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**EFFECT OF FLY ASH AS A CARRIER MATERIAL WITH BGA INOCULANTS ON
SEEDLING GROWTH AND PIGMENTATION OF VIGNA MUNGO L.**

BEHERA GS*, MOHANTA RK, SWAIN PK, PANDA MK & PADHI SB

Centre for Environmental Studies (CES), Forest & Environment Department, Government of
Odisha

*Corresponding Author: ghana.rgnfs@rediffmail.com; MoB.: ++91-9861115351; Fax:
0674-2553182

ABSTRACT

Fly ash from NALCO Captive power plant, Angul, Odisha (India) was used as a career material (Treated material) with BGA (*Anabaena* sp.) for the study of their effects on seedling growth and pigmentation of *Vigna mungo* L. Different concentration (5, 10, 20, 30, 40, 50%) of fly ash/treated fly ash (as career material) was taken and their effect on plant growth parameters (% of germination, shoot & root length, No of lateral roots, leaf length & width, Chlorophyll a & b, total carbohydrate, total protein & total lipid) were studied. Results indicate that 50% of treated fly ash & 20% of untreated fly ash in soil could be used safely for better plant growth.

Keywords: Fly Ash, Career Material, *Anabaena* sp., *Vigna mungo*, Captive Power Plant, Nalco

INTRODUCTION

In India Major Part of the total energy requirement is met through coal, and likely to continue long into the future in view of the enormous coal reserves in India and the country's steadily growing economy. Combustion of coal produces coal Combustion residues (CCR). Components of these CCR include fly-ash, bottom- ash, boiler slag and the flu-gas desulphurization

materials [1]. CCR produce from thermal power plants contain bottom ash in the range of 30-35% of burnt coal [2] and fly-ash about 70-75%) [1]. Indian coal has 30-40% fly-ash content [3]. At present nearly 100 million tons of fly-ash per year is being produced from the thermal power stations spreading throughout the country.

Fly-ash has been found beneficial for the growth of plants due to the presence of several plant nutrient [4]. Its amendment in soil up to 40 percent level brings about an increase in the growth and yield of cucumber, maize, okra, potato, tomato, and wheat [5-9]. So keeping in the view the agricultural utilization of fly-ash, a study was under taken to evaluate their impact on *Vigna mungo*.

MATERIALS AND METHODS

Fly ash was collected in gunny bags from NALCO Captive power plant Angul situated about 139 km. from Bhubaneswar, Odisha, India. They are brought to the CES laboratory. The soil for experimental work was collected from agricultural field up to a depth of 20cm after removing the surface litters. The soil was steam sterilized at 25 lb for 25 minutes in a autoclave. The autoclaved soil was dried and then mixed with both fly -ash and treated fly ash in different ratio.

The certified seeds of *Vigna mungo* sterilized in 0.01% HgCl₂ for 20 minutes were sown in 25×25 cm cement pots containing only sterilized soil and different proportion of fly-ash and treated fly-ash. For the experiments fly-ash/treated fly-ash (as carrier material of *Anabaena* sp.) were mixed with autoclaved soil to obtain following levels (w/w).

F1=Control=only autoclaved soil

F2=5%flyash (FA)/Treated Fly (TFA)-ash+95% autoclaved soil

F3=10%flyash (FA)/Treated Fly (TFA)-ash+90% autoclaved soil

F4=20%flyash (FA)/Treated Fly-ash (TFA) +80% autoclaved soil

F5=30%flyash (FA)/Treated Fly-ash (TFA) +70% autoclaved soil

F6=40%flyash (FA)/Treated Fly-ash (TFA) +60% autoclaved soil

F7=50%flyash (FA)/Treated Fly (TFA)-ash+50% autoclaved soil

The treated fly-ash was prepared by mixing dried blue green algae (*Anabaena* sp.) with fly-ash in the proportions of 1:9(w/w).

RESULTS

The effect of fly-ash & treated fly-ash on germination, shoot length and root length of *Vigna mungo* (7 days) was presented (Table 1). Each value represents the average of five individuals. The percentage of germination significantly increased than the control with increase in concentration of fly-ash up to 30% beyond that it gradually decreases. In case of treated fly ash with *Anabaena* sp. the germination gradually increases at all fly ash combinations as compared to control set. Among fly-ash treated plants maximum germination was obtained (95±2.3%) with 20% and in treated fly ash maximum being (99±2.2%) at 50%. The effect of fly-ash & treated fly-ash on shoot weight, root weight & number of lateral root of *Vigna mungo* (7 days) was presented (Table 2). The growth parameters significantly

increased than the control with increase in concentration of fly-ash up to 30% beyond that it gradually decreases. In case of treated fly ash with *Anabaena* sp. the germination gradually increases at all fly ash combinations as compared to control set. Among fly-ash treated plants maximum shoot weight was obtained (96 ± 6.3 mg) with 20% and in treated fly ash maximum being (107 ± 6.1 mg) at 50%.

The effect of fly-ash & treated fly-ash on leaf length, leaf width & chlorophyll (a & b) of *Vigna mungo* (7 days) was presented (**Table 3**). The growth parameters significantly increased than the control with increase in concentration of fly-ash up to 30% beyond that it gradually decreases. In case of treated fly ash with *Anabaena* sp. the germination gradually increases at all fly ash combinations as compared to control set. Among fly-ash treated plants maximum leaf length was obtained (3.8 ± 0.27 cm) with 20% and in treated fly ash maximum being (3.9 ± 0.28 cm.) at 50%. The effect of

fly-ash & treated fly-ash on total carbohydrate content of *Vigna mungo* (7 days) was studied (**Figure 1**). The growth parameters significantly increased than the control with increase in concentration of fly-ash up to 30% beyond that it gradually decreases. In case of treated fly ash with *Anabaena* sp. the germination gradually increases at all fly ash combinations as

compared to control set. Among fly-ash treated plants maximum carbohydrate was obtained (9.7 ± 0.22 mg.) with 20% and in treated fly ash maximum being (10.6 ± 0.23 mg.) at 50%.

The effect of fly-ash & treated fly-ash on total protein content of *Vigna mungo* (7 days) was studied (**Figure 2**). The growth parameters significantly increased than the control with increase in concentration of fly-ash up to 30% beyond that it gradually decreases. In case of treated fly ash with *Anabaena* sp. the germination gradually increases at all fly ash combinations as compared to control set. Among fly-ash treated plants maximum protein was obtained (5.4 ± 0.16 mg.) with 20% and in treated fly ash maximum being (6.4 ± 0.22 mg.) at 50%. The effect of fly-ash & treated fly-ash on total lipid content of *Vigna mungo* (7 days) was studied (**Figure-3**). The growth parameters significantly increased than the control with increase in concentration of fly-ash up to 30% beyond that it gradually decreases. In case of treated fly ash with *Anabaena* sp. the germination gradually increases at all fly ash combinations as compared to control set. Among fly-ash treated plants maximum lipid was obtained (2.1 ± 0.23 mg) with 20% and in treated fly ash maximum being (2.9 ± 0.19 mg.) at 50%.

Table 1: Effect of fly-ash & treated fly-ash on germination, shoot length and root length of *Vigna mungo*.

| Treatments % | % of germination | | Shoot length (cm) | | Root length(cm) | |
|--------------|------------------|--------|-------------------|-----------|-----------------|-----------|
| | F.A | T.F.A | F.A | T.F.A | F.A | T.F.A |
| Control | 90±2.1 | 90±2.1 | 9.8±0.51 | 9.8±0.51 | 7.3±0.39 | 7.3±0.39 |
| 5 | 91±2.2 | 93±2.7 | 12.4±0.56 | 9.8±0.51 | 6.3±0.42 | 6.8±0.42 |
| 10 | 93±2.4 | 96±2.4 | 12.7±0.61 | 12.8±0.53 | 9.2±0.43 | 10.1±0.44 |
| 20 | 95±2.3 | 97±2.5 | 13.5±0.57 | 13.1±0.61 | 10.4±0.39 | 10.6±0.37 |
| 30 | 92±2.01 | 98±2.2 | 13.2±0.62 | 13.6±0.60 | 9.4±0.41 | 10.9±0.42 |
| 40 | 85±2.1 | 99±2.3 | 12.2±0.58 | 14.1±0.61 | 8.3±0.40 | 11.1±0.38 |
| 50 | 74±2.2 | 99±2.2 | 12.2±0.63 | 14.3±0.62 | 6.2±0.43 | 11.3±0.41 |

Table-2. Effect of effect of fly-ash & treated fly-ash on shoot weight, root weight & number of lateral root of *Vigna mungo*

| Treatments % | Shoot weight(mg) | | Root weight(mg) | | Number of Lateral Root | |
|--------------|------------------|---------|-----------------|---------|------------------------|--------|
| | F.A | T.F.A | F.A | T.F.A | F.A | T.F.A |
| C | 70±4.2 | 70±4.2 | 229±7.1 | 229±7.1 | 19±1.1 | 19±1.1 |
| 5 | 62±5.1 | 65±5.3 | 310±7.6 | 315±7.9 | 22±1.2 | 36±1.4 |
| 10 | 95±5.8 | 98±5.7 | 310±9.2 | 320±8.2 | 28±1.9 | 34±1.2 |
| 20 | 96±6.3 | 99±6.1 | 327±9.3 | 328±9.1 | 32±1.7 | 37±1.7 |
| 30 | 95±5.4 | 99±5.8 | 311±8.4 | 331±8.1 | 30±1.3 | 36±1.4 |
| 40 | 75±6.7 | 105±6.2 | 312±8.7 | 342±8.6 | 27±1.8 | 33±1.8 |
| 50 | 60±5.6 | 107±6.1 | 270±9.1 | 349±8.3 | 29±2.0 | 35±1.5 |

Table 3: Effect of fly-ash & treated fly-ash on leaf length, leaf width & chlorophyll (a&b) of *Vigna mungo*

| Treatments % | LEAF LENGTH(cm) | | LEAF WIDTH(cm) | | CLOROPHYLL-a (µg/mg fr.wt.) | | CLOROPHYLL-b (µg/mg fr.wt.) | |
|--------------|-----------------|----------|----------------|----------|-----------------------------|-----------|-----------------------------|-----------|
| | F.A | T.F.A | F.A | T.F.A | F.A | T.F.A | F.A | T.F.A |
| Control | 2.6±0.21 | 2.6±0.21 | 1.2±0.02 | 1.2±0.02 | 1.28±0.03 | 1.28±0.03 | 0.63±0.01 | 0.63±0.01 |
| 5 | 3.4±0.28 | 3.5±0.25 | 1.4±0.03 | 1.5±0.04 | 1.91±0.04 | 2.05±0.04 | 0.95±0.02 | 0.98±0.02 |
| 10 | 3.7±0.26 | 3.6±0.23 | 1.4±0.05 | 1.6±0.03 | 2.09±0.03 | 2.11±0.02 | 1.03±0.01 | 1.14±0.03 |
| 20 | 3.8±0.27 | 3.7±0.24 | 1.9±0.03 | 1.8±0.04 | 3.67±0.07 | 3.4±0.04 | 1.8±0.03 | 1.12±0.01 |
| 30 | 3.2±0.26 | 3.7±0.26 | 1.4±0.02 | 1.9±0.02 | 3.21±0.02 | 3.5±0.05 | 1.09±0.01 | 1.33±0.02 |
| 40 | 3.3±0.24 | 3.8±0.27 | 1.5±0.04 | 2±0.01 | 1.99±0.02 | 3.6±0.02 | .98±0.02 | 1.48±0.01 |
| 50 | 3.3±0.27 | 3.9±0.28 | 1.4±0.06 | 2.4±0.03 | 1.8±0.02 | 3.4±0.03 | .92±0.01 | 1.69±0.02 |

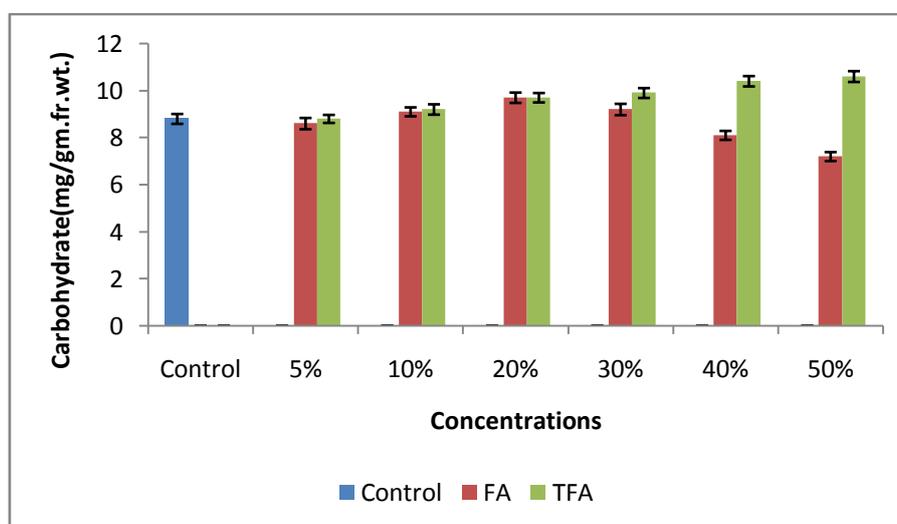


Figure 1: The effect of fly-ash & treated fly-ash on total carbohydrate content of *Vigna mungo*

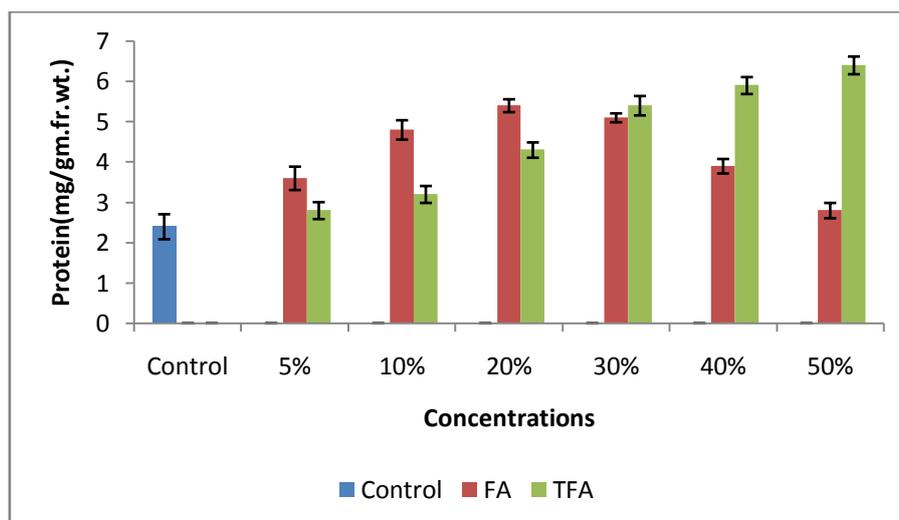


Figure 2: The effect of fly-ash & treated fly-ash on total protein content of *Vigna mungo*

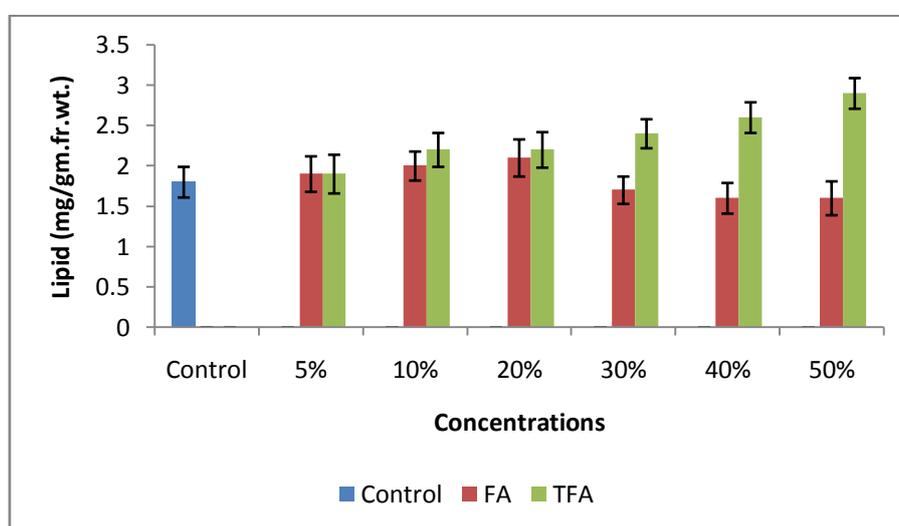


Figure 3: The effect of fly-ash & treated fly-ash on total lipid content of *Vigna mungo*

DISCUSSION

The study reveals that ,the percentage of germination and the growth parameters were found to be increased at 20% fly ash and beyond that it gradually decreases. However with treated fly ash the growth and germination increased with increase in concentration. Hence 20% fly ash concentration & 50% treated fly ash concentration can be used for the growth of plants. The beneficial effect of fly-ash at lower level (10-30%) have already been

observed on many crops-soyabean, cabbage, chick pea, cucumber, lentil, maize, potato, wheat, tomato etc [7-11]. Thus both fly-ash and treated fly-ash can be used as an eco-friendly non-conventional fertilizer at 20% and 50% levels respectively because they will improve the growth and yield of plants side by side the disposal problem of huge amount of fly ash will also be solved. The biochemical analysis of the experimental plant showed that the treated fly ash with *Anabaena* sp. algae showed more

photosynthetic pigment compared to fly ash treated plants. The accumulation of total carbohydrate, total protein and total lipid was found maximum in treated fly ash than only fly ash (un- treated).

CONCLUSION

The present study revealed that fly ash could be beneficial not only in improving plant growth but also used as a carrier material for cyanobacteria. The most suitable treatment for improved plant growth of *Vigna mungo* is 20-25% fly-ash (un treated) & 50% (treated with *Anabaena* sp.) as it gives the maximum growth. This method will solve the problem of fly-ash disposal from the power plant industries for a better utilization in a significant way.

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