EFFECT OF PAPER MILL SLUDGE AS AN AMENDMENT IN ALKALI SOIL AND ITS INFLUENCE ON THE YIELD OF GREEN GRAM [VBN (Gg) 2]

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Abstract: Paper industries produce large amount of solids and its application increases the input of organic matter, and the availability of macro and micronutrients. The effect of paper mill sludge application on soil chemical properties is directly associated with the biological properties, vital for the nutrient turnover and long-term productivity. The paper mill sludge (PMS) used in the study was received from the Tamil Nadu Newsprint and Papers Ltd., Kagithapuram, Karur District, and it was dark brown in colour with unpleasant odour. The PMS was found to be neutral in reaction (pH 7.26) and the EC was 2.19 dS m^{-1}. It contained all plant nutrients in the order of Ca >S> N> K>P >Mg (macronutrients) and Mn >Fe >Zn > Cu (micronutrients). There were six treatments namely PMS @ 30 t ha^{-1} (T_2), gypsum @ 15 t ha^{-1}(T_3), vermicompost 5 t ha^{-1} (T_4), PMS @ 15 t ha^{-1} + gypsum@ 7.5 t ha^{-1}(T_5) and PMS @ 15 t ha^{-1} + vermicompost @ 2.5 t ha^{-1}(T_6). The treatments were replicated four times in a randomized block design. The results revealed that application of paper mill sludge @30 t ha^{-1} would serve as a good source of amendment in alkali soil reclamation, and give higher green gram yield than the application of gypsum @ 15 t ha^{-1} and VC @ 5 t ha^{1}. Application of paper mill sludge might be a better option, particularly in case of legume crop like green gram.

Keywords: Alkali Soil, Gypsum, Paper Mill Sludge, Vermicompost.

Introduction: In the present scenario of intensive agriculture, shrinkage of cultivable land area is inevitable due to urbanization and industrialization. The soil is over exploited due to intensive cultivation with high yielding crops and use of high analysis inorganic fertilizers leading the soil ecosystem to become unproductive. Hence, soil is unable to replenish its original condition of health. Under these circumstances, application and recycling of organic wastes, by- products of agro industries waste as well as wastes from paper, hotel, hostel, urban and rural area etc., as source of manure is the only way to boost the soil health.

Green gram *[Vignaradiata*(L.)Wilczek] is one of the important pulse crops of the world. Green gram, being a legume crop has high demand on sulphur to produce several proteins containing amino acids (Cysteine, cysteine and methionine) and fatty acids. At present, nearly 70% of pulses are produced only through rainfed farming. The average yield of pulses in India is black gram 300 kg/ha, green gram 375 kg/ha and red gram 240 kg/ha. Under salted soil ecosystem, reclamation of alkali soil by application of gypsum or post methonated effluent ameliorates the soil to normal condition. Recently, it was reported that application of sulphur and calcium rich paper industry organic solid (sludge) waste acts as a best soil conditioner to alleviate the alkaline problem of soil to normal condition.

In view of the above, the present investigation on effect of paper mill sludge as an amendment in alkali soil and its influence on the yield of green gram [VBN (Gg) 2] were carried out with the following objectives.

- To study the effect of paper mill sludge as an amendment in alkali soil.
- To study the effect of paper mill sludge in the productivity of green gram under alkali soil condition.

Materials and methods:

Characterization of experimental soil: Representative soil samples were collected from ADAC & RI, Trichy. The soil was black- alkali and belong to *Typic Ustropepts*. Bulk soil samples were collected from several locations of the experimental field. The samples were air-dried, powdered using a wooden mallet and sieved (2 mm sieve). The processed soil samples were stored in polyethylene bags and the important chemical characters were analysed (pH, Exchangeable Ca^{2+}, Na^{+} and SO_4^{2-}). Based on the gypsum requirement of experimental soil (15 t ha^{-1}), the treatments were fixed.

Table 1. Field experiment

S.No	Particulars	
1	Soil type	Clay loam
2	Soil Series	*Madukkur*
3	Taxonomical classification	*Typic Ustropepts*
4	Variety	VBN (Gg 2)
5	Duration	60-75 days
6	Design	RBD
7	Plot size	5 x 4 m^2
8	Replications	4
11	Location	ADAC & RI, Trichy

Treatment details

1. T_1- Control
2. T_2- PMS @ 30 t ha^{-1}
3. T_3- Gypsum @ 15 t ha^{-1}
4. T_4- Vermicompost @ 5 t ha^{-1}
5. T_5- PMS @ 15 t ha^{-1} + Gypsum @ 7.5 t ha^{-1}
6. T6- PMS @ 15 t ha-1 + Vermicompost @ 2.5 t ha-1

The PMS, gypsum, vermicompost and its combinations were applied before planting as per the treatments and ploughed three times and allowed for natural oxidation. The treatments were randomized in each replication. The PMS was applied @ 30 t ha^{-1} for T_2 and 15 t ha^{-1} for T_5 and T_6 treatments, respectively. Gypsum was applied @ 15 t ha^{-1} in T_5 and vermicompost @ 5 t ha^{-1} in T_6. The N, P and S fertilizers were applied as per the recommended doses (25:50:25). The green gram yield was recorded after harvesting of the crop.

Yield: Grain yield was recorded from the net plot area and expressed in kg ha^{-1}.

Statistical analysis: The data collected in the experiments were statistically analysed under randomized block design (RBD) as described by Panse and Sukatme (1976).Wherever the treatments were significant, the critical differences were worked out at five per cent probability level.

Result and Discussion: Application of paper mill sludge was more effective in respect to alkali soil reclamation and as a source of nutrients to the plants.

Characterization of Paper Mill Sludge: The sample of PMS collected from Tamil Nadu Newsprint and Papers Ltd., (TNPL), Kagithapuram, Karur District was dark brown in colour with an unpleasant odour. The unpleasant odour of PMS was attributed to the presence of sulphur and other compounds. The pH was near to neutral (pH 7.26) and was loaded with organic and inorganic salts which reflected on high EC (2.19 dS m^{-1}). These findings were corroborated with the findings of Karthika (2013).

Being originated from plant sources, the paper mill sludge (PMS) contained considerable amount of plant nutrients and organic matter. Among the plant nutrients, Ca and S were found in higher amounts (22.57% and 18.21 %). Similar results were reported by Hameed (1997) and TNPL lime sludge had higher concentration of Ca and Mg recording 8.60 and 11.0 per cent.

Soil pH at harvesting stage of green gram: The present study showed that a significant decrease in soil pH was observed due to the application of PMS @ 30 t ha^{-1} wherein the pH values was 8.32 while in control (T_1) the pH value was 9.42 at HS. The decrease in pH might be attributed to the H^+ ions released during decomposition of organic matter supplied by the PMS. The increase in Ca, Mg and H^+ ions and release of organic acids might be responsible for the changes in soil pH. Similar finding was reported by Nunes *et al,* (2008).

Seed yield: The data revealed that seed yield of the crop was distinctly influenced by the application of PMS. The maximum seed yield (646 kg ha^{-1}) was obtained in PMS @ 30 t ha^{-1} (T_2) and that was 355 kg ha^{-1} higher than control. The second highest yield was obtained in PMS along with VC @ 2.5 t ha^{-1} (593 kg ha^{-1}) followed by gypsum @ 7.5 t ha^{-1} (492 kg ha^{-1}). The yield in gypsum @ 15 t ha^{-1} was on par with VC @ 5 t ha^{-1}. Prasanthrajan *et al. (*2004), Amini *et al.* (2012) and Preethi (2012).

Conclusion: From the results obtained, and observations recorded, it is concluded that the application of paper mill sludge (PMS) @ 30 t ha^{-1} would serve as a good source of amendment for alkali soil reclamation, and to obtain higher green gram yield than the application of gypsum @ 15 t ha^{-1} and vermicompost @ 5 t ha^{-1} in an alkali soil. Hence, the importance of paper mill sludge might be realized for efficient utilization of natural resources in a sustainable manner.

Table 2. Effect of amendments and organic manure and their combinations on pH, exchangeable calcium, sodium, sulphate, exchangeable sodium percentage and seed yield of green gram.

Treatments	pH	Exchangeable calcium(Ca^{2+}) (cmol (p+) kg^{-1})	Exchangeable sodium(Na^+) (cmol (p+) kg^{-1})	Sulphate (SO_4^{2-}) (mg kg^{-1})	ESP	Seed Yield (kg ha^{-1})
T_1- Control	9.42	6.92	5.02	67.29	30.04	291
T_2- PMS @ 30 t ha^{-1}	8.32	9.64	3.15	237.84	16.09	646
T_3– Gypsum @ 15 t ha^{-1}	8.36	9.58	3.31	205.73	17.68	446
T_4– VC @ 5 t ha^{-1}	9.22	7.71	4.81	169.21	27.21	428
T_5– PMS @ 15 t ha^{-1}+ Gypsum @7.5 t ha^{-1}	8.38	9.44	3.4	235.95	18.39	492
T_6– PMS @ 15 t ha^{-1}+ VC@ 2.5 t ha^{-1}	8.74	9.3	3.49	221.78	18.73	593
SEd	**0.08**	**0.06**	**0.03**	**1.26**	**0.74**	**13.71**
CD (P=0.05)	**0.17**	**0.12**	**0.06**	**2.69**	**1.58**	**29.23**

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