DYNAMICS OF ABSORPTION OF SOME BIOGENIC SALTS IN MODIFIED SALINE MEDIUM

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ABSTRACT

The measuring of Ca^{2+}, Mg^{2+}, K^+ has been carried out. This quantity determination had two purposes. It allows us, on the one hand, to show that the assimilation rate of the studied mineral elements and the synthesis of the dry matter are in relation with the composition of the plant organs. On the other hand, to analyse the Na^+/ NH_4^+ antagonism in constantly keeping the concentration of each anion and cation. Within the adjusted saline water T1C, T2C, T3C changing the proportion of NH_4^+ from 15% to 25% in the total mineral nitrogen of the modified saline solution T1 mod, T2mod, T3, mod.

At the level of the two studied species, tomato and bean, the K^+ is very abundant with regard to the cations Ca^{2+}, $Mg2^+$, and Na^+ probably due to the weak capacity of the cationic root exchange of these plants.

The roots of the tomato plants are less loaded with Na+ than the aerial parts. However, the bean stores much more Na^+ at the level of the roots, which migrate with difficulty to the aerial parts [2].

KEY WORDS: Salinity, arid areas, hydromineral need, measuring, sodium, potassium, magnesium, calcium, tomato

DETAILED ABSTRACT

In the mineral nutrition of the plants one seeks has to find which are the ionic interactions which occur when the plants are fed by two forms of NO_3- and NH_4^+. It was observed that the plants supplied with NH_4^+ are often charged out of Ca, Mg and K^+ that those which are fed by NO_3-. Two vegetable species, the tomato (Marmande variety, significant) and the bean (Contender variety, sensitive to salinity) were tested. The experimentation was carried out in system except ground in the presence of seven different nutritive solutions. Two experiments were installed in parallel which comprises each one 420 bean and tomato plants. At the court of the farming cycle of the phase seedbed we used the method of destructive morphological measurement and we carried out three different taking away. Cut 1 (30 days after sowing), cut 2 (45 days after sowing) and cuts 3 (60 days after sowing). The experimental treatments T1C, T2C, T3C represent water existing natural saltworks in Algeria that we transformed into nutritive solution at the same time we used the treatments T1mod, T2mod, T3mod formed by water corrected natural saltworks then modified.

It was observed that the Mg seems to be better absorbed by tomato than by bean at the beginning of the culture. Then it drops after 45 days of the culture to increase the new ones around 60 days of the culture. After 30 days of the culture, the bodies of the tomato plants are charged in K^+ than those with bean. The content of K^+ in the air parts definitely higher than that of the roots considering the extreme mobility of element analysed on the level of the plant. The contents of Na^+ of the analysed bodies do not seem to be very affected with the exception of the treatments with very salted water (T2C and T2). It was noted that the roots of the tomato plants are charged in Na^+ than the air parts.

INTRODUCTION

According to ZORNOZA and CARPENA [5], one of the interesting questions of the nutrition of the plants of today, is research in the ionic interactions which occur when the plants are fed by two forms of nitrogen NO_3- and NH_4^+. The plants which grow with NH_4^+ are often charged out of Ca, Mg and K that those which grow with nitric nitrogen (NO_3). This can be explain by competitive interaction between the ions the nutritive NH_4^+ and cations in the process of absorption. The experiment carried out in our work drank to know the influence of the proportion of NH_4^+ compared to that of nitrates (NO_3-) of the food medium on the nutrition of cucumber and zucchini in saline medium.

MATERIAL AND METHODS

We studied the behaviour of these two plants. Opposite to the antagonism, between the cations from the roots and the aboveground part of the plant exists some effect to eliminate or reduce the Na^+ cation. This induces physiological problems of toxicity type, as long the quantity grows in the medium and this in substituent of ions NH_4^+ at ion NO_3-.

1.Experimental conditions

Two vegetable species: the tomato (Marmande variety, significant) and the bean (Contender variety sensitive to salinity) were tested. The experiment was carried out in system except ground.Which installation comprise 420 bean and tomato seedlings. Seven different nutritive solutions were used. Which installation was organised in 3 blocks, each block contains 3 repetitions and one repetition contains 7 treatment and one treatment contain 10 pots. After germination with 25°C the seedlings were replanted in the pots (one plant in one pot) and were sprinkled with water of Blida having an electric conductivity equal to 0,59 $dS.m^{-1}$ during 48 hours. Then, water of Blida is replaced by the nutritive solution pilot T4 during ten days. After this time, the watering was operated with the various treatments. We quantified in progress farming cycle of the phase seedbed, the states of growth and development according to the method of destructive morphological measurements. To this end, three taking away were carried out: cut 1 (30 days after sowing), cut 2 (45 days after sowing) and cut 3 (60 days after sowing).

2. Experimental treatment

The treatments T1c, T2c, T3c represent natural saltworks water existing in Algeria, transformed into nutritive solutions.

RESULTS

At 30 days after sowing, the tomato assimilates much more calcium than bean (tables 3 and 4). The bean presents a content of Ca^{2+} higher than the two other periods. The air parts of the plants charged in Ca^{2+} than the roots parts with the exception of T2C where opposite effect is observed in particular at tomato. An important lowering of the content of Ca^{2+} is observed at tomato at 45 days after sowing then a light increase of Ca^{2+} in the bodies of the plants. Conversely, the bean knew a remarkable fall of Ca^{2+} on the level of the roots part only and this during the physiological phases C1 and C2. The modification of water corrected saltworks does not seem to note of clear tendency on the content of the element proportioned.

The Mg seems to be appreciated and more easily

Table 1: composition of water natural saltworks transformed into nutritive solutions (Concentration/mol)

	NO_3^-	PO_4^{3-}	SO_4^{2-}	Cl^-	NH_4^+	Na^+	Ca^{2+}	Mg^{2+}	K^+	C.E $dS.m^{-1}$
T_1c pH = 5.8	10.20	3.30	14.75	13.80	1.80	16.50	9.10	8.40	7.60	4,20
T_2c pH = 5.8	10.20	3.30	15.55	37.80	1.80	30.45	16.90	7.25	9.10	6.68
T_3c pH = 5.8	10.20	3.30	8.62	13.73	1.80	9.90	9.25	9.20	4.35	3.58
T_4 pH = 5.8 Witness	10.20	3.30	1.50	0.60	1.80	1.30	5.10	1.80	4.25	1.56

The treatments T1mod, T2mod, T3mod represent corrected natural saltworks water then modified

Table 2: composition of corrected natural saltworks water then modified (Concentration/mol)

	NO_3^-	PO_4^{3-}	SO_4^{2-}	Cl^-	NH_4^+	Na^+	Ca^{2+}	Mg^{2+}	K^+	CE $dS.m^{-1}$
T_1mod :pH 5,8	5,40	3,30	17,45	13,77	1,80	16,50	9,10	8,40	2,77	3,97
T_2mod:pH 5,8	5,40	3,30	15,55	37,80	1,80	30,45	16,90	7,25	4,30	6,13
T_3mod:pH 5,8	5,40	3,30	9,36	14,34	1,80	9,90	9,25	9,20	0,90	3,17

All the treatments receive a complementary solution of oligo-elements and iron

Table 3: Ca content in the bodies of young tomatos (% of dry matter)

		T_1C	T_1 mod	T_2C	T_2 mod	T_3C	T_3 mod	T_4
	Pa	9,60	9,97	10,02	9,70	9,32	10,85	11,74
C_1	Pr	5,20	6,19	10,40	8,30	8,74	6,42	9,86
	Pa	1,41	0,90	0,95	1,86	1,24	1,72	1,63
C_2	Pr	0,72	2,27	2,38	1,29	0,65	0,97	1,58
	Pa	2,42	1,98	1,92	2,28	2,88	1,53	2,21
C_3	Pr	1,54	1,13	2,66	1,88	0,27	1,92	2,54

Pa: air part breaks into leaf + stem.
Pr: roots part

Table 4: Ca content in the bodies of young beans (% of dry matter)

		T_1C	T_1 mod	T_2C	T_2mod	T_3C	T_3mod	T_4
	Pa	2,06	2,11	2,15	2,05	2,38	2,01	2,31
C_1	Pr	1,22	1,24	1,15	1,57	1,46	1,26	1,46
	Pa	1,28	1,74	1,57	2,01	1,40	1,42	1,61
C_2	Pr	0,66	0,61	0,92	0,80	0,61	0,80	0,66
	Pa	0,90	0,87	0,83	1,04	0,97	1,16	1,05
C_3	Pr	0,40	0,37	0,45	0,78	0,41	0,47	0,41

Pa: air part breaks into leaf + stem.
Pr: roots part

Table 5: Mg content in the bodies of young tomato's (% of dry matter)

		T_1C	T_1 mod	T_2C	T_2 mod	T_3C	T_3 mod	T_4
	Pa	3,86	4,10	3,28	3,86	4,34	3,94	2,48
C_1	Pr	1,14	2,56	1,74	2,54	0,08	2,57	2,16
	Pa	0,85	0,75	0,57	0,81	0,91	1,30	0,74
C_2	Pr	0,74	1,05	1,19	0,75	0,76	0,93	0,71
	Pa	1,48	1,28	1,09	1,13	1,84	1,13	0,78
C_3	Pr	1,14	1,24	1,74	1,19	0,08	1,61	1,14

Pa: air part breaks into leaf + stem.

Pr: roots part

Table 6: Mg content in the bodies of young beans (% of dry matter)

		T_1C	T_1 mod	T_2C	T_2 mod	T_3C	T_3 mod	T_4
	Pa	1,61	2,23	1,54	1,14	1,25	1,28	1,12
C_1	Pr	1,09	1,37	0,82	0,94	1,14	1,24	0,87
	Pa	0,27	0,43	0,30	0,34	0,34	0,59	0,34
C_2	Pr	0,30	0,41	0,32	0,38	0,51	0,58	0,39
	Pa	2,16	2,26	1,12	1,37	1,86	2,51	1,17
C_3	Pr	1,27	1,58	0,73	1,52	0,94	1,14	0,97

Pa: air part breaks into leaf + stem.

Pr: roots part

Table 7: Content of K in the bodies of young tomato's (% of dry matter)

		T_1C	T_1 mod	T_2C	T_2 mod	T_3C	T_3 mod	T_4
	Pa	7,53	6,76	7,56	6,88	7,66	5,85	5,12
C_1	Pr	3,15	2,28	3,17	3,28	3,28	2,25	2,31
	Pa	15,75	10,21	12,60	12,52	13,59	10,80	8,58
C_2	Pr	5,55	4,59	8,36	7,03	4,96	3,38	4,51
	Pa	16,43	10,56	15,38	15,16	15,34	8,75	12,09
C_3	Pr	5,06	3,19	7,54	8,81	1,91	2,16	3,57

Pa: air part breaks into leaf + stem.

Pr: roots part

Table 8: Content of K in the bodies of young beans (% of dry matter)

		T_1C	T_1 mod	T_2C	T_2 mod	T_3C	T_3 mod	T_4
	Pa	16,50	11,75	8,25	13,75	13,50	10,25	9,75
C_1	Pr	7,75	3,50	4,25	5,50	5,00	1,50	2,75
	Pa	10,75	6,25	10,75	10,50	9,00	5,00	4,00
C_2	Pr	4,75	2,00	5,50	5,25	5,50	3,00	1,50
	Pa	13,53	7,00	13,50	10,50	10,60	4,25	5,75
C_3	Pr	3,00	2,00	3,00	2,00	2,25	1,25	1,50

Pa: air part breaks into leaf + stem.

Pr: roots part

approached better at tomato than at bean, in particular at the beginning of culture (tables 5 and 6). The evolution of the Mg contents in the tomato bodies shows overall that those decrease abruptly at 45 days after sowing then grow slightly at 60 days of culture. On the other hand the bean expresses a lowering content of Mg^{2+} at 45 days after sowing. With a light increase to reach at 60 days of the values almost similar or slightly higher than those measured with 30 days after sowing. In addition, it is noticed that at the time of a modification of the solutions corrected saltworks, it appears a synergistic pressure with respect to the Mg, which convey more easily roots towards the air parts.

After 30 days of culture, the bodies of the tomato plants are charged in K^+ than those with bean (tables 7 and 8). This seems to be related to the exigency of species during a well-defined phase of its cycle of development. With the inverse, the bodies of tomato plants grows more richer during the periods of culture C1 and C2, whereas those of the bean is poverting themselves

The content of K^+in the air parts definitely higher than those of the roots, considering the extreme mobility of analyzed element on the level of the plant. The modification of water corrected saltworks seems to negatively somewhat affect the content of K^+ in the bodies studied in spite of the strong reductions in concentration of K in the modified mediums which are 63,81 % (T1 mod). 52,74 % (T2 mod), 79,31 % (T3 mod) respectively with the same corrected treatments.

The contents of Na^+ in the analysed bodies do not seem too much to be adsorbed. With exception of the most salted treatments T2 C and T2 mod which present the highest contents taking into account the content Na^+ (30,45 meq/l) in these solutions. The roots of the tomato plants are charged with Na^+ than the air parts. On the other hand, the bean stores much more Na^+ on the level of the roots, which migrates with difficulty towards the air parts. The tomato knows an increase in content in Na^+ on the level in the analysed bodies. On the other hand, the bean expresses a reduction in the Na content at 45 days after sowing then an increase in values after 60 days of culture. The modification of the corrected saltworks solutions, somewhat the entry limit of Na on the level of the tomato roots allows its accumulation on the level of the air part of the plants. At bean with the reverse, it's on the level of the roots that accumulation of Na is most important

CONCLUSION

As previously, the results show that each salted treatment causes in the plant of the complex reactions on the level

Table 9: Na content in the bodies of young tomato's (% of dry matter)

		T_1C	T_1 mod	T_2C	T_2 mod	T_3C	T_3 mod	T_4
	Pa	4,72	5,55	6,11	6,31	3,88	4,43	4,44
C_1	Pr	3,37	3,33	3,53	3,49	2,20	3,05	2,77
	Pa	5,27	5,37	5,82	6,94	4,44	4,72	4,16
C_2	Pr	3,61	3,33	4,16	4,06	3,33	3,23	2,77
	Pa	6,38	7,21	6,11	7,77	6,11	4,43	5,55
C_3	Pr	4,72	4,44	5,00	4,44	4,16	4,02	3,33

Pa: air part breaks into leaf + stem.
Pr: roots part

Table 10: Na content in the bodies of young beans (percentage of dry matter)

		T_1C	T_1 mod	T_2C	T_2 mod	T_3C	T_3 mod	T_4
	Pa	2,05	1,95	2,20	2,10	2,0	1,90	2,05
C_1	Pr	3,00	3,55	3,70	3,76	3,00	3,10	3,65
	Pa	1,00	0,95	1,20	1,0	0,70	0,60	1,70
C_2	Pr	2,90	3,0	3,15	2,95	235	2,25	2,85
	Pa	2,25	1,90	3,35	2,75	1,85	1,30	1,25
C_3	Pr	3,50	3,35	3,00	2,50	1,85	1,80	2,20

Pa: air part breaks into leaf + stem.
Pr: roots part

of transport and ionic accumulations. The approach used in this study makes it possible to distinguish the clean contents from each four element studied in the various analysed bodies. In addition, the modification of water corrected saltworks, where the ammoniacal proportion of nitrogen is increased in solutions T1 mod, T2 mod, T3 mod, the NH_4^+ expresses an antagonistic action with K^+ and Ca^{2+}. This result is in conformity with the theory of LEMAIRE and Al [2], where when nitrogen is present in ammoniacal form NH_4^+ in larger quantity in the nutritive solution, it exerts an antagonistic pressure with respect to the other cations which penetrate in less quantity. Progressively development of the bean plants, lowering of the content of Ca^{2+} in the roots part seems to be in relation to that of K^+. The modification of saltworks water exerts a synergistic or favourable pressure on the absorption of Mg^{2+} by the roots of the plants by the studied species, which migrates quickly it towards the air part. The reduction effect of K^+ is induced by the modification (increase in the proportion of NH_4^+ of 10 % in total mineral nitrogen) on the level of saltworks water T1 mod, T2 mod, T3 mod without to effect the content of K^+. By the analysed bodies although reduction in K^+ is made in a very appreciable way: 63,81 % (T1 mod); 52,74 % (T2 mod); 79,31% (T3 mod). It thus follows a reduction in contents of fabrics of K^+ of the modified salted treatments. The modification of water corrected saltworks returned the concentration of K^+ limiting compared to the capacities of absorption of the plant, but the absorption of K^+, even limited, provides to the plant a sufficient quantity of K^+ to the growth. On the level of the two studied species, tomato and bean, K^+ is very abundant compared to the cations Ca^{2+}, Mg^{2+} and Na^+ probably because of the low cation capacity in the roots exchanges of these plants. In the presence of the salted mediums, accumulations of Na^+ are met in the air part of tomato and the root at bean. However, on the level of the modified treatments, the taking away of K^+, even rather weak, is enough to ensure the needs for the growth, in spite of enrichment of fabrics in Na^+, which becomes the dominating cation then. With K^+ and Cl^-, it contributes for 50 to 60 % to osmotic adjustment (4, 1, and 3).

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