THE MACRONUTRIENTS QUANTITY RELEASE FROM BIODEGRADABLE POTS USED IN VEGETABLE TRANSPLANT

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The nutritive elements retention and migration processes on soils can be find describes in many speciality books, but not for culture substrate used especially in horticulture. The cations exchangeable (K^+, Ca^{2+}, Mg^{2+}, Na^+) regularity process in substrates is the research obiective in explaining the rules process[1–3]. On the active substrate it is necessary to known the quantity of H^+ ions (pH), the cations adsorption as the sum of the exchangeable base (S_B) and the base saturation rate (V%).

The research follows to devise some biodegradable pots novel receipts used in producing salad nursery transplant by evaluating the main substrate agrochemical indicators with effect on macronutrients N, P, K substrate availability, respectively the plant accessibility before the moment of planting.

Agrochemical analysis of the exchangeable forms indicate, at the experimental end period, in most variants of the lettuce nursery transplant, sufficient nutritive resources in substrate, except the control variant, unplanted, where is the lowest level of nutrients. That fact can be explained by the missing effect of rooting zone, responsible with an important contribution of the nutritive exchangeable availability in strong bonded elements.

Key words: Substrate; Nutritive elements availability; Biodegradable pots; Lettuce transplant.

INTRODUCTION

The knowing impact of the agriculture source plastic material pollution on the environmental determined in producing the nursery transplant to search modern solution in obtaining some novel material support, biodegradable, eventually recyclable from other activities and no polluted for soil and plants with main purpose to replace the plastic materials supports[4].

MATERIALS AND METHODS

In the vegetable growing greenhouse department from USAMV Bucharest was set an monofactorial experiment, the factor – type of receipt – had four graduations (T, T2, K, T2) as result of two kind of peat (T – Poiana Stampei Peat from Romania; K – Kekkila Brown Fibrosso Peat from Finland) with or without supplementary applied fertilizers used in receipt in which lettuce nursery were transplanted. The control variant was unplanted. The experiment variants are present in Table 1.

The biological material used in experiment was the lettuce nursery transplant (*Lactuca sativa, var. capitata*, Mona variety).

The pots made by the Ceprohart Brăila.was used for the experiment The pots were filled with Kekkila BP peat (Table 2), characterized by an high content of mineral nitrogen ($N\text{-}NO_3^-$ + $N\text{-}NH_4^+$) and phosphorous and optimum content in potassium and an pH at the inferior limits of the optimum interval, the ratio of N: P: K is 1: 0.6: 0.7. The content in total forms (%) of the N (2.17%), P (0.271%), K (0.18%) can be considered as normal.

During the vegetation period was applied agrotehnical methods specifically in vegetable transplant nursery.

The substrate from each variant was agrochemical investigated and was determinate the influence of the nutritive receipt in the macronutrients (N, P, K) release, the pH and exchangeable sum base $S_B = \Sigma$ (Na, K, Ca, Mg), me/100g substrate variation[5,6].

Soluble forms determination extractable in distilled water in ratio 1:10 m/v (1:1,5 v/v) and exchangeable forms extractable in $AcNH_4$ 0.5m pH=4.65, in ratio of 1:3 v/v (Gäbriels and Verdonck methods) was in conformity with CEN (European Committee for Standardization).

Table 1

Experimental variants

No.	Variant	Description
1	Tmt	Control pot, unplanted, receipt T (70% peat T + 30% carton residual)
2	Ts	Planted pot with lettuce nursery transplant, receipt T (70% peat T + 30% carton residual)
3	T2	Control pot, unplanted, receipt T2 (70% peat T + 30% carton residual + chemical fertilizer)
4	T2s	Planted pot with lettuce nursery transplant, receipt T2 (70% peat T +30% carton residual + chemical fertilizers)
5	Kmt	Control pot, unplanted, receipt K (70% peat K + 30% carton residual)
6	Ks	Planted pot with lettuce nursery transplant , receipt K (70% peat K + 30% carton residual)
7	K2	Control pot, unplanted, receipt K2 (70% peat K + 30% carton residual + chemical fertilizers)
8	K2s	Control pot, unplanted, receipt K2 (70% peat K + 30% carton residual + chemical fertilizers)

Table 2

Agrochemical analysis of the Kekkila BF peat – soluble forms

Specification	pH	Total soluble salts content		Content [ppm]				
		mS/cm	%	$N\text{-}NH_4^+$	$N\text{-}NO_3^-$	$N\text{-}NO_3^- + N\text{-}NH_4^+$	$P\text{-}PO_4^{3-}$	K^+
Kekkila BF	5.92	0.534	0.170	261.5	56.2	317.6	198.4	220

Table 3

Agrochemical analysis of the soluble forms in substrate

Varianta	pH	Content of total soluble salts [%]	$N\text{-}NO_3^-$ [ppm]	$N\text{-}NH_4^+$ [ppm]	$N\text{-}NO_3^- + N\text{-}NH_4^+$	$P\text{-}PO_4^{3-}$ [ppm]	K^+ [ppm]
T mt	6.58	0.0172	6.0	5.5	11.5	trace	11
T2	6.44	0.0195	18.0	7.0	25	1.20	16
Ts	6.33	0.0243	2.5	14.5	17	9.60	4
T2s	6.35	0.0262	2.0	17.0	19	6.60	2
Kmt	6.42	0.0192	8.0	9.0	15	4.60	21
K2	6.11	0.0342	35.0	13.0	48	20.60	35
Ks	6.46	0.0201	2.0	10.0	12	trace	3
K2s	6.15	0.0316	1.5	16.5	18	1.40	5

Table 4

Agrochemical analysis of the exchangeable forms in substrate

Varianta	P_{mobile} [ppm]	$Ca^{2+}{}_{exch}$ [ppm]	$Mg^{2+}{}_{exch}$ [ppm]	$K^+{}_{exch}$ [ppm]	$Na^+{}_{exch}$ [ppm]
T mt	3.6	1836.54	111.44	9.0	20.0
T2	5.0	2244.66	130.07	9.5	17.5
Ts	14.2	2040.60	160.98	10.0	26.0
T2s	9.0	2652.78	167.17	7.5	21.0
Kmt	11.8	1938.57	169.81	11.0	23.5
K2	15.8	2448.72	186.34	9.0	26.0
Ks	13.7	2550.75	201.82	8.0	24.5
K2s	13.9	2244.66	151.40	10.5	23.04

RESULTS AND DISCUSSIONS

For all experimental variants the content in N, P, K and total soluble salts decrease until the end of the experimental period, that shows an accentuate disponibility of those in cultivate substrate and a higher absorption of the plant lettuce.

Agrochemical analysis of the exchangeable forms released at the end of the experimental period (Table 4) in substrate available quantity of nutrients, the exception being the control variants, unplanted, where the nutritive level is lowest. That fact can be explained by the missing rooting zone effect, in which the elements strongly bonded pass in exchangeable forms, available to plants.

Comparison with the control variants of the two receipts the applied fertilizers but also the phytohormones from the lettuce plants rooting zone contribute to the nitrogen release with positive differences for the majority of the studies variants (Table 5). For the variant Ks, the negative differences can be explain only by the stronger nitrogen rooting absorption of the lettuce plants over the limits conferring by the substrate content in nitrogen.

The results concerning the influences of the receipt of the nutritive support composition (biodegradable pot) on the potassium release, K^+ (Table 6) indicate the synergism between the fertilizers supply and rizoderm activity of the lettuce plants.

Results concerning the influences of the applied fertilizers in the receipt of the biodegradable pots on the total soluble salts content (%) dynamics indicate significant increasing for the most experimental variants, very significant in the case of K2 and K2s (Table 7).

The total soluble salts content direct available to the roots absorption have an content with 78,12% for K2 and respectively 64,58% for K2s higher than that of unfertilized control variant. In the case of K2s variant the percent is lowest because of the total soluble salts consume.

Table 5

Influences of the pot receipts and the rizodem lettuce plant on the nitrogen content
N (Σ N-NO_3^- +N-NH_4^+) ppm

Variant	N (Σ N-NO_3^- + N-NH_4^+) [ppm]	Difference	Semnification
T mt	11.5	Mt	Mt
T2	25	+13.5	XXX
Ts	17	+5.5	XXX
T2s	19	+7.5	XXX
DL 5%= 1.88 ppmN, DL 1%= 2.70 ppmN, DL 0.1% = 3.98 ppmN			
Kmt	15	Mt	Mt
K2	48	+33	XXX
Ks	12	–3	ooo
K2s	18	+3	XXX
DL 5%=1.20 ppmN, DL 1%= 1.72 ppmN, DL 0.1% = 2.54 ppmN			

Table 6

Influences of the pot receipts and the rizodem lettuce plant on the soluble potassium content, K ppm

Variant	K^+ [ppm]	Difference	Semnification
T mt	11	Mt	Mt
T2	16	+5	XXX
Ts	4	–7	ooo
T2s	2	–9	ooo
DL 5%= 1.14 ppmK, DL 1%= 1.64 ppmK, DL 0.1% = 2.42 ppmK			
Kmt	21	Mt	Mt
K2	35	+14	XXX
Ks	3	–18	ooo
K2s	5	–16	ooo
DL 5%=2.03 ppmK, DL 1%= 2.92 ppmK, DL 0.1% =4.30 ppmK			

Table 7

Influences of the pot receipts and the rizodem lettuce plant on the total soluble salts content, %

Variant	Total soluble salts content %	Difference	Semnification
T mt	0.0172	Mt	Mt
T2	0.0195	+0.0023	ns
Ts	0.0243	+0.0071	XX
T2s	0.0262	+0.0090	XXX
DL 5%= 0.0036 %, DL 1%= 0.0052 %, DL 0.1% = 0.0076 %			
Kmt	0.0192	Mt	Mt
K2	0.0342	+0.0150	XXX
Ks	0.0201	+0.0009	ns
K2s	0.0316	+0.0124	XXX
DL 5%= 0.0020 %, DL 1%= 0.0029 %, DL 0.1% = 0.0043 %			

Table 8

The exchangeable sum base (S_B), Σ (Na, K, Ca, Mg), me/100 g substrate

Variant	Specification	Na me/100g substrate	K me/100g substrate	Ca me/100g substrate	Mg me/100g substrate	Σ(Na,K, Ca,Mg)= S_B me/100g substrate	pH
V1	Tmt	0.0869	0.0230	9.164	0.913	9.164	6.58
V2	T2	0.0760	0.0243	11.200	1.066	12.266	6.44
V3	Ts	0.1130	0.0256	10.182	1.319	11.501	6.33
V4	T2s	0.0913	0.0192	13.237	1.370	14.607	6.35
V5	Kmt	0.1021	0.0282	9.673	1.391	11.064	6.42
V6	K2	0.1130	0.0230	12.219	1.527	13.746	6.11
V7	Ks	0.1065	0.0205	12.728	1.654	14.382	6.46
V8	K2s	0.1000	0.0269	11.200	1.240	12.440	6.15

The soil solution cations are not adsorption uniform by the organic matter from substrate, being influenced by the soil reaction.

The organic matter has the exchange capacity variable depending on the pH. The retention by the chelating bonds stopped the ions leaching and determines the availability of them to the plants. In the case of the ions fixation by adsorption, Ca and Mg are bonded especial by the organic adsorbent. At the increasing of the total soluble salts content from soil solution the cation adsorbing capacity increase direct proportional.

At the planted variants between exchangeable cations and exchangeable sum base, S_B, existing correlation very significant for Ca (R= 0.9894) and K (R= 0.9354), distinct significant in the case of Mg and unsignificant for Na. The correlation establish for the lettuce plants at the analysis moment, in decreasing order the relation between cation depends of exchangeable sum base, S_B (Fig. 1).

Ca > K > Mg > Na

Between S_B and substrate pH being a significant correlation (R = 0.6700).

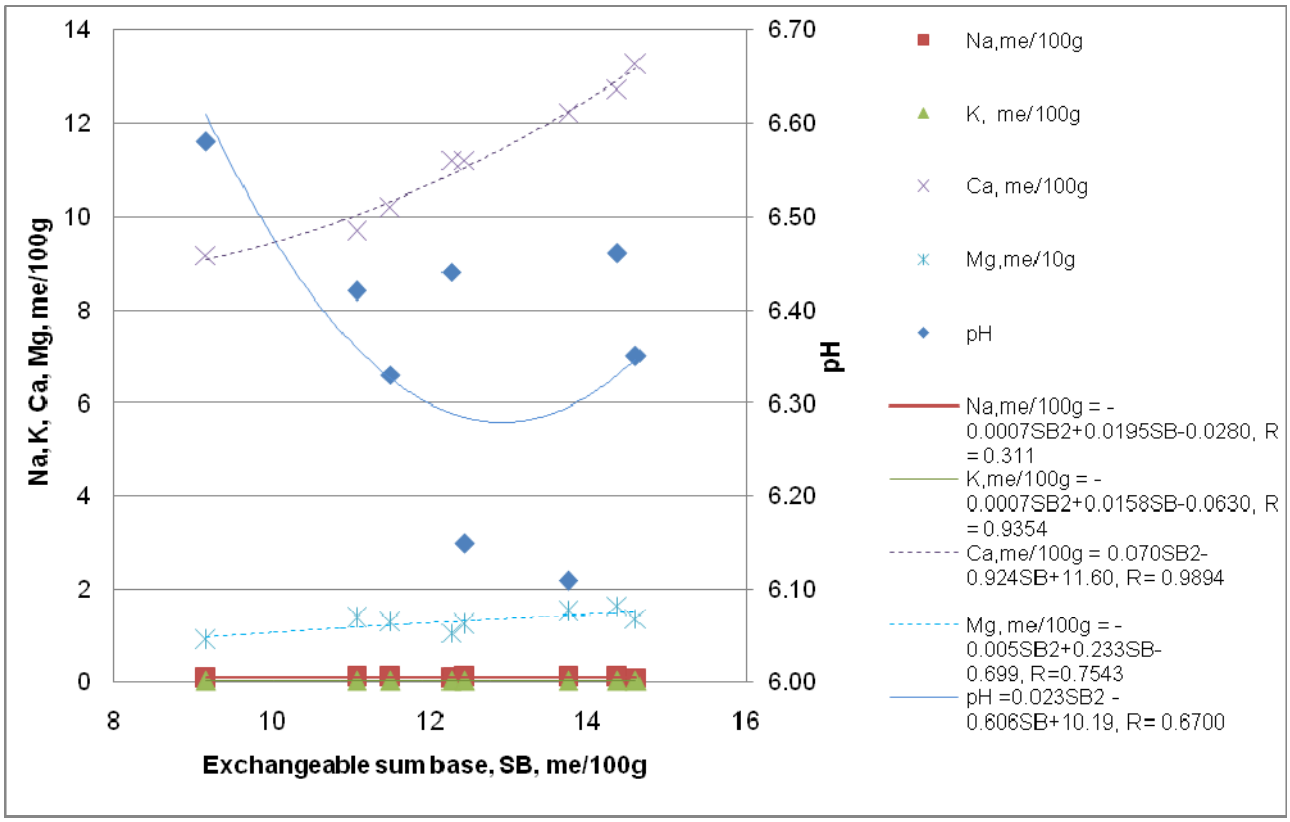

Fig. 1. Correlation between exchangeable sum base and S_B (me/100g) and Na, K, Ca, Mg and pH.

The results regarding the P mobility depending on substrate pH are presenting in figure 2.

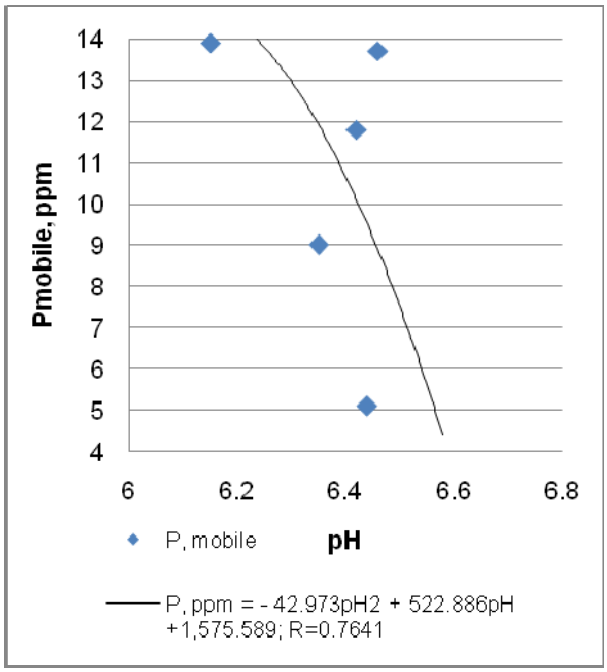

Fig. 2. Correlation between P and substrate pH.

The soil reaction is a determinant factor in phosphorous mobility, in slowly acid pH interval (pH = 5.8–6.2) the phosphorous mobility being at the maximum intensity. At the moderate and very acidic, but also at the neutral and alkaline pH the mobile phosphorous concentration decreases because of the insoluble phosphorus compounds forming.

In lettuce planted variants the pH values varying between 6.11 and 6.58, values that are in or out of pH optimum internal with maximum mobility of phosphorous. The correlation coefficient between P mobile and substrate pH is distinct significant (R = 0.7641).

CONCLUSIONS

1. For all experimental variants the content of the N, P, K soluble forms and total soluble salts decrease until the end of the experimental period, that indicate the disponibility of those in substrate and the availability in absorbing by the lettuce plants.

2. Comparison with control variants, unplanted, the applied fertilizer but also the phytohormons from lettuce rooting zone contribute to the nitrogen availability with differences very significant positive in the majority of the variants.

3. The results regarding the influences of the applied fertilizers on the total soluble salts content (%) indicate significant increasing and very significant of that parameter in the studying variants.

4. In the case of planted variants between exchangeable cations and exchangeable sum base, S_B, the correlation are very significant for Ca and K (R= 0.9354), distinct significant for Mg and unsignificant for Na, the correlation establishing the decrease order in relation of the each cation and S_B.

Ca > K > Mg > Na.

5. The correlation between S_B and substrate pH being significant indicate the substrate pH importance in cations availability of the plant nutrition.

6. The substrate pH values varied between 6.11 and 6.58. Those are in or at the limit of pH optimum interval of the maximum phosphorous mobility.

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