Sharma et al., 2014, 1:8
Journal of Environmental and Agricultural Sciences
ISSN: 2313-8629

Research Article **Open Access**

Effect of Press Mud and FYM Application with Zinc Sulphate on Yield of Hybrid Rice

Manmohan Sharma[1,*], Y. K. Sharma[1] and M. L. Dotaniya[2]

[1]Department of Agricultural Chemistry and Soil Science, Gochar Mahavidhyalaya, Rampur Maniharan, UP, India
[2]Indian Institute of Soil Science, Bhopal- 462 038, India

Abstract: An experiment was conducted to evaluate the effect of press mud and farm yard manure (FYM) in combination of inorganic fertilizer zinc sulphate. The rice variety PRH 10 was used as experimental material and thirteen treatments were applied including T_1 = Control; T_2 = FYM 5 t ha^{-1} +0 kg $ZnSO_4$; T_3 = FYM 5 t ha^{-1} +2.5 kg $ZnSO_4$; T_4 = FYM 5 t ha^{-1} +5 kg $ZnSO_4$; T_5=FYM 5 t ha^{-1} +7.5 kg $ZnSO_4$; T_6 = FYM 10 t ha^{-1} +0 kg $ZnSO_4$; T_7 = FYM 10 t ha^{-1} +2.5 kg $ZnSO_4$; T_8 = FYM 10 t ha^{-1} +5 kg $ZnSO_4$; T_9 = FYM 10t ha^{-1} +7.5 kg $ZnSO_4$; T_{10} = Press mud 5 t ha^{-1} +0 kg $ZnSO_4$; T_{11} = Press mud 5 t ha^{-1} +2.5 kg $ZnSO_4$; T_{12} = Press mud 5 t ha^{-1} +5 kg $ZnSO_4$; T_{13} = Press mud 5 t ha^{-1} +7.5 kg $ZnSO_4$. The results showed that the highest plant height, number of tiller per hill, number of grains per spike, and rice yield (4.85 t ha^{-1}) was obtained by the application of FYM 10t ha^{-1} +7.5 kg $ZnSO_4$ however highest straw yield 6.67 t ha^{-1} was obtained in treatment T_{10} compared to rest of the treatments. This study can be useful for the proper application of zinc fertilizer with the combination of organic plant nutrient sources.

Key words: Farm yard manure, Hybrid rice, integrated nutrient management, press mud, Zinc

Received: May 13, 2014; **Revised:** September 1, 2014; **Accepted** October 5, 2014, Online October 15, 2014
***Corresponding author:** Manmohan Sharma; Email: contactmanmohan@gmail.com

1. Introduction

The importance of zinc (Zn) in crop production can hardly be overlooked. Zinc assumed great importance in Indian agriculture, especially for rice production, during the last two decades. The use of zinc has been put into prominence due to its widespread Zn deficiency in India (Katyal and Aggarwala, 1982). With the introduction of high yielding varieties of cereals and other crops and with the use of nitrogen, phosphatic and potassic fertilizers, large scale zinc deficiencies have been reported from several parts of India. According to the chemical analysis of soils, deficiencies have been reported from several parts of India. Total 0.148 million soil samples were collected from different agro-ecological zones of India, 45 per cent soils were found Zn deficient (Singh, 2001). Depletion of micronutrients in intensive cropping system like rice-wheat takes place quickly, particularly when high N levels was applied without organic amendments (Gupta *et al.*, 2000; Nadeem *et al.*, 2013). The microbial decomposition and secretion of root exudates enhanced the Zn availability in soil (Dotaniya *et al.*, 2013b). It acts as lifesaving mechanism during low Zn condition during crop growth (Dotaniya *et al.*, 2013a).

The availability of micronutrients to plants is governed by a variety of reactions that include complexation with organic and inorganic ligands, ion exchange and adsorption, precipitation and dissolution of soils and acid-base equilibria. Now, due to rising cost of chemical fertilizers and severe environmental concerns of consumers, the use of alternative sources of nutrients like crop residues, farm wastes, and farm yard manure has to be prompted as about 60% of the nutrient demand can be met through organic sources (Gaur *et al.*, 1971). The organic matter plays important role both in enhancing availability and reducing toxic effects of the free cations. The unavailability of micronutrients to the plants is mostly due to their restricted movement particularly from soil solid phase to the plant roots. The beneficial effect of organic manure may be attributed to the production of chelating agents, which form soluble complexes with metallic micronutrients and increase the 'carrying capacity' of the soil solution.

Direct and residual effect of combined application of fertilizers and farm-yard-manure on the nutrient uptake have been shown to helpful in increasing fertilizer-use-efficiency without adversely, affecting soil fertility and compromising crop yield (Khanna and Chaudhary, 1979; Goswami and Singh, 1976). This situation calls for the measures which may enhance the efficiency of applied zinc fertilizer so that the farmers may get needed benefit with application of only limited quantity of Zn affordable to their purse. The proposed investigation was conducted to evaluate the effect of press mud and FYM application with zinc sulphate on yield of hybrid rice.

2. Material and Methods

The experiment was conducted during summer season 2006-07 at progressive farmer's field at Dharki village of district Saharanpur, located between $77^0$15' and $76^0$0' East longitude and $27^0$10' and $29^0$34' North altitude and is situated at the attitude of about 275.05 meters above mean sea level. The rice hybrid PRH-10 was sown and thirteen treatments *i.e.* T_1 = Control; T_2 = FYM 5 t ha^{-1} +0.0 kg $ZnSO_4$; T_3 = FYM 5 t ha^{-1} +2.5 kg $ZnSO_4$; T_4 = FYM 5 t ha^{-1} +5 kg $ZnSO_4$; T_5 = FYM 5 t ha^{-1} +7.5 kg $ZnSO_4$; T_6 = FYM 10 t ha^{-1} +0kg $ZnSO_4$; T_7 = FYM 10 t ha^{-1} +2.5 kg $ZnSO_4$; T_8 = FYM 10 t ha^{-1} +5 kg $ZnSO_4$; T_9 = FYM 10t ha^{-1} +7.5 kg $ZnSO_4$; T_{10} = Press mud 5 t ha^{-1} +0 kg $ZnSO_4$; T_{11} = Press mud 5 t ha^{-1} +2.5 kg $ZnSO_4$; T_{12} = Press mud 5 t ha^{-1} +5 kg $ZnSO_4$; T_{13} = Press mud 5 t ha^{-1} +7.5 kg $ZnSO_4$. FYM and Press mud in different treatments were applied one month before transplanting.

The initial soil properties like pH 7.86, organic carbon (0.63%), phosphorus (9 kg ha^{-1}), potassium (118 kg ha^{-1}) and zinc (0.67 ppm) in low category. The nutrient content of press mud and FYM was analyzed and described in Table 1 & 2. Different doses of zinc sulphate were manually applied at the time of transplanting by broadcasting in each experimental plot according to treatments mentioned.

Table 1: Chemical composition of FYM

Property	Values %
Nitrogen	0.93
Potassium	1.31
DTPA Extractable Zn (ppm)	0.52
C:N ratio	9.5

Recommended doses of NPK (100:60:60 kg ha^{-1}) were applied in all plots including control. Half of dose of nitrogen was applied at the time of planting and rest half dose was applied at 30 and 70 days after transplanting as topdressing in two installments. While, total P and K were applied before transplanting, as a basal dose. The crop yield parameters *i.e,* highest plant height, number of tiller per hill, number of grains per spike, and rice yield were taken at crop harvest. All standard agronomic practices protection measures were adopted to raise the rice crop in a stress free environment. The statistical analysis was done in RCBD with three replications, at 5% level of significance and compared with each treatment with control.

3. Results and Discussion

The grain yield and yield attributes of hybrid rice was significantly differed by application of various treatments in both the years of experiments (Table 3). At 90 DAT the maximum plant height was 113.06 cm in FYM 10 t ha^{-1} + 7.5 Kg $ZnSO_4$ treatment followed by 111.93 in T_8, 111.60 cm in T_7. It was also observed that FYM 10 t ha^{-1} with different levels of zinc sulphate had more plant height in comparison to FYM 5 t ha^{-1} and press mud 5 t ha^{-1} with different corresponding levels of zinc sulphate. The number of tiller per hill at 90 DAT the zinc sulphate was increased with FYM 5 t ha^{-1} , 10 t ha^{-1} and press mud 5 t ha^{-1}, the number of tillers were also increased, but the maximum performance FYM 10 t ha^{-1} + 7.5 Kg $ZnSO_4$ treatment. The maximum number of grains per spike was recorded in FYM 10 t ha^{-1} with 7.5 kg $ZnSO_4$ than the other combination of treatments years.

Table 2: Chemical characteristics of Press mud

Property	Value
Moisture %	74.0
Available N%	0.95
Available P %	0.27
Available K %	0.31
CaO %	2.38
MgO %	1.73
DTPA Extractable Zn (ppm)	0.68

The lowest grain yield was 4.28 t ha^{-1} in plot treated with press mud 5 t ha^{-1} without zinc sulphate in 2006-07. That was at par with the grain yield of FYM 10 t ha^{-1} without zinc sulphate, however, significantly lower than the rest of all treatments including control. While the grain yield of FYM 5 t ha^{-1} without zinc sulphate was at par with control. The highest grain yield was 4.85 t ha^{-1} obtained when FYM 10 t ha^{-1} +7.5 kg $ZnSO_4$ was applied that was at par with FYM 10 t ha^{-1}+ 5 kg $ZnSO_4$. While FYM 10 t ha^{-1} + 2.5 kg $ZnSO_4$ gave at par yield with FYM 5 t ha^{-1}+ 7.5 kg $ZnSO_4$ and FYM 5 t ha^{-1}+ 5 kg $ZnSO_4$. It was also observed that the dose of zinc sulphate with FYM 10 t ha^{-1} and 5 t ha^{-1} was increased from 2.5 to 5 kg ha^{-1}, the grain yield was significantly increased but further increase the dose of zinc sulphate from 5 kg to 7.5 kg ha^{-1} with FYM did not significantly increase the yield. While, with press mud only maximum dose of zinc sulphate significantly increased the grain yield over control.

Higher grain yield were observed in treatments with 10 t FYM ha^{-1} and zinc sulphate. As the zinc sulphate levels increases, the grain yield was also observed to increase. However, organic amendment without $ZnSO_4$ was not show any increase in yield over control. This may because of immobilization

resulting in less supply of available N at critical stages of crop growth which leads to poor grain yield. Similar results earlier were also reported by Reddy (1996). The increase in grain yield of rice with increasing dose of $ZnSO_4$ up to 20 kg ha^{-1} and further increase showed slightly declining effect was also reported by Bhardwaj and Prasad (1981). Kumar and Singh (1996) also reported when they conducted experiments to evaluate the effect of press mud and inorganic fertilizers on yield and nutrient uptake by rice and its residual effect on succeeding wheat crop and soil fertility in rain fed low lands. Maskina and Meelu (1984) also reported that application of 12 t ha^{-1} FYM increased grain yield of rice in non- saline soils.

Table 3: Effect of different levels of organics and zinc sulphate on grain yield

Treatment	Plant height (cm)	Tillers $hill^{-1}$	Grains $spike^{-1}$	Grain yield (t ha^{-1})
T1=Control	104.4	16.13	105	4.50
T2= FYM 5 t +0.0 kg $ZnSO_4$	103.4	15.50	102	4.45
T3 =FYM 5 t +2.5 kg $ZnSO_4$	108.3	16.70	115	4.58
T4 =FYM 5 t +5.0 kg ZnSO4	108.3	17.00	117	4.60
T5 =FYM 5 t +7.5 kg Zn SO4	108.3	17.50	121	4.61
T6 =FYM 10 t +0kg ZnSO4	103.4	15.23	101	4.30
T7 =FYM 10 t+2.5 kg ZnSO4	110.7	17.93	123	4.66
T8= FYM 10 t +5.0 kg ZnSO4	111.5	18.20	127	4.78
T9 =FYM 10t +7.5 kg $ZnSO_4$	112.4	18.33	135	4.85
T10=Press mud 5t +0.0 kg $ZnSO_4$	100.7	14.83	100	4.28
T11=Press mud 5t +2.5 kg $ZnSO_4$	104.0	15.60	103	4.47
T12=Press mud 5t +5.0 kg $ZnSO_4$	105.1	16.20	110	4.53
T13 =Press mud 5t +7.5 kg $ZnSO_4$	107.0	16.46	112	4.53
CD (p=0.05)	3.091	0.800	6.47	0.11

The straw yield was significantly varied in different treatments (Table 4). The maximum straw yield in 2006-07 was 7.67 tha^{-1} in press mud 5 t ha^{-1} + 0 kg $ZnSO_4$. However, in FYM 5 t and 10 t ha^{-1} with 2.5, 5.0 and 7.5 kg $ZnSO_4$ treatments, the straw yield was significantly lower than the control.

While, among three levels of zinc sulphate with press mud 5t ha^{-1} only highest dose (7.5 kg ha^{-1}) had significantly lower straw yield than the control. The concentration of zinc sulphate with different organics treatments increased, the straw yield was significantly reduced in both the years. It was also observed that the straw yield was significantly lower in FYM 10 t ha^{-1} with 2.5, 5.0 and 7.5 kg zinc sulphate treatments as compared to FYM 5 t ha^{-1} and press mud 5 t ha^{-1} with same levels of zinc sulphate in 2006-07.

Straw yield varied in different treatments and was highest in treatments in which organics were applied without zinc sulphate. This was also observed lower than control in all the treatments where organics were applied with increasing levels of $ZnSO_4$. Higher straw yield in these treatments may be due to the poor partitioning of carbohydrate in grain. The results of the study observed slightly in contradiction with Gupta and Kaushik (2004), Bhardwaj and Prasad (1981), Maskina and Meelu (1984) and Kumar (2007). They all were reported that straw yield also increased with application of organics and zinc. The application of organic residue released organic acids by the microbial decomposition and enhanced the nutrient availability in soil mainly phosphorus and improved crop yield (Dotaniya and Datta, 2013; Dotaniya *et al*., 2013a; Dotaniya *et al*., 2014).

Table 4: Effect of different levels of organics and zinc sulphate on straw yield

Treatment	Straw yield (t ha^{-1})
T1=Control	7.45
T2= FYM 5 t +0.0 kg $ZnSO_4$	7.62
T3 =FYM 5 t +2.5 kg $ZnSO_4$	7.11
T4 =FYM 5 t +5.0 kg ZnSO4	7.01
T5 =FYM 5 t +7.5 kg Zn SO4	6.91
T6 =FYM 10 t +0kg ZnSO4	7.63
T7 =FYM 10 t+2.5 kg ZnSO4	6.90
T8= FYM 10 t +5.0 kg ZnSO4	6.85
T9 =FYM 10t +7.5 kg $ZnSO_4$	6.81
T10=Press mud 5t +0.0 kg $ZnSO_4$	7.67
T11=Press mud 5t +2.5 kg $ZnSO_4$	7.57
T12=Press mud 5t +5.0 kg $ZnSO_4$	7.42
T13 =Press mud 5t +7.5 kg $ZnSO_4$	7.18
CD (p=0.05)	0.10

4. Conclusion

Fertilizers cost increasing with enormous rate, and the cost benefit ration of rice crop decline due to higher input cost. Use of locally available plant nutrient sources, enhanced the crop yield at cheaper rate and improve soil health. The Zn deficiency limits the rice crop yield, from this study application of FYM 10t ha^{-1} with 7.5 kg $ZnSO_4$ gave highest yield. It may be a viable option for sustainable rice crop yield in rice belt of India.

Acknowledgement

The authors are grateful to Anil Sharma for providing valuable guidance during preparation of manuscript and highly thankful to supporting staff of Department of Agricultural Chemistry and Soil

Science, Gochar Mahavidhyalaya for the valuable help during experiment.

Competing Interests

Authors declare that they have no competing interests.

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Cite this article as: Sharma et al., 2014. **Effect of press mud and FYM application with zinc sulphate on yield of hybrid rice**. *Journal of Environmental and Agricultural Sciences*. 1:8.