Utilization of Flue Gas Desulfurization (FGD) Gypsum in Reclamation of Sodic soil

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INTRODUCTION

Flue gas desulfurization gypsum (FGDG) is widely available byproduct of forced-oxidation wet scrubbers that are used to reduce sulfur emissions (SO_X) from coal-fired power plants using spray of lime stone slurry. Applications of FGDG in sodic soils supply Ca^{2+} which neutralize soluble alkalinity (CO_3^{2-} and HCO_3^-) and replace exchangeable Na^+. Subsequent leaching of Na^+ in presence of abundant SO_4^{2-} ions reclaim the sodicity of soil. Therefore, reclamation of soil sodicity is accompanied with reduction in alkalinity and improved soil physico-chemical properties suitable for crop production.

METHODOLOGY

An on farm sodicity reclamation experiment was initiated at ICAR–CSSRI, Karnal, India for evaluating the reclamation efficiency of FGDG produced by Thermal Power Plant of India in the lysimeters set up with sodic soils collected from adjoining area of Karnal, India, having $pH_{1:2}$ 10.1, $EC_{1:2}$ 0.70 dS m^{-1} and gypsum requirement of 16.7 Mg ha^{-1}. The FGDG were applied on the equivalent basis of 100 (replacing of cent per cent of Na^+ from soil exchange phases by Ca^{2+}), 75 and 50 GR and standard recommended reclamation dose of mineral gypsum 50GR and unamended control. Leaching was started after 30 days of FGDG application by transplanting sodicity-tolerant rice variety (*cv*. CSR-56). Leachate collecting units were installed at depth of 15 cm to monitor change in pH and EC of the leachates at regular intervals. Rice yield and soil saturation extract pH and EC were monitored after the crop harvest.

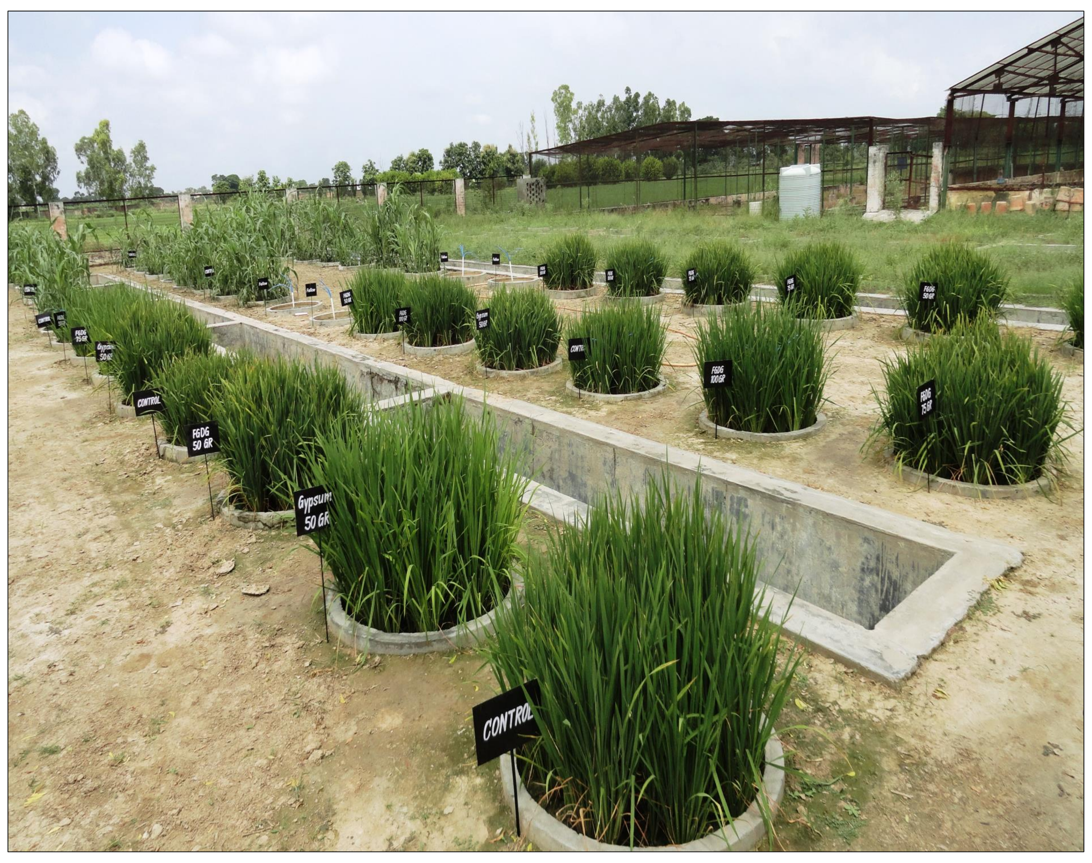

Fig 0. Experimental site

RESULTS

A decrease in the pH of the leachates was observed up to thirty-five days after transplanting (7.50-7.90) with subsequent increase towards alkaline range (8.00-8.60) for all soil treatments (Fig 1). There was significant increase in EC of leachates at 40 days after transplanting of rice; thereafter it declined. The sodium absorption ratio (SAR) of the leachate attained peak at 21 days after transplanting of rice thereafter a gradual decrement was observed.

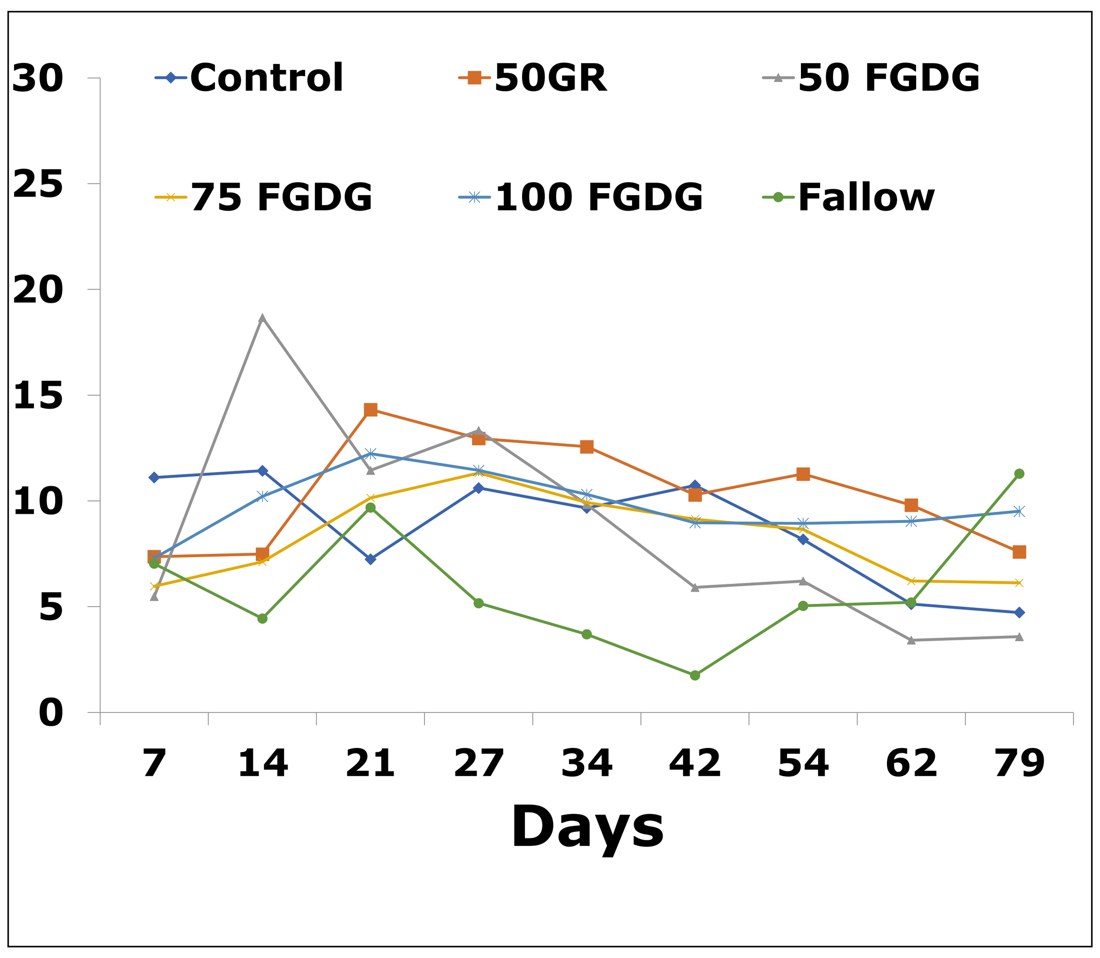

Fig 1. Leachate SAR ($cmol^{1/2}L^{-1/2}$) during rice (2020)

The pHs declined significantly compared to control and fallow treatments at 0-15 cm depth after the rice crop (Fig 2). 100 FGDG application showed lowest pHs value followed by 75 FGDG, 50 FGDG and 50GR. A higher value of EC_e (5.84 dS m^{-1}) was observed in 100FGDG treatment and was significantly higher than other doses of FGDG and mined gypsum at 0-15 cm soil depth. Control and fallow lysimeters had EC_e of 2.01 and 2.20 dS m^{-1}.

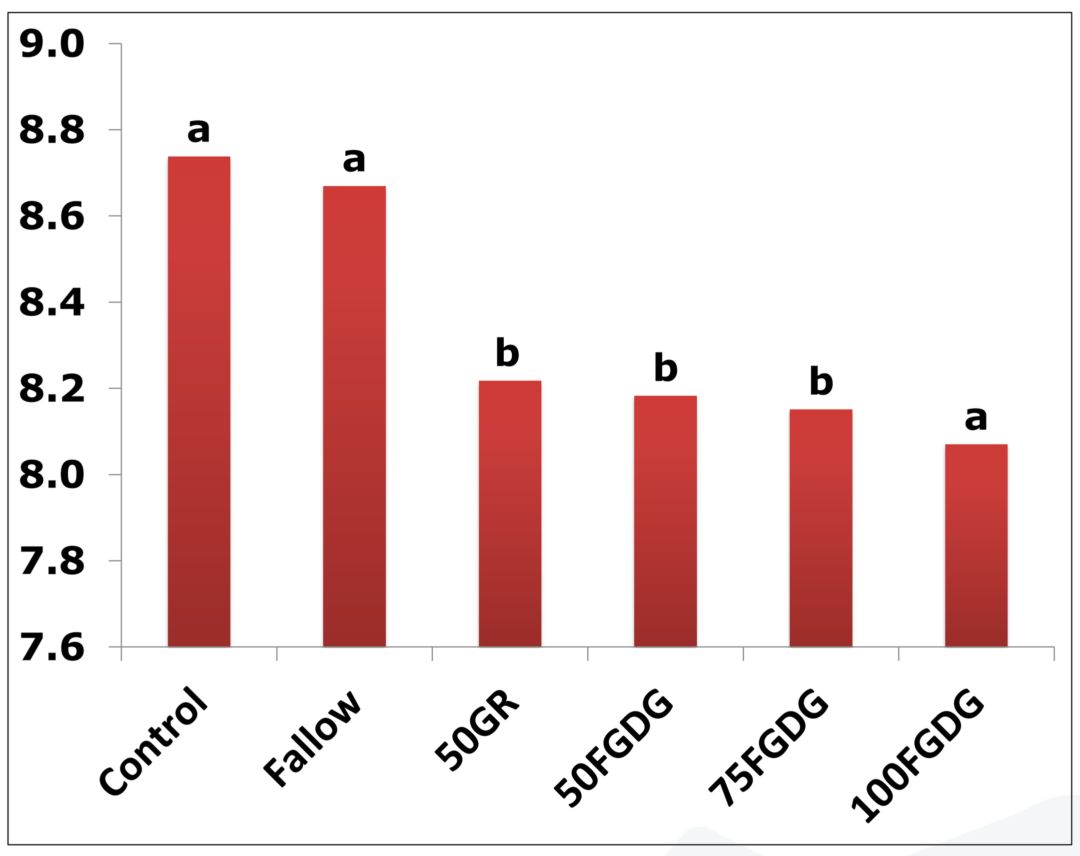

Fig 2. Change in pH_s of soil after rice (2020)

The higher paddy grain yield was recorded in FGDG-100 GR, FGDG-75 GR, FGDG-50 GR (0.43, 0.41 and 0.40 kg m^{-2}) compared to mined gypsum 50GR (0.33 kg m^{-2}) and unamended control (0.23 kg m^{-2}) (Fig 3).

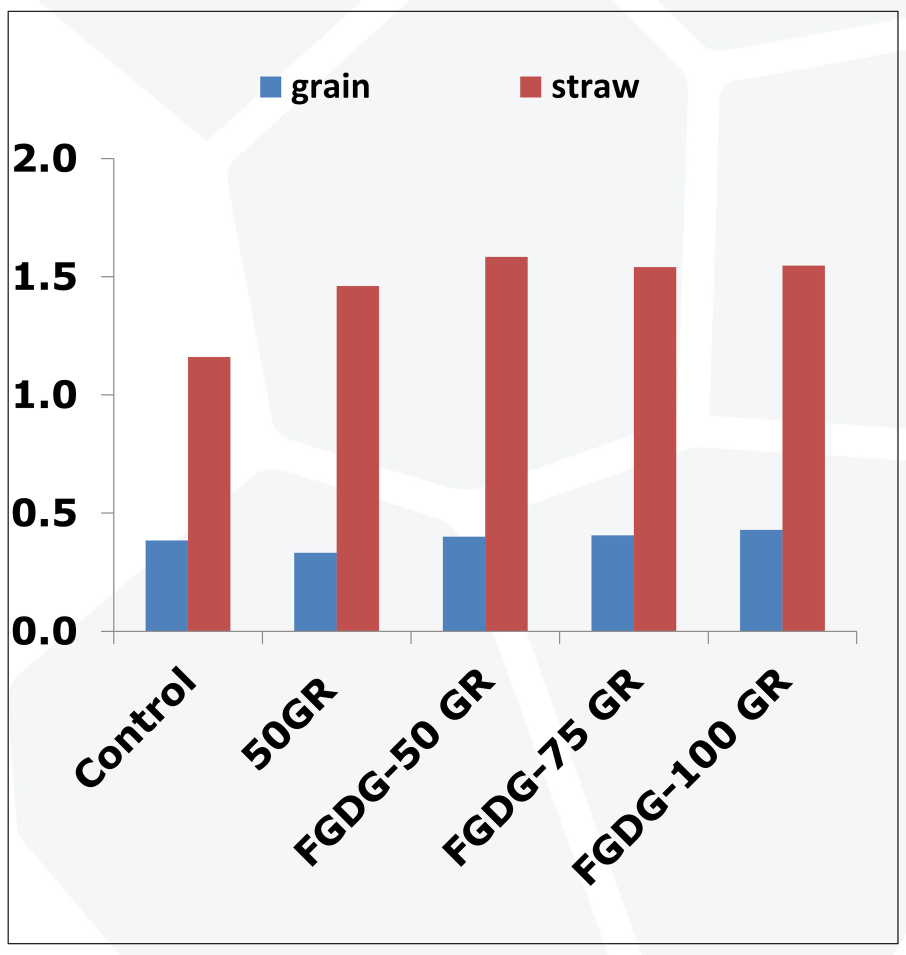

Fig 3. Rice (CSR-56) yield (kg m^{-2}) in lysimeters

CONCLUSIONS

Release of more Na^+ in leachate increased the SAR and leachate pH. Application of gypsum and FGDG supply soluble Ca^{2+} with progress of reclamation and exhibited lower values of SAR in effluent. All doses of FGDG treatment reported a decrement in soil pH and increase in the grain yield.

Decline in pH of the sodic soil and improved grain yield showed the potential of FGDG in the reclamation of sodic soils and its input towards the global food security. The treatment of barren saline-sodic soils with FGD gypsum would be of considerable benefit to both agricultural development and the improvement of ecosystems services.

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