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Impact of fly-Ash-amended soil on growth and yield of leguminous plants

Meenakshi Sharma[1], Rashmi Varma[2]

[1,2]Botany Department, Govt College Kota (India)

ABSTRACT

Practical value of fly ash in agriculture as an "effective and safe "fertilizer. Fly Ash (FA) is a waste product of thermal power station, has great potential for use in agriculture, because it contains almost all macro and micro nutrients . In view of the potential disposal of , Fly Ash this investigation was carried out to search an economical and ecofriendly solution of its disposal by using it as nutrients source in agriculture for growth of crop plants. Fly Ash application increased the number of leaves , plant height , bio mass , number of nodules and yield of leguminous crops(Medicaga sativa L and Trigonella foenum graecium) and recorded maximum in 25% Fly Ash amended soil .

Key Words: - Fly Ash;amended;Micro and Macro nutrients ; growth ; yield ;leguminous crops.

I. INTRODUCTION

About 85 thermal power stations operating in the country generate about 85 million tons of fly ash as waste every year and it is expected that it will reach up to 140 million tons in the year 2020. Fly ash is a potential source of many macro and micro elements to the plant including some toxic metals [1]. It contain almost all the essential plant nutrients but deficient in nitrogen and phosphorus[2]. This deficiency may be overcome by adding cow dung and fly ash amended of soil has resulted in increased plant production when nutrient deficiencies were corrected by its addition. Fly ash is a complex heterogeneous material consisting of both amorphous and crystalline phases [3]. Formation of fly ash depends on the ash content of coal and Indian coal used in power plant generally has very high ash content (35-45%) and lower quality[4].

Application of fly ash in agricultural sector helps in the saving of chemical fertilizers[5]. Crop plants of the families Brassicaceae, Chenopodiaceae, Fabaceae, Leguminoceae and Poaceae are most tolerant to fly ash[6]. Fly ash can be a good additive for neutralizing the acidic soil and will also help as a fertilizer, and it is also help full for seed germination.

Many legumes have evolved to establish symbiosis with nitrogen fixing soil-bacteria collectively known as rhizobia. Rhizobia invade the roots of compatible legume plant leading to the development of specialized root structure called nodules [7-10]. Factors such as soil composition, water content, temperature and pH can also influence plant and rhizobial growth [11-12]and nodule establishment [13-14]. Generally, nodule formation is more sensitive to soil acidity than other aspects of plant growth in Lentil application of coal ash at 25% caused a significant increase in nodule number in plant. Increased nodulation probably enhances the site of root infection

for Rhizobium and hence leads to higher rate of biological nitrogen fixation increase in growth of eggplant at lower fly ash amended level has also been recorded.

The observed responses of the plant regarding their growth is also supported by other workers like on Lactuca sativa; on bean; on wheat; on green gram; on osmium sanctm; on Pisumsativum. Continuous cultivation of the soil has robbed it of chemicals such as nitrogen, phosphorus and potassium. Which are vital for plant growth and are not replaced with organic and chemical fertilizers, pepper yield in Nigeria and other tropical countries is therefore limited by low soil fertility and inability of farmers to purchase fertilizers due to scarcity and cost.

The long term use of inorganic fertilizer has been implicated in soil acidification loss of organic carbon, nutrient imbalance and deficiency of secondary nutrients & micro nutrients. The trend among the resource poor farmers in the region is therefore the use of organic waste known to increase soil pH, improve soil nutrients & physical properties especially those from livestock industry that have been found available in large quantity in topics.

II. MATERIAL AND METHODS

Experimentswere conducted in pot (30 cm) diameter with seven treatments of FA – 0 ,5 ,10 ,15 ,20 ,25 and 30 % Fly Ash(according to weight of soil). Fly Ash used in this experiment was collected from KTPP (Kota thermal power plant)

Table 1 characteristic of soil and fly ash used in pots before sowing of plants (mean ± 1 S.E.)

Parameters	Soil	Fly Ash
pH	8.40 ± 0.00	6.72 ± 0.02
Available P (mg $100g^{-1)}$	10.40 ± 1.22	3.62 ± 0.19
Total N ($mg100^{-1}$)	580.0±24.4	7.30±34.1
Exchangeable K (mg $100g^{-1}$	110±9.02	198.0 ± 1.53
Exchangeable Ca ($mg100^{-1}$)	18.90±1.61	135.2±0.94
Exchangeable Na (mg 100^{-1})	36.00±4.15	44.00±1.17
SulphateS(mg 100^{-1})	6.33±0.71	89.6±0.37
Bulk density (g cm^{-1})	0.74±0.11	0.92±0.18
Organic carbon (%)	1.66±0.12	0.69±0.13

Table 2 Chemical analysis of fly ash

Constituent %	NA_2O	MgO	PO_2O_5	SO_3	CaO	Al_2O_3	SiO_2	TiO_2	Cr_2O_3	Fe_2O_3
Fly ash	0.09	0.285	0.51	0.14	0.47	35.5	59.5	0.94	0.01	2.01

Soil was alkaline in nature pH 8.4, whereas FA was slightly acidic pH 6.72 for the experiment. The soil was prepared by mixing garden soil and sterilized cow dung in 3:1 ratio .seeds were sown in pots at a depth 2.5 cm. Pots were placed in unshaded area and uniformly watered throughout the experiment to maintain equal soil moisture . Random samplings of plants were collected from each treatment and crop for growth analysis.

(a) Medicago sativa L (b) *Trigonella foenum graecium L*

After harvesting root and shoot dry weight is taken and they are added to get the biomass of plant and yield is calculated by weighing weight of 100 seeds. Nodules were plucked, washed and counted. Functional nodules were recognized their pink color. Over dried nodules were weighed

III. RESULT

Maximum germination of seeds of (85% for medicago*sativa L*and 95% *trigonellafaenumgraecum L*) was recorded in 25% FA. whereas in unamended soil it was 70% and 80% .increase in leaf number was observe in Fly Ash – amended plant and recorded maximum in 25% . Fly Ash nodule number in plants was increased by Fly Ash applications and maximum nodules observed with 25% Fly Ash

Bio mass increase at all successive growth stage and also with FA application upto 25% .

Fly Ash Applications and plant age were observed through ANOVA test for bio mass accumulation of both the crop plants

IV. DISCUSSION

It was found in our findings that Fly ash plays an important role for the growth and yield of leguminous plants. FA is a rich source of all essential macro as well as micro nutrients for the plant growth. Singh et al (1997)[15] reported that leguminous plants could grow well on FA – Amended soil without manifestation of any injury symptoms. Wong and wong (1990)[16] with *Brassica chenesis*and *Brassica parachinensis*an .Pandey et al *(1994)*[17] with *Helianthus annuus* have found that low concentration of FA was beneficial for plant productivity . Many legumes have evolved to establish symbiosis with nitrogen fixing soil bacteria collectively known as rhizobia nodules were plucked and counted. Functional nodules were recognized by their pink color . Over Dried nodules were weighed

My study proves that Fly Ash can be alternative source of chemical feritilizers.

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