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Saline and Alkali Soils and Crop Response in the Amaravathy Reservoir Project Ayacut Area, Coimbatore District*

by

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Synopsis: An evaluation of crop growth response in the ill-drained areas of the Amaravathy project on the basis of laboratory tests on soil samples for pH and electrical conductivity is presented and discussed in this paper. This evaluation will prove to be of considerable value in soil advisory work connected with alkali reclamation.

Introduction: Govinda Iyer *et al.* (1961) have reported in the preliminary soil studies in the Amaravathy Ayacut area, that saline, alkaline and hydromorphic soils occur in the valleys under the influence of drainage. When these areas go under large-scale reclamation, advice on reclamation treatments may be often required. Obviously such advice has to be based on soil analytical data from these areas. If an evaluation of these problem soils for possible crop growth response on the basis of their laboratory tests is available, it will be of considerable value for such advisory work. Therefore, in the course of the detailed soil survey work such an evaluation was attempted and the results obtained are reported and discussed in this paper.

Review of Literature: Taylor (1940) laid down that, if salt content of soil exceeds 0·2% or the alkalinity exceeds a pH value of 8·5, soil deterioration commences and crop yields will be below normal. Beyond this no scale was proposed by him. It was Scofield (1942) in the United States who first proposed a salinity scale based on the evidences collected by him in the Pecos River joint investigation for an appraisal of the effect of salts in soils on crop growth. Richards (1954) subsequently modified this scale and this modified scale is in use in the United States Salinity Laboratory to evaluate saline areas for crop responses on the basis of their soil analysis. In this scale conductivity of saturation extracts of the soils has been taken to represent a measure of soil salinity. There is, however, no consideration given to soil alkali in this scale and hence its use is limited to saline areas only. For areas where both salinity and alkali affect crop growth, Agarwal and Yadev (1956) evolved a salinity *cum* alkali scale based on crop and soil data collected by them from Kanpur District in U. P. Since crop and cultivation practices vary with the tract, the authors have stated that the

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proposed scale may not hold good under conditions significantly differen from those obtainable in U. P. They therefore, recommended that the scal may be tested in particular cases before adoption.

Although both saline and alkali conditions as those prevalent ir U. P. affect crop growth in the Amaravathy ayacut area, the crops growr except paddy are entirely different from those investigated by Agarwal anc Yadev (1956). A separate investigation was therefore attempted on the same lines to evaluate these problem soils for possible crop response sc that reliable prediction values could be had for advisory work connected with these soils.

Methods and Materials: The investigation was carried out during the cropping season of 1960—'61. Several areas, where salinity and/or alkali conditions limit crop growth were visited during the survey tours. These areas exhibited considerable variability in the growth status of plants very often even within the same field. In between portions where crop growth was normal, there were patches representing various gradations, including barren spots where the crop had completely failed. This was just as could be expected in saline and alkali areas because of the extreme variability in the characteristics of alkali soil (Kelley, 1951). Seventy four fields were ultimately selected and in these three stages of crop growth namely (1) Normal growth, (2) Growth limited to about 50% of the normal, and (3) No growth at all, were marked out.

In selecting the 74 fields great care was taken to see that only salt or alkali was responsible for limiting crop growth in them. Instances where other possible factors such as level of land, texture, lack of nutrition and shade limited crop growth, were avoided. It was also seen that the entire field chosen was sown uniformly and at the same time and received the same cultural and irrigation management.

Three soil samples were drawn from the active root zone (0–12") one in each of the patches representing the three stages of crop growth mentioned in each field. The 74 fields were distributed among the five crops as follows: Sugarcane (20), Paddy (20), Groundnut (14), *Cholam* (12) and Cotton (8). All the 222 soil samples were brought to the laboratory, air dried, sieved through a 2 mm. sieve and on the sieved sample pH (1:2) and electrical conductivity (E. C.) (1:2) were determined. The pH value was determined with Backman pH meter using glass electrode and conductivity with solubridge. The ratio of soil to water used is the same as that usually used for advisory work in the Soil Testing Service of the State.

Results and Discussion: The laboratory analytical data for pH and E. C. obtained for the soil samples were satistically analysed on the model of a completely randomised design and the analysis of variance table arrived at is entered in Table I. The average values of pH and E. C. for three growth stages of the different crops together with the marginal means and standard errors per observations are given in Table II.

TABLE I.

Analysis of Variance.

Due to	Degree of Freedom	S. S.		M. S.		F.	
		E. C.	pH	E. C.	pH	E. C.	pH
Crops	4	10·8490	4·18	2·7122	1·0450	4·16**	5·00**
Growth Status	2	17·5589	16·18	8·7795	8.0900	13·47**	38·52**
Crops × Growth Status	8	6·8866	2·69	0·8608	0·3362	N. S. 1·32	N. S. 1·57
Error	207	134·8155	44·73	0·6515	0·2100	...	...
Total ...	221	170·1100	67 78				

TABLE II.

Average Values of Electrical Conductivity and pH for Three Growth Stages of the Different Crops Tested in the Amaravathy Ayacut area.

Crops	Growth Status	Normal		50% Normal		No growth		Mean	
		E. C.	pH	E. C.	pH	E. C.	pH	E. C.	pH
Paddy	(20)	0·30	8·25	0·43	8·87	1·03	9·15	0·59	8·75
Sugarcane	(20)	0·31	8·35	0·77	8·81	1·28	8·99	0·79	8·73
Groundnut	(14)	0·20	8·05	0·22	8·40	0·26	8·86	0·23	8·44
Cholam	(12)	0·25	8·34	0·30	8·68	0·64	8·77	0·40	8·60
Cotton	(8)	0·46	8·81	0·44	8·90	1·67	8·93	0·86	8·88
Mean		0·30	8·32	0·46	8·74	0·98	9·00		

SE/Observation < E. C. 0·807 mmhos. pH 0·460 CD 5% for the comparison of growth means < E. C. 0·27 mmhos. pH 0·16

It may be observed from Table I that 'crops' and 'growth status' in both the soil characters have come off highly significant. The interaction effect 'crops x growth status', however, has not proved significant in either.

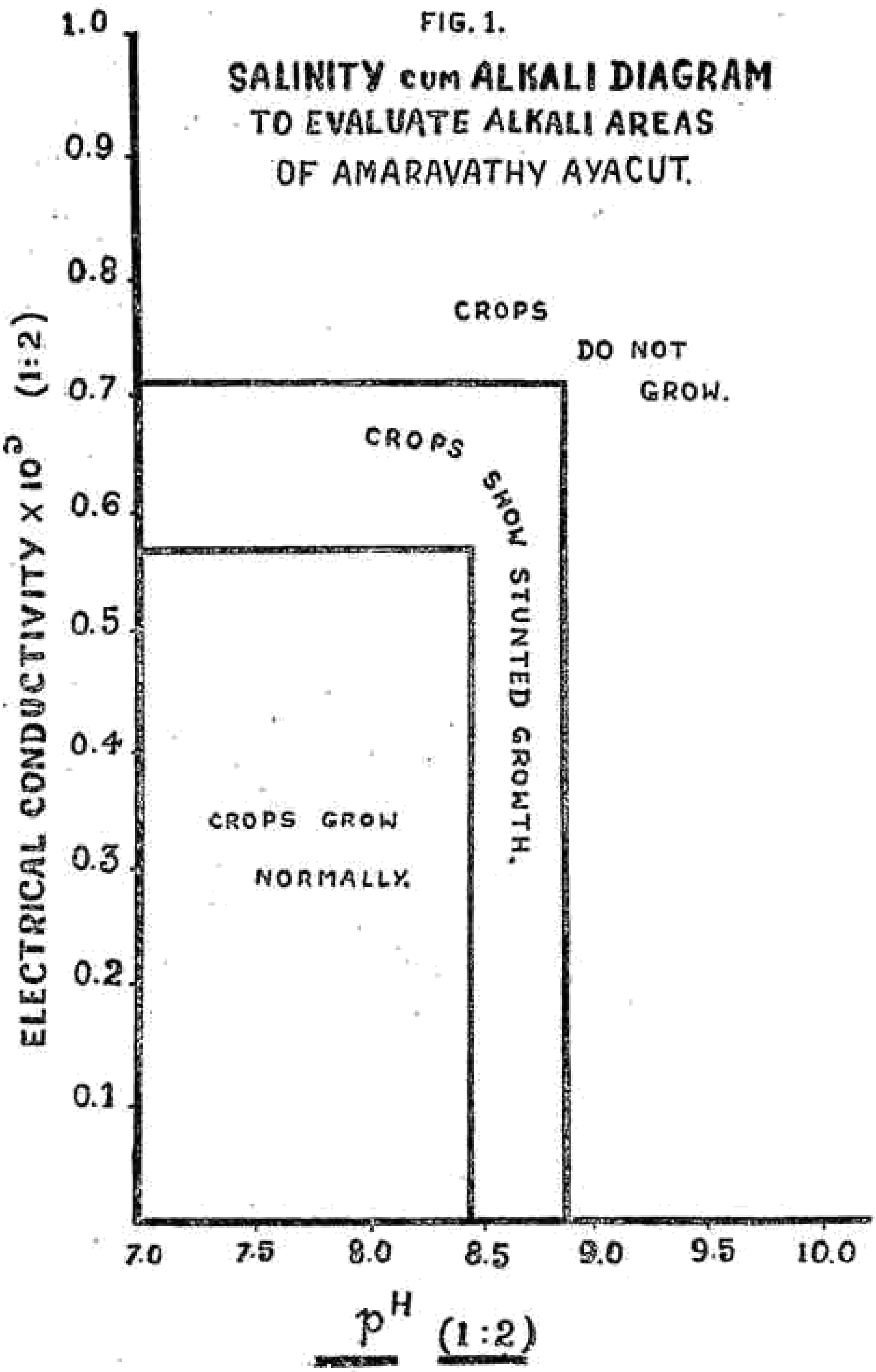
The mean values of pH and E. C. for the crops averaged over the three levels of growth status Table II marginal means for crops) show that they are the highest in cotton (0.86 & 8.88) and lowest in groundnut

(0.23 & 8.44). The differences between any two of the other means are not marked. Similarly, pH and E. C. means for the three stages of crop growth averaged over the five different crops (Table II-marginal means for growth status) rise significantly as one proceeds from the 'normal' to the 'no growth' stage. The soil characters pH and E. C. have thus difinitely proved to have been responsible to a marked extent for the visible differences produced in the growth status of the different crops within the same field.

The interaction effect as already stated has not attained the level of significance in the overall 'F' test. This means that on the average, differences between crops in regard to the values of both pH and E. C. at the various levels of growth status, are uniform. However, an examination of the various interaction means (Table II-means within the two-way table) tends to reveal certain interesting trends in respect of some major components of interaction. Thus, differences in growth particularly between 'normal' and '50% normal' stages have been produced largely by increases in pH values in most cases, whereas differences between '50% normal' and 'no growth' stages, especially in sugarcane and cotton have been chiefly caused by rise in E. C. values. In the case of paddy both pH and E. C. values have accounted for the differences among the three stages of growth. In the 'normal' growth status cotton shows up the highest tolerance limits for pH and E. C. and groundnut appears to be least tolerant.

The critical differences for the comparison of any two of the marginal means for 'growth status' in regard to pH and E. C. are ± 0.16 and ± 0.27 respectively. Making use of these, the limiting values of pH and E. C. for the three growth stages were plotted on a graph paper and lines were drawn so as to separate the three stages of crop growth into the three salinity *cum* alkali categories. The diagram thus obtained is shown in Fig. 1. The higher confidence limits of the 'normal' growth status and the lower confidence limits of 'no growth' status of the pH and E. C. values have been used for the separation of the three salinity *cum* alkali categories viz., (1) crops grow normally, (2) crops show stunted growth and (3) crops do not grow at all.

The diagram presented is of immense practical value for advisory work on the basis of tests on soil samples from the saline and alkali areas of the Amaravathy ayacut. By plotting on the diagram the values of pH and E. C. of the soil sample, it is possible to evaluate with 95% probability crop growth response in the field of the crops usually grown in the ayacut. Thus if a soil sample from the ayacut shows up a pH value of 8.0 and an E. C. value of 0.50 millimhos, the possible crop behaviour



rating of the field as read from the diagram is 'normal growth' and if the E. C. value of the sample is 0.80 millimhos or more for the same pH value of 8.0, the field may be completely barren. Values of soil pH of about 8.9 or more and or values of E. C. of about 0.70 millimhos or more do not support crop growth. Such statements will be correct in 95 out of 100 cases. Suitable advice on reclaiming treatments may then be given for particular fields.

Summary: A survey of the crop growth behaviour in the ill-drained areas of the Amaravathy ayacut area was made during the cropping season of 1960-'61. As a result of this study a suitable diagram has been constructed to evaluate crop growth response in the Amaravathy ayacut area on the basis of laboratory tests on soil samples for soil pH and electrical conductivity. The predicted crop-behaviour rating of the field has a 95% reliability.

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