

Effect of Combined Application of FYM, Fly Ash and Fertilizers on Soil Properties and Paddy Grown on Degraded Land

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ABSTRACT

A field study was carried out on a sandy loam soil at the KVK farm Janjgir Champa, Chhattisgarh to study the effect of enriched fly ash (FA) on rice and soil characteristics of inceptisol during kharif 2013-14. The test crop was rice var. MTU-1010. The application of different treatment FA combinations increased paddy yield compared to 100% GRD. However the control treatment failed to produce the yield in degraded land. Among the treatments, the 75% GRD +60t FAha⁻¹+5t FYMha⁻¹ gave highest paddy yield (42.6 q ha⁻¹) than all other treatments. The straw yield was not significantly influenced by FA treatments, but the beneficial effect of enriched fly ash on higher rice straw yield was observed. Application of 75% GRD + fly ash@ 60 t ha⁻¹ + FYM @ 5 t ha⁻¹ recorded the highest soil available phosphorus, potassium and zinc compared to other treatments and soilavailable N was highest in application of 75% GRD + fly ash@ 40 t ha⁻¹ + FYM @ 5 t ha⁻¹. The soilavailable Cu, Mn and Fe content were not significantly influenced by different combination of FYM, FA and Fertilizers. The organic carbon storage on degraded land increased significantly with the application 75% GRD + fly ash@ 60 t ha⁻¹ + FYM @ 5 t ha⁻¹ (6043.33 kg ha⁻¹) than the 100% GRD and control.

Key words : Fly ash, FYM, Rice, Soil properties, Yield.

INTRODUCTION

Coal is a predominant source of global energy; at present in India it is major source of electrical energy in thermal power plants, which produce 175 million tonnes per year fly ash, which would require about 40,000 hectares of land for the construction of ash ponds (Lal *et al.*, 2012). Fly ash an amorphous ferroaluminosilicate, Physically fly ash occurs as fine particles (60-70%) with a size below 0.075 mm is a by product of pulverized coal fired thermal power station low to medium bulk density, high surface area and very light texture with pH ranged from 4.5 to 12 depending upon S content in the coal (Lal *et al.*, 2012). It can act as a secondary source of fertilizer nutrients like P, K, Ca, Mg, S, Cu,

Fe, Zn, Mn, Mo etc. (Totawat *et al.*, 2002). Fly ash increased the yield in various crops by 20-25% with high nutritional value and found beneficial for soil and crop when fly ash was applied on soil > 10% by weight (Yavarzadeh *et al.*, 2012). Hence, an experiment was conducted with the objective to find out the effect of enriched fly ash on soil health, growth and yield in degraded land.

MATERIALS AND METHODS

A field experiment was conducted in a sandy loam soil at the KVK Research Farm, Janjgir Champa, Chhattisgarh during the kharif season, 2013-14. The experiment design was randomized block design comprised of eight

treatment combinations with three levels of fly ash (20, 40 and 60t 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. Thericevar .MTU-1010 was used as the test crop. The fly ashwas collected from Madhya Bharat Paper Ltd. Village – Birgahni Champa Dist.- Janjgir Champa ,Chhattisgarh . The nutrient contents of used FYM and Fly ash applied in the experiment was given in Table 1.

Table 1: Chemical properties of FYM and FA used in experiment

Particulars	FYM	FA
Organic carbon (%)	5.07	0.36
N (%)	0.92	0.084
P (%)	0.239	0.043
K (%)	0.361	0.33
Fe (%)	0.55	0.73
Mn (%)	0.12	0.016
Zn (%)	0.009	0.007
Cu (%)	0.005	0.003

FYM = Farm Yard Manure , FA = Fly ash

The effect of different treatments was evaluated in terms of soil available major and micro nutrients at crop harvest and the crop yield. Available nitrogen was estimated by alkaline potassium permanganate method (Subbaiah and Asija, 1956). Available phosphorus content was extracted by Olsen'sreagent and determined by ascorbic acid method (Watanabe and Olsen, 1965). Available potassium was extracted by using neutral normal ammonium acetate (Muhr *et al.*,1965) and determined by flame photometer. Organic carbon was determined by Walkley and Black rapid titration method as described by Piper (1957) and storage calculate 0-10 cm depth of soil with having bulk density. Available micronutrients (DTPA extractable) Fe, Mn, Cuand Zn were analyzed by DTPA method using atomic absorption spectrophotometer (Lindsayand Norvell, 1978).

RESULTS AND DISCUSSION

The soil belongs to sandy loam texture and the soil status was low in available nitrogen , phosphorus and high in potassium (Table 3). The soil available micronutrients were above the critical limits except for Zn (Table 4). The control plots failed to produce the yield due to very low N and P status of soil (fig. 1 and Table 2, 3).The application of different treatment combinations except 75% GRD + 20t Fly ash ha⁻¹ with and without FYM increased

Table 2: Effect of combined application of FYM , FA and fertilizers on grain and straw yield of rice

Treatments	Grain yield (q ha ⁻¹)	Straw yield (q ha ⁻¹)
T ₁ - Control	0.00	10
T ₂ - 100% GRD (100:60:40)	31.67	47.50
T ₃ - 75% GRD + 20 t FA ha ⁻¹	26.83	44.83
T ₄ - 75% GRD + 40 t FA ha ⁻¹	33.67	46.33
T ₅ - 75% GRD + 60 t FA ha ⁻¹	31.83	41.50
T ₆ - 75% GRD + 20 t FA ha ⁻¹ + 5 t FYM ha ⁻¹	28	47
T ₇ - 75% GRD + 40 t FA ha ⁻¹ + 5 t FYM ha ⁻¹	37.67	49.42
T ₈ - 75% GRD + 60 t FA ha ⁻¹ + 5 t FYM ha ⁻¹	42.67	51.50
SEm±	2.05	1.74
C.D. (P = 0.05)	6.22	5.30

FA = fly ash, FYM = farm yard manure and GRD = general recommended dose of N, P and K

the grain yield compared to General recommended dose (GRD). The highest grain yield (42.6 q ha⁻¹) was recorded by application of 75% GRD + 60 t

FAha⁻¹ + 5 t FYMha⁻¹, which was at par with 75% GRD+ 40 t FAha⁻¹+5t FYMha⁻¹. Thus application of fly ash not only increased the paddy yield by 30%



Fig. 1 : Effect of different fly ash treatments on crop growth

Table 3 :Effect of combined application of FYM , FA and fertilizers on available major nutrients and organic carbon storage of soil at harvest.

Treatments	Available major nutrients (kg ha ⁻¹)			SOC Storage
	Nitrogen	Phosphorus	Potassium	C (kg ha ⁻¹)
T ₁ - Control	109	0.74	550.36	5045.33
T ₂ - 100% GRD (100:60:40)	135.89	1.16	580.49	5188.67
T ₃ - 75% GRD + 20 t FA ha ⁻¹	135.89	1.28	562.01	5457.33
T ₄ - 75% GRD + 40 t FA ha ⁻¹	137.98	1.43	576.57	5346.67
T ₅ - 75% GRD + 60 t FA ha ⁻¹	133.80	1.22	565.37	4728.00
T ₆ - 75% GRD + 20 tFA ha ⁻¹ + 5t FYM ha ⁻¹	137.98	1.28	569.93	5484.00
T ₇ - 75% GRD + 40 tFA ha ⁻¹ + 5t FYM ha ⁻¹	139.89	1.37	600.06	5776.33
T ₈ - 75% GRD + 60 tFA ha ⁻¹ + 5t FYM ha ⁻¹	137.80	1.52	616.09	6043.33
initial	107.40	0.80	549.81	4710
SEm±	2.13	0.043	12.03	126.22
C.D. (P = 0.05)	6.46	0.13	36.5	382.84

Table 4 : Effect of combined application of FYM , FA and fertilizers on available micronutrients

Treatments	Soil available micronutrients (mg kg ⁻¹)			
	Iron	Manganese	Zinc	Copper
T1 - Control	7.63	8.35	0.70	0.38
T2 - 100% GRD (100:60:40)	8.63	9.11	0.74	0.39
T3 - 75% GRD + 20 t FA ha ⁻¹	9.43	10.61	0.82	0.56
T4 - 75% GRD + 40 t FA ha ⁻¹	9.86	10.94	1.21	0.82
T5 - 75% GRD + 60 t FA ha ⁻¹	8.74	10.20	1.13	0.52
T6 - 75% GRD + 20 t FA ha ⁻¹ + 5t FYM ha ⁻¹	9.63	9.71	1.24	0.62
T7 - 75% GRD + 40 tFA ha ⁻¹ + 5 t FYMha ⁻¹	10.07	11.77	1.30	0.90
T8 - 75% GRD + 60 t FA ha ⁻¹ +5 t FYMha ⁻¹	11.02	12.75	1.42	0.92
Initial	8.09	9.72	0.68	0.43
SEm±	0.79	1.0 4	0.12	0.13
C.D. (P = 0.05)	NS	NS	0.38	NS

but also saved the 25% of NPK fertilizer. The straw yield was significantly higher in different treatments over control and further combination of fly ash with or without FYM was found similar to GRD but showed at most 8.42% increased in straw yield. The supply of nutrients, conducive to physical environment leading to better aeration, root activity and nutrient absorption and the consequent complementary effect by fly ash application with organic and inorganic fertilizer would have resulted in higher grain and straw yield of rice this finding are in conformity with that of Reddy *et al.* ,(2010) . The beneficial effect of fly ash on yield was also reported by Aggarwal *et al.*(2009) in wheat and sorghum and by Arivazhagan *et al.* (2011) in rice , wheat , maize , ragi.

An increase in soil available major and micronutrients status on degraded soil was observed (Table 3 and 4). The soil available N status was significantly higher by the application of the treatments over control. The soil test Phosphorus was significantly higher under the combined treatment over 100% GRD and control, the treatments 75% GRD + 60t FAha⁻¹ + 5t FYM ha⁻¹ and 75% GRD+ 40 t FAha⁻¹ + 5 t FYMha⁻¹ showed higher soil test P compared to GRD . Similarly in different FA combination treatments 75 % GRD + 60t FAha⁻¹ + 5t FYM ha⁻¹ and 75% GRD+ 40 t FAha⁻¹ + 5 t FYMha⁻¹ over GRD showed higher available K status in soil, further the fly ash when combined with organic and chemical fertilizer showed remarkable increase in soil available K over 100% GRD . The

organic carbon storage was increased with the combination of treatments and was maximum in 75% GRD + 60t FAha⁻¹ + 5t FYM ha⁻¹(6063.33 kg ha⁻¹) as compare to GRD and control .

The application of 75% GRD + 60 t FAha⁻¹ + 5 t FYMha⁻¹ has recorded higher available Zn as compare to 100% GRD and control (Table 4) . The Fe , Mn and Cu content was not influenced by the different combination of treatments.

The increase in soil available major nutrients status due to fly ash application was reported by Khan *et al.* (2008) and Ramet *et al.* (2011) the increase in available major nutrients except K concluded by Dey *et al.* (2012). The organic carbon was increased application of FA and FYM reported by Karmakar *et al.*, (2009). The beneficial effect of fly ash on improvement of soil health in respect of physico-chemical parameters, nutritional status and microbial population may be due to the cumulative effect of improvement in individual physico-chemical characteristics (Yeledhalli *et al.*,2008).

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