DYNAMICS OF ABSORPTION OF SOME BIOGENICS SALTS AT TOMATO AND BEAN PLANT CULTIVATED IN SALINE MEDIUM

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ABSTRACT

The study carried out on the mineral assimilation in saline environment by tomato and bean cultures allowed us to distinguish through the various studied stages, a specific assimilation of the mineral element Ca, Mg, K, Na. This study aimed at looking at how assimilation rate of the studied mineral element. The dry matter is in relation with the mineral composition of the plant organs.

KEYWORDS: Salinity, hot arid areas, hydromineral need, measuring, potassium, calcium, magnesium, and tomato, bean

INTRODUCTION

The respective requirement out of water and from each biogenic salt varies during development. The cells don't absorb indifferently the ions type, which are offered. This selectivity is exerted with opposition of some ions, as the sodium, which penetrates badly in the cells. With the reverse, the cells accumulate certain ions as the potassium, which are found in higher concentrations than in the external medium (5).

At once absorbed, the biogenic salts are pulled by the crude sap towards in the various parts of the plant where they are metabolised (3). The plant manages to primarily satisfy the mineral needs by absorption via the roots. A foliar absorption is possible but is exceptional and is always limited (12):

- The absorptive ions follow the same morphological ways as water.
- The cells don't absorb indifferently the ions, which are offered to them.
- Selectivity exerted for certain ions like Na^+ and Ca^{2+}, which penetrate very badly in the cell.
- The cells accumulate certain ions like K^+, which are more concentrated than in the medium.
- The speed of crossing the membranes of the cells by the anions is lower than that of the actions.

This difference can cause by rebalancing of the positive and negative loads between the external, and interior medium involving an acidification or an alkalisation of environment (2).

MATERIALS AND METHODS

The experiment was led in hydroponie. A seedling by pot was set up. Two vegetable species: the tomato (Marmande variety) and the bean (Contender variety) species fairly sensitive and sensitive to salinity were tested. Seven mediums were used. In this experimentation, 420 bean and tomato seedlings were used. After germination with 25°C the seedlings are mended in the pots and are sprinkled with water of Blida having an electric conductivity equal to 0,59 ds.m-1during 48 hours. Then, water of Blida is replaced by the nutritive solution pilot T4 during ten days. After this time, watering was operated with the various treatments. The protocol of test adopted destructive measures since three taking away or noted cuts. C1, C2, and C3 were carried out during the cycle of development of the species tested C1: 30 days after sowing, C2: 45 days after sowing and C3: 60 days after sowing

Experimental treatments

T1, T2, T3 represent the natural saltworks water existing in Algeria. They were reconstituted on the experimental site with the water of Blida. The water has electric conductivity's of 3.45; 5.65 and 2.87 d.S M-1 respectively and of pH = 7,8.

T1C, T2C, T3C represent the natural saltworks water above mentioned but corrected in nutritive solutions having electric conductivity's of 4.20; 6.68 and 3.58 dS M-1 and of pH=5,8.

The T4 treatment represents the pilot nutritive solution synthesised with water of Blida according to standards defined by Coïc and Lesaint (1983) of conductivity equal to 1.56 dSm-1 and of pH = 5,8.

A complementary solution of oligo elements is brought to the various treatments, exeption the natural saltworks water (T1, T2 and T3). After the realisation of each three cuts or taking away, the body of the plants (sheet, stem, and root) is separate. An average taking away sample is carried out to leave a mixture all the plants of each studied species and this by treatment and block. The bodies are weighed and put at drying oven with 75°c until a stability of the dry weight. The mineralisation of the dry matter was carried out by an attack triacid of the type: HNO3 - H2 SO4 - HClO4 according to the proportion 10 - 1 - 4.

The proportioning of potassium, calcium and magnesium is carried out by a spectrophotometer with atomic absorption. The proportioning of sodium was carried out with a spectrophotometer with flame.

RESULTS

According to results of tables 1 and 2, we notice that during the first four weeks, the bean and tomato plants manufacture little matter dries and assimilate much calcium.

As we notice in particular at tomato as the plant irrigated with natural saltworks water form roots whose their Ca content is very high compared to that of the air part (sheet + stem). This shows well in unfavourable condition of culture (salinity and ionic balance) metabolic activity of tomato is slowed down and consequently an accumulation of Ca observed on the level of the roots of the plants

The analysis of the Ca content shows that this element is not very mobile in the plant.

Strongly observed at tomato is the decrees during the second culture period (45 days after sowing) on the level of the analysed studied species the lowering Ca content. The correction of natural saltworks water largely does not seem affected the Ca content in the studied bodies.

According to results of tables 3 and 4, magnesium is represented in rather low content in the roots of the plants what confirms its facility of absorption by the plants and its transfer towards the air part.

Table 1: Ca content in the bodies of young tomato's (% of matter dries)

		T_1	T_1 C	T_2	T_2C	T_3	T_3C	T_4
	Pa	8,78	9,60	9,92	10,02	12,19	9,32	11,74
C_1	Pr	8,57	5,20	13,02	10,40	14,77	8,74	9,86
	Pa	1,75	1,41	1,70	0,95	1,73	1,24	1,63
C_2	Pr	1,48	0,72	1,23	2,38	1,41	0,65	1,58
	Pa	1,88	2,42	2,90	1,92	2,42	2,88	2,21
C_3	Pr	1,66	1,54	2,89	2,66	1,57	0,27	2,54

Pa: air part breaks into leaf + stem
Pr: racinaire part

Table 2: Ca content in the bodies of young beans (% of matter dries)

		T_1	T_1 C	T_2	T_2C	T_3	T_3C	T_4
	Pa	1,85	2,06	1,81	2,15	2,33	2,39	2,31
C_1	Pr	1,35	1,22	2,67	1,15	1,64	1,46	1,46
	Pa	1,95	1,28	2,16	1,57	1,34	1,40	1,61
C_2	Pr	0,64	0,66	0,98	0,92	0,75	0,61	0,66
	Pa	0,94	0,90	0,88	0,83	1,02	0,97	1,05
C_2	Pr	0,36	0,40	0,48	45	0,38	0,41	0,41

Pa: air part breaks into leaf + stem
Pr: racinaire part

Table 3: Mg content in the bodies of young tomatos (% of matter dries)

		T_1	T_1 C	T_2	T_2C	T_3	T_3C	T_4
	Pa	3,66	3,86	3,81	2,28	4,62	4,34	3,48
C_1	Pr	1,24	1,14	1,57	1,74	1,20	0,08	1,14
	Pa	1,46	0,85	1,30	1,19	1,25	0,91	0,74
C_2	Pr	1,23	0,74	1,00	0,57	1,12	0,76	0,71
	Pa	1,24	1,82	1,82	1,69	1,85	1,84	1,16
C_3	Pr	1,13	1,14	1,57	1,24	1,20	0,08	0,94

Pa: air part breaks into leaf + stem
Pr: racinaire part

Table 4: Mg content in the bodies of young beans (% of matter dries)

		T_1	T_1 C	T_2	T_2C	T_3	T_3C	T_4
	Pa	1,16	1,41	1,15	1,54	1,20	1,25	0,62
C_1	Pr	1,46	1,69	1,50	1,82	1,49	1,44	0,87
	Pa	0,69	0,27	0,42	0,30	0,36	0,34	0,34
C_2	Pr	0,89	0,30	0,42	0,32	0,62	0,51	0,39
	Pa	1,57	1,27	0,64	0,73	1,66	0,94	0,97
C_{3-}	Pr	1,93	2,16	1,17	1,12	1,68	1,86	1,17

Pa: air part breaks into leaf + stem
Pr: racinaire part

This observation is similar with that of MORAD (8), which announces the opposite of Ca^{2+}, Mg^{2+} is a variable component, insofar as it migrates easily in the various parts of the plant.

After 30 days of culture, the accumulation of Mg seems to be more important on the level of the roots of bean irrigated by water natural saltworks T1, T2. The correction of water saltworks facilitates the transfer of Mg of the roots towards the air part by allowing a better assimilation in particular at bean. Progressively development of the plants, we notice after 45 days of culture, a reduction in Mg content on the level of the bodies studied for each analysed treatment. This is probably related to the needs for the plants that are not high during this phase of development. On the other hand the needs are made feel at 60 days after sowing where we records an appreciable Mg migration of the roots towards the stems and the sheets of the plants coinciding with the period of flowering at tomato and at bean.

An analysis of tables 5 and 6 watch that the composition out of potassium of the bodies of tomato 30 days after sowing is lower than that of bean. Compared to the pilot plants (T4 treatment) the plants have a stronger proportion of K in the analysed bodies. It is remarkable to the extreme poverty of the bodies of the tomato plants irrigated by the natural treatment more salted T2. This can be explain by the difficulty of assimilation difficulty of K by the roots and its transfer towards the air part following the high osmotic pressure and ionic imbalance of the medium.

Correction of natural saltworks water taking away of K by the plants as well as the contents. The air part of the plants presents a K content higher than that of the roots, which can say that the analysed element presents a great mobility at the scaleof the cell, bodies, and plant as announces it VILAIN (12). The analysis at 45 days after sowing of the K content in the course of the vegetative growth of the cultures shows that the content of this sum of money decreases gradually at bean with exception of T2 C. Inversement, the content of K^+ believes at tomato in the bodies of the plants (phase of development corresponding at the stage of flowering beginning where the K content of the sheets is important).

As we note, in tables 7 and 8, actual values on the level of the bodies of the pilot plants in comparison with those of the other treatments different step significantly of the presumably standard values. This makes it possible to say that whatever the Na content in the mediums, this last remainder not very mobile with exception of the most salted treatments T2 and T2 C which express the contents highest and which seem to be in relation to the content of this element (30,45 cmol+) in the solutions. The assimilation of Na at tomato is more important than at bean.

The roots of bean are charged out of Na than the air part because of the strong retention of this last in conducting or vascular fabrics. In general manner, it seems that the bean sheets charged out of Na, are compared with the roots. Our results are in conformity with those published, (4, 9, 10, 11, 13), which observed that at the bean (plant glycophyte), most sensitive to NaCl, and the accumulation of Na decrease roots, stems, with the sheets. Progressively development of the plants, the content Na of the analysed bodies decreases at bean and increases at tomato. At 60 days after sowing, the roots of the studied plants reveal an accumulation of Na+ in the roots by limiting its transfer in great quantity in the air parts while thus creating the shape adaptation of the plants in salted medium. The correction of water saltworks increases the content of Na+ in the plants by thus stimulating its absorption by the roots and its routing towards the stems then the sheets. This effect is more important at tomato than at bean.

CONCLUSION

Taking into account the results obtained, the concept of selectivity at a plant seems a function of the needs for each physiological phase. We noticed an inequality in absorption of K and of Na. The absorption of K is higher than that of Na according to MAZLIAK (7), the great majority of the cells has a system of active repulsion of sodium and a system active absorption of potassium while utilising cellular mechanisms of the "pump sodium". K^+ and Na^+ are presented in the form of antagonistic or inhibiting ions mutual. The content of K in the analysed bodies largely exceeds the other elements proportioned because of their presence in large quantity and essential. This importance lies in its fundamental role than the regulation of the functions of the plant, by supporting the synthesis of sugars and takes part in their transfer towards the bodies of reserve, while intervening in chlorophyllian assimilation. In addition, the calcium contents at 30 days after sowing at tomato are very high compared to bean. Our results are comparable with those of Al-RAWAHY et al. (1), which indicate that Na+ holding more initially to the level of the roots then, it migrates towards the sheets. The passage of the sodium of the roots towards the sheets is a mechanism of strength to salinity since the tomato species sensitive to salinity easily releases Na of the roots towards the air part. Conversely, the bean species sensitive to salinity migrates very slowly Na towards the stems and the sheets. But the fact which deserves to be particularly underlined is the difference between cation

Table 5: Content of K in the bodies of young tomato's (% of matter dries)

		T_1	T_1 C	T_2	T_2C	T_3	T_3C	T_4
	Pa	6,90	7,53	2,18	7,56	6,28	7,66	5,12
C_1	Pr	2,18	3,15	2,18	3,17	1,67	3,28	2,31
	Pa	6,96	15,75	4,58	12,60	9,73	13,59	8,58
C_2	Pr	6,19	5,55	5,88	8,36	4,74	4,96	4,50
	Pa	11,82	16,43	7,90	15,38	12,73	15,34	12,09
C_3	Pr	5,04	5,06	2,14	7,54	5,08	1,91	3,57

Pa: air part breaks into leaf + stem
Pr: racinaire part

Table 6: Content of K in the bodies of young beans (% of matter dries)

		T_1	T_1 C	T_2	T_2C	T_3	T_3C	T_4
	Pa	10,50	16,50	10,0	8,25	8,25	13,50	9,25
C_1	Pr	06,0	7,75	4,50	4,25	3,0	05,0	2,75
	Pa	6,75	10,75	9,75	10,75	6,25	09,0	4,0
C_2	Pr	5,25	4,75	4,75	5,50	5,75	5,50	1,50
	Pa	9,50	13,53	15,0	13,50	8,0	10,60	5,75
C_3	Pr	5,50	3,0	3,0	3,0	5,50	2,25	1,50

Pa: air part breaks into leaf + stem
Pr: racinaire part

Table 7: Content of Na+ in the bodies of young tomato's (% of matter dries)

		T_1	T_1 C	T_2	T_2C	T_3	T_3C	T_4
	Pa	3,84	4,72	5,94	6,11	5,23	3,88	4,44
C_1	Pr	3,22	3,37	3,63	3,53	2,22	3,20	2,77
	Pa	3,94	5,27	8,88	5,82	5,44	4,44	4,16
C_2	Pr	2,77	3,61	3,05	4,16	2,50	3,33	2,77
	Pa	5,27	6,38	11,38	6,11	5,27	6,11	5,55
C_3	Pr	2,50	4,72	4,72	5,00	2,77	4,16	3,33

Pa: air part breaks into leaf + stem
Pr: racinaire part

Table 8: Content of Na+ in the bodies of young beans (% of matter dries).

		T_1	T_1 C	T_2	T_2C	T_3	T_3C	T_4
	Pa	1,80	2,05	2,20	2,20	2,00	2,00	2,05
C_1	Pr	2,75	3,00	3,80	3,70	2,70	3,00	3,65
	Pa	0,70	1,00	0,65	1,20	0,60	0,70	0,85
C_2	Pr	1,85	2,90	2,60	3,15	1,30	2,35	2,85
	Pa	0,25	2,25	0,75	3,35	0,20	1,85	1,25
C_3	Pr	1,70	3,50	2,50	3,00	1,15	1,85	2,20

Pa: air part breaks into leaf + stem
Pr: racinaire part

balances racinaires and foliar of the studied species: it is as well as tomato characterised by air parts relatively rich in K and Na has roots low in magnesium; on the other hand the bean, which is different from tomato by a relatively small percentage of Mg in its air parts, has roots richer in sodium.

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