seedlings variety T_{61} showed that foliar application with 0.1% molybdenum significantly increased responses in respect of number of root nodules and also increased the length, diameter, fresh weight, number of grains per pod, and T.S.S. content of grains significantly.

REFERENCES

Blomfield, P. D. 1954. Note on molybdenum response on peas in Nelson. *N. Z. J. Sci. Tech.*, **36**:46.

Boliko and A. G. Savvina. 1940. Role of molybdenum in plant development. *Compt. rend. acad. Sci. V. R. S. S*, **29**:507-9.

Chu, E., C. W. Lieng and E. E. Chen. 1963. Effect of minor elements on the growth and yield of Soyabean in some important soil types of China. *Soils & Fert.*, **27**:1817.

Crofts, F. C. 1954. Superphosphate and molybdenum responses in peas at Wollonghar. *Agric. Gaz. N. S. W.*, **65**:185-86.

Hagstrom, G. R. and K. C. Berger. 1963. Molybdenum status of three wisconsin soils and its effect on four legume crops. *Agron. J.*, **55**:399-401.

Minina, E. I. 1960. A contribution to the problem of the physiological role of molybdenum in plants (Russian). *Doklady. Akad Nauk. SSSR.*, **130**:461-64.

Zurovska, V. J. A. 1958. The effect of molybdenum on the yield and quality of peas. *Tr. Akad. Nauk Lat VSSR.*, **9**:151-64.

Studies on the Productivity Rating of Alluvial Soils

by

T. A. GOVINDA IYER[1], V. RENGANATHAN[2], L. MOHAMED GHOUSE[3] and G. TEEKARAMAN[4]

An appraisal of nutrient status of soils and crop productivity was made at the Pennar alluvial deposits at the Sugarcane Research Station, Cuddalore. With the recognition of availability concepts of soil nutrients, soil chemists tried to correlate crop productivity with nutrient contents and attempted to fix optimum concentration of these nutrients in soils at which the yields will be optimum without the addition of nutrients. Some of the major contributions on this aspect with reference to sugarcane is summarised (Ranganathan 1966).

The availability concept is used for predicting crop requirements based on soil analysis at the soil testing laboratories for improving crop production.

Though under a given set of conditions, nutrient status is a good index of crop productivity, its absolute magnitude is profoundly influenced by physical characteristics of soil such as texture, depth and slope, climatic conditions and drainage conditions of the area. Storie (1950) developed a system of rating soils for their inherent crop productivity by an inductive process where several profile characteristics were weighed in relation to the production of a specific crop. Raychaudri and Anjaneya Reddy (1963)

1. Assistant Agricultural Chemist, Cuddalore, 2. Assistant Soil Chemist, 3 and 4. Assistants in Chemistry.

successfully used this system in evaluating red soils of Bangalore District. Another deductive process is developed in United States of America where mean yields of specific crops are taken as expression of all the environmental factors as well as soil characteristics of a given soil type. Bruce and Metzger (1933) used this rating system for Maryland soils. This method is now extensively used in soil surveys with ratings 1 to 100, being the standard yield of the principal crop on the well developed and extensive soil group of the region.

The applicability and efficacy of the various rating systems for alluvial soils were studied with the Pennar alluvial deposits at the Sugarcane Research Station, Cuddalore.

Materials and Methods: Soil profiles were examined at 22 representative sites in the 136 acre farm. The first foot and second foot soil samples were collected for determining their physical and chemical characteristics (Basic Experiment Records, Chemistry Unit, Sugarcane Research Station, Cuddalore, 1958–1964).

The yield data from the various agronomic trials, where improved agricultural practices were followed were collected over several years and the mean yields were determined for assessing their inherent productivity (Basic Experimental Records, Agronomy Unit, Sugarcane Research Station, Cuddalore).

In certain heavy clay soils there were variations in crop growth over very short distances. The data on EC and pH at the root zone in spots with stunted and vigorous growth occurring side by side were also collected.

Results: The examination of soil profiles up to 6 feet showed three distinct types. The characteristics of these three types of profiles are given in Table 1.

TABLE 1. *Profile characteristics of three types of soils occurring in the farm*

I		II		III	
Area – 40 acres		Area – about 45 acres		Area – 50 acres	
0–12″	Grey brown, clay to clay loam, neutral to alkaline prismatic, sticky, hard on drying, sparse nodular kankar	0–12″	Sandy single grained neutral	0–14″	Brown sandy loam granular, neutral
12–42″	Red brown clay with infiltrations – iron mottling and more of kankar	12–42″	Sandy loam, blocky	18–20″	Dark brown clay loam, blocky
42–72″	Brown silty clay - hard on drying, less kankar and more iron mottlings.	42″ & below	Sticky clay with nodular kankar	20–72″	Red brown structureless sand

ANNEXTURE I. *The physical and chemical characters of the three farm soil types*

Soil type	Clay %	Water holding capacity %	Pore space capacity %	pH	EC mmho/cm	Organic C %	Total N %	C/N	Total			Available		CEC me/100 g soil	CEC me/100 g clay
									CaO %	P_2O_5 %	K_2O %	P_2O_5 %	K_2O %		
Clay															
0–12″	32.1	50.8	54.8	7.8	0.30	0.17	0.04	4.8	0.53	0.049	0.41	0.008	0.023	20	60
12–24″	32.6	55.9	55.8	7.6	0.40	0.17	0.03	5.4	0.59	0.050	0.36	0.007	0.022	22	86
Sandy															
0–12″	6.9	38.5	19.8	6.9	0.36	0.15	0.03	4.9	0.39	0.027	0.29	0.018	0.016	2.5	35.0
12–24″	6.9	36.6	48.5	7.1	0.38	0.10	0.03	3.9	0.39	0 023	0.33	0.018	0.018	3.0	42.0
Sandy loams															
0–12″	10.5	43.8	51.1	7.4	0.29	0.24	0.05	5.2	0.52	0.031	0.34	0.010	0.021	5.2	52.0
12–24″	21.0	48.0	53.4	7.6	0.39	0.19	0.04	4.2	0.53	0.033	0.31	0.009	0.028	10.3	51.5

The physical and chemical properties of the three types of soils are given in Annexure 1. The physical properties and CEC followed the variations in clay content. The classifications based on nutrient content are given in Table 4.

The spots where growth was stunted in heavy clay soils were black in colour, slippery and cracky. The EC and pH at the root zone are furnished in Table 2.

TABLE 2. *Values of pH and EC of soil samples from the areas showing varying growth of sugarcane in nearby spots*

Soil test	Good growth A		Medium growth B		Poor growth C		Very poor growth D	
	0–6″	6–12″	0–6″	6–12″	0–6″	6–12″	0–6″	6–12″
pH	7.3	7.5	8.1	8.5	8.7	8.9	9.1	9.3
EC	0.2	0.2	0.2	0.28	0.27	0.27	0.37	0.49
Growth rating	100%		50% of A		25–50% of A		25% of A	

The EC and pH were higher at the spots showing stunted growth than in the nearby spots with good crop growth. The affected spots showed typical alkali conditions with the associated nodular $CaCO_3$.

The mean cane yields of the variety CO 419 with improved agricultural practices in the three different soil types were collected from the basic records of the farm and are presented in Table 3.

TABLE 3. *Mean cane yields in Mt/acre in the soil types and average percentage rating*

Type No.	Soil type	No. of experiments averaged	General mean Mt./acre (Standard)	Mean yield of CO 419 Mt./acre	General mean on sampled fields	Average % rating over standard
I	Clay	5	45.3	49.4	43.0	95
II	Sandy	12	47.4	30.5	45.3	95
III	Sandy loam	7	49.1	55.0	48.4	99

The rating of soils by different methods for the three types of soils observed are furnished in Table 4.

TABLE 4. *Rating of soils by different systems*

Rating	Type I clay	Type II sandy	Type III sandy loam
Reserve nutrient	Poor in N Medium in P and K	Poor in N and P Medium in K	Poor in N and P Medium in K
Available nutrient	Poor in N and P	Poor in N Medium in P and K	Poor in N Medium in P and K

TABLE 4. *(Contd.)*

Rating		Type I clay	Type II sandy	Type III sandy loam
Storie index				
Character	A	Deep alluvial	Deep alluvial	Deep alluvial
,,	B	Heavy surface	Surface sandy	Surface sandy loam
,,	C	Nearly level well drained	Nearly level well drained	Nearly level well drained
Rating		42 (Fair)	57 (Fair)	77 (Good)
Deductive process				
Percentage on standard yield		95	95	99

It appears therefore from the above table that soil types get graded for inherent productivity in the same order in both the Storie rating and the deductive rating. These inherent productivity can be further enhanced by making the nutrient availability to the optimum by adjusting the application of fertilizers based on the soil nutrient availability and the rate of replenishment of available nutrients from the soil reserves.

Discussion: *Soil formation and different systems of productivity rating of soils:* The soils of Sugarcane Research Station are alluvial in origin being deposited by River Pennar. The alluvial bed is thick in the area with the absence of ferrugenous gravel in the sub-soils which characterize the Gadilam river bank nearby. The presence of kankar and iron mottlings above or near clay horizons suggests weathering of secondary clay minerals after deposition of alluvium. The iron mottlings are also more in the water-logged areas and further confirms their formation insitu. Such secondary reactions involving precipitation of $CaCO_3$ from exchangeable sites especially at high pH (Kelly, 1951) leading to local disturbances in soil reaction were responsible for wide variation of crop growth at short distances, within a field. Such variations lead to large experimental error reducing the precision in treatment comparisons. Indeed this type of local disturbances are more in clayey soils where there are more chances for localized reduction in leaching and impediment in the drainage conditions.

The alluvial soils are often disturbed by floods and are always considered young. Therefore these soils do not reflect the various environmental factors such as obtained in the other mature soils. Hence the surface texture is usually taken to classify alluvial soils.

Storie (1950) considered soil profile, surface texture slope, drainage and nutrient status as important factors in deciding inherent crop-productivity. All these factors except surface texture do not vary much in alluvial soils within a contiguous area. Therefore soils get classified based on surface texture. The order with the decreasing productivity is sandy loam, sandy and clay.

The deductive process which takes into account mean yields of a specific crop as the index of crop productivity also falls in the same order as in the inductive process. These results indicate that the productivity rating of alluvial soils can be based on surface texture.

Nutrient content in relation to productivity ratings: The medium, content and CEC of 35 to 60 meq / 100 g clay indicate the silicious nature of clay minerals. The organic matter and N are poor in all soils. The physical constants, CEC *etc.* follow closely the variations in the clay content. The reserve forms of P are lower in sandy soils and hence the exhaustion will be faster while in clayey soil, the availability is poor. In both soils the addition of adequate amount of P are quite essential to maintain crop yields. It appears that sandy loam and loamy type of soils with clay content between 20-30% have highest inherent crop-productivity with all desirable characteristics suited for agricultural purposes.

Summary: A productivity rating of alluvial soils of Sugarcane Research Station, Cuddalore was attempted both by inductive and deductive process. The inherent crop-productivity of alluvial soils is better indicated by their surface texture. The Storie and the deductive methods gave almost the same rating. The order of rating with decreasing crop productivity is sandy loam, sandy and clay.

The reserve form of P is poor in sandy and sandy loam soils while the availability is poor in clayey soils. Both sandy and clayey soils require further additions of P to maintain crop yields. Moreover in clayey soils, local disturbances with rise in pH and EC lead to wide variations in crop growth and poorer yields. The variations in nutrient availability and the reserve forms are useful in arriving at the manurial schedules for the different types of soils occurring in the form. In clayey and sandy types further soil management practices are essential to improve upon the inherent crop-productivity.

Acknowledgement: The authors are thankful to Sri S. Varadarajan and Sri C. Ekambaram for their guidance and keen interest in this study. Thanks are also due to the Indian Central Sugarcane Committee for partly financing the scheme.

REFERENCES

Bruce, O. C. and Metzger. 1933. *Maryland Agrl. Exp. Sta. Bull.*, 351.

Kelly, W. P. 1951. Alkali-soils - their formation Properties and Reclamation Reinhold. *Pub. Crop., N. Y.*

Renganathan, V. 1966. Proc. of All India Symp. on Sug. Dev. New Delhi. *Pub. ISMA., Calcutta, pp.* 107-15.

Raychaudhuri, S. P. and P. S. Anjaneya Reddi. 1963. *J. Indian Soc. Soil Sci.*, **11**: 311-19.

Storie, R. E. 1950. *Trans. Fourth Int. Congr. Soil Sci.*, **1**: 336.