



The effectiveness of cyanobacteria mixed with optimum concentration of fly ash, in enhancing starch content in wheat (*Triticum aestivum*)

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Abstract

The present paper deals with the study of starch content of wheat plants. Wheat plants grown with cyanobacteria (*Anabaena* and *Nostoc*) mixed with the optimized fly ash and changes in starch content were investigated. A pot experiment was conducted to study the effect of cyanobacteria (*Anabaena* and *Nostoc*) mixed with fly ash on starch content of the wheat plant. With this biofertilizer starch content of wheat plant get increased. Addition of this biofertilizer to the soil in different doses improves starch content and it is beneficial for wheat plant. Experimental observation revealed the best result in wheat with 12% fly ash mixed with 40% of *Anabaena* and 60% of *Nostoc*. Improvement in the growth of wheat plants was observed. This study revealed that cyanobacteria mixed with fly ash have an excellent potential to increase the Starch content of wheat. This is also helpful in reducing, use of chemical fertilizers in agriculture.

Keywords: fly ash, cyanobacteria, biofertilizer, pot culture experiment

Introduction

Recently, the interest in crop production is centered on using microorganisms, as cyanobacteria, including biofertilizers, which are eco-friendly, can replace chemical fertilizers and offer financial and ecological benefits to farmers. The use of biofertilizer allows farmers to reduce the use of chemical fertilizers and pesticides, which are dangerous to the environment and increase the risk for human health^[1].

Cyanobacteria are one of the significant organisms in reference of the nitrogen fixation^[2]. Flyash (FA) acts as a suitable substrate for the growth of various microorganisms by utilizing trace elements in it acting as a soil ameliorates. FA improves the physical properties of soil and nutrient status of soil^[3, 4].

Research work has been performed on several plants grown with fly ash and cyanobacteria^[5, 6]. Rice and Wheat are most popular cereal as daily food in the world. Wheat is the most cultivated food crop and in India it is the second important staple cereal food grain. As a rabi season crop, wheat played a vital role in stabilizing the food grain production of country. *Triticum aestivum* is currently grown in India in almost agricultural zones. So here wheat is used as experimental plant^[7].

Plants use starch as a way to store excess glucose, which is predominantly present as amylose and amylopectin. All plant seeds and tubers contain starch. Dietary starch is present in many staple foods, such as maize, rice, wheat, potatoes, cassava, barley, rye, taro, yams, etc. Starch provides about 4.2 kilocalories per gram. In humans, starch may serve as a major source of glucose. Glucose is essential as it is involved in general metabolism, e.g., glycolysis (for energy synthesis), glycogenesis (for glycogen synthesis), pentose phosphate pathway (for pentoses and NADPH syntheses for use in nucleic acid synthesis and lipid synthesis, respectively)^[8].

Present research work was performed to assess the ability of *Anabaena sp.* and *Nostoc sp.* (cyanobacteria), as biofertilizers, to study the starch content of wheat plants, under conditions of optimum use of fly ash, to decrease the use of chemical fertilizers and environment pollution.

Material and Methods

Sample collection of fly ash

Fly ash was collected from a coal-based thermal power plant of the Suratgarh Thermal Power Plant (STPP) located at Suratgarh, Sriganganagar, Rajasthan (India). Fly Ash is a by-product of goods being generated from thermal power plants from pulverized coal combustion.

Sample collection of soil

For the experimental work, soil was collected from the agricultural field up to 20 cm. Before utilization, the soil was sterilized. The autoclaved soil was dried and then mixed with 12% fly ash in soil^[9, 10].

The objective of this study is to determine the effect of the cyanobacteria (*Nostoc* and *Anabaena*) on starch content of wheat plant grown in soil mixed with optimum concentration of fly ash.

Pot Experiment

Surface sterilized wheat grains were planted in pots filled with soil. Wheat seeds were thoroughly washed with sterile distilled water before sowing in the Pot. Cultures of *Anabaena* and *Nostoc* were used to mix with soil having optimized concentration of Fly ash i.e. 12%^[9, 10]. Pots were divided into ten groups as group 1-10 (12% fly ash mixed soil with 10%-100% cyanobacteria; *Anabaena* & *Nostoc*) respectively, the experiment was conducted on wheat for biochemical analysis to study changes in its starch content. In each experiment, the initial control set to be organic soil with 12% flyash and then there are pots having 10-100% concentration of *Anabaena* and *Nostoc*.

Each plant soil-combination was a separate completely-randomized experiment consisting of five replications. The experiment was performed in October-November. Plants were irrigated with water. Samples were harvested 45 days after planting.

Biochemical Analysis of Wheat

All the samples were analyzed for starch concentrations as per method suggested by Anthrone Reagent Method (Hansen and Moller, 1975) [11].

Experimental Observation

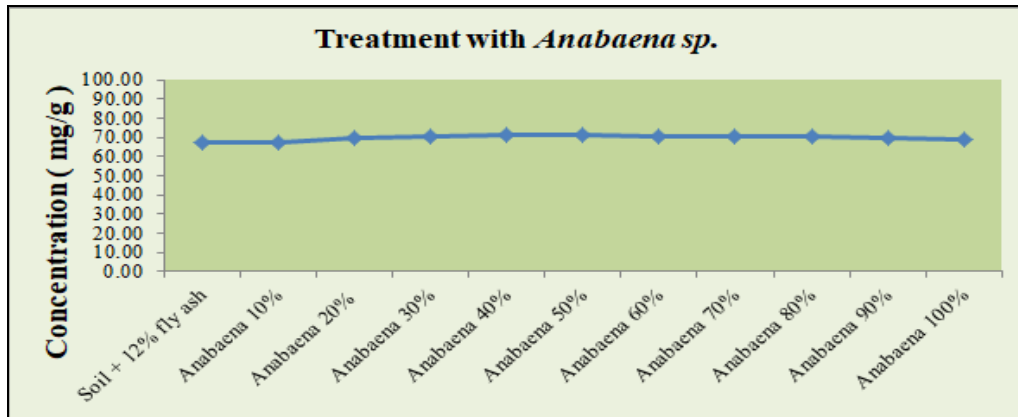


Fig 1: Influence of different concentrations of *Anabaena sp.* for determination of Starch in Wheat

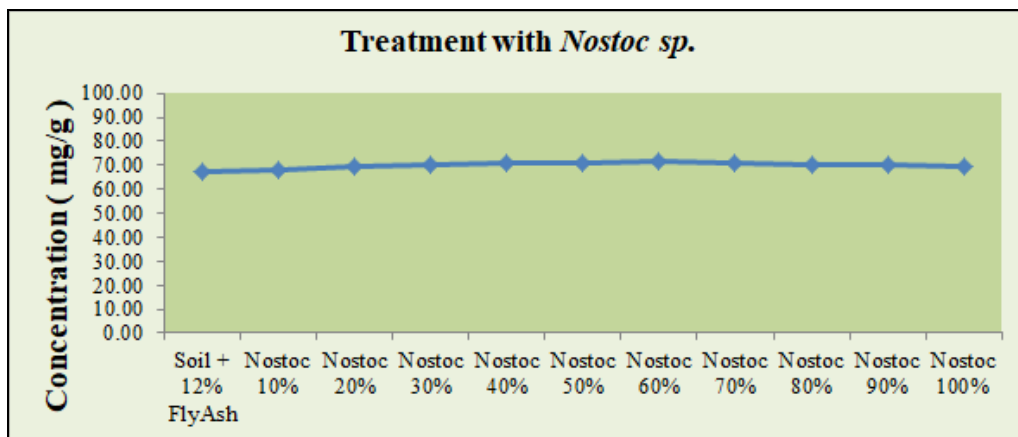


Fig 2: Influence of different concentrations of *Nostoc sp.* for determination of Starch in Wheat

Result and Discussion

The impact of different concentrations of cyanobacteria (*Anabaena* and *Nostoc*) on Starch content of wheat plants was analyzed and the results (Fig. 1,2) were obtained.

Maximum Starch showed in 12% fly ash mixed soil with 40% of *Anabaena sp.* (Starch 71.23 mg/g (Fig.1), maximum Starch showed in 12% fly ash mixed soil with 60% of *Nostoc* (Starch 71.40 mg/g)(Fig.2). A significant increase in Starch content of wheat plants was observed.

Similar results were obtained by Tiedemann *et al.* (1980) [12], Pachpande (1990) [13] and Nanda *et al.* (1991) [14]. These authors reported that soaking seeds of cucumber and pumpkin with extract of *Westiellopsisprolifera*, an N₂-fixing cyanobacterium, promoted germination and their subsequent growth and development. Researchers indicate that the biofertilizer with cyanobacteria can increase rooting of grapes cuttings and germination of sunflower seeds and improve plant growth, as observed in rice, barley, oats, tomato, radish, cotton, sugarcane, maize, chili, lettuce, gillyflower, grapevine and corn [15-24]. It is suggested that the increased Starch of plants can be caused by the ability of microalgae to restore soil's natural nutrient cycles, to build soil organic matter and also by enriching plants with various nutrients, hormones and secondary metabolites, which have the crucial impact on growth [25-27]. Efficient atmospheric

nitrogen-fixing strains of cyanobacteria (*Nostoc linkia*, *Anabaena variabilis*, *Aulosirafertilisima*, *Calothrix sp.*, *Tolypothrix sp.* and *Scytonema sp.*) were identified from various agro-ecological regions and utilized for rice production [28]. The growth promotion in response to the application of *Nostoc muscorum* (N-fixing cyanobacteria) could be attributed to the nitrogenous and nitrate reductase activities of the algae applied to the surface of plants, stimulated the growth of plants [29-30].

Fogg (1966) [31] reported that ammonium and amide-nitrogen accounted for most of the total extracellular nitrogen produced by nitrogen-fixing cyanobacteria. The results of this study indicate that the application of cyanobacterial inoculants enhanced the Starch and phenol content of the wheat crop.

Conclusion

Based on this experiment, it can be concluded that starch content of wheat plant shows significant improvement with 12% flyash soil mixed with 40% of *Anabaena sp.* and 60% of *Nostoc sp.* It shows that there is ample scope for the safe utilization of fly ash and cyanobacteria in agriculture without severe harmful effects. The use of organic fertilizers, bio-fertilizers and other microbial products is beneficial because it allows limiting chemical fertilizer application, which is detrimental to the environment.

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