THE INFLUENCE OF SUBSTRATE COMPOSITION ON THE DEVELOPMENT OF SEEDLINGS OF ANNUAL FLOWERS *CATHARANTHUS ROSEUS L.*

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ABSTRACT

The substrate of different composition, prepared on the basis of domestic raw materials and their impact on the development of seedlings of flower CatharanthusroseusL. were researched.

The selection of species was made according to the length of the vegetation (10-14 weeks) of seedlings as well as on the basis of their presence in the product assortment of producers in Serbia. The production of the initial seedling was carried out by means of speedling system in plastic containers, and further growing was resumed after transplanting in pots and on substrata made of Tutun peat, zeoplant and perlitof 7 different composition.

It has been determined that tested substrata, regarding their physical and agrochemical properties are favourable for growing seedlings of Catharanthusroseus.The development of obtained seedlings (plant height, above-ground mass, root shoot ratio) on the substrata comprising zeoplant, was better than the development achieved on ready-made-commercial substratum. The best development of plants-seedlings Catharanthusroseus `Pacifica`-red on the substratum 3, $T_{80}+P_{10}+Z_{10}$.

INTRODUCTION

In today's market, it is easy to find substrata which are prepared on the basis of various components of organic and mineral origin. According to Tunis and McDonald (1979) and Landis et al.,(1990) modern substrata which are mostly suitable for the container production of flower seedlings consist of of peat, sand, perlite and vermiculite. As the price of peat rises worldwide (Frolking et.al, 2001; Schilstra, 2001), the need for new alternative materials which will be used in the production becomes essential (Abad et.al, 2001; Guerin et.al, 2001; Garcia-Gomez et.al, 2002; Adalberto, et.al, 2006). The results obtained by several independent researchers (Boyer et.al, 2007; Samadi, 2011) underline the importance of finding alternative substrata for the production of flowers in glasshouse production. For countries such as Serbia one of the ways, according to Stevanović et. al (1994), Stevanović and Pavlović (1995), Vujošević (2012) may be the use of domestic resources. The research encompasses domestic resources of peat (organic component in substrata) and mineral raw materials of zeolite and perlite (mineral component in substrata) which Serbia has in abundance. Tutin peat was created by decomposition of moss, ferns and reeds partly in terms of the mountain climate at an altitude of 1150 m. How expires company engaged in its exploitation (Dallas, 2009), the Tutin peat is considered the highest quality organomineral fertilizer not only in Serbia but also in Europe and its exploitation can be done in the next 200 years.Zeolites as "the purest materials on Earth" belong to rock minerals which are composite aluminosilicate minerals. Their structure is crystal, three-dimensional, hard and as such much more stable than the structure of clay minerals. In their natural geochemical composition, zeolites have some biogenic elements which plants may use directly as nutrients. Therefore, zeolites perform the function of a nutritious substratum and conditioner. In the glasshouse production of seedlings, a particular kind of fertiliser – *Zeoplant* has a widespread use today; it is produced on the basis of natural zeolite and it is enriched with nutrients (nitrogen, phosphorus, potassium, calcium, and magnesium). The results of research have shown that the use of zeoplant in substrata for the production of tomatoes, in the amount of 15-25%, enhances the plant development (Glintić and Pavlović, 1994) and improves the quality of fruits (Damjanović et.al., 1994). In substrata for the production annual seedlings flower, results of research have shown that zeoplant improves the quality of seedlings, Vujosevic, 2012.

For mending the water and air capacity of substrata, the materials of mineral origin including perlite are used most frequently according to Gunther (1987). Perlite is produced in Serbia and as an indispensible component in substrata it is easily accessible and cheap. Considering the resources of organo-mineral raw materials which Serbia has in abundance and which can be used for the preparation of substrata, the aim of this research was to test the justifiability of their use for the preparation of substrata suitable for growing one of the most commonly grown kinds of annual flowers, long vegetation of seedlings, *Catharanthus roseus L.*

MATERIALS AND METODS

The research on the influence of substrate composition for the production of *Catharanthus roseus*L.-`*Pacifica*` *red*seedlings byusing domestic raw materials was done during 2010 in the glasshouse of the Faculty of Agriculture, University of Belgrade. We investigated substrata of different composition, prepared on the basis of domestic raw materials: Tutin peat (T), Perlite (P) and Zeoplant (Z). We tested the physical and agrochemical properties of substrata and monitored their impact on the development of seedlings of annual flowers *Catharanthus roseus L.*series `*Pacifica*` red PanAmerican seed as the most frequently grown kind of annual flowers. The production of the initial seedling was done according to the *seedling system* in plastic containers of the HP QP 144/4,5P type in the ready-made seeding substratum *Floragard B-fine*. After the transplantation to plastic TEKU pots (pot system) of the VVC 9cm series, with a volume of 0.32l, the plants were grown on substrata of different compositions according to the following variants: 1.Control- imported substratum (Floragard Medium Coarse), 2. Control-Tutin peat 100%, 3. Tutin peat 80% with 10% perlite and with 10% zeoplant, 4. Tutin peat 70% with 10% perlite and with 20% zeoplant, 5. Tutin peat 60% with 10% perlite and 30% zeoplant, 6. Tutin peat 70% with 20% perlite and with 10% zeoplant, 7 Tutin peat 60% with 20% perlite and 20% zeoplant.

Substrata were made based on the volume ratio of components. For each variant we tested, we took 50 plants of the initial seedling for transplantation, while the selection was made randomly. The following parameters of seedlings quality were analyze: plant`s high (cm), above-ground masses (g) and the calculated root/shoot ratio.

The laboratory tests of physical and agrochemical characteristics of substrata were performed before as well as after transplantation into pots. The tests were carried out in the Laboratories for Physics and Soil Agrochemistry at the Faculty of Agriculture, University of Belgrade. To determine the physical properties of tested substrata, we used internationally recognised methods which are also adopted by the YU societies (Bošnjak, 1997): *density (volume) weight* – by Kopecky's cylinders of 100 cm^3, and *prompt moisture* – by computation.

As regards the agrochemical properties, we analysed: *thereaction of substrata* – pH of substrata – using potentiometric method; *salt content (EC)* – by measuring electrical conductivity of water extract of substratum – conductometric method (Jakovljević et al.1985); *organic carbon and humus* – the Tyurin dichromate method, Simakov's modification (Mineen, 2001); *total nitrogen* – semi-micro Kjeldah method, Bremner's modification (Bremner, 1996); *accessible nitrogen* – the direct distillation method according to Bremner (Bremner, 1965); *accessible phosphorus and potassium* – Al method of Egner Riehm (1960); *the content of accessible Ca and Mg* – the extraction with 1M of ammonium acetate, AAS-Atomic Absorption Spectrophotometry (Pantović et al., 1989); *the content of accessible microelements Fe, Mn, Cu and Zn*, using the AAS method from the DTPA solution (Jakovljević 1985).

The experimental results were analyzed by means of descriptive and analitycal statistics with the statistical package STATISTICA. The results of research were reflected in descriptive statistics basic indicators (arithmetic mean, and its standard error, standard deviation, Mediana test, minimum and maximum values and variation ratio). With respect to the objective on the study, from the statistical point of view, was studied the hypothesis that there was no difference between average values of studied features. Since the samples are of the same size, the importance of difference in average values of the testing parameters was tested using the parameter model of the analysis of variance (ANOVA) and the least significant difference test

RESULTS AND DISSCUSION

All substrata we tested had good physical properties (Table 1). The volume weight of substrata indicate the suitability of using substrata for growing plants. It is always smaller than the specific mass value because of porosity. Certain values for volume weight in examined substrata ranged from 0.19 g/cm^3 (ready-made – commercial substratum) to 0.433 g/cm^3 in substratum 5 T_{60}+P_{10}+Z_{30} (Table 1). As regards certain values for the overall porosity which was high in all examined substrata and ranged from 77,63 % to 86,90 % (Table 1) examined substrata can be considered as loose. Substrata in which organic matter (peat) was a dominant component compared to the share of mineral components had the highest values for porosity.

Table 1

Physical properties of tested substrata

Substrata	Volume weight (g/cm)	Porosity (%)
1. Ready-made substratum	0.199	86.90
2.Peat (T) 100%	0.219	84.89
3. T_{80}+P_{10}+Z_{10}	0.361	79.01
4. T_{70}+P_{10}+Z_{20}	0.416	77.63
5. T_{60}+P_{10}+Z_{30}	0.433	79.47
6.T_{70}+P_{20}+Z_{10}	0.356	80.65
7.T_{60}+P_{20}+Z_{20}	0.33	82.72

As to examined substrata, the difference in terms of agrochemical characteristics was set, it reflected the development of seedlings *Catharanthus roseus L.-Pacifica red* (Table 2). Many researchers (Bailey et.al, 1995**,** Harbaugh, 1994, Compton and Nelson, 1996) indicate the importance of continuous monitoring and maintenance of the most relevant agrochemical properties of substrata in contemporary (container) production of seedlings: pH, the content of soluble salts (EC), the quantity of accessible elements.

At the beginning of the experiment, pH values of examined substrata were in the category from acidic to weakly acedic (Table 2). Due to the young plants' ability to affect the change in pH of substratum by increasing or decreasing it, certain pH value of substratum after the research showed that plant seedlings of *Catharanthus* have the ability to increase pH value, therefore setting the optimal value for growing it 5.01-7.19 (Table 2) which is in accordance with the research of Bailey et al. (1995).

Table 2

The main agrochemical properties of tested substrata at the start and at the end of research

Ordinal No of variant	Substrata	pH (H_2O)		Humus (%)		Total N (%)		C/N		EC_{25} (mS/cm)	
		before	after	before	after	before	after	before	after	before	after
1.	Ready-made substratum	5.13	6.35	68.47	68.96	0.798	9.366	49.7:1	4.3	1.479	0.132
2.	Peat (T) 100%	6.02	7.19	48.06	52.20	1.628	16.68	17.1:1	1.8	0.192	0.331
3.	$T_{80}+P_{10}+Z_{10}$	4.88	6.17	36.13	21.13	1.202	6.86	17.2:1	1.8	0.830	0.241
4.	$T_{70}+P_{10}+Z_{20}$	4.99	5.28	26.75	15.67	1.019	5.929	15.2:1	1.5	0.918	0.311
5.	$T_{60}+P_{10}+Z_{30}$	4.96	5.01	20.98	17.02	0.864	5.859	14.1:1	1.7	0.953	0.562
6.	$T_{70}+P_{20}+Z_{10}$	4.78	6.16	37.548	24.05	1.170	7.917	18.6:1	1.8	0.815	0.263
7.	$T_{60}+P_{20}+Z_{20}$	5.13	6.08	21.33	19.88	0.842	6.923	14.7:1	1.7	0.993	0.178

Even though the initial content of the total nitrogen in all examined substrata was high and ranged between 0.798 % and 1,628 % (Tab.2), its content increased at the end of vegetation which is in accordance with the results of Stevanovic and Pavlovic (1995) indicating low fertilising ability of peat in the first part of vegetation due to small mineralisation capacity and wider C/N ratio.

The content of humus in examined substrata decreased as the percentage of peat (Table 2) declined. The highest percentage of humus was found in the ready-made commercial substratum (68.47 %) and then in the examined substratum with 100 % peat (48.06 %). The lowest percentage of humus was determined in the examined substratum with the smallest share of peat, variant 5 and it was 20.98 %. Based on the C/N ratio in the examined substrata with Tutin peat, perlite, and zeoplant (from 14,1:1 to 18,6:1), examined substrata had a favourable C/N ratio with respect to mineralisation compared to the ready-made commercial substratum (49.7:1).

The content of soluble salts (EC) in all examined substrata from variant 2 to varaint 7 both before and after the research was within optimal limits, smaller than 1mS/cm (Table 2) which is in accordance with the recommendation of Harbaugh, (1994); Elfeky et.al, (2007). The initial content of soluble salts in the ready-made commercial substratum was the highest (1.479 mS/cm).

The differences in the content of easily accessible, macro and micro elements (Table 3 and Table 4) in examined substrata were determined. The most deficient substratum in terms of the content of easily accessible macro nutrients was pure peat followed by substrata which had mostly peat without the mineral component – zeoplant (Table 3). The naturally small content of easily accessible nutrients in peat and small fertilisation capacity, especially in the first part of vegetation, are indicated by Stevanović and Pavlović(1995) in their research. The content of easily accessible forms of nitrogen, phosphorus, and potassium in examined substrata increased with the application of zeoplant which is in accordance with the research results of Minato, (1988); Pavlović, (1997) who found that zeolite-zeoplant have a positive effect in substrata as regards nutrients. The initial content of easily accessible forms of nitrogen in examined substrata was smaller in those substrata in which there was use 10% of zeoplant (3 and 6) and higher in substrata with additional 30 volume percent of zeoplant (5) and it ranged between 1343.3 mg/kg and 3606.4 mg/kg (Table 3).

Upon the completion of vegetation, significantly smaller content of nitrogen was determined (Table 3), especially NH_4-N which shows that optimal conditions were created during the production process of seedlings, especially the temperature of substratum which agreed with its transformation to NO_3-N. Similarly, the initial C/N ratio in examined substrata (Table 2) favoured the mineralisation of nitrogen.

The content of easily accessible phosphorus and potassium was also the smallest in substrata without the prepared zeoplant (Table 3). The small content of these necessary macroelements was compensated for by the use of zeoplant. The highest content (765mg/kg P_2O_5 and 282mg/kg K_2O) was reached by using 20 % zeoplant (Table 3). Reaching the maximum content of easily accessible potassium by using the highest dose of zeoplant is in accordance with the data presented by Hanić, (1990) andPavlović, (1997) in which they underline the fact that peat is very scarce in this macronutrient and that the application of zeoplant leads to the increase of its content.

Table 3

The content of accessible macroelements in tested substrata at the start and at the end of research

Ordinal No of var.	Substrata	Accessible N mg/kg						Easily accessible (mg/100g)				Ratio cmol/kg	
		NH_4^+		NO_3^-		NH_4+NO_3		P_2O_5		K_2O		Ca/Mg	
		bef.	After	bef.	after	bef.	after	bef.	after	bef.	after	bef.	after
1.	Ready-made substratum	74.9	8.4	1554	2.8	1628.9	11.2	280	4.8	183	2.9	9.2:1	4.8
2.	Peat (T)100%	140	1.4	164.5	40.6	304.5	42	3.5	1.4	10	3.2	4.2:1	4.6
3.	$T_{80}+P_{10}+Z_{10}$	1177.4	28	165.9	70	1343.3	98	475	97	200	72	1.5:1	3.4
4.	$T_{70}+P_{10}+Z_{20}$	3095.4	60.2	101.5	149.8	3196.9	210	720	136	282	67	1.8:1	4.1
5.	$T_{60}+P_{10}+Z_{30}$	3392.9	130.2	213.5	211.4	3606.4	341.6	695	197	234	152	2.3:1	3.9
6.	$T_{70}+P_{20}+Z_{10}$	1947.4	46.2	413	82.6	2306.4	128.8	540	278	200	158	1.4:1	3.1
7.	$T_{60}+P_{20}+Z_{20}$	3112.9	32.2	315	56	3427.9	88.2	765	166	274	74	2.1:1	4.2

As regards the balanced nutrition, it is necessary to establish a good potassium (Ca^{2+}) to magnesium (Mg^{2+}) ratio in substrata. A well balanced ratio of these elements affects the acceptance of necessary microelements. Therefore, in examined substrata in which zeoplant accounted for 20 volume percent, an optimal ratio of these two tested indispensible macronutrients was established, 2:1 (Table 3).

Table 4

The content of accessible microelements in tested substrata (mg/kg) at the start and at the end of research

Ordinal No of variant	Substrata	Fe		Mn		Cu		Zn	
		before	after	before	after	before	after	before	after
1.	Ready-made substratum	15.69	7.04	7.96	3.92	1.20	0.90	3.30	12.75
2.	Peat (T) 100%	267.12	146.98	1.37	0.87	0.48	0.89	0.10	1.44
3.	$T_{80}+P_{10}+Z_{10}$	198.97	219.80	1.90	2.44	0.47	1.18	0.63	2.57
4.	$T_{70}+P_{10}+Z_{20}$	172.09	189.24	2.14	6.90	0.48	1.27	0.69	2.46
5.	$T_{60}+P_{10}+Z_{30}$	140.33	210.96	2.20	11.25	0.37	1.53	0.69	3.21
6.	$T_{70}+P_{20}+Z_{10}$	193.88	172.91	2.09	1.90	0.48	1.11	0.70	8.92
7.	$T_{60}+P_{20}+Z_{20}$	144.98	155.71	2.14	2.28	0.40	1.45	0.64	28.27

In the beginning, the smaller content of easily accessible microelements (manganese-Mn, zinc-Zn, and copper-Cu) in examined substrata was increased by applying zeoplant (Table 4). The content of accessible iron, which was dependent on the amount of organic matter as indicated by Stevanović (2000) decreased in examined substrata in which the share of organic component (peat) was smaller and mineral component (zeoplant) higher. As the percentage of mineral component was higher the content of accessible iron in examined substrata was smaller. Iron was mostly taken in from substrata in which Tutin peat accounted for 80-100 %. This speaks of not only greater demands of vinca for iron but also of favourable conditions for taking it in: favourable water and air properties of substrata, optimal pH, low content of phosphorus in substrata with predominantly organic matter. The use of zeoplant in the amount of 20 to 30 volume percent resulted in an increase in the accessible manganese and copper in examined substrata compared to the small content at the start but even though it was increased, its content remained at the level of low supply. The content of accessible zinc in examined substrata from the initial small values reached the values of mean supply (Table 4).

The results on the development of produced seedlings of *Catharanthus roseus*, seen through the: high plants,above-ground mass and calculated dry root mass to dry above-ground mass ratio (Table 5. and 6) indicate that it is justifiable to introduce domestic raw materials (T, P and Z) into the preparation of substrata for growing it. It can be noted that in all examined substrata (Table 5) without the added zeoplant (variants 2,) the seedlings of *Catharanthusroseus*had the most unfavourable: average high plant (9,84 cm), average above ground mass (3,484g) and ratio in the development of root and above-ground mass (Table 6), 1:3,5. Using the smallest tested dose of zeoplant (10%) the plants of produced seedlings had the most favourable average high (23,287 cm) and average above-ground mass (12,588g).

Table 5

Basic statistical indicators for the analysed parameters of *Catharantus roseus-`Pacifica` red* seedlings quality using varios on substrata differente composition

Pparameters	Ordinal No of variant	Variant	Arithmetic mean	Медијана	Standard deviation	standard error	min	mah	Coeff var. (%)
Hihg plant (cm)	**1.**	Ready-made substratum	23,120	23,350	2,865	0,523	17,100	**28,100**	12,390
	2.	Peat (T)100%	9,840	10,000	1,209	0,221	6,600	11,600	12,284
	3.	**$T_{80}+P_{10}+Z_{10}$**	23,103	23,600	2,521	0,460	15,800	27,300	10,914
	4	**$T_{70}+P_{10}+Z_{20}$**	20,427	20,500	3,533	0,645	12,300	26,900	17,294
	5	**$T_{60}+P_{10}+Z_{30}$**	19,113	19,250	2,300	0,420	15,400	24,200	12,036
	6	**$T_{70}+P_{20}+Z_{10}$**	**23,287**	23,850	2,912	0,532	16,800	27,900	12,505
	7.	**$T_{60}+P_{20}+Z_{20}$**	22,740	23,150	2,605	0,476	16,400	27,400	11,455
Above groud mass (g)	**1**	Ready-made substratum	**13,302**	13,185	1,634	0,298	10,110	16,630	12,283
	2	Peat (T)100%	3,484	3,370	0,647	0,118	2,240	5,160	18,556
	3	**$T_{80}+P_{10}+Z_{10}$**	12,588	12,960	2,174	0,397	7,830	18,140	17,271
	4	**$T_{70}+P_{10}+Z_{20}$**	9,712	9,670	2,383	0,435	4,650	14,490	24,537
	5	**$T_{60}+P_{10}+Z_{30}$**	9,776	9,980	1,880	0,343	4,300	13,040	19,227
	6	**$T_{70}+P_{20}+Z_{10}$**	11,874	11,930	2,777	0,507	4,460	16,000	23,383
	7	**$T_{60}+P_{20}+Z_{20}$**	10,344	10,025	1,670	0,305	7,150	15,050	16,140
Root/shoot ratio	**1**	Ready-made substratum	1:7,6						
	2	Peat (T)100%	1:3,5						
	3	**$T_{80}+P_{10}+Z_{10}$**	1:8,7						
	4	**$T_{70}+P_{10}+Z_{20}$**	1:7,4						
	5	**$T_{60}+P_{10}+Z_{30}$**	1:6,9						
	6	**$T_{70}+P_{20}+Z_{10}$**	1:7,8						
	7	**$T_{60}+P_{20}+Z_{20}$**	1:8,4						

In all examined substrata with improved as physical characteristics by using the perlite in tested dose 10 % and 20%, and nutritious composition by using zeoplant in the amount of 10 and 20 % (variants 3, 4, 6, and 7) the achieved ratio ranged from 1:7,4 to 1:8,7 (Table 5). Similarly, the results indicate that the use of zeoplant in substrata of 10 or 20 % exerted influence on the ratio in the development of root and above-ground mass which almost became equal to the ratio which was achieved when plants were grown on the standardised, ready-made commercial substratum, 1:7.6 (variant 1). The results is in accordance with the data presented by Vujosevic et.al, (2013) on the development of produced seedlings of marigold*seen through the calculated dry root mass to dry above-ground mass ratio. The widest ratio examined 1:8,7 was achieved in* variant 3 (T_{80}+P_{10}+Z_{10}), and the narrowest in variant 2 (T_{100}) 1:3.6.

The results of Levene's test (Table 6) indicates that the heterogeneous sample variance for the tested parameters. Since the analyzed samples of the same size, the significance of differences of average values has been tested by applying the parameter model analysis of variance (ANOVA). According to the results of this test (Table 6) using the variants were obtained by a group of plants that are statistically significant differences in average test parameters (height, above-ground mass, root / shoot ratio).

Table 6

Results of*Levene's variance homogenity test and ANOVA for the* using varios on substrata differente composition on *Chatharanthus roseus - `Pacifica` red* seedlings

Analysed parameters	Levene test		ANOVA	
	F	p	F	p
High plant(cm)	2,500	0,003**	124,893	0,001**
Above ground mass masa (g)	3,153	0,000**	94,263	0,000**
Root/shoot ratio	2,225	0,000**	4,373	0,000**

p≤ 0,05(*) the difference is significant
p≤0,01(**)the difference is highly significant

The comparison of differences of average values of seedlongs quality two treatments for all tested parameter of development of seedlings was carried out by means of the LSD test (Table 7). The results of this test showed that growing seedlings *Catharanthus roseus `Pacifica` red* on substrates in which the proportion of organic component ranges from 60-80% and mineral perlit and zeoplant of 10-20% have a significantly favorable effect on the general development of plant seedlings. The Increased of zeoplant of 30% significantly reducing height plants and above ground mass.

Table 7

The levels of significance among plant parameters of *Catharanthus roseus*"*Pacifica"-red*seedlings on the basis of the LSD test

Analysed parameters	Tretmans	2. Peat $(T)_{100}$	3. T_{80}+ P_{10}+Z_{10}	4. T_{70}+ P_{10}+Z_{20}	5. T_{60}+ P_{10}+Z_{30}	6. T_{70}+ P_{20}+Z_{10}	7. T_{60}+ P_{20}+Z_{20}
Plants hihg cm	1. Ready-made substratum . $\overline{x}$ =23,120	0,000	0,980	0,000	0,000	0,801	0,566
	2. Peat $(T)_{100}$		0,000	0,000	0,000	0,000	0,000
	3. T_{80}+P_{10}+Z_{10}			0,000	0,000	0,782	0,583
	4. T_{70}+P_{10}+Z_{20}				0,048	0,000	0,001

	5. $T_{60}+P_{10}+Z_{30}$					0,000	0,000
	6. $T_{70}+P_{20}+Z_{10}$						0,409
	7. $T_{60}+P_{20}+Z_{20}$						
Above ground mass (g)	**1. Ready-made substratum. $\overline{x}$ =13,302**	0,000	0,001	0,003	0,016	0,937	0,000
	2. Peat(T)$_{100\%}$		0,000	0,000	0,000	0,000	0,000
	3. $T_{80}+P_{10}+Z_{10}$			0,674	0,325	0,001	0,000
	4. $T_{70}+P_{10}+Z_{20}$				0,572	0,002	0,000
	5. $T_{60}+P_{10}+Z_{30}$					0,013	0,000
	6. $T_{70}+P_{20}+Z_{10}$						
	7. $T_{60}+P_{20}+Z_{20}$						
Root/shoot ratios	**1. Ready-made substratum. $\overline{x}$ =1:7,6**	0,000	0,002	0,000	0,001	0,001	0,000
	2. Peat (T)$_{100\%}$		0,181	0,911	0,237	0,318	0,904
	3. $T_{80}+P_{10}+Z_{10}$			0,220	0,876	0,733	0,145
	4. $T_{70}+P_{10}+Z_{20}$				0,284	0,376	0,817
	5. $T_{60}+P_{10}+Z_{30}$					0,852	0,192
	6. $T_{70}+P_{20}+Z_{10}$						0,264
	6. $T_{70}+P_{20}+Z_{10}$						
	7. $T_{60}+P_{20}+Z_{20}$						

CONCLUSION

Based on the results of researches on the influence of substrata composition on the development of *Chataranthus roseus* seedlings the following conclusions can be made:

Examined substrata prepared on the basis of domestic raw materials (Tutin peat, zeoplant and perlite) with their physical and agrochemical properties were suitable for growing *Chataranthus roseus –`Pacifica` red* seedlings.

The overall porosity of tested substrata as the most important physical property of substrata ranged from 77.63 % to 86.90 % and it indicated that we are dealing with loose substrata.

A certain pH value of examined substrata, from 4.78 - 6.02 was suitable for growing *Chataranthusroseus –`Pacifica` red* seedlings.

The content of water-soluble salts in all examined substrata variants on the basis of domestic raw materials was optimal, smaller than 1mS/cm.

The most favourable calcium to magnesium ratio was achieved in all examined substrata in which the share of zeoplant was 20 % (T_{70}+P_{10}+$Z_{20,}$ T_{60}+P_{20}+Z_{20}).

The content of accessible nutrients in examined substrata was increased with the use of zeoplant. The highest content of accessible nitrogen, phosphorus and potassium was determined in substrata in which the share of zeoplant was 20 %.

As regards accessible microelements, initially small content of manganese, zinc and copper was increased with the use of zeoplant in the amount of 20-30 %. The amount of accessible iron in substrata decreased as the share of zeoplant increased to 20-30 % at the expense of reducing the organic component (Tutin peat).

Examined substrata had a positive effect on the growth of seedlings *Catharanthus roseus-"Pacifica"red.*

- The highest average height of plants seedlings *Catharanthus* roseus *"Pacifica"- red* (23,28cm) is achieved on the substrate 6, T_{70}+P_{20}+Z_{10}.It was similar like average height of plants were grown on the standardised, ready-made commercial substratum (23,120 cm).
- Highest average above-ground mass by plants-seedlings *Catharanthus roseus "Pacifica" - red* on the finished-commercial substrate and the substrate 3, T_{80}+P_{10}+Z_{10} (13,3g and 12,588g).
- The best development of *Catharanthus* seedlings on the basis of the calculated root/shoot ratio was recorded on substrata in which the organic component (Tutin peat) varied from 70-80 %, the share of perlite ranged from 10-20 %, and the share of zeoplant from 10-20 %.

Versions substrate 3,(T_{80} +P_{10}+$Z_{10)}$ and 6,(T_{70} + P_{20} + $Z_{10)}$ are prepared on the basis of domestic raw materials and their relationship is exactly balanced according to the requirements of seedlings *Catharanthus roseus "Pacifica" -red*.

Using substrata of these compositions for growing *Catharanthus roseus-"Pacifica" red* makes the substitution of the imported substratum possible. The use of these substrata produces the seedlings of good quality. The price of substratum and therefore the price of the final product is lower.

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