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Fly ash for soil nourishment: A case study for Brinjal and Groundnut

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Abstract

The Deep Nagar Thermal Power Plant, Bhusawal in Maharashtra generates fly ash @ 2000 to 3000 MT per annum and is used for soil nourishment for two local crops namely brinjal (*Solanum melongena*) and ground nut (*Arochis hypogoea* Linn). During the course of study the fly ash obtained from power plant is characterized for its agro- properties and it is blended with black cotton soil in various proportions then further laboratory scale studies were done for growth of brinjal and groundnut plants using various blends of soil and fly ash. Growth parameters of plants including optimum proportion of fly ash for plants growth, edibility of agro-products were observed and examined for its entire life cycle. It was observed during study that fly ash proportion of around 10 to 20% by weight of black cotton soil is optimum for various crops besides this it was observed that while fly ash of higher proportion can also be used without disturbing the natural fertility environment of soil. Thus, use of fly ash for soil nourishment for above-mentioned crops is a viable method of fly ash disposal, added with the benefit of better crop yield.

Keywords*: Agricultural utilization, Fly ash, Optimum proportion*

Introduction

Presently India's 65% electricity is produced by its Thermal Power Plants. There are nearly 85 thermal power plants in India. The number is likely to reach 112 by 2020. These plants generate about 110 MMT of fly ash as waste. If dumped as it is in soil, fly ash gets lifted in air and creates air pollution and may lead to spread of diseases like silicosis, fluorosis, respiratory disorders etc. It may travel to water bodies along with run-off and may increase salinity and heavy metal toxicity to significant level. It even affects ground water table in long turn. In excess quantity it affects soil fertility by altering its salinity and redox potential. Reuse of fly ash as agro-nutrient supplement is getting popular all over the world (Plank and Martens, 1974; Chang *et al.*, 1977; Page *et al*., 1979; Adirano *et al.*, 1980; Gracia *et al*., 1995; Buck *et al*., 1990). It has certain micro nutrients that are beneficial for crops.

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These nutrients are not available in chemical fertilizers.The present work uses locally available fly ash, obtained from Deep Nagar Thermal Power Plant, Bhusawal. It has been characterized for agricultural parameters in the laboratory. Its suitability for various locally available crops including brinjal and ground nut has been investigated by laboratory scale studies. The study indicates that fly ash in the proportion of 10% to 20% by weight of soil can be used advantageously for various crops. It not only enhances the plant growth but also provides a safe alternative for fly ash disposal. The only concern with the fly ash used in agriculture is about the metallic toxicity caused by heavy uptake of element by plants. However the edibility as examined in the laboratories has indicated no such problem for the present case.

Materials and Method

The present study is a laboratory scale study. Plastic tubs, having size 45 cm diameter and 25 cm depth are used as pots for plant growth. Various blends of fly ash with black soil, varying from 0% to 25% at the step of 5% of fly ash have been used. Seven to eight seeds of above-mentioned plants are sowed in each tub. Watering is done regularly. After germination and

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few days growth, three plants are left in the tub and others are removed. The plants are watered regularly. Their growth parameters including stem thickness, height of plant, first day of flowering, number of flowers, first day of fruit formation, number of fruits etc are monitored. The fruit quality from edibility point of view is also examined. Fly ash, soil and water used for experimentation are examined for agricultural parameters.

Results and Discussion

Table 1 shows the characteristics of fly ash that are significant from agricultural point of view. It is clear from the table values that fly ash used here is poor in terms of NPK content but is a rich source of trace elements.Table 2 shows the characteristics of black cotton soil used. Table 3 represents the characteristics of soil-fly ash blend. Table 4 shows the characteristics of water used for plant irrigation

Table 1: Characteristic of fly ash

S. No.	Parameters	Observed value
1	% carbon	0.44
2	N	Not detected
3	P	0.74%
4	K	0.33%
5	% Ca	0.127
6	% Fe	0.229%
7	% Mg	0.0726%
8	Electrical Conductivity	0.36 μmho/cm
9	Mn	264.11 ppm
10	Zn	24.36 ppm
11	Cu	18.51 ppm
12	As	Not detected
13	Ni	1.95 ppm
14	pH	7.6

Table 2: Characteristics of soil

S. No.	Parameters	Observed value
1	% carbon	0.24
2	N	94.08 kg/ha
3	P	8.26 kg/ha
4	K	396.4 kg/ha
5	% Ca	0.274
6	% Fe	Not detected
7	% Mg	-
8	Electrical Conductivity	0.31 μmho/cm
9	Mn	1.1 ppm
10	Zn	0.1 ppm
11	Cu	0.20 ppm
12	As	-
13	Ni	-
14	pH	8.0
15	Bulk Density	103.4 gm/cc
16	Water holding capacity	0.45 ml/g

Table 3: Characteristics of soil – fly ash blend

S. No.	Soil-fly ash blend	Conductivity μmho/cm	pH of Blend	Permeability mm/sec
1	0%	0.70	7.0	0
2	5%	0.62	7.0	0
3	10%	0.62	7.0	0
4	15%	0.66	7.0	0
5	20%	0.71	7.0	2.23
6	25%	0.84	7.0	2.65
7	Soil with Urea	0.77	7.0	3.01

Brinjal:

Effect of fly ash on plant height:

Fig. 1 and 2 shows the height of plant after four and eighteen weeks of seeding.

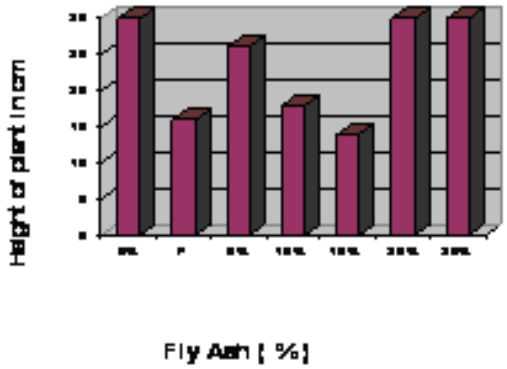

Fig 1: Brinjal Plant height after 4 weeks

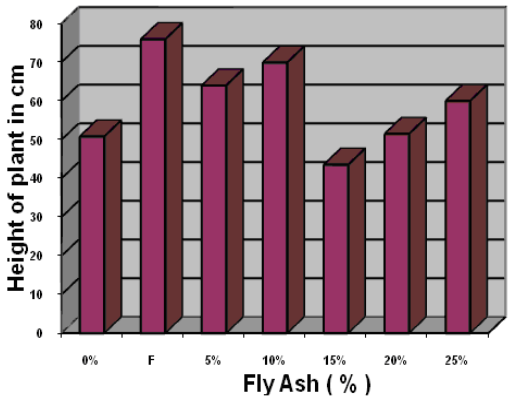

Fig 2: Brinjal Plant height after 18 weeks

The plant growth parameters are monitored for the complete life cycle of plant. Only representative results are presented here.

Table 4: Characteristics of water

S. No.	Parameter	Observed value
1	pH	7.0
2	Conductivity	113 µmho/cm
3	Alkalinity	213.4 mg/l

Effect of fly ash on stem thickness

The effect after 16 weeks is shown in Fig 3

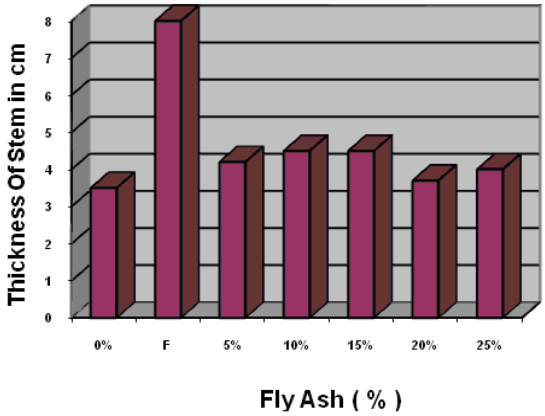

Fig 3: Thickness of brinjal stem after 18 weeks

Effect of fly ash on number of flowers:

No. of flowers in 18th week are shown in Fig 4

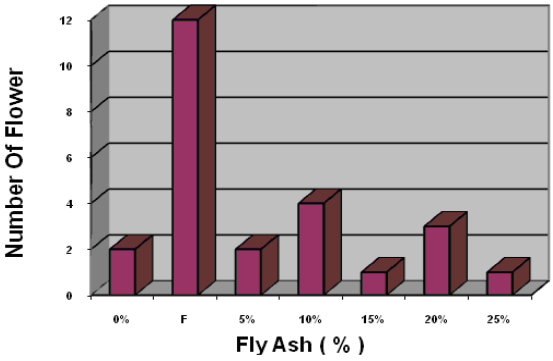

Fig 4: No. of brinjal flowers after 18 weeks

Effect of fly ash on number of fruits

The effect is shown in Fig 5

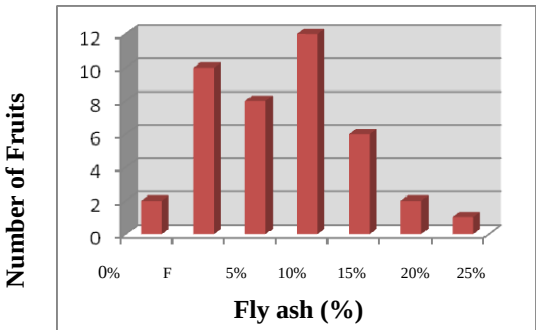

Fig 5: No. of fruits after 18 weeks

Groundnut:

In case of groundnut plant, height of plant is irrelevant as the stem is spiral.

Effect of fly ash on number of leaves:

No. of leaves after 6 week are given in Fig 6.

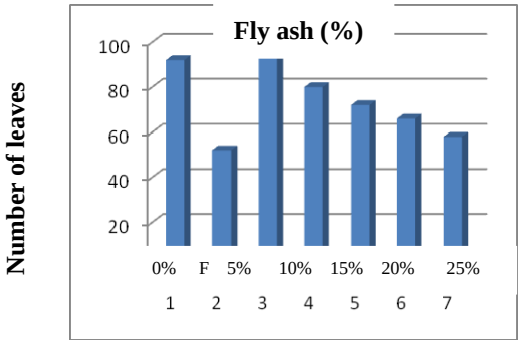

Fig. 6: No. of leaves in ground nut plant after 6 weeks

Effect of fly ash on fruits in Groundnut

No. of fruits after 14 weeks are given in Fig 7

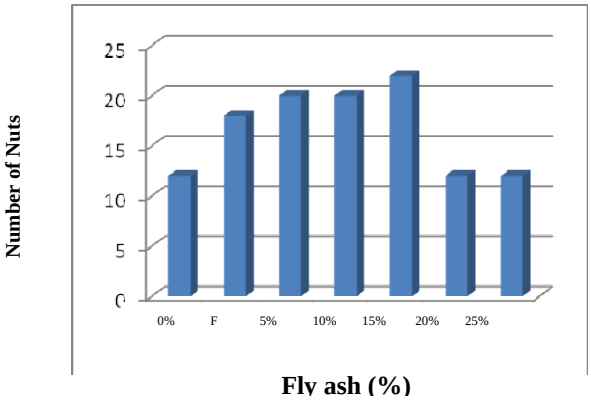

Fig 7: No. of fruits in groundnut after 14 weeks

Edibility examination of fruits

Brinjal, and groundnut are examined from edibility point of view. The results are given in Table 5.

It can be seen that the heavy metals in fruits are within limits. Hence the fruits are safe for consumption.

Table 5: Observed values for brinjal and Groundnut

Parameter	Permissible limit (ppm)	Observed value for brinjal	Observed value for ground nut
Copper	-	2.55	2.43
Iron	-	28.49	26.34
Lead	0.1	Not detected	0.03
Cadmium	0.05	0.05	0.02
Zinc	-	2.99	1.56
Arsenic	-	Not detected	Not detected

Conclusion

The present work reveals that addition of fly ash in the soil improves the yield of brinjal and groundnut. The fly ash is a potential source of plant nutrients. It is found that blend of 10 % fly ash with soil improves the yield of brinjal and blend of 15 % fly ash with soil improves the yield of groundnut. Characterization of fly ash confirmed the report of Tripathi and Sahu (1997), that fly ash contain all nutrients for plant growth except Nitrogen. In fact a blend of fly ash with fertilizer can provide both nutrients as well as trace elements required by plants and may prove to be most effective.

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