A SUBSTRATE BASED ON GRAPE MARC COMPOST USED IN SOME ORNAMENTALS CULTURE

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The exploit of grape marc compost (an organic compound resulted from the wine production), into the ornamentals containerized culture – *Tamarix tetrandra*, *Chamaecyparis pisifera* Boulevard, *Chamaecyparis lawsoniana* Stardust, *Ligustrum ovalifolium* imposed the study of variation in soil of soluble, mobile and exchangeable forms of P, K, Ca, Mg, Na, available elements for containerized plants.
The studies concerned a substrate composed from forestry compost, leaves compost, peat and grape marc compost – 1:1:1:0.5. This was percolated on columns with distilled water and Coïc nutritive solution in order to establish the cation exchange, retention and release of ions that occur after irrigation or fertilization with nutritive solutions of containerized plants.
The pH, total content of salts, soluble forms of nutrients – phosphates, nitrates, ammonium, calcium, magnesium, potassium and sodium were analyzed in the substrate before and after percolation. The exchangeable forms of nutrients were determined using the Gäbriels and Verdonck method, in $AcNH_4$ 0.5M, pH=4.65, 1:3 v/v ratio.

Key words: Substrate; Marc compost; Nutritive elements availability; Ornamentals culture.

INTRODUCTION

In the fight against pollution, the main concern of civilized societies is to exploit the vegetal and urban waste by recycling it in agriculture. Having a high content of organic matter, these materials can be valuable components for substrates designated for ornamentals production[1].

The researches make efforts to find new substrates to recycle vegetal and urban waste and to replace the peat, a natural soil difficult to acquire. Composting organic waste and transforming it into substrates for ornamentals culture, it imposes the study of their physical-chemical characteristics, the results on plants growth and development.

Our researches were focused on the use of grape marc compost (an organic compound resulted from the wine production) together with other components (forestry compost, leaves compost, peat) as cultural substrates with favourable physico-chemical properties for ornamentals growth and development.

MATERIALS AND METHODS

1. Selection of components for substrate

Organic components selected for substrates were: forestry compost, leaves compost, peat and grape marc compost (an organic compound resulted from the wine production) in – 1:1:1:0.5 ratio.

Agrochemical characterization of components and substrates considered: pH, soluble salts content, soluble forms of: nitrogen as nitrate and ammonium, phosphorus, potassium, calcium, magnesium, exchangeable forms of: potassium, calcium, magnesium and total forms of: nitrogen, phosphorus, potassium[2] (Table1).

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Table 1

Agrochemical analysis of components and substrate used for ornamentals culture

Variant	pH	Soluble salts [%]	N-NH_4^+ [ppm]	N-NO_3^- [ppm]	PO_4^{3-} [ppm]	K^+ [ppm]
Forestry compost (FC)	5.69	0.800	95.25	455.50	280.5	970
Leaves compost (LC)	8.11	0.515	31.75	283.00	6.0	280
Peat (P)	6.36	0.321	8.00	348.00	5.6	290
Grape marc compost (GC)	8.34	0.256	64.50	15.00	452.0	1275
Mixture 1:1:1:0.5	6.80	0.463	20.25	300.50	43.9	1105

The mixture (substrate) presented a slightly acid pH and a high content in salts (0.463 %). Also, the values indicated a very high content in soluble nitrogen (20.25 ppm + 300.50 ppm) and potassium (1105 ppm) and a high content of phosphorus (43.9 ppm) for the substrate.

2. Biological material used for the experiments

Considering the results of analysis made on substrate, we selected the following species:

- Broadleaf species: *Tamarix tetrandra, Ligustrum ovalifolium* „Aureum"
- Conifers species: *Chamaecyparis pisifera* "Boulevard", *Chamaecyparis lawsoniana* "Stardust"

For each species we use 20 plants which were planted in 5L containers and maintained according with the specific technologies.

3. Ions retention and leaching in the substrate

The laboratory module represented by substrate columns percolation tried to establish the cations exchange, retention or leaching[3], following the plants watering or fertilization with nutritive solutions (acidic Coïc solution), due to the pH adjustment, by alkalinization of substrate induced by grape marc compost[4,5].

The cations exchanges that occur in the substrate were studied by percolation on glass columns of 3 cm in diameter and 25cm height which were filled with 20 cm of substrate.

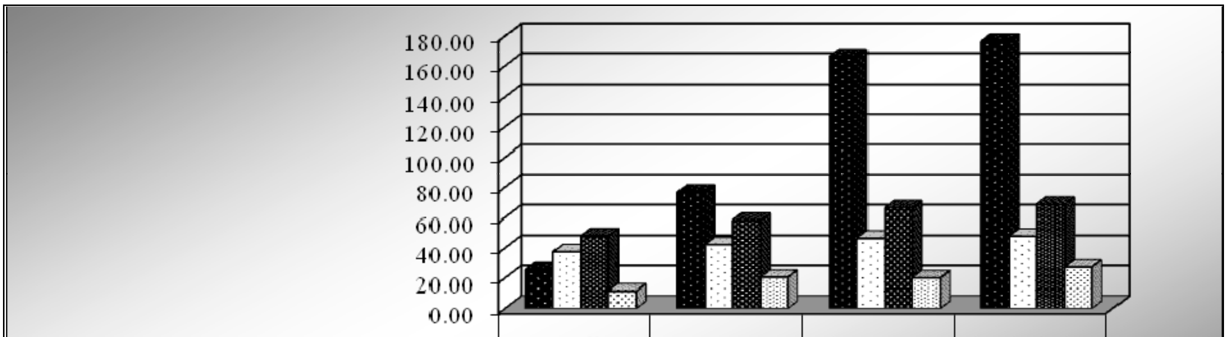
The substrate was first saturated with distilled water and then a percolation solution (water and Coïc solution) – 1:10 ratio, was percolated on the top of the column. The percolated solution was collected, the volume was measured and the percolation velocity was determined.

The pH, soluble salts, phosphates, nitrates, ammonium, calcium, magnesium, potassium and sodium in the resulted percolate were analyzed.

After the percolation of the two solutions, the substrate was studied – pH, soluble salts, soluble forms in water (1:10 ratio) of phosphate, nitrates, ammonium, calcium, magnesium, potassium and sodium (Table 3). Also, the exchangeable forms of phosphorus, calcium, magnesium, potassium and sodium were determinate (Table 4) in ammonium acetate $AcNH_4$, pH 4.65, ratio 1:3 (Gäbriels and Verdonck).

RESULTS AND DISCUSSIONS

The behaviour of species growing on the proposed substrate was studied by measurements during vegetation period[6] (Fig. 1).



	April	June	August	October
Tamarix tetrandra	25.40	76.60	166.10	176.40
Chamaecyparis pisifera Boulevard	37.40	42.10	46.30	47.75
Chamaecyparis lawsoniana Stardust	47.80	58.10	66.20	68.60
Ligustrum ovalifolium	11.35	20.40	19.95	27.14

Fig. 1. Height of plants growing on the substrate during vegetation period (2007).

* In June after the second measurements the plants were pruned at 10 cm in order to stimulate the branching.

It can be observed from Figure 1 the species different reaction to the substrate. For *Tamarix tetrandra* an intense growing of plants was recorded on June and August, with 51.20 cm and, respectively, 89.50 cm. Comparing the two species of *Chamaecyparis* we observed that *Chamaecyparis lawsoniana* used better the nutrients supplied by the substrate. Data showed the lowest growth for *Ligustrum ovalifolim*. The values of August were below June because of the pruning applied to the plants for branching in June (Table 2).

After percolation, due to the different disposability of nutrients, the pH value of the substrate was higher, especially in the case of distilled water. This was a consequence of a high content in cations coming from the organic component – grape marc compost that increases the substrate pH. The process was attenuate in the case of percolation with Coïc acidic nutritive solution.

The mobile forms of phosphorus and exchangeable of K, Ca, Mg, Na were extracted with $AcNH_4$ 0.5 M at pH = 4.65 from the substrate used to produce different ornamentals. Comparing these with soluble forms, we found superior quantities of these ions as a result of a much more powerful extraction. The substrate was percolated then with water and Coïc nutritive solution (rich in nutrients) and analyzed. The elements in the substrate were higher after percolation with water than Coïc solution (Table 5).

Coïc solution, having a balanced content of ions, determined a much more rapid equilibrium between ions into the substrate and nutritive solution; thus, the ions were present in high quantities into the percolate comparing with the water.

160.45% of mobile P was dislocated by percolation with water but just 3.74% was found in percolate. As regarding the percolation with Coïc solution, from the 106.33% of mobile P dislocated, we found 8.50% in percolate.

The percolation with water, in the case of exchangeable K, dislocated 88.75% from it, a percent of 11.25% remaining undislocated, 13.75% was found in percolate and only 75% exchangeable K in substrate. After percolation with Coic solution, the percolate contained 30.62% exchangeable K and the substrate, 55.62%.

For exchangeable Ca, the total dislocated quantities were small not only after water percolation but also Coic solution (21.34%, respectively 10.89%); 78.65% of calcium remained undislocated in the case of water and 89.10% of Coic solution. In percolate we found 0.19% Ca (water percolation) and 1.04% (Coic solution percolation).

The presence of organic compounds into the components of substrate explains the powerful retention of calcium in the substrate (Table 6).

Table 2

Growth enhancement during vegetation

Species	**April–June**	**June–August**	**August–October**
Tamarix tetrandra	51.2	89.5	10.35
Chamaecyparis pisifera Boulevard	4.70	4.20	1.45
Chamaecyparis lawsoniana Stardust	10.30	8.10	2.40
Ligustrum ovalifolium	9.05	10.45	7.19*)

* The difference is lower because the were pruned in June at 10 cm in order to stimulate the branching

Table 3

The analysis of soluble forms in water (1:10) after substrate percolation with distilled water and Coïc solution

Variant	pH	Soluble salts %	$P\text{-}PO_4^{3-}$ ppm	$N\text{-}NO_3^-$ ppm	$N\text{-}NH_4^+$ ppm	Ca^{2+} ppm	Mg^{2+} ppm	K^+ ppm	Na^+ ppm
Distilled water									
Substrate 1:1:1:0.5	7.67	0.0579	62.0	5.5	16	193.86	38.59	378	37
Coïc solution									
Substrate 1:1:1:0.5	7.30	0.0620	360	95.5	trace	234.67	35.17	340	19

Table 4

Nutrients and exchangeable cations balance into the substrate

Variant	P, ppm				
	Mobil into the initial substrate	Mobil into the substrate after percolation with dist. H_2O	In water percolate	Mobil into the substrate after percolation with Coïc solution	In Coïc percolate
Substrate 1:1:1:0.5	255.25	400.00	9.56	249.70	21.72
Variant	K, ppm				
	Exchangeable into the initial substrate	Exchangeable into the substrate after percolation with dist. H_2O	In water percolate	Exchangeable into the substrate after percolation with Coïc solution	In Coïc percolate
Substrate 1:1:1:0.5	800	600	110	445	245
Variant	Ca, ppm				
	Exchangeable into the initial substrate	Exchangeable into the substrate after percolation with dist. H_2O	In water percolate	Exchangeable into the substrate after percolation with Coïc solution	In Coïc percolate
Substrate 1:1:1:0.5	7142	1510	14.28	704	74.48
Variant	Mg, ppm				
	Exchangeable into the initial substrate	Exchangeable into the substrate after percolation with dist. H_2O	In water percolate	Exchangeable into the substrate after percolation with Coïc solution	In Coïc percolate
Substrate 1:1:1:0.5	308.72	599.15	4.05	294.54	30.91
Variant	Na, ppm				
	Exchangeable into the initial substrate	Exchangeable into the substrate after percolation with dist. H_2O	In water percolate	Exchangeable into the substrate after percolation with Coïc solution	In Coïc percolate
Substrate 1:1:1:0.5	46.50	20.00	8.30	10.25	9.80

Table 5

Mobile P and exchangeable K, Ca, Mg, Na (%) dislocated, undislocated and found into the percolate after percolation with distilled water

Variant	P (%)			
	Total mobile dislocated	Mobile undislocated	Mobile in the substrate after percolation	Found into percolate
Substrate 1:1:1:0.5	160.45	–	156.70	3.74
Variant	K (%)			
	Total exchangeable dislocated	Exchangeable undislocated	Exchangeable in the substrate after percolation	Found into percolate
Substrate 1:1:1:0.5	88.75	11.25	75.00	13.75
Variant	Ca (%)			
	Total exchangeable dislocate	Exchangeable undislocated	Exchangeable in the substrate after percolation	Found into percolate
Substrate 1:1:1:0.5	21.34	78.65	21.14	0.19
Variant	Mg (%)			
	Total exchangeable dislocate	Exchangeable undislocated	Exchangeable in the substrate after percolation	Found into percolate
Substrate 1:1:1:0.5	195.38	–	194.00	1.31
Variant	Na (%)			
	Total exchangeable dislocate	Exchangeable undislocated	Exchangeable in the substrate after percolation	Found into percolate
Substrate 1:1:1:0.5	60.86	39.14	43.01	17.84

Table 6

Mobile P and exchangeable K, Ca, Mg, Na (%) dislocated, undislocated and found into the percolate after percolation with Coïc solution

Variant	P (%)			
	Total mobile dislocated	Mobile undislocated	Mobile in the substrate after percolation	Found into percolate
Substrate 1:1:1:0.5	106.33	–	97.82	8.50
Variant	K (%)			
	Total exchangeable dislocated	Exchangeable undislocated	Exchangeable in the substrate after percolation	Found into percolate
Substrate 1:1:1:0.5	86.25	13.75	55.62	30.62
Variant	Ca (%)			
	Total exchangeable dislocated	Exchangeable undislocated	Exchangeable in the substrate after percolation	Found into percolate
Substrate 1:1:1:0.5	10.89	89.10	9.85	1.04
Variant	Mg (%)			
	Total exchangeable dislocated	Exchangeable undislocated	Exchangeable in the substrate after percolation	Found into percolate
Substrate 1:1:1:0.5	105.41	–	95.40	10.01
Variant	Na (%)			
	Total exchangeable dislocated	Exchangeable undislocated	Exchangeable in the substrate after percolation	Found into percolate
Substrate 1:1:1:0.5	43.11	56.89	22.04	21.07

Exchangeable Mg was strong dislocated in both cases: 195.38% with water and 105.415 with Coïc solution. 1.31% Mg was found into the water percolate and, respectively, 10.01% into Coïc solution percolation. The substrate had a higher content of Mg (194%) after water percolation then Coïc solution (95.40%).

The exchangeable Na was in lower quantities comparing with the other cations. The dislocated and undislocated quantities of Na (with the two solutions) from the substrate are presented in the following: after water percolation, 60.86% exchangeable Na was dislocated, 39.14% remained undislocated and 17.84% was found in percolate; after Coïc solution, 41.11% was dislocated, 56.89% remained undislocated and 21.07% was found in percolate.

CONCLUSIONS

1. The comparative study of adaptability of species on the proposed substrate indicated the best response of *Tamarix* plants, with the highest growth rate and the biggest height at the end of vegetation period (176.4 cm).
2. *Chamaecyparis* Stardust had used better the nutrients than *Chamaecyparis* Boulevard.
3. In case of studied ions, the retention and leaching is different.
4. The substrate reacted different in the case of water percolation; the percent of nutrients dislocated was higher.
5. In case of Coïc solution percolation, with high content of ions (P, K, Mg and Na), we found high quantities of ions in percolate. An exception was calcium, which was better retained by organic component of the substrate; 78.65% of this ion was undislocated by water percolation and 89.10% by Coïc solution.

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