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Effect of flyash on some physico-chemical parameters of soil and growth of Chickpea in Arpa irrigation project area of Bilaspur district of Chhattisgarh

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ABSTRACT

A study on the effect of flyash on the physico-chemical characteristics viz. pH, electrical conductivity and trace element concentration, of soil of Arpa irrigation project area of Bilaspur District (C.G.) has been made during present investigation. Results obtained reveal that the increasing proportion of flyash in soil considerably increase the value of these characteristics. Effect of these changes on the growth parameters like root length, chlorophyll content, grain yield per plant and average seed weight of chickpea (*Cicer arietinum* Linn.) were also made. All these were found to be favourably affected by flyash induced changes in soil characteristics. We put forth a base for recommendation of flyash application at least for cultivation of chickpea in acidic soil.

Key words: Electrical conductivity, flyash, Arpa irrigation project area and chickpea.

INTRODUCTION

Agriculture on earth is as old as human civilization. Crop production is directly dependent on the availability of mineral elements in soil. In fact the soil system is viewed as a triple phased system of solid, liquid and gaseous phase. All the macro and micro nutrients except C, H and O originate from soil. These nutrients are based in the solid phase and their usual pathway to the plant system is through the surrounding liquid phase, the soil solution and then to plant root and other cells. This pathway may be expressed as:

M (solid) $\rightleftharpoons$ M (solution) M (plant root) M plant top

Where 'M' is the plant nutrient element in continual movement through the soil plant system. Plants require a number of essential nutrients for their normal development. Nitrogen, phosphorous and potassium are known as primary plant nutrients; calcium, magnesium and sulphur as secondary nutrients, iron, manganese, copper, zinc, boron, molybdenum and chlorine as trace and micro nutrients. Mineral deficiency in soil posses a serious problem for better crop production. This deficiency is in turn caused due to various factors like over exploitation of soil, erosion, leaching, use of high yielding varieties etc.

Indian soils are usually very poor in organic matter and many of essential nutrients. Micronutrients especially have been found deficient in high textured and calcareous soil. (Dudal 1980, Korrant et. Al., 1974; Takkar and Randhawa, 1978). Studies on the soil characteristics with regard to availability of minerals in the soil of Chhattisgarh

have been few and far between. Soil in this state differs considerably in their characteristics being medium and deep loamy, red, yellow, lateritic, clayey and heavey clayey (Kanwar and Randhawa, 1974). As compared to west and central Madhya Pradesh, production of one of the important legumes i.e. Gram or chickpea (*Cicer arietinum Linn.*) is quite low in Chhattisgarh. Though, the soil has not been surveyed and analysed properly for trace element contents, lack of response in the presence of external application of NPK and better crop yield in the soil supplemented with micronutrients like Zn, Mn and Mo convincingly point towards mineral poverty of the soil (Gupta, 2000).

Use of flyash in agriculture is being debated since last three decades. This is a by procut of thermal power stations. In India alone, approximately 60 million tones of flyash is produced annually settling of which is a serious problem. Some workers like page et. Al. (1979). Hill and Lamp (1980) and Elseewi et. Al. (1979) Patel S. (2001) have demonstrated the use of flysah for increasing crop production of Alfalfa Barley. White Clover and Swiss Chard. As far as its mode of action in enhancing crop production is concerned, it does not lies only in the availability of some necessary minerals in flyash rather is has also been found to improve the physical and chemical characteristics of soil (Adrinao and Page, 1980). However, some other workers have reported that flyash may inhibit crop production and cause deterioration of soil due to presence of trace of some toxic elements like As, Cd, Sb and Pb (Thicke, 1988).

Therefore, the present investigation was undertaken with the rational to evaluate the possible application of flyash in soil for the production of chickpea in the Arpa irrigation project area of Bilaspur District of Chhattisgarh.

MATERIAL AND METHODS

Site Location of Study

During present investigation, the command area of Arpa Irrigation project located mainly in the Bilaspur district of Chhattisgarh State was taken into consideration. It is a broad plain located between 81^0 49" to 82^0 15" E Longitude and 21^0 45" to 22^0 80" N latitude. Northern boundary is demarcated by Arpa river, west by its right bank canal, south by Maniyari river and eastern boundary by Bhatapara branch canal. Elevation of the area ranges from 900 to 1000 metre above from average sea level. Slope direction I smainly from north to south. The climate is almost subtropical in nature. For the sake of convenience and coverage of whole irrigation area, soil samples were collected from around nine villages viz. Parchped, Karpari, Arang, Hanai, Lakholi, Chandkhuri, Dhamtari, Kalkasa and Laripani.

Determination of trace element concentration

1 gram of soil was taken in a platinum crucible. Two drops of water, 5 ml. of HF and 0.5 ml. of $HClO^4$ was added. Whole mixture was heated at 200^0 C till the liquid was evaporated. After cooling. 5 ml. of Conc. HCl and a little quantity of water was added. The mixture was again heated in an electrical Bunsen burner till dryness. The procedure was repeated till samples were completely dissolved. The dissolved liquid was taken in 100 ml. volumetric flask and diluted upto the mark. The solution was employed for spectrophotometric determination of trace elements by method described elsewhere, Zn and Mo (Busev et. Al., 1981) as well as Mn (Vogal, 1994).

Determination of Soil Electrical conductivity

The electrical conductivity of the soil was determined in 1:2 soil water suspension which was prepared by dissolving 10gm of soil in 20 ml. of distilled water. The suspension was shaken for 24 hours. The solution was filtered and Electrical conductivity was measured through conductivity meter by the method described by Hess (1994).

POT experiments

In order to measure the root length, chlorophyll content, grain yield per plant and average seed weight, chickpea plants were grown one in each pot (volume 0.5 cft). Root length was measured after four week of growth. Chlorophyll a and b contents per unit weight of freshly harvested leaves were estimated by the method described by Sadasivam and Manickam (1996). Plain soil as well as soil containing optimum concentration of NPK were taken as control.

RESULTS AND DISCUSSION

The normal pH in the soil samples collected from all the 9 villages under investigation was ranging from 6.10 to 6.35. Different combinations of soil and flyash were mixed homogenously and filled up in pots. Before measuring the pH, electrical conductivity and trace elements concentration, pots were watered and left undisturbed at least for 3 days. The results thus obtained indicated that with increasing proportion of flyash in soil, the pH value increases sharply and at 50:50 combination, it was just above neutral (Table 1). Similar was the case with electrical conductivity. Average E.C. of soil samples (without flyash) collected from different sites was 0.610 to 0.630 m. mhos/cm. This rose to 0.859 m. mhos/cm. 1:1 soil flyash combination. The concentration of Zn and Mo was found to be affected very little with the addition of flyash into soil. However, it did not show my effect on manganese content.

Plants were grown five in each pot in order to have an insight on the effect of flyash on their growth pattern and yield parameter. Root length was measured after four weeks of growth. A direct correlation between flyash supplement and root length was noticed as it was 11.56 cm. in pot

Table 1: Effect of flyash on pH, electrical conductivity and trace elements concentration (Zn, Mo and Mn) in soil

S. No.	Soil and flyash combination	pH	Electrical Conductivity (m. mhos/cm)	Trace elements Conc. (ppm)*		
				Zn	Mo	Mn
1.	Plain soil	6.21	0.62	53	15.5	210
2.	Plan soil + NPK	6.50	0.64	55	16.00	109
3.	90% soil + 10% flyash + NPK	6.66	0.65	55	16.25	132
4.	80% soil + 20% flyash + NPK	6.70	0.691	56	17.39	150
5.	70% soil + 30% flyash + NPK	6.85	0.750	57	18.25	165
6.	60% soil + 40% flyash + NPK	6.91	0.762	58	19.66	170
7.	50% soil + 50% flyash + NPK	7.10	0.859	62	20.22	169

* Average of 5 readings.

Table 2: Effect of flyash on root length, Chlorophyll content grain yield and average seed weight of chickpea

S. No.	Soil and flyash combination	Plant growth and yield parameters*			
		Root length (cm.)	Chlorophyll content (mg/gm)leaf	Grain yield Plant (gm)	Average seeds weight (1000) seeds) (gm.)
1.	Plain soil	11.20	3.86	25.70	265
2.	Plan soil + NPK	11.56	3.85	30.20	268
3.	90% soil + 10% flyash + NPK	12.10	3.95	30.45	265
4.	80% soil + 20% flyash + NPK	12.60	4.10	34.70	275
5.	70% soil + 30% flyash + NPK	13.10	4.15	35.15	273
6.	60% soil + 40% flyash + NPK	13.85	4.20	38.00	275
7.	50% soil + 50% flyash + NPK	14.30	4.26	38.50	279

* Average of 5 readings

containing soil without flyash and 14.30 cm. in 50:50 soil flyash combinations (Table 2). Chlorophyll a and b content (mg/gm) of freshly harvested leaf also showed considerable increase. Average grain yield per plant increased from 32.5 to 38.65 gm. and average seed weight also increased from 265 to 179 gm. per thousand grains

It is now an established fact that mineral complex in the soil system directly control the growth and development of plants. This lies in the fact that some of the elements are either essential structural components of living cell system or they help to catalyse different biochemical reactions within cells which are essential to keep them alive. Magnesium (Mg) and Molybdenum (Mo) may be cited as examples. The former is the structural component of chlorophyll molecules and the latter is the part of the enzyme nitrogenase which is essential for biological nitrogen fixation Zn, Mo, B, Mn, etc. are known to produce luxuriant vegetative growth, early flowering, healthy pods and goods grain setting (Thorne and watt, 1965). These along with many other trace elements have been reported to be present in sufficient amount in flyash (Gluscoter, 1978). This may be attributed as a reason why plants perform well in its presence. However, the flyash has also been found to affect plant growth indirectly. Singh and Singh (1986) have reported enhanced uptake of N, P, and K by rice in its presence. This phenomenon was reflected through increased grain and straw yield. Due to its alkaline nature, flyash neutralizes the acidic soil and thereby helps nutrient uptake at neutral pH.

Another aspect of flyash application in agriculture should also be taken into consideration. Works of Thicle (1988) is quite noteworthy in this regard. He opined that some potentially harmful trace elements like As, Cd, Sb and Pb present in flyash may adversely affect the growth of plant. Not only that it may also cause permanent deterioration of soil quality. If the alkaline nature of flyash is taken into consideration it may pose serious problem if applied in neutral or alkaline soil.

Recommendation of flyash in agriculture as a potential source of micro nutrients and ameliorating agent for soil needs a lot of research work pertaining to its effect on soil water plant relationship, txture of soil etc. Other physico chemical parameters affecting soil crop relationship should also be taken into consideration. Inspite of all the pros and cons. the finding of the present investigation provide sufficient base for recommendation of flyash application in soil (atleast in acidic soil) for better crop production of checkpea.

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