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# ROLE OF FLY ASH IN AGRICULTURE: A SCIENTIFIC WAY TO IMPROVE SOIL HEALTH

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Intensive cultivation leads to meet the food demand of present generation but overexploitation of natural resources like soil and water bodies in relation to their capabilities results in decreasing level of organic matter and soil health. Sustainability is necessary to meet the demand of present generation as well as keep the soil fertile and healthy for future generations without deteriorate its quality. Scientific management, timely and safe disposal of fly ash is a unsolved problem. At present time, there is a need of safe and profitable disposal of fly ash is needed. Fly ash contains various essential plant nutrients. Fly ash is a cheaper and easily available source of plant nutrients. Utilization of fly ash in agriculture will be a milestone in timely disposal of fly ash with reduction in cost of cultivation. Fly ash improves the soil health which results in higher crop yield. Fly ash is a cheaper and easily available source of plant nutrients as compared to costly chemical fertilizers, which reduce dependency on chemical fertilizers as well as reduce the cost of cultivation.

In the last decades, rising population of our country enforced on traditional sources of energy to produce more outcome to fulfil the demands of present generation. With the time, various alternate source of energy production come into limelight like solar energy, wind, turbine, thermal plant, nuclear power generation plants. Even with discovery of such type of energy sources, the hyperbolic use of coal cannot be counterbalanced in various developing countries like India. In India, per year about 175 million tonnes of fly ash is produced from various thermal power generation plants and it is expected to production of 300 million tonnes fly ash in near future (Pani *et al.*, 2015). Every year, during the combustion of coal in thermal power plants, Bricks kilns and other industries, various by products produced.

Among these, fly ash is a major important by product, which management and safe disposal is an unsolved problem. The generation of electricity leads to anthropogenic emission of $CO_2$, $SO_2$, $NO_x$ along with fly ash in huge quantity by thermal power plants (Singh and Pandey, 2013). Every year more than 100 million tonnes of fly ash is produced in more than 1800 thermal power plants and bricks kilns units. Presently the utilization of fly ash on global basis is about only 25% of total fly ash produced, remaining is landfilled and surface impounded (Lea*et al.*, 2021).

**Fig 1:** Coal-based fly ash

## Disposal of Fly Ash

In general fly ash is disposed either by dry or wet method. In dry method, fly ash is disposed through dumped it in landfills and dry basins, While in wet method, fly ash is washed out in artificial lagoons with the help of water, which commonly called Pond Ash. Both these method of disposal of fly ash is costly and harmful to human health along with lead to soil quality and health degradation. Landfilling of fly ash adversely affect the soil fertility and pollute the quality of ground water also.

**Fig 2:** Fly ash pond

## Effect of Fly Ash on Soil Properties

### 1. Soil Texture

The application of fly ash to heavy black clay soils can be alter their texture and make them more friable to easily plough them and favour to enhance germination of crop seeds and minimize soil crusting. An application of fly ash improve the soil texture (Panda and Biswal 2018).

### 2. Soil Structure

With the application of appropriate quantity of fly ash can be make soil crumby and granular with improve soil structure, which favour crop growth and yield. Fly ash improves the soil structure, when applied to soils (Dhindsa *et al*., 2016).

### 3. Bulk Density

Fly ash reduce the bulk density of soil, when applied to the soils. The impact of fly ash on soil physical properties on several soils mixed with 50% fly ash reveals that reduction in bulk density of soil. The particle of fly ash is very similar to silt, which alter the bulk density of soil, when applied to soils (Panda and Biswal, 2018).

### 4. Porosity (%)

Anaddition of fly ash to sandy soils alters the soil texture permanently with increased micro porosity and improved water holding capacity of such soils (Michel *et al.*,2004).

### 5. Electrical Conductivity

Anapplication of fly as 10, 20, 30 and 40% (w/w basis) in clay, sandy clay loam, sandy and sandy loam resulted in increased electrical conductivity (Panda and Biswal, 2018).

### 6. Infiltration Rate

Fly ash improve soil physical properties like soil texture, soil structure, aeration status.Moderate infiltration rate favour a great enhance soil aggregation and minimize runoff losses and protect the soil from erosion. So, fly ash can be used for enhanced water infiltration rate.

### 7. Soil Organic Matter

Fly ash is a good source of organic matter, when applied to soil, it has been enhancing the level of soil organic matter. Soil organic matter is a good source or store house of plant available nutrients. Soil organic matter hold the plant nutrients by chelate formation and minimize their leaching losses.

### 8. Water Holding Capacity

The application of appropriate quantity of fly ash improves the levels of water holding capacity of a soil(Dhindsa *et al*., 2016). Several field experiments reveals that soils mixed with 50% fly ash showed a higher water holding capacity as compared to other soil. An application of fly as 10, 20, 30 and 40% (w/w basis) in clay, sandy clay loam, sandy and sandy loam resulted in increased water holding capacity (Panda and Biswal, 2018).

### 9. Soil pH

Fly ash can be used to correct both the soil acidity and soil alkalinity. Fly ash can be acidic or alkaline which is depends upon the source and combustion process.The application of fly as 10, 20, 30 and 40 % (w/w basis) in clay, sandy clay loam, sandy and sandy loam resulted in increased soil pH (Panda and Biswal, 2018). Fly ash when applied to acidic soils, act as a liming material to neutralize soil acidity which enhance the available nutrient status of the soil. The principal beneficial characteristics offly ash is due to carbonate and hydroxide salt present in it.

### 10. Cation Exchange Capacity

Fly ash contains various cations and anions, when fly ash is applied to soil, these cations and anions replace otherion on exchangeable sites and enhanced cation exchange capacity which favours certain plant nutrients availability. An application of fly ash increase the level of cation exchange capacity of soil (Tomar *et al*., 2015).

### 11. Soil Fertility level

Fly ash is also a rich source of various micronutrients including Fe, Mn, Zn, Cu, Boron and Molybdenum (Meena *et al.*, 2019). Higher concentration of essential plant nutrients including K, Ca, Mg, Na, Zn and Fe in fly ash increased the yield of agricultural crops.An application of fly ash with municipal biosolids prove N and P to the soil with leading to better crop

production (Sahoo *et al*., 2021).So, fly ash can be used as a source of nutrient. An application of fly ash with municipal bio-solids prove N and P to the soil with leading the better crop production (Sahoo *et al*., 2021).

**12. Microbial population and enzymatic activities**

Fly ash is when applied to acidic soils, it corrects the soil acidity by rise the soil pH which create a favourable environment for bacterial and other certain microbial population resulted in nutrient transformation and nitrogen fixation. The soil applications of fly ash increase activity of invertase, amylase, dehydrogenase and protease enzyme in soil system (Sarangi *et al*., 2001). There was a significant effects on soil health in terms of microbial populations, enzyme activities with improved bacterial community diversity (Lea*et al*., 2021).

**13. Better Crop Yield**

Fly ash contains essential plant nutrients in higher quantities**.** Higher concentration of essential nutrients in fly ash including K, Ca, Mg, Na, Zn and Fe increased the yield of agricultural crops. An application of fly ash with municipal bio-solids prove N and P to the soil with leading to better crop production (Sahoo *et al*., 2021).

**14. Act as Pesticide**

Astudy reported that more than 50 species of insect pest of major agricultural crops found susceptible to fly ash treatment. Fly ash can be used to control both chewing and sucking pests of field crops like leaf folder, grasshopper, brown plant hopper, yellow caterpillar, brown bug, red ear head bug, black bug. Soil application of 5% fly ash to tomato crop found root knot nematode infestation.

## Conclusion

Fly ash contains various essential plant nutrients in a wider range, which make it an alternate source of plant nutrients and as a soil ameliorant to improve the soil quality and health. Fly ash is a cheap and easily available source of plant nutrient. Fly ash application in various soils has been showed an admirable positive effect on various physic-chemical and biological properties as well as plant biomass and nutrient uptake by crop plants. Fly ash can be used as ameliorant in both acidic and sodic soils depends upon nature of fly ash. Applications of fly ash alone or combinations of with appropriate doses improve soil health and subsequently crop yields.

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