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STATUS OF AVAILABLE PHOSPHORUS IN SOIL TREATED WITH INDUSTRIAL WASTE OF WAZIRPUR , DELHI

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MASTER OF PHILOSOPHY

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CERTIFICATE

This is to certify that the research work embodied in this dissertation entitled "*STATUS OF AVAILABLE PHOSPHORUS IN SOIL TREATED WITH INDUSTRIAL WASTE OF WAZIRPUR , DELHI*" has been carried out in the School of Environmental Sciences , Jawaharlal Nehru University , New Delhi for the partial fulfillment of the award of Master of Philosophy .This work is original and has not been submitted, so far, in part or full , for any other degree or diploma of any University.

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SUDARSHANA CHANDRYAN

CONTENTS

Lists of Tables

Lists of Figures

CHAPTER 1

INTRODUCTION

INTRODUCTION

Industrialization is generally believed to be the universal remedy for economic backwardness. Mounting pressure on industrialization to withstand in context of advancement towards economic stability is constantly degrading the environment through air ,water and soil pollution.

As we all know that environment and our earth have limited assimilative and carrying capacity i.e. they sustain our environment we have to control every type pollution. By this way we can safeguard quality of life also.

Population growth, increasing urbanization and industrialization and rising standards of living have all contributed to an increase in both the amount variety of waste generated in most countries. Furthermore, many countries are new faced with dealing not only with greater volumes of but also m ore dangerous waster materials. This section of the 'UNEP Environment Data Report" is concerned principally with the generation and disposal of solid waste arising and liquid effluents (S.C. Santra's Environment Sciences.)

Solid waste may be defined as an unwanted or descended materials in solid forms resulting from industrial, commercial, domestic and various other anthropologicl activities. The term waste is of no concern and is of no use to any one. It creates problem because it is not wanted by anyone so people discarded it at low cost like land, water and in air-causing environmental problems. Solid waste generated by this way may be hozardous or non hazardous. Hazardous wastes could be defined as any material or mixture of materials that is corrosive, flammable, reactive ,toxic, or irritable. These chemicals are capable of causing serious injury, illness or dangerous disease to all live stock.

Solid waste can be classified according to source. Major categories include household and consumer wastes (i.e. municipal waste) industrial wastes, agricultural waste, extraction wastes, energy production wastes, and sewage sludges wastes can be classified by hazard and by composition. Information on waste arising. particularly on industrial and hazardous wastes, is often to difficult assemble. Inefficient data collection methods. Infrequency of surveys reluctance of industry to supply information and confusion over definition of hazardous coaster - are all contributory factors. The amount of municipal wastes (by mass) is less than industrial wastes. (S.C. Santra's Environmental sciences).

The industrial wastes an practically more troublesome than other coasts. It consists of toxic inorganic , organic materials and heavy metals which are harmful in degradation causing hazardous to humane health, living organisms and ecosystem (Table I) shows hazardous material from some industries.

Table 1. Shows hazardous waste with their respective point of source.

(Source: M. Phil. dissertation of Jagdisha Chandra)

	As	Cd	CHc_b	Cr	Cu	Pb	Hg	Other Organics_b	Sn	Zn
Mining& Metallurgy	*	*		*	*	*	*		*	*
Paints & Dies		*	*	*	*	*	*	*	*	
Pesticides	*		*			*	*	*		*
Electricals & Electronics_a			*		*	*	*		*	
Chemical manufacturing			*	*	*		*	*		
Explosive	*				*	*	*	*		
Rubber & plastics			*				*	*		*
Batteries		*				*	*			*
Pharmaceuticals	*						*	*		
Textiles				*	*			*		
Petroleum & coal	*		*			*				
Pulp& paper							*	*		
Leather				*				*		
Printing &duplicating	*		*	*	*	*		*	*	
Electroplating & metal finishing		*		*	*					*

a- chlorinated hydrocarbons

b- aerolein, chloropicerin dimethyl, sulphate, di nitro, di nitro phenol, nitroaniline, pentachlorophenol

The national capital territory of Delhi, with a population of approximately 12 millions covering an area of 1483 km square km is highly polluted due to a large number of industries. It has a lays clusters of small scale industries in India with a spectacular growth during the period 1968 to 1996 (Office of the commissioners of Industries, Delhi 1996), Out of its 28 industrial sites 'Wazirpur Industrial Area ‘is a major industrial area releasing a significant quantity of hazardous solid wastes. There industries often dump their wastes on road side, or even in the industrial premises. The waste water swept away in open drainage and underground sewage system, which gets accumulated over the streets and become a streamlet with the dirty and hazardous wastes material of industries. Thus it effects the ground water quality biota and even the health of the people living in nearby surrounding area (Lenka et.al. 1992: Rau et. Al,; 1993).

Therefore in order to safe our environment from this pollution solid waste management should be done. From earliest civilization burial of waste always been comparatively easy in rural areas. Solid waste treatment has necessarily always been more advanced in the largest cities. Disposal problems becomes difficult with increase of population density. Simultaneously there is a greater production of wastes per unit area and a decrease proportion of land available for its disposal. Therefore the history of solid for its disposal. Therefore the history of solid waste management is largely connected with the histories of largest cities (Handbook of solid waste Management; D.G. Wilson). There are a lot of methods for solid waste management . Landfill, garbage farming, organic composting. Biogas production, instineration, Recycling of certain waste materials after sorting by rag pickers and others.

Our lab has been engaged with the research work on management of solid waste generated in Wazirpur Industrial Area of Delhi from the last 12 years . Several of my seniors have under taken and completed work to the said theme on physico-chemical and microbial aspects-

Phosphorus is very important nutrient of soil. Many rocks contains phosphorus usually in the form of phosphate (PO_4^{-3}) that are bound into the mineral structure. When rocks weathered, minute amount of phosphate dissolve and become available to plant. Thus phosphorus in soil exists in three form total phosphorus, organic phosphorus and available phosphorus available phosphorus mainly present in soil in the form of di and tricalclum phosphate in neutral and alkaline soil and Fe and Al phosphate in acid soil. So by reducing metallic ions more phosphate can be present in soluble form.

The waste generated in 'Wazirpur Industrial Area' contains a high amount of phosphorus due to use in some metal finishing industries and also soap manufacturing industries. This high phosphorus containing waste when disposed into surrounding area it creates problem in plant growth. When this waste goes to the lakes, ponds, etc. it causes entrophication (CPCB, Annual Report 1996-1997)

But when this waste mixed in soil in limited amount and after treatment (Chemical, physical), it can give relief upto certain level.As phosphorus is one of the very impotent macronutrient for the soil community , the present investigation was undertaken with the following objective :

To study the status of available phosphorus in soil treated with industrial waste of Wazirpur, Delhi.

CHAPTER 2

LITERATURE REVIEW

LITERATURE REVIEWS

Modern days literature on solid waste present in a voluminous. Industrial wastes consists of a variety of chemical which are extremely toxic to living beings.

Reviews of abroad

Industries manufacturing paper, textile, steel fertilizers, pesticides etc. releases metallic wastes oils, greases, solvents, plastics, heavy metals, plasticisers, suspended solids inorganic and organic pollutants and non-degradable materials in the soil consequently these toxicants are transferred to different organisms in their food chain and causing a no. of undesirable effect.

Industrial effluents when discharged thorough sewage system will Persian the biological purification mechanism of sewage treatment causing several soil and water borne diseases. Most of these pathogens are unsusceptible to degradation and are injurious to health.

It is reported more than 70 millions of organic chemicals are synthesized every year in the world. Amino acids, Albuminson, gutters, which undergoes putrefaction by bacterial action, release sulpher and phosphorous compounds. These compounds produce sulphuretted gases like H_2S and SO_2 as well as oxides of phosphorus which causes mustid and putrid smell in water.

Metallic contaminants (e.g. Hg, pb, Zn, As, Cd, Cr, Na, k, Cu, etc.) destroy bacteria and beneficial microorganisms, in the soil. Heavy metals tender to precipitate phosphatic compounds and catalyzes their decomposition. These metals are considered to be indestructible poisons and their accumulation in soil for a long period may be highly fatal to living organisms.

Soluble salts, needed by industries are responsible for cost damage. They cause crop loss, soil loss, metallic erosion and lead to costly cleansing activities. Salts accumulation in the soil has been a perpetual problem.

Severe agricultural crop damage is caused by high acid and alkalinity of the soil coming from chemical industries.

The interaction of components of electroplating waste and its toxicity was studied of phosphate from domestic sewage has been proved to be the must important step in the control of eutrophication. *Gerrites (1993)* observed that disposal of waste water in soil makes condition favorable for precipitation of PO^{-3}_4 at $Ca_3(Po_4)_2$.

O.C.EZE & P.Loganathan; (1990) studied that phosphate sorption was gradually unaffected by pH at low P addition at the two concentration of salts, whereas at high phosphorous additions sorption generally decreased with increase in pH. They also studied that phosphate sorption by samples from the B horizon increased with increase in period of incubation with lime, whereas in the samples of Ap horizon no consistent trend of was obtained.

Kate Lajtha & Sherman.H.Bloomer (1988) studied that phosphorus is geochemically fixed in soils through interactions with calcium -, Aluminium-, & iron phosphate minerals.

G.R.Cline, W.C.Lindmann and R.Quintero(1985) said that $NaHCO_3$-P level continously increased upto 84 days incubation period. Its value was directely related toamount of sludge. A very rapid increasment occur within Ist week but after that it was almost constant.

Xin-TaoHe,Sam J.Trainoand Terry J.Logan (1992)said that compsting is a good method for waste management in Europe and USA.

K.A.Kelling ,L.M.Walsh ,D.K.Keeny ,J.A.Ryan ,and A.F.Peterson (1997) said that sludge amendment resulted in immediate marked increase in Bray,s Pi extrctable P. However , the extractable Plevel decreased with time after sludge application ,probably as a result of P fixtation.

Emil Ryden , and Erasmus Otabbang(1977) said that in soil amendment inert P pool increased , indicating that P transformation favoured the production of more stable compounds.

Non-point pollution control measures are as diversified as the source of pollution themselves and uniform technology can be proposed to control diffuse sources. The traditional means to control collection and treatment which works well for most point sources, would be prohibitively expensive for non-point pollution control and could be used only in rare cases when all other controls at the source fail. The "Best management practices" should

1) Manage pollution generated by non-point pollution
2) Achieve water quality compatible with water quality goals,
3) Be "most effective in preventing or reducing the amount of pollution generated".
4) Be practicable

The application and selection of best management practices should be based on-

1. Type of land-use activity
2. Physical condition in water shed.
3. Pollutants to be controlled
4. Site specific conditions

Reviews of India

Dumping of solid waste is a popular and inexpensive way of getting rid of wastes. But disposal of waste is not free of disadvantages. Land fill is seems to be the possible, way of waste disposal. Land fill operation, which is a biological method of treatment, involves the depositing of refuse, compacting and covering it with a soil.

Till a few decades back, the main worry was to find a new space to take the space of filled up dumps. But with rapidly increasingly population density, these land fills became full to be brim so fewer land space could be found for use as a new waste dump.

As the government and town planners searched for new sites for dumping the mounting wastes. The filled land fills became matter of attention for several reasons.

Although the land fill make use of raw and partially treated sewage, yet the dumping of sewage is most dangerous to workers and consumers of the produce, because raw sewage provides an excellent growth of pathogenic microorganisms, protozoan , cysts and heliminiths eggs etc.

Land filling has become source of acute environmental problems. The leachates escaping out of the garbage mountains and a chronic mixture of gases after explosive produced as a result of anaerobic decomposition of waste by microorganisms. These gases can be very hazard for living beings.

So land filling is also a process which needs a lot of attentions. (CPCB, Annual Report 1996-1997).

CPCB carried out survey on solid waste management in five metro cities - Delhi Mumbai, Calcutta, Chennai & Banglore. This survey indicate that total Delhi have an are of 1484 kim^2 & population is 12.20 millions. The solid waste generated is 6000 tonnes/day i.e. 0.492 kg/day solid waste per capita. This puts a garbage pressure of 4.042 tonnes/kim^2. The waste generated in this way have a pressure on land fill is 5000 (CPCB Annual Report 1999-2000).

The implementation of the action of plan for pollution control in 1551 medium & large scale unites identified under 17 highly polluting industrial sectors was continued. The follow up of the action taken against the defaulting industries under section 5 of the E (P) Acct, 1986 was further intensified & as a result the non of defaulting industries has been reduced from 147 in March 1996 to 67 in March 2000.

There solid waste generating industries spew their waste directely in river & lakes also. For this CPCB ran of a programme called as "Industrial Pollution Controll Along the rivers & Lakes". In 1997 there were 851 industries who spew their waste directly in river of lakes but in March 2000 it was only 93. CBCB in a report (publication, solid waste management) put a lot of method for processing & Disposal of waste. In this report they have reported that (a) waste generation is expected to increase from 48 million tonnes to 300 million by 2047 (490 grams ' per capita to 945 grams per capita).

(b) Estimated requriement to land for disposal would be 169.6 sq. km in 2047 as compared to 20.2 sq. km in 1997.

(c) The task of handling solid waste (300 million tonnes in 2047) would be equivalent to the task corvently faced in moving the total cal produced in the country.

The project on inventorisation and management has been taken not only by world but India also. It is doing by identifying hazardous waste generating industries, quantification of these waste can be reduced.

CHAPTER 3

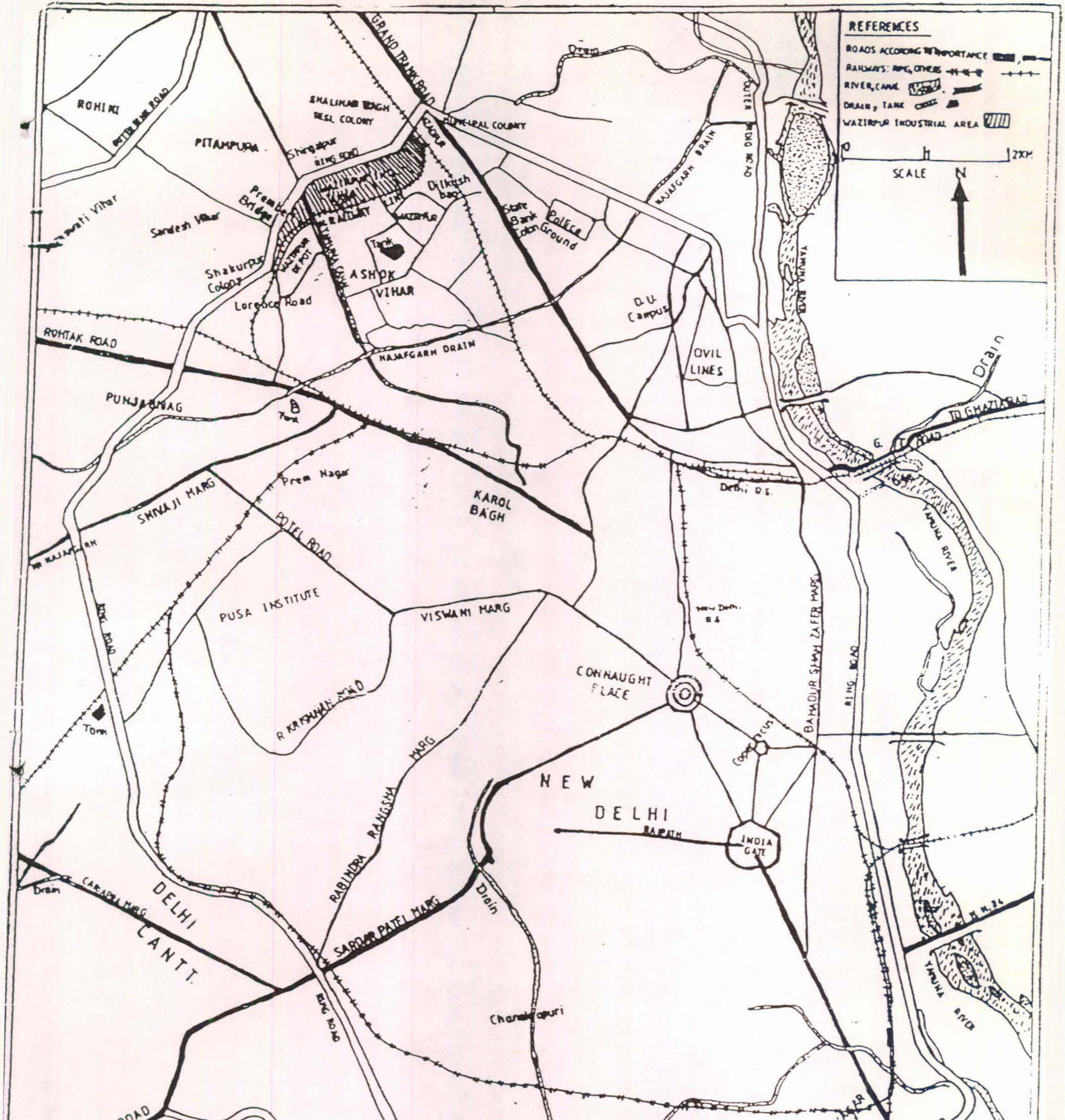
AREA OF STUDY

DESCRIPTION OF STUDY AREA

Wazirpur Industrial Area which covers an area of 210 acres is situated North-west part of Delhi (fig.1). North western ring road and north-western ring railway system are two ring road system which surrounds this highly polluted area.

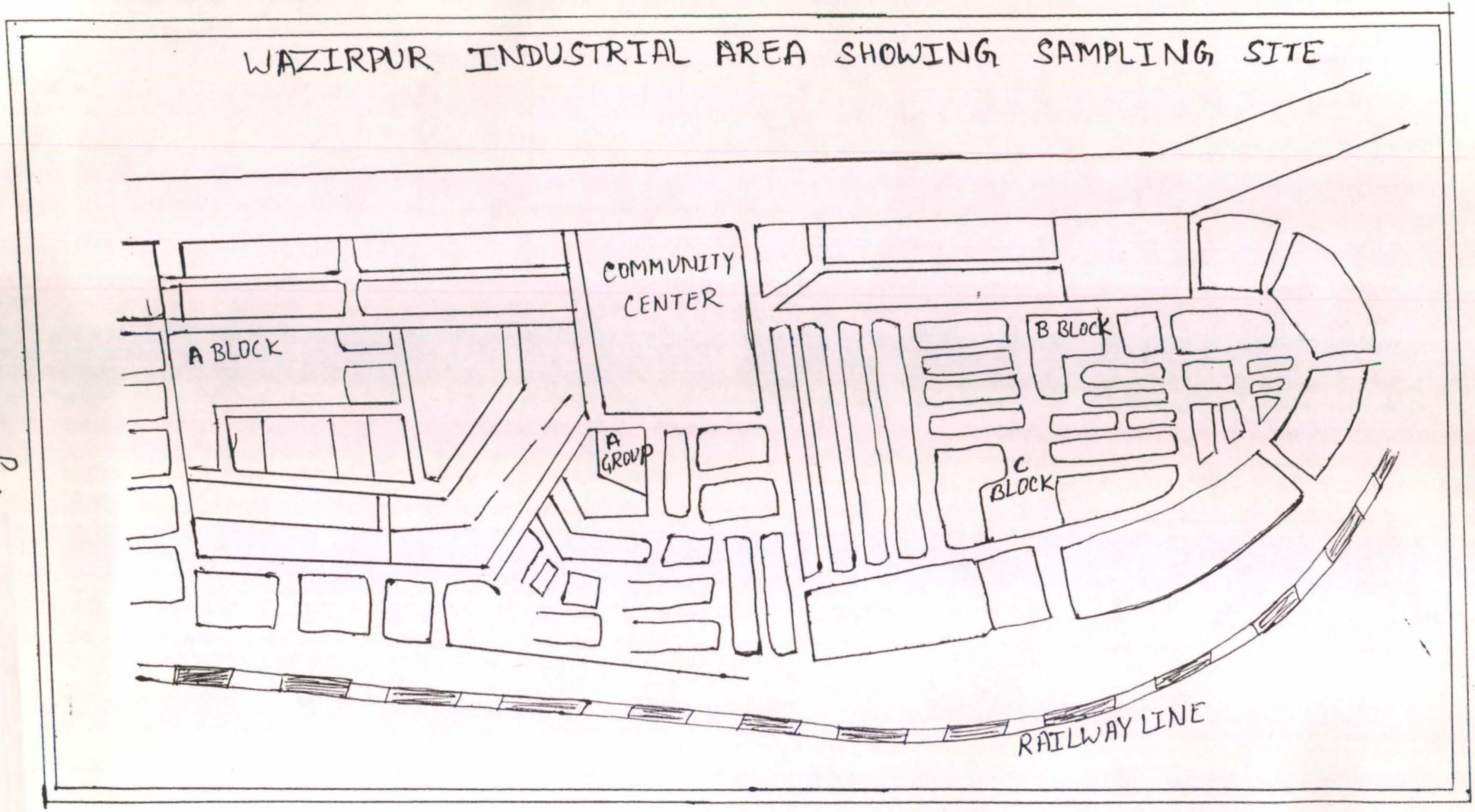
In starting this area had approximately 1000 industries among only 424 were registered. But after 1998 due to strong recommendation of CPCB and DPCC a lot of unregistered industries are now close (Table-2). The main polluting industries which are still in working conditions are electroplating, rolling & pickling and textiles. The other main industries are rubber, plastic, soap, electronic goods, etc. (Table- 3) Due to its large no. of small scales industries and their unmonitored level of pollution, Wazirpur has emerged as one of the major polluted industrial sites of Delhi.

The entire area is divided into three industrial parts A, B & C (Figure 2) Due to large no. of small scale industries, every day huge amounts of toxic wastes are spewing out of those units.



149 DELHI SHOWING WAZIRPUR AREA

Fig: 2



WAZIRPUR INDUSTRIAL AREA SHOWING SAMPLING SITE

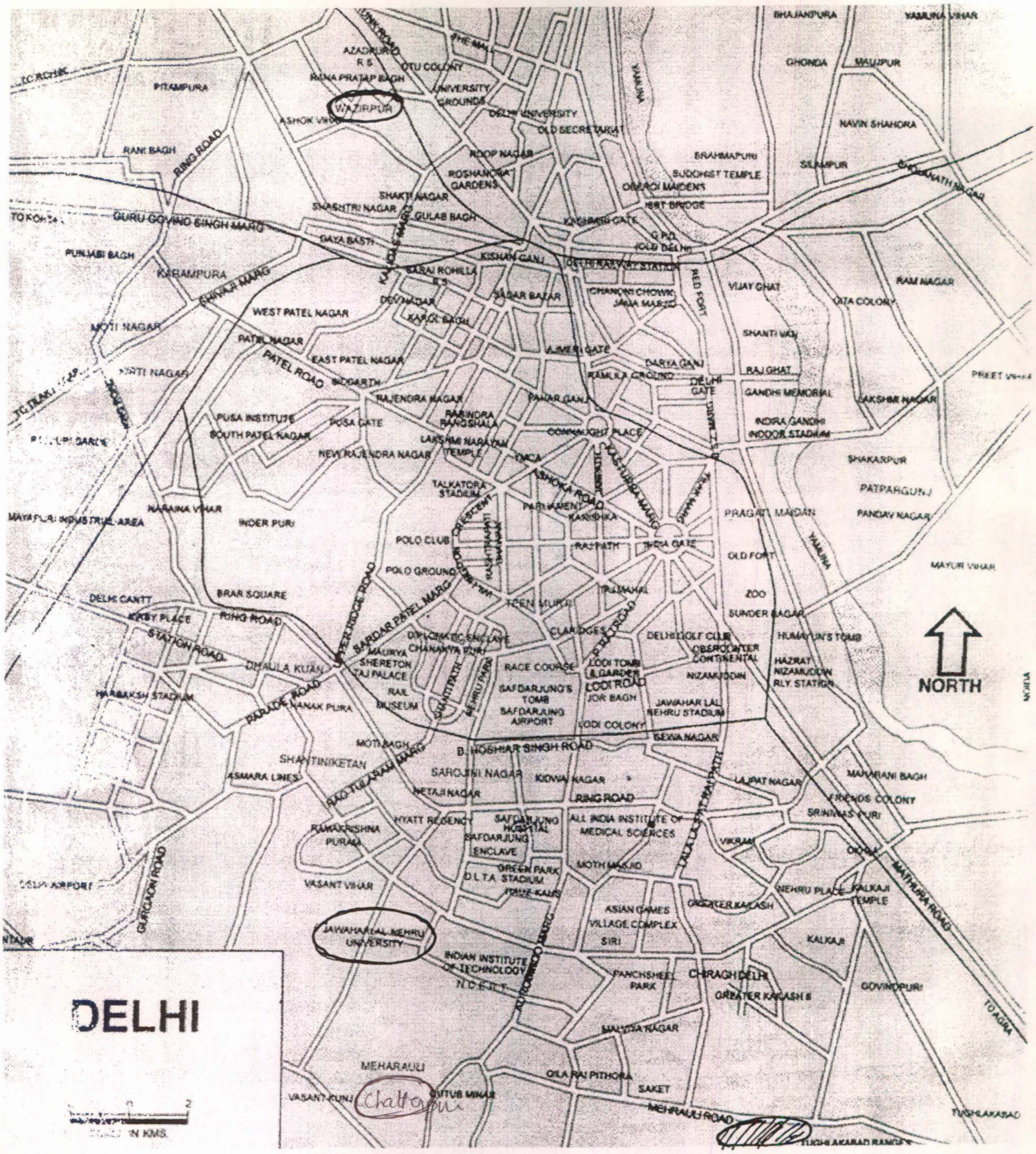


Fig 3: DELHI SHOWING, WAZIRPUR, JNU AND CHATTERPUR

Table- 2: List of Registered Industries in Wazirpur

Blocks	No. of Industries
A	253
A Group	089
B	036
C	046

Source: Small scale industries Association Wazirpur 1995)

Table- 3: List of Various Industries in Wazirpur

1.	Textile	46
2.	Electroplating and Anodizing	20
3.	Rolling an Pickling	50
4.	Soap	10
5.	Others	30
Total		156

(M.Phil.Dissertation of Jagdish Chandra 1998)

Since main pollution creating industries are basically electroplating rolling and Pickling, Textiles, therefore major raw materials where are used in the processing are strong acids like HNO_3, H_2SO_4 , HF, coating materials like Cr & Zn, bleaching powder, dyes, Iron sheets, charcoal etc. So these outputs mainly govern the characteristics of the output wastes. However nitrogenous wastes, garbage and rubbish released from labour dwellings and mixed with industrial wastes inside the industrial area also influence the properly of wastes.

Even closing of some industries due to CPCB this area do not have a sound and satisfactory disposal system. The solid wastes are usually clumped on the road side along the industrial premises. Blocking of drains and canals by these solid wastes result in flooding of liquid wastes all over the locality. Therefore it affects health of the workers very badly. Even the drained waste water carrying the toxic material wish it, ultimately empties into river Yamuna, a main source of drinking water for the people of Delhi.

JNU is situated south east of Delhi. It is a university area so not disturbed by men activities. This is situated at Arawali rocks. So the soil formation in this area is still in developing stage. The soil is shallow, loamy type. The floara obtained in this area is highly bushy type due to climate and conditions. But this soil is rich in nutrient because weathering of rock is still continuing. (N.S.B.S. Report 2000)

Chattarpur is also situated south part of Delhi. The soil there present is highly cultivated from long days because it is a residential area and land is used for production of vegetables and crops etc. The soil here found is a permanent type i.e. the soil genesis has been completed in this area. The formers of this area used a lot of fertilizers for more production. Soil is light blackish in colour as weathering has been completed. (N.S.B.S. Report 2000)

CHAPTER 4

MATERIALS AND METHODS

MATERIAL AND METHODS

1. Work Plan

The work plan was prepared to highlight the status of available phosphorus in soil mixed with solid waste of industrial area. Different parameters analysed under each head were as follows

2. Physico chemical properties

- Measurement of pH, electric conductivity, moisture content and water holding capacity
- Study of cation exchange capacity (CEC)
- Study of available phosphorus
- Study of organic phosphorus
- Study of total phosphorus

3. Sampling Site

Ten samples are taken from each block (A,B &C) of Wazirpur Industrial Area, in each season i.e. in Monsoon, winter 4 and in summer. So having thirty samples. Soil from JNU and Chattarpur also taken.

4. Sample Collection

Samples were collected from ten spots from each block for each waste sample taken from the surface to 30 cm below and mixed. Stainless steel trowel was used for collection of samples and thereafter samples were packed in air tight polythene bags. JNU and Chattarpur soil taken and tighly packed in large polythene bags.

5. Frequency of Sampling

Samples were collected three (3) times in a year. It was done on following dates

Industrial waste	**soil**
Aug 2000(Monsoon waste)	Oct.2001(chatterpur soil)
Dec 2000(Winter waste)	Sept.2001(JNU soil)
May 2001(Summer waste)	

6. Storage of Samples

Samples were stored in cold room at 4°C to avoid further contamination and chemical changes in it.

7. Processing of Samples

Except the pH, Electric conductivity and moisture content both soils and waste samples were air diried. Aggregates were lightly crushed, seived through 0.2 mm sieve. Then again samples were packed in polythene bag and kept at 4°C. From thirty samples of Block A some representative samples were taken on the basis of pH (Highly acidic samples were only taken). These samples were mixed properly by quadrate system to homogenize it. Both soil samples are also mixed properly and seived through 2mm seive

Now ,soil samples and waste samples are mixed according to percent (0%, 10%, 20% ,30% of waste). These samples (soil+waste) were mixed properly by again quadrate system. Now ,lime is added again by percent (0,05., 1.0) of samples (soil +waste).

These samples are now filled in small polythene bag by maintaining moisture content and kept in incubator at 28°C. Same procedure is followed with Jnu and Chattarpur soil with season variation of waste samples. Sample are kept in incubator for 0,10,20,30,45, 60, 90, 120 days. Samples are daily examine and maintained moisture by adding double distilled water.

Table 4 : Parameters of Physico-chemical Analysis and their specific methods used

S.no.	Parameter	Method and Instrument used
1.	PH	Digital pH meter (zenar)
2.	E.C.(mili siemen/cm)	Digital conductivity meter
3.	Moisture content(%)	Water loss from fresh sample at 105°C during 48 hours
4.	Water holding capacity	Water loss from saturated sample at 105°C during 48 hours
5.	Total Phosphorus(%)	Block Digestion followed by ascorbic procedure with no .pH adjustment
6.	Available	Bray's no. 1 for waste

	phosphorus(ppm)	samples and otesen's for soil and waste samples
7.	Organic Phosphorus(ppm)	Jackson & chung method
8.	C.E.C.	Direct Distillation method

1. pH

Principle

The pH of a sample is a mesure of the H^+ activity and depends largely relative amounts of the adsorbed bydrogen and metallic ions. Thus it gives good indication of the acidity and alkalinity of a sample. However pH is conventionally defined as the reciprocal of H^+ concentration i.e. it is inversily proportional to logarithm $[H^+]$.

The activity of H^+ in suspension aH^+ is expressed in grams ions per litre.

The pH of samples in suspension highly depends upon solid waste: water ration and increase with dilution. Different laboratories follow the different dilution, but 1:5 and 1:10 sample: water ratio are the most common.

Apparatus:

Apparatus used for the experiment were one glass electrode, pH meter with calomel reference electrode and salt bridge, 150ml beakers, magnetic stirrer, spatula, tissue paper, thermometer, digital balance, 250ml beaker, measuring cylinder, wash bottle etc.

Reagents:

Reagents for the experiment were buffer solution of pH 4.0, 7.0 and 9.2 and saturated KCl (40 gm/l) for the bridge distilled water.

Procedure:

(a) Preparation of sample and water suspension:

Sample: distilled water of 1:10 (w/v) ratio were taken in 150ml beakers and stirred by magnetic stirrer upto 10 min. and kept for pH measurement.

(b) Measurement of pH:

First the pH meter was kept on at room temperature for about 30 min. then the pH meter was calibrated with different buffer solution. After calibration of instrument solution of the sample were taken for pH measurement. Sample: KCl (IN) was also taken for measurement. Each sample was repeated 4 times to get a concordant reading. Standard error of the instrument was also calculated for correct reading.

II. Electrical Conductivity:

Principle:

Conductivity is a measure of current carrying capacity, thus gives a clear idea of soluble salts present in samples. Conductivity is non-specific and varies with the proportion of various species in the solution. It express the resistance of a 1cm$_3$of water to the passage of current, usually at 25°C. The resistance ®is defined as:It is inversily proprotional electric current and proprotional to electric volt

Electrical conductance is reciprocal of resistance which can be expressed as:

$$C=1/R = I/E$$

Where C= Electrical conductance (EC) in milli siemen/cm

Conductivity values depend on dillution of the sample. However sample water ratio 1:5 and 1:10 are most common for conductivity study. To reduce microbial influence on conductivity, measurement should be done within few hours of preparation of solution.

Apparatus:

Apparatus used for the experiment were electrical conductivity meter, magnetic stirrer, wash bottle, thermometer, digital balance and measuring cyliner.

Reagents:

Reagents used for the experiment were 0.02N KCl (1.4912 gm KCl/L) and CO_2 free distilled water.

Procedure

(a) Preparation of sample and water suspension:

Sample : distilled water of 1:10 (w/v) ratio taken in a breaker and stirred well for about 10 min. and kept constant for half an hour.

(b) Measurement of Electrical Conductance

First the electrical conductivity meter with cell was kept on at room temperature and the cell constnt was adjusted. After half an hour the instrument was calibrated with 0.01 KCl and then the sample water suspensions were taken for EC measurement. For measuring EC, platinum electrode was dipped into the suspension and EC was measured in milli siemen/µmSamples were repeated 4 times to get concordant value. Standard error was also calculated for correct reading.

III. Moisture Content (M.C.)

Principle:

Solid waste generally gets moisture from the infiltration of percipitate water when dumped in the open places. However, the samples collected were mostly saturated with water and acids because these were dumped after extracting from acidified liquid wastes coming from the industries. The moisture content of a sample at any time, more or less depends on its water holding capacity and environmental conditions with time. The moisture content is the amount of water held by the fresh samples at the time of collection. It is generally expressed in percentage with respect to the initial fresh weight of the samples.

Apparatus:

Apparatus used for the experiment were oven, balance, petridish with covers, desiccator and thermometer. No reagent was used here.

Procedure

First clean oven-dry petridish were taken and weighed accurately (upto+ 0.001 gm). Then about 10gm of waste, soil & soil+waste sample from each fresh sample were taken and weighed. After taking the second weight, samples with petridish were kept inside the oven at 105°C. Weights were noted after 24 hours and once again after 48 hours. To get a concordant value samples were repeated 4 times in same way.

IV. Water Holding Capacity:

Principle:

Water holding capacity is defined as the maximum amount of water of a freely drained sample can hold. It is estimated after a saturated sample under study has been allowed to drain without allowing its moisture stores to be depleted by evaporation. The water holding capacity of a sample always depends on its physicoehcmical nature. It is expressed as the weight of the water held by 100gm of oven dry sample.

Apparatus:

Apparatus used for the experiment were oven, balance, patridish desiccator, thermometer, water bottle with water, conical flask, funnel and breaker (100ml).

Reagent:

Reagent used for this experiment were filter paper and water

Procedure:

First about 25gm of each processed sample was taken in 100ml beaker. The beakers containing samples were flooded with water and left for 2 hours for full saturation. Then the saturated samples from the beaker were taken on the filter paper in the funel by adding few drops of water. Then about 10 gm of saturated samples were taken in previously measured patridish when the last drop of water were funnelled out. After taking the second weight the plates with samples were kept inside the oven at 105°C, then weights were taken after 24 hours and once again after 48 hours.

V. Total Phosphorus:

Principle

Analysis of total phosphorus needs the complete oxidation of organic matter. However complete oxidation can be achieved by several methods. In weight oxidation mehod oxidation finally leaves a sulphuric acid solution. Hydrogen peroxide is added as an additional oxidizing agent, selenium is used as catalyst while K_2SO_4 is added to raise the boiling point of the mixture. The main advantages of this mehod are that a single digestion is requred (for both plant and soil material) to bring nearly all nutrients into solution. All organic phosphorus converted into inorganic form. The total phosphorus is then colorimetrically determined by ascorbic acid reduced molybodenum blue in acideic medium.

Apparatus

Apparatus used for the experiment were spectrophotometer, wash, bottle, pipettle, block digester, test-tube, balance, flask (5oml), and beaters etc.

Reagents:

Reagents used for this experiment were of two types

a) Digestion mixture

(i) Selenium powder

(ii) Potassium sulphate

(iii) Hydrogen peroxide

(iv) H_2SO_4 (concentrated)

Selenium powder 0.42g and K_1g and K_2 SO_4 were added to 350 ml of H_2O_2 (30%) and mixed well well. Then 420 ml of concentrated H_2SO_4 was added slowly with care while cooling in an ice both. This mixture is stored at 2°C.

(b) Reagents for Spectrophotometric Analysis of Ascorbic acid mehod - no pH adjustment

1) **H_2SO_4 5N:** 148 ml concentrated H_2SO_4 was added to 500 ml of distilled water while cooling in an ice bath.

Then the volume is diluted to 1 litre.

(ii) Ammonium Molybdate/Antinomy potassium tartrate solution:

12 g of ammonium molybdate was dissolved in 250ml of warm (50^0C) distiled water. Seperately 0.291 g antimony potassium tartrate (ksb.$C_4H_4O_6$) was dissolved in 100 ml of distilled water. Then the both solution are added to 1 litre of 5 N H_2SO_4 above. Then the volum was diluted to 2 litre and kept in a cool and dark place.

(iii) Ascorbic Acid Reducing Agent

2.108 g of ascorbic acid ($C_6H_{18}O_6$) was dissolved n 400 ml of ammonium molybdate/potassium antimony tartrate solution and was mixed properly. This was made at time of analysis.

(iv) Standard Phosphorus stock solution (1000 ppm)

1.0967 g of even dry KH_2PO_4 was dissolved in 250ml of distilled to get 100 ppm phosphorus. From this 10 ppm of working solution was prepared by taking 10ml of 1000 ppm and diluted it to 1 litre.

Procedure

a) Digestion

First 0.3g of each dry processed sample was taken in dry and clean digestion tube. Then 4.4 ml digestion mixture to each test tube of the samples and blank was also run without samples. Samples were digester at 360°C for 3hr then the colourless sand white solution were taken out and cooled with adding about 25 ml of distilled water. Lastly the volume of the solution was made up to 50 ml after transferring into volumetric flask and allowed to settle.

b) Preparation of working Standard

Working solution of 0,1,2,3,4,5, 10 ml were pietted into 50 ml of volumetric flook. Then 10 ml of ascorbic acid reducing agent was added to each flask and the volume was made up to the mark and left for 1 min. to develop colour.

c) 5ml of the supernatent clear wet ashed digested solution was taken into 50 ml volumetric flask. Then 20 ml of distilled water was added in each flask and followed by 10ml of ascorbic acid reducing agent to each flasks. Then the volume is made upto the mark. However was done at same time. Then after 1 min absorbance was measured at 880 nm wave length.

VI. Available Phosphorus

Principle

The principle first involves the extraction of available phosphorus by means of extractant. The combination of NH_4F & HCl is designed to remove adsorbed and easily acid soluble forms of phosphorus, largely the Calcium phosphats and a portion of aluminium and iron phosphate NH_4F dissolves aluminium and Iron phosphate by complex formations with these metal irons.

$NaHCO_3$ in case of neutral and alkaline sample. In the second step available phosphorus in the extracts is colorimetrically determined by chlorostannous - reduced molybdophosphoric blue in hydrochloric acid system

Apparatus

Apparatus used for this experiment were speectrophotometer, wash bottle, pipetle, testtube, balance, measuring cylinder, vlumetric flask, beakers, filter paper (whatman no.1) and conical flsk.

Reagents:

Reagents used in this experiment were of 3 types

a) Reagent for Olsen's method (for alkaline sample)

i) Reagents for sample extract.

$NaHCO_3$ of 0.5 M (pH-8.5) was prapred by dissolving 4.2 g of N_aHCO_3 in one litre of distilled water. The pH (8.5) was adjusted by adding 10% NaOH .

ii) Reagents for colour development

15 g of ammonium molybdate (A.R.) was dissolved in 300 ml of distilled water by warming at 60°C. After cooling 350 ml of 10 N HCl was adjusted correctely by titration

iii) Stannous Chloride

10 g of crystalline $SnCl_2$ (A.R.) was dissolved in 25 ml of concentrated HCl by keeping airtight while on warming and stored in

amber coloured bottle carefully avoiding all contact with all. Just before use 1 ml was diluted to 66 ml with distilled water.

Reagents for Bray's No.1 Method (for acidic samples)

i) Reagents for sample extract.

2.775 g of NH_4F was added to 2.5 litre of 0.025 NHCl. The normality of HCl was checked with NaOH solution.

(ii) **Reagent for Colour development**

15 g of ammonium molybdate was dissolved in 300 ml of distilled water by warming at 60°C. then 350 ml of 10NHCl was added and made upto 1 litre. The normality of HCl was adjusted with NaOH solution.

(iii) Stannous Chloride Solution (Same as Olsen's method)

C. Phosphorus Stock solution (100 ppm);

0.439 g of dried KH_2PO_4 was dissolved in 500 ml distilled water by adding 25 ml of $7NH_2SO_4$. Then total content was diluted to 1 litre.

Procedure

a) Sample extract for olsen's Method

2.5 g of sample in 100 ml of conical flask with a little activated carbon (free of phosphorus) was added followed by 50 ml of olsen's reagent. A blank was run without the sample. The flask were shaken for 30 min on a platform type shaker and the contents filtered immediately thorugh whatman no.1 paper into dry clean beaker.

b) Samples Extract for Bray's No.1 Method

5 g of soil and 50 ml of reagents wre taken in 100ml of flask and shaken exactly for 5 min. and filtered by whatman no.1 filter paper. To avoid interferences 7.5 ml of 0.8N boric acid was added t0 5 ml of extract.

c) Preparation phosphorus Standard Solution

First 2 ppm of working standard was prepared by dissolving 20 ml of 100 ppm phosphorus stock solution in 1000 ml. 0,1,2,3,4,5, and 10 ml of 2 ppm phosphorus were pipetted respectively only into 50 ml volumetric flask. To each of them added 2ml of $SnCl_2$. Addition of $SnCl_2$ in standard and samples were done. Simultaneously and then after 10 min absorbance were measured by spectrophotometer.

d) Sample Analysis

First 5 ml of extract was taken in 50 ml volumetric falsk. Then 5 ml of Bray's reagent was added. Olsen's Reagent added dropwise to remove CO_2. Then the neck of the flask was down and content was diluted upto 20 ml and was added with 2ml of $SnCl_2$ solution. Lastly the volume was made upto mark and absorbance noted at 660 nm wavelength.

Principal

H_2O_2 is strong oxidizing agent it oxidizes all organic form of phosphorus and gives it in solution. Ammonium floride combines with all phosphorus which present in mineral form. So it also comes in solution. This phosphorus is estimated by spectophotormeter.

Reagent:

1. 30% H_2O_2
2. 18.5 g NH_4F is dissolved in1 litre of distilled water
3. Colour developing Reagent - As in olsen's method

Apparatus - Spectrophotometer,

Procedure

1.0g of sample taken in 100 ml of plastic vials. Then added 30% H_2O_2 and 50 ml 0.5 N acid ammonium floride. Shaked it on rotar shakes for 1hr. then filtered the sample by what man no. 1 Filter paper. In filtrate estimated organic phosphorus + mineral phosphorus by olsen's method.

In second time took 1g of sample in 100 ml plastic vials. Then added only 50 ml 0.5 N acid NH_4F. Same procedure is followed like previous. In this filtrate gave only mineral phosphorus. By difference of both organic phosphorus estimated.

Calculation

oganic phosphorus =Mineral phosphorus +Organic phosphorus -Mineral Phosphorus

VIII. Cation Exchange Capacity (CEC)

Principle

Cation exchange capacity is measurement of exchangeable cations present is soil. This is the basic data property which gives a lot of information about soil. Exchangeable cations which present in soikl have the tendency to replace by a minimum ion (NH_4^+). These ammonium ion then tightly bound by molecules from which other cations has been removed. When this sample is distillated by Kjelhdal and titrated by acid gives the cation exchange capacity.

Apparatus

Kjelhdal heater,. Kjelhdal flask, conical flask, Burette etc.

Reagents

a) 1.ON HCl - 81 ml of concenrated HCl was diluted to 1 litre.

b) 1.0NAmmonium Acetate- Weighed 77.08 g of ammonium acetate and dissolved in 1 litre pH is adjusted to 7.0

c) Ethenol - 5% 475 ml of 95% ethenol was diluted to 500 ml.

d) 2% boric acid - 20 g of Boric acid was dissolved in 1 litre of distilled water and then add 0.5 ml of mixed indicator

e) 10% KCl - pH 2.5 - 5.0 kg KCl dissolved in 4.5 litre of water pH is adjusted by 1NHCl (32 ml) and volume made up to 5 litre.

f) 45% NaOH: 450 g of NaOH dissolved in 1 litre of distilled water.

Procedure:

Weighed 5 g of sample and dissolved in 50 ml of ammonium acetated solution (1N). Kept this for overnight by cover it through watch glass. In next morning the extra NH_4^+ was wash out by washing it or filter paper through 5% ethenol solution. The washing was done upto filtrate gave presence of ammomium ion with Nesseler's Reagent. Then left it for 1/2 an hour to drop out everydrop of alcohol.

Now these sample along with filter paper kept in Kjelhdal's falsk & add 350 ml of distill water then added 25 ml of 45% of NaOH. Distillate was collected in 250 ml of conical flask already having 20 ml of 2% boric acid solution. Distillate was collected up when it goes upto 200 ml. Then this distillate is titrated against 0.1NHCl. the acid consumes shows the cation exchange capacity.

CHAPTER 5

RESULTS AND DISCUSSION

RESULTS AND DISCUSSION

On the basis physico-chemical analysis of raw samples (Table-5and 6) and incubated samples (soil treated with industrial waste) different results are obtained which are tabulated in table (7-15).

The graphical (histograms) representation showing the relationship of available phosphorus in two soil treated with Industrial wastes in presence or absence of lime of during the incubation.

Table-5 : Physico-chemical characteristic of industrial waste and soil

S.No.	Sample name	pH	E.C.	M.C.(%)	W.H.C.	C.E.C	A.P. (ppm)	O.P. (ppm)	T.P.(%)
1	M Waste	5.24	0.44	2	34	9.5	30.2	290	0.046
2	W Waste	2.78	1.2	3.75	34	7.5	13.95	400	0.066
3	S Waste	3.28	1.18	4.25	28	10.52	18.08	450	0.07
4	Ch.Soil	8.61	0.1	1.5	37	10	9.25	147.5	0.024
5	j.n.u.soil	8.55	0.09	2	32	11.66	13	350	0.052

M – monsoon , W – winter , S – summer , Ch – chatterpur , A.P. – available phosphorus , O.P. – organic phosphorus , T.P. – total phosphorus

Table – 6 : Correlation between different physico-chemical parameters

	pH	E.C.	M.C.(%)	W.H.C.	C.E.C.	A.P.(ppm)	O.P(ppm)	T.P.(%)
pH	1							
E.C.	-0.96642	1						
M.C.(%)	-0.88148	0.961558	1					
W.H.C.	0.472703	-0.53648	-0.71224	1				
C.E.C.	0.642536	-0.57718	-0.3527	-0.35714	1			
A.P.(ppm)	-0.37415	0.145091	0.033877	-0.20774	-0.10385	1		
O.P.(ppm)	-0.72865	0.767715	0.866094	-0.85183	-0.08583	0.191187	1	
T.P.(%)	-0.79848	0.832196	0.902587	-0.79919	-0.2048	0.19349	0.992503	1

E.C. – electrical conductivily , M.C.(%) – moisture content , W.H.C. – water holding capacity , C.E.C. – cation exchange capacity , A.P. – available phosphorus , O.P. – organic phosphorus , T.P. – total phosphorus

Table – 7 : pH in chatterrpur soil treated with waste of different seasons

S.No.	%of waste	season	%of soil	%of lime	0th Day	10th Day	20th Day	30th Day	45th Day	60th Day	90th Day	120th Day
1	0		100	0	8.57	8.6	8.4	8.58	8.03	7.95	7.69	7.96
2	0		100	0.5	9.86	9.09	8.85	8.7	8.51	8.22	7.95	8.2
3	0		100	1	10.5	9.3	9.0	8.85	8.68	8.26	7.99	8.32
4	10		90	0	7.87	8.25	8.1	8.02	8.04	7.67	7.79	8.01
5	10	M	90	0.5	8.2	8.18	8.05	8.04	8.18	7.79	7.82	7.72
6	10	O	90	1	7.81	8.03	8.0	8.11	8.21	7.86	7.85	7.81
7	20	N	80	0	7.45	7.74	7.8	7.5	7.97	7.5	7.82	7.82
8	20	S	80	0.5	7.7	7.91	8.2	7.82	8.05	7.59	7.86	7.65
9	20	O	80	1	8.14	8.12	8.25	8.01	8.18	7.86	7.75	7.77
10	30	O	70	0	6.88	7.38	8.40	7.73	7.73	7.37	7.68	7.48
11	30	N	70	0.5	7.45	7.84	8.0	7.68	8.07	7.86	7.6	7.68
12	30		70	1	8.28	8.04	8.25	7.9	7.88	8	7.8	7.62
13	10	W	90	0	7.78	8.12	8.0	7.96	8.07	7.72	7.64	7.65
14	10	I	90	0.5	7.86	8.2	8.2	7.98	8.1	7.66	7.72	7.85
15	10	N	90	1	8.58	8.27	8.35	8.08	8.13	7.87	7.8	7.99
16	20	T	80	0	7.54	7.72	7.5	7.67	7.82	7.6	7.5	7.6
17	20	E	80	0.5	7.99	7.98	7.62	7.85	7.91	7.68	7.7	7.75
18	20	R	80	1	8.48	8.14	7.9	8.01	8.02	7.75	7.85	7.95
19	30		70	0	7.23	7.38	7.25	7.42	7.55	7.33	7.3	7.43
20	30		70	0.5	7.87	7.7	7.6	7.76	7.79	7.78	7.45	7.55
21	30		70	1	8.73	8	7.85	7.92	7.9	7.85	7.6	5.79
22	10		90	0	7.55	7.95	7.85	7.99	7.93	7.64	7.73	7.73
23	10	S	90	0.5	7.72	7.99	7.9	8.07	7.95	7.66	7.89	7.95
24	10	U	90	1	8.15	8.01	7.8	8.01	7.95	7.7	7.99	8.05
25	20	M	80	0	7.17	7.5	7.3	7.57	7.69	7.47	7.4	7.75
26	20	M	80	0.5	7.47	7.76	7.56	7.78	7.82	7.66	7.5	7.85
27	20	E	80	1	8.49	8.07	7.98	7.87	7.96	7.83	7.63	8.0
28	30	R	70	0	6.77	7.28	7.0	7.27	7.41	7.08	7.14	7.22
29	30		70	0.5	7.28	7.55	7.25	7.51	7.7	7.52	7.3	7.4
30	30		70	1	8.38	8	8.0	7.8	7.89	7.8	7.44	7.55

Table – 8 : Electrical conductivity in chatterpur soil treated with waste of different seasons

S.No.	%of waste0	Season	%of soil	%of lime	0th Day	10th Day	20th Day	30th Day	45th Day	60th Day	90th Day	120th Day
1	0		10	0	0.119	0.129	0.135	0.16	0.166	0.126	0.172	0.16
2	0		10	0.5	0.149	0.118	0.143	0.162	0.133	0.135	0.166	0.168
3	0		10	1	0.295	0.13	0.135	0.143	0.128	0.119	0.182	0.163
4	10	M	90	0	0.424	0.462	0.465	0.47	0.372	0.298	0.351	0.322
5	10	O	90	0.5	0.406	0.47	0.475	0.473	0.353	0.29	0.368	0.335
6	10	N	90	1	0.425	0.405	0.435	0.468	0.36	0.291	0.354	0.356
7	20	S	80	0	0.612	0.587	0.625	0.668	0.522	0.403	0.386	0.376
8	20	O	80	0.5	0.54	0.609	0.665	0.698	0.562	0.447	0.366	0.532
9	20	O	80	1	0.612	0.638	0.65	0.675	0.541	0.439	0.435	0.594
10	30	N	70	0	0.72	0.795	0.85	0.884	0.658	0.536	0.548	0.63
11	30		70	0.5	0.694	0.764	0.8	0.854	0.694	0.412	0.65	0.489
12	30		70	1	0.68	0.728	0.763	0.795	0.478	0.548	0.628	0.63
13	10		90	0	0.328	0.356	0.409	0.436	0.269	0.256	0.384	0.306
14	10	W	90	0.5	0.335	0.418	0.42	0.423	0.262	0.248	0.369	0.303
15	10	I	90	1	0.352	0.373	0.389	0.428	0.226	0.263	0.498	0.4
16	20	N	80	0	0.453	0.561	0.6	0.614	0.34	0.38	0.529	0.438
17	20	T	80	0.5	0.462	0.581	0.625	0.55	0.326	0.398	0.55	0.485
18	20	E	80	1	0.482	0.535	0.55	0.568	0.298	0.388	0.5	0.4
19	30	R	70	0	0.604	0.672	0.7	0.729	0.418	0.45	0.648	0.573
20	30		70	0.5	0.758	0.702	0.725	0.76	0.394	0.595	0.595	0.359
21	30		70	1	0.618	0.674	0.658	0.785	0.419	0.487	0.6	0.4
22	10		90	0	0.399	0.455	0.485	0.501	0.27	0.313	0.432	0.359
23	10	S	90	0.5	0.393	0.45	0.465	0.471	0.267	0.32	0.44	0.402
24	10	U	90	1	0.456	0.486	0.5	0.526	0.32	0.315	0.425	0.385
25	20	M	80	0	0.562	0.636	0.7	0.654	0.375	0.443	0.608	0.372
26	20	M	80	0.5	0.58	0.696	0.71	0.719	0.465	0.468	0.638	0.538
27	20	E	80	1	0.608	0.663	0.7	0.738	0.456	0.504	0.548	0.348
28	30	R	70	0	0.659	0.786	0.77	0.754	0.436	0.517	0.633	0.62
29	30		70	0.5	0.73	0.785	0.8	0.839	0.498	0.541	0.667	0.6
30	30		70	1	0.72	0.79	0.75	0.788	0.539	0.487	0.700	0.685

Table – 9 : pH of JNU soil treated with waste of different seasons

s.No.	%of waste	Season	% of soil	%of lime	0th day	10th day	20th day	30th day	45th day	60th day	90th day	120th day
1	0		100	0	8.37	8.12	8.8	8.44	7.93	7.78	6.8	7.44
2	0		100	0.5	9.08	9.24	9.16	8.87	8.17	8.07	7.02	7.55
3	0		100	1	9.25	9.1	9.21	8.99	8.27	8.13	7.22	7.85
4	10	M	90	0	8.07	8.24	8.31	8.26	7.08	7.88	7.2	7.77
5	10	O	90	0.5	7.98	8.23	8.28	8.22	7.97	7.87	7.47	7.7
6	10	N	90	1	8.17	8.08	8.26	8.28	7.94	7.9	7.52	7.52
7	20	S	80	0	7.78	8.18	8.12	8.11	7.96	7.88	7.55	7.6
8	20	O	80	0.5	7.83	8.19	8.38	8.08	7.95	7.98	7.63	7.59
9	20	O	80	1	7.91	7.92	8.22	8.08	7.84	7.97	7.69	7.55
10	30	N	70	0	7.7	7.92	8.02	7.78	7.89	7.82	7.56	7.6
11	30		70	0.5	7.78	8	8.07	7.97	7.93	7.83	7.59	7.54
12	30		70	1	7.85	8.13	8.13	8	8.07	7.9	7.59	7.57
13	10	W	90	0	8.2	7.75	8.55	8.18	8.09	7.85	7.63	7.35
14	10	I	90	0.5	8.28	8.0	8.85	8.22	7.75	7.88	7.33	7.49
15	10	N	90	1	8.44	8.1	8.98	8.18	7.79	7.94	7.45	7.63
16	20	T	80	0	7.84	7.5	8.35	8.15	7.81	7.71	7.55	7.42
17	20	E	80	0.5	7.9	7.75	8.4	8.01	7.93	7.86	7.45	7.63
18	20	R	80	1	8.3	7.95	8.5	8.06	7.96	7.89	7.53	7.9
19	30		70	0	7.8	7.4	8.2	7.9	7.99	7.86	7.7	7.26
20	30		70	0.5	7.89	7.8	8.29	7.94	7.87	7.87	7.21	7.59
21	30		70	1	8.2	7.98	8.35	7.98	7.92	7.91	7.45	7.68
22	10	S	90	0	8.17	8.3	8.25	8.05	7.99	7.9	7.6	7.45
23	10	U	90	0.5	8.24	8.44	8.35	8.09	7.87	7.92	7.35	7.65
24	10	M	90	1	8.32	8.5	8.45	8.12	7.92	7.95	7.55	7.8
25	20	M	80	0	7.71	7.98	8.15	7.86	7.96	7.83	7.69	7.6
26	20	E	80	0.5	7.35	8.65	8.3	7.91	7.74	7.86	7.57	7.78
27	20	R	80	1	7.27	9.02	8.4	7.88	7.78	7.92	7.65	7.8
28	30		70	0	7.41	7.6	7.9	7.69	7.76	7.79	7.62	7.57
29	30		70	0.5	7.58	7.8	8.0	7.76	7.79	7.81	7.62	7.7
30	30		70	1	7.85	8.2	8.1	7.81	7.84	7.89	7.83	7.99

Table – 10 : Electrical conductivity of JNU soil treated with waste of different seasons

S.No.	%of waste			%of soil	%of lime	0th Day	10th Day	20th Day	30th Day	45th Day	60th Day	90th Day	120tl Day
1	0			100	0	0.116	0.084	0.078	0.069	0.154	0.169	0.159	0.138
2	0			100	0.5	0.153	0.076	0.076	0.101	0.149	0.142	0.159	0.152
3	0			100	1	0.138	0.074	0.078	0.091	0.132	0.149	0.174	0.165
4	10			90	0	0.405	0.33	0.355	0.397	0.625	0.339	0.629	0.68
5	10		M	90	0.5	0.402	0.38	0.377	0.408	0.35	0.354	0.591	0.6662
6	10		O	90	1	0.413	0.378	0.399	0.429	0.354	0.369	0.612	0.696
7	20		N	80	0	0.538	0.529	0.556	0.608	0.528	0.509	0.927	1.051
8	20		S	80	0.5	0.576	0.592	0.558	0.548	0.56	0.52	0.954	1.051
9	20		O	80	1	0.559	0.545	0.585	0.547	0.519	0.528	1.016	1.034
10	30		O	70	0	0.669	0.65	0.71	0.776	0.654	0.589	1.22	1.328
11	30		N	70	0.5	0.679	0.686	0.649	0.686	0.69	0.668	1.225	1.327
12	30			70	1	0.695	0.666	0.666	0.696	0.685	0.694	1.176	1.283
13	10	W		90	0	0.289	0.222	0.305	0.358	0.302	0.464	0.526	0.502
14	10	I		90	0.5	0.25	0.230	0.298	0.314	0.323	0.54	0.48	0.46
15	10	N		90	1	0.314	0.26	0.3	0.324	0.329	0.53	0.5	0.49
16	20	T		80	0	0.445	0.44	0.351	0.381	0.458	0.596	0.884	0.879
17	20	E		80	0.5	0.429	0.4	0.5	0.522	0.488	0.612	0.924	0.93
18	20	R		80	1	0.418	0.407	0.522	0.501	0.451	0.623	1	0.9
19	30			70	0	0.566	0.545	0.529	0.589	0.356	0.559	1.098	1.163
20	30			70	0.5	0.532	0.522	0.559	0.596	0.391	0.639	1.109	1.1
21	30			70	1	0.512	0.482	0.582	0.614	0.387	0.669	1.059	1.155
22	10			90	0	0.328	0.3	0.348	0.409	0.375	0.343	0.6	0.474
23	10		S	90	0.5	0.348	0.325	0.335	0.389	0.393	0.363	0.565	0.44
24	10		U	90	1	0.34	0.328	0.4	0.43	0.399	0.413	0.59	0.465
25	20		M	80	0	0.52	0.48	0.522	0.572	0.542	0.483	0.899	1.02
26	20		M	80	0.5	0.552	0.5	0.549	0.569	0.562	0.503	0.95	0.97
27	20		S	80	1	0.549	0.502	0.489	0.516	0.54	0.513	1.019	1.03
28	30		R	70	0	0.649	0.6	0.665	0.7	0.606	0.628	1.233	1.28
29	30			70	0.5	0.626	0.585	0.622	0.659	0.646	0.708	1.25	1.3
30	30			70	1	0.557	0.6	0.631	0.661	0.632	0.738	1.176	1.202

Table – 11 : Available phosphorus (ppm) in Chatterpur soil treated with waste of different seasons

S.No.	%of waste	Season	%of soil	%of lime	0th day	10thday	20th day	30th day	45th day	60th day	90th day	120th day
1	0		100	0	9.25	10.35	11.12	8.98	6.56	5.72	5.28	5
2	0		100	0.5	12.8	13	13.98	10.92	8.52	7.02	6.98	6.5
3	0		100	1	10.5	11	11.99	9.92	8	6.72	6.09	5.5
4	10		90	0	8.65	9.5	10.45	8	6.08	4.99	4.48	4.12
5	10	M	90	0.5	11	12.09	14.99	9.25	7	5.44	4.83	4.54
6	10	O	90	1	9.58	11.19	13.01	8.45	6.41	5.28	4.64	4.38
7	20	N	80	0	6.81	7.79	8.98	7.2	5.72	4.34	4	3.42
8	20	S	80	0.5	8.6	10.6	11.45	7.68	6.36	5.08	4.54	4.2
9	20	O	80	1	7.03	9.42	10.72	7.45	5.92	4.78	4.28	4.1
10	30	O	70	0	4.53	6.35	8.99	6.43	4.8	4.09	3.5	3.07
11	30	N	70	0.5	6.55	7.95	10.02	7	5.28	4.57	3.9	3.6
12	30		70	1	7.43	8.51	12.19	7.36	5.72	5.08	4.5	4
13	10		90	0	6.68	10.64	12.08	10.02	8.78	5.34	5.8	4.22
14	10	W	90	0.5	8.22	13.99	14.72	11.56	9.7	6.4	5.45	4.83
15	10	I	90	1	7.23	12.06	13.45	10.76	8.92	5.72	4.01	4.54
16	20	N	80	0	5.52	9.02	10.91	9.9	7.5	4.28	5	3.74
17	20	T	80	0.5	7.03	10.2	12.19	10.39	8.31	5.28	4.58	4.54
18	20	E	80	1	6.23	9.8	11.01	10.08	7.35	5.12	3.32	4.25
19	30	R	70	0	4.65	6.53	9.03	8.32	6.01	3.77	5.32	3
20	30		70	0.5	6.88	8.16	10.79	9.91	7.98	6.08	6.28	4.8
21	30		70	1	7.86	9.16	11.98	10.05	8.01	7.09	5.28	5.5
22	10		90	0	5.88	7.52	10.19	8.1	6.35	5.69	6.88	4.86
23	10	S	90	0.5	6.33	8.85	13.17	11.05	9.14	7.2	5.88	6.08
24	10	U	90	1	6.03	8.01	12.01	9.98	7.43	6.4	4.54	5.34
25	20	M	80	0	4.6	6.48	9.03	7.13	5.98	4.7	4.83	4
26	20	M	80	0.5	5.31	7.4	11.15	9.19	8.02	5.31	4.73	4.32
27	20	E	80	1	4.7	6.98	10.01	8.5	6.94	5.05	3.5	4.12
28	30	R	70	0	3.45	5.6	8.39	6.45	5.01	4	3.9	2.9
29	30		70	0.5	3.96	6.07	10.45	7.01	5.45	4.38	4.48	3
30	30		70	1	4.22	6.69	8.95	8.08	6.13	5.4	4.48	3.5

Table – 12 : Available phosphorus (ppm) in JNU soil treated with waste of different seasons

S.No.	%of waste	Season	%of soil	% of lime	0th day	10thday	20th day	30th day	45th day	60th day	90th day	120th day
1	0		100	0	13.01	16.52	17.94	14.72	12.61	6.25	6	5.5
2	0		100	0.5	16.49	19.41	20.52	16.83	14.53	6.75	6.35	6
3	0		100	1	14.29	17.12	19.11	16.51	13.4	6.43	6.15	5.8
4	10		90	0	12.05	15.3	16.81	12.1	7.87	5.81	5.5	4.5
5	10	M	90	0.5	15.5	18.1	19.41	13.31	8.16	6.21	6	5.1
6	10	O	90	1	13.09	16.9	17.15	12.48	7.68	6.01	5.8	4.9
7	20	N	80	0	9.21	12.16	13.01	10.53	6.92	4.8	4.3	3.5
8	20	S	80	0.5	11.16	14.26	15.91	10.27	8.08	5.25	5	4.2
9	20	O	80	1	13.17	13.98	14.02	11.1	7.68	5.1	4.8	3.8
10	30	O	70	0	7	11.2	13.18	8.16	5.92	3.36	3	2.7
11	30	N	70	0.5	9.8	12.24	15.11	9.89	6.44	3.8	3.51	3
12	30		70	1	10.98	13.23	16.21	12.83	6.85	4.48	4.52	4.19
13	10		90	0	11.98	14.68	16.39	13.52	10.27	7.08	6.28	5.94
14	10	W	90	0.5	14.01	17	18.62	16.18	13.35	8.81	7.85	6.5
15	10	I	90	1	13.15	16.55	17.11	15.22	11.72	8.18	7.25	6.18
16	20	N	80	0	9.19	11.4	12.02	10.25	8.1	6.08	5.24	4.95
17	20	T	80	0.5	11.95	14.04	16.04	14.18	12.19	8.4	7.04	6.25
18	20	E	80	1	10.21	13.24	14.83	11.15	10.9	7.18	6.9	5.39
19	30	R	70	0	8	10.05	10.9	8.01	6	4.8	4.5	4.2
20	30		70	0.5	9.12	12.19	11.9	8.91	6.68	5.98	5.24	5
21	30		70	1	10.1	13.1	10.44	9.42	7.8	6.37	6	5.52
22	10		90	0	12.91	14.53	15.54	12.37	9.4	6.64	6.5	6
23	10	S	90	0.5	15.1	16.26	17.09	14.23	11.94	8.04	7.52	7.2
24	10	U	90	1	14.13	15.04	16.64	13.32	14.84	7.47	7.01	6.2
25	20	M	80	0	10.19	12.5	13.54	10.77	7.31	6.03	5.5	4.5
26	20	M	80	0.5	13.88	14.26	15.09	12.85	8.31	6.73	6.2	5.28
27	20	E	80	1	12.1	13.63	14.04	11.08	7.88	6.5	6	5.02
28	30	R	70	0	8.12	10.9	11.99	8.96	6.53	4.58	4.25	4
29	30		70	0.5	9.59	11.86	12.93	10.78	7.26	5.98	5.68	5.23
30	30		70	1	10.98	13.08	14.63	12.09	9.63	6.18	5.98	5.75

Table No. 13: Total phosphorus of Chatterpur soil treated with industrial waste of different

	%of waste		%of soil	%of lime	0th day	10th day	20th day	30th day	45th day	60th day	90th day	120th day
1	0		100	0	0.024	0.028	0.032	0.038	0.033	0.03	0.028	0.026
2	0		100	0.5	0.024	0.029	0.032	0.039	0.033	0.03	0.029	0.028
3	0		100	1	0.024	0.028	0.033	0.038	0.034	0.029	0.028	0.026
4	10		90	0	0.026	0.03	0.034	0.04	0.036	0.032	0.03	0.028
5	10	M	90	0.5	0.026	0.032	0.035	0.042	0.037	0.033	0.03	0.028
6	10	O	90	1	0.026	0.031	0.036	0.041	0.037	0.033	0.031	0.029
7	20	N	80	0	0.028	0.033	0.036	0.042	0.039	0.035	0.033	0.03
8	20	S	80	0.5	0.028	0.32	0.036	0.042	0.038	0.035	0.033	0.031
9	20	O	80	1	0.028	0.033	0.039	0.042	0.038	0.034	0.032	0.03
10	30	O	70	0	0.031	0.035	0.04	0.045	0.042	0.038	0.036	0.034
11	30	N	70	0.5	0.031	0.034	0.039	0.045	0.04	0.038	0.036	0.033
12	30		70	1	0.031	0.035	0.037	0.045	0.039	0.037	0.035	0.033
13	10		90	0	0.028	0.032	0.037	0.043	0.04	0.036	0.033	0.03
14	10	W	90	0.5	0.028	0.033	0.038	0.043	0.4	0.035	0.032	0.03
15	10	I	90	1	0.028	0.033	0.04	0.044	0.04	0.035	0.032	0.031
16	20	N	80	0	0.032	0.036	0.04	0.046	0.041	0.038	0.035	0.033
17	20	T	80	0.5	0.032	0.035	0.041	0.045	0.042	0.038	0.035	0.033
18	20	E	80	1	0.032	0.036	0.046	0.046	0.042	0.039	0.035	0.032
19	30	R	70	0	0.037	0.041	0.045	0.052	0.045	0.042	0.038	0.035
20	30		70	0.5	0.037	0.042	0.045	0.052	0.046	0.042	0.037	0.035
21	30		70	1	0.037	0.042	0.04	0.053	0.046	0.043	0.036	0.034
22	10		90	0	0.029	0.034	0.04	0.053	0.042	0.04	0.036	0.034
23	10	S	90	0.5	0.029	0.034	0.04	0.045	0.042	0.039	0.037	0.034
24	10	U	90	1	0.029	0.033	0.039	0.045	0.043	0.04	0.036	0.034
25	20	M	80	0	0.033	0.038	0.043	0.048	0.045	0.04	0.037	0.036
26	20	M	80	0.5	0.033	0.038	0.044	0.048	0.046	0.042	0.04	0.038
27	20	E	80	1	0.033	0.037	0.043	0.047	0.045	0.042	0.039	0.037
28	30	R	70	0	0.038	0.043	0.048	0.055	0.05	0.046	0.044	0.04
29	30		70	0.5	0.038	0.044	0.048	0.053	0.05	0.047	0.044	0.039
30	30		70	1	0.038	0.045	0.05	0.053	0.049	0.046	0.044	0.041

Table – 14 : Total phosphorus (%) of JNU soil treated with waste of different seasons

S.No.	%of waste	Season	%of soil	%of lime	0th day	10th day	20th day	30th day	45th day	60th day	90th day	120th day
1	0		100	0	0.052	0.055	0.058	0.05	0.04	0.037	0.03	0.02
2	0		100	0.5	0.052	0.054	0.056	0.051	0.041	0.038	0.032	0.021
3	0		100	1	0.052	0.056	0.058	0.051	0.043	0.042	0.033	0.022
4	10		90	0	0.051	0.057	0.06	0.052	0.046	0.044	0.035	0.025
5	10	M	90	0.5	0.051	0.056	0.06	0.052	0.047	0.042	0.032	0.027
6	10	O	90	1	0.051	0.058	0.059	0.051	0.049	0.045	0.035	0.025
7	20	N	80	0	0.05	0.057	0.061	0.053	0.05	0.046	0.036	0.031
8	20	S	80	0.5	0.05	0.058	0.062	0.054	0.05	0.048	0.038	0.03
9	20	O	80	1	0.05	0.058	0.062	0.053	0.051	0.047	0.037	0.034
10	30	O	70	0	0.049	0.059	0.063	0.055	0.052	0.05	0.04	0.031
11	30	N	70	0.5	0.049	0.06	0.061	0.055	0.051	0.049	0.039	0.034
12	30		70	1	0.049	0.06	0.062	0.056	0.052	0.05	0.045	0.04
13	10		90	0	0.053	0.056	0.062	0.051	0.044	0.04	0.038	0.035
14	10	W	90	0.5	0.053	0.057	0.06	0.052	0.044	0.042	0.04	0.037
15	10	I	90	1	0.053	0.058	0.061	0.05	0.048	0.045	0.041	0.039
16	20	N	80	0	0.055	0.058	0.06	0.056	0.05	0.048	0.045	0.04
17	20	T	80	0.5	0.055	0.06	0.061	0.055	0.05	0.046	0.044	0.042
18	20	E	80	1	0.055	0.059	0.06	0.055	0.051	0.047	0.042	0.038
19	30	R	70	0	0.056	0.059	0.06	0.056	0.047	0.05	0.045	0.041
20	30		70	0.5	0.056	0.061	0.062	0.056	0.048	0.052	0.048	0.044
21	30		70	1	0.056	0.062	0.063	0.058	0.048	0.05	0.048	0.045
22	10		90	0	0.055	0.062	0.064	0.054	0.041	0.043	0.039	0.032
23	10	S	90	0.5	0.055	0.061	0.062	0.052	0.043	0.045	0.04	0.033
24	10	U	90	1	0.055	0.062	0.063	0.053	0.044	0.047	0.041	0.032
25	20	M	80	0	0.054	0.06	0.061	0.051	0.043	0.04	0.038	0.036
26	20	M	80	0,5	0.054	0.058	0.06	0.05	0.044	0.045	0.04	0.035
27	20	E	80	1	0.054	0.062	0.063	0.053	0.045	0.042	0.04	0.036
28	30	R	70	0	0.057	0.065	0.067	0.055	0.048	0.045	0.041	0.038
29	30		70	0.5	0.057	0.065	0.067	0.057	0.05	0.047	0.041	0.038
30	30		70	1	0.057	0.064	0.067	0.056	0.05	0.046	0.042	0.04

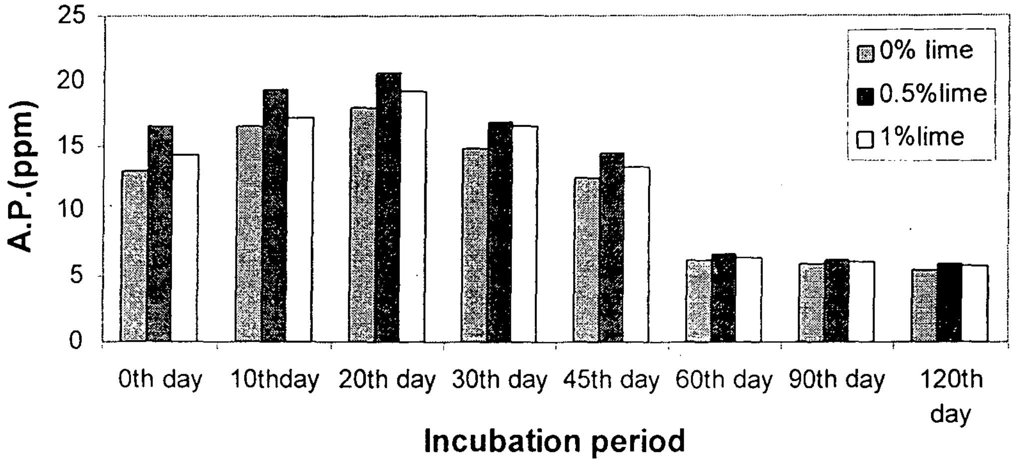


Fig 4 : Available Phosphorus (AP) in JNU soil treated with 0% waste (M)

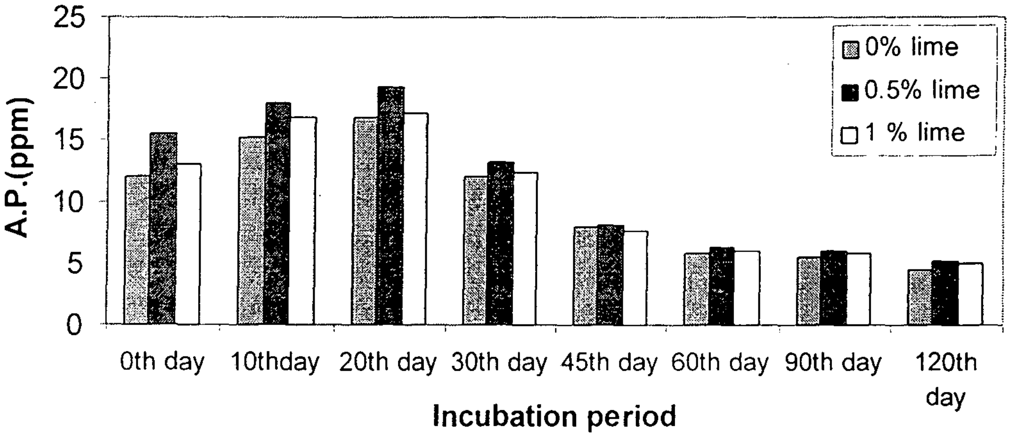


Fig 5 : Available Phosphorus (AP) in JNU soil treated with 10% waste (M)

Fig 6 : Available Phosphorus in JNU soil treated with 20% waste (M)

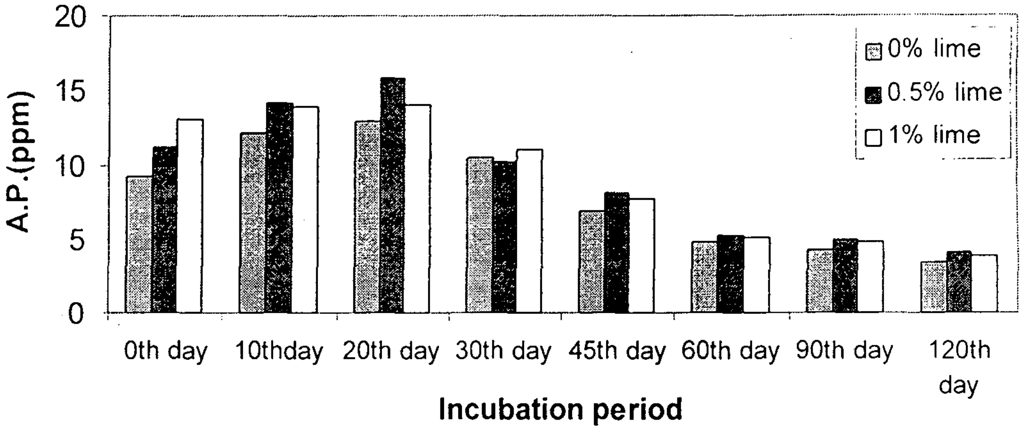


Fig 7 : Available Phosphorus (AP) in JNU soil treated with 30% waste(M)

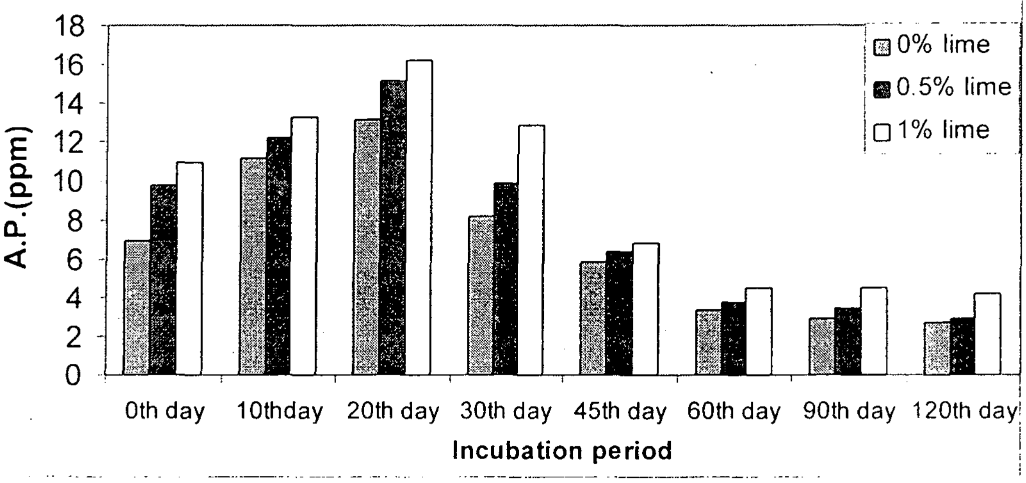


Fig 8 : Available Phosphorus in JNU soil treated with 10% waste(W)

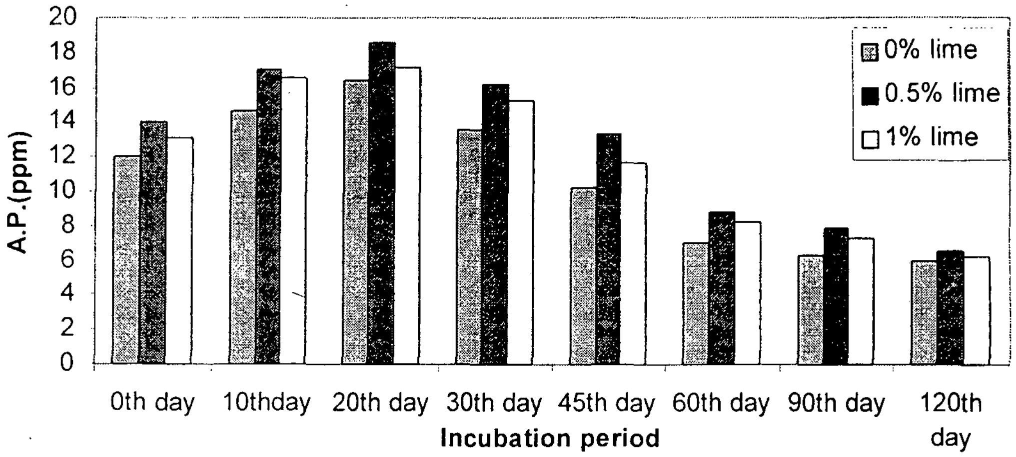


Fig 9 : Available Phosphorus in JNU soil treated with 20% waste (W)

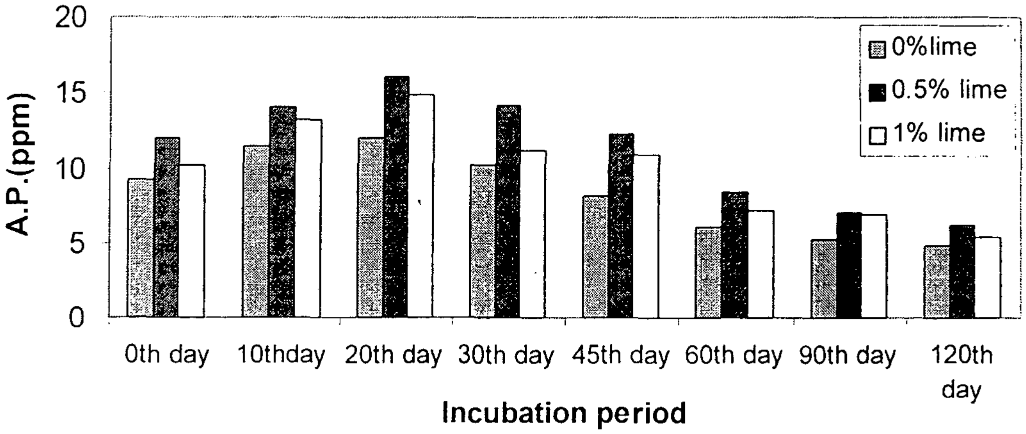


Fig10 : Available Phosphorus in JNU soil treated with 30% waste (W)

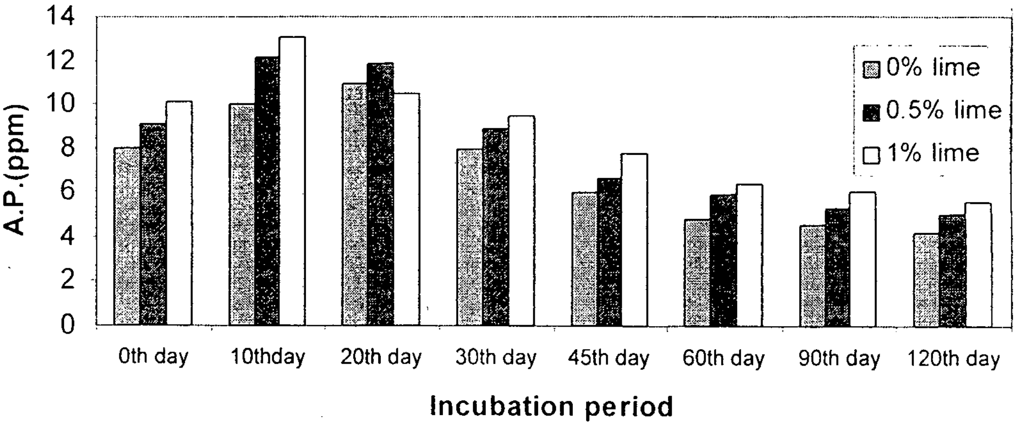


Fig 11 : Available Phosphorus in JNU soil treated with 10% waste (S)

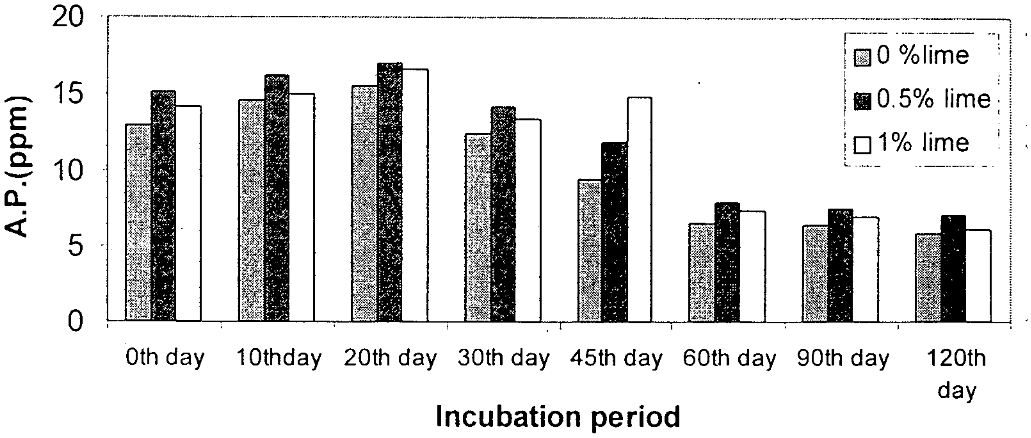


Fig 12 : Available Phosphorus in JNU soil treated with 20% waste (S)

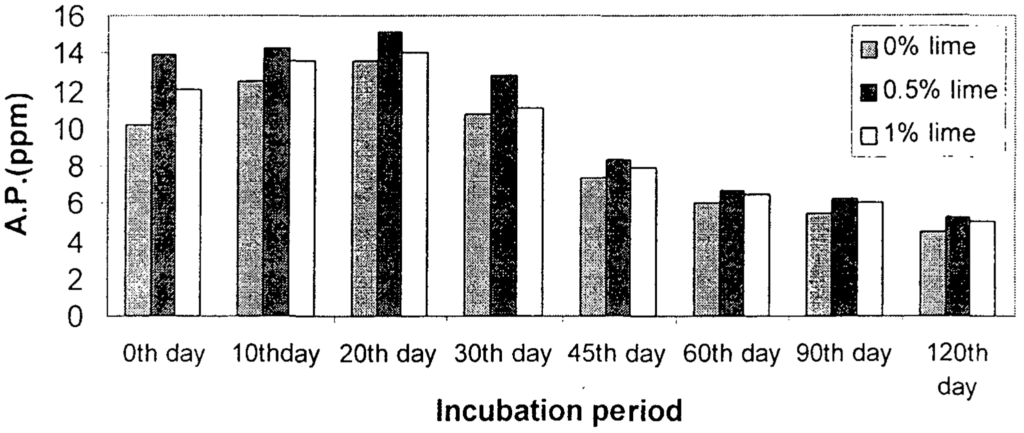


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Fig 13 : Available Phosphorus in JNU soil treated with 30% waste (S)

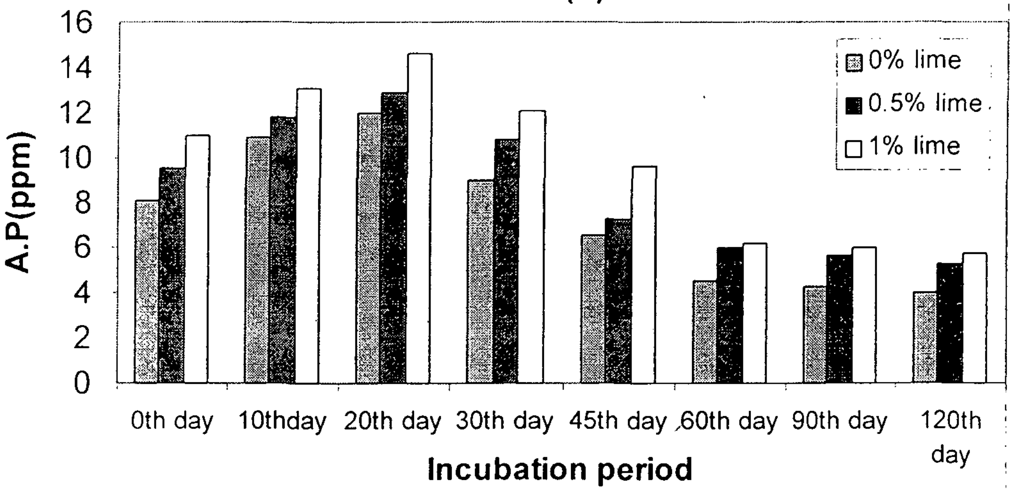


Fig 14: Available phosphorus (AP) in Chatterpur soil with 0% waste (M)

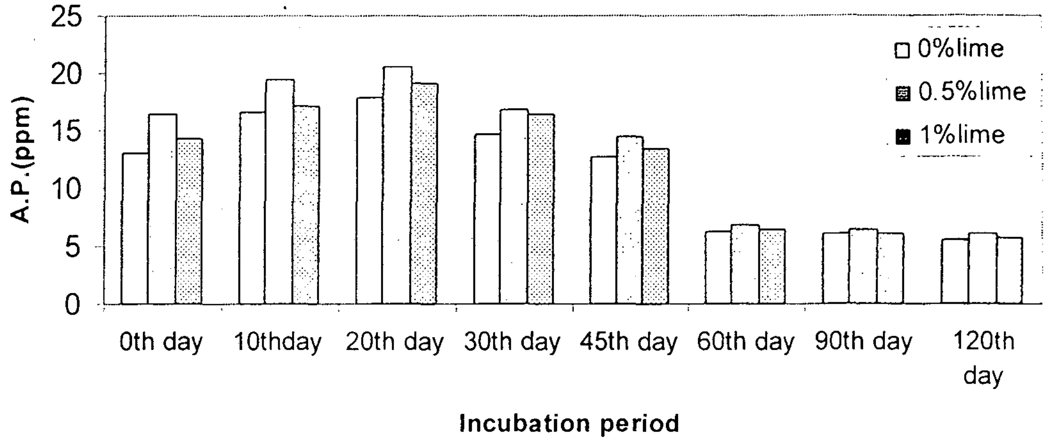


Fig 15: Available phosphorus (AP) in Chatterpur soil treated with 10% waste(M)

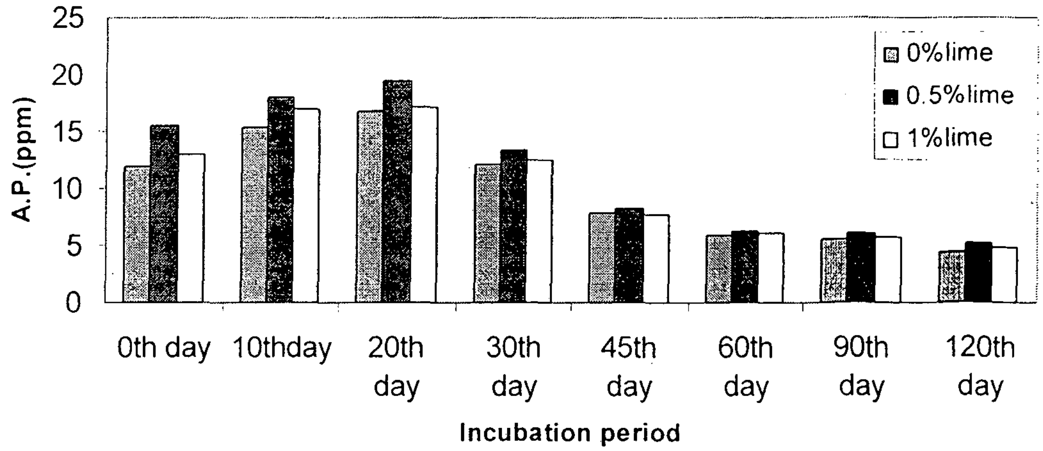


Fig 16 : Available Phosphorus (AP) in Chatterpur soil treated with 20% waste (M)

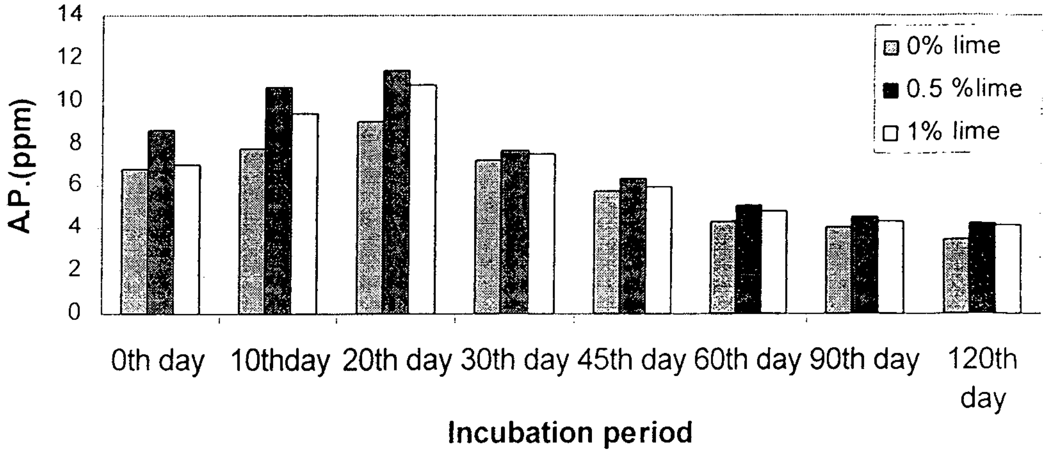


Fig 17 : Available Phosphorus (AP) in Chatterpur soil treated with 30% waste (M)

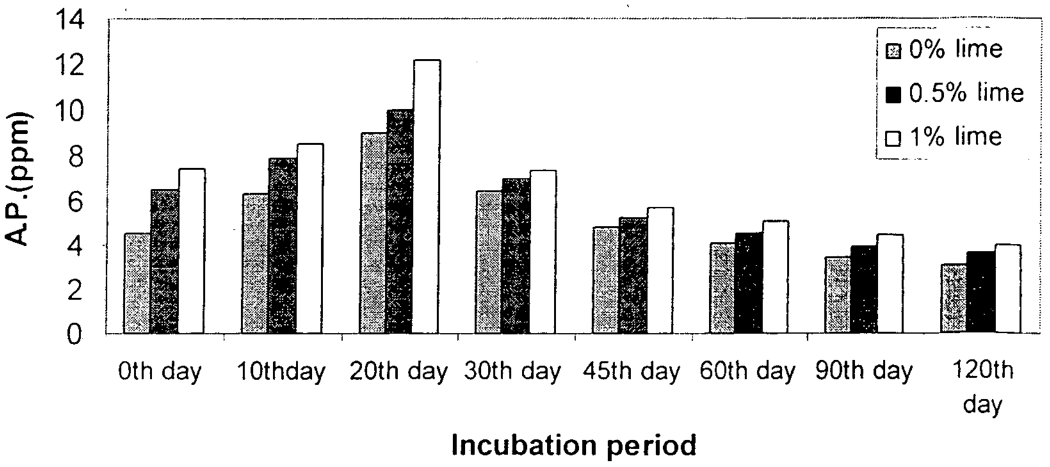


Fig 18 : Available Phosphorus (AP) in Chatterpur soil treated with 10% waste (W)

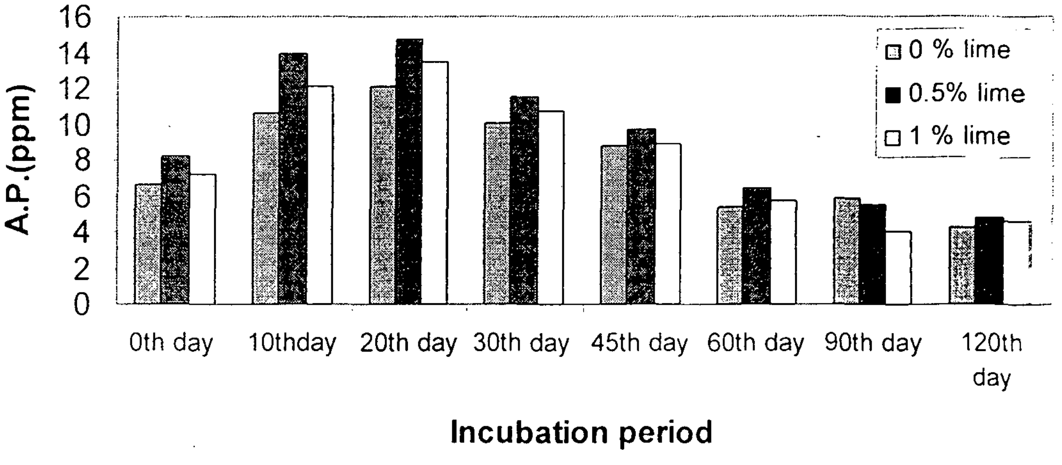


Fig 19 : Available Phosphorus (AP) in Chatterpur soil treated with 20% waste (W)

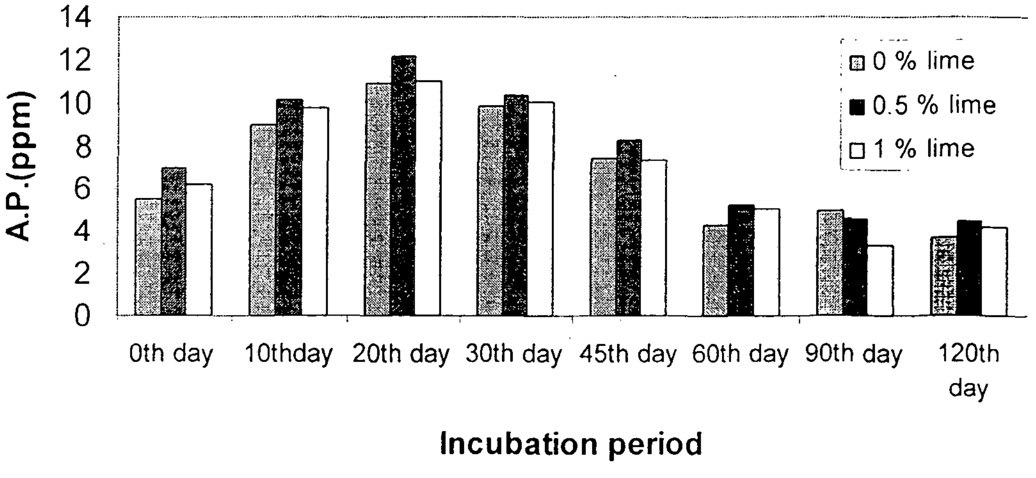


Fig 20 : Available Phosphorus (AP) in Chatterpur soil treated with 30% waste (W)

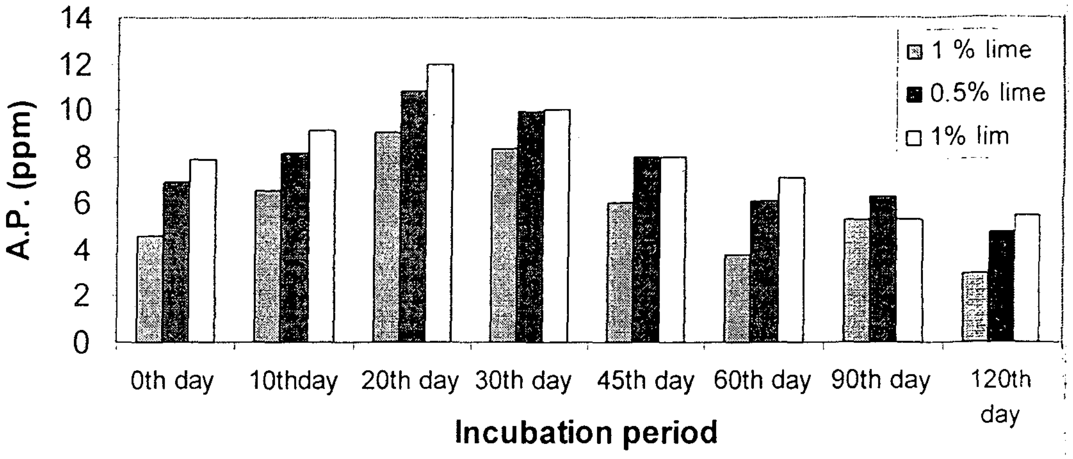


Fig 21 : Available Phosphorus (AP) in Chatterpur soil treated with 10% waste (S)

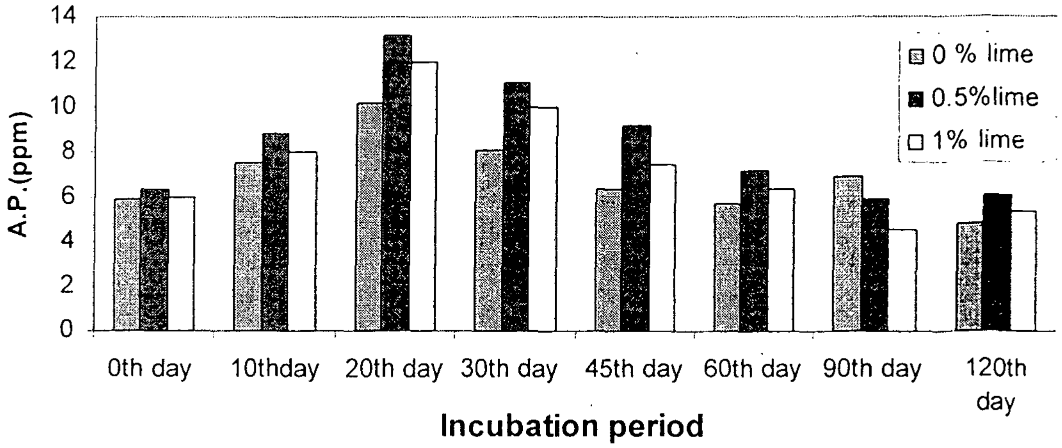


Fig 22: Available Phosphorus (AP) in Chatterpur soil treated with 20% waste (S)

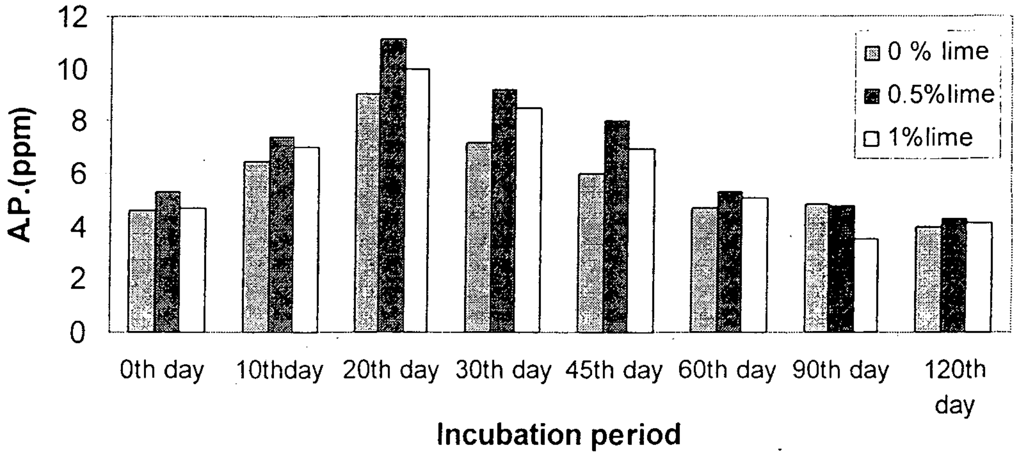
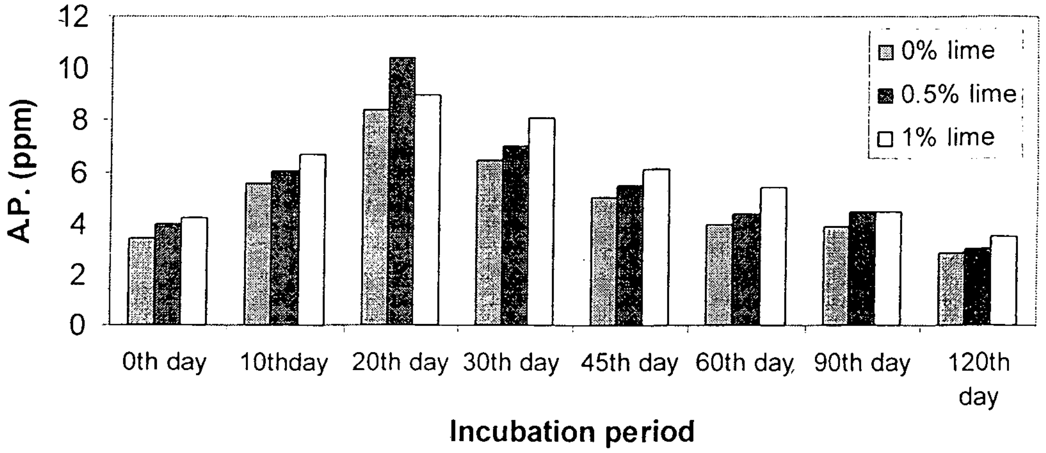


Fig 23 Available Phosphorus (AP) in Chatterpur soil treated with 30% waste (S)



pH

From the table 5 it is noted that JNU soil (uncontaminated) pH value was 8.55 and Chatterpur soil (contaminated and cultivated) show pH value of 8.61.

It is also evident from the same table waste collecting the monsoon season was having pH value 5.25 followed by waste in summer season 3.28 and pH value of 2.78 was observed in waste collected in winter season. (M>S>W>).

In other words, the winter sample was the most acidic one.

From the table -7 it is clear that when 100% Chatterpur soil is treated with 0, 0.5, 1.0 % lime the pH value on 0th day become 8.57, 9.86, 10.5 respectively. This is in the expected lime.

But with the passage of 120th days the final pH values turn out to be 7.96, 8.2, and 8.32. the result thus show pH values are reduced or neutralize to certain extent.

Similar observation was found by Emil Rydin and Erasmus Otabbong in 1997.

In absence of lime as the %age of waste increased there was corresponding reduction in pH value during the incubation study in all three season (table-7), in Chatterpur soil.

Similar trends of pH values were observed also in JNU soil treated with different doses of waste (Table-9).

Available phosphorus

From table 11and 12 it is clear that available phosphorus in both soil in absence of waste and lime shows the value of around 13ppm and 9ppm for JNU and Chatterpur soil respectively. Its value increases by application of 0.5 and 1% lime. 0.5% lime gives the better result in comparison 1% lime dose.

Up to 20th days of application of waste with lime gives the maximum availability of phosphorus in both soil as JNU and Chatterpur (Table 11 and 12).

In case of 30% of waste along with the 1% lime has increased the Available phosphorus content of both JNU and Chatterpur soil and that is also valid within 20 days of incubation period (Table11 and 12).

E.C.

From the table -5 it was observed that Chatterpur soil have more E.C.(0.1mili siemens/cm) than JNU soil (0.09 mili siemens/cm) soil. It was also observed that waste collected in winter season have the highest EC value (1.2 mili siemens/cm)followed by summer waste (1.18 mili siemens/cm) and monsoon waste (0.044 mili siemens/cm).

From table 5 it can be say that winter waste contains highest no. of cations than other 4 samples.

From table 8 it is clear that in cent percent soil EC values for 0, 0.5, 1% were 0.119 0.179 and 0.259 respectively. But with the passage of incubation period .It was increased for 0 and 0.5% lime but decreased for 1% lime (0.16, 0.168, and0.163 mili siemens/cm).

During incubation period it was cleared (Table 8) that EC values of soil treated with 0.5 % lime till 30th day after that it has decreased .Same pattern was followed by each sample.

From table 8 it is clear that in cent percent soil EC values for 0, 0.5, 1% were 0.119 0.179 and 0.259 respectively. But with the passage of incubation period , it was increased for 0 and 0.5% lime but decreased for 1% lime (0.16, 0.168, and0.163 mili siemens/cm).

During incubation period it was cleared (Table 8) that EC values of soil treated with 0.5 % lime till 30th day after that it has decreased. Same pattern was followed by each sample.

From Table10 it is clear that EC (mili siemens/cm) for JNU soil with 0, 0.5, and 1% lime

With the waste with same %age of lime from Table 10 it is cleared that EC was increased incubation study also .But maximum EC was found with 1% lime treatment.

Total phosphorus

From table 13 it is clear that total phosphorus for 0th day of chatterpur soil was unchanged with respect to lime treatment. It was highest for 30th day but after that it was in decreasing order (45,60,90,120 day).

Same treated was also obtained for chatterpur soil treated with different waste with lime.

From table 14 it is cleared that total P for 0th day was unchanged with respect to lime treatment in pure JNU soil .It also cleared from table 14 that total P was highest at 20th day and after it was in decreasing order.

Total P of JNU soil which treated with monsoon showed the different pattern that it was in decreasing order with decreasing %age of waste . This can be explain by table 5 which show that monsoon season waste have lower phosphorus

CHAPTER 6

CONCLUSIONS

CONCLUSION

The available phosphorous generally increased up to 20th day of incubation. After that from 30th day the available phosphorous of the amended soil was found to continuously decreasing and had gone more than 50% reduction at the end of experiment (4month).The 0.5 %lime treatment gave the better result because at this lime dose available phosphorous was high in each season's sample and for pure soil also .But it was applicable only up to 20%waste amended soil.

For 30% waste amended soil 1% lime gave the better result in comparison to other.

Total P was increased up to 30th day for Chatterpur soil then it decreased continuously up to end of experiment. But for JNU soil it increased up to only 20th day then it follow the same order like previous soil

Study focused on determining potentially mobile-P and change in different P-fraction associated with rainwater percolation. The results are also of interest from a plant nutrition standpoint since the amount of potentially mobile phosphorous measured in this experiment can be related the amount of potentially crop-available phosphorous.

We always think about economically beneficial site of any experiment. Here we try to find out to decrease the toxic affect of industrial waste. From the results the status of available phosphorous shows that this waste can be used as a resource material. If we grow a plant or crop in this waste amended soil there is no need of giving any phosphorous fertilizers. Up to 20th day one can get benefit of this accumulated increased amount of available phosphorus.

Everybody knows that utility of phosphorous for plant growth maximum required at the time of flowering and fruiting. But this is not only the consideration of experiment. Here we have also to consider the time of cropping, type of waste, type of soil, mobility of available phosphorous and moisture content of soil. By considering all these factors one can not easily reduce the volume of waste but utilize the essential element released in the decomposition process. Moreover, considerable has been thrown through this work on the status of available phosphorus in soil treated with said industrial waste in presence or absence of lime and future work can be undertaken on fill studies.

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