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EFFECT OF FLY ASH APPLICATION ON THE CHLOROPHYLL CONTENT OF WHEAT (*Triticum aestivum)*

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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 demand large area of land for ash ponds and would pose a threat for air and water pollution. Fly ash utilization has increased from 1 MT/yr during 1994 to 130 MT/year during 2013, primarily as an outcome of concerted efforts under Fly Ash Mission-India. In the present study, it was shown that utilization of fly-ash as a carrier in bio-fertilizer formulations emerged as safe and effective alternatives. 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 similar physicochemical properties with soil. Fly ash addition to the soil in different doses improves photosynthetic pigments concentration beneficial for a wheat plant. We can conclude that though fly ash is a waste of concern but now has become a boon for sustainable agriculture.

Keywords: DAT; Fly ash; Photosynthetic pigments; Sustainable agriculture; Wheat.

Introduction

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 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. It can mix homogeneously and can improve agronomic properties of soil[1]. The high concentration of micronutrient and macronutrient presents in fly ash increases the yield of many crops in the agricultural

field. 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[2]. Fly ash could be successfully utilized to increase the yield of maize crop in terms of growth parameters like plant height, root height, dry matter percentage and chlorophyll and carotene content[3]. Therefore, the present study was carried out to evaluate the beneficial dose of fly ash that will help to increases crop productivity without any loss.

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 phytopigments 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 cropwere recorded at pre-harvest 30, 60, 90 days after transplantation (DAT) and at maturity in January 2017 on phytopigments parameters. Chlorophylls are the essential and important components of photosynthesis. They occur in chloroplasts as green pigments in all photosynthetic plant tissues. Biochemical assay Chlorophyll content of plant leaves was estimated by Arnon's method using 80% acetone for preparing leaf extract[4].

Result and Discussion

The impact of different concentration of fly ash in soil on Wheat plant chlorophyll content was analyzed and the results are presented in Table 1. Total chlorophyll and carotenoid contents also decreased significantly with increasing concentrations of FA as compared to that of the control at 50 days. Maximum Chlorophyll-a showed in 12% fly ash with soil (Chlorophyll-a 0.239 μg/gm) (Table 1, Fig.1), maximum Chlorophyll-b showed in 8% fly ash with soil (Chlorophyll-b 0.045 μg/gm) (Table 1, Fig.2), maximum Chlorophyll-total showed in 12% fly ash with soil (Chlorophyll-total 0.430 μg/gm) (Table 1, Fig.3).

Table 1. Effect of different concentration Fly ash incorporation in soil on Chlorophyll status of the wheat crop (2016-17)

Treatment	Chlorophyll A	Chlorophyll B	Chlorophyll Total
Control (Soil)	0.119	0.021	0.233
Fly ash (2%)	0.125	0.021	0.230
Fly ash (4%)	0.204	0.028	0.298
Fly ash (6%)	0.211	0.041	0.321
Fly ash (8%)	0.135	**0.045**	0.393
Fly ash (10%)	0.192	0.028	0.388
Fly ash (12%)	**0.239**	0.042	**0.430**
Fly ash (14%)	0.219	0.039	0.389
Fly ash (16%)	0.187	0.031	0.293
Fly ash (18%)	0.137	0.028	0.243
Fly ash (20%)	0.163	0.026	0.282

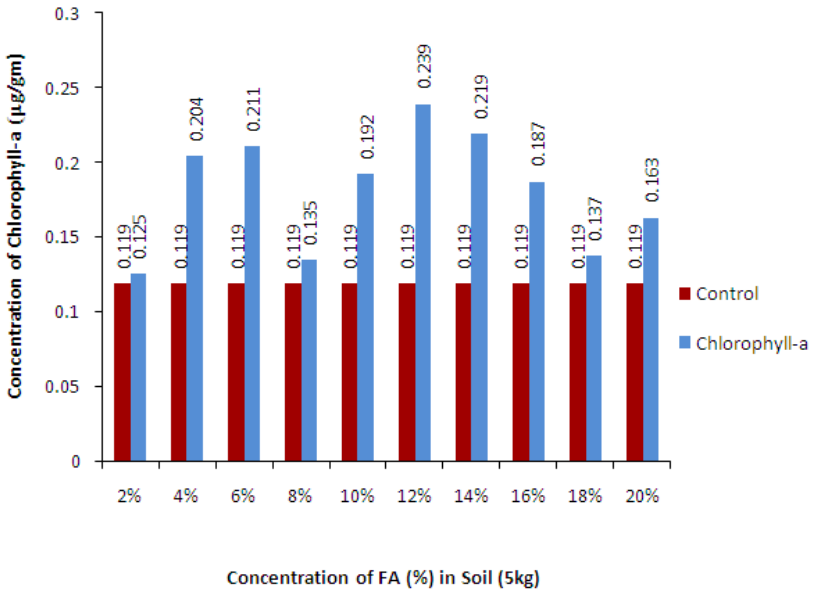

Fig.1 Standard Graph of Chlorophyll-a estimation

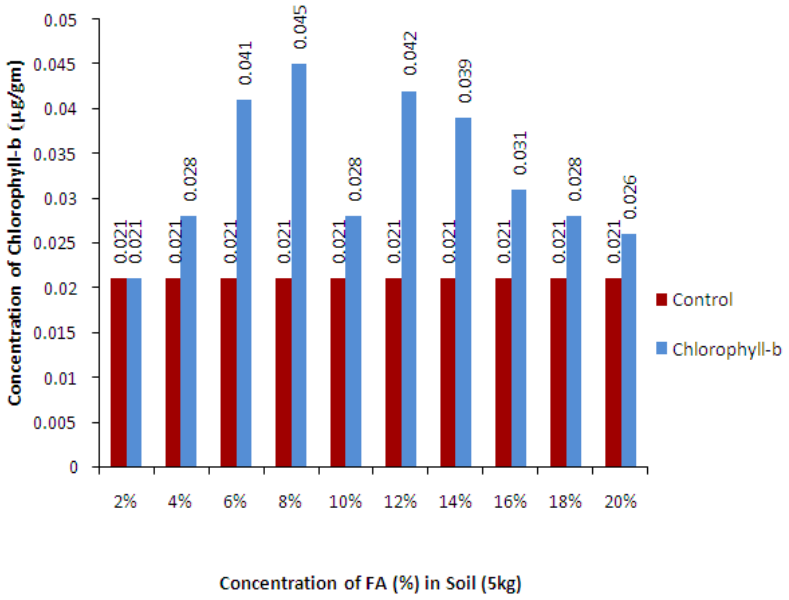

Fig. 2 Standard Graph of Chlorophyll-b estimation

Though the beneficial use of fly ash has been recognized in various areas like in concrete, brick making, soil stabilization treatment and other applications. Flyash having considerable both the soil amending and nutrient - enriching properties as macro and micronutrients is helpful in improving crop growth and yield[5]. The low dose rate of fly ash increased chlorophyll contents significantly[6]. The chlorophyll alkalinity caused soluble salts on the leaf surface[7]. Thus present study Wheat plant chlorophyll content was analyzed and the results are presented like as Maximum

quantity of Chlorophyll-a (0.239µg/gm) was recorded by mixing 12% fly ash in soil, maximum quantity of Chlorophyll-b (0.045µg/gm) was recorded by mixing 8% fly ash in soil, maximum quantity of Chlorophyll-total (0.043µg/gm) was recorded by mixing 12% fly ash in soil, (Table 1, Fig. 1 to 3).

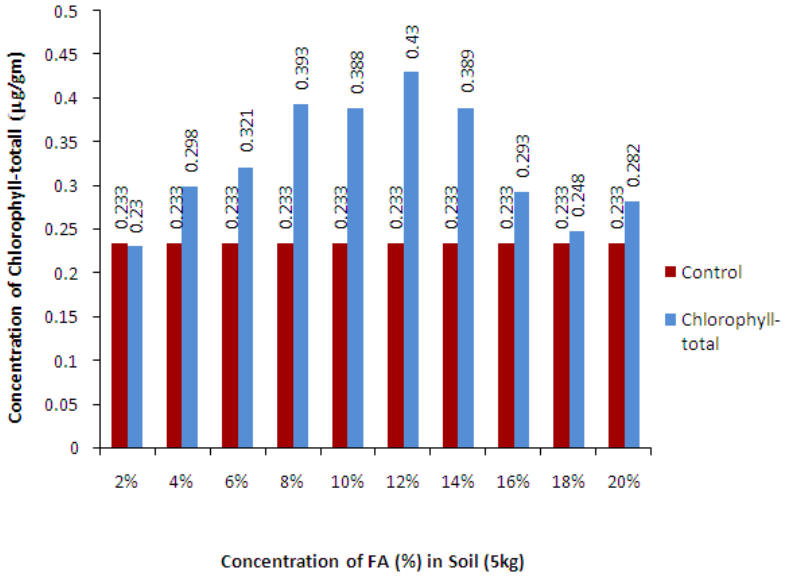

Fig. 3 Standard Graph of Chlorophyll-total estimation

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[8]. Dry biomass yield of ryegrass, tomato, and growth of spinach significantly increased with fly ash application of acid soils[9]. The addition of fly ash in sandy soils as a replacement of P and K fertilizer increased the dry matter production of clover[10]. The plant height of barley and sorghum crops increased in concentration of available mineral nutrients in amended soils[11]. In our study, 12% fly ash levels proved to be optimally useful for the plant growth. Leaf area and leaf pigment content of the treated plants also increased. 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.

Sunflower plant (*Helianthus annuus* L.) plants treated with fly ash exhibited improved growth[12]. Relative growth rate (RGR) and net assimilation rate increased by over 20% at a low fly ash application rate. Leaf area and leaf pigment content of the treated plants also increased. Similarly, *Beta vulgaris* grown in fly ash – amended soil revealed that application of low amount (2%) of fly ash favored plant growth and improved yields[13]. It is also observed that tomato plant grown in fly ash mixture showed luxuriant growth with bigger and greener leaves. Plant growth, yield, carotenoids, and chlorophylls were enhanced in 40- 80 % fly ash amended soils.

At 100% fly ash, yield was considerably reduced[14].

Many researchers added to fly ash in the soil to evaluate the long-term consequences of fly ash on soil environment[15, 16] and crop productivity[17]. Fly ash incorporation in the sandy loam soil (up to 40%) modified the soil environment, mainly moisture retention, release and transmission behavior, pH, EC and organic carbon. The texture of the soil-ash admixture remained sandy loam up to 10% ash application, beyond this level the texture turned to loamy soil. Numerous studies report the impact of fly ash addition on the yields of different crops with either depressions or enhancements in yield [18, 19, 20, 21, 22, 23]. 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[24].

The above study proves that the effect of the quantity of fly ash occurs on the qualities of photosynthetic pigments.

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