Indian J.L.Sci.2(2) : 99-102, 2013

ISSN : 2277-1743 (Print)
ISSN : 2278-7879 (Online)

IMPACT OF FLY-ASH AMENDED SOIL ON GROWTH AND RHIZOME SETTING IN AN ENDANGERED MEDICINAL PLANT *Acorus calamus* Linn.

N. K. MISHRA[1]

Department of Botany, A.B.R. P. G. College, Anpara, Sonebhadra, U.P., India
E-mail: neelkanth_2007@rediffmail.com

ABSTRACT

Fly-ash, the Coal Combustion Residue is a problem for environment but has been proven to be effective in agricultural production because of its alkaline nature, rich nutrient content, and occurrence of micro and macro-elements. Under the view of the fact that fly-ash may prove to be a better nutrient supplement for plants when amended in soil. Thus the effort was made to conduct an experiment on the effect of Fly-ash amended soil on an endangered medicinal plant *Acorus calamus* Linn. of family Araceae. This paper deals with the growth and rhizome setting performance of *Acorus calamus* Linn.(Araceae) in different levels of amendments of common field soil with fly-ash. The findings revealed that the lower doses (10-20%) of fly-ash are beneficial to the growth of the plant. Over all, this study indicates that fly-ash amendment of soil may increase the productivity of *Acorus calamus* and may go a long way in conservation of this endangered plant.

KEYWORDS : CCR, CCP, Fly-ash, Bottom ash, Sweet flag, *Achorus calamus* Linn.

Coal is the most popular fuel substitute for power generation. Full combustion of coal generates a huge amount of energy. During this energy production process, the after left is known as resedue or ash. Coal can range in ash content approximately from 2%-30%. and of this around 85% becomes fly-ash. Klein et al., 1975 report that up to 90% of the ash in many coal-fired plants is fly ash, resulting from the combustion of powdered coal in electric generating plants. The remaining 15% is called bottom-ash and isn't lifted up by the fuel gases due to weight of its larger particles. The fly-ash lifted up sets down after some time on various surfaces as well as on ground and again mixes with bottom-ash. The mixture is technically the Coal Combustion Residue (CCR) and is commonly known as Fly-ash. It is also known as a Coal Combustion Product (CCP) and it consists of inorganic, incombustible matter present in the coal that has been fused during combustion into a glassy, amorphous structure. C.C.R. is primarily composed of silt-sized, glassy spheres with numerous impurities within and on the surface of these small silt and sand like particles. Physically, fly -ash occurs as very fine particles, having an average diameter of < 10 μM., 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 the operating conditions of the Thermal Power Stations. Approximately on an average 95 to 99% of fly-ash consists of oxides of Si, Al, Fe & Ca and about 0.5 to 3.5% consists of Na, P, K and S and the remainder of the ash is composed of trace elements.

In fact, Fly Ash consists of all the elements present in soil except organic carbon and nitrogen and thus it can be concluded that Fly ash is the finely divided mineral residue. It was found that this material could be used as an additive / amendment material in agriculture applications. It provides an array of plant available macro-nutrients (Ca, Mg, K and S) and micro-nutrients (B, Fe, Mn, Cu, Zn, etc.) along with improved water holding capacity and aggregation. These nutrients from fly ash have been proved to be beneficial to plants through soil application or foliar dusting. (Mishra and Shukla, 1986)

Singh and Yunus (2000); Krajickova and Majstrick (1984); Mishra and Shukla (1986); Chang et al., (1977) have reported on the deleterious effects of fly-ash on growth of plants. Hodgson and Buckley (1975); Adriano et al., (1980); El-Mogazi et al.,(1988); Inouhe et al., (1994), Singh et al., (1997), Rai et al., (2000) report that the bio-accumulation of B, As, Se, Mo, V, Al and Cd may be extremely hazardous to the plants.

A good amount of researches has already been done on the production and yield of agricultural plants after fly-ash amendment of soil. Kumar et al., (2001) has reported that the yield in such an amendment increases by 15-25%. Aitken and Bell (1985); Singh et al. (2000) report that some plants have been able to grow on fly-ash amended soils without any injury symptom. Besides it some reports suggest that small applications of fly-ash in agricultural

[1]**Corresponding author**

Table 1 : Effect of CCR Amended Soil on Different Parameters of Growth And Rhizome Setting in *Acorus calamus*

Fly-Ash composition ► **Parameter ▼**	F: S 0 : 100 Control	F : S 10 : 90	F: S 20 : 80	F: S 30 : 70	F: S 40 : 60	F: S 50 : 50
No. of leaves	10	9	19	8	5	5
No. of branches	2	2	5	2	1	1
Photosynthetic area /leaf (cM)²	28	30	30	16	8	6
Height of plant (cM)	30	34	33	28	25	18
Fresh Biomass of Rhizome (g)	46	55	58	51	35	25

fields are suitable for better crop management (Gutenmann et al., 1976; Furr et al., 1978).

MATERIALS AND METHODS

Under the view of the fact that fly-ash may prove to be a better nutrient supplement for plants on amendment of soil by it, the effort was made to conduct an experiment on the effect of C.C.R. Amended soil on Growth and Rhizome Setting in a medicinal Plant *Acorus calamus* Linn. which belongs to the family Araceae and has been declared to be endangered. (Ayensu, 1986).

The fly-ash used in this experiment was collected from NTPC, Shaktinagar, Sonebhadra (U.P.) and was analyzed for its physico-chemical properties. The common field soil was sterilized into oven so as to remove any trace of biological existence. Then after that the sterilized soil was amended with fly ash in w/w % as 10 %w/w (90% soil : 10% Fly-ash), 20 % w/w, 30 %w/w, 40 %w/w, 50% w/w and so on till absolute (100% Fly-ash).

The saplings of Achorus calamus were procured from the botanical garden of authors' affiliation and were selected on the basis of their weight, no. of nodes, length, no. of eyes to be similar. Then after that the saplings were planted into erthen pots containing different grades of soil : fly-ash compositions. A control was maintained in soil to compare the results and five replicas were made for the experimental setup. The setup was allowed to grow naturally with the precaution of any disturbance.

The setup was observed on each fortnight for three months for the growth parameters like no. of leaves, no. of branches, total photosynthetic area and height of plants. The rhizomes were tested for their biomass at maturity.

OBSERVATION AND DISCUSSION

The observation shows that the amendment of soil with fly-ash proves to be comparatively more productive because the growth parameters of the test plants showed that the lower grades of amendment increases the plant growth. As it is depicted by the in table, 1 the 20% fly ash is more beneficial as it shows greater values of growth parameters than that of control and 10%.

The no. of leaves increases from 10 to 19, the no. of branching from 2 to 5, the photosynthetic area from 28 cm² to 30 cm², the height of plant by 30 cm to 33 cm² and the fresh Biomass of the rhizome from 46 g. to 58 g (Figure, 1 &2).

Higher grades of fly ash amendments prove to be detrimental to the growth of *Acorus calamus* as it is clear from the above observation that the values of the growth parameters decreases.

The observations of the experiment on effects of Coal Combustion Residue (CCR) amended soil on growth and rhizome setting in *Acorus calamus* Linn. delineate that amendment of soil with fly-ash in production of this plant may be salubrious and invigorating.

This study indicates that the lower grades of amendment of soil with fly-ash (up to 20%) may be beneficial for productivity while the higher concentrations are deleterious to the growth of *Acorus calamus*. It may be due to the presence of higher concentration of toxic metals in the fly-ash which causes stunting of growth, early senescence and lesser food assimilation and as a result lesser productivity.

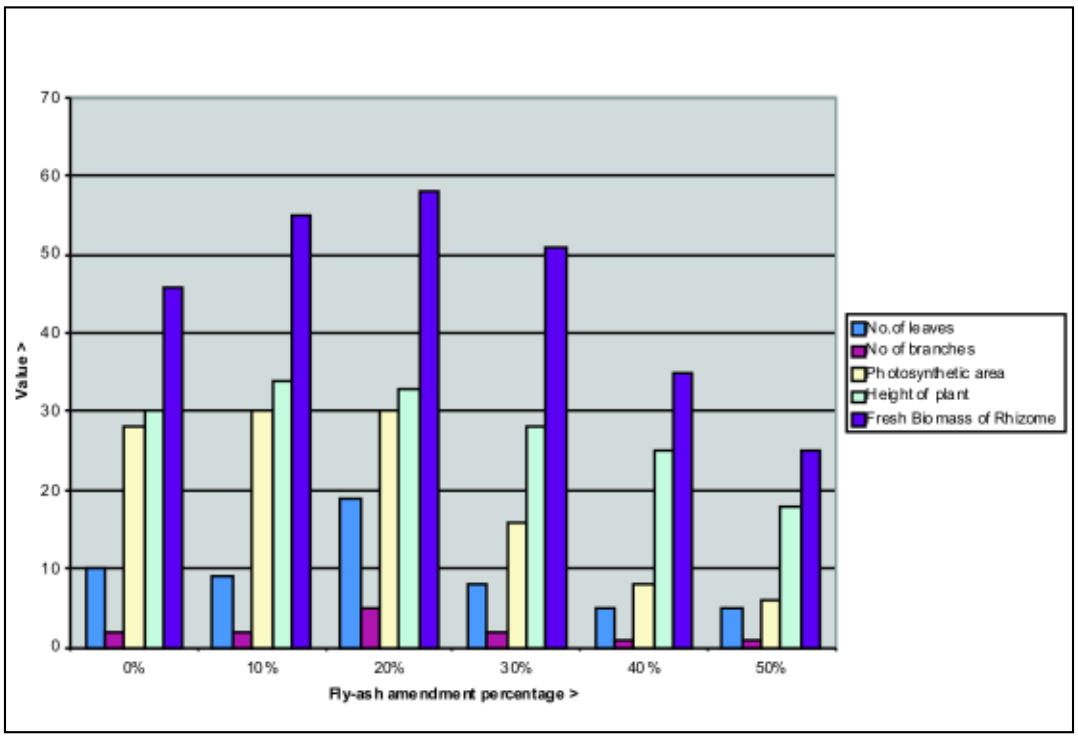

Figure 1 : Effect of Fly-Ash Amended Soil on Growth and Rhizome Setting in *A. calamus*

Figure 1 : Growth of *A. calamus* in Fly-Ash Amended Soil.

REFERENCES

Adriano D.C., Page A.L., Elseewi A.A., Chang A.C., Straughan I., 1980. Utilization and disposal of fly-ash and other coal resedues. In: Terrestrial ecosystems : A review J. Environ. Qual. **9** : 333-334.

Aitken R.L. and Bell L.C., 1985. Plant uptake and phototoxicity of Boron in Australian fly ashes. Plant and Soil, **84** : 245-257.

Ayensu S.E., 1986. World Medicinal Plant Resource. In Conservation for Productive Agriculture. Eds. Chopra, V.L. and Khoshoo T.N., ICAR, New Delhi :11-49.

Chang A.C., Lund L.J., Page A.L., Warneke J.E., 1977. Physical properties of fly-ash amended soils. J. Environ. Qual. **6**:267-270.

El-Mogazi D., Lisk D.J., Weinstin L.H., 1988. A review of physical, chemical and biological properties of fly-ash and effects on agricultural ecosystems. Sci. Total Environ. **74**:1-37.

Gutenmann W.H., Bache C.A., Youngs W.D. and Lisk D.J., 1976. Selenium in fly ash. Science, **191**:966-7.

Hodgson D.R. and Buckley G.P., 1975. A practical approach towards the establishment of trees and shrubs on pulverized fuel ash. In : Chadwick, M.J., Goodman, G.T. (eds.), The ecology of resource degradation and renewal. Blackwell, Oxford: 305-329.

Inouhe M., Ninomiya S., Tohoyama H., Joho M. and Murayama T., 1994. Different characteristics of root in the Cadmium-tolerence and Cd binding complex formation between mono and dicotyledonous plants. J. Plant Res., **107**:201-207.

Klein D.H., Andren A.W., Carter J.A., Emery J.F., Feldman C., Fulkerson W., Lyon W.S., Ogle J. C., Taimi Y., Van Hook R.I. and Bolton N., 1975. Pathway of 37 Trace Elements Through Coal-Fired Power Plants. Environmental Science and Technology **9**:973-979.

Krajickova A. and Majstrick V., 1984. The effect of fly-ash particles on the plugging of stomata. Environ. Pollut. Ser. A **36**: 83-93.

Kumar V., Goswami G. and Zacharia, A.K., 2001. Fly-ash use in Agriculture : Issues and concerns. Technology demonstration project commissioned by fly-ash mission under technology information forcasting assessment council (TISAC) news and views : 1-6.

Mishra L.C. and Shukla K.N., 1986. Effects of fly-ash deposition on growth, metabolic and dry matter production of maize and soyabean. Environ. Pollut..Ser. A, **42**: 1-13.

Rai U.N., Tripathi R.D., Singh N., Kumar A., Ali M. B., Pal A. and Singh S.N., 2000. Amelioration of fly-ash by selected nitrogen fixing blue green algae. Bull. Environ. Contam. Toxicol. **64**: 294-301.

Singh N. and Yunus, M., 2000. Environmental impacts of fly-ash. In Iqbal, M., Srivastava P.S., Siddiqui, T.O. (eds.) Environmental Hazards : Plants and People. CBS, New Delhi, : 60-79.

Singh V.K., Behal K.K. and Rai U.N., 2000. Comparative study on the growth of mulberry (*Morus alba*) plant at different levels of fly ash amended soil. Biol. Memoirs., **26**(1) : 1-5.