Journal of Agroecology and Natural Resource Management
p-ISSN: 2394-0786, e-ISSN: 2394-0794, Volume 6, Issue 1; January-March, 2019, pp. 9-12
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http://www.krishisanskriti.org/Publication.html

The Impact of Fly ash Application on the Carbohydrate Content of Wheat (*Triticum aestivum*)

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Abstract—*Fly ash is a waste material predominantly generated in the production of electricity. Thermal power plants use pulverized coal as a fuel source to generate power by obtaining fly ash as a by-product. 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). If it is not used then it would pose a threat for air and water pollution. In India landfill covers a vast area thus depleting the land for agricultural use (Ahmaruzzaman, 2010). In the present study, we tried to assess the feasibilities of possible effective and safe utilization of fly ash as a soil amendment in north Rajasthan wheat field and its impact on wheat plants, especially at Biochemical carbohydrate properties. Fly ash addition to the soil in different doses improves carbohydrate concentration beneficial for a wheat plant. Experimental examination shows the best result in wheat physiological response on 12% fly ash from vegetative part of wheat.*

Keywords: *Fly ash (FA); carbohydrate; Sustainable agriculture; Soil; Wheat.*

1. INTRODUCTION

Fly ash consists mainly of amorphous glass and a few crystalline phases. The crystalline phases of fly ash consist gypsum ($CaSO_4$ $2H_2O$), aluminosilicate glass, mullite ($3Al_2O_3$ $2SiO_2$), quartz (SiO_2), magnetite (Fe_3O_4), anhydrite ($CaSO_4$), ettringite ($3CaO$ Al_2O_3 $3CaSO_4$ $32H_2O$), opaline SiO_2, hematite (Fe_2O_3), lime (CaO), chlorite, feldspars and spinel ($_{FeAlO4}$) depending on the mineralogy of the feed coal [10, 17]. The degree of soil pH change on FA application is dependent on the factors like the difference between the pH of FA and soil, the buffering capacity of the soil, and the FA capacity as determined by the amount of CaO, MgO, and Al_2SiO_5 present[26]. FA improves the physical properties of soil and nutrient status of soil [20]. FA has been used for the correction of sulfur and boron deficiency in acid soils [1]. Elemental composition of FA (both nutrient and toxic elements) varies due to types and sources of used coal [3]. Its use in agriculture was initially due to its liming potential and the presence of essential nutrients, which promoted plant growth and also alleviated the nutrient deficiency in soils [19]. Although, the lower levels of FA in the soil caused enhancements of both growth and yield, however, the adverse effects at higher levels were observed for crops [16]. The effect of FA on soil fertility largely depends upon the properties of original coal and soil. FA, which can be acidic or alkaline depending on the source, can be used to buffer the soil pH [7]. An extensive variation in the BD of FAs (0.81–1.16Mg/m3) [2, 22), was observed. A marked decrease in the BD of a variety of agricultural soils (1.25–1.65 mg/m3) after FA addition [18], and improvement in soil property, workability, WHC, and permeability of different soil types after the decrease in their BD on FA improvement are well recognized. Soil moisture is a key variable of the climate system which has impacts on water, energy, and biogeochemical cycles. FA helps to preserve soil moisture [23]. Lime in FA readily reacts with acidic components in soil and releases nutrients such as S, B, and Mo in the form and amount beneficial to crop plants. The low dose rate of fly ash increased chlorophyll contents significantly [4]. The chlorophyll alkalinity caused soluble salts on the leaf surface [6]. Nowadays in India, the use of fly ash in agriculture has become of much concern. Therefore, an attempt was made to summarize the information available on the effect of fly ash on soil properties and crop growth.

Wheat is the staple food of millions of people, being one of the three globally produced Cereals (Maize and Barley being the other two). Although rice is the second largest produced cereal in the world, its production is localized to Western and Eastern Asia. 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 which is a by-product of Thermal power plants also plays an important role and combination of fly ash mixed with soil. Fly ash has similar physicochemical properties with soil. Fly ash can mix homogeneously and improve agronomic properties of soil. Therefore, the present study was carried out to evaluate the beneficial dose of fly ash that will help increases crop productivity without any loss.

2. MATERIAL AND METHODS

A field experiment was conducted during the Rabi season of 2017-18 in the pots in Sri Ganganagar District to study the efficacy of fly ash as fertilizers on carbohydrate 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 2018 on Biochemical carbohydrate. Carbohydrate is an essential and important component of plants. The biochemical assay carbohydrate content of plant leaves was estimated by the Anthrone method.

Principal

Carbohydrates are dehydrated with concentrated H_2SO_4 to form "Furfural", which condenses with anthrone to form a green color complex which can be measured by using colorimetrically at 620nm (or) by using a red filter. Anthrone reacts with dextrins, monosaccharides, disaccharides, polysaccharides, starch, gums, and glycosides. But they yields of color where is to form carbohydrate to carbohydrate.

Regents

Anthrone reagent: Dissolved 200mg of anthrone reagent in 100ml of concentrated H_2SO_4.

Standard Glucose solution: a) Stock standard: Weigh 100mg of Glucose and transfer it carefully into a 100ml with Distilled water.(100mg of Glucose in 100ml of Distilled water). **b) Working standard:** Dilute 10ml of stock standard solution in 100ml with distilled water in a volumetric flask.

Procedure

To take 0.2 to 1ml of working standard solution of five different test tube and added water to bring the volume to 1ml in each test tube added 4ml of anthrone reagent and mixed the contents as well and covered the test tube with bath for 10 min then cool the test tube to the room temperature and measured the optical density in a photoelectric colorimeter at 620nm (or) by using a red filter. Simultaneously prepared a blank with 1ml of distilled water and 4ml of anthrone reagent. Constructed a calibration curve on a graph paper, by plotting the glucose concentration (10 to 100mg) on x-axis and absorbance at 620nm on the y-axis.Computed the concentration of the sugar in the sample from the calibration curve. While calculating the sugar concentration in the unknown sample, the dilution factor has to be taken into account.

Plant Material Preparation and Extraction

The fresh plant was collected and washed with running tap water followed by double distilled water. It was subjected to extraction by phosphate buffer.10gm of each leaf; stem and rhizome were macerated with 50ml of phosphate buffer using mortar and pestle and filtered using what man filter paper by centrifuging at 4000 rpm for 20 minutes by discarding the palate. The above steps were performed for each leaf, stem and rhizome samples separately until a clear extract was obtained. The extract was stored in a refrigerator for further use.

3. RESULT AND DISCUSSION

The impact of different concentration of fly ash in soil on Wheat plant carbohydrate content was analyzed and the results are presented in Table 1. Total carbohydrate content also decreased significantly with increasing concentrations of FA as compared to that of the control at 50 days. Maximum carbohydrate showed in 12% fly ash with soil (carbohydrate 0.800 µg/ml) (Table 1, Fig.1).

Table 1: Effect of different concentration Fly ash incorporation in soil on another Biochemical status of the wheat crop (2017-18)

Treatment	**Carbohydrate (µg/ml)**
Control (Soil)	0.371
Fly ash (2%)	0.592
Fly ash (4%)	0.691
Fly ash (6%)	0.649
Fly ash (8%)	0.75
Fly ash (10%)	0.755
Fly ash (12%)	**0.800**
Fly ash (14%)	0.732
Fly ash (16%)	0.423
Fly ash (18%)	0.413
Fly ash (20%)	0.354

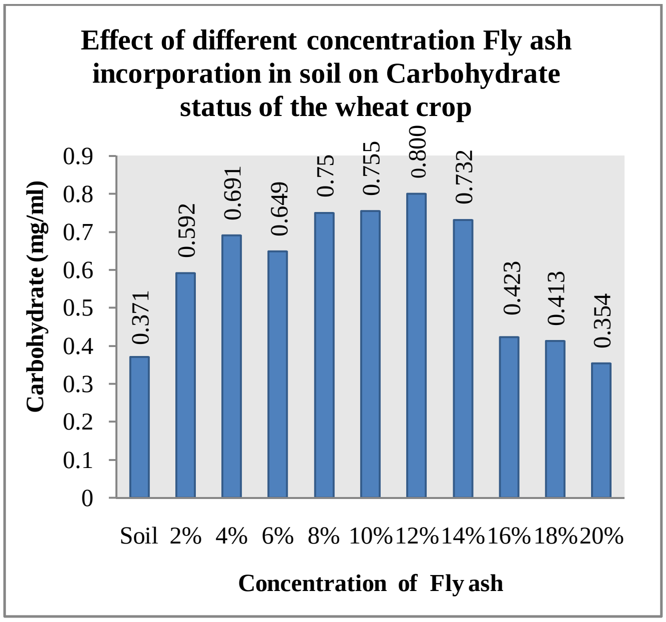

Fig. 1: Standard Graph of Carbohydrate estimation

Similar observations were made for cotton and wheat grain yield with 20% fly ash which increased N, P and K nutrients and increased the growth and yield [24]. Dry biomass yield of ryegrass, tomato, and growth of spinach significantly increased with fly ash application of acid soils [13]. Maize and soybean receiving fly ash through aerial spray with different doses increased leaf area and metabolic rate, as well as photosynthetic pigments and dry matter compared with their respective controls [15]. An enhancement in protein content due to fly ash application in soybean, wheat, gram, sorghum, and maize [8, 9]. A significant increase in the plant root biomass and nutrient content upon FA addition to soil [25] and higher nutrient concentrations (K, Ca, Mg, S, Zn, and B) in Brassica grown on soils treated with FA-amended compost as compared to control values were inferred. A significant increase in the nutrient uptake of oilseed crops and improvement in the fertility status of soil after the FA application were noticed. FA application improved the Si content of rice plants [11]. Fly ash has also been viewed as a source of plant nutrients such as calcium (Ca), boron (B), sulfur (S), and molybdenum (Mo)[21]. In our study, 12% of fly ash levels proved to be optimally useful for plant growth. Through a lot of research has been done on the use of fly ash in meliorating poor physical conditions and· nutritional deficiency of different soils for various crops. There was uncertainty as to the rates of coal fly ash needed for optimum physiological processes and growth. Addition of 10 t ha-1 fly ash increased growth rates and concentrations of chlorophylls a and b, but reduced carotenoid concentrations in barley (*Hordeum vulgare*) and ryegrass (*Secale cereale*) canola (*Brassica napus*), radish (*Raphanus sativus*), field peas (*Pisum sativum*), and Lucerne (*Medicago sativa)* [27]. Transpiration in barley was increased due to fly ash application [27]. Investigation studies of fly ash with fertilizers and organic manures may give a better understanding of its use of sustainable crop production.

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