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Effect of flyash and organic manures on soil dehydrogenase activity and nutrient uptake of the maize

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Abstract
A field experiment was conducted to study the soil dehydrogenase activity and nutrient uptake by maize as influenced by application of flyash and organic manures during the *kharif* 2015. The results showed that the soil dehydrogenase activity and nutrient uptake by maize were conspicuously increased with application of flyash with organic manures compare to application of only flyash. The highest activity of soil dehydrogenase activity (11.57 µg TPF h^{-1} g^{-1} soil) was observed with treatment receiving flyash @ 15 t ha^{-1} + municipal compost @ 15 t ha^{-1} along with RDF. Similarly total macro nutrient uptake of N, P_2O_5, K_2O, S were 213.00, 27.91, 269.02, 34.94 kg ha^{-1} respectively and micronutrient uptake maximum total uptake of Fe, Mn, Cu and Zn (2708.33, 1406.64, 104.95 and 699.29 g ha^{-1} respectively) were found in treatment receiving flyash @ 15 t ha^{-1} + municipal compost @ 15 t ha^{-1} along with RDF compare to other treatment combinations.

Keywords: Maize, flyash, municipal compost, vermicompost, FYM, RDF, dehydrogenase activity, nutrient uptake

Introduction
Disposal of solid wastes is a major problem as it requires large problem as it requires large pondage area and may cause atmospheric pollution if not managed properly. About 130 coal-based thermal power stations in India are producing over 165 million tons flyash per year. Presence of essential plant nutrients such as N, P, K, Ca, Mg, S and micronutrients make it a source of plant nutrients (Pandey and Singh, 2010) [7] and increases yield of several crops by its application. Apart from nutrition, flyash generation is increased to 300 million tons per annum in 2017 and it expected to increase 900 million tons per annum by 2031-32. This will lead to major environmental problem. Both in disposal as well as in utilization, utmost care has to be taken to safeguard the interest of human life, wild life and environment (Central electricity authority India, 2012-13) [3]. The solution therefore lies in recycling of these wastes in one or the other way to the maximum extent possible. One of the possible areas for disposal of large quantities of these wastes would be agricultural land. Flyash and Muncipal compost are types of solid wastes, which contains appreciable amounts of nutrients, required by crops. Maize (*Zea mays* L.) is the world's third most important cereal crop after wheat and rice. It is one of the leading crop cultivated over an area of 9.5 mha and productivity of 2.45 t ha^{-1} in India (FAO STAT, 2014). In Karnataka, maize is cultivated over an area of 1.38 mha with an average productivity of 2.88 t ha^{-1} which is far below the potential. Similarly, in Raichur district area and productivity is 850 ha and 32.87 q ha^{-1}, respectively (FAO STAT, 2015). The application of flyash in different proportion with or without NPK fertilizers along with different organic manures like FYM, vermicompost and municipal compost improve the efficiency of nutrients added, and their uptake by crops, thus augment the crop yields. In combination with organic manure, flyash can enhance soil microbial activities, nutrient availability and plant productivity (Sikka and Kansal., 1995) [11]. A considerable amount of research has been carried out to blend flyash with varieties of organic and inorganic materials, like animal manure, poultry manure, sewage sludge, composts, pressmud, vermicompost, biochar, bio inoculants, *etc*.
In view of this, the present investigation to study effect of flyash and other organic manures on dehydrogenase activity and nutrient uptake by maize crop was taken up during kharif season 2015 at college of agriculture, Raichur.

Table 1: Initial properties of soil of experimental site

Particular	Value
Soil pH	8.02
EC (dSm^{-1})	0.25
OC ($g\ kg^{-1}$)	5.10
Nitrogen (N)	117.51
Phosphorus (P_2O_5)	55.36
Potassium (K_2O)	188.61
Sulphur (S)	14.39
Bacteria (No. $\times 10^6$ cfu g^{-1} soil)	6.04
Fungi (No. $\times 10^3$ cfu g^{-1} soil)	5.26
Actinomycetes (No. $\times 10^4$ cfu g^{-1} soil)	5.64

Material and methods

The field experiment on effect of flyash and organic manures application on soil was conducted during the *kharif* 2015 at Agricultural college farm, Raichur, situated on the latitude of 16° 15' N latitude and 77° 20' E longitude with an altitude of 389 meters above the mean sea level and is located in North Eastern Dry Zone of Karnataka. The soil of the experimental site was medium black and clay loam in texture with the available nitrogen (117.51 kg ha^{-1}), phosphorus (55.36 kg ha^{-1}), potassium Dehydrogenase activity (μgTPFh^{-1} g^{-1} soil) 12.42 (188.61 kg ha^{-1}), Sulphur (14.39 kg ha^{-1}), organic carbon content (5.10 g kg^{-1}). Likewise the initial microbial population *viz.*, bacteria (6.04 × 10^6 cfu g^{-1} soil), actinomycete (5.64 × 10^4 cfu g^{-1} soil), fungi (5.26 × 10^3 cfu g^{-1} soil) and dehydrogenase activity (12.42 μg TPF h^{-1} g^{-1} soil) of the experimental site was recorded (Table 1). The experiment included eight treatments consisted of T_1: Control, T_2: Flyash @ 30 t ha^{-1}, T_3: FYM @ 10 t ha^{-1}, T_4: Muncipal compost @ 30 t ha^{-1}, T_5: Vermicompost @ 5 t ha^{-1}, T_6: Flyash @ 15 t ha^{-1} + FYM @ 5 t ha^{-1}, T_7: Flyash @ 15 t ha^{-1}+ Muncipal compost @ 15 t ha^{-1}, T_8: Flyash @ 15 t ha^{-1} + Vermicompost @ 2.5 t ha^{-1}. For each treatment NPK @150:75:37.5 kg ha^{-1} + $ZnSO_4$ @ 25 kg ha^{-1} applied.

Table 2: Properties of amendments used in experiment

Particulars	FA	FYM	MC	VC
Soil pH	7.98	7.00	7.65	6.97
EC (dS m^{-1})	1.86	0.70	2.80	1.50
OC (%)	1.50	11.50	17.24	31.60
Total N (N) (%)	0.056	0.98	1.3	3.5
Total P (P_2O_5) (%)	0.082	0.014	0.72	0.258
Total K (K_2O) (%)	2.100	1.500	2.28	0.870
Total S (S) (%)	0.550	0.680	0.57	0.60
Total Fe (mg kg^{-1})	13.02	25.60	350.64	39.80
Total Cu (mg kg^{-1})	1.70	3.40	6.98	3.50
Total Mn (mg kg^{-1})	9.40	125.6	135.2	136.50
Total Zn (mg kg^{-1})	28.50	20.32	118.70	29.84

Maize crop variety C-818 were used for investigation. The amendments like flyash (FA), municipal compost (MC), vermicompost (VC) and farm yard manure (FYM) were analysed before using for experiment (Table 2) and were applied 30 days before sowing as per treatments. Nitrogen (N), phosphorus (P) and potassium (K) were applied in the form of urea, diammonium phosphate (DAP) and muriate of potash (MOP), respectively and zinc was applied in the form of $ZnSO_4$ @ 25 kg ha^{-1}. All these nutrients were applied 5 cm away from the seed line and 5 cm deep in to soil. Basal dose of fertilizer (half of nitrogen and full dose of phosphorus and potassium) was applied at the time of planting and remaining half of nitrogen was applied at 30 DAS. The soil sample were collected at 0-15 cm depth from each plot of experiment site before sowing, at 55 DAS and at harvest stage and used for the following enzymatic analysis. The dehydrogenase activity in free rhizosphere was carried out before sowing, 55 DAS and after the harvest of crop by following the procedure as described by Casida *et al.* (1964) [2]. The results are expressed as μg of triphenyl formazan (TPF) formed per gram of soil per day.

Result and discussion

In the present study, the total Uptake of N, P, K and S by maize at harvest in treatment receiving only RDF was 101.76, 10.01, 100.61 and 16.63 kg ha^{-1} respectively. Whereas the total uptake of these nutrients increased due to combined application of RDF, flyash with different organic manures. The maximum total uptake of N, P, K and S by maize found 213.00, 27.91, 269.02 and 34.94 kg ha^{-1}, respectively due to application of RDF and flyash with municipal compost. Total Uptake of Fe, Mn, Cu and Zn at harvest in treatment receiving only RDF was 1208.59, 659.73, 38.57 and 284.83 g ha^{-1}. Whereas, the total uptake of these micronutrients increased significantly due to combined application of RDF and flyash with different organic manures. The maximum total uptake of Fe, Mn, Cu and Zn (2708.33, 1406.64, 104.95 and 699.29 g ha^{-1}) were found due to application of RDF and flyash with municipal compost (Table 3).

Combined application of flyash and different organic manures along with RDF significantly increased the uptake of N, P, K and S. This may attributed to the continuous availability of N, P, K and S nutrient elements throughout the crop growth period as the nutrients from inorganic sources were available to the crop in the early stages and the nutrients released from the organic sources (flyash or organic manures) they become available in the later growth stages of the crop. Similar results were reported by Selvakumari *et al*. (2000) [2], who observed increased uptake of N, P, K and S by rice in treatment receiving flyash with fertilizers and organic manures. Similarly Yavarzadeh and Shamsadini (2012) [13] observed increased uptake in wheat due to application of flyash along with vermicompost. The increase in uptake of different nutrient elements such as Fe, Mn, Cu and Zn due to combined application of RDF, flyash with different organic manures might be attributed by partly due to direct addition of these nutrients to soil through flyash and different organic manures, and partly due to increased mobilisation of native nutrients by microbial activity and chelating effect. Similar interaction effect was reported by Das *et al.* (2013) [4].

The enzyme dehydrogenase is regarded as an indicator of total life in the soil and a strong indicator of biological activity. Dehydrogenase activity in the soil at initial stage was non-significant, treatment T_7 recorded the highest (13.8 μg TPF ha^{-1} g^{-1} soil) and it was found on par with T_6 (12.8 μg TPF ha^{-1} g^{-1} soil), T_8 (12.9 μg TPF ha^{-1} g^{-1} soil). It was superior over rest of the treatments and lowest activity of dehydrogenase activity was recorded in T_1 (11.3 μg TPF ha^{-1} g^{-1} soil). At 55 DAS dehydrogenase activity in the soil was significantly higher with treatment T_7 (23.1 μg TPF ha^{-1} g^{-1} soil), which was superior over other treatments and minimum activity of dehydrogenase was observed in T_1 (8.8 μg TPF ha^{-1} g^{-1} soil). It was found on par with T_6 (19.6 μg TPF ha^{-1} g^{-1} soil) and T_8 (19.8 μg TPF ha^{-1} g^{-1} soil). Similarly, dehydrogenase activity at harvest was significant and followed the same trend as that of 55 DAS (Table 4).

Table 3: Effect of fly ash and organic manures application on total nutrient uptake by maize

Treatment	N	P_2O_5	K_2O	SO_4	Cu	Fe	Mn	Zn
	(kg ha^{-1})				(g ha^{-1})			
T_1	101.76	10.01	100.61	16.63	38.57	1280.89	659.73	284.83
T_2	152.06	17.53	178.01	21.45	58.65	1582.01	820.33	434.74
T_3	120.31	13.83	144.92	20.15	46.04	1381.61	713.82	342.29
T_4	135.32	16.51	173.72	21.76	50.11	1479.52	764.81	375.62
T_5	136.39	16.66	176.22	21.19	56.33	1529.00	792.66	406.81
T_6	179.10	20.88	214.45	25.30	98.58	2605.48	1352.03	659.40
T_7	213.00	27.91	269.02	34.94	104.95	2708.33	1406.64	699.29
T_8	189.32	22.57	233.45	32.12	100.49	2639.69	1370.09	670.54
S. Em.±	9.93	2.56	16.99	3.17	3.78	82.38	42.82	5.39
C.D. at 5 %	34.16	7.52	58.40	9.45	11.25	245.25	127.47	16.03

Treatment

T_1: RDF	**T_5: VC @ 5 t ha^{-1}**
T_2: FA @ 30 t ha^{-1}	T_6: FA @ 15 t ha^{-1} + FYM @ 5 t ha^{-1}
T_3: FYM @ 10 t ha^{-1}	T_7: FA @ 15 t ha^{-1}+ MC @ 15 t ha^{-1}
T_4: MC @ 30 t ha^{-1}	T_8: FA @ 15 t ha^{-1} + VC @ 2.5 t ha^{-1}

Note: NPK @ 150:75:37.5 kg ha^{-1} + $ZnSO_4$ @ 25 kg ha^{-1} was applied for all treatments

The enhancement of soil chemical, biological, and microbiological properties more in maize grown under organic and inorganic treatments due to nutrient level and environmental conditions could help microbial growth which has positive effects on the overall plant performance. The presence of more microbial and biological activity in the rhizosphere leads to beneficial functions for crops such as plant growth promotion, nitrogen fixation, phosphate solubilization, induced systemic resistance and protection against pathogens (Rao, 2005) [9].

Table 4: Effect of fly ash and organic manures application on dehydrogenase activity in soil

Treatment	Initial	At 50% Tasseling	At Harvesting stage
	(µg TPF h^{-1} g^{-1} soil)		
T_1: RDF	11.32	8.82	5.91
T_2: FA @ 30 t ha^{-1}	11.54	13.21	8.61
T_3: FYM @ 10 t ha^{-1}	12.51	14.94	6.37
T_4: MC @ 30 t ha^{-1}	12.02	14.36	7.07
T_5: VC @ 5 t ha^{-1}	12.66	15.94	9.47
T_6: FA @ 15 t ha^{-1} + FYM @ 5 t ha^{-1}	12.84	19.62	10.77
T_7: FA @ 15 t ha^{-1}+ MC @ 15 t ha^{-1}	13.87	23.13	11.57
T_8: FA @ 15 t ha^{-1} + VC @ 2.5 t ha^{-1}	12.94	19.84	11.47
S. Em.±	0.87	1.23	1.19
C.D. at 5 %	NS	3.74	3.56

Note: NPK @ 150:75:37.5 kg ha^{-1} + $ZnSO_4$ @ 25 kg ha^{-1} was applied for all treatments

Conclusion

From this study, it can be concluded that the impact of flyash on total nutrient uptake and dehydrogenase activity in the soil is thus inconsistent, but in the presence of organic manures the effect is more favourable. Among the treatments T_7: FA @ 15 t ha^{-1} + MC @ 15 t ha^{-1} along with RDF recorded highest followed by T_6: FA @ 15 t ha^{-1} + FYM @ 5 t ha^{-1} and T_8: FA @ 15 t ha^{-1} + VC @ 2.5 t ha^{-1}. Thus integrated use of Fly ash, organic manure (FYM) and inorganic fertilizers increased the total nutrient uptake and dehydrogenase activity thereby sustained soil health.

References

1. Arivazhagan K, Ravichandran M, Dube SK, Mathur VK, Khandakar RK, Yagnanarayana K *et al*. Effect of coal flyash on agriculture crops: showcase project on use of flyash in agriculture in and around thermal power station area of national thermal power corporation Ltd., India. World of coal ash conference, Denver, USA, 2011.
2. Casida LE Jr., Klein DA, Santoro T. Soil dehydrogenase activity. Soil Sci. 1964; 98:371-376.
3. Central electricity authority India. Annual report on fly-ash utilization, 2012-13.
4. Das BK, Choudhury BH, Das KN. Effect of integration of flyash with fertilizers and FYM on nutrient availability, yield and nutrient uptake of rice in Inceptisols of Assam, India. Int. J Res. Tech. 2013; 2(11):2278-7763.
5. Faostat (Food and Agriculture Organization of the United Nations Statistics Division), 2014. http://faostat.fao.org/default.aspx.
6. Faostat (Food and Agriculture Organization of the United Nations Statistics Division). 2015. http://faostat.fao.org/default.aspx
7. Pandey VC, Singh N. Impact of flyash incorporation in soil systems. Agric. Ecosyst. Environ. 2010; 136:16-27.
8. Pramer D, Schmidt EL. Experimental soil microbiology, Minnesota, 1964.
9. Rao DLN. Soil microbial diversity in chemical and organic farming. Paper presented at ‘‘National seminar on organic farming-Current Scenario and future thrust’’. ANGRAU, Hyderabad, 2005, 61-64.
10. Shah Z, Adans WA, Haven CDV. Consumption and activity of the microbial population in an acidic upland soil and effects of liming. Soil Bio. Biochem. 1990; 22(2):257-263.

11. Sikka R, Kansal BD. Effect of flyash application on yield and nutrient of composition rice, wheat and on pH and available nutrient status of soils. Bioresource Tech. 1995; 51:199-203.
12. Selvakumari G, Bhaskar M, Jayanthi D, Mathan KK. Effect of integration of flyash and fertilizers and organic manure on nutrient availability, yield and nutrient uptake of rice on Alfisols. J Indian Soc. Soil Sci. 2000; 48:268-278.
13. Yavarzadeh MR, Shamsadini H. Safe Environment by using flyash and vermicompost on wheat, International conference on transport, Environ. Civil Engg. Kuala Lumpur, Malaysia, 2012.