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Integrated effect of inorganic and organic fertilizers with fly ash on total micronutrients uptake by rice crop

Kiran Patel and RN Singh

Abstract
The present investigation entitled "Influence of integrated effect of inorganic and organic fertilizers with fly ash on total micronutrients uptake by rice crop in acid soil of northern hills zone (C.G.)" was carried out during *kharif* season of 2014-15 at Ajirma village, Surajpur district (Chhattisgarh). The treatments comprised of control, 100% GRD (100:60:40), 75% GRD + 20 t fly ash ha^{-1}, 75% GRD + 40 t fly ash ha^{-1}, 75% GRD + 60 t fly ash ha^{-1}, 75% GRD + 20 t fly ash ha^{-1} + 5 t FYM ha^{-1}, 75% GRD + 40 t fly ash ha^{-1} + 5 t FYM ha^{-1} and 75% GRD + 60 t fly ash ha^{-1} + 5 t FYM ha^{-1} were laid out in Randomized Block Design (RBD) with three replications. The total iron, manganese, zinc, and copper (4141.21, 245.80, 123.05 and 32.96 g ha^{-1},) uptake was found in T_8 (75% GRD + 60 t fly ash ha^{-1} + 5 t FYM ha^{-1}) where it was minimum (2178.72, 115.04, 50. 99 and 9.72 g ha^{-1}) in control.

Keywords: fly ash, FYM and total micronutrient

Introduction
Fly ash is a byproduct from burning pulverized coal in electric power generating plants. During combustion, mineral impurities in the coal (clay, feldspar, quartz, and shale) fuse in suspension and float out of the combustion chamber with the exhaust gases. As the fused material rises, it cools and solidifies into spherical glassy particles called fly ash. 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) [5]. Disposal of high amount of fly-ash from thermal power plants absorbs huge amount of water, energy and land area by ash ponds. In order to meet the growing energy demand, various environmental, economic and social problems associated with the disposal of fly-ash would continue to increase. Therefore, fly-ash management would remain a great concern of the century. Fly-ash has great potentiality in agriculture due to its efficacy in modification of soil health and crop performance. The high concentration of elements (K, Na, Zn, Ca, Mg and Fe) in fly-ash increases the yield of many agricultural crops. Fly ash sample are enriched in several trace metals such as Fe, Mn, Cu, Ni, Pb and Zn which are very essential for the growth of the plants in agricultural field. The increased accumulation of essential trace elements such as Mn, Zn and Cu by the paddy shoot or grain might be due to increased activity of ionic transporters (Hall and Williams, 2003). The impact of fly ash and FYM incorporation in soil on yield and nutrient availability to rice. The results revealed that concentration of macro and micronutrients in rice showed considerable increase when grown in fly ash incorporated soil with and without FYM application. The uptake of macro and micronutrient by rice grain also increased correspondingly with increasing level of fly ash application (Saini *et al.*, 2010) [8]. In combination with various organic manure, fly ash can enhance soil microbial activities, nutrient availability and plant productivity (Sikka and Kansal, 1995) [9]. 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) [1]. One can therefore expect that interaction between the predominantly inorganic fly ash and organic matter may further enhance its beneficial effect on plant growth in problem soils (Page *et al*, 1979) [7]. The accumulation of Fe was maximum in all the parts of plant followed by Si and both metals showed more translocation to leaves while Mn, Zn, Cu, Ni and Cd showed lower accumulation and most of the metal was confined to roots in all the three cultivars. As was accumulated only in leaves and was not found to be in detectable levels in roots and seeds. In All the three cultivars of rice heavy metal accumulation was

Fe > Si > Mn > Zn > Ni > Cu > Cd > as in all the plant parts Dwivedi *et al*. (2007) [2]

Materials and Methods

Micronutrients, i.e. Fe, Mn, Cu and Zn were extracted by using 0.005 M diethylene triamine penta acetic acid (DTPA), 0.01 M calcium chloride dihydrate and 0.1 M triethanol amine (TEA) buffered at pH 7.3 and the concentrations of the nutrients in the filtrate were analyzed by atomic absorption spectrophotometer (Lindsay and Norvell, 1978) [6].

Results and Discusions

Total uptake (g ha^{-1}) of micronutrients (Fe, Mn, Zn and Cu) by rice

Total Fe uptake

The results on iron uptake as influenced by treatments is presented in Table 1 and Fig. 1. It ranged between 2178.72-4141.21 g ha^{-1}. The maximum iron uptake (4141.21 g ha^{-1}) was found in T_8 (75% GRD + 60 t fly ash ha^{-1} + 5 t FYM ha^{-1}) where it was minimum (2178.72 g ha^{-1}) in control. The treatment T_8 (75% GRD + 60 t fly ash ha^{-1} + 5 t FYM ha^{-1}) at par with Treatments T_7 (75% GRD + 40 t fly ash ha^{-1} + 5 t FYM ha^{-1}).

Total Mn uptake

The results on manganese uptake as influenced by treatments is presented in Table 1 and Fig. 1. It ranged between 115.04-245.80 g ha^{-1}. The maximum manganese uptake (245.80 g ha^{-1}) was found in T_8 (75% GRD + 60 t fly ash ha^{-1} + 5 t FYM ha^{-1}) where it was minimum (115.04g ha^{-1}) in control. The treatment T_8 (75% GRD + 60 t fly ash ha^{-1} + 5 t FYM ha^{-1}) at par with T_6 (75% GRD + 20 t fly ash ha^{-1} + 5 t FYM ha^{-1}) and T_7 (75% GRD + 40 t fly ash ha^{-1} + 5 t FYM ha^{-1}).

Total Zn uptake

The results on total zinc uptake as influenced by treatments is presented in Table 1 and Fig. 1. It ranged between 50.99-123.05 g ha^{-1}. The maximum total zinc uptake (123.05 g ha^{-1}) was found in T_8 (75% GRD + 60 t fly ash ha^{-1} + 5 t FYM ha^{-1}) where it was minimum (50. 99g ha^{-1}) in control. The treatment T_8 (75% GRD + 60 t fly ash ha^{-1} + 5 t FYM ha^{-1}) was significantly superior to all treatments.

Total Cu uptake

The results on total copper uptake as influenced by treatments is presented in Table 1 and Fig. 1. It ranged between 9.72-32.96 g ha^{-1}. The maximum total copper uptake (32.96 g ha^{-1}) was found in T_8 (75% GRD + 60 t fly ash ha^{-1} + 5 t FYM ha^{-1}) where it was minimum (9.72 g ha^{-1}) in control. The treatment T_8 (75% GRD + 60 t fly ash ha^{-1} + 5 t FYM ha^{-1}) at par with T_6 (75% GRD + 20 t fly ash ha^{-1} + 5 t FYM ha^{-1}) and T_7 (75% GRD + 40 t fly ash ha^{-1} + 5 t FYM ha^{-1}).

Das *et al*. (2013) [3] reported that the effect of RDF and fly ash on uptake of N, P, K and micronutrients (Fe, Mn, Cu and Zn) showed that, their uptake in straw and grain increased significantly over control with 100% RDF and RDF 50% + FYM 5 t ha^{-1}. Addition of chemical fertilizer alone or in combination with FYM resulted in higher available nutrient contents in soil and subsequent uptake of them in increased amount. Similarly it has been seen that uptake of available macro and micro nutrients increased significantly with increasing doses of fly ash. The interaction effect of fertilizer, FYM and fly ash was also statistically significant on uptake of available nutrients. The highest total uptake of N, P, K and Fe, Mn, Zn, Cu (119.22, 73.84 and 209.69 kg ha^{-1} and 3574.9, 1354.3, 180.2 and 104.9 g ha^{-1}, respectively) were recorded in treatment RDF 50% + FYM 5 t ha^{-1} + FA 15 t ha^{-1} and the lowest being 49.01, 27.83 and 53.87 kg ha^{-1} and 546.0, 397.3, 53.1 and 23.1 g ha^{-1}, respectively, in control.

Table 1: Influenced by integrated effect of inorganic and organic fertilizers with fly ash on total micronutrients uptake (g ha^{-1}) by rice crop at harvest stage

Treatments	Total uptake (g ha^{-1})			
	Fe	Mn	Zn	Cu
T_1 Control	2178.72	115.04	50.99	9.72
T_2 100% GRD (100:60:40)	3623.38	191.36	80.53	16.19
T_3 75% GRD+ 20 t fly ash ha^{-1}	2930.23	157.92	69.45	15.97
T_4 75% GRD+ 40 t fly ash ha^{-1}	3128.31	169.17	80.29	16.84
T_5 75% GRD+ 60 t fly ash ha^{-1}	3578.96	205.02	91.76	21.32
T_6 75% GRD+ 20 t fly ash ha^{-} + 5 t FYM ha^{-1}	3959.20	229.50	106.62	25.50
T_7 75% GRD+ 40 t fly ash ha^{-1} + 5 t FYM ha^{-1}	3982.05	233.96	108.25	26.81
T_8 75% GRD+ 60 t fly ash ha^{-1} + 5 t FYM ha^{-1}	4141.21	245.80	123.05	32.96
SEm±	58.96	5.78	3.39	3.39
CD (P = 0.05)	178.83	17.53	10.29	10.06

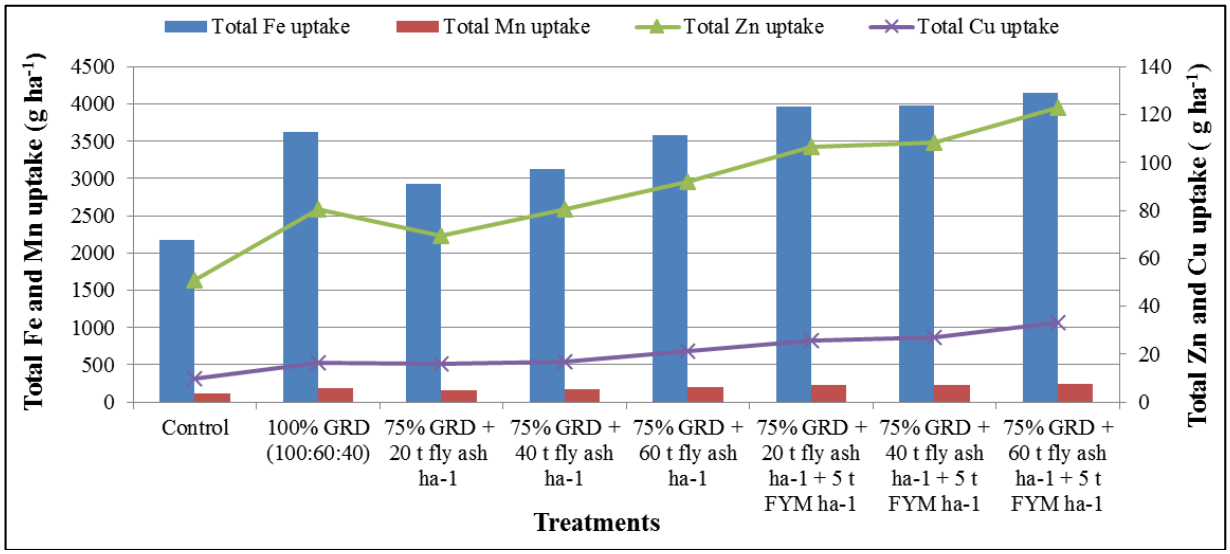

Fig 1: Influenced by integrated effect of inorganic and organic fertilizers with fly ash on total micronutrients uptake (g ha^{-1}) by rice crop at harvest stage

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