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INFLUENCE OF GYPSUM, RICE-HULL AND DIFFERENT LEVELS OF SALINE WATER IRRIGATION ON WATER SOLUBLE CATIONS AND ORGANIC MATTER CONTENT IN DIFFERENT SALINE SOILS IN RESPONSE TO WHEAT

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ABSTRACT

Water soluble Na content in saline soils were increased strikingly with the increment of salinity levels (6, 12 dS m^{-1}) and also with time, which ranged from 0.30 to 3.87 C mol kg^{-1} and 0.59 to 3.82 C mol kg^{-1} in Sonagazi and Badarkhali saline soils at maturity stage, respectively. Gypsum and rice-hull alone or in combinations were observed to be effective in decreasing Na even at the higher salinity levels. Water soluble K, Ca and Mg were found to be increased with the treatments. In Sonagazi soil Na content 43.40%, K 42%, Ca 33.33% and Mg 30.37% decreased with the combined application of gypsum 300 kg ha^{-1} and rice-hull 8 t ha^{-1} as compared with controlled ($EC_0G_0H_0$). Same as in Badarkhali saline soil Na content 44.34% and Ca content 23.40% decreased with the combined application of gypsum 300 kg ha^{-1} and rice-hull 8 t ha^{-1}, but K content 45.63% decreased with the application of gypsum 300 kg ha^{-1} alone, whereas Mg content 11.76% decreased with the combined application of gypsum 300 kg ha^{-1} and rice-hull 4 t ha^{-1} as compared with controlled ($EC_0G_0H_0$) at maturity stage of wheat. In both saline soils organic matter content increased with the increased salinity levels. Organic matter content 48.78% and 48.68% increased in Sonagazi and Badarkhali saline soil respectively with the combined application of gypsum 300 kg ha^{-1} and rice-hull 8 t ha^{-1}.

KEYWORDS: Wheat, Gypsum, Rice Hull, Salinity, Soluble Cations

INTRODUCTION

The problem of salt-affected soils has gained ever-increasing importance in science, technology, ecology, and economics alike during the last decades. Soil salinization is closely associated to these often conflicting requirements and has become a global problem, even one of the most important issues in many countries, as manifested by recent land utilization programs taking into account protection of the natural environment [1]. Salinization is one of the major soil degradation processes that has turned millions of hectares of our agricultural land unfit for profitable crop production [2]. Soil salinization does not only mean a simple increase in the amount of salt in the soil, but also entails catastrophic changes in soil properties which render the soil useless for agriculture. Salts affect certain soil physicochemical properties, which may reduce the suitability of the soil as a medium for plant growth. Salinity is not only a problem in arid areas but also in the coastal areas under humid conditions [3]. Salinity is a growing problem for farmers worldwide. The UN Food and Agriculture Organization [4] in Rome estimates that more than 700 million hectares of the world's soil – an area which would cover about two-thirds of the US- are poisoned either by salt or by other forms of sodium. On arable land, much of the problem is of farmer's own making, because they spray their crops with poor- quality, salt water. The FAO estimates that 20 per cent of irrigated farmland is now choked with salt, plus 2 per cent of non-irrigated land. In effort to keep this land productive, researches are attempting to develop new strains of crop that survive in salty soil [5].The salts, which cause salinity, have historically been associated with the Indus plains, which were formed by alluvial deposition into shallow sea [6].Salinity problem received very little attention in the past, but due to increased demand for growing more food to feed the booming population of the country it has became imperative to explore the potentials of these lands. [7]. As in a growing population and developing irrigated agriculture, the problems are far too many and therefore efforts to overcome them have accordingly to be concerted and undaunted. An objective portrayal of the true state of art in the management and reclamation of existing saline soils and prevention of salinization in the newly irrigated lands is an equally challenging task. Many research reported that the application of saline water with gypsum increased the removal of Na from the soil profile, appreciably decreased the soil pH, improved water infiltration rate and raised crop yield. Rice hull also improved water holding capacity of soil. It also increased organic matter content of the soil and subsequently increased crop yield.

METHODS

The study was conducted using BARI-20 (Gourave) wheat in the net house at Dhaka University, Bangladesh to evaluate the effect of different levels of salinity, gypsum and rice-hull in relation to saline soil reclamation. The soils were collected from Sonagazi thana of Feni (Latitude $20^0 25^/$ to $23^0 02^/$ N), and from Badarkhali thana of Cox's Bazar (Lantitude $88^0 35^/$ to $92^0 24^/$). Sonagazi soil was a Silty Clay Loam (fine silt, saline, poorly drained, derived from young tidal deposits, isohyperthermic *Aeric Fluvaquent*) affected by various degree of salinity and has an EC_e 4.6 dS m^{-1}, pH 7.6, organic matter 1.11%, total N 0.12% , C/N ratio 9.6, available N 52 mg kg^{-1}, available S 329 mg kg^{-1}, available P 2.7 mg kg^{-1} [8], carbonate nil [8], bicarbonate 0.06% [8], CEC 23.03 C mol kg^{-1} [9], water soluble ions viz. Na 0.45 C mol kg^{-1}, K 0.07 C mol kg^{-1}(flame photometer), Ca 0.50 C mol kg^{-1} , Mg 2.12 C mol kg^{-1} (EDTA method), exchangeable cations viz. Ca 7.50 C mol kg^{-1}, Mg 3.75 C mol kg^{-1} ,Na 0.83 C mol kg^{-1}, K 0.32 C mol kg^{-1} and moisture content 3% [10]. Badarkhali soil was also a Silty clay loam affected by various degree of salinity and has an EC_e 9.2 dS m^{-1}, $_p{}^H$ 6.4, organic matter 1.50%, total N 0.17% , C/N ratio 8.9, available N 31 mg kg^{-1}, available S 451 mg kg^{-1} , available P 1.6 mg kg^{-1} [8], carbonate nil [8], bicarbonate 0.06% [8], CEC 28.74 C mol kg^{-1} [9], water soluble ions viz. Na 1.74 C mol kg^{-1}, K 0.19 C mol kg^{-1}(flame photometer), Ca 0.50 C mol kg^{-1} , Mg 1.50 C mol kg^{-1} (EDTA method), exchangeable cations viz. Ca 6.25 C mol kg^{-1}, Mg 7.50 C mol kg^{-1}, Na 2.22 C mol kg^{-1}, K 0.77 C mol kg^{-1} and moisture content 2.3% [10].

Table 1: Treatment Combinations of the Experiment Used

Sonagazi Soil		Badarkhali Soil	
Pot No.	**Treatment**	**Pot No.**	**Treatment**
T_1	$EC_0G_0H_0$	T_{28}	$EC_0G_0H_0$
T_2	$EC_6G_0H_0$	T_{29}	$EC_6G_0H_0$
T_3	$EC_{12}G_0H_0$	T_{30}	$EC_{12}G_0H_0$
T_4	$EC_0G_{200}H_0$	T_{31}	$EC_0G_{200}H_0$
T_5	$EC_6G_{200}H_0$	T_{32}	$EC_6G_{200}H_0$
T_6	$EC_{12}G_{200}H_0$	T_{33}	$EC_{12}G_{200}H_0$
T_7	$EC_0G_{300}H_0$	T_{34}	$EC_0G_{300}H_0$
T_8	$EC_6G_{300}H_0$	T_{35}	$EC_6G_{300}H_0$
T_9	$EC_{12}G_{300}H_0$	T_{36}	$EC_{12}G_{300}H_0$
T_{10}	$EC_0G_0H_4$	T_{37}	$EC_0G_0H_4$
T_{11}	$EC_6G_0H_4$	T_{38}	$EC_6G_0H_4$
T_{12}	$EC_{12}G_0H_4$	T_{39}	$EC_{12}G_0H_4$
T_{13}	$EC_0G_0H_8$	T_{40}	$EC_0G_0H_8$
T_{14}	$EC_6G_0H_8$	T_{41}	$EC_6G_0H_8$
T_{15}	$EC_{12}G_0H_8$	T_{42}	$EC_{12}G_0H_8$
T_{16}	$EC_0G_{200}H_4$	T_{43}	$EC_0G_{200}H_4$

Table 1: Contd.,

T_{17}	$EC_6G_{200}H_4$	T_{44}	$EC_6G_{200}H_4$
T_{18}	$EC_{12}G_{200}H_4$	T_{45}	$EC_{12}G_{200}H_4$
T_{19}	$EC_0G_{200}H_8$	T_{46}	$EC_0G_{200}H_8$
T_{20}	$EC_6G_{200}H_8$	T_{47}	$EC_6G_{200}H_8$
T_{21}	$EC_{12}G_{200}H_8$	T_{48}	$EC_{12}G_{200}H_8$
T_{22}	$EC_0G_{300}H_4$	T_{49}	$EC_0G_{300}H_4$
T_{23}	$EC_6G_{300}H_4$	T_{50}	$EC_6G_{300}H_4$
T_{24}	$EC_{12}G_{300}H_4$	T_{51}	$EC_{12}G_{300}H_4$
T_{25}	$EC_0G_{300}H_8$	T_{52}	$EC_0G_{300}H_8$
T_{26}	$EC_6G_{300}H_8$	T_{53}	$EC_6G_{300}H_8$
T_{27}	$EC_{12}G_{300}H_8$	T_{54}	$EC_{12}G_{300}H_8$

EC_0, EC_6, EC_{12} represent salinity level 0, 6, 12 dS m^{-1}.G_0, G_{200}, G_{300} represent 0, 200, 300 kg ha^{-1} gypsum.H_0, H_4, H_8 represent 0, 4, 8 t ha^{-1} rice hull. Six kg of air dried, ground and 2.0 mm sieved composite soils was filled in each earthen pots. The seeds were collected from the courtesy of Bangladesh Agriculture Research Institute (BARI), Gajipur. As a basal dose half of Urea and TSP fertilizers are mixed with the soil of each pot as respectively 240 kg ha^{-1} and 450 kg ha^{-1}. Then the soil was irrigated with tap water. Seeds are sown in the pot.

After sowing soils are irrigated with tap water by sprinkler process when required. Weeding is done after 15 days of seedling. Another half of Urea and TSP are given in the pot on this day. Irrigation with saline water started after 55days of seedling. Each pot required 300 ml of saline water.

RESULTS AND DISCUSSIONS

Water soluble Na, K, Ca and Mg content in soil increased with the application of higher levels of saline water. And the higher levels of saline water irrigation decreased the growth of wheat but the application of gypsum and rice-hull was found to be additive for growth even at the highest level of saline water irrigation.

Sodium

The water soluble sodium content increased markedly with the increase of salinity levels in both Sonagazi and Badarkhali saline soil. The Na content also increased with the advanced stage of growth. Application of gypsum and rice-hull alone and their combination was found to be effective in decreasing Na content in both soils (Figure: 1&2). In Sonagazi saline soil, the maximum value of Na was found 3.87 C mol kg^{-1} with the treatment $EC_{12}G_0H_0$ and the minimum value 0.30 C mol kg^{-1} was found with the treatment $EC_0G_{300}H_8$.

But in Badarkhali soil the maximum value of Na was found 3.82 C mol kg^{-1} with the treatment $EC_{12}G_0H_0$ and the minimum value was found 0.59 C mol kg^{-1} with the treatment $EC_0G_{300}H_8$. Gypsum at the rate of 300 kg ha^{-1} is more effective for decreasing Na content in Sonagazi soil than that of gypsum 200 kg ha^{-1}. While trend of effects of gypsum was observed reverse in Badarkhali soil. Rice hull at the rate of 8 t ha^{-1} is also more effective than 4 t ha^{-1} in both soils.

Within the combinations of rice-hull and gypsum, rice-hull of 4 t ha^{-1} with gypsum of 200 and 300 kg ha^{-1} were found to reduce more sodium content than other combinations in Sonagazi soil and Badarkhali soil. The results obtained in this experiment are in close conformity with the findings of Jain (13), who reported that the concentration of sodium increased in different degree in soil with higher levels of saline water irrigation. These results are also in similar with earlier research findings of Gupta [11].

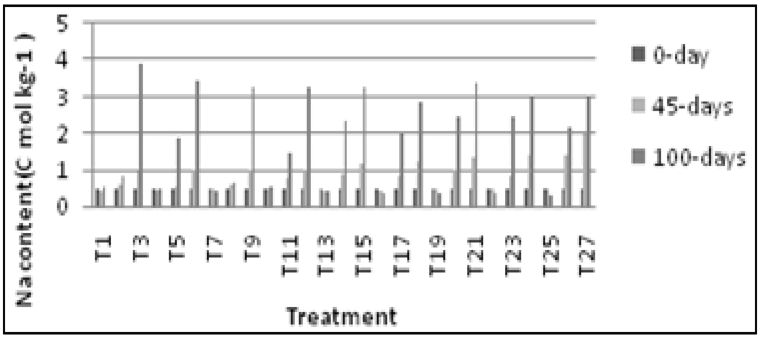

Figure 1: Na Content at Sonagazi Saline Soil at Different Stage at Wheat as Influenced by Gypsum, Rice-Hull and Different Levels of Salinity

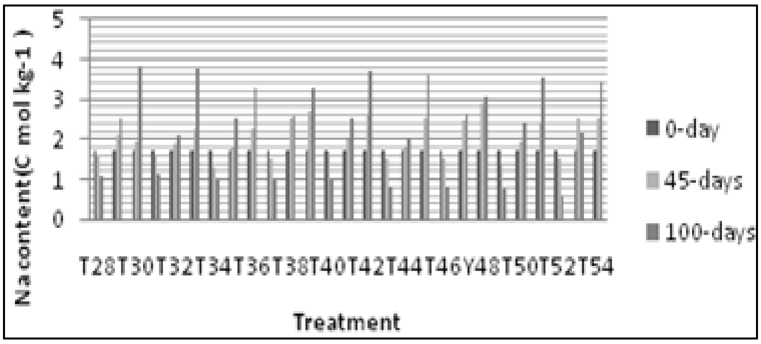

Figure 2: Na Content at Badarkhali Saline Soil at Different Stage of Wheat as Influenced by Gypsum, Rice-Hull and Different Levels of Salinity

Potassium

K content in soil also increased with application of higher levels of salinity. Gypsum and rice-hull alone and the combination of them was found to be effective in decreasing K content in both soils (Figure 3 & 4). Gypsum at the rate of 300 kg ha^{-1} is more effective than 200 kg ha^{-1} in both soils to decrement of K content. Rice-hull at the rate of 4 t ha^{-1} was also more effective than 8 t ha^{-1} in both soils. In Sonagazi soils the combination of rice-hull 8 t ha^{-1} with gypsum 200 and 300 kg ha^{-1} was found more effective than other combination for reducing salinity level. But in Badarkhali soil rice-hull 4t ha^{-1} with gypsum 200 and 300 kg ha^{-1} was found more effective for decreasing salinity in the soil. The highest concentration of K was found 0.383 C mol kg^{-1} in Sonagazi soil and in Badarkhali soil the highest value was 0.452 C mol kg^{-1} which was found with the treatment $EC_{12}G_0H_0$ in both soils. In Sonagazi soil the lowest value was 0.029 mol kg^{-1} with the treatment $EC_0G_{300}H_8$. But in Badarkhali soil gypsum 300 kg ha^{-1} alone is responsible for the lowest value of K content which is 0.056 C mol kg^{-1}. Increasing the salinity of irrigation water increased the concentration of both Na and K ions in soil which is similar with the finding of this experiment [12].

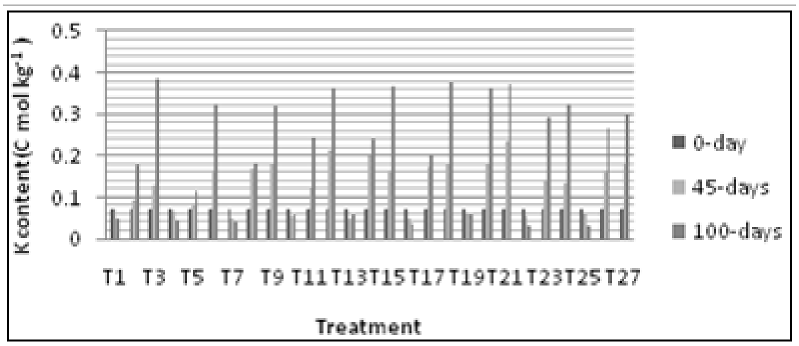

Figure 3: K Content at Sonagazi Saline Soil at Different Stage of Wheat as Influenced by Gypsum, Rice-Hull and Different Levels of Salinity

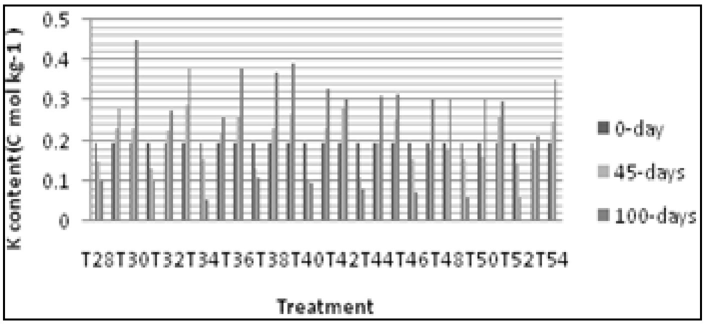

Figure 4: K Content at Badarkhali Saline Soil at Different Stage of Wheat as Influenced by Gypsum, Rice-Hull and Different Levels of Salinity

Calcium

Water soluble calcium content of all soils are presented in Table 2. Like Na and K, Ca content also markedly increased with the increased level of salinity in both soils (Table 3). Application of gypsum and rice-hull alone and their combination was found to be effective in decreasing Ca content in both soils, though they were irrigated with saline water. In both Sonagazi and Badarkhali saline soil the maximum value of Ca was found with the treatment $EC_{12}G_0H_0$ which were 2.22 C mol kg^{-1} and 2.50 C mol kg^{-1} respectively at maturity stage. The minimum value in both soils were found with the treatment $EC_0G_{300}H_8$, in Sonagazi soil which was 0.30 C mol kg^{-1} and 0.36 C mol kg^{-1} in Badarkhali soil. Gypsum application at the rate of 200 kg ha^{-1} is more effective than 300 kg ha^{-1} in Sonagazi soil. But in Badarkhali soil gypsum of 300 kg ha^{-1} is more effective. Rice-hull of 8 t ha^{-1} alone was more effective in Sonagazi soil for reducing Ca, but in Badarkhali soil rice-hull 4 t ha^{-1} was found to reduce more calcium content than 8 t ha^{-1}.

Magnesium

Water soluble Mg content was found increased with the increase of salinity levels in both soils (Table 3). But with the application of gypsum, rice-hull and their combination like Na, K, and Ca in both soils Mg content also decreased though they are irrigated with saline water. At maturity stage in both soils highest value of Mg was found with the treatment of $EC_{12}G_0H_0$. In Sonagazi soil the highest value was 3.25 C mol kg^{-1} and in Badarkhali soil it was 2.95 C mol kg^{-1}. Gypsum of 300 kg ha^{-1} was more effective in Sonagazi soil than gypsum of 200 kg ha^{-1} in case of decreasing Mg level. But in Badarkhali soil gypsum of 200 kg ha^{-1} was more effective to reducing Mg level. Within the combinations, gypsum 200 kg ha^{-1} with rice-hull 4 t ha^{-1} and 8 t ha^{-1} reduce more Mg content in both Sonagazi and Baderkhali saline soils at the maturity stage. The concentration of sodium, calcium and magnesium increased in different degrees in soil with higher levels of saline water irrigation [13]. These results are also in similar with earlier research findings of Gupta [11].

Table 2: Water Soluble Ca (C Mol Kg^{-1}) of Sonagazi and Badarkhali Soil at Different Stage of Growth of Wheat (BARI-20) as Influenced by Gypsum and Rice Hull in Association with Alternate Saline Water Irrigation

Treatment Denotation	Pot No	Sonagazi Soil (Days)			Pot No	Badarkhali Soil (Days)		
		0	45	100		0	45	100
$EC_0G_0H_0$	T1	0.50	0.47	0.45	T28	0.50	0.48	0.47
$EC_6G_0H_0$	T2	0.50	0.72	1.05	T29	0.50	1.14	1.52
$EC_{12}G_0H_0$	T3	0.50	0.90	2.22	T30	0.50	1.55	2.50
$EC_0G_{200}H_0$	T4	0.50	0.45	0.36	T31	0.50	0.47	0.43
$EC_6G_{200}H_0$	T5	0.50	0.65	0.97	T32	0.50	1.02	1.13
$EC_{12}G_{200}H_0$	T6	0.50	0.79	1.05	T33	0.50	1.10	1.25
$EC_0G_{300}H_0$	T7	0.50	1.40	0.31	T34	0.50	0.45	0.41

Table 2: Contd.,

$EC_6G_{300}H_0$	T8	0.50	1.10	1.20	T35	0.50	0.59	0.69
$EC_{12}G_{300}H_0$	T9	0.50	1.15	1.57	T36	0.50	0.65	1.10
$EC_0G_0H_4$	T10	0.50	0.47	0.44	T37	0.50	0.48	0.46
$EC_6G_0H_4$	T11	0.50	0.25	1.58	T38	0.50	1.12	1.92
$EC_{12}G_0H_4$	T12	0.50	1.30	1.80	T39	0.50	1.36	1.97
$EC_0G_0H_8$	T13	0.50	1.15	0.43	T40	0.50	0.47	0.46
$EC_6G_0H_8$	T14	0.50	1.17	1.54	T41	0.50	1.52	1.98
$EC_{12}G_0H_8$	T15	0.50	1.20	1.73	T42	0.50	0.67	1.15
$EC_0G_{200}H_4$	T16	0.50	0.42	0.40	T43	0.50	0.46	0.43
$EC_6G_{200}H_4$	T17	0.50	0.57	1.04	T44	0.50	1.00	1.93
$EC_{12}G_{200}H_4$	T18	0.50	0.82	1.95	T45	0.50	1.05	1.12
$EC_0G_{200}H_8$	T19	0.50	0.40	0.37	T46	0.50	0.45	0.41
$EC_6G_{200}H_8$	T20	0.50	0.55	0.98	T47	0.50	1.50	1.65
$EC_{12}G_{200}H_8$	T21	0.50	0.96	1.90	T48	0.50	1.52	1.95
$EC_0G_{300}H_4$	T22	0.50	0.41	0.39	T49	0.50	0.40	0.37
$EC_6G_{300}H_4$	T23	0.50	0.56	1.00	T50	0.50	1.15	1.78
$EC_{12}G_{300}H_4$	T24	0.50	0.85	1.70	T51	0.50	1.30	1.98
$EC_0G_{300}H_8$	T25	0.50	0.45	0.30	T52	0.50	0.41	0.36
$EC_6G_{300}H_8$	T26	0.50	0.75	1.06	T53	0.50	1.35	1.78
$EC_{12}G_{300}H_8$	T27	0.50	1.05	1.66	T54	0.50	1.61	1.79

EC_0, EC_6, EC_{12} represent salinity level 0, 6, 12 dS m^{-1}.G_0, G_{200}, G_{300} represent 0, 200, 300 kg ha^{-1} gypsum.H_0, H_4, H_8 represent 0, 4, 8 t ha^{-1} rice hull.

Table 3: Water Soluble Mg (C Mol Kg-1) of Sonagazi and Badarkhali Soil at Different Stage of Growth of Wheat (BARI-20) as Influenced by Gypsum and Rice Hull in Association with Alternate Saline Water Irrigation

Treatment Denotation	Pot No	Sonagazi Soil (Days)			Pot No	Badarkhali Soil (Days)		
		0	45	100		0	45	100
$EC_0G_0H_0$	T1	2.12	1.50	1.35	T28	1.50	0.25	1.02
$EC_6G_0H_0$	T2	2.12	2.17	2.20	T29	1.50	0.96	2.50
$EC_{12}G_0H_0$	T3	2.12	2.50	**3.25**	T30	1.50	2.21	**2.95**
$EC_0G_{200}H_0$	T4	2.12	2.00	1.78	T31	1.50	1.03	0.98
$EC_6G_{200}H_0$	T5	2.12	2.15	2.67	T32	1.50	2.05	2.50
$EC_{12}G_{200}H_0$	T6	2.12	2.30	2.92	T33	1.50	2.20	2.90
$EC_0G_{300}H_0$	T7	2.12	1.65	1.02	T34	1.50	2.00	0.95
$EC_6G_{300}H_0$	T8	2.12	2.30	2.51	T35	1.50	2.25	2.60
$EC_{12}G_{300}H_0$	T9	2.12	2.50	2.74	T36	1.50	2.50	2.69
$EC_0G_0H_4$	T10	2.12	1.47	1.18	T37	1.50	1.30	1.15
$EC_6G_0H_4$	T11	2.12	2.63	2.97	T38	1.50	1.55	2.12
$EC_{12}G_0H_4$	T12	2.12	2.55	2.99	T39	1.50	1.69	2.56
$EC_0G_0H_8$	T13	2.12	1.35	1.10	T40	1.50	1.31	1.08
$EC_6G_0H_8$	T14	2.12	2.40	2.50	T41	1.50	1.55	1.78
$EC_{12}G_0H_8$	T15	2.12	2.55	2.78	T42	1.50	1.58	2.00
$EC_0G_{200}H_4$	T16	2.12	2.00	1.01	T43	1.50	0.40	0.97
$EC_6G_{200}H_4$	T17	2.12	2.10	2.33	T44	1.50	0.70	2.00
$EC_{12}G_{200}H_4$	T18	2.12	2.62	2.75	T45	1.50	1.55	2.55
$EC_0G_{200}H_8$	T19	2.12	1.50	1.12	T46	1.50	1.21	0.92
$EC_6G_{200}H_8$	T20	2.12	2.55	2.74	T47	1.50	2.20	2.50
$EC_{12}G_{200}H_8$	T21	2.12	1.55	2.98	T48	1.50	2.00	2.27
$EC_0G_{300}H_4$	T22	2.12	2.00	1.09	T49	1.50	1.00	**0.90**
$EC_6G_{300}H_4$	T23	2.12	2.39	2.57	T50	1.50	1.98	2.06
$EC_{12}G_{300}H_4$	T24	2.12	2.51	2.83	T51	1.50	2.06	2.24
$EC_0G_{300}H_8$	T25	2.12	1.06	**0.94**	T52	1.50	1.29	0.93
$EC_6G_{300}H_8$	T26	2.12	2.60	2.77	T53	1.50	2.03	2.47
$EC_{12}G_{300}H_8$	T27	2.12	2.86	2.93	T54	1.50	2.22	2.63

EC_0, EC_6, EC_{12} represent salinity level 0, 6, 12 dS m^{-1}.G_0, G_{200}, G_{300} represent 0, 200, 300 kg ha^{-1} gypsum.H_0, H_4, H_8 represent 0, 4, 8 t ha^{-1} rice hull.

Organic Matter

Sonagazi saline soil contained 1.113% and Badarkhali saline soil contained 1.501% organic matter initially. The percentage of organic matter content in the soil increased with increasing of salinity levels, these may be due to the low decomposition of organic matter at higher levels of salinity. On the other hand, percentage of organic matter content decreased with the addition of gypsum but with the addition of rice-hull organic matter content increased in the soil. Both in Sonagazi and Badarkhali saline soil the maximum value 0.279% and 0.621% was found with the treatment $EC_{12}G_{300}H_8$ and the minimum value 0.042% and 0.194% was found with the treatment $EC_0G_{300}H_0$ at the maturity stage.

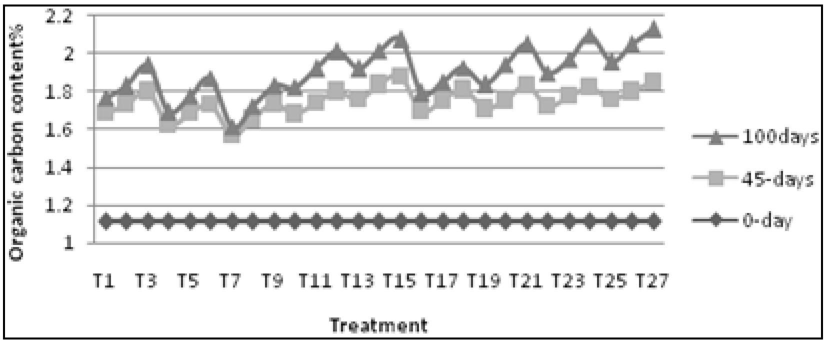

Figure 5: Organic Matter Content (%) in Sonagazi Saline Soils at Different Stage of Growth of Wheat as Influenced by Gypsum Rice-Hull in Association with Different Level of Saline Water Irrigation

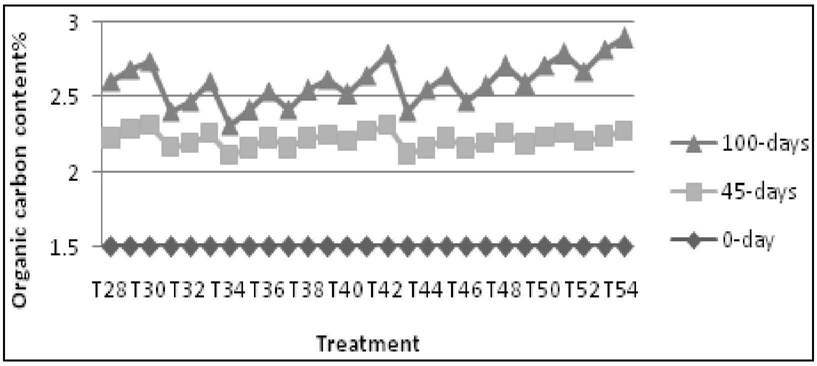

Figure 6: Organic Matter Content (%) in Badarkhali Saline Soils at Different Stage of Growth of Wheat as Influenced by Gypsum Rice-Hull in Association with Different Level of Saline Water Irrigation

Gypsum at the rate of 200 kg ha^{-1} was more effective in both saline soils than gypsum of 300 kg ha^{-1} in case of increasing organic matter content. Application of rice-hull 8 t ha^{-1} induced more organic matter than 4 t ha^{-1} in both saline soils. Within the combinations of rice hull and gypsum, rice-hull 8 t ha^{-1} with gypsum 300 kg ha^{-1} was found better than other combinations in both soils in the case of increasing organic matter content in the soil at the maturity stage. These results are in close harmony with the findings of Ahmed who reported that organic matter content of the soil increased when higher levels of saline water were used for irrigation [14].

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