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EFFECT OF GRADED DOSE OF FLY ASH APPLIED WITH AND WITHOUT FYM ON MICROBIAL AND ENZYMATIC ACTIVITY OF SOIL

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ABSTRACT

The study on effect of graded dose of fly ash applied with and without FYM on , microbial and enzymatic activity of soil conducted in entisol. The test crop was rice var. MTU-1010 . The Dehydrogenase activity (DHA) at tillering and harvesting stage of rice soil increased significantly. The highest DHA was recorded in 75% GRD + 40 t FA ha^{-1} + 5 t FYM ha^{-1} (T_7) 25.83, 15.20, while the lowest DHA was observed in control (T_1) 13.23, 6.07 ug TPF g^{-1} soil day^{-1} at tillering and harvesting stage respectively. The similar pattern were observed in both soil microbial biomass carbon and urease activity, that the treatment 75% GRD + 40 t FA ha^{-1} + 5 t FYM ha^{-1} (T_7) had maximum and the minimum in control (T_1), the soil microbial biomass carbon was 154.11, 134.53 and 113.81, 100.95 ì g C g^{-1} dry soil and urease activity was 47.37, 33.03 and 35.20, 28.60 ì g TPF g^{-1} soil day^{-1} at tillering and harvesting stage respectively. All microbial activity higher at tillering stage in 75% GRD + 40 t FA ha^{-1} + 5 t FYM ha^{-1} (T_7) but decrease at harvesting stage.

INTRODUCTION

Fly ash is a by-product of the Thermal Power Station, where coal energy is converted into electrical energy. The demand for electrical energy is increasing day by day and in the absence of its utilization of the byproduct of thermal plant, it is been getting accumulated and for storing large area of arable land will be required which is therefore finding immediate use of fly ash for different purposes is very important material containing mineral nutrients as minor components which attracts the agriculture scientists for its utilization in improving crop and soil productivity. It is similar to soil in some of physical and chemical properties, as it contains major, secondary and trace elements, which are found in earth crust. Total major nutrients N and P were low *i.e.* 0.056 and 0.087 % respectively, but it contains sufficient by higher amount of total K (0.172%), CaO (1.60%), MgO (0.96%) and total trace elements *i.e.* Mn 3.98 ppm, Cu 3.60 ppm , Zn 1.30 ppm and Fe 3.81 ppm, respectively (Bhoyer,1998) . Presence of organic matter in soil has an additive effect as it reduces the concentration of toxic metals through sorption, lowers the C/N ratio and provides organic compounds, which promote microbial proliferation and diversity (Wong and Wong, 1986; Pitchel and Hayes, 1990). In combination with various organic manure, fly ash can enhance soil microbial activities, nutrient availability and plant productivity (Sikka and Kansal, 1995). Fly ash ameliorate and increase in the usability percent a well known biological modifier, recycling of wastes using earthworm has become an important component of substantial agriculture, which has a multidirectional impact in terms of safe disposal of wastes preventing environmental pollution besides providing nutrient rich material (Jabeen *et al*., 2012) and (Jabeen *et al*., 2010).

The paper deals with Effect of graded dose of fly ash applied with and without FYM on rice productivity, microbial and enzymatic activity of soil

MATERIALS AND METHODS

The experiment was conducted in a entisol at the research village - Gaitara, Tilda block, Raipur district (C.G.) during *kharif* season of the year, 2015. The experiment design was randomized block design comprised of eight treatment combinations with three levels of fly ash (20, 40 and 60 t ha^{-1}) and two levels of FYM (0 and 5 t ha^{-1}). Fly ash and FYM applied as per the treatments before transplanting the rice. All the plots received the 75 percent of general recommended dose (GRD) of NPK fertilizers (100-60-40 kg ha^{-1}) except control and 100 percent GRD. The rice var. MTU-1010 was used as the test crop.

Soil microbial biomass carbon was determined by the fumigation extraction method as per the procedure of Jenkison and Powlson (1976). The dehydrogenase activity in soil was determined by method given by Klein *et al*. (1971). The assay of urease activity in soils involves estimation of urea hydrolysis in soils by determination of the urea remaining after incubation of soil with urea solution at $37^o{}_C$

RESULTS AND DISCUSSION

Dehydrogenase activity

Table 1: Effect of different treatment on dehydrogenase activity of soil

Treatments	Dehydrogenase activity (ìg TPF g^{-1} soil day^{-1}) Tillering	Harvesting
T1 – Control	15.20	6.07
T2 - GRD (100:60:40)	16.27	7.57
T3 - 75% GRD + 20 t fly ash ha^{-1}	18.63	7.83
T4 - 75% GRD + 40 t fly ash ha^{-1}	19.10	8.20
T5 - 75% GRD + 60 t fly ash ha^{-1}	18.53	7.97
T6 - 75% GRD + 20 t fly ash ha^{-1} + 5 t FYM ha^{-1}	22.10	10.13
T7 - 75% GRD + 40 t fly ash ha^{-1} + 5 t FYM ha^{-1}	25.83	13.23
T8 - 75% GRD + 60 t fly ash ha^{-1} + 5 t FYM ha^{-1}	24.53	11.17
SEm±	0.99	0.33
CD (P = 0.05)	3.01	1.01

Table 2: Effect of different treatment on dehydrogenase activity of soil

Treatments	Microbial biomass carbon (ìg C g^{-1} dry soil) Tillering	Harvesting
T1 – Control	134.53	100.95
T2 - GRD (100:60:40)	137.20	108.50
T3 - 75% GRD + 20 t fly ash ha^{-1}	139.17	105.01
T4 - 75% GRD + 40 t fly ash ha^{-1}	142.07	106.33
T5 - 75% GRD + 60 t fly ash ha^{-1}	137.68	104.36
T6 - 75% GRD + 20 t fly ash ha^{-1} + 5 t FYM ha^{-1}	144.35	109.79
T7 - 75% GRD + 40 t fly ash ha^{-1} + 5 t FYM ha^{-1}	154.11	113.81
T8 - 75% GRD + 60 t fly ash ha^{-1} + 5 t FYM ha^{-1}	147.05	108.05
SEm±	4.90	2.17
CD (P = 0.05)	14.87	6.58

Table 3 : Effect of different treatment on urease activity of soil

Treatments	Urease activity (ìg TPF g^{-1} soil day^{-1}) Tillering	Harvesting
T1 – Control	33.03	28.60
T2 - GRD (100:60:40)	37.90	24.97
T3 - 75% GRD + 20 t fly ash ha^{-1}	42.57	25.57
T4 - 75% GRD + 40 t fly ash ha^{-1}	40.43	34.70
T5 - 75% GRD + 60 t fly ash ha^{-1}	43.67	32.10
T6 - 75% GRD + 20 t fly ash ha-1 + 5 t FYM ha^{-1}	41.07	31.20
T7 - 75% GRD + 40 t fly ash ha-1 + 5 t FYM ha^{-1}	47.37	35.20
T8 - 75% GRD + 60 t fly ash ha-1 + 5 t FYM ha^{-1}	45.53	36.20
SEm±	1.25	2.49
CD (P = 0.05)	3.79	7.57

Dehydrogenase activity as influenced by different combinations of fly ash at tillering and harvesting stages in presented in Table 1. At tillering stage the treatments of fly ash with and without FYM showed significantly higher dehydrogenase activity as compared to control (T_1). The fly ash when applied with FYM was alone superior over 100 % GRD (T_2). It ranged from 15.20 - 25.83 ìg TPF g^{-1} soil day^{-1}. The minimum dehydrogenase activity was recorded under control (T_1). The maximum dehydrogenase activity was obtained with 75% GRD + 40 t fly ash + 5 t FYM ha^{-1} (T_7) was found statistically at par with 75% GRD + 60 t fly ash ha^{-1} + 5 t FYM ha^{-1} (T_8) .

At harvesting stage maximum dehydrogenase activity was observed in 75% GRD + 40 t fly ash + 5 t FYM ha^{-1} (T_7) and the minimum was obtained under control (T_1). The dehydrogenase activity showed the similar trend as tillering stage, but the activity value decreased in harvesting stage. It may be due to depletion of moisture contents. compare control and other treatments. It ranged from 6.07-13.23 ìg TPF g^{-1} soil day^{-1}. The highest dehydrogenase activity was found in treatment of fly ash combined with FYM and inorganic fertilizer compared to 100 % GRD and fly ash alone.

The increase in dehydrogenase activity with integrated application of fly ash, FYM and inorganic fertilizers may be attributed to the increasing population of micro-organism like bacteria *etc.*, due to increased availability of substrate through FYM releasing enzymes of intra cellular origin. Rao and Raman (1998) reported that there was a 2 to 2.5 fold increase in enzyme activity in cropping treatments during the active growth stage of the crop. The increased activity of enzymes was attributed to the activity of plants roots and rhizosphere effect. Similar results were reported by Rautary(2005). Jabben *et al.*(2011) also reported that the significant stimulation of soil respiration and microbial activities (dehydrogenase activity) were observed up to 5% fly ash amendment when the soils contained earthworms. This may be due to increased microbial activity induced by substrates that are produced by the earthworms and soil organic matter becoming more susceptible to microbial attack and the contribution of cellular lysing from water-induced osmotic shock to an easily mineralizable C pool that is consumed by the surviving soil microbes.

Soil microbial biomass carbon (SMBC)

The data presented in Table 2 revealed that the SMBC is significantly increased at tillering stage with different treatments. It ranged from 134.53 –154.11 ìg C g^{-1} dry soil. The maximum SMBC was obtained in treatment 75% GRD + 40 t fly ash + 5 t FYM ha^{-1} (T_7). The minimum value was recorded at control (T_1). The treatments 75% GRD + 40 t fly ash ha^{-1} + 5 t FYM ha^{-1} (T_7) was at par with treatments 75% GRD + 20 t fly ash ha^{-1} + 5 t FYM ha^{-1} (T_6), and 75% GRD + 60 t fly ash ha^{-1} + 5 t FYM ha^{-1} (T_8) but showed significantly higher SMBC over control (T_1) and 100 % GRD (T_2). The SMBC 75% GRD + 40 t fly ash ha^{-1} (T_4), 75% GRD + 20 t fly ash ha^{-1} + 5 t FYM ha^{-1} (T_6), 75% GRD + 40 t fly ash ha^{-1} + 5 t FYM ha^{-1} (T_7) and 75% GRD + 60 t fly ash ha^{-1} + 5 t FYM ha^{-1} (T_8) while lowest obtained in control.

At harvesting stage, SMBC ranged from 100.95-113.81 ìg C g^{-1} dry soil. The maximum SMBC was recorded in treatment 75% GRD + 40 t fly ash ha^{-1} + 5 t FYM ha^{-1} (T_7) followed by treatment 75% GRD + 20 t fly ash ha^{-1} + 5 t FYM ha^{-1} (T_6) and 75% GRD + 60 t fly ash ha^{-1} + 5 t FYM ha^{-1} (T_8). The minimum value was obtained under control (T_1). It was significantly increased in treatments 100 % GRD (T_2), and fly ash doses when applied with FYM as compared to control, but at par with the fly ash treatments when applied without FYM. No significant increase in SMBC when fly ash applied with and without FYM when compared to 100 % GRD.

Keeping in the view of above results the soil microbial biomass carbon increased with fly ash application alone or in combination with FYM in soil. The reduction in SMBC minimum when FYM was mixed with fly ash. This showed that FYM helped to maintain SMBC content in the root zone. It is a sound indicator of soil health since it regulates nutrient cycling and acts as a highly labile source of plant available nutrients. The nutrients content of fly ash alone or with FYM provides nutrients to the micro-organism for carrying out various metabolic activities without any adverse effect. Chandrakar *et al.* (2015) Nayak *et al.* (2013) and Kohli and

Goyal (2010) also reported the increased soil microbial activity with the integrated application of fly ash and FYM. Similar result observed by Bharat *et al.* (2015).

Urease activity

The data presented in Table 3 showed that urease activity at tillering stage significantly increased influenced by the application of the treatments. Further the fly ash doses applied with or without show higher urease activity as compared to 100 % GRD. The effect of fly ash doses on urease activity more when applied with FYM. The treatment 75% GRD + 40 t fly ash ha^{-1} + 5 t FYM ha^{-1} (T_7) and 75% GRD + 60 t fly ash ha^{-1} + 5 t FYM ha^{-1} (T_8) were at par but show significantly higher urease activity compared to 100 % GRD (T_2). The treatment 100 % GRD was also showed significantly higher urease activity compared to control (T_1).

At harvesting stage all the fly ash treatments when applied with or without FYM were at par each other with regards to urease activity but the increasing doses fly ash combined with FYM show higher activity. The treatment 75% GRD + 40 t fly ash ha^{-1} + 5 t FYM ha^{-1} (T_7) and 75% GRD + 60 t fly ash ha^{-1} + 5 t FYM ha^{-1} (T_8) showed significantly higher urease activity as compared to 100 % GRD (T_2).

The highest urease activity was found in treatment of fly ash combined with FYM and inorganic fertilizer compared to GRD and fly ash alone. urease 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). The Farm yard manure increased urease activity, dehydrogenase activity and microbial biomass carbon. Similar finding were also reported by Babhulkar *et al.* (2000) and Ram *et al.* (2011). Fly ash application at a low rate may slightly suppress, increase or not affect microbial respiration reported by Lim *et al.* (2012). When fly ash applied at rates above a critical level adverse impact on microbial activity due to high salinity, pH and concentration of certain element such as B and AS. Similar finding were reported by Lim *et al.* (2014) and Pichtel and Hayes (1990).

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