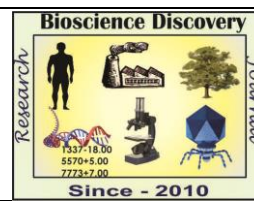


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Print & Online, Open Access, Research Journal Available on <http://jbsd.in>

ISSN: 2229-3469 (Print); ISSN: 2231-024X (Online)

Research Article



Effects of Vermicomposted Fly Ash on Morphological and Biochemical attributes including Anti Oxidant Enzymes of *Allium cepa* L.

Raval Rucha U^{1*}, Patel Kailash P^{1.}, Jadav Rajendra² and Reddy M. N.¹

¹Department of Biosciences, Veer Narmad South Gujarat University, Surat, Gujarat, India

²Department of Chemistry, R. A. College of Science, Ahmedabad, Gujarat, India

*E-mail address: ravalrucho92@gmail.com

Article Info

Received: 26-09-2017,

Revised: 09-12-2017,

Accepted: 19-12-2017

Keywords:

Anti oxidant enzymes,
Chlorophyll, Fly Ash,
Morphological parameters,
Protein.

Abstract

The aim of this research is to study the morphological, biochemical and enzymological effects of different concentrations (Control, 20%, 50%, 80% and 100%) of vermicomposted Fly Ash from Thermal Power plant, emended with pressmud on *Allium cepa*. 10 seeds were grown in the pot study, the tests were triplicated. In morphological study Root length, Shoot length, Shoot width, Leaf length and number of leaves were observed. In biochemical study protein and chlorophyll content were examined by different methods like Lowry and McKinney's methods respectively. Superoxide dismutase, Catalase and Guaiacol peroxidase were checked in enzymatic study. Morphological parameters were observed the best in 20% Fly Ash concentration. At the lower concentration protein was found to be slightly increased, whereas, the chlorophyll content was found highest in 20%. The anti oxidant enzymes were increased at lower concentration and started to decrease at higher concentration. Thus, the 20% of Fly Ash concentration was proved to be the best for the better plant growth with lesser damage.

INTRODUCTION

As the industrialization increases, pollution also increases. Because electricity is a basic need for day to day life, more Thermal Power Plants are established. (Mistry Brijal *et al*, 2017.) Fly ash (FA), a by-product of coal combustion, is generated in coal based thermal power plants. India currently produces 120 million tons per year and it is estimated that it will cross the figure of 150 million tons in the coming next years. Its management is a matter of concern nowadays. (Vimal Chandra Pandey *et al.*, 2010).

Fly ash can be beneficially used as source of essential plant nutrients like manganese, magnesium, calcium, potassium, phosphorus, copper, zinc and iron in different climatic conditions and soil types using different doses. (Yavarzadeh and Shamsadini, 2012) Fly ash shows

adverse effects when used in higher concentration due to accumulation of toxic elements. To overcome this effect, fly ash can be vermicomposted and supplemented with organic matter, pressmud. (Niyazi and Chaurasia, 2014) Fly has been found to be beneficial for the plants up to some optimum concentration. It is observed that it helps enhancing growth and yield of the plants.

Fly ash contains heavy metals such as Fe, Cu, Ni, Cd, Cr, etc., which can cause metal toxicity in plants. In higher concentration, these metals can be phytotoxic and can result in reactive oxygen species (ROS). The redox metals may induce oxidative stress with over production of ROS such as super oxide free radicals (O_2^-), hydroxyl radicals (OH^\cdot), hydrogen peroxide (H_2O_2) etc. (Abolghassem *et al*, 2015).

MATERIALS AND METHODS

Experimental designs

Allium cepa seeds were purchased from Agriculture Produce Market Committee, Surat, Gujarat.

Fly Ash was collected from Thermal Power Plant, Ukai. The Thermal Power Plant is located at 21°12'36.5"N and 73°33'26.23"E. Pressmud was collected from Sugar Factory, Bardoli. Soil was Vermicomposted with different concentration of FlyAsh (Control, 20%, 50%, 80% and 100%), while the concentration of Pressmud was kept the same. 100 *Eisenia foetida* Earthworms were added to each concentration. Vermicomposted soil was ready by few months.

Morphological study

10 seeds were sown in each pot, seeds were irrigated on every alternate day with distilled water.

Morphological characters like Root length, Shoot length, Shoot width, Number of leaves and Leaf length were checked after the maturation of each plant.

Biochemical study

Chlorophyll from the mature plant leaves was estimated by McKinney’s method (1941) whereas Protein was estimated by Lowry *et al.* (1951)

Enzyme study

Anti oxidant enzymes were studied from the bulb of onion plants. Superoxide dismutase (SOD) (EC 1.15.1.1) activity was determined by (Beauchamp and Fridovich, 1971). The activity of Guaiacol peroxidase was determined spectrophotometrically as described by (Chance, B. and Maehly, A.C, 1955). Activity of catalase was assayed according to the method of (Aebi, 1984).

RESULTS

Morphology



Figure 1 (Morphology of *Allium cepa*)

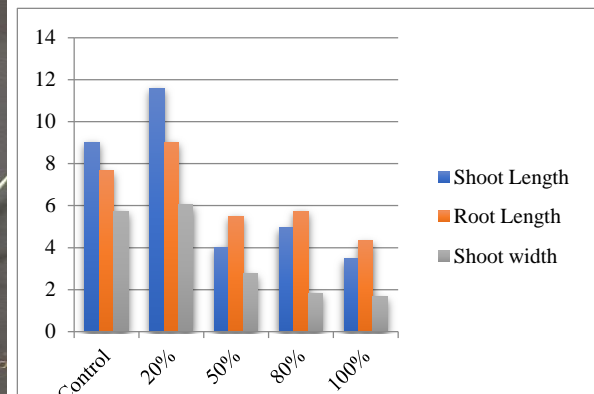


Figure 2 (Morphological characteristics of *Allium cepa*)

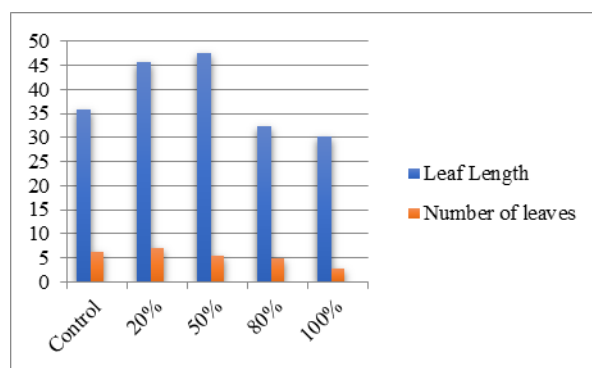


Figure 3 (Characteristics of *Allium cepa* leaves)

Biochemical Study

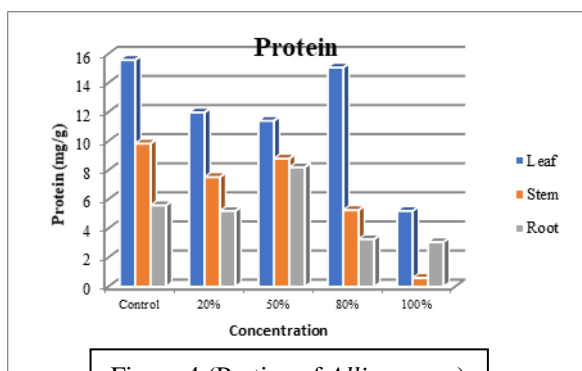


Figure 4 (Protein of *Allium cepa*)

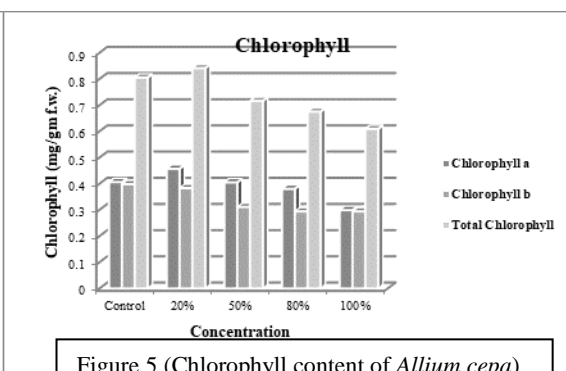


Figure 5 (Chlorophyll content of *Allium cepa*)

Enzymology

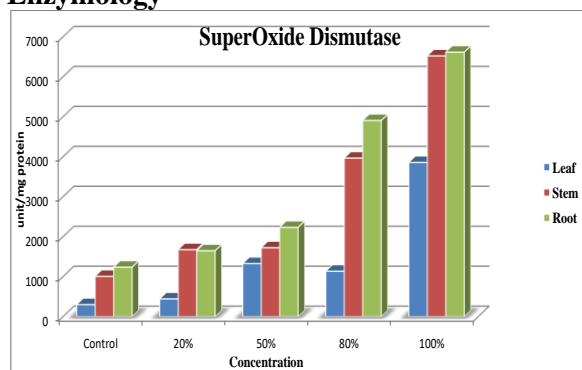


Figure 6 (SuperOxide Dismutase)

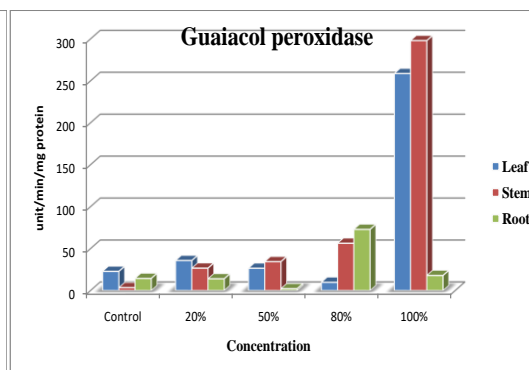


Figure 7 (Guaiacol peroxidase)

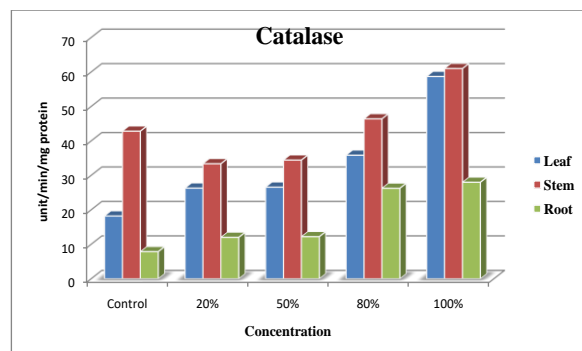


Figure 8 (Catalase)

Discussion:

Morphology

Fly ash affected on plant growth, pigment, protein content and enzymes in different ways. Fly ash contains useful nutrients, that is why the addition of fly ash enhance the availability of the micro and macro elements for plants.(Navneet Sharma and Dinesh Kumar Singh, 2016).Onion plants showed enhanced growth in 20% Fly Ash concentration. (Figures 1,2,3). Some properties of soil like water holding capacity, ion exchange

capacity and soil porosity also increased with addition of vermicomposted Fly ash to the soil. These improvements in the soil lead to enhanced growth of plants. (Kamal Singh *et al*, 2010). The higher concentration of Fly ash in the soil led to stress condition in the plants, thus the growth of plants grown in 80% and 100% of concentration showed the restricted growth. (Figures 1,2,3). Whereas,50% of Fly ash concentration showed slightly decreased or almost similar growth to that of the control and 20%.

Biochemical Study

Increased concentration of Fly ash in soil enhanced the protein concentration in Leaf and Stem of plants (Figure 4), but the extreme higher concentration of Fly Ash restricted the protein concentration. This took place because of the stimulatory and inhibitory effects. Increased protein content at lower concentration might be due to optimum amount of nitrate and potassium. Protein content at higher concentration might be inhibited because of the toxic effects of the metals present in fly ash. (Pramod *et al.*, 2015.) Increased amount of chlorophyll at lower concentration (Figure 5) might be because of the presence of favorable nutrients in vermicomposted Fly Ash. The metals like Magnesium, Zinc and Iron present in Fly Ash are essential for chlorophyll pigments. However, these elements crossed their optimum limits in higher concentrations and acted as toxicants, so the pigment concentration gradually dropped with higher concentration of Fly Ash. (Tanushree Bhattacharya *et al.*, 2015).

Enzymology

In presence of heavy metal ions, the hydroxyl radicals are formed from H₂O₂. The unsaturated fatty acid component of membrane lipids is highly susceptible to these [•]OH radicals and peroxidised in its presence. The mechanism adopted by plants to cop up with the free radicals and peroxides include three anti oxidative enzymes: SOD, Catalase and Guaiacol peroxidase. They are important in oxidative stress response of plants. These enzymes have specific functions in normal conditions. (Gaurav Kumar Singh, 2014). These enzymes generally increased in stress condition and at the extreme stress condition, the amount tends to suppress. (Randy Allen, 1995). The gradual increase was observed in SOD and CAT, which showed that the stress responsive mechanism was working to prevent the plants from stress. Whereas, the drastic increase in Guaiacol peroxidase activity indicated the weakening of H₂O₂ scavenging system due to extreme stress condition. An increase in SOD, CAT, APX has also been reported in other heavy metal treated plants by many authors. (Zhou ZS *et al.*, 2008). At higher concentrations or at longer exposures of heavy metals, ROS production occur which results into decrease of enzyme activity. (Malecka A. *et al.*, 2012).

Conclusion:

From the above research it can be concluded that the lower concentration of vermicomposted Fly Ash

is beneficial to the plant growth and yield whereas, the higher concentration can be harmful for the plants. The ideal concentration for the better plant growth from the conducted research is 20% of Fly Ash.

Acknowledgement:

This work was carried out at Department of Bioscience, Veer Narmad South Gujarat University, Surat and funded by UGC-BSR JRF programme.

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How to cite this article

Raval Rucha U, Patel Kailash P, Jadav Rajendra and Reddy M. N., 2018. Effects of Vermicomposted Fly Ash on Morphological and Biochemical attributes including Anti Oxidant Enzymes of *Allium cepa* L.. *Bioscience Discovery*, **9**(1): 166-170.