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Preparation of Leaching Curves for Soils of drainage pilot area, Kalipatnam, West Godavari district of Andhra Pradesh : Laboratory Column Study

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ABSTRACT

In this study water requirement for leaching of soils of Kalipatnam drainage pilot area were estimated in the laboratory column experiment. With application of 30 cm of water about 86% of salts are leached. pH of drained water gradually increased to 9.28 at 30 cm of water application from initial pH of 7.39 indicates the saline sodic nature of the soil. With incremental addition of water, Mg/Ca ratio of drained water reduced from 5.32 to 0.50. Majority of calcium, magnesium and chlorides leached with initial stages of leaching process.

Key words : Laboratory column study, Leaching curves, Saline sodic soil.

Soluble salts that accumulate in soils must be leached below the crop root zone to maintain Productivity. Leaching is the basic management tool for controlling salinity. Water is applied in excess of the total amount used by the crop and lost by evaporation. The strategy is to keep the salts in solution and flush them below the root zone. The amount of water needed is referred as the leaching Requirement or the leaching fraction.

The amount of irrigation water required to drain the salts depends on the initial salt content of the soil, desired level of soil salinity after leaching, soil depth to which reclamation is desired and soil characteristics. A useful thumb rule is, a unit depth of water will remove 80 per cent of the salts from a unit soil depth (Ayres and Westcot, 1976). Prediction models used to estimate the water requirement for one time leaching are useful for limited extent only. However, for more reliable estimates, it's desirable to conduct salt leaching tests on a limited area and prepare leaching curves before installation of any subsurface drainage system. Leaching curves relate the ratio of actual salt content to initial salt content in the soil (ECo/ ECi) to the depth of leaching water per unit depth of soil. But in the field studies it is not possible to know the nature of leaching process, type of salts leached etc,. Column studies under laboratory conditions provides clues to address these gaps. Hence, an attempt has been made to estimate the leaching requirement under laboratory conditions and leachate quality and leaching process was studied for saline sodic soils of Kalipatnam drainage pilot area.

MATERIAL AND METHODS

Kalipatnam operational pilot area is located in the Mogaltur mandal of West Godavari District of Andhra Pradesh at 16°23' Northern latitude and 81°32' Eastern longitude covering an area of 18ha in the Kalipatnam village of Mogaltur mandal, West Godavari district, A.P. The soils are saline sodic clay loam soils (Table 1) and water logged (Figure 2). Salinity of these soils is widely varying (5.90 to 44.80 dS m^{-1}) with an average ECe of 15.70 dS m^{-1} during S*ummer*, 2005 (Figure 3). Bulk soil sample with ECe of 14.2 dS m^{-1} was collected during *Summer*, 05 and 15 cm soil column was packed in 16 cm diameter plastic columns. Care was taken to simulate field conditions to maintain bulk density. 6.3 cm diameter plastic pipes were not worked out for these soils, as soils are saline sodic due to dispersion of soil particles. Nylon mesh cloth supported sieve was placed at the bottom of the column and leachates were collected from the bottom. Good quality irrigation water was added at 5 cm increment upto 30 cm and leachates were collected after 10 cm, 15 cm, 20 cm, 25 cm and 30 cm of water application. 5 cm of water application is utilized for initial wetting of the soil and hence no leachates after 5 cm of water application were collected. pH, EC, cations and anions in the leachates were estimated (Richards,1968).

RESULTS AND DISCUSSION

Perusal of data (Table 2) indicates that leachates water quality and amount of leachates collected with incremental addition of water from 10 cm to 30 cm, EC of leachates decreased from 31.8

Table 1. Physico- chemical characteristics of soils of Kalipatnam pilot area.

S.No	Parmeter	Range
1	pH	6.09-8.32
2	ECe (d Sm^{-1})	5.90-44.80
3	Mg/Ca	0.14-4.05
4	SAR	17.18-89.18
5	ESP% (SAR)	19.04-56.58

Table 2. Water quality of leachates under laboratory soil column study.

S.No	Sample	pH	Ca (meq L^{-1})	Mg (meqL^{-1})	Na (meq L^{-1})	K (meq L^{-1})	Mg/Ca	SAR	Chlorides (meq L^{-1})	SO_4^{-2} (meq L^{-1})	CO_3^{-2} (meq L^{-1})	HCO_3^{-2} (meq L^{-1})
1	10 cm	7.39	47	250	9.45	9.30	5.32	0.78	230	3.28	0	47
2	15 cm	8.29	5	7	7.35	3.32	1.40	3.00	450	3.21	6	5
3	20 cm	8.64	4	3	5.6	1.83	0.75	2.99	30	3.15	5	4
4	25 cm	9.26	3	2	3.5	1.33	0.67	2.21	20	3.12	5	3
5	30 cm	9.28	2	1	3.15	1.16	0.50	2.57	15	2.61	4	2

Table 3. Percent of initial soil salts leached in the leaching process

Water Added (cm)	EC (dSm^{-1}) of extract	Volume of Extract (ML)	Grams of Salts (2.6 Kg soil)	% salts of initial soil
10	31.8	690	14.04	58.33
15	5.58	610	2.18	67.38
20	3.31	815	1.73	74.55
25	2.23	590	0.84	78.05
30	1.6	600	0.61	80.60

to 1.6 dS m^{-1}. First 10 cm of water leached about 58 per cent of initial salts. With application of 30 cm of water 81 per cent of salts were leached from the 15 cm soil column (Table 3).

pH of leachates gradually increased from 7.39 at 10 cm to 9.28 at 30 cm of water application (Table 2, Figure 2). This rise in pH can be attributed to excess chlorides present in the initial period of leaching process has suppressed the hydrolysis of sodium. As majority of chlorides leached in the initial stage of leaching process (230 meq L^{-1} at 10 cm, 450 meq L^{-1} at 15 cm of water application), after this stage sodium hydrolysis has resulted in the rise of soil pH. These results confirm the saline sodic nature of soil (Richards, 1968).

Out of 324 meq L^{-1} of magnesium, 61 meq L^{-1} of calcium leached with 30 cm of water application, 92 per cent and 77 per cent magnesium and calcium, respectively, leached in the first leachate (10 cm of water application) (Table 2). Mg / Ca ratio of leachates decreased from 5.32 to 0.5 with incremental addition of water from 5 cm to 30 cm.

Sodium and potassium followed similar trend, gradually decreased with incremental addition of water. SAR of the leachates increased from initial 0.78 to 2.57 in the final leachate. These results support the rise in pH of leachates with addition of water.

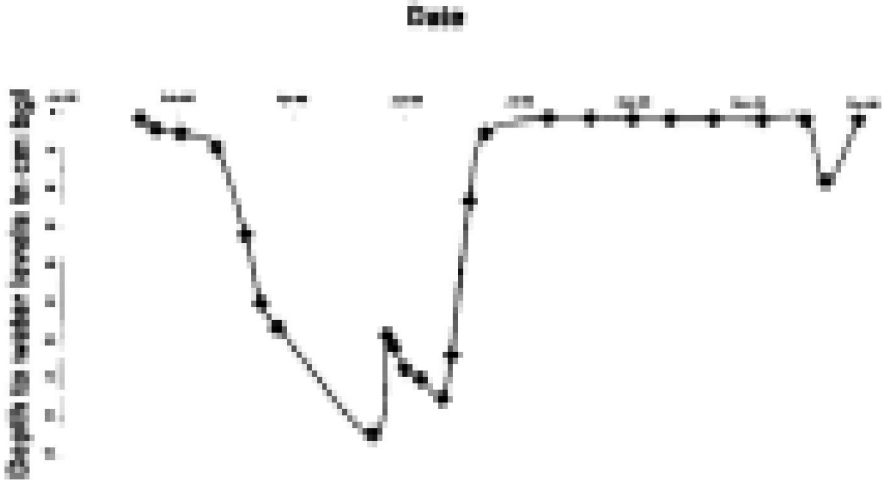

Figure 1. Depth to water level(cm) in pilot area

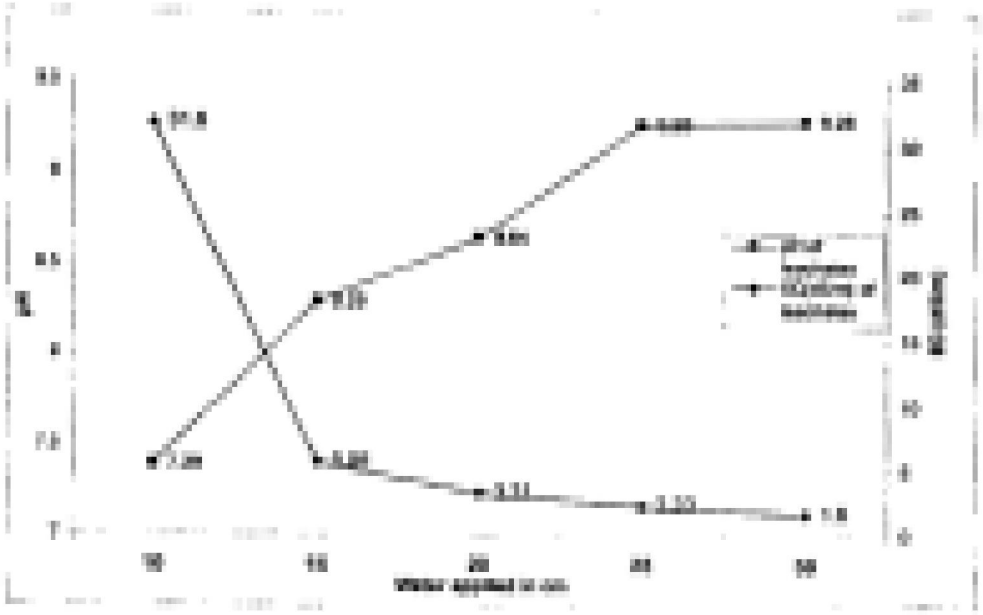

Figure 3. Changes in soil pH of leachates with application of water

Total cation or anions to EC of water is not following the general trend (EC/10= Total cation/ anions). Similar type of deviations was also noticed in other studies (Al Jaloud, 1994) as the leaching process is different from soil equilibrium solution or normal water.

Conclusions

The quantity of salts removed per unit quantity of water leached can be increased appreciably by leaching the soil at low moisture conditions i.e. under unsaturated conditions. The salts in the profile increases to a maximum value close to the wetting front and drops to its initial value below the wetting depth. Moreover, use of leaching curves will enable us to arrange the various steps of accurate planning in relation to reclamation water requirement as well as the time needed for completion of reclamation procedure. Since a leaching curve is only valid for the soil and salt conditions under which the relationship was established, it will usually be necessary to determine the leaching curves applicable to the specific conditions of each reclamation project. Leaching study under laboratory condition gives better picture of leaching process.

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