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LAUROCERASUS OFFICINALIS ROEM. SEEDLINGS AND THEIR RESPONSE TO COMPOSITION AND PROPERTIES OF SUBSTRATES BEING CULTIVATED IN CONTAINERS

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Introduction

Introduction of Strange ornamental cultivars improve productivity of green plantations, parks ornamentality, optimize their species composition and increase biological diversity. *Laurocerasus officinalis* Roem. is a perspective exotic cultivar which possesses such properties as fast growth, drought- and frost-resistance.

Moreoften to get planting stock in an open soil is to come across bad quality plants, irrational planning of nursery area, damaged root-system while digging up, large labour resources for digging up plants with soil, difficult transportation. Cultivation of seedlings with closed root system is one of reliable methods to get high-quality planting stock of ornamental arboreal-shrub plants, what favors their intensive growth. According to common standards of growing planting stock in containers it`s recommended to use a lot of various substrates for either cultivars of arboreal ornamental plants, but detailed soil and agrochemical characteristics of composition and properties of both substrates and their components are absent in scientific literature, biometrical parameters of *Laurocerasus officinalis* Roem. seedlings are not presented as well [3, 5, 7-10, 16-18, 20-21]. That`s why it was extremely important to carry out soil-biological investigations of *Laurocerasus officinalis* Roem. growth being cultivated in different substrates.

Study objective is to determine optimal substrate for cultivation of high-quality planting stock of *Laurocerasus officinalis* Roem. in containers. Among study tasks there were researching the granulometric, structural, chemical, physical and chemical properties, and agrochemical parameters.

Objects and research methods

The investigations took place at experimental farm “Primorskoye” NBG-NSC (urban village Partenit, the city of Alushta). Research objects were 6 substrate variants intended for *Laurocerasus officinalis* Roem. cultivation in containers. Traditionally used in EF “Primorskoye” substrate was chosen as control variant (variant 1).

Standardized methods were applied to study substrates and plants [11, 14]. Granulometric (patterns were treated by sodium pyrophosphate before analysis) and microaggregate composition of substrates and their components were determined by method of N.A. Kachynsky [12], structural composition – by method of N.I. Savvinov [6]. Humus was analyzed by Tyurin`s method [19], ammonia nitrogen – by phenol method, nitrate nitrogen – by method of ion-selective electrodes [2], mobile phosphorus and exchangeable potassium – by Michigin method in modification CINAO [2], slightly soluble salts in aqueous extract – by method of Arinushkina [4], calcium carbonates – by Golubev acidimetric method [15], pH of aqueous suspensions – potentiometricaly, base saturation – by Pfeffer [1]. Plant condition was assessed according to their biometric parameters and ornamentality.

Results and discussion

The most intensive way of *Laurocerasus officinalis* Roem. growth was fixed for variants 4 and 5, which were composed of 2 fertile ingredients and bank sand. Let`s analyze properties of these variants and control.

Substrate, commonly used in work of EF "Primorskoye" (control), was characterized by loamy sandy-silt granulometric composition. This composition mainly consisted of large and small dust fractions, silt fractions made 29%. Substrates of 4 and 5 variants were characterized by light granulometric composition – middling loamy sandy-silt. These substrates contained 66% of sandy-large-middling silt fractions and 33% of silt and powdery dust; 39% of physical dust while substrate of control included 50% of it (table 1). It was found out that alternative substrates are either lighter by granulometric composition than control variant is, or more favorable for root system.

Structural condition of substrates is one of the most considerable parameters of their fertility. Size and correlation of aggregates are of great importance in creation of optimal water-air and nutrient soil regimes. Structure of study substrates was assessed according to percentage of aggregates there ranged from 0,25 up to 10 mm [13]. In control variant content of such aggregates made 72 %, while coefficient of structural properties of variants 4 and 5, calculated according to correlation of aggregates content (10-0,25 mm) and amount of dust and blocky partings, made 2,5 and 2,2 relatively. Therefore, study substrates were characterized by perfect aggregate properties.

All substrates contained calcium carbonate, which caused alkalescent and alkaline reaction of aqueous suspension. In control substrate with beach sand concentration of $CaCO_3$ was high and reached 21%, while in substrates 4 and 5 with bank sand there were only 7-9% of carbonates (table 2). In both cases chlorosis symptoms were not revealed.

Table 2

Chemical and physical-chemical composition of substrates

Variant	Humus, %	$CaCO_3$, %	$pH_{aqueous}$
Variant 1 (control)	2,05	21,46	7,60
Variant 4	4,50	9,45	7,32
Variant 5	2,98	7,25	7,15

According to analysis of aqueous extract substrates of control and 4 variants were not saline (Table 3). Substrate of variant 5 had a slight sulfate salinization (content of slightly soluble salts made 0,36%) , though calcium sulfate (gypsum) harmless for plants prevailed in salt composition.

Table 1

Granulometric fine earth composition of substrates components

Pattern	Content of fractions (mm), %						Amount of fractions (mm), %		
	1-0,25	0,25-0,05	0,05-0,01	0,01-0,005	0,005-0,001	<0,001	<0,01	>0,05	0,01-0,001
Variant 1 (control	18,2	12,36	19,04	3,5	17,81	29,09	50,4	30,56	21,31
Variant 4	19,4	26,61	15,68	5,2	11,19	21,92	38,31	46,01	16,39
Variant 5	20,77	25,51	13,98	5,95	12,06	21,72	39,73	46,29	18,01

Table 3

Cationic-anionic structure of substrates aqueous extract

Pattern	Amount of salts, %	CO_3		HCO_3		CL		SO_4		Ca		Mg+		Na+
		ME*	%	ME*	%	ME*	%	ME*	%	ME*	%	ME*	%	ME*
Variant 1 (control)	0,115	0	0	0,29	0,017	0,46	0,016	2,48	0,019	2,29	0,046	0,46	0,006	0,48
Variant 4	0,289	0	0	0,58	0,035	33	0,012	3,43	0,165	2,5	0,05	1,41	0,017	0,43
Varinat 5	0,35	0	0	0,46	0,028	0,17	0,006	4,58	0,22	4,45	0,089	0,46	0,006	0,3

Table 4

Composition of substrates absorbed bases

Pattern	Exchangeable cations, % of total				Absorbed bases, mg/eq/100 g of sample	Exchangeable cations, % of total			
	Ca	Mg+	Na+	K+		Ca	Mg+	Na+	K+
Variant 1 (control)	14,2	2,9	0,12	0,59	17,81	79,7	16,3	0,7	3,3
Variant 4	12,8	1,6	0,08	0,37	14,85	86,2	10,8	0,5	2,5
Variant 5	23,6	2,8	0,1	0,48	26,98	87,4	10,4	0,4	1,8

*ME – mg/equivalent/ 100 g of soil

The most dangerous for plants salts are sodium carbonate (soda) and chlorides. Sodium and magnesium sulphates have toxical effect on plants being in large concentrations, but not so dangerous as sodium and magnesium bicarbonates. In study substrates the most toxic for plants salt, soda, wasn`t found out, while concentration of harmful for ornamental arboreal-bushy plants chlorides, bicarbonates and sulphates Na+ and Mg+ didn`t exceed the permitted limits even under conditions of subhumid.

Amount of absorbed bases in substrate of control variant made 18, while variants 4 and 5 made 15 and 27 mg/eq/100 of a sample relatively (table 4). Calcium concentration in composition of absorbed bases in study substrates exceeded magnesium content. Concentration of absorbed Ca^{2+} of control variant made 80%, Mg^{2+} - 16%, Na^{2+} - 0,7%, K+ - 3,3% of total base amount. In substrates of 4 and 5 variants absorbed Ca^{2+} made 86 and 87%, Mg^{2+} - 11% for both, Na^{+} - 0,5 and 0,4%, K^{+} - 2,5 and 1,8% of exchangeable cations amount, relatively. This content of absorbed magnesium and sodium didn`t cause alkalinity of substrates or damage the plant growth.

Mobile forms of the principal nutrient substances and their content in period from May to September 2013 were determined in the study substrates for *Laurocerasus officinalis* seedlings of 2010, 2011 and 2012 planting years (fig.).

Control variant of substrate presented 0,93 mg/kg of nitrate nitrogen in the beginning of vegetation. Substrates of 4 and 5 variants contained 2,86 and 2,06 mg/kg relatively. In the middle of vegetation concentration of nitrate nitrogen in control variant increased up to 3,28 mg/kg, and till 6,79 and 7,47 mg/kg in substrates 4 and 5 relatively. Such a phenomenon during period of intensive plant growth is explained by optimal hydrothermal conditions for ray fungus, oligonitrophils and other micro organisms. By the end of vegetation concentration of nitrate nitrogen in study substrates went down. Variations of nitrate nitrogen content through the vegetative period in substrates of control variant had minimal parameters. In September NO_3 reached 0,91 mg/kg in control variant, while in variants 4 and 5 it made 4,80 and 5,21 mg/kg relatively.

Dynamics of ammonium nitrogen content in substrates is similar to nitrate nitrogen. In the beginning of vegetative period ammonium nitrogen concentration made 6,67 in control variant but in July it increased up to 12,75 mg/kg. By the end of vegetation it decreased till 11,36 mg/kg. In May variants of substrates 4 and 5 had minimal content of ammonium nitrogen in comparison with the middle or end of vegetation – 6,67 and 9,64 mg/kg relatively. In July concentration of this component increased up to 18,78 mg/kg (variant 4) and 22,84 mg/kg (variant 5). By the end of vegetation nitrogen content reduced till 17,71 and 21,65 mg/kg in variants 4 and 5 relatively. As to NH_4^{+} substrate of the 4^{th} variant had much less than variant 5, but more than control variant. According to the leaf apparatus, plants didn`t suffer from the lack of nitrate or ammonium nitrogen, at the same time registered concentration of nitrogen indicates that it`s quite sufficiently for *Laurocerasus officinalis* cultivation in containers.

Seasonal dynamics of mobile phosphorus in substrates developed in another way in comparison with nitrogen. Maximum content of mobile phosphorus was fixed in May further its concentration gradually went down as *Laurocerasus officinalis* absorbed intensively. In the end of vegetation period substrates trended to increasing of mobile phosphorus as process of growth and development went down. In the beginning of vegetation period in substrate of the control variant concentration of mobile phosphorus made 4,66 mg/kg, but in July it increased up to 9,80 mg/kg. By the end of vegetation mobile phosphorus reduced till 6,57 mg/kg. In substrate of variant 4 maximum concentration of mobile phosphorus was fixed in May – 51,16 mg/kg, but in July it decreased till 46,23 mg/kg, what was also explained by plant intensive consumption. By the end of vegetation phosphorus went up again and reached 50,21 mg/kg. In the beginning of vegetation mobile phosphorus was registered at 63,64 mg/kg in

substrate of variant 5, in July – 59,51, in the end of vegetation – 56,20 mg/kg. On average through the whole period of vegetation the highest concentration of mobile phosphorus was fixed in variant 5, which was 8,5 times more than in control variant. Visual diagnostics of leaves proved phosphorus was sufficient for plant growth and such a nutrient regime was favorable to cultivate *Laurocerasus officinalis* in containers.

Mobile potassium in substrate of control variant made 36,48 mg/kg in the beginning of vegetation, variants 4 and 5 – 43,58 and 49,17 mg/kgrespectively. In July having favorable hydrothermal conditions concentration of potassium in all study substrates increased: control – 43,32, variant 4 – 56,38, variant 5 – 102,79 mg/kg. By the end of vegetation mobile potassium resources went down till 38,15 mg/kg in control variant, 52,14 and 89,50 mg/kg in variants 4 and 5 relatively.

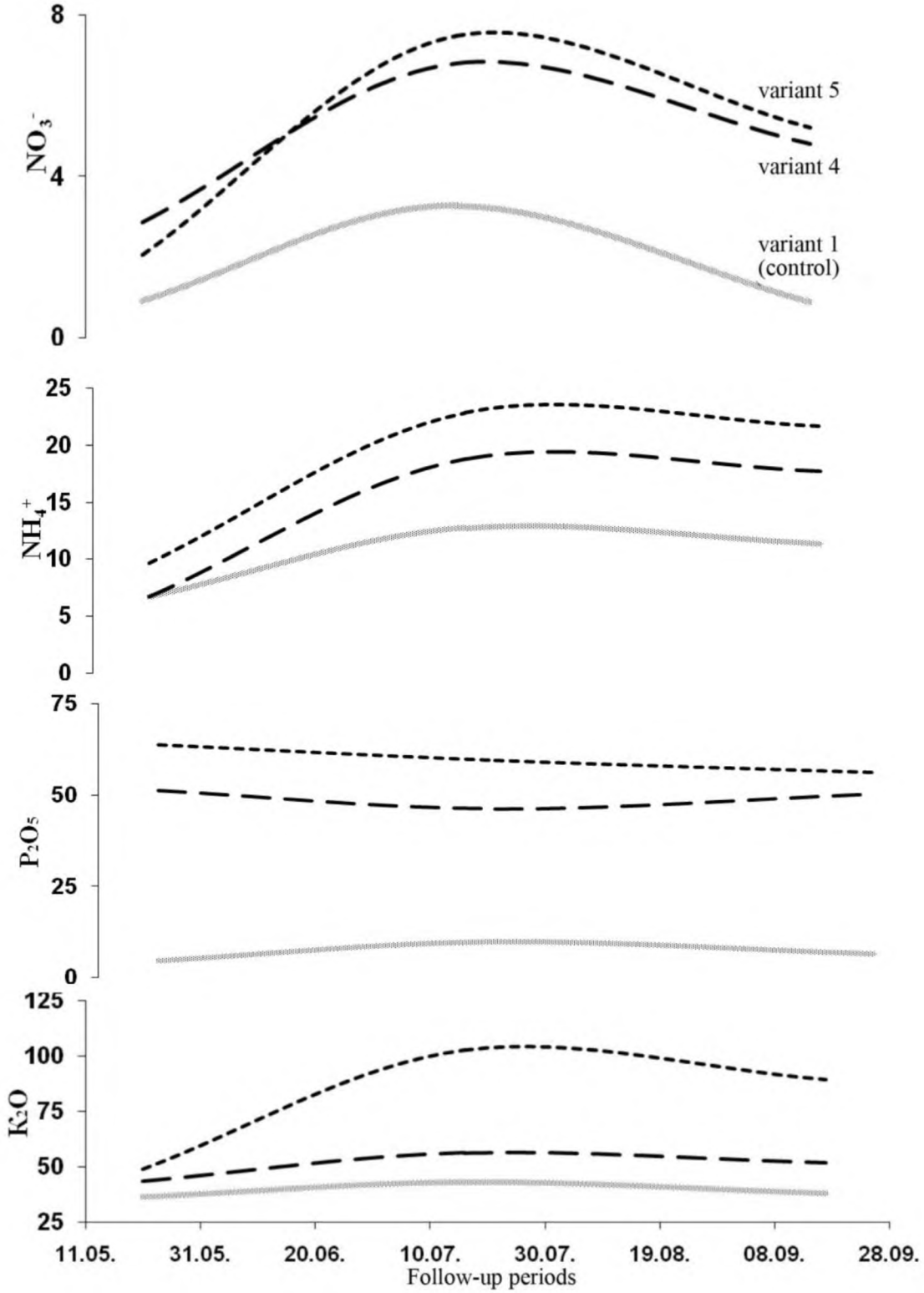

Fig. Dynamics of N, P and K mobile forms (mg/kg) in study substrates for *Laurocerasus officinalis* Roem. (2013)

Variant 5 the most favorable substrate by mobile potassium content for *Laurocerasus officinalis* cultivation was marked out. Therefore allowing for potassium nutrition substrate variants 4 and 5 occurred the best for *Laurocerasus officinalis* cultivation in containers.

During 2013 seedlings of *Laurocerasus officinalis* cultivated in containers responded to fertility of substrates in different ways. Low vital condition of plants, their ornamentality, small amount of growth were fixed in control variant of substrate. The best variant which consists of 2 fertile ingredients and sand (variant 5) annual growth made 75,42±1,26 sm what is 244 times more than in control one. Plants of 2011 and 2012 in the best variant of substrate exceeded control variant 100 and 115 times.

Maximum branching were registered for plants of 2010 in variant 5 – 37,21±1,13, while for plants of 2011 and 2012 it made – 28,35±1,89 and 22,16±2,02 relatively. Diameter of plant crown (plantation of 2010) made 28,12±2,62 in control variant, 41,14±14 and 45,99±2,59 sm – variants 4 and 5 relatively. Plants of 2011 and 2012 had maximum diameter of crown being cultivated in substrate of 5 variant – 37,28±1,77 and 30,28±1,01 sm relatively. Such a biometrical parameter as stem diameter was maximum for variant 4 (plantation of 2010) – 2,21±0,74 sm, plantation of 2011 and 2012 – 1,77±1,12 and 1,31±3,03 relatively. The optimal ratio of biometrical parameters was fixed for plants in substrate of variant 5.

Parameters *of Laurocerasus officinalis* biomass were the most suitable to compare qualitative characteristics of its seedlings. Maximum weight of the root part was registered for variants 4 and 5 – 69 and 78 g relatively, minimum – 38 g – control variant. Ratio between underground and overground components of the plant substance made 1:3 for variants 4 and 5, while control one presented 1:4. The highest resource of overground phytomass was fixed for variants 4 and 5 – 194 and 229 g relatively. In comparison with control pattern, variant 5 exceeded this parameter 1,5 times.

Integrated study of substrates composition, properties and *Laurocerasus officinalis* response to their fertility level permitted to propose optimal ratio of substrate ingredients for cultivation of standard seedlings with close root system.

Conclusions

1. Studied substrates are characterized by favorable for plant cultivation middling loamy and granulometric composition with optimal ratio of sandy, dusty and silty fractions.
2. Substrates have a good structure and there were no considerable differences between them according to this parameter.
3. Substrates were not slated by readily soluble salts, alkalinity wasn`t registered.
4. The most favorable nutrient regime by nitrate and ammonium nitrogen, mobile phosphorus and potassium consisted of 2 fertile ingredients and sand – variants 4 and 5.
5. Substrates of patterns 4 and 5 presented a high degree of fertility, where *Laurocerasus officinalis* revealed a good level of ornamentality, best parameters of growth and more powerful root system.

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It terms of this research the following was investigated: granulometric, structural-aggregate and chemical composition, physicochemical properties, agrochemical parameters and nutrient regime of (N, P, K) substrates, assessment of their fertility and adaptability for cultivation of *Laurocerasus officinalis* Roem. in containers.