A STUDY ON MACRONUTRIENTS OF ALKALINE SOILS BY USING PRESSMUD

E. SANJEEVA RAYUDU[1], M. SRIMURALI[2], K. VENKAIAH[3]

[1]Associate Professor, [2,3]Professor ,
[1,2]Department of Civil Engineering, [3]Department of Soil Science,
[1]G.Pulla Reddy Engineering College, Kurnool,
[2]Sri Venkateswara University, Tirupati,
[3]A.N.G.R. Agricultural University College, Tirupati.
[1]Email: rayu.svu@gmail.com
[2]Email: msrimurali@gmail.com
[3]Email: keerthivenkaiah@yahoo.com.

ABSTRACT: This paper communicates the amelioration studies of alkaline soils by using pressmud for agricultural purpose. In the present studies have been conducted for identification of alkaline soils and also for characterization of pressmud to assess its potential for amelioration of macronutrients of alkaline soils for agricultural purpose. Alkaline soils are found to have high values of pH and SAR, less macro nutrients. Pressmud from sugarcane industrial wastes contain significant quantities of macronutrients like Nitrogen, Phosphorous, potassium, which are quite essential for agricultural soils. Hence, amelioration studies were conducted by treating the alkaline soil with pressmud quantities ranging from 15 to150 ton/ha. A number of pH, EC, Organic carbon and macronutrient properties were investigated. From this study, it is revealed that the macronutrients of alkaline soils like Nitrogen, phosphorous, potassium and EC values were improved and values of pH decreased. The study also estimated, the quantities of paddy husk ash required for amelioration of micronutrients in alkaline soils.

Key Words: **Alkaline soils, Amelioration, pH, EC, Organic carbon, Macronutrients and Pressmud**

1. INTRODUCTION

Phenomenal increase in population in the past two centuries and the increased demand for food production to meet their requirement ushered in the Green Revolution resulting in adoption of modern agricultural practices, use of (often indiscriminate) chemicals, domestic wastewater, industrial wastes and farm machinery etc [1].

Some industrial wastes contain valuable material and some times, are being used or reused in unscientific manner or many times placed in wrong place completely, posing a great hazard to the human environment. Hence, balanced utilization and management of disposable wastes has assumed importance, in order to prevent environmental pollution and to conserve the resources [2].

Land is the most vital resource of any country. It is a fixed asset and cannot be expanded to meet the needs of an increasing population. Therefore, it must be used carefully and in the

best possible manner. Agriculture is the primary activity in developing countries like India. About 60 to 70% of the total population is dependent on agriculture for livelihood [3].

It is estimated that a vast area of land around 952 million hectares all over the world is affected with alkalinity or salinity or both [4]. A large area in India, nearly 9.38 million hectare is occupied by salt-affected soils out of which 3.88 million hectares are alkaline soils and 5.5 million hectares are salinity soils [5]. These soils have high pH values, low porosity values, low organic carbon and less macro nutrients and micro nutrients, less fertility rendering them unsuitable for agricultural crop [6]. They require suitable reclamation method or nourishment with nutrients to convert them into a fertile land at cheaper cost.

Various organic amendments such as Municipal Solid Waste (MSW) compost or Sewage sludge have been investigated for their effectiveness in salt effected soil remediation [7-9].
The application of manure by farmers often improves nutrients values and the use of products which are commercially available, but the cost is on the higher side [10].

Industrial wastes like phospho-gypsum, press mud, fly ash, molasses, Paper sludge from pulp and paper etc. have been identified as valuable amendments, as they not only play a pivotal role in reclaiming the alkaline and acidic soils but also supply essential major and micro nutrients on their application to soil. So far, only limited industrial wastes have been tried and used for amelioration [11-13].

The present work deals with the use of pressmud for amelioration of alkaline wastelands. Nutrient values like Nitrogen, Phosphorous, and potassium determine the usefulness of soil for agriculture, where as alkaline soils do not possess the required quantities of these parameters. Pressmud from sugarcane industrial wastes contain significant quantities of macro nutrients like N, P, K, which are quite essential for agricultural soils. Thus industrial wastes like pressmud can alter the nutrient values.

2. MATERIALS AND METHODS

2.1. Location of Experimental Work

The experimental study was carried out in the Environmental Engineering laboratory of Civil Engineering Department of Sri Venkateswara University, Tirupati, Andhra Pradesh, India. The alkaline soil sample and Pressmud were collected from industrial development area of Gajulamandam, near Tirupati (Latitude$13^0$35’47”N, Longitude$79^0$31’36”E).

2.2 Materials

The soil samples were collected from the upper 30 cm soil layer were sieved (2mm diameter sieve) to increase the uniformity of experiment and were analyzed for various parameters as per the standard procedures, to identify alkaline soil and corresponding agricultural deficiencies [14, 15].

Pressmud from sugarcane industry were tested and analysed for parameters same as that of soil as per the standard procedures to assess the potential for amelioration of alkaline soils macronutrients. Results indicated that Pressmud of Sugarcane Industry is rich in macronutrients and hence this waste was preferred for amelioration of alkaline soil.

2.3 Experimental setup

A study was carried out under laboratory conditions. Pressmud was mixed thoroughly at different proportions with alkaline soils, sample of each mixer were placed in plastic trays (30 cm x30 cm x15 cm size) and maintained 39% field capacity for 90 days curing period [16]. 1996). Soil samples were analyzed after curing and evaluated for best proportion of husk ash yielding optimal amelioration of soil. Finally a quantity of paddy husk ash is to be applied for amelioration of alkaline soils for agricultural purpose was established.

3. RESULTS AND DISCUSSION

Industrial wastes have got an enormous potential for amelioration of barren lands, which are excessively present. The industrial wastes have diverse characteristics of parameters, which are considered to be useful for agricultural purpose. Hence, in the present work an attempt has been made to ameliorate macronutrients of alkaline soils near Gajulamandyam, Tirupati with the available local industrial waste, pressmud. This was done, taking into consideration the important parameters required for soil amelioration based on requirement for land fertility. The results are presented in tabular form and illustrated in graphical form also. These are followed by discussion.

3.1. Nature of soil

Several chemical properties of the soil were evaluated and they are presented in table1

Table 1 - Properties of the untreated alkaline soil

Property (unit)	Value
pH	8.8
EC (mmhos/cm)	3.2
SAR	13.41
Organic matter (%)	2.82
N (kg/ha)	222
P (kg/ha)	9.88
K (kg/ha)	286

Based on the evaluation the alkaline soil was identified and selected. The standards used for this classification and identification are pH is more than 8.5, EC is less than 4.0 mmhos/cm and SAR is greater than 13. These parameters in the present study are 8.8, 3.2 mmhos/cm and 13.41 respectively [17].

3.2. Nature of industrial waste

Results of analysis of studies carried out on industrial wastes are presented in the table 2.

Table 2 - Properties of Pressmud waste from sugarcane industry

Property (unit)	Value
pH	7.5
EC (mmhos/cm)	8.71
Organic matter (%)	73
N (ppm)	125
P2O5 (ppm)	200
K2O (ppm)	320

Perusal of the data indicates that pressmud is capable of ameliorating the macronutrients of soil.

3.3. Treatment with Pressmud

Pressmud was blended with alkaline soils at ten different proportions and was kept for curing period of 90 days. After treatment, the soil samples were analyzed and results of analysis are presented herewith along with discussion of results. The data pertaining to physic- chemical and chemical characteristics of alkaline soils treated with different doses of pressmud from sugarcane industry are given in table 3.

3.3.1 pH:

Soil pH is a measure of the degree of acidity or alkalinity of the soil. It is an important characteristic of soil, which influences the availability, toxicity and deficiency of nutrient elements and also influences the soil microorganism.

Data related to variation in soil pH at different proportions (Treatments) of pressmud is presented in table 3. As the quantity of effluent increased, the pH value decreased, gradually, from 8.88 to 7.96. The decreasing of trend of pH values is due to application of pressmud and maintaining field capacity 39%. The treatment with pressmud is effective in bringing down pH values from alkaline to near neutral value which is essential to agricultural purpose.

Table.3 Macro-Nutrients of Alkaline soil Treated with Pressmud

Treatment (Quantity)	pH	EC mmhos/cm	Macro Nutrients Kg/ha		
			N	P	K
T0	8.8	3.80	222	9.88	286
T1 (15 ton/ha)	8.77	3.81	226	17.52	321
T2 (30 ton /ha)	8.68	3.83	230	20.73	345
T3 (45 ton /ha)	8.60	3.87	234	26.13	356
T4 (60 ton /ha)	8.54	3.89	237	32.31	368
T5 (75 ton /ha)	8.46	3.92	242	38.40	377
T6 (90 ton /ha)	8.38	3.94	245	42.14	385
T7 (105 ton /ha)	8.26	3.96	249	49.28	397
T8 (120 ton /ha)	8.17	3.99	252	54.78	410
T9 (135 ton /ha)	8.08	4.03	257	60.20	421
T10 (150 ton /ha)	7.96	4.05	261	65.36	440

3.3.2 Electrical conductivity (EC):

The EC value of soil denotes degree of salinity. The soil salinity also affects the physical condition of the soil, chemical characteristics of soil like nutrient availability, non-nutrient availability, toxicity etc. and also the nature of the biological lives in the soil.

An examination of the data presented in table 3, revealed that EC values increased progressively with the increase in quantity of pressmud. The EC values of treated alkaline soil enhanced from 3.20 to 4.05 mmhos/cm. This can be attributed to accumulation soluble salts that are present in the pressmud used for treatment. The Electrical conductivity value of effluent (Table 2) is 8.71 mmhos/cm and stands an evidence of higher soluble salts.

The same trend of accumulation of salts in the soil contaminated with effluent discharged from dyeing units in the Nagari region of Chitoor district in Andhra Pradesh was reported [18].

Available Nitrogen:

Nitrogen is the first fertilizer element of the macronutrients usually applied in commercial fertilizers. Nitrogen is very important nutrient for plants and it seems to have the quickest and most pronounced effect. It plays an important role in vegetative growth and it imparts dark green color to plants.

Available nitrogen content in the soil is 222 kg/ha and it is low as per the Standard rating chart for soils [19]. From the data presented in figure 1, it could be noticed that pressmud treated alkaline soils were improved to medium in available N content and ranged from 226kg/ha to 261 kg/ha. Steady increase in the available N was observed with increasing dosage of prssmud. The accumulation of available nitrogen in treated alkaline soil is mainly due to the presence of nitrogen content (125 ppm) in pressmud.

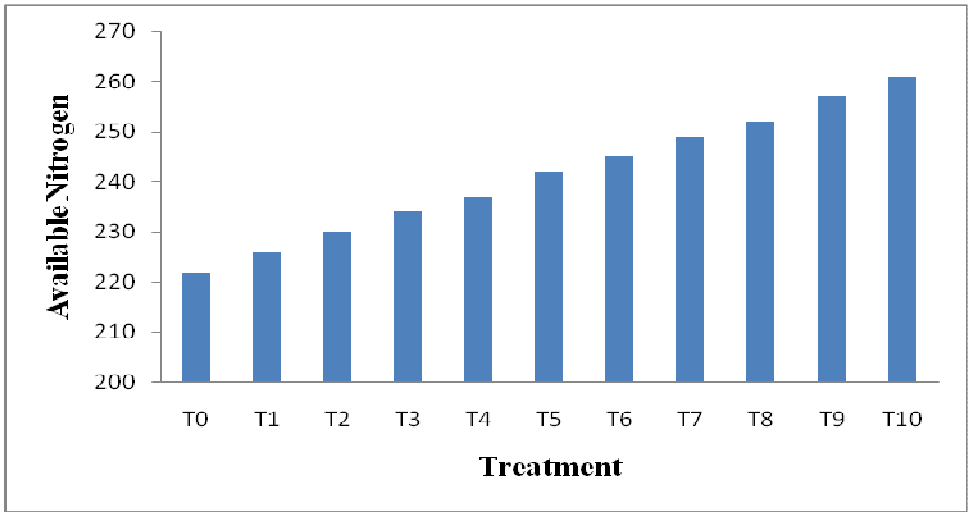

Figure 1. Variation of available Nitrogen at different proportions of pressmud

Available phosphorous:

Phosphorus is the second fertilizer element and it is an essential constituent of every living cell and for the nutrition of plant and animal. It takes active part in all types of metabolism of plant.

Available phosphorous in the soil is 9.88 kg/ha and is low as per the Standard rating chart for the soils. As the pressmud rich in phosphorous content (200ppm), there may be improvement in phosphorous content value and the same is evident from the data presented in figure 2. The highest value of 35.36 kg/ha was recorded in treatment 10, whereas the lowest value of 17.52 kg/ha was noticed with the treatment 1. This is presence of considerable content of phosphorous (200ppm) in pressmud.

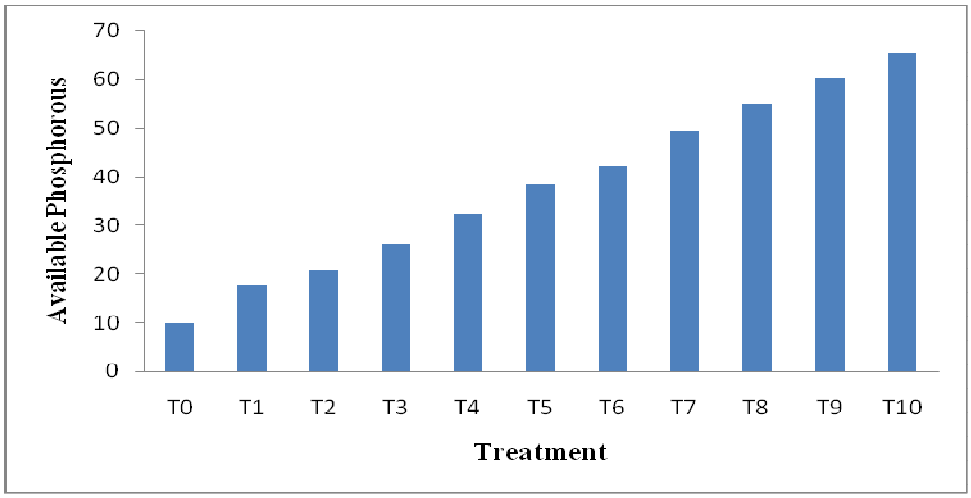

Figure 2. Variation of available Phosphorous at different proportions of pressmud

Potassium:

Potassium is the third fertilizer element. Potassium acts as a chemical traffic policeman, root booster, stalk strengthener, food former, sugar and starch transporter, protein builder, breathing regulator, water stretcher and as a disease retarded but it is not effective without its co-nutrients such as nitrogen and phosphorus.

Available potassium content in the soil is 286 kg/ha and is high as per the Standard rating chart for soils. From the data presented in figure 3, it could be noticed that the Potassium value increased progressively with an increase in the dosage of pressmud. The potassium value of treated alkaline soil enhanced from 321 kg/ha to 440 kg/ha. The highest value of 440 kg/ha was recorded at high dosage; whereas the lowest value of 321 kg/ha was noticed at low dosage. The higher concentration of available potassium in treated alkaline soils might be attributed to the higher content of potassium (320 ppm) presented in the pressmud.

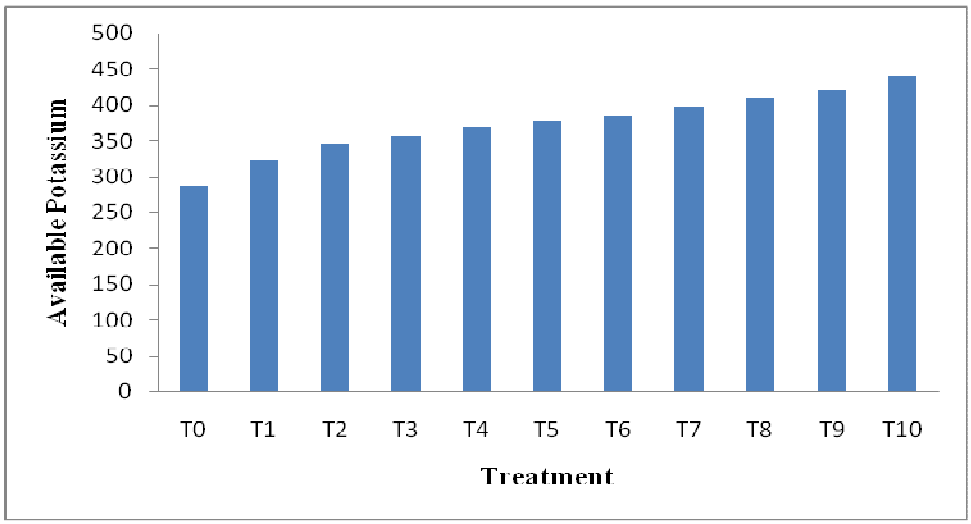

Figure 3. Variation of avilable Potassium at different proportions of pressmud

4. CONCLUSION

The study has revealed that alkaline soils, when treated with pressmud, responded favorably, in terms of macronutrients amelioration. Blending/treatment of alkaline soil resulted in substantial improvement in macronutrients of the soil. pH and alkaline nature of the soil substantially reduced. The Electrical Conductivity was also gradually increased and was beyond the limit of Electrical Conductivity 4 mmhos/cm [20] after treatment 8(T8). Hence it can be established that 120 ton/ha of pressmud is required for amelioration of alkaline soils for agricultural purpose

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