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Utilization of Fly Ash to Improve Biochemicals Constituents of *Triticum Aestivum* (Wheat)

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Abstract: ***In the present study, we tried to assess the feasibilities of possible effective and safe utilization of fly ash as soil amendment in north Rajasthan wheat field and its impact on wheat plants, especially at Biochemical (Protein, Starch and Phenol) properties. Our results showed that various concentration of FA (2 to 20 %) amendments have significantly improved the Biochemical properties of wheat. Experimental examination shows a best result in wheat physiological response on 12% fly ash from vegetative part of wheat. It was revealed that the application of fly ash has a positive effect on biochemical properties of Triticum aestivum.***
Keywords: Fly ash, Biochemical properties, Wheat and Soil

I. INTRODUCTION

Fly ash is a residue resulting from pulverized coal combustion. The Indian coal constitutes about 30-40% fly ash after complete burning (Kumar et al., 2000). Its generation in the country has increased from 40 Million ton (MT)/yr (1994) to about 235 MT/yr (2013). It is projected to be 325 MT/yr (2016-17), 500 MT/yr (2021-22) and 1000 MT/yr (2031-32). This large volume of fly ash occupies large area of land and possesses threat to environment. As such, there is an urgent and imperative need to adapt technologies for gainful utilization and safe management of fly ash on sustainable basis. Use of fly-ash as a carrier in these formulations is an effective way of utilization of problematic fly-ash waste in a useful manner. Fly-ash has great potentiality in agriculture due to its efficacy in modification of soil health and crop performance.

A. Physico-chemical Characteristics of Fly Ash

The fly ash, obtained from Suratgarh Thermal Power Plant, was analyzed by different methods. The texture of fly ash in relation to particle size was determined by hydrometer method (Allen et al., 1974). The pH was measured with the help of pH meter after obtaining an extract from fly ash and water suspension in the ratio of 1:1 (w/v). Total organic carbon, total nitrogen, and total phosphorus were analyzed by Degtjareff method (Walkey and Black, 1934); Microkjeldahl method (Nelson and Sommers, 1972) and Molybdenum blue method (Allen et al., 1974), respectively. The equipment was calibrated at the beginning and end of each testing session by injecting various volumes of standard solutions by the analyst.

Wheat is the second most important food crop of the country after rice both in area and production. The total area under the crop is about 29.8 million hectares in the country. India stands second in the production of wheat in the world contributing over 13 percent of the total area and 12 percent of the total production of wheat in the world. Wheat is a species of Poaceae Family and it has caryopsis fruit. In India, it is a winter crop grown in Rabi season with a temperature between 10-l5°C and rainfall between5-15cm. Wheat cropping season is from October-November to March-April in Rajasthan. There are many species of wheat which together make up the genus *Triticum* the most widely grown is common wheat (*T. aestivum*). Fly ash has similar physicochemical properties with soil. Fly ash can mix homogeneously and improve agronomic properties of soil (Change et.al 1979). The physicochemical properties and biological properties of soil were improved by fly ash at proper amendment lead to improving the productivity. Application of fly ash in soil improved the physicochemical properties of soil viz., bulk density, porosity and water holding capacity. Fly ash has tremendous potential as a nutrient supplement and plays a favourable role in increasing growth and yield (Ahmad & Ton 1986). Fly ash is the treasure of trace elements. It makes the trace element readily available to the crop when mixed with soil (Bharud 2002 & Change et.al 1979). Fly ash was established as a source of essential plant nutrients like calcium, magnesium, potassium, phosphorus, copper, zinc, manganese, iron, boron and molybdenum (Sengupta 2002) as well as a rich source of micronutrients (Doran and Martins, 1972 and Page et al., 1979). Growing body of evidence suggests that fly ash contains many essential and micronutrients that are required for agricultural production (Hill and Lamp 1980; Weinstein et al. 1989; Kalra et al., 1997). Physically fly ash occurs as very fine particles having an average diameter or less than 10 mm, low to medium bulk density, high surface area and very light texture.

Chemically the composition of fly ash from the thermal power station consists of oxides of Si, Al, Fe and Ca and about 0.5 to 3.5 per cent consists of Na, P, K and S and the remainder of the ash is composed of trace elements. In fact, fly ash consists of practically all the elements present in soil except of organic carbon and nitrogen. Thus, it was found that this material could be used as an additive or amendment material in agriculture applications (Rautoray et al. 2009).

B. Effect of fly ash on Development of Crops

The effect of fly ash application in various crops has been investigated on crop production for quantity and quality products for safe human consumption (Doran and Martins, 1972 and Page et al., 1979). Fly ash application was found to be beneficial in cereals (Plank et al. 1975 Vipin and Singh, 2010; Zhi et al 2011), pulses and oil seeds (Thanunathan et al.,2001; Manisha et al. 2010; Patil et al., 2010; Shou Chen et al., 2011), vegetables (Bharud et al., 2002; Prasanthrajan and Kannan 2007; Rizvi and Khan 2009; Patil et al., 2010; Zhi et al. 2011) and in tree species (Sudha and Dinesh, 2010; Pourrut et al., 2011).Effect of fly ash on growth and development of crops were reported from 1975.

Plank et al. (1975) conducted a field investigation to study the effect of a weathered fly ash sample on yield and nutrient concentration of corn (*Zea mays* L.) and to determine rates of fly ash that could be applied to soils without adversely affecting plant growth.

The weathered fly ash used for study could be applied to soils at cumulative rates of 288 metric tons/ha without inimically affecting crop growth (Plank et al., 1975).

Treatments of coal ash at 100 g/kg or calcium carbonate at 1.0 g/kg promoted the height, bearing spikelets, grains per spike, 1000 grains weight and yield of wheat (Patil et al., 2010). In cotton -wheat cropping system, in light textured soil, application of fly ash during the first year increased the seed cotton yield and there was a residual beneficial effect on subsequent wheat crop (Singh et al., 2009).

Applications of coal fly ash increased the shoot dry weight and significantly increased foliar and stem N, P, and K content in spring wheat at harvest compared with the control (Zhi et al., 2011).

II. MATERIAL AND METHODS

A field experiment was conducted during the Rabi season of 2016-17 in the pots in Sri Ganganagar District to study the efficacy of fly ash as fertilizers on wheat plants, especially at Biochemical (Protein, Starch and Phenol) properties.of wheat (*Triticum aestivum*). The fly ash used in this study collected from the Suratgarh Thermal power plant (TPP) Sriganganagar, Rajasthan, India. The soil was collected from the test field form 30 cm from organic places before sowing and after harvest, air dried, sieved (<10 mm) and analyzed for physicochemical properties.

The observations on the crop were recorded at pre-harvest 30, 60, 90 days after transplantation (DAT) and at maturity in January 2017 on Biochemical (Protein, Starch and Phenol) parameters. Protein, Starch and Phenol are the essential and important components of plants.

Biochemical assay protein content of plant leaves was estimated by Lowry's method using BSA stock solution, analytical reagent Alkaline Na_3C0_3 and Folin-Ciocalteau reagent for preparing leaf extract properties. Sugars are first extracted treating the finely powdered dried grains or leaves sample repeatedly with 80% alcohol. The residue is then treated with cold perchloric acid to solubilise starch.

After filtration, starch in the perchloric acid extract is hydrolyzed to glucose in hot acidic medium, which undergoes dehydration to hydroxyl methyl furfural, this condenses with anthrone to give a blue coloured complex and is determined quantitatively by anthrone-sulphuric acid. Estimation of phenol with folin-ciocalteu reagent is based on the reaction between phenol and an oxidizing agent phospomolybdate, which result in the formation of a blue complex. The intensity of the coloured is measured in a spectrophotometer.

III. RESULT AND DISCUSSION

The impact of different concentration of fly ash in soil on Wheat plant Protein, Starch and Phenol content were analyzed and the results are presented in Table 1. Protein, starch and phenol contents also decreased significantly with increasing concentrations of FA as compared to that of the control at 50 days. Maximum Protein and starch showed in 12% fly ash with soil (Protein2.387 µg/gm) (Table 1, Fig.1), maximum starch showed in 12% fly ash with soil (starch 0.426 µg/gm) (Table 1, Fig.2), maximum Phenol showed in 10% fly ash with soil (Phenol 0.237 µg/gm) (Table 1, Fig.3).

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Table1. Effect of different concentration Fly ash incorporation in soil on other Biochemical status of the wheat crop (2016-2017)

Treatment	Protein	Starch	Phenol
Control (Soil)	1.379	0.308	0.176
Fly ash (2%)	1.17	0.381	0.189
Fly ash (4%)	0.281	0.383	0.195
Fly ash (6%)	0.296	0.395	0.199
Fly ash (8%)	1.797	0.377	0.221
Fly ash (10%)	1.312	0.378	**0.237**
Fly ash (12%)	**2.387**	**0.426**	0.186
Fly ash (14%)	2.175	0.338	0.2
Fly ash (16%)	2.288	0.283	0.205
Fly ash (18%)	1.445	0.327	0.187
Fly ash (20%)	0.236	0.31	0.138

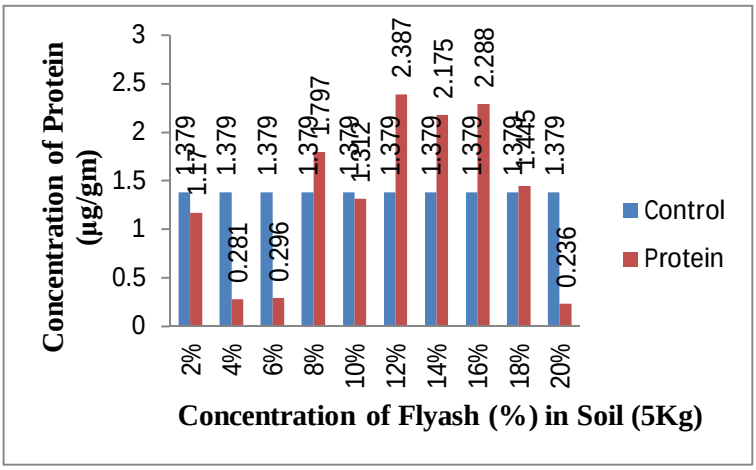

Fig.1 Standard Graph of Protein estimation

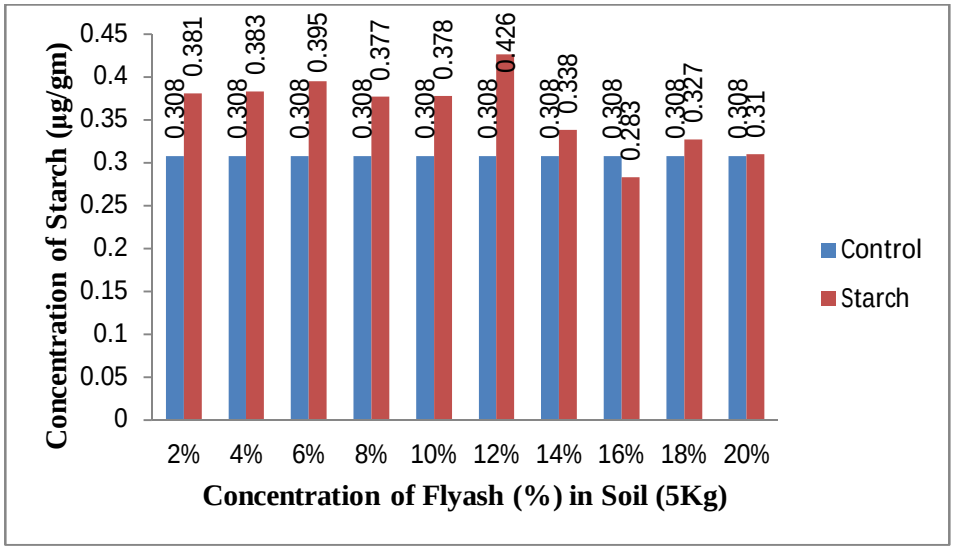

Fig.2 Standard Graph of Starch estimation

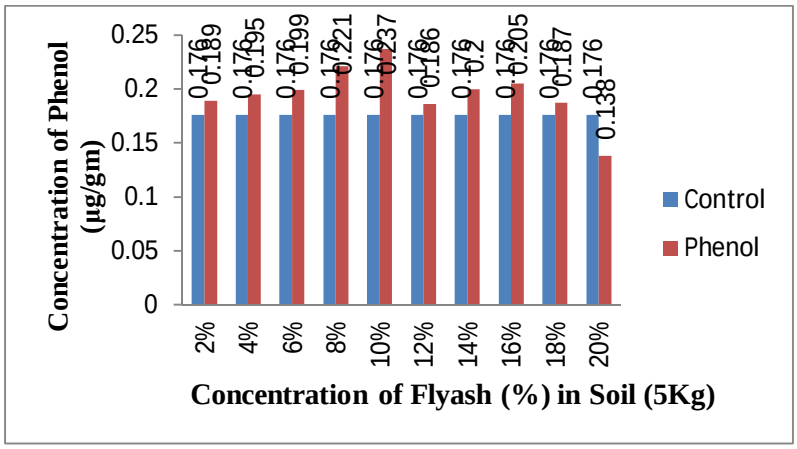

Fig.3 Standard Graph of Phenol estimation

In the present study, no visible injury symptoms were observed in any of the treatments during the growth and development of wheat plant. Fly ash application in soil improved the growth of rice and maize up to certain treatments and after that, fly ash concentration caused deleterious effects on the plant growth. In our study, 12% fly ash levels proved to be optimally useful for the plant growth. The observed responses of the plants are also supported by other workers, like Bharti et al., on green gram; Pathan et al., on *Cynodon dactylon* (L.) Pers, Cv Wintergreen; Parveen et al., on *Mentha citrata*; Hisamuddin and Singh, on *Pisum sativum*. Their findings indicated that the concentration of fly ash for better plant growth varied from plant to plant. Based on the experiment, it can be concluded that there is an ample scope for the safe utilization of fly ash in agriculture without serious deleterious effects.

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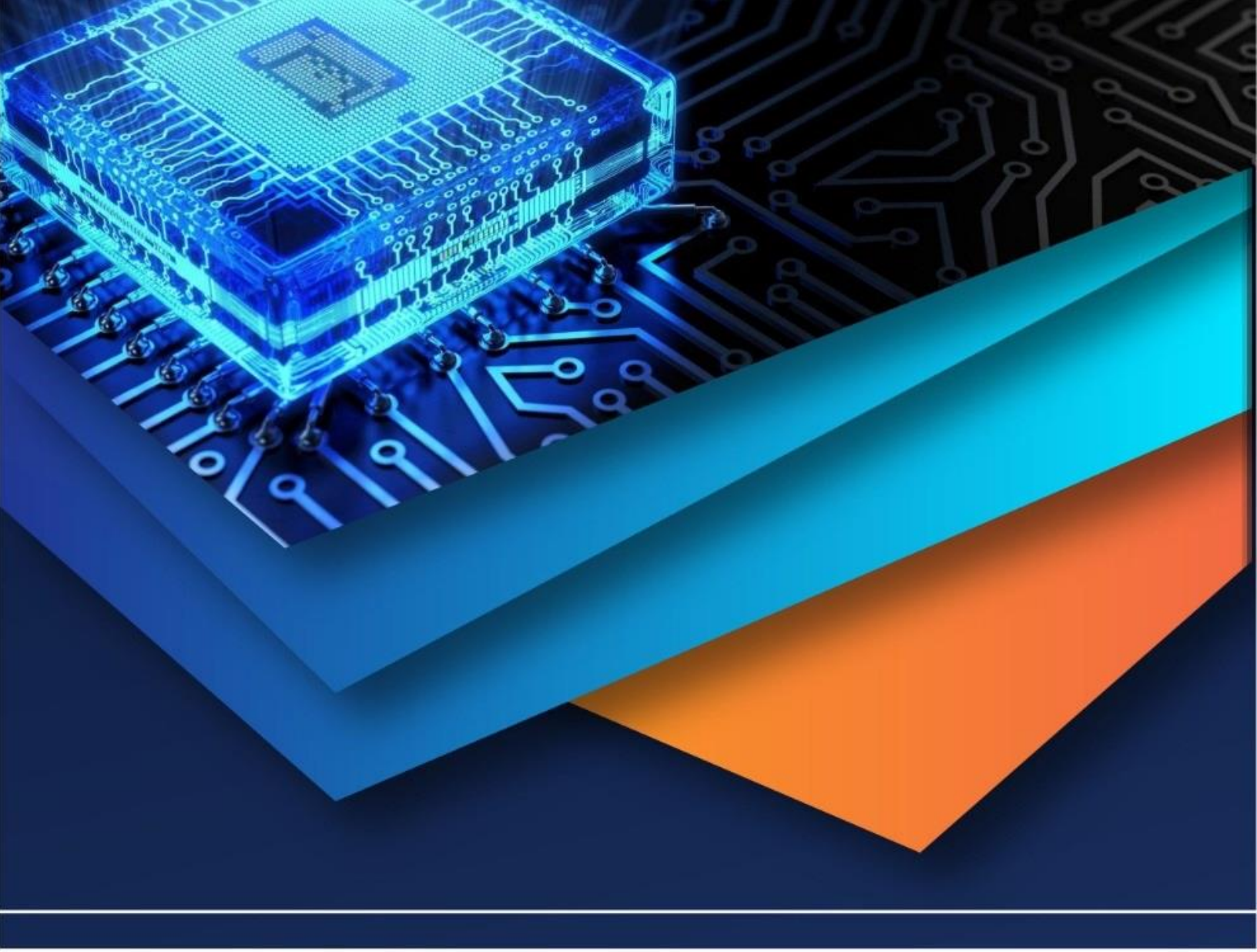

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