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Influence of Continuous and Intermittent Leachings With and Without Amendments on Reclamation of Saline-Sodic Soils

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Pot experiment stduies showed that intermittent leaching had no particular advantage over continuous leaching in control, gypsum and sulfuric acid treatments in both the soils containing 1 per cent and 10 per cent free calcium carbonate content. In general, the sulfuric acid proved superior over gypsum but its higher dose proved harmful in soil having low calcium carbonate content.

Leaching not only removes the salts but replaces the exchangeable sodium by solubilizing the native or applied calcium compounds. Miller *et al.* (1965), Nielson *et al.* (1966) and Keller and Alfaro (1966) reported that leaching of salts may be improved greatly by controlling soil water content and flow velocity during leaching. Sahota and Bhumbla (1970) have observed that intermittent ponding is much better than continuous ponding. On the contrary Abrol and Bhumbla (1973) had reported that intermittent ponding has no particular advantage over continuous ponding under field condition. As leaching presents a problem in highly saline-sodic soils due to low permeability may be overcome by applying gypsum or by solubilizing calcium salts already present in the soil.

MATERIAL AND METHODS

For a pot experiment, the bulk soil samples from 0 to 30 cm layers were collected from Kagarol and Kukthala villages of Agra district. The soil samples were mixed thoroughly, air-dried and 10 kg soil filled in each pot (diameter 25 cm) with an outlet at bottom. The treatments were as follows: A. Leaching methods: (i) Continuous, (ii) Intermittent. B. Amendments: (i) Control, (ii) Gypsum at 50 per cent GR (iii) Gypsum at 100 per cent GR, (iv) Sulfuric acid at 50 per cent GR, (v) Sulfuric acid at 100 per cent GR.

Required amount of gypsum and sulfuric acid was applied in each pod after filling the soil. Leaching was started in July in all the pots. A 6 cm irrigation with good quality canal water was given each time to continuous ponding before the water applied previously was completely absorbed at the surface. In the intermittent leaching treatment, irrigation was given after 3 to 4 days of disappearance of water at surface. In all, 30 cm water was allowed to pass through soil. After completion of leaching, soil samples were collected from each pot, mixed treamentwise and analysed for different physico-chemical

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properties as described in U. S. D. A. Hand Book No. 60 (Anon., 1954). After leaching, wheat was grown. Grain yield was recorded and analysed statistically for test of significance.

RESULTS AND DISCUSSION

The soils of Kukthala and Kagarol villages had EC 145·5 and 180·5 m mhos/cm, pH 10·2 and 10·3 and ESP 84 and 80 respectively showing highly saline-sodic characteristics. They also contained toxic amount of water-soluble boron content. The soils only vary in free calcium carbonate conent as Kukthala and Kagarol soils contain 1 per cent and 10 per cent respectively (Table I).

The effectiveness of two ways of leaching viz., intermittent and continuous and different amendments and their doses was judged on the basis of changes in physico-chemical properties immediately after completion of leaching and follow up crop performance.

TABLE II Grain yield of wheat

Treatments	Wheat grain yield (g/pot) Kukthala soil	Kagarol soil
Methods of leaching:		
Continuous leaching	17.9	21.6
Intermittent leaching	17.5	21.3
SEm ±	0.244	0.337
CD at 5%	NS	NS
Amendments:		
Control	4.5	6.5
Gypsum at 50% GR	18.5	22.9
Gypsum at 100% GR	21.5	24.4
Sulfuric acid at 50% GR	24.2	25.6
Sulfuric acid at 100%	19.9	28.2
SEm ±	0.384	0.523
CD at 5%	1.228	1.659

Effect on ECe, pH and ESP:

Mixing of gypsum and sulfuric acid followed by leaching reduced ECe, pH and ESP of the soils markedly bringing soils to near normal condition. Reduction in water-soluble salt content in control (no amendment) pot was also high but the sodocity represented by

TABLE I Physico-chemical properties of the surface soils of Kagarol and Kukthala.

Location	Mechanical Analysis Sand %	Silt %	Clay %	H. C. (cm/hr)	Organic carbon (%)	$CaCO_3$ (%)	G. R. (me/100 g)	pH	ECe (mmhos/cm)	SAR	C. E. C. (me/soil g)	ESP
Kukthala village	43.2	32.4	22.2	0.044	0.105	1.0	15.4	10.20	145.5	3137	9.39	83.7
Kagarol village	54.2	23.0	13.4	0.051	0.126	10.0	13.6	10.30	180.5	3833	6.42	80.1

pH and ESP slightly increased over initial values in both the soils containing low and high calcium carbonate content. More than 90 per cent soluble salts were leached from both the soils but the removal of salts in two soils did not show any relationship with the kind and levels of amendments.

pH of the soils dropped by 1·9 unit in Kagarol and 1·7 unit in Kukthala soils in gypsum and 2·3 unit and 4·2 unit in sulfuric acid treated pots, respectively. Gypsum application at 100 per cent GR reduced the pH approximately by 0·1 unit more as compared to 50 per cent GR in both the soils. Similarly, in the case of sulfuric acid treatment the reduction was by 0·3 unit in Kagarol and 2·3 unit in Kukthala soil with 100 per cent GR level. The ESP of both the soils showed an increase in control pots but the application of gypsum brought ESP from 84 to 18 with 50 per cent GR and to 11 with 100 per cent GR in Kukthala soil while with these levels the ESP in Kagarol soil decreased from 80 to 17 and 15 respectively. The effects of sulfuric acid application was more marked than gypsum in respect of pH and ESP. Most striking observation was that Kukthala soil having low calcium carbonate content ($<$ 1 per cent) attained pH below 7 and ESP below 3 when sulfuric acid was applied at 50 per cent GR.

Both Kagarol and Kukthala soils under intermittent and continuous leachings attained the values of ECe from 180 and 145 mmhos/cm to 7, 6 and 8, 7 mmhos/cm, pH from 10·3 and 10·2 to 8·7, 8.6 and 7·7, 7·9 and ESP from 80 and 84 to 28, 25 and 25, 20 respectively. Both intermittent and continuous leaching did not differ much in respect of changes in ECe, pH and ESP values of both the soils having low and high free calcium carbonate content. Miller *et al.* (1965) and Nielson *et al.* (1966) indicated that the efficiency of salt leaching was greatly increased by controlling the soil water content and flow velocity of water during leaching. Under field conditions, this accomplished by providing either intermittent ponding and intermittent sprinkling. But Abrol and Bhumbla (1973) have shown that intermittent leaching with and without gypsum had no particular advantage over continuous leaching. They ascribed this to low permeability of sodic soils resulting in water movement in unsaturated conditions even in continuous ponded treatments. In the present study also continuous leaching was either slightly superior to or on par with intermittent leaching, in improving the physico-chemical properties of soils.

Sulfuric acid proved to be a more efficient reclaiming agent than gypsum. Sharma *et al.* (1971) also reported similar results for saline-sodic soils. The efficiency of sulfuric acid is due to faster rate of base exchange reaction. But in soils having low free calcium carbonate content, the higher rate of sulfuric acid application proved not very useful.

Crop Perfomance :

The grain yield data of wheat grown after leaching are given in Table II

Addition of gypsum as well as sulfuric acid increased the grain yield of wheat in both the soils and sulfuric acid was superior to gypsum. In both the soils, the yield increased significantly when gypsum dose was increased from 50 to 100 per cent GR. In the case of sulfuric acid the yield was significantly higher at 100 per cent GR over 50 per cent GR in Kagarol soil (10 per cent $CaCO_3$) while the reverse was the case in Kukthala soil (1 per cent $CaCO_3$). Continuous ponding and intermittent leaching produced similar grain yields.

REFERENCES

ABROL, I. P. and D. R. BHUMBLA. 1973. Field studies on salt leaching in a highly saline-sodic soil. *Soil Sci.*, 115 : 429-33.

ANONYMOUS. 1954. Diagnosis and improvement of saline and alkali soils. Hand book No. 60. Published by U. S. Dept. of Agriculture, U.S.A.

KELLER, J. and J. F. ALFARO. 1966. Effect of water application rate of leaching. *Soil Sci.*, 102 : 107-15.

MILLER, R.J., D. R. NIELSON and J.W. BIGGAR 1965. Chloride displacement in Punche clay loam in relation to water movement and distribution. *Water Resour. Res.*, 1 : 67-73.

NIELSON, D. R., J. W. BIGGAR, and J. N. LUTHIN. 1966. Desalinization of soils under controlled unsaturated flow conditions *6th Intern. Congr. Irrig. Drain.*, New Delhi. 15-24.

SAHOTA, N. S. and D. R. BHUMBLA. 1967. Effect of leaching saline-alkali soils with and without gypsum on the soluble salts, boron, exchangeable calcium and sodium of the soils. *Indian J. agric. Sci.* 50 : 763-71.

SHARMA, V. K., C. L. MEHROTRA and V. P. SAXENA. 1971. Effect of ameliorants on the physical conditions of saline-alkali soils. All India Symposium Soil Salinity (Kanpur).