

Original Research Article

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Effect of Fly Ash Deposition on Biochemical Parameters of Different Crop Plants around Parichcha Thermal Power Plant, Jhansi, India

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ABSTRACT

Keywords

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The present study evaluated the effects of fly ash on biochemical parameters of wheat, maize, gram and pea nearby Parichha Thermal Power Plant, Jhansi. It was observed that increase in fly ash concentration to a limited extent increase the soil quality and plant growth. Adverse effects can be observed at high concentration of fly ash. The study revealed that the limited concentration of fly ash could be beneficial for agriculture. Use of fly ash in agriculture as nutrient can be economical and eco-friendly solution of its disposal.

Introduction

Fly ash is generally the by-product produced due to the combustion process. It is actually captured from the chimneys of coal fired power plants. Generally it is known to be rich in variety of trace elements like As, B, Ca, Mo, S, Sr, Se etc., but toxic when present in excess amount (Mehra *et al.*, 2000). The crop productivity of the soil increases on the addition of significant amount of fly ash due to the presence of micronutrient and macronutrient in it. Crop productivity may also reduce if the concentration of toxic metal is high in the

fly ash (Sharma *et al.*, 2015; Murugan and Vijayarangam, 2013).

Fly ash contains a huge problem for disposal as it is a waste product itself (Kanchan *et al.*, 2015). The present annual quantity of fly ash generated in India has increased from 98.57 million ton during 2004-05 to 184.14 million ton during 2014-15, a growth of about 90% (CEA, 2015). During the year 2014-15, about 42.26% of total fly ash generated was utilized in cement sector followed by 13% in mine filling, 11.72% in

making bricks and tiles, 10.77% in reclamation of low lying areas, 9.56% in ash dyke raising, 3.32% in roads and embankments, 1.93% in agriculture, 0.74% in concrete, 0.01% in hydro power sector and 6.70% in others etc. (CEA, 2015).

The present study involves the evaluation of effect of fly ash on biochemical parameters of crop plants growing nearby Parichha Thermal Power Plant, Jhansi.

Materials and Methods

Collection of samples

Fresh leaves of wheat, maize, gram and pea from mature plants were collected from five different sites around Parichha Thermal Power Plant, Jhansi. Five replicate of each sample was collected from each site to minimize the sampling error. Samples were collected in polyethylene bags, labeled accordingly and brought to the laboratory for the biochemical analysis. The study was done for consecutively three years i.e. 2010-2013.

Biochemical study

Total chlorophyll and carotenoid content were estimated by Arnon, 1949. The amount of protein was estimated by the method of Lowry *et al.*, 1951.

Results and Discussion

The results obtained for all biochemical parameters in various plants during 2010-2013 are presented in table 1, 2 and 3 respectively.

Chlorophyll

Chlorophylls are essential components for photosynthesis and occur in chloroplast as green pigments in all photosynthetic plant tissues (Rao, 2015). The chlorophyll

contents were ranged between 1.10 to 1.59 (2010-11), 1.12 to 1.88 (2011-12), 1.24 to 1.95 (2012-13) in wheat, 0.95 to 1.75 (2010-11), 1.13 to 1.75 (2011-12), 1.29 to 1.95 (2012-13) in maize. Similar pattern was also observed in gram and pea. It is noticeable that chlorophyll content is increasing regularly. It might be due to the presence of high concentration of nitrogen, potassium, magnesium and phosphorous in fly ash which is regularly depositing in the soil nearby Parichha Thermal Power plant. Similar results were also reported in *Coelus forskohlii* and *Andrographis paniculata* (Sinha *et al.*, 2013).

Carotenoids

Carotenoids are colourful organic pigments found in chloroplasts and chromoplasts of plants. These pigments may elevate the photosynthetic activity, which resulted in improved growth and yield of plant (Khan and Khan, 1996). The result shows the elevation of carotenoid content during 2010-11 and 2011-12 while it is declining during 2012-13 in all cereals. The carotenoid content is increasing due to presence of utilizable plant nutrients like sulphate, phosphorous, potassium, calcium, boron, magnesium, manganese etc. in fly ash. Increasing trend of carotenoid in maize is also recorded by Agarwal, 2005.

Protein

Protein concentration was recorded 13.2% to 18.9% in wheat, 20.5% to 25.6% in maize, 12.2% to 21.5% in gram and 18.2% to 19.8% in pea during 2010-11. The protein concentration was increased during 2011-12. It was recorded 19.4% to 22.2% in wheat, 22.6% to 27.5% in maize, 17.2% to 19.5% in gram and 21.9% to 24.8% in pea. It was increased again in 2012-13 and found 15.5% to 19.3% in wheat, 21.2% to 28.6% in maize, 24.2% to 29.9% in gram and 19.2%

to 29.7% in pea. Protein concentration showed a remarkable increase consistently, which suggests synthesis of some new

proteins which helps the affected plants to combat the stress induced by fly ash.

Table.1 Different biochemical parameters in various crops around Parichha Thermal Power Plant during 2010-2011

Plant	Total chlorophyll (mg/g of FW)					Carotenoids (mg/g of FW)					Protein (%)				
	S1	S2	S3	S4	S5	S1	S2	S3	S4	S5	S1	S2	S3	S4	S5
Wheat	1.10	1.19	1.52	1.45	1.59	0.11	0.13	0.17	0.14	0.15	13.2	14.5	18.9	15.4	15.3
Maize	0.95	1.05	1.75	1.12	1.32	0.15	0.16	0.18	0.17	0.17	20.5	22.5	25.6	22.9	23.5
Gram	2.00	2.04	2.35	2.15	2.25	0.20	0.21	0.25	0.21	0.22	12.2	12.5	21.5	15.2	19.9
Pea	1.56	1.60	1.98	1.75	1.68	0.15	0.18	0.22	0.19	0.20	18.5	18.9	19.8	18.2	18.7

Table.2 Different biochemical parameters in various crops around Parichha Thermal Power Plant during 2011- 12

Plant	Total chlorophyll (mg/g of FW)					Carotenoids (mg/g of FW)					Protein (%)				
	S1	S2	S3	S4	S5	S1	S2	S3	S4	S5	S1	S2	S3	S4	S5
Wheat	1.12	1.22	1.75	1.62	1.88	0.21	0.22	0.45	0.27	0.56	19.4	19.9	21.5	20.3	22.2
Maize	1.13	1.42	1.68	1.50	1.75	0.19	0.25	0.38	0.28	0.55	22.6	25.5	25.5	26.9	27.5
Gram	2.20	2.25	2.69	2.56	2.85	0.26	0.35	0.35	0.35	0.55	17.2	18.2	18.9	18.5	19.5
Pea	1.42	1.95	2.11	1.98	2.18	0.24	0.28	0.48	0.38	0.59	21.9	22.5	24.2	22.7	24.8

Table.3 Different biochemical parameters in various crops around Parichha Thermal Power Plant during 2012-13

Plant	Total chlorophyll (mg/g of FW)					Carotenoids (mg/g of FW)					Protein (%)				
	S1	S2	S3	S4	S5	S1	S2	S3	S4	S5	S1	S2	S3	S4	S5
Wheat	1.24	1.25	1.76	1.84	1.95	0.24	0.25	0.27	0.33	0.35	15.5	15.6	17.8	18.5	19.3
Maize	1.29	1.45	1.75	1.84	1.95	0.25	0.26	0.28	0.27	0.29	21.2	28.6	24.5	24.8	25.9
Gram	1.22	1.44	1.85	2.25	2.55	0.30	0.31	0.32	0.35	0.39	24.2	26.8	28.8	29.2	29.9
Pea	1.98	2.08	2.35	2.55	2.80	0.32	0.38	0.38	0.44	0.49	19.2	20.8	21.5	25.5	29.7

The similar observations were also reported in *Medicago sativa* (Chakraborty, 2009), *Brassica juncea* (Gautam *et al.*, 2012) and *Caulerpa scalpelliformis* (Sornalakshmi and Kumar, 2014). Soil metabolic activities, activities of amylase, invertase and protease,

chlorophyll a and b, carotenoid and protein content are increases in fly ash amended soil (Bhandari, 2006; Bozkurt and Karacal, 2001; Rai *et al.*, 2003).

In conclusion, the present study concluded that fly ash could be beneficial in improving

plant growth and soil quality at a limited extent. But if it used in excess amount it could results vice versa. Utilization of fly ash in agriculture fields can also be one more strategy of fly ash management.

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