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Short Note

Effect of Fly ash combination with inorganic fertilizer and FYM on dehydrogenase activity in Entisol

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Abstract
Field experiment were conducted in farmer field around National Thermal Power Corporation (NTPC) Tilda, Raipur (Chhattisgarh) during kharif season 2013 to evaluate different doses of fly ash (20, 40, 60 t ha^{-1}) combination with and without organic fertilizer on dehydrogenase activity in soil. Application of increasing doses fly ash with FYM was found to increase dehydrogenase activity and the highest recorded under application of 75% GRD + 40 t ha^{-1} fly ash + 5 t FYM ha^{-1} and tended to marginal decrease dehydrogenase activity 60 t fly ash ha^{-1}. The analysis of fly ash amendment soils and the produce rice grown are well within the permissible and safe limit even after the application of fly ash at higher dose 40 t ha^{-1} to the soil.

Keywords: Fly ash, FYM, GRD, Rice, dehydrogenase activity

Introduction
Rice (*Oryza sativa* L.) is the world"s most important crop and the primary source of food for more than half of the world's population. Rice is the seed of the monocot plants *Oryza sativa* (Asian rice) or *Oryza glaberrima* (African rice). As a cereal grain, it is the most widely consumed staple food for a large part of the world's human population, especially in Asia. Every year, rice is the principal cereal and significant calorie source for one-half to two-thirds of the world's population. Nutrient imbalance is one of the major abiotic constraints limiting productivity of cereal. In Chhattisgarh state, rice is grown largely 70 per cent under rainfed Condition whose productivity is greatly influenced by the pattern of rainfall distribution, soil type, soil nutrient status, temperature and climatic factors. The High cost of fertilizer and low purchasing capacity of the small and marginal peasants of the country which restrict the use of costly fertilizer inputs.

Coal is the prime source of energy for mankind all over the world which fulfills about 30% of its energy requirement. Coal plays the most vital role in the energy scenario of India. Fly ash is a product of Thermal Power Plant, which was produced during burning of coal for energy purpose, is a major concern. Fly ash is the portion of the combustion residue that enters the flue gas stream in power-generating facilities and consists of many small, glass-like particles ranging in size from 0.01 to 100 mm (Davison *et al*.1974) [3]. The response of fly ash addition in the soil on soil health and crop productivity is limited for soils of Chhattisgarh there is need to be evaluated on long term sustainable aspect. Hence, the objective of this study was to determine the effect on fly ash on dehydrogenase activities with inorganic fertilizer and FYM on soil health.

Materials and methods
A field experiment was conducted during *kharif* season 2013-14 at Gaitara, Raipur. The soil of the experimental plot having pH 6.81.Gaitarais located at Raipur district lies at 21º 55' N latitude and 81º78'E longitudes. It has an average elevation of 278.89 m. The experiment was planned with is 8 treatment, *viz.,* T_1 - (Control), T_2 – general recommended dose (GRD) of fertilizer (N, P_2O_5 and K_2O), T_3 - (75% GRD + 20 t Fly ash ha^{-1}), T_4 - (75% GRD + 40 t Fly ash ha^{-1}), T_5 - (75% GRD + 60 t Fly ash ha^{-1}), T_6 - (75% GRD + 20 t Fly ash ha^{-1} + 5 t FYM ha^{-1}), T_7 - (75% GRD + 40 t Fly ash ha^{-1}+ 5t FYM ha^{-1}) and T_8 -(75% GRD + 60 t Fly ash ha^{-1} + 5t FYM ha^{-1}) with three replication in randomized block design. The general recommended dose of fertilizer (N, P_2O_5 and K_2O) for rice was 100, 60 and 40 kg ha^{-1}, respectively.

Urea, diammonium phosphate and muriate of potash were taken as fertilizer sources for N, P_2O_5 and K_2O. Fly ash and FYM used as soil amendment and the nutrient content (N, P_2O_5, K_2O) of Fly ash and FYM was 0.14%, 0.078%, 0.029% and 0.60%, 0.41%, 0.53%, respectively. The variety used for rice was MTU- 1010. The rice was transplanted in second week of august 2013 and harvested on second week of November. The mean rainfall received during the cropping season was 1250 mm. The soil samples were air dried, grinded, sieved (2mm sieve) and used for analysis for various soil properties by standard procedure.

Results and discussion

Dehydrogenase activity

Biological oxidation of soil organic compounds is generally a dehydrogenation process carried out by specific dehydrogenases involved in the oxidative energy transfer of microbial cells (Burns, 1978). The activity of dehydrogenase enzyme in the soil system is very important as it indicates the potential of a soil to support biochemical processes which maintain soil fertility (Joychim *et al*., 2008) [4].

The data presented in Table 1 showed that dehydrogenase activity at tillering stage significantly increased with the treatments. It ranged from 15.01-26.71 µg TPF g^{-1} soil day^{-1}. The maximum dehydrogenase activity was obtained with T_7 (26.71) followed by treatment T6 (24.67) and T8 (25.03 µg TPF g^{-1} soil day^{-1}) and the minimum dehydrogenase activity was recorded under control (15.01).The treatment T7 (75% GRD + 40 t fly ash ha^{-1} + 5 t FYM ha^{-1}) was found statistically at par with T8 (75% GRD + 60 t fly ash ha^{-1} + 5 t FYM ha^{-1}) it was significantly superior to rest of the treatments. At harvesting stage dehydrogenase activity was found significantly superior to control and other treatments. It ranged from 6.83-13.95 µg TPF g^{-1} soil day^{-1}. The maximum dehydrogenase activity was noted in T7 (13.95) and the minimum was obtained under T_1 (control (6.83). The treatment T7 (75% GRD + 40 t fly ash ha-1 + 5 t FYM ha^{-1}) was found statistically at par with T8 (75% GRD + 60 t fly ash ha-1 + 5 t

FYM ha-1) and it was significantly superior to rest of the treatments. The highest dehydrogenase activity was found in treatment of fly ash combined with FYM and inorganic fertilizer compared to GRD and fly ash alone. A positive effect on soil biological properties is produced when these are amended by fly ash and FYM. Dehydrogenase activity increased with increasing application of fly ash. This might be due to supply of organic carbon and prolonged nutrient availability. Similar results were reported by Rautary (2005), Chandrakar *et al*. (2015) [2].

Conclusion

It may be concluded that there is considerable scope for proper utilization of fly ash in conjunction with FYM and chemical fertilizer improving soil productivity. Overall, the effect of fly ash on dehydrogenase activity is thus inconsistent, but in the presence of organic manure (FYM), the effect is positive. Integrated use of organic manure (FYM), Fly ash with recommended levels of inorganic fertilizers increased the dehydrogenase activity resulting in more microbial proliferation and thereby sustained soil health. The results of the present study there by support the concept of integrated nutrient management practices.

Table 1: Effect of different dose of fly ash with inorganic and organic fertilizer on Dehydrogenase activity.

Treatment	Dehydrogenase activity (µ TPF g-1 soil day-1)	
	Tillering	Harvesting
T1- Control	15.01	6.83
T2- GRD (100:60:40)	17.36	7.78
T3- 75% GRD + 20 t Fly ash ha^{-1}	20.96	8.23
T4- 75% GRD + 40 t Fly ash ha^{-1}	19.97	8.02
T5- 75% GRD + 60 t Fly ash ha^{-1}	17.64	8.05
T6-75% GRD + 20 t Fly ash ha^{-1} + 5 t FYM ha^{-1}	24.67	11.05
T7-75% GRD + 40 t Fly ash ha^{-1} + 5 t FYM ha^{-1}	26.71	13.95
T8-75% GRD + 60 t Fly ash ha^{-1} + 5 t FYM ha^{-1}	25.03	12.55
SEm±	0.60	0.57
CD(P=0.05)	1.82	1.74

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