 ± 0.1	1.5–2.5	15.8	75	–
4-methyl-2-piperidin-1-yl-pyrimidine-5-carboxylic acid					
0,01 %	3.3 ± 0.1***[3]	3.0–3.5	9.1	78*	83.3
0,05 %	2.8 ± 0.1**[2]	2.5–3.0	10.7	78*	55.6
0,1 %	2.2 ± 0.1[1]	2.0–2.5	13.6	79*	–
2-benzylamino-4-methyl-pyrimidine-5-carboxylic acid					
0,01 %	2.9 ± 0.2**[2]	2.5–3.0	12.5	78*	61.1
0,05 %	3.4 ± 0.2***[3]	3.0–3.5	13.5	80*	88.9
0,1 %	3.8 ± 0.2***[3]	3.5–4.0	11.9	82**	111.1
4-methyl-2-morpholin-4-pyrimidine-5-carboxylic acid					
0,01 %	2.3 ± 0.1[1]	2.0–2.5	13.0	74	–
0,05 %	2.8 ± 0.1**[2]	2.5–3.0	10.7	75	55.6
0,1 %	3.9 ± 0.2**[2]	3.0–4.5	15.4	78*	116.7

Designations:
Cv – variation coefficient
* – differences with the control group are significant ($p < 0.05$)
** – differences with the control group are significant ($p < 0.01$)
*** – differences with the control group are significant ($p < 0.001$)
[1] – differences with the Epin group are significant ($p < 0.05$)
[2] – differences with the Epin group are significant ($p < 0.01$)
[3] – differences with the Epin group are significant ($p < 0.01$)

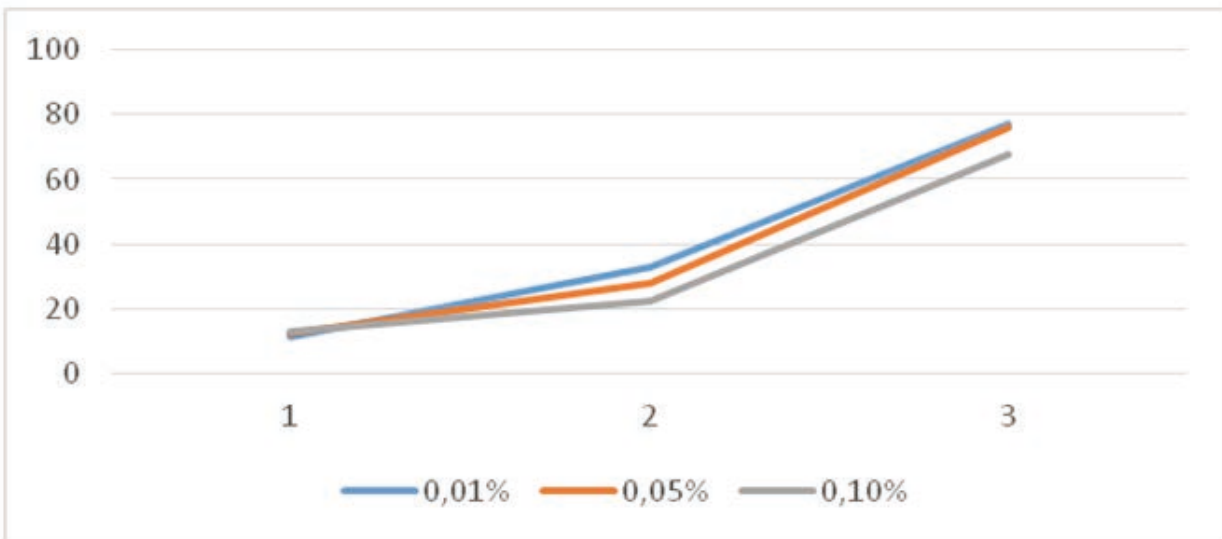

Fig. 1: The height of the seedling of *Rhododendron ledebourii* (in mm) seedlings after the seed were treated with 4-methyl-2-piperidin-1-yl-pyrimidine-5-carboxylic acid; 1 – seedlings (21 days), 2 – plants 3 months, 3 – plants 7 months

Table 2: The height of *Rh. ledebourii* seedlings 7 months after the seed were treated with the studied synthesized organic compounds

Concentration, %	Average height of the plants, cm	Min - max, cm	Cv, %	The seeds germination, %	Increase in the height of the plants, %
Control group	5.6 ± 0.2	4.5–6.5	11.5	72	–
Epin group	5.7 ± 0.2	5.0–6.5	9.3	75	–
4-methyl-2-piperidin-1-yl-pyrimidine-5-carboxylic acid					
0,01%	7.7 ± 0.2***[3]	7.0–8.5	7.6	78*	22.9
0,05%	7.6 ± 0.2***[3]	6.5–8.5	8.7	78*	27.5
0,1%	6.8 ± 0.2***[3]	6.0–7.5	7.9	79*	33.5
2-benzylamino-4-methyl-pyrimidine-5-carboxylic acid					
0,01%	7.2 ± 0.2***[3]	6.5–8.0	7.5	78*	22.9
0,05%	7.7 ± 0.2***[3]	7.0–8.5	7.5	80*	27.0
0,1%	8.4 ± 0.2***[3]	7.5–9.0	6.9	82**	17.8
4-methyl-2-morpholin-4-pyrimidine-5-carboxylic acid					
0,01%	6.4 ± 0.2*[1]	5.5–7.5	11.5	74	13.3
0,05%	6.5 ± 0.2**[2]	5.5–7.5	11.5	75	14.6
0,1%	6.9 ± 0.2***[3]	6.0–7.5	6.9	78*	19.0

Designations:
Cv – variation coefficient
* – differences with the control group are significant ($p < 0.05$)
** – differences with the control group are significant ($p < 0.01$)
*** – differences with the control group are significant ($p < 0.001$)
[1] – differences with the Epin group are significant ($p < 0.05$)
[2] – differences with the Epin group are significant ($p < 0.01$)
[3] – differences with the Epin group are significant ($p < 0.01$)

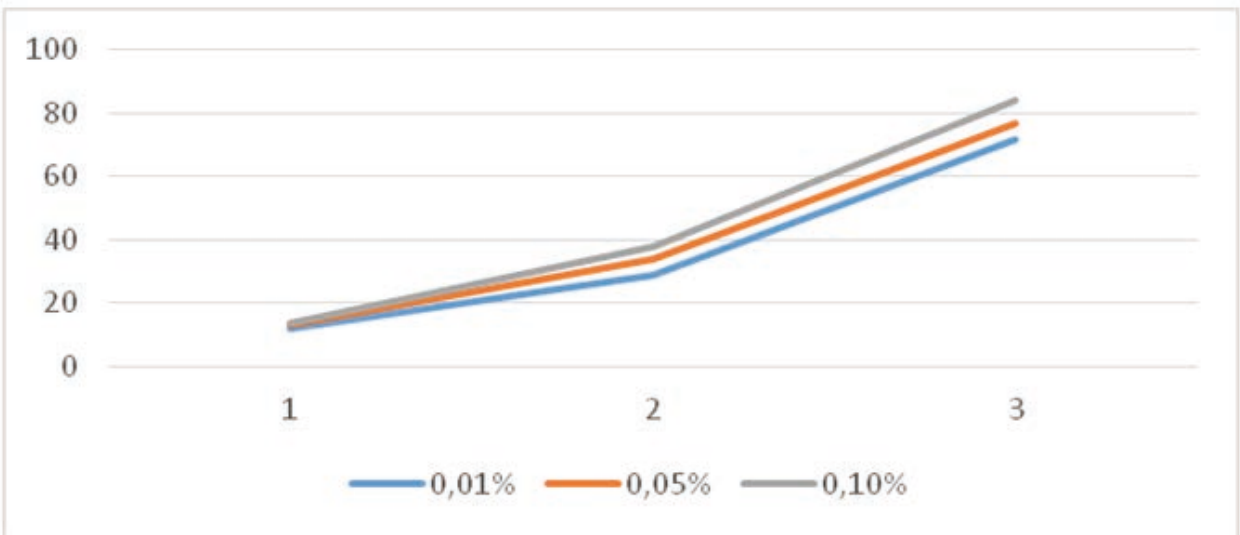

Fig. 2: The height of the seedling of *Rhododendron ledebourii* (in mm) seedlings after the seed were treated with 4-methyl-2-morpholin-4-pyrimidine-5-carboxylic acid, 1 – seedlings (21 days), 2 – plants 3 months, 3 – plants 7 months

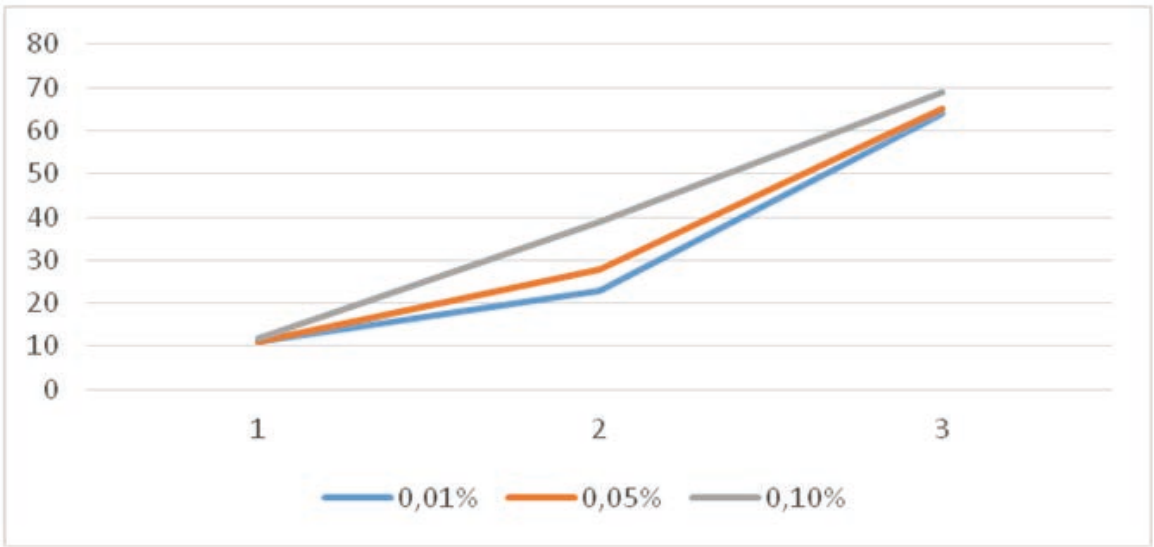

Fig. 3: The height of the seedling of *Rhododendron ledebourii* (in mm) seedlings after the seed were treated with 2-benzylamino-4-methyl-pyrimidine-5-carboxylic acid1, 1 – seedlings (21 days), 2 – plants 3 months, 3 – plants 7 months

Table 3: The height of *Rh. smirnowii* seedlings 7 months after the seed were treated with the studied synthesized organic compounds

Concentration, %	Average height of the plants, cm	Min - max, cm	Cv, %	The seeds germination, %	Increase in the height of the plants, %
Control group	1.4 ± 0.1	1.0–2.0	24.1	58	–
Epin group	1.4 ± 0.1	1.0–2.0	28.1	60	–
2-benzylamino-4-methyl-pyrimidine-5-carboxylic acid					
0,01 %	1.8 ± 0.1*[1]	1.5–2.0	14.7	64*	29.6
0,05 %	1.9 ± 0.1**[1]	1.5–2.0	12.7	68*	37.0
0,1 %	2.0 ± 0.1**[2]	1.5–2.5	20.4	72**	48.1

Designations:
Cv – variation coefficient
* – differences with the control group are significant ($p < 0.05$)
** – differences with the control group are significant ($p < 0.01$)
*** – differences with the control group are significant ($p < 0.001$)
[1] – differences with the Epin group are significant ($p < 0.05$)
[2] – differences with the Epin group are significant ($p < 0.01$)
[3] – differences with the Epin group are significant ($p < 0.01$)

The growth ratio of *Rhododendron ledebourii* seedlings (in the experimental group as compared to the control group) after the seeds were treated with organic compounds of pyrimidinecarboxylic acids, demonstrates that the stimulating effect is most obvious 3 month after the start of the experiment. However, some treatment do not effect growth (Table 1). 7 month after the start of the experiment, the stimulating effect deteriorates, but all the compounds at any concentration studied in this paper still have a positive effect (Table 2).

It was shown significant influence of the treatment of seeds with the synthesised organic compounds (as a factor) on the height of the *Rhododendron* seedlings. The power of influence of the treatment of seeds with the synthesised organic compounds on the height of the seedlings was evaluated using the one-way analysis of variance (Table 4-6).

4-methyl-2-piperidin-1-yl-pyrimidine-5-carboxylic acid, 2-benzylamino-4-methyl-pyrimidine-5-carboxylic acid, and 4-methyl-2-morpholin-4-pyrimidine-5-carboxylic acid with concentrations of 0.01, 0.05, and 0.1 % resulted in the increase in the height of

Table 4: The power of influence (in %) of the seed treatment on the height of *Rhododendron ledebourii* seedlings on the 3 month after the start of the experiment

Stimulator	as compared to the control group	as compared to the Epin group	as is
4-methyl-2-piperidin-1-yl-pyrimidine-5-carboxylic acid	5.0***	8.8***	8***
2-benzylamino-4-methyl-pyrimidine-5-carboxylic acid	7.4***	7.9***	8.3***
4-methyl-2-morpholin-4-pyrimidine-5-carboxylic acid	7.2***	8.9***	8.2***

Designations: *** - the influence of the factor is significant ($p < 0.001$)

Table 5: The power of influence (in %) of the seed treatment on the height of *Rhododendron ledebourii* seedlings on the 7 month after the start of the experiment

Stimulator	as compared to the control group	as compared to the Epin group	as is
4-methyl-2-piperidin-1-yl-pyrimidine-5-carboxylic acid	6.7***	7.5***	6.7***
2-benzylamino-4-methyl-pyrimidine-5-carboxylic acid	8.4***	8.9***	8.5***
4-methyl-2-morpholin-4-pyrimidine-5-carboxylic acid	4.9***	3.3**	5.6**

Designations: *** - the influence of the factor is significant ($p < 0.001$)
*** - the influence of the factor is significant ($p < 0.001$)

Table 6: The power of influence (in %) of the seed treatment on the height of *Rh. smirnowii* seedlings on the 7 month after the start of the experiment

Stimulator	as compared to the control group	as compared to the Epin group	as is
2-benzylamino-4-methyl-pyrimidine-5-carboxylic acid	4.3***	4.2***	6.2***

Designations: *** - the influence of the factor is significant ($p < 0.001$)

Rhododendron ledebourii seedlings. A direct correlation can be observed: the higher the concentration of 2-benzylamino-4-methyl-pyrimidine-5-carboxylic acid (within the range between 0.01 and 0.1 %), the higher the seedlings of *Rhododendron ledebourii* and *Rhododendron smirnowii* are. The same correlation is observed for *Rhododendron ledebourii* seedlings, when 4-methyl-2-morpholin-4-pyrimidine-5-carboxylic acid is applied. When *Rhododendron ledebourii* seeds were treated with 4-methyl-2-piperidin-1-yl-pyrimidine-5-carboxylic acid at the concentration between 0.01 and 0.1 %, a negative correlation was observed: the lower the concentration, the higher the seedlings.

We can thus say, that the studied synthesised organic compounds of pyrimidinecarboxylic acids are characterised by high biological activity and stimulate the growth of ornamental woody plants when their concentrations are low. The stimulating effect is most obvious 3 months after the seed treatment (the seedlings are 55.6–116.7 % higher than the seedlings in the control group). 7 month after the start of the experiment the stimulating effect starts deteriorating. Compounds of pyrimidinecarboxylic acids increase the height of *Rhododendron ledebourii* seedlings by 13.3-33.5 %, and the height of *Rhododendron smirnowii* seedlings by 29.6-48.1 %. Apparently, pyrimidinecarboxylic acids are more biologically active than other chemical substances, as their chemical structure is similar to the structure of a natural growth stimulator - indole acetic acid (heteroauxin). It can be assumed that auxin activity was kept better within 3 month, than during 7 month after the start of the experiment.

Earlier research studied the stimulating effect of 0.01–0.05 % 4-methyl-2-piperidin-1-yl-pyrimidine-5-carboxylic acid on the germination and growth of the seedlings of spreading marigold: with the concentration of 0.03-0.05 %, the height of the plants increased (differences with the control group are reliable, $p < 0.001$). However, other compounds of pyrimidine-5-carboxylic acids at the studied concentrations demonstrated stronger stimulating effects (Vostrikova et al., 2012; Kalaev et al., 2013 a).

Obtained results are consistent with earlier studies by R. G. Gafurov and co-workers on carbon N- and O-benzyl-containing compounds that have bright auxin activity, which is ensured by the presence of a benzyl group at the nitrogen or oxygen atom (Gafurov and Makhmu-

tova, 2003, 2005). These compounds contain effector fragments that together determine the stress protective activity, namely, the quaternary ammonium and benzyl groups and the hydroxyethyl group - an analog of the benzoxyethyl group (Budykina et al., 2005; Timeyko et al., 2005). Tested substance (2-benzylamino-4-methyl-pyrimidine-5-carboxylic acid) contains similar fragments, so it also shows bright auxin activity. Based on the literature data (Budykina et al., 2005; Timeyko et al., 2005) and the results of our research, it can be assumed that used compound has the stress-protective activity for valuable ornamental plants of *Rhododendron* species.

4 CONCLUSIONS

In this paper, it has been demonstrated that the effect of the same concentrations of synthesised organic compounds of pyrimidine carboxylic acids on the seedlings of woody plants after the pre-sowing seed treatment doesn't differ. *Rhododendron ledebourii* and *Rhododendron smirnowii* seedlings demonstrated similar direct correlations: when the concentration of 2-benzylamino-4-methyl-pyrimidine-5-carboxylic acid and 4-methyl-2-morpholin-4-pyrimidine-5-carboxylic acid (for *Rhododendron ledebourii* seeds only) rose from 0.01 to 0.1 %, the height of the seedlings increased. Therefore, 4-methyl-2-piperidin-1-yl-pyrimidine-5-carboxylic acid, 2-benzylamino-4-methyl-pyrimidine-5-carboxylic acid, and 4-methyl-2-morpholin-4-pyrimidine-5-carboxylic acid at concentrations of 0.01, 0.05, and 0.1 % can be used as growth stimulators for species of *Rhododendron* genus. 2-benzylamino-4-methyl-pyrimidine-5-carboxylic acid proved to be more effective at the initial development stages of *Rhododendron* seedlings. Within 3 month after the seeds of *Rhododendron ledebourii* were soaked in water suspensions of 2-benzylamino-4-methyl-pyrimidine-5-carboxylic acid at concentrations of 0.01-0.1 %, the height of the seedlings increased by 61.1-111.1 %. Thus, investigated pyrimidine carboxylic acids at concentrations of 0.01-0.1 % can be recommended as effective growth stimulants for *Rhododendron*.

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