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Some Properties of Saline-Alkaline Soils of Aydin-Söke Plain and Activity of Gypsum as Amelioration Material

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ABSTRACT

The study has been carried out in two different areas; a farmer area in Söke Plain and in experimental station of Adnan Menderes University. The aims of study, are to determine of some physical and chemical properties of the soils and to search of activity of gypsum (CaSO4) used in alkaline soils having high sodium. For this purpose, 50,100 and 150 kg/da gypsum were applied to the experimental soils besides control. These applications were made in autumn after harvest period and before the winter rains. In order to determine affects of gypsum on some physical and chemical properties of the soils such as texture, pH, soluble salt content, lime, EC, organic matter content, boron, aggregate stability, dispersion ratio, suspension and dispersion percent. Disturbed and undisturbed soil samples were taken from 0-10,10-20,20-30, 30-40, 40-60, 60-90 cm depths in May after spring rain and in September when the soils are drier. The obteined data taken from the analyses were evaluated as statistically. The results showed that gypsum doses used as amelioration material are effective to lead Na into soil solution by leaving from soil colloids. However this phenomenon was not found sufficient in the soils of sesecond experimental area. Hence gypsum doses that will be used in soils having high alkalinity should be higher and the soils should be washed with high quality water after gypsum treatment because of unsufficient rains in the area.

Key words: salinity, alkalinity in soil, amelioration, gypsium.

INTRODUCTION

Estimating that the world's popolation will be approximetaly 8 billion in year 2025 there will be a minimum two time increase of nutrition need for human being in the next 50 years (Howel, at all., 2001). Salinity and alkalinity problems reduces soil fertility. Because of that reason the soils for agricultural lands become unuseful conditions. In these study, it is aimed to determine the effects of the amelioration material as gypsum on physical and chemical soil properties of salinity and alkalinity soils in Söke Plain and in Adnan Menderes Universty Resource Practice Farm.

MATERIAL

The Gypsum doses which were applied for the experimental land desing were as fallows: control, 50 kg da-1, 100 kg da-1 and 150 kg da-1. After these applications the soil samples which were taken from different soil depths in time periods were used as material for these study.

METHOD

The different gypsum doses which were applied to an experimental design of 500 m2 follows as: control, 50 kg da-1, 100 kg da-1 and 150 kg da-1 the application were carried out in November. The first soil samples were taken in May and at the same time when the spring rain become less. The disturbed and undisturbed soil samples which were taken in May and at the end of the Spring rain period from different soil depths were 0-10, 10-20, 20-30, 30-40, 40-60 and 60-90 cm.

RESULTS and DISCUSSION

Before applying the different gypsum doses, there were taken from all plots from different soil depths soil samples to make some analyses as ph, EC and Na in order to determining the soil conditions in this area (Table 1.)

Table 1. The analyse results before the gypsum applications.

GYPSUM	I. Test Area				II. Test Area			
	Depth (cm)	pH	EC (dS m^{-1})	Na (ppm)	Depth (cm)	pH	EC (dS m^{-1})	Na (ppm)
50 kg da^{-1}	0-30	8.45	0.38	33	0-30	8.73	3.06	240
	30-60	8.36	0.58	26	30-60	9.72	1.53	280
	60-90	8.33	0.99	31	60-90	9.60	4.14	300
100 kg da^{-1}	0-30	8.43	0.59	29	0-30	8.50	3.07	240
	30-60	8.33	0.71	34	30-60	9.89	1.00	170
	60-90	8.24	1.31	38	60-90	9.71	0.89	180
150 kg da^{-1}	0-30	8.31	0.54	25	0-30	8.88	2.83	320
	30-60	8.38	0.87	29	30-60	9.61	2.30	430
	60-90	8.24	0.77	32	60-90	9.80	1.16	250

According to these results, in the first test area the soils were alkaline and at the second test area the soils showed high alkaline and very high alkaline conditions. According to the EC values, none of the test fields showed a salinity problem. The Na contents showed in the first test area low contents but at the second there was a high content of Na which can lead to alkalinity problems.

The taken soil sample results before applying gypsum showed that gypsum could be a good amelioration material for the second test area. Although there were no problems at the first test area it was thought to apply gypsum to understand how many Na content will take place in soil by moving from the colloid material.

According to the statistical results for both soil sampling periods, at the first test area in the soil surface layer (0-30 cm), the Na, K, Mg and the soil organic matter content changes according to time were statistically significant ($P<0.05$) (table 2).

Table 2. The statistical results at the first test area.

I. Test Area: 0-30 cm depth																
DOSES	pH (1:2,5)	EC (dSm^{-1})	Salt (%)	O.M. (%)	$CaCO_3$ (%)	Na^+	K^+	Ca^{++}	Mg^{++} (me 100 g^{-1})	B (ppm)	Dispersion Percentage (%)	Süspansion Percentage (%)	Dispersion Rate (%)	Porosity (%)	Volume Weight (g/cm^{-3})	Aggregate Stability (%)
Control	7.67	1010	0.04	0.71	9.05	0.47	0.66	10.81	6.55	3.17	54.51	30.46	56.11	43.90	1.42	1.05
50 kg da^{-1} Gypsum	7.60	1043	0.03	0.61	6.27	0.46	0.54	8.60	3.67	3.32	37.62	27.53	73.85	42.65	1.49	0.77
100 kg da^{-1} Gypsum	7.82	944	0.03	0.74	6.50	0.48	1.03	9.51	4.50	3.84	43.71	28.53	65.31	31.70	1.65	1.11
150 kg da^{-1} Gypsum	7.78	817	0.03	0.94	7.60	0.37	0.73	9.97	5.59	3.65	54.38	34.34	63.45	35.97	1.54	1.18
Mean	7.72	954	0.03	0.75	7.35	0.45	0.74	9.72	5.08	3.49	47.55	30.22	64.68	38.56	1.52	1.03
LSD dos :	0.12	ns	ns	0.34	0.9	0.13	ns	0.68	0.93	0.37	5.76	7.12	13.93	7.62	0.14	ns
LSD time	ns	ns	ns	0.14	ns	0.10	0.34	ns	0.43		ns	ns	ns			
LSD dos*time	ns	ns	ns	0.28	ns	0.21	ns	ns	0.86		ns	ns	ns			

I. Test Area: 0-90 cm depth																
DOSES	pH (1:2,5)	EC (dSm^{-1})	Salt (%)	O.M. (%)	$CaCO_3$ (%)	Na^+	K^+	Ca^{++}	Mg^{++} (me 100 g^{-1})	B (ppm)	Dispersion Percentage (%)	Süspansion Percentage (%)	Dispersion Rate (%)	Porosity (%)	Volume Weight (g/cm^{-3})	Aggregate Stability (%)
Control	7.76	849	0.03	0.68	9.26	0.52	0.50	10.81	6.53	3.23	52.37	29.09	56.24	39.47	1.51	0.98
50 kg da^{-1} Gypsum	7.74	1010	0.03	0.68	5.90	0.69	0.37	9.00	4.31	3.35	40.18	27.31	69.02	39.91	1.50	0.88
100 kg da^{-1} Gypsum	7.86	1094	0.03	0.85	6.54	0.86	0.63	9.85	5.38	3.69	46.25	28.89	62.67	33.68	1.63	1.05
150 kg da^{-1} Gypsum	7.83	677	0.02	0.97	7.16	0.45	0.52	10.11	5.69	3.63	50.07	31.03	62.04	32.51	1.63	1.10
Mean	7.80	907	0.03	0.79	7.22	0.63	0.51	9.94	5.48	3.47	47.22	29.08	62.49	36.39	1.57	1.00
LSD dos :	ns	335.14	0.012	0.21	1.41	0.53	ns	0.78	1.44	0.22	6.47	4.79	10.06	6.32	ns	ns
LSD time	ns	ns	ns	0.10	ns	ns	ns	0.37	ns		ns	ns	4.83			
LSD dos*time	ns	ns	ns	0.21	ns	ns	ns	ns	ns		ns	ns	ns			

The Na, Ca, organic matter content, lime and dispersion rates at 0-30 cm soil depth were found statistically significant in the second test area ($P<0.05$). The gypsum applications have statistically significant influence on Ca, pH, Organic matter content, lime, suspension and porosity (table 3).

Table 3. The statistical results at the second test area.

II. Test Area: 0-30 cm depth																
DOSES	pH (1:2,5)	EC (dSm^{-1})	Salt (%)	O.M. (%)	$CaCO_3$ (%)	Na^+	K^+	Ca^{++}	Mg^{++} (me 100 g^{-1})	B (ppm)	Dispersion Percentage (%)	Süspansion Percentage (%)	Dispersion Rate (%)	Porosity (%)	Volume Weight (g/cm^{-3})	Aggregate Stability (%)
Control	7.87	3635	0.12	1.08	13.18	6.41	0.34	9.40	5.53	7.52	60.55	52.70	87.12	47.43	1.37	0.26
50 kg da^{-1} Gypsum	8.20	3452	0.12	0.75	12.19	6.42	0.31	8.77	5.34	8.94	59.54	51.53	86.43	35.00	1.49	0.26
100 kg da^{-1} Gypsum	8.46	2372	0.08	0.59	11.54	5.78	0.30	10.01	5.07	9.09	59.91	53.29	89.00	35.40	1.51	0.17
150 kg da^{-1} Gypsum	8.10	3447	0.12	0.74	11.89	6.71	0.28	9.28	5.90	8.30	60.88	49.92	82.24	46.03	1.38	0.34
Mean	8.16	3226	0.11	0.79	12.20	6.33	0.31	9.37	5.46	8.46	60.22	51.86	86.20	40.97	1.44	0.26
LSD dos :	0.34	ns	ns	0.24	1.42	ns	ns	0.39	ns	ns	ns	7.3	ns	10.39	ns	ns
LSD time	ns	ns	ns	0.23	0.96	1.47	ns	0.87	ns		1.99	ns	ns			
LSD dos*time	ns	169.34	0.05	ns	ns	ns	ns	ns	ns		ns	7.81	12.10			

II. Test Area: 0-90 cm depth																
DOSES	pH (1:2,5)	EC (dSm^{-1})	Salt (%)	O.M. (%)	$CaCO_3$ (%)	Na^+	K^+	Ca^{++}	Mg^{++} (me 100 g^{-1})	B (ppm)	Dispersion Percentage (%)	Süspansion Percentage (%)	Dispersion Rate (%)	Porosity (%)	Volume Weight (g/cm^{-3})	Aggregate Stability (%)
Control	8.38	2951	0.10	0.87	15.21	6.54	0.24	9.27	5.11	7.49	60.75	54.76	90.17	47.22	1.38	0.26
50 kg da^{-1} Gypsum	8.50	2691	0.10	0.77	15.31	5.60	0.21	9.02	4.81	6.73	60.32	53.51	88.67	39.47	1.48	0.35
100 kg da^{-1} Gypsum	8.72	1838	0.06	0.52	15.60	4.96	0.20	9.71	4.26	7.27	60.00	52.76	88.04	37.34	1.53	0.22
150 kg da^{-1} Gypsum	8.43	3131	0.11	0.88	13.30	6.71	0.20	9.30	5.20	7.88	59.81	51.63	86.49	46.62	1.35	0.30
Mean	8.51	2653	0.09	0.76	14.85	5.95	0.22	9.32	4.84	7.34	60.22	53.17	88.34	42.66	1.43	0.28
LSD dos :	ns	967.93	0.038	0.37	ns	ns	ns	ns	ns	ns	ns	ns	ns	6.72	0.13	ns
LSD time	ns	ns	ns	0.22	ns	ns	ns	0.68	ns	ns	1.68	ns	6.44			
LSD dos*time	ns	ns	ns	0.31	ns	ns	ns	ns	ns	ns	ns	ns	ns			

The Na content for 0-30 cm soil depth after gypsum application showed in both test fields important statistical results. In Mai, also after the rain period, the Na content was lower than in the summer period when the soil moisture was higher. This situation can be explained as the capillarity in soil which becomes in summer seasons higher rates that in spring while the Na transfers to the surface layer of the soil. The lack of water condition of these soils leads to a precipitation of Ca and Mg ions as carbonates. Because of that reason the Ca and Mg concentrations decrease and the Na content increases relatively (Saglam, M.T., 1997). The low soil content and the higher lime contents in the second test field can also be explained for that reason.

As the soil moisture increases, the soluble Ca replaces with the adsorbed Na so the soluble Na content becomes higher concentrations in soil. This effect is a function of the available water content in soils. Moreover according to the dilution in soil the adsorbed Na content replaces with H ions so the pH value increases. Meanwhile there can be seen an important increase at the soluble CO3 and HCO3 contents (Munsuz et. al., 2001).

RESULTS

As a result, the applied gypsum material for both test fields affects the soil positively by replacing the Na ions from the colloid material to the soil but insufficient for the soil at the second test field. Because of that reason, those soils which have high lime and alkaline content needs higher gypsum doses and the soluble Na content in soils must be removed with an additional good quality of water where the rain is not sufficient.

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