International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(1): 309-312

Received: 17-11-2017
Accepted: 23-12-2017

LK Ramteke
IGKV, Raipur, Chhattisgarh, India

SS Sengar
IGKV, Raipur, Chhattisgarh, India

R Kumar
IGKV, Raipur, Chhattisgarh, India

Correspondence
LK Ramteke
IGKV, Raipur, Chhattisgarh, India

Effect of fly ash, organic manure and fertilizers on available micro nutrient in rice-wheat cropping system in *alfisols* and *vertisols*

LK Ramteke, SS Sengar and R Kumar

Abstract
Field experiment was conducted under *Alfisols* at KVK, Farm Katghora, Korba and *Vertisols* at Instructional Farm Indira Gandhi Krishi Vishwavidyalaya, Raipur during 2011,2012and 2013.To assess the impact of different doses of fly ash alone or in combination with manure and fertilizers on available micro nutrient in rice –wheat cropping system in *Alfisols* and *Vertisols* in the following treatments (i.e. T_1Control, T_2- 10 t FA ha^{-1}, T_3-20 t FA ha^{-1} T_4-STCR (based fertilizer recommendation), T_5-75% NPK ha^{-1}, T_6-100% NPK (100:60:40), T_7-75% NPK ha^{-1}+ 10 t FA ha^{-1}, T_8-75% NPK ha^{-1} + 20 t FA ha^{-1}, T_9-100% NPK ha^{-1}+ 10 t FA ha^{-1}, T_{10}-100% NPK ha^{-1} + 20 t FA ha^{-1}, T_{11}-75 % NPK ha^{-1}+ 5 t FYM ha^{-1}, T_{12}-100% NPK ha^{-1} +5 t FYM ha^{-1}, T_{13}- 75% NPK ha^{-1} + 5 t FYM +10 t FA, T_{14}- 75% NPK ha^{-1} + 5 t FYM +20 t FA ha^{-1}, T_{15}-100% NPK ha^{-1} +5 t FYM+10 t FA ha^{-1} and T_{16}- 100% NPK ha^{-1} +5 t FYM+20 t FA ha^{-1}) under Split Plot Design with factorial arrangment of crop and soil in main plot and treatment in sub plot. The available soil Fe, Mn, Zn and Cu significantly increased due to addition of fly ash in *Alfisol* and *Vertisol* in rice-wheat cropping system. The available Mn and Zn significant influenced by interaction of soil x crop x treatments. The treatment, T_{16} recorded highest available soil Fe, Mn, Zn and Cu and T_1, recorded lowest available Fe, Mn, Zn and Cu contain in soil.

Keywords: Fly ash, Available micro nutrients, rice-wheat cropping system

Introduction
The high concentration of elements (K, Na, Zn, Ca, Mg and Fe) in fly ash increased yield of agricultural crops. The major source of electrical energy is coal based thermal power plants, which produce 175 million tonnes, fly ash which would require about 40,000 hectares of land for the construction of ash ponds (Lal *et al.*, 2012) [6]. The Ministry of Power and Planning Commission estimates that the coal requirement and generation of fly ash during the year 2031-32 would be around 1800 million tonnes and 600 million tonnes respectively (Kanungo, 2013) [3]. fly ash application @ 10 t ha^{-1} significantly increased the cation exchange capacity, primary, secondary and trace elements like N, P, K, Ca, Mg, Cu, Zn and Mn of soil Kuchanwar *et al.* (1997) [5]. Incorporation of FYM and fly ash at 10 t ha^{-1}, in general, improved the CEC, organic carbon content, available nutrient status and decreased the soil pH Totawat *et al*. (2002) [8]. The micronutrients contents was slightly increased with use of sludge and fly ash applied plots in compression to control Kanojia and Singh (2008) [2]. The available 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) [7].

Available micronutrient in soil
Soil available iron
Table 1 show that available iron in soil significantly increased due to addition of fly ash in rice-wheat cropping system in *Alfisol* and *Vertisol*. The higher available iron was recorded in rice under *Alfisol* during 2011, 2012 and pooled data. Table 2 shows that the treatment, T_{16} recorded higher available iron and it was at par with treatments, T_{15} and T_{14} in 2011, 2012 and pooled data. The lowest available iron was recorded in treatment, T_1. The interaction of crop x soil x treatments was non significant.

Soil available manganese

Table 1 shows that available manganese in soil significantly increased due to addition of fly ash in rice-wheat cropping system in *Alfisol* and *Vertisol*. The higher available manganese was recorded in rice under *Alfisol* during 2011, 2012 and pooled data.

Interaction between crop × soil × treatments reveals (Table 3) that, rice × *Vertisol* × treatment and rice × *Alfisol* × treatment, treatment T_{16} recorded significantly highest available manganese content in soil among all the treatments in pooled data. It was at par with treatment, T_{15} in rice × *Vertisol* × treatment and T_{15}, and T_{14} in rice × *Alfisol* × treatment. The lowest available manganese content in soil was recorded in T_1. In case of wheat × *Vertisol* × treatments and wheat × *Alfisol* × treatment, T_{16} recorded higher available manganese content in soil. It was at par with T_{15} and T_{14} in wheat × *Vertisol* × treatment and wheat × *Alfisol* × treatment. The lowest available manganese content was recorded in T_1.

Soil available zinc

Table 4 shows that available zinc in soil was significantly increased due to addition of fly ash in rice-wheat cropping system in *Alfisol* and *Vertisol*. The higher available zinc was recorded in wheat under *Alfisol* during 2011-12 and pooled data.

Table 5 shows that the treatment, T_{16} recorded highest available zinc in 2011, 2012 and pooled data. It was at par with treatment, T_{15} in 2012 and pooled data. The lowest available zinc was recorded in treatment, T_1.

Table 1: Effect of fly ash alone or in combination with organic manure and fertilizers on available iron and manganese in rice-wheat cropping system in Alfisol and Vertisol at harvest.

Particular	Available iron (mg kg^{-1})						Available manganese (mg kg^{-1})					
	2011		2012		Pooled		2011		2012		Pooled	
	Vertisol	*Alfisol*	*Vertisol*	*Alfisol*	*Vertisol*	*Alfisol*	*Vertisol*	*Alfisol*	*Vertisol*	*Alfisol*	*Vertisol*	*Alfisol*
Rice	10.30	10.47	10.50	10.94	10.40	10.71	7.63	7.43	7.85	7.59	7.74	7.51
Wheat	9.30	10.77	9.26	10.86	9.28	10.81	6.62	7.27	6.70	7.41	6.66	7.34
	SEm±	CD at 5%	SEm±	CD at 5%	SEm±	CD at 5%	SEm±	CD at 5%	SEm±	CD at 5%	SEm±	CD at 5%
A	0.039	0.133	0.022	0.077	0.019	0.065	0.029	0.101	0.017	0.058	0.014	0.050
B	0.039	0.133	0.022	0.077	0.019	0.065	0.029	0.101	0.017	0.058	0.014	0.050
A×B	0.055	0.189	0.031	0.109	0.027	0.092	0.041	0.143	0.024	0.083	0.020	0.070

Table 2: Effect of fly ash alone or in combination with organic manure and fertilizers on available iron in rice-wheat cropping system in *Alfisol* and *Vertisol* at harvest.

Treatments			Available iron (kg ha^{-1})					
			2011		2012		Pooled	
T_1	-	Control	8.37		9.09		8.73	
T_2	-	10 t FA ha^{-1}	9.03		10.04^{d}		9.54^{f}	
T_3	-	20 t FA ha^{-1}	9.31		10.24^{c}		9.78^{e}	
T_4	-	STCR	10.00^{c}		10.04^{d}		10.02^{d}	
T_5	-	75%NPK ha^{-1}	9.63		9.78^{d}		9.70^{e}	
T_6	-	100% NPK ha^{-1}	9.94		10.00^{d}		9.97^{e}	
T_7	-	75%NPK ha^{-1}+10 t FA ha^{-1}	10.03^{c}		10.19^{c}		10.11^{d}	
T_8	-	75%NPK ha^{-1}+20 t FA ha^{-1}	10.39^{c}		10.36^{c}		10.38^{c}	
T_9	-	100%NPK ha^{-1}+10 t FA ha^{-1}	10.48^{b}		10.61^{b}		10.54^{c}	
T_{10}	-	100%NPK ha^{-1}+20 t FA ha^{-1}	10.81^{b}		10.80^{b}		10.80^{b}	
T_{11}	-	75% NPK ha^{-1}+5 t FYM ha^{-1}	10.56^{b}		10.35^{c}		10.45^{c}	
T_{12}	-	100%NPK ha^{-1}+5 t FYM ha^{-1}	10.73$_{b}$		10.47^{c}		10.60^{b}	
T_{13}	-	75%NPK ha^{-1}+5 t FYM+10 t FA ha^{-1}	10.77^{b}		10.82^{b}		10.79^{b}	
T_{14}	-	75%NPK ha^{-1}+5 t FYM+20 t FA ha^{-1}	10.93^{a}		10.99^{a}		10.96^{a}	
T_{15}	-	100%NPKha^{-1}+5 t FYM+10 t FA ha^{-1}	11.08^{a}		11.13^{a}		11.11^{a}	
T_{16}	-	100%NPK ha^{-1}+5 t FYM+20 t FA ha^{-1}	11.31^{a}		11.32^{a}		11.31^{a}	
			SEm±	CD at 5%	SEm±	CD at 5%	SEm±	CD at 5%
C			0.122	0.342	0.117	0.327	0.098	0.275
A×C			0.173	0.483	0.165	0.462	0.139	0.389
B×C			0.173	0.483	0.165	N/A	0.139	0.389

Table 3: Effect of fly ash alone or in combination with organic manure and fertilizers on available manganese in rice-wheat cropping system in *Alfisol* and *Vertisol* at harvest.

Treatments			Available manganese (mg kg^{-1})			
			Rice		Wheat	
			Vertisol	*Alfisol*	*Vertisol*	*Alfisol*
T_1	-	Control	7.390^{c}	6.518	5.543	6.672^{h}
T_2	-	10 t FA ha^{-1}	7.625^{c}	6.767	5.700	6.838^{g}
T_3	-	20 t FA ha^{-1}	7.680^{c}	6.978	5.928	7.035f
T_4	-	STCR	7.553^{d}	6.745	5.733	6.828^{g}
T_5	-	75%NPK ha^{-1}	7.510^{d}	6.582	5.568	6.778^{g}
T_6	-	100% NPK ha^{-1}	7.547^{d}	6.695	5.627	6.818^{g}
T_7	-	75%NPK ha^{-1}+10 t FA ha^{-1}	7.635^{c}	6.768	5.925	7.027^{f}
T_8	-	75%NPK ha^{-1}+20 t FA ha^{-1}	7.705^{c}	7.365	6.357	7.235^{e}

T_9	-	100%NPK ha^{-1}+10 t FA ha^{-1}	7.753[c]	7.802[d]	7.768[c]	7.423[d]
T_{10}	-	100%NPK ha^{-1}+20 t FA ha^{-1}	7.823[c]	7.910[d]	7.885[c]	7.563[c]
T_{11}	-	75% NPK ha^{-1}+5 t FYM ha^{-1}	7.643[c]	8.027[c]	5.770	7.468[d]
T_{12}	-	100%NPK ha^{-1}+5 t FYM ha^{-1}	7.695[c]	8.075[c]	5.830	7.562[c]
T_{13}	-	75%NPK ha^{-1}+5 t FYM+10 t FA ha^{-1}	7.908[b]	8.295[b]	7.988[b]	7.850[b]
T_{14}	-	75%NPK ha^{-1}+5 t FYM+20 t FA ha^{-1}	7.958[b]	8.477[a]	8.215[a]	8.038[a]
T_{15}	-	100%NPKha^{-1}+5 t FYM+10 t FA ha^{-1}	8.153[a]	8.540[a]	8.328[a]	8.100[a]
T_{16}	-	100%NPK ha^{-1}+5 t FYM+20 t FA ha^{-1}	8.280[a]	8.685[a]	8.480[a]	8.238[a]
SEm±			0.106			
CD at 5% level			0.298			

Soil available copper

Table 4 shows that available copper in soil was significantly increased due to addition of fly ash in *Vertisol* and *Alfisol* in rice-wheat cropping system. The higher available copper was recorded in wheat under *Alfisol* during 2011-12 and pooled data.

Interaction between crop × soil × treatments reveals (Table 6) that, rice × *Vertisol* × treatment and rice × *Alfisol* × treatment, T_{16} recorded significantly highest available copper content in soil among all the treatments. It was at par with treatment, T_{15} and T_{14} in rice × *Vertisol* × treatment, rice × *Alfisol* × treatment. In case of wheat × *Vertisol* × treatments and wheat × *Alfisol* × treatment, T_{16} was recorded higher available copper content in soil. It was at par with T_{15} in wheat x *Vertisol* × treatment and wheat × *Alfisol* × treatment. The lowest available copper content was recorded in T_1.

The available micronutrient (Fe, Mn, Zn, and Cu) in soil increased with increasing doses of fly ash alone or in combination with organic manure and fertilizer. This might be due to fact that fly ash contains sufficient amount of the micronutrients, hence good source of micro nutrients. The above results are also in conformity as reported by Kene *et al.* (1991), Deshmukh *et al.* (2000) [1] and Kuchanwar *et al.*(1997) [5].

Table 4: Effect of fly ash alone or in combination with organic manure and fertilizers on available zinc and copper in rice-wheat cropping system in *Alfisol* and *Vertisol* at harvest.

Particular	Available Zinc (mg kg^{-1})						Available Copper (mg kg^{-1})					
	2011		2012		Pooled		2011		2012		Pooled	
	Vertisol	*Alfisol*	*Vertisol*	*Alfisol*	*Vertisol*	*Alfisol*	*Vertisol*	*Alfisol*	*Vertisol*	*Alfisol*	*Vertisol*	*Alfisol*
Rice	0.97	1.04	1.06	1.03	0.95	1.03	0.83	0.98	1.18	1.25	1.07	1.11
Wheat	0.99	1.09	1.12	1.12	1.07	1.11	1.02	1.08	1.03	1.17	1.02	1.13
	SEm±	CD at 5%	SEm±	CD at 5%	SEm±	CD at 5%	SEm±	CD at 5%	SEm±	CD at 5%	SEm±	CD at 5%
A	0.003	0.011	0.004	0.015	0.004	0.012	0.006	0.020	0.005	0.018	0.004	0.013
B	0.003	0.011	0.004	0.015	0.004	0.012	0.006	0.020	0.005	0.018	0.004	0.013
A×B	0.005	0.016	0.006	0.021	0.005	N/A	0.008	0.028	0.007	0.026	0.005	0.018

Table 5: Effect of fly ash alone or in combination with organic manure and fertilizers on available zinc in rice-wheat cropping system in *Alfisol* and *Vertisol* at harvest.

Treatments			Available zinc (kg ha^{-1})					
			2011		2012		Pooled	
T_1	-	Control	0.89		0.94		0.91[j]	
T_2	-	10 t FA ha^{-1}	0.93		1.02		0.97[h]	
T_3	-	20 t FA ha^{-1}	0.99		1.06		1.02[g]	
T_4	-	STCR	0.92		0.99		0.95[i]	
T_5	-	75%NPK ha^{-1}	0.89		0.95		0.92j	
T_6	-	100% NPK ha^{-1}	0.91		0.96		0.93[i]	
T_7	-	75%NPK ha^{-1}+10 t FA ha^{-1}	0.97		1.03		1.00[g]	
T_8	-	75%NPK ha^{-1}+20 t FA ha^{-1}	1.02		1.06		1.04[f]	
T_9	-	100%NPK ha^{-1}+10 t FA ha^{-1}	1.04		1.12		1.08[e]	
T_{10}	-	100%NPK ha^{-1}+20 t FA ha^{-1}	1.08		1.16		1.12[d]	
T_{11}	-	75% NPK ha^{-1}+5 t FYM ha^{-1}	1.04		1.06		1.05[f]	
T_{12}	-	100%NPK ha^{-1}+5 t FYM ha^{-1}	1.07		1.10		1.08[e]	
T_{13}	-	75%NPK ha^{-1}+5 t FYM+10 t FA ha^{-1}	1.10		1.17[c]		1.13[c]	
T_{14}	-	75%NPK ha^{-1}+5 t FYM+20 t FA ha^{-1}	1.13		1.21[b]		1.17[b]	
T_{15}	-	100%NPKha^{-1}+5 t FYM+10 t FA ha^{-1}	1.18		1.24[a]		1.21[a]	
T_{16}	-	100%NPK ha^{-1}+5 t FYM+20 t FA ha^{-1}	1.22[a]		1.27[a]		1.24[a]	
			SEm±	CD at 5%	SEm±	CD at 5%	SEm±	CD at 5%
C			0.009	0.025	0.012	0.035	0.011	0.031
A×C			0.012	N/A	0.018	0.049	0.016	N/A
B×C			0.012	0.035	0.018	0.049	0.016	0.044

Table 6: Effect of fly ash alone or in combination with organic manure and fertilizers on available copper in rice-wheat cropping system in *Alfisol* and *Vertisol* at harvest.

Treatments			Available copper (mg kg^{-1})			
			Rice		Wheat	
			Vertisol	*Alfisol*	*Vertisol*	*Alfisol*
T_1	-	Control	0.975	0.970	0.933	0.964
T_2	-	10 t FA ha^{-1}	1.061^{c}	1.037	0.967	1.017
T_3	-	20 t FA ha^{-1}	1.113^{b}	1.065	0.984	1.082
T_4	-	STCR	1.033^{d}	0.999	0.959	0.988
T_5	-	75%NPK ha^{-1}	0.958	0.995	0.938	0.967
T_6	-	100% NPK ha^{-1}	0.977	1.015	0.951	0.983
T_7	-	75%NPK ha^{-1}+10 t FA ha^{-1}	1.044^{d}	1.063	0.956	1.079
T_8	-	75%NPK ha^{-1}+20 t FA ha^{-1}	1.078^{c}	1.094	1.001	1.145
T_9	-	100%NPK ha^{-1}+10 t FA ha^{-1}	1.099^{c}	1.134	0.977	1.180
T_{10}	-	100%NPK ha^{-1}+20 t FA ha^{-1}	1.114^{b}	1.188	1.010	1.223
T_{11}	-	75% NPK ha^{-1}+5 t FYM ha^{-1}	1.035^{d}	1.200	0.992	1.151
T_{12}	-	100%NPK ha^{-1}+5 t FYM ha^{-1}	1.056^{d}	1.239	1.011	1.211
T_{13}	-	75%NPK ha^{-1}+5 t FYM+10 t FA ha^{-1}	1.127^{b}	1.302^{b}	1.079	1.206
T_{14}	-	75%NPK ha^{-1}+5 t FYM+20 t FA ha^{-1}	1.156^{a}	1.349^{a}	1.094	1.266
T_{15}	-	100%NPKha^{-1}+5 t FYM+10 t FA ha^{-1}	1.185^{a}	1.378^{a}	1.156^{a}	1.323^{a}
T_{16}	-	100%NPK ha^{-1}+5 t FYM+20 t FA ha^{-1}	1.221^{a}	1.393^{a}	1.200^{a}	1.364^{a}
SEm±			0.020			
CD at 5% level			0.055			

References

1. Deshmukh, Anjali, Matte DB, Kene DR, Bhaisare Bharti. Soil properties influenced by fly ash application. J Soil Crops. 2000; 10(1):69-71.
2. Kanojia RK, Singh SS. Studies on the effect of sludge and fly ash on soil physical properties of soil under rice-wheat cropping system. The Allahabad Farmer. 2008, 13(2)
3. Kanungo SP. Laboratory studies and field application of fly ash in forest nurseriesand plantation at CSIR- IMMT, National workshop on use of fly ash in forestry and development of degraded/ wasteland, held during. 2013, 23-33.
4. Kene DR, Lanjewar SA, Ingole BM, Chaphale SD. Effect of application of fly ash on physico-chemical properties of soil. J. Soils Crops. 1991; 1(1):11-18.
5. Kuchanwar OD, Matte DB, Kene DR. Effect of fly ash application on physic-chemical properties of soil. J.Soils and Crops. 1997; 7(1):73-75.
6. Lal K, Chhabra R, Mongia AD, Meena RL, Yadav RK. Release and uptake of potasium and sodium with fly ash application in rice on reclaimed alkali soil. Journal of the Indian Society of Soil Science. 2012; 60:181-186.
7. Lindsay WL, Norvell WA. Development of DTPA soil testing for Zinc, iron, manganese and copper. Soil Sci. Soc. America J. 1978; 42:421-428.
8. Totawat KL, Nagar GL, Jat SL, Jangir RK. In: Symposium on Effect of fly ash on the performance of wheat on ustochrepts of sub humid plains of India. Held during 14-21 August 2002, Thailand, Symposium. 2002; 24(215):1-11.