

# Effect of Various Amendments on the Yield of Rice Crop under Saline-Sodic Conditions in Mardan/Swabi Districts

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## ABSTRACT

A field study was carried out at two sites: village Nazar Killi and Ziam Banda of districts Mardan and Swabi, respectively during Kharif, 2000 to examine the effect of various amendments on the yield of rice crop under saline conditions. The treatments were control, 100% GR, 20 ton FYM ha<sup>-1</sup>, 2.5 ton pressmud ha<sup>-1</sup>, 10 ton FYM ha<sup>-1</sup> + 1.25 ton pressmud ha<sup>-1</sup>, 100% GR + 20 ton FYM ha<sup>-1</sup>, 50% GR + 1.25 ton pressmud ha<sup>-1</sup> and 33% GR + 1.25 ton pressmud ha<sup>-1</sup> + 10 ton FYM ha<sup>-1</sup>. All the treatments increased the paddy yield considerably. The most effective treatment noted was the combination of gypsum, pressmud and farmyard manure (94% increase in yield over control) followed by pressmud alone (60%) or in combination with FYM (57%). Of all the treatments, gypsum proved the best in reclaiming the soil with regards to pH and gypsum requirement as it reduced pH and GR at 14-18% and GR 88-100%, respectively.

**Key Words:** Gypsum; FYM; Pressmud; Rice

## INTRODUCTION

Agricultural, chemical and industrial wastes (such as gypsum, farmyard manure and pressmud) have been advocated to improve soil affected by high sodicity. Farmyard manure is especially beneficial as it improves soil physical structure and provides nutrients for plants. It has been reported that the use of acid or acid forming material including organic matter is likely to improve the soils by solubilizing calcium from the calcium carbonate present in the soil (Chand *et al.*, 1977; Verma & Abrol, 1980). NFDC (1998) and Ibrahim *et al.* (2000) reported that organic manures were effective in increasing yield and good physical condition of the soil.

Pressmud from sugar mill is another enriched source of organic matter and contains substantial quantities of nutrients for improving physical conditions and improvement of soil fertility (Ibrahim *et al.*, 1993; Gupta *et al.*, 1987; Nisar, 2000). It also contains sulfur, which helps to acidify the soil. This acidification makes soluble calcium available and thus improves soil structure and increases the leaching of salts. Sangakkara (1994) concluded that there was 20% increase in vegetable yield with organic sources of nutrients like farmyard manure, poultry manure, sugarcane filter cake and crop residues. Increase in sugarcane yield with the application of pressmud was also reported by Alexander (1972). Haider *et al.* (1976) reported significant decrease in SAR and increase in the infiltration rate and yield of wheat, cotton, sorghum, maize, alfalfa and clover with the application of pressmud. Milapchand *et al.* (1980) reported that pressmud, poultry manure and farmyard manure increased the extractable zinc in soils and helped to retain the applied zinc in the available form.

Gypsum (CaSO<sub>4</sub>·2H<sub>2</sub>O) helps to rectify sodium abundance by leaching down the excess sodium from clay particles as a sodium sulfate and thus makes physical and

chemical conditions conducive for plant optimum nutrient uptake (Khan *et al.*, 1990).

Keeping in view the importance of these amendments on the reclamation of salt affected soils, an experiment on two sites in the districts of Swabi and Mardan was conducted on rice during Kharif 2000 with the objectives to study the comparative effect of gypsum, pressmud and farmyard manure on the yield of rice crop and to study the ameliorative effect of these amendments on the salt affected soils.

## MATERIALS AND METHODS

The experiment was conducted at villages Nazar Killi and Ziam Banda districts Mardan and Swabi, respectively during Kharif 2000. The experiment consisted of eight treatments, having three replications with RCB design. Local variety of coarse rice was sown in the month of July. Gypsum according to the soil test value of GR at both the field sites was used in experiment.

Pressmud, farmyard manure and gypsum alone and in various combinations were applied to the soil well before. A blanket application of NPK fertilizer @ 120:90:50 kg ha<sup>-1</sup> was also made. Half of the recommended dose of nitrogen was added at the time of sowing the rice crop and the remaining nitrogen was applied at the time of 2nd irrigation. Phosphorus and K were applied at the time of sowing. The crop at both sites was harvested on November 8 and 4, 2000, respectively. The yield data were obtained and statistically analyzed. Detail of the treatments is given in Table I.

Soil samples were collected before the application of treatments and were analyzed in the laboratory. Physical and chemical characteristics of the sites (Pre-transplanting) are given in the Table II.

**Table I. Detail of different treatments**

Treatments	Gypsum Application	*P.M. (tons ha <sup>-1</sup> )	**FYM (tons ha <sup>-1</sup> )
T <sub>1</sub> (Control)	0.0% of soil GR	0.00	0.00
T <sub>2</sub>	100% of soil GR	0.00	0.00
T <sub>3</sub>	0.0% of soil GR	0.00	20.00
T <sub>4</sub>	0.0% of soil GR	2.50	0.00
T <sub>5</sub>	0.0% of soil GR	1.25	10.00
T <sub>6</sub>	100% of soil GR	0.00	20.00
T <sub>7</sub>	50% of soil GR	1.25	0.00
T <sub>8</sub>	33% of soil GR	1.25	10.00

\* = Press mud; \*\* = Farm Yard Manure

**Table II. Physico-chemical characteristics of soils prior to the application of treatments**

Characteristics/Variables	Site-I (Nazar Killi, Mardan)	Site-II (Ziam Banda, Swabi)
pH	9.500	9.100
EC (dS m <sup>-1</sup> ) (1: 5 susp.)	0.890	0.210
GR (tons acre <sup>-1</sup> )	10.200	8.250
Textural Class	Silt Loam	Loam
N (%)	0.025	0.025
P (mg kg <sup>-1</sup> )	13.600	16.600
K (mg kg <sup>-1</sup> )	270.000	162.000
Organic matter (%)	0.510	0.510
CaCO <sub>3</sub> equi. (%)	5.100	4.500

## RESULTS AND DISCUSSION

**Paddy yield.** Yield data of paddy rice at both the sites are presented in Table III. It is evident from the data that all the amendments either applied singly or in combination have considerably increased the yield of paddy rice. Of all the treatments, combined application of all the three amendments i.e. Gypsum @ 33% of GR + 1.25 tons pressmud per hectare + 10 tons farmyard manure per hectare out yielded all others where 94% increase in yield over that of control was recorded. This treatment was followed by a combination of pressmud and farmyard manure.

**Table III. Effect of various amendments on paddy yield (kg ha<sup>-1</sup>)**

Treatments	Site-I	Site-II	Average
T <sub>1</sub>	2777 c	2333 d	2555 (-)
T <sub>2</sub>	3917 a	3333 cd	3625 (42)
T <sub>3</sub>	3333 bc	3333 cd	3333 (30)
T <sub>4</sub>	3333 bc	4667 ab	4000 (57)
T <sub>5</sub>	3333 bc	4833 a	4083 (60)
T <sub>6</sub>	3250 bc	4333 abc	3792 (48)
T <sub>7</sub>	3500 ab	3667 bc	3584 (40)
T <sub>8</sub>	4067 a	5250 a	4959 (94)

Means bearing the same letter(s) are statistically non-significant ( $P < 0.05$ ); The figures in parentheses denote % increase over control

Pressmud yielded 21% more than the average yield obtained from gypsum and farmyard manure applied separately. The data further depict that when pressmud was added to farmyard manure or to a combination of gypsum and farmyard manure, the yield increment got almost doubled (from 30 to 60% in former case and from 48 to 94% in the later case). The results are in agreement with that of Tiwana *et al.* (1997) who reported that pressmud has significantly increased sugarcane yield. Relatively lesser response of rice crop to farmyard manure application may be attributed to its slow release of nutrients which decomposes over time (NFDC, 1998) and that of gypsum to its low solubility (Ghafoor & Muhammad, 1990). The decomposition of manure was further aggravated due to dry spell prevailed during most part of the crop season.

**Economic analysis.** Economic analysis of yield data presented in Table IV showed that highest rate of return (2.02 VCR) was obtained with the application of pressmud alone @ 2.5 tons per hectare, however, corresponding paddy yield (4000 kg ha<sup>-1</sup>) was not satisfactory as compared to combined application of gypsum, pressmud and FYM whereby substantial paddy yield (4959 kg ha<sup>-1</sup>) was obtained.

**Table IV. Economic analysis of the yield data**

Treat.	Average yield kg ha <sup>-1</sup>	Yield increase over control kg ha <sup>-1</sup>	Value of increased yield (Rs.)	Cost of inputs (Rs.)	V.C.R.*
T <sub>1</sub>	2555	---	---	---	---
T <sub>2</sub>	3625	1070	7490	11400	0.66
T <sub>3</sub>	3333	778	5446	8200	0.66
T <sub>4</sub>	4000	1445	10115	5000	2.02
T <sub>5</sub>	4083	1528	10696	6600	1.62
T <sub>6</sub>	3792	1237	8659	19600	0.44
T <sub>7</sub>	3584	1029	7203	8200	0.88
T <sub>8</sub>	4959	2404	16828	10400	1.62

\* = Value Cost Ratio

**Effect on soil health.** The data in Table V show that all the three amendments have considerably decreased soil pH at both the sites. It was lowered from 9.5 to 7.8 by the application of 100% Gypsum and to 8.3 by the combined application of 33% gypsum, 1.25 tons per acre press mud and 10 tons FYM per acre at Site-I. Electrical conductivity of the sites was raised by gypsum application while decreased with other treatments. Gypsum requirement of the soils decreased almost 50 to 99%. It was reduced tremendously with the application of gypsum, whereas it decreased slightly with other treatments. Similar trend was also observed at the other site. Better ameliorative response to gypsum compared with other treatments may be attributed to its rich calcium content which also help in the management of sodium saturated soils as reported by a number of authors (Bressler *et al.*, 1982).

**Table V. Post harvest analysis of plots for pH, EC and GR**

Treat.	Site-I			Site-II		
	pH	EC (dSm <sup>-1</sup> )	GR (t acre <sup>-1</sup> )	pH	EC (dSm <sup>-1</sup> )	GR (t acre <sup>-1</sup> )
T <sub>1</sub>	9.2	0.34	9.9	8.9	0.15	8.0
T <sub>2</sub>	7.8	1.08	---	7.8	0.56	1.0
T <sub>3</sub>	9.0	0.36	4.8	8.0	0.15	2.4
T <sub>4</sub>	8.9	0.31	4.1	8.7	0.21	2.4
T <sub>5</sub>	9.2	0.36	3.1	8.5	0.21	2.4
T <sub>6</sub>	8.2	0.28	1.0	8.3	0.35	1.4
T <sub>7</sub>	8.8	0.36	2.4	8.5	0.23	1.0
T <sub>8</sub>	8.3	0.20	4.0	8.4	0.27	1.0

## CONCLUSIONS

- All the treatments increased the paddy yield considerably.
- The most effective treatment noted was the combination of gypsum, pressmud and farmyard manure (94% increase in yield over control) followed by pressmud alone (60%) or in combination with FYM (57%).
- Of all the treatments gypsum proved the best in reclaiming the soil with regards to pH and gypsum requirement as it reduced pH and GR at 14-18% and GR 88-100%, respectively.

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