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Studies on the Effects of Flyash and Plant Hormones on Soil Metabolic Activities

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In the present work, flyash, plant hormones have been used in pot experiments on wheat to study their effects in plant growth parameters, protein and amino acid contents.

Key Words: Amino acids, Plant growth parameters, Plant hormones protein, Flyash.

INTRODUCTION

Nearly 26 million hectares of land in India has been found to be acidic (pH 5.6-6.50)[1]. Acidic soil shows Al^{3+} ion toxicity[2] resulting in reduced microorganism activity as well as Ca, Mg, Mo, N and S deficiency. The flyash amended soil shows rise in pH, available phosphorus and organic carbon. Plant growth hormones like indole acetic acid (IAA), gibberellic acid (GA) and α-naphthalene acetic acid (NAA) contributed to increase plant growth parameters. In the present work, increase in protein and essential amino acid contents on the wheat have been investigated.

EXPERIMENTAL

Fresh flyash from NTPC District Korba, India and soil from Mand irrigation project area were dried and mixed homogeneously for pot experiments. Pot experiments done in triplicate. The scheme of pot experiments has been described in the Table-1. The analytical determination methods for the analysis soil were performed according to the previously described methods[3-11]. The physical properties and trace elements in the soil and flyash combinations are given in the Table-2, wheat variety used for present studies is Lerma roso.

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TABLE-1
FLYASH AND THEIR VARIOUS COMBINATIONS

S. No.	Combinations	Symbols used
1	Plain soil	**A**
2	90 % Soil + 10 % Flyash + NPK (600:400:200 g) + IAA + GA + NAA	**B**
3	80 % Soil + 20 % Flyash + NPK (600:400:200 g) + IAA + GA + NAA	**C**
4	70 % Soil + 30 % Flyash + NPK (600:400:200 g) + IAA + GA + NAA	**D**

TABLE-2
PHYSICAL PROPERTIES AND TRACE ELEMENTS COMPOSITION OF SOIL AND FLYASH COMBINATIONS

S. No.	Symbols	pH	Electrical conductivity (mmhos/cm)	Trace elements concentration (ppm)		
				Zn	Mo	B
1	**A**	6.45	0.97	69	0.04	0.30
2	**B**	6.77	1.40	75	0.05	0.35
3	**C**	6.90	1.90	84	0.06	0.40
4	**D**	6.90	1.90	84	0.06	0.40

RESULTS AND DISCUSSION

In the present work, it has been found that flyash amended soil regulates soil pH and helps to increase trace elements resulting in improvement of plant growth parameters as observed by previous workers[12,13]. Two wheat varieties, namely - Thorn and Redcoat showed different tolerance to Al^{3+} toxicity due to soil acidity[14]. Soybean (*G. max*) also shows retarded plant growth parameters[15].

Adequate quantity of NPK increase vegitative growth. Flyash optimizes soil pH and makes trace elements uptake possible by the wheat plant. Flyash amended soil shows increased soil metabolic activities resulting in increase in plant growth parameters.

After flyash application, availability of organic carbon, organic matter, P, N increases and biochemical properties of flyash amended soil are improved (Table-3). The use of plant hormones namely IAA, GA and NAA promote flowering, cell elongation, respiration and increased water uptake[16].

TABLE-3
IN THE TREATMENT D FOLLOWING RESULTS FROM SOIL WERE OBTAINED

S. No.	Properties	Results
1	Organic carbon (%)	0.52
2	Organic matter (%)	0.75
3	Available P (%)	5.90
4	Available N (%)	0.10
	Biochemical properties after 90 d	
5	Protease activity	32 μg tyrosine/g soil/h
6	Invertase activity	77 μg tyrosine/g soil/h
7	Soil respiration	CO_2 evolved in g/m^2/h
8	Total chlorophyll	12.30 mg/g fresh leaves
9	Protein content	21 %

IAA and NAA increased respiration which is corrleated with increased water uptake and with increased amino acids[17]. Contribution of plant hormones in protein synthesis has been further confirmed by previous workers[18,19]. Concentration of NAA in the order of 1.42×10^{-5} m has been found to double enzymatic activities[20].

Protein hydrolyzate obtained from the seeds of wheat was analyzed by HPLC. It shows the presence of essential amino acids namely leucine phenyl alanine, valine, threonine and methionine (in picomoles). The presence of these amino acids have been further confirmed by their molecular interactions with 50 % aqueous ethanol solution as shown by their respective electronic absorption spectra as shown in Table-4.

TABLE-4
ELECTRONIC ABSORPTION SPECTRA OF L-AMINO ACID -I_2 SYSTEMS IN 50 % AQUEOUS ETHANOL SOLUTION

S. No.	System containing L-amino acid + I_2 in 50 % aqueous ethanol solution	λ_{max} absorbance
1	Leucine	212 (0.630), 296 (0.369), 359 (0.380)
2	Phenyl alanine	212 (0.495), 294 (0.235), 357 (0.230)
3	Valine	212 (0.99), 290 (0.176), 358 (0.101)
4	Threonine	212 (1.09), 291 (0.335), 358 (0.190)
5	Methionine	215 (0.345), 287 (0.362), 325 (0.362)

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