Influence of,Leaching With Gypsum and Compost of Rice Straw on Improvement of Salt Affected Soil and Rice Growth

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ABSTRACT

A study was conducted to investigate the efficiency of leaching process with gypsum, and compost, and their combination on improvement an unproductive salt affected soil, the rice growth and nutrient uptake. Columns were packed with the salt affected soil collected from northern Nile Delta. The treatments were gypsum in rates of 0, 3, 6, and 9 Migagrame/feddan (Mg fed.$^{-1}$), compost in rates of 10 and 20 Mg fe.$^{-1}$ and combination of 3 gypsum with compost 10 Mg fed.$^{-1}$. The columns were saturated with tap water, and transplanted with rice. Successive leaching was done with same volume of irrigation water. The percolated water volume and its electrical conductivity (EC_d) were measured. Soil physical and chemical properties and plant analysis were done.

The results indicated that absolute differences in leachate volumes, due to leaching process, were relatively small for no amended soil and increased with gypsum application rates. The percolation of water through the gypsum treated soil columns was much faster than control indicating that gypsum was the main factor to percolate process. Compost with gypsum was more effective than compost alone. Electrical conductivity of percolated water (EC_d) values had a sharply decreasing then after the third leaching a slight decreasing was recorded with gypsum treatments. However, the EC_d values had the same trend, but the slight decreasing was retarded until the 4th leaching with compost treatments. The mean value of EC_d in leachate was reduced from 32.83 to 4.63 dSm^{-1}. This decrease was a function of the leaching numbers of the soil.

Consequently, leaching the soil treated with gypsum was more effective in removing the total soluble salts (TSS). Leaching with compost did not create a sodification hazard and ESP obtained values at the end of leaching were lower than the control. As expected the increasing gypsum rates decreased ESP. Moreover, a high degree of soil improvement was realized when leaching began with gypsum+ compost and ESP value was decreased to 11.49.

The results revealed that the rice shoot dry weight was increased from 9.29 to 29.01 g/column as gypsum rates increased from zero to 9 Mg fed$^{-1.}$ The corresponding value for compost was 25.03 g/column at 20 Mg fed.$^{-1}$. The combined effect of compost and gypsum was greater than individual (40.05 g/column). Nitrogen and phosphorus content in rice dry matter was increased with compost application while they were not significantly affected by gypsum application rates. In addition K content was not significantly affected. The Na content was lower, however Ca and Mg content was higher in gypsum compared with compost treatments. Thus, it can be said that leaching the salt affected soil with gypsum plus compost was entirely safe. This treatment is more profitable than the leaching with water only.

Key words: Compost, gypsum, leeching process, salinity, and salt affected soil and rice plant.

INTRODUCTION

Soil degradation in terms of excess of salts is one of the problems in the arid region in general and Egypt in particular. The rapid expansion of irrigated agriculture, together with the presence of inadequate drainage systems led to an unproductive soil environment. Hamdi *et al.* (1996) prepared soil salinity maps for the Northern part of the Nile Delta. They found good fertile soils as well as salt affected ones having different levels of salinity. Since quite a portion of the Northern part of the Nile Delta soils are saline or saline sodic affected to variable degree, gypsum comes into consideration. Its application ahead of rice planting would be better than ahead of any crop because of inundation condition. In the Nile Delta rice is the main crop and occupies annually about 0.6 million hectares, (Tantawi, 2004). The agriculture practices in this region are to remove or burn its straw. These practices led to air pollution and losses of nutrient elements and organic matter. Composting rice straw and additing to soil may increase the moisture holding capacity, maintains sufficient pore spaces to permit good air circulation and drainage of the excessive water and dilution of salt concentrations in the soil solution, (Luken , 1962, P ttaswamygowda and Pratt ,1973, Gupta *et al.*, 1984, El Etreiby,1992 and El-Etreiby *et al.* 1996). Moustafa and Shabassy (1959) pointed out that both organic matter as wheat straw and gypsum ameliorated the black alkaline soil characteristics, but they recommended that addition of decomposed organic matter might be better than wheat straw. Massoud *et al* (1989) found that yield of rice increased by all treatments of gypsum and manure, but the combination of gypsum and manure have more effective. Sharma and Singh (1984) studied the effect of additions of gypsum, urea, super phosphate and zinc sulphate to sodic soil, and found that grain and straw of rice were increased by all treatments. Moreover, Richards (1954) and Kaddah (1963) cleared that the tolerance of rice to salt ranged from 6 to 10 dS.m^{-1}. El

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Ghamry *et al.* (1979) found that the highest yield of rice obtained in the clay loam soil at ESP equal to 15.74, while the lowest one was obtained at 27.81. Kovda (1961) suggested that use of about 2-3 times the field capacity of fresh water to remove the excess soluble salts. In the reclamation of saline and sodic soils, the primary objective is to reduce the concentration of soluble salts and exchangeable sodium in the profile to a non-injurious level by leaching. Reduction of exchangeable sodium involves its replacement on the clay complex by another cation such as calcium, before it is leached, (Richards, 1954, Dutt, 1964, Balba and Ellaithy, 1968, Elgabaly 1975, Balba ,1979 and Massoud *et al.*, 1989).

The presented investigation is an attempt to study the effect of leaching with gypsum, compost rates and their combination upon the (i) soil properties and removal of soluble salts and (ii) on rice growth and nutrient absorption. It is thought that the laboratory study of leaching process simulates the process when it is carried out under the field conditions.

MATERIALS AND METHODS

The current work was carried out in greenhouse at Soil Salinity Lab., Alex. The soil used in this study was a mixture of surface soil samples, 0-30 cm collected from the Nile Delta (Egypt). The soil textural was sandy clay loam (sand 50.9, silt 9.3 and Clay 39.8 %). The soil total N, OC and $CaCO_3$ content were 0.25, 0.34 and 1.33%, respectively. The soil hydraulic conductivity, bulk density and total porosity percentage were 31.20 mm day^{-1}, 1.46 $g.cm^{-3}$ and 44.90 %, respectively. The water chemical compositions and the main soil properties are given in Tables (1) and (2), respectively.

Soil and Plant Analytical Methods:

Bulk density, hydraulic conductivity measurements and mechanical analysis for sand, silt and clay were measured (Day, P.1965). Organic carbon was determined by Walkley-Black method, and total nitrogen by macro-Kjeldahl method (Black ,1965). Exchangeable cations Ca, Mg, K and Na were determined by extraction with 1N NH4OAc solution at pH7 according to Richards (1954). Soluble cations, soluble anions, pH and EC were determined in 1:5 soil - water extracts according to Richards (1954). Shoot samples of the rice plant were taken 66 days after transplanting, washed in 0.1N HCl followed by distilled water, oven dried at 65 C^{o} for 72 hr, ground, digested and analyzed for Na, K, Ca, Mg and total N and P according to Chapman and Parker (1961).

Experimental Procedure:

Perspex columns of 20.0 cm inside diameter and 120.0 cm height were uniformly filled with a mixture of surface soil collected from the Nile Delta, so that a bulk density of 1.46 g cm^{-3} was obtained. A 10 cm layer of sand gravel was placed at the bottom of each column and drainage outlet in the gravel sand layer was connected by tubing to control the percolated water. The columns were saturated with tap water and transplanted with rice (*Oryza sativa L.*) cv. local with five seedlings (25day-old) and thinned later to four/column. The system used for irrigation and drainage consisted of closing the bottom hole in each column filling it with equal amount of irrigation water (5 cm above the soil surface). The water was restricted for four days then all-

Table 1. Analyses of the tap water used in leaching process.

EC dSm^{-1}	pH	soluble anions (meq L^{-1})				soluble anions cations (meq L^{-1})				SAR	KAR
		$CO_3^{=}$	HCO_3^{-}	Cl^{-}	SO_4^{-}	Ca^{++}	Mg^{++}	Na^{+}	K^{+}		
0.49	7.15	--	0.32	1.35	1.00	2.20	1.18	1.7	0.20	1.31	0.15

Table 2. The main characteristics of the used soil (0-30 cm).

pH (1:5)	EC (1:5) $dS.m^{-1}$	Soluble cations (m eq l^{-1})				Soluble anions (m eq l^{-1})				Exchangeable cations meq/100g				ESP
		Na^{+}	K^{+}	Ca^{++}	Mg^{++}	$CO_3^{=}$	HCO_3^{-}	Cl^{-}	$SO_4^{=}$	Na^{+}	K^{+}	Ca^{++}	Mg^{++}	
8.4	4.46	37.92	0.21	2.50	3.79	-	1.10	34.50	8.82	15.40	0.41	8.95	7.54	47.68

-owed to drain from the bottom hole for three days. The successive leaching process was six times during the experimental period. The percolate was collected in a suitable respectable and its volume (Q) and electrical conductivity (EC_d) were measured.

The treatments were applied as follow:

T1 = Control (leaching)

T2 = gypsum (3 Mg fed.$^{-1}$)

T3 =gypsum (6 Mg fed.$^{-1}$)

T4 =gypsum (9 Mg fed.$^{-1}$)

T5 = compost (10 Mg fed.$^{-1}$)

T6 = compost (20 Mg fed.$^{-1}$)

T7 =gypsum (3 Mg fed. -1)+ compost (10 Mg fed.-1)

The gypsum was from EL-gharbaniat containing about 98% CaSO4.2H2O and 2% CaCO3. The gypsum was mixed with the top 20 cm. The C/N ratio of compost was a mean value of 12.95 and the total N and P contents reached 0.88 % and 23.29 ppm, respectively. All columns were fertilized with the recommended rate of N-P-K and placed on a greenhouse bench with open climatically conditions. The experiment was arranged in a complete randomized design with three replicates. Statistical analysis was carried out according to Dagnelie (1975).

RESULTS AND DISCUSSION

The data record in Table (2) show that the physical and chemical properties of the studied soil were poor permeability to water. The hydraulic conductivity was 31.20 mm day^{-1}. The result agreed with that reported by Gobran *et al.* (1982). The EC_s of 1:5 extract was as high as 4.46 dS.m^{-1} with pH of 8.4. It was also found that Na was predominated. Table (3.a.) and Fig. (1) show the percolated volumes as a function of leaching number of irrigation water added with different gypsum rates. The results indicated that absolute differences in leachate volumes, due to leaching process, were relatively small control and increased with gypsum application rates. Furthermore, percolation of water through the gypsum treated soil columns was much faster than that found in the columns without gypsum. These results are in agreement with that reported by Balba and Ellaithy (1968). As gypsum rate increases response curve occupies a higher position; indicating that gypsum was the main factor to percolate process. The data in Table (3.b) and Fig, (2) illustrated that the leaching process with compost and /or gypsum treatments had the same trend.

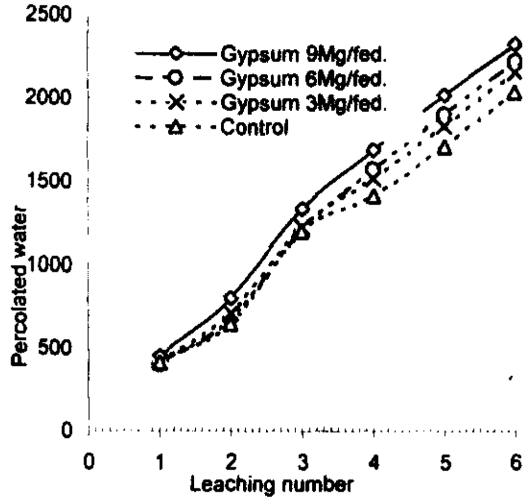

Fig.1. Effect of leaching with gypsum rates on accumulated percolate volume from the coulmns

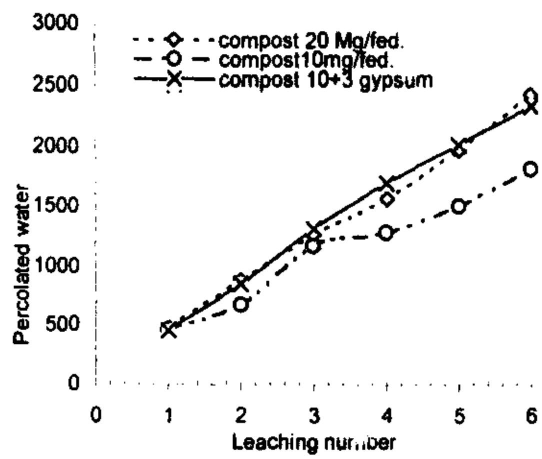

Fig. 2. Effect of leaching with compost and /or gypsum on accumulated percolate volume from the coulmns

Percolated water (EC_d) and removal salts:

Electrical conductivity of percolated water (EC_d) was affected by leaching with gypsum and /or compost rates (Fig.3 and 4). The EC_d values sharply decreased after the second leaching then after the third a slight decreasing was recorded with gypsum treatments. However, with compost treatments the EC_d values had the same trend, but the slight decreasing was retarded until the 4th leaching, (Fig. 4). After 6th leaching, the mean value of EC_d in leachate was reduced from 32.83 to 4.63 dSm^{-1}.

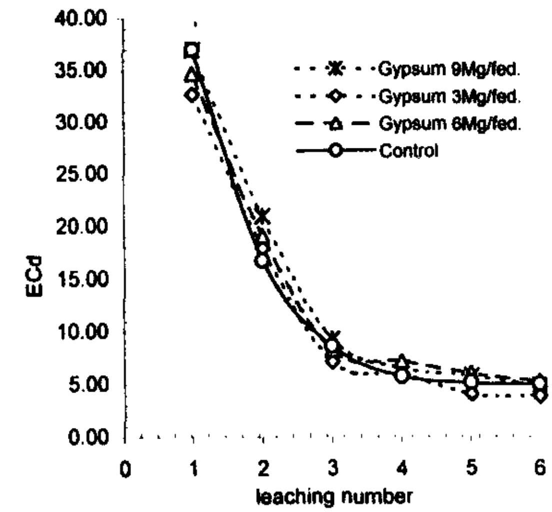

Fig.3. Effect of leaching with gypsum rates on ECd of drainage water from soil column.

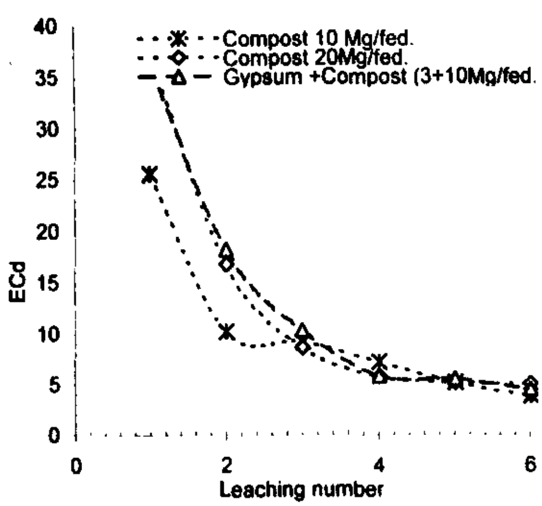

Fig. 4. Effect of leaching with compost and/or gypsum on ECd of drainage water from soil column

In the type of experiments of the solute displacement, a check on the concentration of the solute is always useful. A mass balance check for TSS by use of the trapezoid rule of integration for the area under the experimental curves of Fig. (5) and (6) was done in each case. These calculations indicated that the total soluble salts (TSS) in leachate had the same trend as EC_d for all treatments. The leatchates were high concentrated in the first days of leaching. The greatest part of salts was removed at the second leaching step, after which the rate was greatly reduced in the subsequent steps. When the soil columns were mixed with gypsum, the leaching was more effective in removing the soluble salts, (Table 3.a.). Although, compost addition retarded the amounts of soluble salts, leaching the soil treated with compost did not create a sodification hazard and ESP obtained at the end of leaching were lower than the control. Similar results were found by Moustafa and Shabassy (1959). Comparison between the accumulated salts removed by leaching with gypsum and/or compost, revealed that the gypsum with compost was more effective in displacing the TSS. This would be an indirect effect of compost for enhancing good soil physical properties, which lead to better salt leaching processes. Kovda (1961) suggested that use of about 2-3 times the field capacity of fresh water to remove the excess soluble salts.

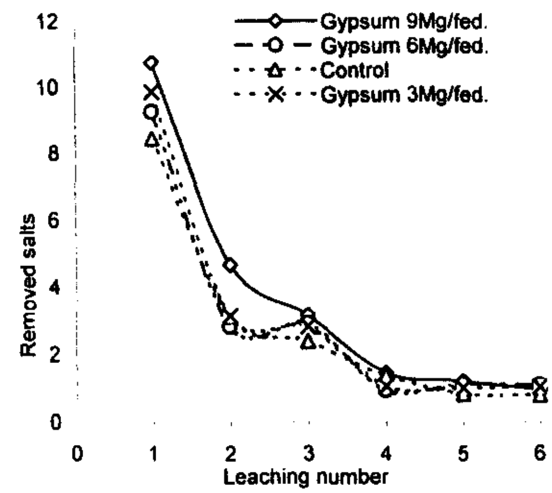

Fig. 5. Effect of leaching with gypsum rates on removed total soluble sails (TSS) from the columns.

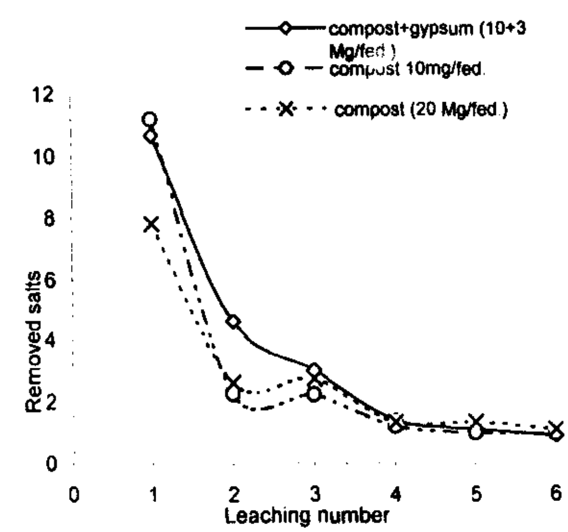

Fig. 6. Effect of leaching with compost rates and/or gypsum on removed total soluble salts (TSS).

Soil salinity and ESP:

The amount of salts remaining in soil columns after leaching process with different treatments are presented in Table (4). The results revealed that salinity as measured by the electrical conductivity (ECs) decreased with increasing leaching water and was related to the rate of amendments. Comparison between the decreasing in the exchangeable sodium by leaching alone and accompanied by gypsum, Table (4), shows that the latter case was more effective in displacing the exchangeable sodium than the former. These results are in agreement with that reported by Dutt *et al.* (1972) and Gobran *et al* (1982). However, leaching reduced EC_s to a mean value of 0.54 compared with initial value of 4.46 $dS.m^{-1}$.

The pronounced effect of leaching on the exchangeable sodium was higher with gypsum and compost treatments and lower with leaching alone. In case of gypsum treatments, exchangeable sodium percentages (ESP) were decreased to 15.66, 11.74 and 10.50 at the rate of 3, 6 and 9 Mg/fed., respectively. The corresponding values with compost treatments were 22.72 and 16.50 at the rate of 10 and 20 Mg/fed., respectively. The combined effect of compost and gypsum was greater than individual, (Table 3). Although compost addition supplied amounts of Na, it did not create a sodification effect and ESP obtained values at the end of leaching were lower than in the control. The leaching alone was reduced the ESP from 47.68 to 26.19. This attributed to contribute the soil $CaCO_3$ providing an additional source for dissolved Ca. Balba (1963) showed that the soil $CaCO_3$ was more soluble under saline conditions and effectively participates in the soil actions. The exchangeable potassium was increased with compost treatments and decreased with leaching alone. This may due to compost which supplying the soil solution by additional amounts of cations. El Etreiby *et al.* (1996) reported that the K from compost of rice straw was estimated to be 1.92 %.

Table 3.a.. Percolated volume (Q),EC_d and removed salts (RS) from the soil columns as affected by successive leaching and gypsum treatments.

Control			Gypsum 3 Mg/fed.			Gypsum 6 Mg/fed.			Gypsum 9 Mg/fed.		
Q (ml)	EC $dS.m^{-1}$	RS (g)	Q (ml)	EC $dS.m^{-1}$	RS (g)	Q (ml)	EC $dS.m^{-1}$	RS (g)	Q (ml)	EC $dS.m^{-1}$	RS (g)
418	37.40	9.90	405	32.70	8.48	418	34.70	9.28	455	37.00	10.77
295	16.79	3.20	275	17.94	3.16	233	19.12	2.85	350	21.00	4.70
515	8.65	2.85	525	7.18	2.41	555	8.26	2.93	532	9.36	3.19
292	5.79	1.08	367	5.99	1.41	210	7.21	0.97	352	6.58	1.48
313	5.15	1.03	330	4.08	0.86	297	6.03	1.15	330	5.82	1.23
327	5.16	1.052	327	3.87	0.81	325	5.31	1.10	312	4.93	0.98

Table 3.b.. Percolated volume (Q), EC_d and removed salts (RS) from the soil columns as affected by 6 successive leaching and compost and/or gypsum treatments.

Compost 10 Mg/fed			Compost 20 Mg/fed			Compost+ Gypsum 10+3 Mg/fed.		
Q (ml)	EC $dS.m^{-1}$	RS (g)	Q (ml)	EC $dS.m^{-1}$	RS (g)	Q (ml)	EC $dS.m^{-1}$	RS (g)
465.0	37.70	11.22	478.5	25.60	7.84	458.0	36.5	10.70
211.0	16.79	2.27	406.0	10.16	2.64	397.0	18.24	4.63
498.5	8.65	2.76	379.5	9.22	2.24	456.5	10.37	3.03
332.0	5.79	1.23	297.0	7.21	1.37	382.0	5.85	1.43
309.0	5.16	1.02	414.5	5.16	1.37	326.5	5.5	1.15
298.0	5.03	0.96	450.5	3.85	1.11	316.0	4.5	0.91

Table 4. Chemical characteristics of the studied soil as affected by leaching with compost and/or gypsum treatments.

Treat. No.	pH (1:5)	EC, (1:5) dS.m^{-1}	Soluble Cations (meL^{-1}) Na	K	Ca	Mg	Exchangeable Cations (me/100g) Na	K	Ca	Mg	ESP
T1	8.8	0.34	1.99	0.26	0.01	0.06	5.81	0.45	8.70	7.22	26.19
T2	8.2	0.47	2.01	0.10	0.03	0.28	3.12	0.50	9.50	6.80	15.66
T3	8.3	0.40	5.96	0.11	0.03	1.02	2.44	0.55	10.95	6.85	11.74
T4	8.2	0.53	5.33	0.12	0.17	1.05	2.38	0.50	12.84	6.65	10.50
T5	8.5	0.97	6.06	1.74	0.05	0.58	4.81	0.62	8.90	6.84	22.72
T6	8.3	0.68	3.29	0.12	0.03	0.36	3.48	0.65	8.98	7.98	16.50
T7	8.4	0.39	3.84	0.09	0.15	0.27	2.55	0.61	10.84	7.50	11.49

Rice growth and nutrients content:

Shoot dry weight, plant height, and elements content of rice as affected by leaching with gypsum and/or compost amendments after 66 days following transplanting are given in Table (5). Shoot dry weight was increased steadily from 9.29 to 29.01 g/column as gypsum application rates increased from 0 to 9 Mg fed^{-1}. The same trend was observed for compost, where application of 10 Mg fed^{-1} increased rice dry weight to 20.29 g/column, further application of compost to 20 Mg fed^{-1} gave higher yield of 25.03 g/column. The data show that the highest dry weight of rice was recorded (40.05 g/column), when treatment T7 (3 Mg fed^{-1} gypsum + 10 Mg fed^{-1} compost) were applied to the salt affected soil. The dry weight of rice was 15.09 and 20.29 g/column for addition 3 Mg fed^{-1} gypsum and 10 Mg fed^{-1} compost alone (T5), respectively. The result of plant height was not significantly affected by gypsum and/or compost treatments.

Nitrogen and phosphorus content in rice dry matter was increased clearly to 0.24 and 30.6 ppm, respectively as compost application was 10 Mg fed^{-1}, (T5). The highest N content were observed at 20 Mg fed^{-1} (T6). The data indicated that N and P contents in rice were not significantly affected by gypsum application rates. In addition K content was not significantly affected by either gypsum or compost treatments. Sodium content was generally decreased by gypsum application rates. Moreover, Na content in rice was lower in gypsum treatments (T2, T3, and T4) compared with compost treatments (T5 and T6). These results led to the conclusion that gypsum is a good source of Ca^{+2} that replaced Na^{+} on the exchange complex, which in turn leached out by irrigation water. This was not the case in using compost application at

Table 5. Rice dry weight, plant height and elements content as a function of treatments.

Treat No..	Plant weight (g/column) (cm)	Plant height	Elements content Total N %	P mg. K^{-1}	Na	K	Ca	Mg
					-------	%	-------	
T1	9.29g	43.0	0.18d	15.0ab	1.52a	1.77	038d	0.22c
T2	15.09f	44.5	0.20c	14.9ab	0.76b	1.75	0.45cd	0.36b
T3	17.59 e	43.5	0.19c	19.3ab	0.57b	1.66	0.57b	0.38b
T4	29.01b	42.0	0.17d	13.6b	0.56b	1.67	0.74a	0.51a
T5	20.29d	40.5	0.24b	30.6a	1.35a	1.81	0.41cd	0.29c
T6	25.01c	42.5	0.32a	38.6a	1.47a	1.84	0.48bc	0.24c
T7	40.05a	45.0	0.25d	31.3a	0.65b	1.85	0.48bc	0.40b
$L.S.D_{(0.05)}$	1.55	n.s	0.02	15.30	0.24	n.s	0.84	0.06

which Na^+ in soil solution was higher and as a result Na content in rice dry matter was higher. Calcium and magnesium were 0.74 and 0.51 % for 9 Mg fed^{-1} gypsum compared with 0.38 and 0.22 % for control, respectively. The same trend was observed for compost, which increased Ca and Mg content distinctly at 20 Mg fed^{-1}.

The results suggest that both amendments helped in boosting the rice plant, which may be the results of direct nutritional effect as well as indirectly through improving soil physical and chemical soil properties. El Etreiby *et al.* (1996) reported that the nutritional effect of compost of rice plants was estimated to be 4.4 % N, 0.3 % P, and 1.92 % K. It is clear that the combined effect of gypsum and compost was greater than individual and leaching salt affected soils with both amendments was entirely safe. This treatment was more profitable than the leaching with water only regardless of the amounts of water percolated and leaching period under the experimental conditions.

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الملخص العربي

تأثير عملية الغسيل مع الجبس وكمبوست قش الأرز على تحسين الأراضي المتأثرة بالأملاح ونمو الأرز

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في تجربة تم تنفيذها لدراسة كفاءة عملية الغسيل مع إضافة معدلات من الجبس وكومبوست قش الأرز ومخلوط منهما على تحسين ارض متأثرة بالأملاح وغير منتجة وأيضا على نمو الأرز وامتصاص العناصر الغذائية. تم تعبئة أعمدة بقطر ٢٠وارتفاع ١٢٠ سم بأرض متأثرة بالملوحة مأخوذة من مناطق شمال الدلتا. و تشتمل معاملات الدراسة على الغسيل بعد إضافة الجبس بمعدلات: مقارنة، ٣، ٦و ٩ ميجا جرام /فدان – إضافة كمبوست قش الأرز معدلات ١٠، ٢٠ ميجا جرام /فدان – إضافة ٣ ميجا جرام /فدان جبس + ١٠ ميجا جرام /فدان كمبوست. تم تشبيع الأعمدة بماء الرى (الحنفية) وشتل الأرز (٢٥يوم).وأجريت عملية الغسيل ٦ مرات بكميات متساوية من مياة الرى لكل عمود. قدر حجم الراشح وتم قياس ECd فيه وحسبت الأملاح الكلية به . وكذا قدرت الخواص الطبيعية و الكيماوية للأرض. وتم تقدير الوزن الجاف والطول لنبات ا لأرز وتحليل العناصر عند عمر ٦٦ يوما.

أوضحت الدراسة أن الفرق المطلق فى أحجام مياه الصرف المتحصل عليها نتيجة لعملية الغسيل كانت صغيرة نسبيا لمعاملة المقارنة ويزداد بزيادة معدلات اضافة الجبس. حيث كان الراشح خلال الأرض المعاملة بالجبس أسرع من معاملة المقارنة. وهذا يدل على أن الجبس هو العامل الاساسى المؤثر فى عملية الرشح وذلك تتفادى سيادة Mg و Na. إضافة كمبوست قش الأرز مع الجبس كان أكثر فاعلية من الكمبوست فقط.

بينت الدراسة انخفاض كبير فى قيمة التوصيل الكهربى للراشح ECd فى بداية عمليات الغسيل حتى الغسلة الثالثة وبعدها يصبح الانخفاض صغيرا وذلك فى الأعمدة المعاملة بالجبس ، أما الأعمدة المعاملة بالكمبوست فتسلك نفس الاتجاة ولكن حتى الغسلة الرابعة. و انخفضت متوسط قيم التوصيل الكهربى لماء الصرف ECd من ٣٢,٨٣ الى ٤,٦٣ ديسى سيمتر/ م وبالتالى فأن الغسيل فى وجود الجبس كان أكثر كفاءة فى ازالة الأملاح الذائبة الكلية من الأرض. وبالرغم من أن الكمبوست عطل قليلا من مرور الماء خلال الأرض أثناء عملية الغسيل إلا أنها تقلل من الاضرارالناتجة من زيادة الصوديوم وكانت النسبة المئوية للصوديوم المتبادل ESP اقل من معاملة المقارنة فى نهاية عملية الغسيل. وتحقق تحسن للأرض بدرجة كبيرة باستعمال مياة الغسيل مع اضافة الجبس+ الكمبوست حيث انخفضت قيمة ESP الى ١١,٤٩.

وأظهرت النتائج زيادة الوزن الجاف لنبات الأرز من ٩,٢٩ إلى ٢٩,٠١ جم / عمود عند زيادة معدلات الجبس من صفر إلى ٩ ميجا جرام /فدان. وكانت القيمة المقابلة مع زيادة معدل الكمبوست إلى ٢٠ ميجا جرام هي ٢٥,٠٣ جم /عمود. بينما كان التأثير المشترك للجبس والكمبوست أعلى من كلا منفرد (٤٠,٠٥جم/عمود). وقد زاد محتوى الأرز منN وP مع معاملات الكمبوست بينما لم يكن للجبس تأثير معنوي. وكذا Kلم يتأثر معنويا . أنخفض Na وزاد Ca و Mg مع معاملات الجبس مقارنة بمعاملات الكمبوست. ويمكن القول أن عملية الغسيل الأرض المتأثرة بالأملاح مع إضافة الجبس والكمبوست كانت أمنة تماما. هذه المعاملة فائدتها اكبر من عملية الغسيل بالمياه فقط.