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IMPACT OF FLY ASH AND PRESS MUD AMENDMENT ON PROPERTIES AND HEAVY METAL CONCENTRATION OF AN ALKALI SOIL AND THEIR IMPACT ON PLANT GROWTH

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ABSTRACT

Erroneous agricultural practices and dumping of industrial waste have contaminated our soils and increased problem like soil alkalinity and salinity. Waste like fly ash and press mud has vast potential to be used in agriculture because they contain appreciable amount of nutrient. The present study was undertaken with an objective to explore the possibility of using both the industrial waste to alkali soil to evaluate their potential of ameliorating properties. It has been concluded from the experiment that the application of pressmud and flyash at the rate of 10% could be effective as soil amendments however, it also cause a build up of certain heavy metals like chromium and arsenic which are potent health hazards, therefore proper management strategies will have to be adopted.

KEYWORDS: Flyash, Pressmud, Alkali soil.

INTRODUCTION

Revolution in agriculture and industries after independence had played a significant role in improving the economics status of country but this revolution has led to evolution of pollution. Erroneous agricultural practices and dumping of industrial wastes have contaminated our soils and increased problem like soil alkalinity and salinity.

Fly ash, released from the thermal power station and other industries is a major wastes product in India. The total flyash production in India is estimated to be 2-3 times more than other countries[1]. The disposing off method of flyash in surrounding water and soil resulting in huge environment as well as ecological problem. The previous study on flyash shown a vast potential for use in agriculture as it contains appreciable amounts of plant nutrient[2]. The use of flyash is found to increase the crop yields and is also capable of improving the physic-chemical characteristics of soil[3]. In addition to this, flyash also contains wide range of harmful metals like Arsenic, Cadmium, Lead, Tin, Nickel, Chromium etc.[4] when concentration of Cd and Pb exceed from there normal limits, over which they tend to inhibit the growth of plants[5] therefore the excessive use of flyash is hazardous to crops and useful microbes[6] as well as human and animals. Thus the use of flyash in agriculture has to be made with utmost care in scientific manner while using in agriculture soils for crop growth.

Pressmud, is one of the major by-products of sugar industry, constituting 4-5% of cane weight and 35 kg per tones of cane. According to recent reports in Tamil Nadu more than 4 lakhs tones of sugarcane is crushed by sugar industries leading to the production of 100 tones of pressmud per day. Its importance lies in its fertilizers value as it contains1.63% of Nitrogen, 2.52 % of phosphorous and 0.55 % of potassium on dry weight basis[7].

OBJECTIVE OF THE STUDY

The objectives of the present study were to study the impact of fly ash and pressmud on various physic-chemical properties of an alkali soil with respect to parameters like pH, Electrical conductivity, Sodium and Potassium also the impact of the above industrial wastes on soil dehydogenase activity to assess the effect on overall microbial activity and seedling growth of wheat. The study on heavy metal contamination of the soil after the treatment of above industrial wastes was also the objective of the study.

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MATERIAL AND METHODOLGY

The flyash used for the conducting the experiments were collected from Thermal Power Plant, Suratgarh, Rajasthan. The pressmud was collected from Rohtak (Meham) Sugar Mill, Haryana. The soil used in the study was collected from Hisar, Haryana where all the experiments were performed.

Experimental Set up

Pot experiment were done under controlled laboratory conditions using the following experiment setup. A total of 9 plastic pots were grouped into 3 sets with three replicates for two samplings (at 10 days and 25 days). The three sets had the following treatment:

[1] Alkali Soil (Serving as control)
[2] Alkali Soil + Flyash (10% of total dry weight of soil)
[3] Alkali Soil + Pressmud (10 % of total dry weight of soil)

The soils sample after treatment were allowed to stabilize by incubating them at $27^0C \pm 3^0C$ and were watered on alternate days to keep them moist.

Chemical analysis

Chemical analysis of various parameters was done on zero day (before incubation), 10 days after incubation and 15 days after sowing of seeds. The physic-chemical parameters included pH, Electrical Conductivity, Sodium, Potassium, Total Organic Carbon, Nitrogen, Phosphate.

The heavy Metals included: Arsenic, Iron, Magnesium, Lead, Chromium and Manganese. The biological Property studied was dehydogenase activity. Plants growth was studied with respect to root/shoot ratio (length wise), chlorophyll contents of leaves. All these parameters were studied on 25^{th} day with correspond to 12 days of seedling stage.

RESULT AND DISCUSSION

The characteristics of Soil, Flyash and pressmud used for the experiment are shown in Table-1. The soil is of alkaline nature with pH 8.5 with little salinity i.e. EC= 3.8 dSm^{-1}. However, the total organic carbon is moderate i.e. 2.74%. The flyash used in the experiment was alkaline pH=7.9 with low EC=0.22 dSm^{-1} and did not show any Carbon and Nitrogen. The pH of the pressmud was also alkaline i.e pH=7.9 but its EC was quite high i.e. 4.84 dSm^{-1}.

Table 1 Characterization of Soil, Flyash, Pressmud and Gypsum.

Material	pH	EC dsm^{-1}	Na (%)	K (%)	N(%)	TOC(%)
Soil	8.5	3.8	3.9	1.1	0.42	2.74
Fly Ash	7.9	0.22	0.4	ND	ND	ND
Press Mud	7.9	4.85	1.2	1.1	1.12	ND

ND= Non Detectable

Table 2 Effect of applications of various types of industrial waste on pH, EC, Na and K composition of an alkaline soil.

Treatment*	pH			EC			Na(%)			K(%)		
	0 Day	10 Day	25 Day	0 Day	10 Day	25 Day	0 Day	10 Day	25 Day	0 Day	10 Day	25 Day
Control	8.5	8.3	8.2	3.8	7.7	6.9	8.1	7.1	6.7	1.1	1.1	1.2
Soil + FA	8.2	8.1	8.1	4.1	10.2	8.9	4.3	3.5	2.2	1.1	1.4	0.9
Soil + PM	8.4	8.3	7.9	6.24	9.41	8.2	3.7	2.5	2.1	1.2	0.7	0.3

*FA= Flyash, PM= Pressmud

Table 2 is showing the effect of various industrial wastes on pH, EC, Na, and K composition of alkaline soil. In control, the pH has been decreased after 25 days of incubation this may be due to the uptake of ions by the seedlings grown in a soil as well as due to root exudates and rhizosphere effects of the wheat seedlings which could together contribute to lowering of pH t some extent.

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The pH of the amended soils decreased significantly as compared to the control soil, this decrease in pH may be attributed to the lower of pH of each of the industrial waste materials than the pH of the soil taken. Thus all the amendments were found to be useful for lowering the pH of the soil from 8.5 to 7.9. The Electrical conductivity of the treated soil were found to increase significantly as compared to control due to presence of soluble salts in all the wastes which caused a rise in Soil Electrical Conductivity. The increase in soil EC after 10 days is may be due to use of saline tap water used for irrigation. But after the growth of seedling the EC of each soil sample decreased, this may be because of uptake of ions by growing seedling in these soils.

The concentration of sodium was quite high as the soil was alkaline in nature. The alkalinity is mainly because of Na_2CO_3 and $NaHCO_3$ in the soil, hence a high exchange of sodium was observed in the control soil. After 25 days the concentration of sodium decreases significantly in all the soil samples which may be due to the uptake of the sodium metals by growing seedlings.

Table 3 Effect of applications of various types of industrial waste on some important nutrients and dehydogenase activity of an alkaline soil.

Treatment*	N(%)			TOC(%)			Phosphate (%)			DHA (%)		
	0 Day	10 Day	25 Day	0 Day	10 Day	25 Day	0 Day	10 Day	25 Day	0 Day	10 Day	25 Day
Control	0.42	0.56	0.56	2.74	2.81	3.99	0.19	0.2	0.27	0.075	0.088	0.12
Soil + FA	0.56	0.56	0.56	3.22	3.24	4.89	0.18	0.19	0.27	0.083	0.092	0.13
Soil + PM	0.84	0.84	1.12	3.81	3.81	6.78	0.27	0.32	0.46	0.13	0.14	0.18

*FA= Flyash, PM= Pressmud

Table 3 shows the variation of some important nutrients and dehydogenase activity of soil with different industrial waste. The percentage of Nitrogen was found to increase in or remain constant after 25 days of experiment in each treatment. The nitrogen concentration in soils after the amendment tended to increase. Likewise Total Organic Carbon (TOC) also increased with all treatments. The increased in Nitrogen concentration is may be increased by microbial mineralization, this also shown by increased in dehydogenase activity (DHA) of soil. Increased in DHA may be due to decreased in pH of each amended soil as well as unamended soil which is likely to favour microbial growth and hence microbial activity. The concentration of phosphate also show increasing trend in response to each treatment, particularly after 25 day of experiment. These seems to be better solublization of phosphorous after stabilization period of 25 day, which again corroborates with the data of DHA, indicating improved microbial mobilization and mineralization of bound forms of phosphorous into soluble forms.

Table 4 Variation in Seedling growth of Wheat in Soil, treated with various types of industrial waste .

Treatment*	Chlorophyll A (µg/g) Mean ±SD	Chlorophyll B (µg/g) Mean ±SD	Total Chlorophyll (µg/g) Mean ±SD	Root:Shoot
Control	258.4± 43.5	212.4±30.5	464±69.8	0.8:1
Soil + FA	381.2± 39.03	356±0.85	644.8±212.9	0.7:1
Soil + PM	284± 56.3	264±45,6	550.8±100.7	0.71:1

*FA= Flyash, PM= Pressmud NG = No Growth

Chlorophyll content of seedling grown in each soil treatment is shown in Table 4 . the concentration of chlorophyll is high in case of all the treatment, is higher than that in control in case of flyash amended soil. This shows that the flyash have a beneficial effect on the growth of wheat plants. If compare to root shoot ratio, it also shows that, the plant grown in flyash amended soil has better growth, this could be ascribed due to improved availability of nutrients, decline pH, enhanced microbial activity.

Table 5 Effect of applications of various types of industrial waste on Heavy Metal composition of an alkaline soil.

Treatment*	Arsenic	Iron	Magnesium	Lead	Manganese	Chromium
Control	0.01	0.02	0.215	0.006	0.032	0.017
Soil + FA	0.019	0.8519	0.22	0.006	0.0245	0.0142
Soil + PM	0.0167	0.968	0.0137	0.0057	0.0375	0.0137

*FA= Flyash, PM= Pressmud

The effect of various type of industrial waste on heavy metal composition of alkaline soil is given in table 5. Heavy metal concentration in alkaline soil after application of various types of industrial waste does not show too much variation except in case of iron. This might be due to presence of iron in the industrial waste.

CONCLUSION

The present study shows that if we use fly ash and pressmud as an amendment for alkali soil it is useful in lowering its pH and increasing some of the essential nutrients. But, it also causes a buildup of certain heavy metals in the soil which could be harmful.

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