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RESEARCH ARTICLE

EFFECT OF ORGANIC ACIDS AND FLY ASH ON RELEASE PATTERN of SO_4^{2-}- SAND CHANGE IN pH AND EC OF ALLUVIAL AND BLACK SOILS OF BALLIA

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ABSTRACT

Incubated soil samples from different treatment combinations were showed that pH of both alluvial and black soil have very small variation but T_2, T_{11} and T_{14} were appeared in decrease the alkalinity and to continued upto 60 DAT. The EC of treated soil with different combination of organic acid and fly ash in both alluvial and black soil have not much showed more decreasing trend but minimize the soluble salt content. The available sulphur amount have increasing by all treatment combination from 20 to 60 DAT in both alluvial and black soil but treatment T_4 ,T_{12} and T_{14} have greater release than the control pot.

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INTRODUCTION

Fly ash is a major solid industrial waste in India. It is by waste product of thermal power stations where electricity is produced by firing and finely powdered coal. This Huge amount of fly ash is produced every day at every thermal power station in country and dumped in ash disposal areas which creates the land degradations problems and may cause potential environmental hazards, in spreading diseases and leaching of unwanted chemicals into ecosystem. Among chemical means or additives, fly ash/lime provides an economic and powerful means of improvement, as demonstrated by the significant transformation that is evident on mixing with heavy clay. Fly ash provides the uptake of vital nutrients (Ca, Mg, Fe, Zn, Mo, S and Se) by crops and vegetation and can be considered as a potential growth improver. Physically, fly ash occurs as very fine particles, having an average diameters of < 10 mm low to medium bulk density, high surface area and very light texture. Chemically the composition of fly ash varies depending on the quality of coal used and operating conditions of thermal power stations. Approximately on an average 95 to 99 % of fly ash consists of oxides of Si, Al, Fe, and Ca and about 0.5 to 3.5 % consists of Na, P, K and S and the remainder of the ash composed of trace elements. It contains 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). Fly ash is chemically a ferroalumino silicate and a major solid west of the industrial areas. The entire amount are damping near the power plant. Fly ash contains many nutrients elements which are essential for plant growth, which can be increase crop productivity (Page *et al.* 1979; Andrino *et al.* 1980) and improve soil fertility. Similarly, Organic acids may play a key role in rhizosphere and pedogenic processes for future prospects. Keeping in view of the above fact a laboratory experiment was conducted on fly ash with different organic acid for the release pattern of sulphur in black and alluvial soil.

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MATERIALS AND METHODS

Collection of fly ash: Dry fly ash was collected from National Thermal Power Corporation plant, Bijpur, Sonbhadra (U.P.). Before application in pots fly ash was sieved, air dried and weighed as per need of treatment combination. Then fly ash was characterized to know their composition of fly ash as-

Collection of soil: The study was conducted by using surface soil samples collected from Agriculture Farm Nidhariya, S.M.M. Town P.G. College, Ballia and black soil from village Kathariya located in Sohaon Block of Ballia District. Soil samples were collected by the help of khurpi. Collected soil were air dried powdered and made free from the plant roots, gravels and stones etc. before pot filling.

Table 1. Properties of fly ash

Parameters	Values
pH	7.05
EC	1.006
Bulk density (Mgm^{-3})	1.23
N (ppm)	0.102
P (ppm)	0.025
Exchangeable K (ppm)	33.6
Ca (meq/100g)	226.8
Mg (meq/100g)	210.9

After well processed soil samples were ready to analysis of targeted possible parameters in laboratory of Department of Agriculture Chemistry and Soil Science S.M.M. Town P.G. College, Ballia.

Collection of organic Acid: The organic acid viz. mallic acid, tartaric acid, citric acid are available from laboratory of Department of Agriculture Chemistry and Soil Science, Faculty of Agriculture, Shri Murli Manohar Town P.G. College Ballia (U.P.).

Pot filling and Incorporation of Organic Acid

The 200 g air dried, powdered, well processed and sieved (through 2 mm sieve) soil of 0-15 cm of Agriculture farm and field of village Kathariya was filled in plastic pot and that was undesirable material undecomposed organic residues, pot pieces, gravels etc were removed. The soil was pulverized and powdered before mixing of fly ash and other treatments. Therefore as per treatment combination of malic acid @ 3 mg, tartaric acid @ 4 mgand citric acid @ 6 mg per Kg was mixed with each of dissolved 100 ml distilled water respectively. The different dose of fly ash as per treatment combination were mixed. After filling the pots moisture was maintained 60% by addingof distilled water and observedroom temperature every day during the study period. Experiment was arranged in the incubation experiment conducted in adopted small potwithrandomized block design (RBD) of 16 Number of treatments and 03 replication.

Details of treatments combination

Treatments	details of treatments
T_1	Control (without any treatment)
T_2	MA 3 mg + 100 ml water
T_3	TA 4 mg +100 ml water
T_4	CA 6 mg + 100 ml water
T_5	MA 3 mg +TA 4 mg + 100 ml water
T_6	MA 3 mg + CA 6 mg +100 ml water
T_7	MA 3 mg + CA 6 mg + TA 4 mg + 100 ml water
T_8	FA
T_9	FA + CA 6 mg + 100 ml water
T_{10}	FA + MA 4 mg + 100 ml water
T_{11}	FA + CA 6 mg + 100 ml water
T_{12}	MA 3 mg + CA 6 mg + TA 4 mg + FA + 100 ml water
T_{13}	CA 6 mg + TA 4 mg + 100 ml water
T_{14}	MA 3 mg + CA 6 mg + FA + 100 ml water
T_{15}	TA 4 mg + MA 3 mg + FA + 100 ml water
T_{16}	TA 4 mg + CA 6 mg + FA + 100 ml water

FA = Fly ash@1 mg/Kg, MA = Malic acid, CA = Citric acid, TA = Tartaric acid N–Nitrogen (as source of from urea) P –Phosphorus (as a source from single super phosphate) K- Pottasium (as muretefrom potash)

Observation: Initial soil was analyses for pH, EC, Organic carbon, available N, P, K and S exchangeable Ca and Mg by adopted the standard methods described by Kanwar and Chopra (1998), Jackson (1973), Singh *et al.* (2005). The treated soil samples were drowning at 20, 40, 60 days after treatment (DAT) for the analysis of pH, EC andSO_4^{2-}.The room temperature was ranged between during the incubation study. The statistical analysis of the data from different treatments their parameters done by method described by Gomez and Gomez (1984). Using RBD (Randomized Block Design) for significance of the treatment mean was made with help of critical difference calculated as under.

Table 2. Initial Properties of experimental soil

Properties	Alluvial soil	Black soil
Bulk density (Mg-3)	1.40	1.20
pH	7.85	7.92
EC(d Sm^{-1})	1.03	1.04
Organic carbon (%)	0.48	0.59
Available N (kg ha^{-})	150.6	180.16
Available P (kg ha^{-1})	15.6	20.17
Available K (kg ha^{-1})	185	440
Exchangeable Ca (cmol (p^+) kg	6.3	6.80
Exchangeable Mg (cmol (p^+) kg	3.3	3.3

RESULTS AND DISCUSSION

Soil pH

Alluvial and black soil p^H (Table 3) were showed from 7.8 value with FA+CA application to 7.22 by the application of @ 6 mg CA +1 mg FA at 20 DAT, 40 DAT, 60 DAT. pH value of all treatment combination were gradual increased except application of fly ash @ MA, CA, TA, FA of @ 3 mg, 4 mg, 6 mg, 1 mg respectively. In black soil value was ranged from 7.93 pH by application of MA, CA, TA, FA application to 7.05 @ 3 mg, 6 mg, 4 mg, 1 mg @ 20 ,40, 60 DAT. pH value of all treatment combination were gradual decreased except alone application of fly ash over the control. After treatments of fly ash with organic acid, soil pH decreased from its initial value particularly organic acid were added, Though pH tended to decrease in alluvial soil T_1, T_2, T_3, T_4, T_6, T_7, T_8, T_9, T_{10} and increase in the black soil T_1 to T_{16} were attributed to increase in partial pressure of CO_2 and production of organic acids (Sadana and Bajwa, 1985) due to its electrical changes The application (T_5 and T_6) of conjunctive use of crop residue with fly ash with helped in H^+ activity (Raman *et al.* 1996).

The applications of higher dose of fly ash were found to increase the pH value might be due to initial pH value of fly ash. So, that, rapid change in soil pH in organic acid pots were related to the concentration of excess anions and decomposition of the materials cause of acidification and slow down the soil pH (Tang *et al.,* 1999). During kharif season on the different fly ash concentration showed that soil pH increased with increasing in concentration of fly ash. (Brahmachari *et al.,* 1999). The physico-chemical properties of soil, pH values increased with both grade of fly ash amendments during a season and due to the replications. The gradual increased in soil pH, electrical conductivity, Organic carbon and organic matter with increased application rate of fly ash. pH of the soils slightly increased fly ash addition but the difference was non-significant. Similarly, the soil become more porous. Improving soil texture was investigated for agronomic benefits and improving the nutrient status of soil. Fresh ash has been found more effective in raising soil pH to levels conductive to maximum plant growth that of weathered ash in a given soil. Sarangi *et al.* (2001) observed that gradual increases in soil pH, conductivity, available phosphorus, organic carbon and organic matter with increased application of fly ash.

Table 3. Effect of fly ash and Organic acid on soil pH of alluvial and black soil at different days of incubation

Treatment Combination	20 DAT		40 DAT		60 DAT	
	Alluvial Soil	Black Soil	Alluvial Soil	Black Soil	Alluvial Soil	Black Soil
T_1 Control	7.84	7.80	7.77	7.88	7.45	7.29
T_2 MA 3 mg	7.73	7.44	7.56	7.31	7.23	7.27
T_3 TA 4 mg	7.71	7.34	7.55	7.29	7.20	7.25
T_4 CA 6 mg	7.60	7.32	7.43	7.30	7.28	7.23
T_5 MA 3 mg + TA 4 mg	7.55	7.35	7.55	7.27	7.24	7.16
T_6 MA 3 mg + CA 6 mg	7.50	7.56	7.34	7.49	7.32	7.19
T_7 MA 3 mg + CA 6 mg + TA 4 mg	7.65	7.87	7.34	7.75	7.24	7.08
T_8 FA	7.68	7.49	7.59	7.41	7.29	7.15
T_9 FA + CA 6 mg	7.71	7.54	7.67	7.38	7.34	7.15
T_{10} FA + MA 3 mg	7.78	7.70	7.69	7.58	7.33	7.12
T_{11} FA + TA 6 mg	7.75	O7 7.45	7.77	7.33	7.22	7.15
T_{12} MA 3 mg +CA 6 mg +TA 4 mg + FA	7.41	8.14	7.25	7 7.93	7.31	7.05
T_{13} CA 6 mg + TA 4 mg	7.60	7.66	7.33	7 7.45	7.35	7.01
T_{14} MA 3 mg + CA 6mg + FA	7.56	7.46	7.19	7 7.30	7.26	7.02
T_{15} TA 4 mg + MA 3 mg + FA	7.80	7.41	7.66	7.38	7.23	7.04
T_{16} TA 4 mg + CA 6 mg + FA	7.24	7.30	7.22	7 7.31	7.31	7.06
C.D. (P=0.05)	N.S.	N.S.	N.S.	N.S.	N.S.	L N.S.

DAT= (Days after treatment), F.A. = Fly Ash@1mg/Kg, M.A. = Malic Acid, CA = Citric Acid, TA = Tartaric Acid

Table 4. Effect of fly ash and Organic acid on soil EC of alluvial and black soil at different days of incubation

Treatment Combination	20 DAT		40 DAT		60 DAT	
	Alluvial Soil	Black Soil	Alluvial Soil	Black Soil	Alluvial Soil	Black Soil
T_1 Control	1.021	1.021	1.005	1.017	1.003	1.013
T_2 MA 3 mg	1.030	1.021	1.012	1.015	1.009	1.008
T_3 TA 4 mg	1.029	1.020	1.015	1.013	1.007	1.007
T_4 CA 6 mg	1.030	1.017	1.017	1.014	1.006	1.009
T_5 MA 3 mg + TA 4 mg	1.030	1.020	1.012	1.012	1.007	1.008
T_6 MA 3 mg + CA 6 mg	1.030	1.020	1.019	1.011	1.008	1.008
T_7 MA 3 mg + CA 6 mg + TA 4 mg	1.030	1.021	1.015	1.016	1.007	1.007
T_8 FA	1.030	1.021	1.017	1.013	1.008	1.008
T_9 FA + CA 6 mg	1.030	1.020	1.014	1.015	1.009	1.009
T_{10} FA + MA 3 mg	1.030	1.021	1.018	1.017	1.007	1.010
T_{11} FA + TA 6 mg	1.029	1.020	1.014	1.015	1.008	1.008
T_{12} MA 3 mg +CA 6 mg +TA 4 mg + FA	1.021	1.019	1.011	1.011	1.007	1.009
T_{13} CA 6 mg + TA 4 mg	1.029	1.018	1.013	1.012	1.008	1.006
T_{14} MA 3 mg + CA 6mg + FA	1.029	1.021	1.010	1.013	1.008	1.009
T_{15} TA 4 mg + MA 3 mg + FA	1.030	1.020	1.011	1.015	1.007	1.008
T_{16} TA 4 mg + CA 6 mg + FA	1.029	1.018	1.022	1.017	1.006	1.010
C.D.= (P=0.05)	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

DAT= (Days after treatment), FA = Fly Ash@1mg/Kg, MA = Malic Acid, CA = Citric Acid, TA = Tartaric Acid

Table 5. Effect of fly ash and Organic acid on a available sulphur (mg kg^{-1}) of Alluvial and Black soil at different days of incubation

Treatment Combination	20 DAT		40 DAT		60 DAT	
	Alluvial Soil	Black Soil	Alluvial Soil	Black Soil	Alluvial Soil	Black Soil
T_1 Control	22.5	18.75	23.75	18.75	21.25	17.5
T_2 MA 3 mg	31.21	20	42.5	18.75	30	15
T_3 TA 4 mg	17.5	17.5	43.75	17.5	36.25	21.25
T_4 CA 6 mg	40.0	20	45	20	18.75	16.25
T_5 MA 3 mg + TA 4 mg	31.25	16.25	41.25	16.25	45	17.5
T_6 MA 3 mg + CA 6 mg	30	17.5	31.25	16.25	31.25	17.5
T_7 MA 3 mg + CA 6 mg + TA 4 mg	26.25	20.0	27.5	18.75	17.5	20
T_8 FA	30	21.25	28.75	22.5	22.5	20
T_9 FA + CA 6 mg	20	16.25	47.5	20	31.25	21.25
T_{10} FA + MA 3 mg	17.5	18.75	42.5	17.5	17.5	18.75
T_{11} FA + TA 6 mg	21.25	20	41.25	20	22.5	21.25
T_{12} MA 3 mg + CA 6 mg +TA 4 mg + FA	23.75	23.75	38.75	18.75	31.25	17.5
T_{13} CA 6 mg + TA 4 mg	26.25	13.75	43.75	20	17.5	16.25
T_{14} MA 3 mg + CA 6 mg + FA	32.5	21.25	43.75	18.75	23.75	20
T_{15} TA 4 mg + MA 3 mg + FA	31.25	17.5	45	20	36.25	18.75
T_{16} TA 4 mg + CA 6 mg + FA	28.75	20	40	21.25	32.5	17.5
C.D.= (P=0.05)	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

DAT= (days after treatment), FA = Fly Ash 1mg@/Kg, MA = Malic Acid, CA = Citric Acid, TA = Tartaric Acid

An appreciable change in the soil physico-chemical properties, rising of pH and increased crop yield was obtained by mixed application of fly ash and paper factory sludge and farm yard manure.

Electrical Conductivity of soil EC (dSm^{-1})

The electrical conductivity values in (table 4) revealed that there was no marked difference was found among the treatment combination of organic acid with fly ash and alone fly ash application. The EC of alluvial and black soil under study was ranged from 1.006 to 1.029 dSm^{-1} and 1.010 to 1.018 dSm^{-1} respectively, indicated at the all three stage of experiment. Although, a slight declined value of EC was observed in among the treatments at all the stage at 20, 40, 60 days of incubation. The higher EC value was observed in the application of fly ash with high dose might be due to addition of Na and other salts which has already contained by fly ash (Alamgir *et al.*, 2012, Lunch *et al.,* 2016). The electrical conductivity of soil increases with fly ash application and so does the metal content. Increasing EC value of soil due to addition of fly ash which may be attributed to the fact that the soluble salts from fly ash might have dissolved in soil moisture and there by increased the ionic concentration of soil solution (Selevakumari *et al.* 2000).

SO_4-S (mg/kg)

The available sulphur content (Table 5) was gradual increased with stage of experiment in all treatment combination. At 20 DAT of experiment, alone application of higher (T_9) dose fly ash showed significantly high value (20 mg/kg) than T_3 and T_9. The similar pattern was observed at all stages of experiment. The content was varied with the treatment depending upon soil pH and organic acid and treatment of industrial water use system. A greater amount of available S was found in 60 DAT than 40 DAT in alluvial soil with the treatment combination of $T_3$and T_{15}. The continuous release of greater extant of available sulphur by the application of fly ash in soil then organic acid might be due to prolong the phosphate solubilization, use of organic manure and sulphur containing fertilizer have led to low sulphur content in these stage. Several soil factors influences the availability of sulphur and hence the status of different forms of sulphur in soil varied widely with soil type. Bolangoudar and Satyanarayana (1990).Infect application of fly ash @ 1mg in 200 g soil considerable increased in alluvial soil as compassed to black soil from 20 to 40 DAT. Addition of unweathered sulphur fly ash up to 8% to calcareous soil resulted in high crop yield due to increased availability of S from fly ash (Page *et al.* 1979).

Conclusion

The pH of alluvial soil and black soil was treated by fly ash with different organic acid at all three stage of incubation in both soil were little variation by alone application of fly ash, but the value in T_{16}, T_{13} were not much more difference with fly ash + organic acid. The EC of alluvial soil and black soil by application of fly ash with organic acid treatment on under study was ranged from T_{16} to T_1 in both soils were decreased with no marked differences. The available sulphur content was found gradual increased from 20 to 60 DAT in both alluvial and black soil but alluvial soil have greater release than black soil at all stages of incubation. Among the different treatments T_2 and T_{15} in alluvial soil and T_{12} and T_{14} have appeared to greater release of SO_4^{2-}- S. Alone application of dose of fly ash showed significantly high value than T_1 in both tables.

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