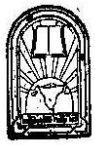

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EFFECT OF CHLORIDE AND SULFATE SALTS ON GROWTH OF PEANUT AND COWPEA

By

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ABSTRACT

Peanut variety Baladi "107" and cowpea "Lupia Fetriat" which were grown in a green house sand culture experiment were subjected to different salt treatments. These include NaCl, $MgCl_2$, $CaCl_2$, mixture of chlorides, Na_2SO_4, $MgSO_4$, mixture of sulphates and mixture of sulphates and chlorides added in concentration of 4000 ppm. The base solution was Bond's modified nutrient solution of 1000 ppm. Inoculation with the proper rhizobia was also included as a treatment. The dry weight and height os plants, number of root nodules nitrogen percent and yield were tested at two intervals during the growth stage.

Inoculation was successful for peanut but not for cowpea. At a salt concentration of 5000 ppm. in irrigation solution, the depression effect on the tested characteristics for both peanut and cowpea depended on the Cl^-: $SO_4^=$ in the irrigation solution. Calcium ions in the chloride form had the most deteriorating effect.

INTRODUCTION

It is well known that symbiosis between rhizobia and their host legume is affected by different environmental factors. (Vincent , 1965). The amount of nitrogen fixed, therefore, varies according to the extent to which the environmental conditions permit the symbiotic potential to be realized.

Under normal field condition, the amount of atmospheric nitrogen assimilated by legumes varies from 30 to 140 pounds per acre in a growth season and was 88 pounds/acre for peanut (Nutman, 1965).

Under saline conditions nodulation of legumes seems to face some problems (Vincent, 1965 ; Dahiya and Singh, 1976 and Richards,1954). Many investigators (Morris, 1958a; Longanathan and Krishnamoorthy , 1977) showed the necessity of Ca^{++} and Mg^{++} to legumes, but their toxic levels in irrigation water was seldom studied under field conditions (Vincent, 1965). He showed the necessity of $SO_4^=$ to legume plants while Fox et al. (1977) stated that older leaves accumulated

sulphur if it was supplied in excess. Neither necessity nor toxicity of Na^+ and Cl^- to the symbiotic nitrogen fixation process under field conditions has been completely investigated.

The objective of the present study was to investigate the salinity effect on the growth of cowpea and peanut under different types and concentration of salt solutions.

MATERIALS AND METHODS

Peanut (Arachis hypogaea) variety "Baladi 107" and cowpea (Vigna sinensis) variety "Lupia Fetriat" planted in sand treated with Bond's modified nutrient solution (Allen, 1959) were used for this study. The experiment was carried out under a green house condition in glazed pots of 35 cm diameter and 45 cm height.

Fifteen seeds were sown per each pot in May 1979 and 4 weeks later 6 plants per pot were left to maturity. The experiment was terminated in September of the same year. Irrigation with basic nutrient and salt solutions was carried out each other day in excessive amounts to prevent salt accumulation during the growth season through free drainage.

The experiment comprised 8 salt treatments: 4000 ppm NaCl, 4000 ppm $CaCl_2$, 4000 ppm $MgCl_2$, 4000 ppm Na_2SO_4, 4000 ppm $MgSO_4$, mixture of chlorides (1333 ppm NaCl + 1333 ppm $CaCl_2$ + 1333 ppm $MgCl_2$), mixture of sulfates (2000 ppm Na_2SO_4 + 2000 ppm $MgSO_4$) and mixture of chlorides and sulphates (666 ppm NaCl + 666 ppm $CaCl_2$ + 666 ppm $MgCl_2$ + 1000 ppm Na_2SO_4 + 1000 ppm $MgSO_4$) . The salt treatment was dissolved in the Bond's nutrient solution which was contained 1000 ppm of nutrients. So, the total salt concentration of each treatment was 5000 ppm.

Two more treatments were included in the experiment: the first, Bond's nutrient solution with neither salt added nor inoculation and the second, Bond's nutrient solution without salt added but with inoculation. These two treatment were the control of the experiment. The treated pots were inoculated with the effective rhizobia to the legume variety, a week after sowing. The rhizobia was previously isolated from effective nodules of each legume. All treatments were run in 6 replicates.

The height, fresh and dry weights (66°C for 48 h.) and number of nodules of plants at 2 intervals during the growth season (48 and 78 days from sowing for peanut and 67 and 106 days for cowpea) were measured from two different sets of the experiment. The yield as pods and grains was taken only for cowpea. The nitrogen content of peanut plants was determined according to Jackson (1962).

The data obtained were statistically analysed (Steel and Torrie, 1960).

RESULTS AND DISCUSSION

According to the design of the experiment 3 types of effect are available for discussion: 1- the inoculation effect judged by comparison between the two controls, 2- the total salinity effect by comparison between the second control and the salt mixture treatment and 3- the specific salinity effect by comparison among the individual salt treatments.

Inoculation effect:

For peanut, Table 1 show that inoculation increased significantly the dry weight and height of plants, the number of root nodules and the nitrogen uptake at the age of 48 days. The obtained increase due to inoculation amounted to 24, 17, 252 and 30 % of that of control 1, respectively. This effect extended to the later age but to a lower magnitude with respect to the number of nodules and vanished with respect to the height of plants . The nitrogen percent was not affected at any age.

For cowpea (Table 2) inoculation had no effect on any property tested at any age.

These results would agree with Vincent (1965) who stated that seed inoculation may result in failure or partial success . With respect to cowpea, Brown (1959) showed that nodulating ability of rhizobia ranged from those that were widely promiseous to others that were markedly specific.

Total salinity effect:

The treatment of mixture of salts comprising chlorides and sulphates in equal amounts, in comparison to that of the control 2, would as previously mentioned refer to the effect of salinity i.e. osmotic effect. In this connection with respect to peanut, the data presented in Table 1 show that salinity of 5000 ppm depressed significantly the dry weight and height of plants and consequently the nitrogen uptake as the nitrogen percent was not effected. This effect became greater as the plants matured. The depression in dry weight was 28% at the age of 48 days while reached 43% at the age of 78 days of that of the control (1000 ppm). The number of nodules was not affected.

With respect to cowpea , as shown in Table 2, the reduction in dry weight due to the same salinity level was similar to that in peanut as it reached 42% of that of the control by the age of 106 days, though the effect at the earlier age was not significant.

Table 1: Effect of inoculation and different salts on growth characteristics of peanut *.

Treatment	After 48 days of sowing					After 78 days of sowing				
	Dry weight g	Number of nodules	Plant height cm	Nitrogen mg	Nitrogen %	Dry weight g	Number of nodules	Plant height cm	Nitrogen mg	Nitrogen %
1-Control (1) ..... (No salt,no inoculation)	4.6	28.9	20.5	125.3	2.70	12.5	58.0	36.5	292.7	2.34
2-Control (2) ..... (No salt,inoculation)...	5.7	101.9	24.1	163.5	2.85	15.1	173.5	37.5	361.5	2.48
3-NaCl	3.2	103.9	18.3	83.3	2.57	7.6	167.5	27.8	167.7	2.20
4-$CaCl_2$.....	2.8	91.7	15.6	46.9	2.41	3.6	95.7	19.8	85.1	2.30
5-$MgCl_2$.....	2.9	90.5	18.0	71.5	2.44	8.0	165.7	28.7	179.3	2.20
6-Mixture of chlorides ...	2.7	100.6	16.6	63.4	2.29	6.3	166.6	24.6	153.8	2.43
7-Na_2SO_4	5.1	103.1	21.5	148.9	2.92	14.0	197.4	31.3	358.2	2.56
8-$MgSO_4$	5.1	107.4	22.5	155.4	3.03	13.3	157.1	32.4	359.9	2.68
9-Mixture of sulphates ...	5.6	117.8	21.9	161.8	2.86	12.9	138.7	29.9	342.7	2.63
10-Mixture of chlorides and sulphates	4.1	107.1	21.2	110.8	2.70	8.6	164.6	33.5	208.9	2.40
L.S.D.$_{0.05}$	1.1	29.6	2.9	35.5	0.21	2.4	40.7	4.0	73.7	0.27

* All data are presented per plant basis (average of 36 plants = 6 replicates(pots)x 6 plant per pot).

Table 2: Effect of inoculation and different salts on growth characteristics of cowpea * .

Treatment	After 67 days of sowing			After 106 days of sowing						
	Dry weight g	Number of nodules	Plant height cm	Dry weight g	Number of nodules	Plant height cm	Pods		Grains	
							Number	Weight g	Number	Weight g
1- Control (1) ..... (No salt,no inoculation)	4.1	19.1	34.8	4.0	21.9	60.6	5.2	4.2	26.7	3.2
2- Control (2) ..... (No salt, inoculation)	4.1	24.6	34.6	4.8	26.7	63.7	5.5	4.6	31.5	3.7
3- NaCl	1.7	2.8	17.6	1.4	14.7	27.4	3.7	2.6	20.3	1.9
4- $CaCl_2$.....	1.1	2.3	16.1	1.3	5 .3	25.2	2.2	1.2	12.2	0.9
5- $MgCl_2$.....	1.7	2.9	17.8	1.7	9.9	33.3	2.9	1.9	15.7	1.4
6- Mixture of chlorides	2.5	6.9	25.0	1.7	10.5	32.6	2.8	1.8	13.1	1.4
7- Na_2SO_4	2.0	19.8	21.8	3.7	31.4	57.9	7.2	6.6	41.7	4.7
8- $MgSO_4$	4.2	22.2	33.7	3.3	11.6	50.3	5.1	4.0	22.2	3.2
9- Mixture of sulphates	3.8	18.1	33.2	3.4	19.5	44.3	5.5	4.4	30.6	3.4
10- Mixture of chlorides and sulphate	3.3	21.5	28.3	2.0	20.9	31.9	5.5	4.7	34.3	3.7
L.S.D.$_{0.05}$	1.6	11.5	5.0	2.1	9.8	21.5	2.9	2.8	20.8	2.2

* All data presented per plant basis (average of 36 plants = 6 replic pot) .

However, the yield was not influenced, either pods or grains, number or weight. Similar effects were observed by Richards (1954), Lagerwerf and Eagle (1961) and Dahiya and Singh(1976).

Specific salinity effect:

Comparisons among single salt treatments with reference to the mixture salt treatments would reveal any specific salt effect since all treatments were adjusted to the same concentration of 5000 ppm.

With respect to peanut (Table 1), chloride salts treatment, compared to that of sulphate, reduced the dry weight and height of plants as well as the nitrogen percent. Total nitrogen uptake, being a product of N% and dry matter, was the most influenced by chloride relative to sulphate. The number of nodules, however, was not affected. Among chloride salts, $CaCl_2$ was the most depressive on grwoth parameters. For mature plants, the dry weight and height of plants , number of nodules, nitrogen uptake and nitrogen percent were all significantly lower for $CaCl_2$ than for either $MgCl_2$ or NaCl treatments which otherwise had almost equal effects. As sulphate: Mg^{++} or Na^{+} were of equal effect. It might be of interest to notice that the sulphate mixture treatment did not bring any change in growth characteristic other than the control treatment. Therefore, the reduction in growth parameters brought in by the chlorides + sulphates mixtures treatment seemed to be a specific effect of chloride ions rather than osmotic effect.

This can also found with cowpea (Table 2), but the level of significance was not reached in most of the cases.

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