COMPUTER ASSISTED DIAGNOSIS OF PLANT NUTRIENT DEFICIENCY SYMPTOMS

A CASE STUDY OF NITROGEN PHOSPHORUS AND POTASSIUM DEFICIENCY IN MAIZE CROP

BY

BELLO ABDULMUMIN SULAIMAN
PGD/MCS/508/97/98

PROJECT SUBMITTED TO THE DEPARTMENT OF MATHEMATICS, AND COMPUTER SCIENCE OF FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA.

IN PARTIAL FULFILLMENT FOR THE AWARD OF POST GRADUATE DIPLOMA IN COMPUTER SCIENCE.

SEPTEMBER, 2000

CERTIFICATION

We wish to certify that this project is an original work carried out by Bello A. Sulaiman and has been prepared in accordance with the regulations governing the preparation and presentation of projects in the department of Mathematics and Computer Science, Federal University of technology, Minna, Niger State, Nigeria.

....
Professor K. R. Adeboye
(Supervisor)

....
Dr. S. A. Reju
(Head of Department)

....
(External Examiner)

DEDICATION

This project work is dedicated to Almighty Allah, the most beneficent, the most merciful, the most kind, the knower of what is HIDEN and what is OPENED; His Messenger Prophet MUHAMMAD (S. A. W) the LAST of ALL Prophets, family of Sulaiman Bello, and to my beloved mother Mallama Wosilat Sulaiman Bello.

DECLARATION

I hereby declare that this project was written solely by me and it is a record of my research work under the supervision of Professor K. R. Adeboye of the Department of Mathematics and Computer Science, Federal University of Technology, Minna. That it has not in any form been presented to any other organization for any purpose.

All sources of information are acknowledged as references.

....
Bello A. Sulaiman

ACKNOWLEDGEMENT

I am grateful to Almighty Allah (S.W.T) for sparing my life and giving me courage to undertake this project.

I wish to express my profound gratitude and appreciation to my able supervisor, **Professor K. R. Adeboye** for his constructive criticism which encouraged me to produce this quality work.

I am also equally indebted to the Head of Department of Mathematics and Computer Science **Dr. S. A. Reju** for his fatherly advice and interest.

Sincerely and faithfully thanks are due to the **project co-ordinator and all the lecturers in the department** for their endless efforts towards the success of the work.

Sincere thanks go to my brother *Mallam Lukman Sulaiman* for moral and financial support. I also wish to thank my parent *Late Alhaji Sulaiman Bello* and *Mallam Wosilat Sulaiman Bello* for their endless labour on the success of the entire *Sulaiman Bello* family.

TABLE OF CONTENTS

PAGE

Title Page..i
Certification..ii
Dedication..iii
Declaration..iv
Abstract..v
Acknowledgement..vi
Table of Contents..vii

CHAPTER ONE

1.0 Introduction..1

1.1 Aim and Objective of the study on diagnosis of plant nutrient deficiency symptom..1

1.2 Plant nutrient deficiency symptom..1

1.21 History of artificial intelligence..2

1.22 Expert system..3

1.23 History of maize crop..6

CHAPTER TWO

2.0 Review of plant nutrient diagnosis..8

2.1 Study on plant nutrients..8

2.2 Feasibility study on the existing method of diagnosing nutrient deficiency..9

2.3 Limitation of the existing method of diagnosis..11

CHAPTER THREE

3.0 Analysis of the Existing system..12

3.1.0 Analysis of the existing method of diagnosing nitrogen..12

3.1.1 Analysis of the existing method of diagnosing phosphorus deficiency in maize crop..12

3.1.2 Analysis of the existing method of diagnosing potassium deficiency in maize crop plant . . . 12

3.2 Main objective of system analysis on diagnosing in maize crop plant . . . 13

3.3 Information Accessibility on the project work . . . 15

CHAPTER FOUR

4.0 New System Design . . . 16

4.1 New System Specification . . . 16

4.2 Justification of the New System . . . 17

4.3 System requirement (New System Requirent) . . . 17

4.4 Design input specification Database on the system . . . 17

4.5 Cost implication of the new system for diagnosing N.P.K. deficiency symptom . . . 20

4.6 Structure of input specification Data base file . . . 21

4.7 Modular program structure (procedure) . . . 21

CHAPTER FIVE

5.0 System implementation . . . 24

5.1 Programming (written program) . . . 24

5.2 Installation of the new system . . . 24

5.3 New system testing . . . 25

5.4 Conversation (i.e change over from old system to New System) . . . 27

5.5 New system maintenance . . . 27

5.6 Conclusion and Recommendation . . . 27

5.6.1 Conclusion . . . 27

5.6.2 Recommendation . . . 28

REFERENCES . . . 30

ABSTRACT

Due to nutritional value and wide utilization of these primary nutrient elements in the growth of maize and vitality of maize crop-plant and yield production, expert system is applied to diagnose the primary nutrient element deficiency symptoms and corrective measures in maize crop. The existing method is carefully studied using several finding techniques and analysis. The techniques employed for fact finding are record review, interview and observation; journals review. System development method is employed to evaluate all aspects of the existing system of diagnosing plant nutrient deficiency symptom in maize crop-plant and to design a new system to compliment the existing one. In designing the new system, a computer program is written in modules for selecting the process under the main menu for execution. The records under main menu include consultation update and Exit All these are aimed at establishing a new system that will improve on the diagnosing nitrient deficiency symptoms in maize crop.

CHAPTER ONE

1.0 INTRODUCTION

1.1 AIM AND OBJECTIVE OF STUDY ON DIAGNOSIS OF PLANT NUTRIENT DEFICIENCY SYMPTOM.

This project is aimed at studying the existing method of diagnosing plant nutrient deficiency symptoms in maize crop plant with a view of improving on it, through the use of computer Assisted Diagnosis (CAD) using Expert System facilities of the computer. The project is geared towards establishing the fact that improvement can be made on procedures and methods adopted in diagnosing nutrient deficiency symptoms in crop plant through the use of computer as a means of storing, filing and processing of all the data relating to deficiency symptoms accurately and reliable.

The necessity to carry out this project arises from the following:

(a) to solve or reduce the problems associated with wrong application of fertilizer to maize crop.

(b) To encourage cultivation of maize crop with low production cost.

(c) To fulfil the requirement for the award of post graduate diploma in computer science.

1.2 PLANT NUTRIENT DEFICIENCY SYMPTOM

The characteristic signs revealed by the plant(s) due to lack of one or a few of the nutrient element(s) is known as deficiency symptom.

The plant may develop mineral deficiency disease recognizable by symptoms of deficiency of that element. Lack or deficiency of any of the essential nutrient element results in cessation of growth or even death of crop plant, it may also result in stunted growth or premature sexual maturity and senescence, chlorosis, and Necrosis.

Nutrient deficiency symptoms for individual element vary considerably from plant to plant. Nevertheless there are certain classified symptoms which are commonly associated with shortage or lack of the individual element.

1.21 HISTORY OF ARTIFICIAL INTELLIGENCE

Artificial intelligence is the science of making machine do things that would required intelligence if done by man. Artificial intelligent is seen as means of throwing light on, for example human conversation or learning ability. Some aimed simply to build clever toys such as Amcubot, a robot (with fingers, eyes and brain) that can solve any scrambled Rubic cube in less than four (4) minutes, while other artificial intelligence, researchers works in the mainstream of common computer manufacture concerned merely with the development of successful commercial product.

Theoretical artificial intelligence found are relevant to any area of interest, but the main thrust behind fifth generation research is to generate practical systems that will have a beneficial on society on the viability of industrial economics and a quality of life. Nelsser (1967) proposed a specific information processing model comprising specific memory stores and processes, and by 1980, all part was able to declare that ..... the advent of Artificial intelligent is the single most important development in the history of psychology.

Homer, was acquainted with the concept of Artificial intelligence perhaps 800 years B.C. and the ancient historian polybios believed that Nabis, a director of sports (about 200 B.C) used a robot to compel rich citizens to pay their taxes.

In 1879, Villiers de I'Isle Adam depicts a remarkable woman animated by electricity. In the seventeenth century, boats were constructed with animated figures. In 1890, a wooden cat was constructed and was able to catch rats and dance tiger flies.

In the eighteenth century, Switzerland craft men (such as Pierre, Henri-bouis and Joquet-Droz) devised automata, that could write, draw pictures and play musical instruments.

1.22 EXPERT SYSTEM

Expert systems are computer programs which store and interpret human expertise. They are used to give advice and reach decisions in the light of evidence given to them in much the same way as human experts would be consulted. The computer based expert system can help solve a range of problems in a specialized field of knowledge by asking question, considering relevant factors and then giving a considered opinion or decision. For example there are expert systems that give advice on personal finance and taxes, that interpret complex legislation, that advice farmers on crop-protection, that diagnose faults in equipment, that evaluate field evidence in geological prospecting e.t.c. Increasingly, expert systems are being used to model kowledge that has not previously been represented in conventional programming. Since early eighties (80s), few famous expert system have been exploited commercially for example, prospector which sets as a geological adviser, and computer manufacturer Dec's Xcon which figures VAX computers.

To refine the earlier definition, Expert system is a computing system which embodied organised knowledge about some area of human expertise which enables it to perform as a skilful and cost effective consultant: by Donald Michiel an early pioneer in field of Artificial intelligent.

Expert system are being developed to solve a range of practical problems. Expert systems have been defined as (quoted by d'Agapeyeff 1983) "Problem solving program that solve substantial problems generally considered as being difficult and required expertise". They are called knowledge based because their performance depend critically on the use of facts and heuristics used by experts. The body of knowledge (facts) and heuristics (which may be regarded as rules of thumb) are represented in the computer. The program uses the heuristics to operate on the stored knowledge in the light of a user enquery, and ideally, the systems reasoning can be explained to the user to indicated how a particular conclusion was reached.

The British computer society's committee of the specialist Group on Expert System has defined Expert system as "The embodiment with a computer of a knowledge based component from an expert skill in such a form that, the machine can offer intelligent advice or take an intelligent division about a processing function. A desirable additional characteristics which many would regard as fundamental, is the ability of the system on demand to justify its own line of reasoning in a manner directly intelligible to the enquirer. The style adopted to obtained these characteristics is rule base.

Expert system are used as an alternative to written manuals, for rapid or to get information required more rapidly and to distribute advice. Expert system can be adopted to assist in training and giving instructions. An expert system may be regarded as a means of recording and accessing human competence in a particular specialist field. The most robust interpretation (e.g. Duda et al 1980) suggested that an expert system is capable of human like performance and can serve thereby as a replacement expert.

Examples of expert systems use for different purposes include:-

Purpose	**Name of Expert System**
Diagnosis	Mycin, Tracker, Wheat counsellor
Prediction	Prospector, Dipmeter adviser
Design	Xcow
Planing	Gates, palnpower
Monitoring	Linkman, Excort Traudwatch
Achieving	DuBoulay's CTS CANNER
Interpretation	VATIA, Employment Law Adviser
Intelligent funtaEnd	ELAS Expert Language-Analysis
Training/Instruction	MecHO (PHYSICS PROBLEM SOLVING)

The expert system is computer program that gives advice, it act as a store for the knowledge and skill of an expert. Whoever interacts with expert system, it is as if he was consulting an expert.

1.23 HISTORY OF MAIZE CROP

Maize crop is an annual cereal grass, (zea mays) also called india corn, native to the new world and widely cultivated in tropical and subtropical regimes. (1 – 4.5m high), it belong to the family Graminea.

Maize was the dominant staple food for the early civilizations of Western hemisphere and today still plays an important role in the diet of millions of people because of its capacity to produce a large amount of dry matter per hectar, its ease to cultivate, versatile food uses and storage characteristics.

Maize is grown throughout the world and is a staple food crop, particular in Latin American and the Southern, Western and Eastern parts of Africa. In 1934, the total area under maize cultivation was about 130 million hectares of land,, with a world production of about 449 million tones. In that same year, the U.S. A alone produced over 194 million tones (FAO 1984). The U.S.A, China and India are the major maize growing countries.

About 2000 cultivers, based on the vegetation characteristics have been reported (Well hausan et al, 1957). However, all the cultivated speccies grown for food, feed and industrial purposes have been classified as (Zea mays). The most important maize varieties are flint corn,

Dentcorn, flour or soft and popcorn. Other varieties of minor importance includes sweet-corn, waxy corn and starchy sweet corn.

Hoffman (1965) estimated that some 100 million people in the world consume maize in the form of the round, unleaved cakes, or as porridge. In many areas maize is used as carbohydrate sources for the preparation of alcoholic and non-alcoholic drinks, for example beer and Mahewu in U.S.A. Maize starch is used as thickening agent; as a gel forming agent in toppings and cake icing. Oil is extracted from maize and nutritionally excellent; the oil is highly digestible and a good source of essential fatty acid. Maize is also fed to livestock (as livestock feed). For instance in the United States from 75 – 90 percent of maize crop is fed to livestock (Jugenheimer 1976).

Table 1.1 Composition of Maize Kernel (Dry weight).

Constituent	Composition (%)
Carbohydrate	80
Protein	10
Oil	4.5
Fibre	3.5
Mineral	2.0

Maize is generally recognised to be high in carbohydrate, low in quantity of protein and relatively low in oil. Maize is usually referred to as a starch product.

In term of world production maize is the third most important cereal crop (after wheat and rice). The U. S. A being the chief producing country.

CHAPTER TWO

2.0 REVIEW OF PLANT NUTRIENT DIAGNOSIS

2.1 STUDY ON PLANT NUTRIENT

Plant nutrients are mineral elements that are required for proper growth of plant. The nutrient element are important for good yield. The nutrients are viewed here as compartmentalized, occurring as primary (soil) or secondary (rock) minerals and as available nutrients in the atmosphere or in living or dead organic matter (Borman et al 1974).

Although, thirteen mineral elements are known to be necessary for plant growth; these are nitrogen(N) phosphorus (P), potassium (K), calcium (Ca), magnessium (mg), Sulphur (S), manganese (MN), Boron (Bo), Cupper (Cu), Iron (Fe), molybodenum (Mo), Zinc (Zn) nd chlorine (Cl).

Because of the fact that these nutrient elements are required in different quantities by the plant. They are divided into three groups called primary, secondary (macronutrient) and micronutrient (trace) elements.

Plant physiologists categorized essential elements and inorganic compounds according to relative quantities required by plants for adequate nutrition. The primary (nitrogen, phosphorus and potassium) and the secondary (calcium, sulphur) elements are required in large amount, most of them form parts of the structural components of plant cells and are referred to as macronutrient elements; while cupper, zinc, iron, manganese, chlorine, iron and Molybdenum are generally concerned with cell metabolism and enzymes and are thus needed in very small amount.

Nutrient level are frequently limiting to plant growth consequently, when nutrients are added, both species composition and productivity change. Willis (1963) studied the nitrogen and phosphorus in limited, calcareous slune grass land where fertilizer application increased density, productivity and the importance of grass at the expense of broad leaves species.

The nutritional state of a plant in regard to elements present in the growth medium may be viewed as: (a) deficient (b) adequate or (c) injuriously excessive.

Nutrient deficiency symptom for individual element vary considerably from plant to plant. Deficiencies, caused by lack of only one or few of the vital elements are often revealed by very characteristics symptoms.

2.2 FEASIBILITY STUDY ON THE EXISTING METHOD OF DIAGNOSING NUTRIENT DEFICIENCY

Feasibility study is the process of carrying out preliminary investigation of a system or an organisaiton.

The existing methods of diagnosing plant nutrient deficiency include:-

1. Physical observation/Examination of the plant
2. Plant tissue nutrient analysis
3. Soil chemical Analysis

Physical observation/Examination: This method involves the observation of the plant growth and development, the stem girth, the plant coloration, the fruit size and yield.

Plant tissue nutrient Analysis: The basic principle behind this technique in that the nutrient concentration of the plant is determined in relation to the amount of the nutrient available in the soil. If nutrient level in tissue falls below "critical' concentration, they must be deficiency in that element for optimum plant growth.

Soil chemical analysis is a rapid chemical method for producing the fertility status of the soil. It is usually done in four parts:

i. Collection of soil samples of the farm land
ii. Determination of available nutrients
iii. Interpretation of analysis results
iv. Formulation of fertilizer recommendation

The above existing methods are usually carried out manually by referring to test. In the past, when plants fail to grown, change in colour, or little or no yield produced, there was no scientific means of diagnosing the plant and analysing the soil. All examination were based on physical examination, the result from this method is quite limited. Despite the limitation, it is still practised today even by the Agronomist and soil scientist. Since it gives a pre-knowledge of what is wrong.

After physical observation, in the event of serious crop yield loss, the land is discarded. This practice of discarding he land leads to loss of knowledge as to the cause of loss of yield. With the advent of scientific development, the land is not discarded, rather a soil chemical analysis and plant tissue are carried out to ascertain the cause of the crop yield failure.

2.3 LIMITATION OF THE EXISTING METHOD OF DIAGNOSIS

The crop growers must be conversant with growth habit and other physical characteristics of the plant. Any change in the normal growth habit could be an indication of indirect deficiency. Although there is no clear cut of symptom for any nutrient deficiency (synagistic effect).

One of the limitation associated with physical examination is that there are some other factors which tend to have similar symptoms as that of nutrient deficiency and a such were physical observation of the plant will not be able to diagnose the major problem of the plant actually.

The effect of some pathogen (pathological effect) usually, manifest similar symptoms as that of nutrient deficiency. The effect of light intensity, soil pH, temperature, soil moisture, relative humidity (i.e physical and climatic factors) all these also tend to affect the physiological functioning of the plant and therefore result in (physical) symptomatic manifestation.

Plant tissue analysis:- The use of plant tissue analysis in the diagnosis and correction of nutrient deficiency is limited by the fact that nutrient concentration calibration data for many plants parts and for growing condition are limited. It is a technique that needs a specialist to carry it out.

Similarly, soil chemical analysis is a method that requires the attention of soil scientist. The analysis cannot be done by a lay man and secondly, it involves laboratory apparatus and reagents which are not easily available, affordable and accessible to all.

CHAPTER THREE

3.0 ANALYSIS OF THE EXISTING MEHTOD OF DIAGNOSING NUTRIENT DEFICIENCY

3.1.0 ANALYSIS OF THE EXISTING METHOD OF DIAGNOSING NITROGEN DEFICIENCY

The method adopted in diagnosing nitrogen deficiency in maize crop plant is physical examination of the above ground vegetative parts of the plant. The growth of the plant, leaf colour (change of colour), grain size (Cob).

Deficiency of nitrogen is expressed by retarded growth, yellowing of leaves. Small fruit (Cob) and no increase in stem length.

3.1.1 ANALYSIS OF THE EXISTING METHOD OF DIAGNOSING PHOSPHORUS DEFICIENCY

The existing method of diagnosing the phosphorus deficiency is by observing the plant growth and development, leaf colour grain production and maturity.

The deficiency symptoms for phosphorus is characterized by stunted growth, change of leaves colour from green to Reddish purple colour, delay fruiting and ripening of grains.

3.1.2 ANALYSIS OF EXISTING METHOD OF DIAGNOSING POTASSIUM DEFICIENCY

Potassium deficiency is diagnosed by observing the plant stand, the leaf colour. The potassium symptom manifest by lodging or breakage of plant stem, change of leaf colour from green to mottle yellow later to orange with dead spots; necrosis of the leaf margins and curling of leaves.

Plant tissue nutrient analysis is done when the corrective measures taken to avert the deficiency observed on the plant failed to yield better result. The analysis is done by taken randomly selected crop plant from the farm land to laboratory for nutrient concentration test.

Soil chemical analysis. This is done to predict the nutrient status of the soil and also to ascertain the occurrence of soil borne pathogen.

Soil samples of the farm land are taken to the laboratory for analysis. The soil properties routinely determine in laboratory are soil pH, soil organic matter nitrogen, phosphorus and potassium and lime requirement for soils with low pH.

3.2 MAIN OBJECTIVE OF SYSTEM ANALYSIS ON DIAGNOSING NITROGEN, PHOSPHORUS AND POTASSIUM DEFICIENCY SYMPTOMS IN MAIZE CROP PLANT

Due to nutritional and wide utilization of maize (corn) and vitality of these primary nutrient elements in the growth of maize crop plant and yield production. It is the intention of these project to produce a diagnostic system after the symptoms are known, using the computer thereby enhancing the following:

(i) Reduction in time consumed in going through text

(ii) Provide on demand a ready diagnosis for the deficiency symptom.

(iii) To overcome the bottle neck of the expert scarcity

(iv) Creating a file for each nutrient element deficiency symptoms with its corresponding corrective measures.

Nitrogen is an indispensable element in the life of crop plant. It is an essential constituent of protein chlorophyll and protoplasm. It is needed for growth and reproduction.

Phosphorus enhance maize crop performance especially in the tropics. Phosphorus is a constituent element in many specific compound making up the plant structure. It plays an important part in metabolic processes such as respiration, fat and albumen formation in the crop plant. Phosphorus is needed for development processes. It is essential in the following; seed and fruit formation. It aids in strengthening the skeletal structural of the maize plant. Thus prevent lodging and also increase the plant resistances to disease.

Potassium is known to help synthesize carbohydrate and vitamins and also aid in growth of plant body. Potassium is required for the formation of starch in maize grains. It also strengthen the stalk of the plant with availability of the potassium, the plant tissue resist the attack of fungus and bacterial as well as lodging.

These three primary nutrient elements, apart from being needed by the plant for growth, development and for yield production, they are constituents of plant tissue.

Maize owes its importance to principal use as food and feed. It is converted on a large scale to other form of food for human, such as starch, oil, and many industrial application such as feed concentrates, commercial resins, and glue, beverages e.t.c. Apart from wide utilization of corn and its nutritional value the cultivation of corn provide more food with less effort than did any other cereal crop.

3.3 IMFORMATION ACCESSIBILITY

The information regarding the project work was obtained from the following sources:-

(1) Experts: These include Agronomist, Botamist, Pedologists and peasant farmers

(2) Books or textual files

(3) Direct experience of the programmer

(4) Interview of absentees farmer.

CHAPTER FOUR

4.0 NEW SYSTEM DESIGN

4.1 SYSTEM SPECIFICATION

Hardware requirement needed to run this software consist of an IBM Computer or compatible with a minimum of 364MB of memory.

Recommended hardware configuration are:

1. An IBM PC/AT or 100% compatible computer
2. 364MB of RAM minimum
3. An IBM Bios or compatible and keyboard.

Software Requirement

The operation system for running this system is the disk operating system, system disk are contained in the disks and are accessed through using command. Secondly, one diskette containing the Dbase IV (software) and all the necessary files. This diskettes has to be inside the drive at all times during the running of the program.

4.2 JUSTIFICATION OF THE SYSTEM

It has become important for the farmer (crop growers) to have a computer based system for diagnosing lack of nutrient in plant for purpose of efficiency. This system will satisfy the growing need for improve yield (productivity).

This system is meant for farmers, schools, and Universities etc. with the system accurate diagnosis can be made, hence appropriate and proper control measures can be applied invariably reducing the poor yield production.

4.3 SYSTEM REQUIREMENT

The requirement for this system are as follows:

(1) Increased speed

(2) Large and secured storage facilities

(3) Need for accuracy

(4) Quick accessibility of information

(5) Automation

These features are incorporated into system to enhance the performance of the new system.

4.4 INPUT SPECIFICATION

A. Nutrient Elements

B. Symptoms

C. Control measures.

A. Nutrient elements Data

1. Nitrogen
2. Phosphorus
3. Potassium

B. Deficiency Symptom Data

1. Chlorosis (leaf colouration)
2. Necrosis (death of cells/tissues)
3. Stunted growth (no growth and development)
4. Delay fruit ripening
5. Stalk breakage
6. Lodgin of plant

C. **Control Measure Data**

1. Application of manure
2. Application of chemical fertilizer
3. Planting of cover crops
4. Crop-rotation
5. Bush fallowing

Nutrient Element 1: NITROGEN

Deficiency Symptoms:

(i) Stunted growth (reduce in growth rate and development)

(ii) Development of chlorosis in older leaves and spreading to the young leaves (yellowing of leaves)

(iii) Stems and leaf veins may take on a red colour.

Corrective Measures:

(1) Incoperation of organic (e.g compost. green manure animal dung) into the soil.

(2) Application of Nitrogeneous fertilizer such as N. P. K, Sulphate of Ammonia, CAN at rate 200Kg per hectare

(3) Crop – rotation

- Nutrient Element 2. PHOSPHORUS

Deficiency symptoms:

(i) Retarded growth of the affected plants (reduce stem extension)

(ii) Necrotic spots (death of parts) on leaves, fruits or other structures

(iii) Reddish purple leaves

(iv) Delay fruit ripening.

Corrective Measures:

(i) Application of organic fertilizer such as dried animal dung

(ii) Application of chemical fertilizer such as single super phosphate 115 Kg per hectare

(iii) Use of complete compound fertilizer N. P. K at rate of 200Kg/hectre

(iv) Crop-rotation

Nutrient Element 3: POTASSIUM

Deficiency Symptoms:

(i) Mottle chlorosis (yellow mottling of leaf-surface and later develops into path network of orange colour

(ii) Necrosis of the leaf margins and curling of leaves

(iii) A wide spread blackening of leaves mat occur

(iv) Breaking of the affected plant stalk or lodging of the plant.

Corrective Measures:

(i) Application of potash fertilizer (such as murat of potash, chloride of potash) into the soil

(ii) Application of compost manure into the soil

(iii) Incorporation of wood ash into the soil

(iv) Crop rotation

4.5 COST IMPLICATION OF THE NEW SYSTEM

1. Cost of hardware and software

Processor 80286/80386	N100,000.00
RAM 1.2GB	
Disk drive/slot	
(a) 3.5" 1.44MB	
(b) 5¼" 1.2MB	
Hard disk 364MB	

2.

Printer 2 LaserJet	N60,000.00
Operating System MS-DOS 4.0	N10,000.00
UPS 500 volts	N10,000.00
Development cost	N40,000.00

Installation cost	N15,000.00
Salary of staff involved	N15,000.00
Staff training cost	N20,000.00

3. Operating Cost

(a) Paper	N 3,000.00
(b) Ribbon	N 400.00
(c) Diskette	N 2,000.00
(d) Maintenance	N 1,000.00

4.6 STRUCTURE FOR INPUT SPECIFICATION DATABASE FILE

FIELD	FILE NAME	TYPE	WIDTH	DEC
1	Nutrient elements	C	15	o
2	Deficiency symptoms	C	50	o
3	Control Measures	C	60	o

4.7 MODULAR PROGRAM STRUCTURE (PROCEDURE)

In modular structure each process has its duty to perform effectively in the proposed system. The duties are as follows:-

Main Menu

This is the program that displays the main menu of the system. It consists of the following options:

1. Consultation
2. Update knowledge base
3. Delete knowledge base
4. Modification of knowledge base (Edit)
5. Exit

These options are sub-programs. They are displayed for execution.

Consultation

This section is concerned with the consultation. The existing symptoms in knowledge base are display for the user to select the symptoms that matches what is observed on the plant after the selection. After the selection, the nutrient-element responsible for deficiency symptom is displayed then control measures displayed.

Update knowledge Base

The update knowledge base consists of the following options:

(1) Update symptoms

(2) Update nutrient elements

(3) Update Control

(4) Exit

Any of the option can be updated from time to time by insertion of new data

Delete Knowledge Base

This section is concerned with definition of any particular part of the knowledge that is not required. It consists of the following options:

(1) Delete options

(2) Delete Deficiency symptom

(3) Delete Control

(4) Delete nutrient element

(5) Exit

Modification of Knowledge Base (Exit)

As the name implies, it is concerned with modifying of knowledge. Edit knowledge has a menu. The menu consists of the following options.

1. Modify Deficiency symptom
2. Modify nutrient element
3. Modify control measure
4. Exit

CHAPTER FIVE

5.0 SYTEM IMPLEMENTATION

5.1 PROGRAMMING (WRITTEN PROGRAM)

The program use the files created in the system application in chapter four (4) and knowledge base. This has been successfully written using querry language and modular. The program is shown in the appendix.

5.2 INSTALLATION

Installation of this system can be done by computer experts. The procedure given below can be used. The hardware facilities required are IBM PC/AT and printer.

Diskette containing the system is also required. The system can be 5 ¼ or two (2) floppy diskette will do.

Procedure for Installation

Boot your system before you install DIAGNOSI.

1. Insert the disk lebelled "DIAGNOSI" in drive A: and close the disk drive door
2. Create a subdirectory called CAD in disk drive C:
3. TYPE A>COPY *.* C:>/DIAGNOSI
4. Follow the instruction on the screen to enter your name and organization
5. Choose the continue botton
6. Follow the instruction on the screen to enter the directory where you want to install DIAGNOSI
7. Choose the continue botton

5.3 NEW SYSEM TESTING

Every program must be tested before it can be used for production runs. Program testing determines the reliability of the program. System testing involves two kinds of activities: Integration and Acceptance testing.

Acceptance testing: Involves planning and execution of function tests, performance tests, and stress test to verify that the implemented system satisfies its requirement.

Integration Testing: Botton up integration is the traditional strategy used to integrate the components of the software system into a function whole. Botton up integration consists of unit testing, followed by substem testing, followed by testing the entire system.

In general, if DBASE IV files are not available on the machine to be used, then you must already have had it on two floppy diskette lebelled I & II. However, if your computer already has DBASE IV then, after booting the system you will get the C prompt written thus: C>.

1. Then Type

   C>CD DBASE

   C>DBASE

   After doing this, you have completed loading DBASE IV you should be ready to run the system.

2. Press ESCAPE key and the system takes you to the dot prompt.

3. Put the diskette containing the system in drive A and type

   . Set default to A

   . Do DIAGNOSI

   A message will appear on the screen as shown below.

COMPUTER ASSISTED DIAGNOSIS OF PLANT NUTRIENT DEFICIENCY SYMPTOMS.

CASE STUDY OF NITROGEN, PHOSPHORUS AND POTASSIUM DEFICIENCY IN MAIZE CROP.

BY

BELLO ABDULMUMIN SULAIMAN

FOR THE AWARD OF POST GRADUATE DIPLOMA IN COMPUTER SCIENCE.

PRESS ANY KEY TO CONTINUE

4. After this, the main menu appears and the system is ready to execute any of the chosen option/choice.

5. However, in a situation where the user has DBASE IV on floppies (diskette) then, the following procedures should be followed:

C>

Put the system disk I and change the drive by typing C>A:

A>DBASE

After loading the files from these diskettes, the computer will ask you to insert the system disk II and press the Enter Key. On doing this, you have succeeded in loading DBASE IV files. Press ESCAPE to receive the dot prompt, then type Do DIAGNOSI

The steps 4 & 5 above are repeated.

5.4 CONVERSION

The change over from the old system to the new system is known as conversion. Parallel approach is chosen for this system. Parallel approach means using both new and old system together.

5.5 NEW SYSTEM MAINTENANCE

The term "Software Maintenance" is used to describe the software engineering activities that occur following the delivery of a software product to the customer.

Maintenance activities involves making, enhancement software product, adapting products to new environments and modifying the software to suit the new environment.

5.6 CONCLUSION AND RECOMMENDATION

5.6.1 CONCLUSION

Significant technology advances have been made in recent years which has lead to increased efficiency in crop-production in many parts of the world, but some notable advances can only be applied in limited areas. No doubts diagnosing nutrient deficiency symptom needs automation to meet modern standard and speed. It is therefore imperative for the existing system of diagnosing nutrient deficiency to be modified to suite the trends of technological, social and economic changes that manifest in farming.

This was what prompted the student to employ one of the available means which is the system development method to evaluate all aspects of the existing system of diagnosing nutrient deficiency symptoms in maize crop and to design a new system to implement the existing one.

In general, a data base file on dignosing nutrient deficiency symptoms was developed to over comes the hard task involved in processing the information before presenting the control measures, also to reduce cost involved in inviting an expert to the farm on regular basis.

The implementation of the proposed system will ensure improvement in diagnosing nutrient deficiency symptom in crop-plants in terms of reliability, effectiveness and accuracy, corrective measure, above all improve productivity in agriculture.

5.6.2 RECOMMENDATION

It is hereby recommended that the proposed system should be implemented as this would bring a lot of benefit to the farmers. These benefits include:

- Accuracy of information in time consumed in finding control measures.
- Provide on demand already diagnosis for the deficiency symptoms.
- To overcome the bottleneck of the expert scarcity.

Infact the advantage of using expert system for diagnosing nutrient deficiency in modern agriculture cannot be over emphasized.

This project used database file structure to store every data and information needed, this makes it easier as it provides a lot of facilities like consultation, updating, editing, ( ), deleting and so on. These will help the stored data to be retrieved any time task needed to be performed and the data integrity maintained.

In the light of all these benefits, it is hereby recommended that computer assisted diagnoses nutrient deficiency symptom would be the most effective method of diagnosing plants nutrient deficiency.

REFERENCES

1. Asiedu J.J. (1989) — Processing of Tropical crops, published by MaCmillan Press Limited London and Basingstoke 1989.

2. Komolafe M. F. (1976) — Agricultural Science for Schools and Colleges. Published by Onibonage Press and book Industry Nigeria Limited IBADAN, 1976.

3. McGraw-Hill (1989) — Encyclopedia of Science & Technology. Hill Publishing Company New York 1989. Published by MC GRANT.

4. Russel E. W. (1988) — Russel's Soil conditions and plant growth 11th edition Published by Longman Scientific and Technical Longman House, Burnt Mill, Harlow. England. 1988.

5. Simona G. L. (1983) — Towards 5th Generation Computer Published by National Computing Centre Limited England, 1983.

6. Ulysses S. Jones (1987) — Fertilizer and Soil Fertility Published by prentice-Hall of India Private Limited New Dehil 1987.

7. United State Department of Agriculture Washington D.C. (1950) — Crops in peace and War. The year of Agriculture 1950 – 51, Published by United State Government Printing Office Washington D.C.

8. Willia C. N., Chew W. Y. Rajaratnam S. A. (1980) — Tree and Field Crops of the Wetter Region of the Tropics. Published by Longman Group House Birortmill Harlow England 1980.

PROGRAM CODES

```
SET TALK OFF

SET CENTURY ON

SET STATUS OFF

SET ECHO OFF

SET SCORE OFF

SET DATE TO BRITI

DO HEAD

DO WHILE .T.

CLEAR

SET CLOCK TO 1,65

@1,2 SAY DATE()

@1,15 SAY "COMPUTER ASSISTED DIAGNOSIS"

@2,0 TO 2,79 DOUBLE

@4,20 TO 6,31

@5,21 SAY "MAIN MENU"

@8,10 TO 18,60

Choice = 0

@10,14 SAY " [1]... CONSULTATION"

@12,14 SAY " [2]... UPDATE KNOWLEDGE"

@14,14 SAY " [3]... EXIT"

@20,15 SAY "Enter choice (1-3) : " GET CHOICE PICT "9" RANGE 1,3

READ

DO CASE
```

```
    CASE CHOICE = 1
      DO CONSULT
    CASE CHOICE = 2
      DO UPKNOW
    CASE CHOICE = 3
      CLEAR
       EXIT
ENDCASE

ENDDO
SET TALK ON
SET STATUS ON
SET ECHO ON
SET SCORE ON

PROCEDURE HEAD
CLEAR
@2,2 TO 22,60 PANE
@16,18 SAY "COMPUTER ASSISTED DIAGNOSIS"
@17,18 SAY "OF PLANT NUTRIENT DEFICIENCY SYMPTOM"
@18,15 SAY "CASE STUDY OF NITROGEN,PHOSPHORUS"
@19,15 SAY "AND POTASSIUM IN MAIZE CROP"
@10,20 SAY "WRITTEN BY"
@12,18 SAY "BELLO ABDULMUMIN SULAIMAN"
```

```
@14,18 SAY "PGD/MCS/508/97/98"
@20,10
WAIT " "
RETURN

PROCEDURE CONSULT
CLEAR
@1,15 SAY "COMPUTER ASSISTED DIAGNOSIS"
@2,0 TO 2,79 DOUBLE
@4,30 SAY "CONSULTATION"
@5,30 SAY "============"
USE NITRODEF.DBF
@7,10 SAY LINE1
@9,10 SAY LINE2
@11,10 SAY LINE3
@13,10 SAY LINE4
ANS = " "
@17,8 SAY "Does any of the Deficiences symptom occurs(Y/N)? "
GET ANS PICT "!"
READ
IF ANS ="Y"
@7,2 CLEA TO 20,78
USE NITROCOT.DBF
```

```
@6,20 SAY "THE NUTRIENT IS NITROGEN"
@7,20 SAY "THE CONTROL MEASURES ARE"
@9,10 SAY LINE1
@11,10 SAY LINE2
@13,10 SAY LINE3
@15,10 SAY LINE4
WAIT
ELSE
@7,8 CLEAR TO 20,79
USE PHOSDEF.DBF
@7,10 SAY LINE1
@9,10 SAY LINE2
@11,10 SAY LINE3
@13,10 SAY LINE4
@15,10 SAY LINE5
ANS2 = " "
@17,8 SAY "Does any of the Deficiences symptom occurs(Y/N)? "
GET ANS2 PICT "!"
READ
IF ANS2 = "Y"
@7,8 CLEAR TO 20,79
@7,20 SAY "THE NUTRIENT ELEMENT IS PHOSPHORUS"
@8,10 SAY "THE CONTROL MEASURES : "
USE PHOSCOT.DBF
```

```
@9,10 SAY LINE1
@11,10 SAY LINE2
@13,10 SAY LINE3
@15,10 SAY LINE4
      WAIT
  ELSE
  @7,8 CLEAR TO 20,79
  USE  POTDEF.DBF
  @7,10 SAY LINE1
  @9,10 SAY LINE2
  @11,10 SAY LINE3
  @13,10 SAY LINE4
  @15,10 SAY LINE5
  ANS3 = " "
  @17,8 SAY " Does any of the Deficiency symptom occur (Y/N)? "
GET ANS3 PICT "!"
   READ
   IF ANS3 = "Y"
   @7,8 CLEAR TO 20,79
   @8,20 SAY " THE NUTRIENT ELEMENT IS POTASSIUM "
   @8,10 SAY " THE CONTROL MEASURES: "
      USE POTCOT.DBF
   @9,10 SAY LINE1
   @11,10 SAY LINE2
```

```
   @13,10 SAY LINE3
   @15,10 SAY LINE4
     WAIT
   ENDIF
   ENDIF
   ENDIF
   CLOSE DATABASES
   RETURN

PROCEDURE UPKNOW
CLEAR
@1,15 SAY "COMPUTER ASSISTED DIAGNOSIS"
@2,0 TO 2,79 DOUBLE
@4,30 SAY "UPDATING KNOWLEDGE"
@5,30 SAY "=================="
@7,20 SAY "NITROGEN"
USE NITRODEF.DBF
STORE LINE1 TO MLINE1
STORE LINE2 TO MLINE2
STORE LINE3 TO MLINE3
STORE LINE4 TO MLINE4
@8,5 GET MLINE1
@9,5 GET MLINE2
@10,5 GET MLINE3
```

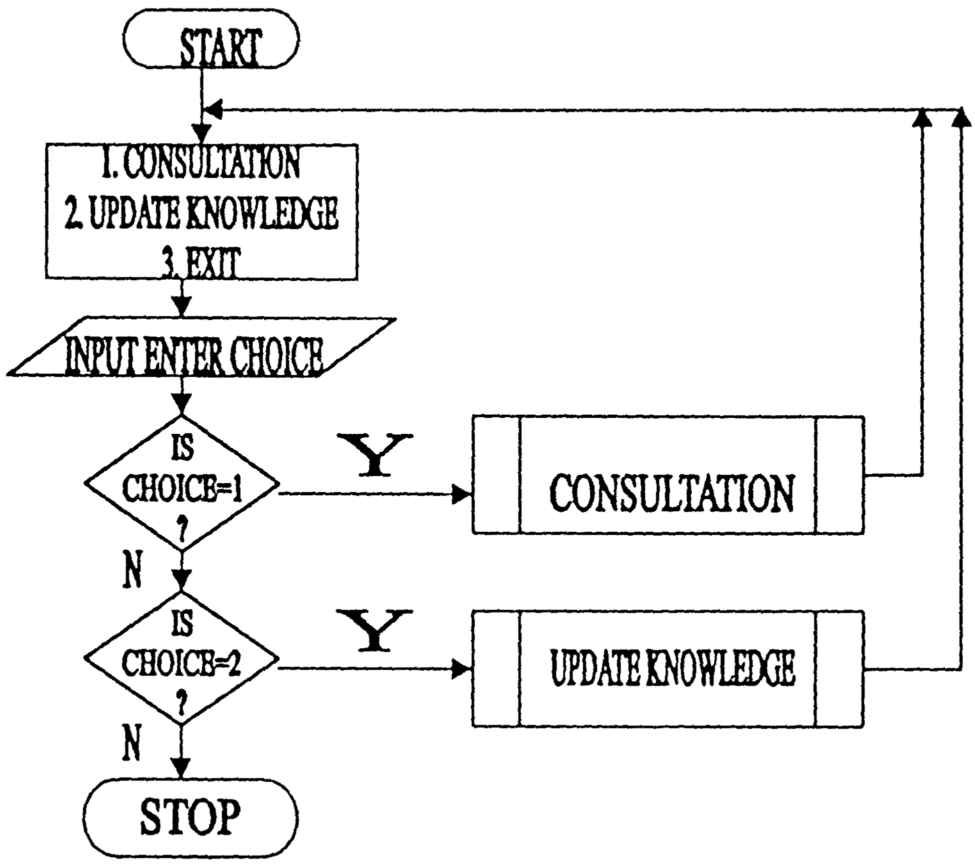
```
@11,5 GET MLINE4
READ
REPLACE LINE1 WITH MLINE1, LINE2 WITH MLINE2, LINE3 WITH MLINE3
REPLACE LINE4 WITH MLINE4
USE NITROCOT.DBF
STORE LINE1 TO MLINE1
STORE LINE2 TO MLINE2
STORE LINE3 TO MLINE3
STORE LINE4 TO MLINE4

@8,5 GET MLINE1
@9,5 GET MLINE2
@10,5 GET MLINE3
@11,5 GET MLINE4
READ
REPLACE LINE1 WITH MLINE1, LINE2 WITH MLINE2, LINE3 WITH MLINE3
REPLACE LINE4 WITH MLINE4
WAIT
@7,2 CLEAR TO 20,78
 7,20 SAY "PHOSPHORUS"
USE PHOSDEF.DBF
STORE LINE1 TO MLINE1
STORE LINE2 TO MLINE2
 TORE LINE3 TO MLINE3
```

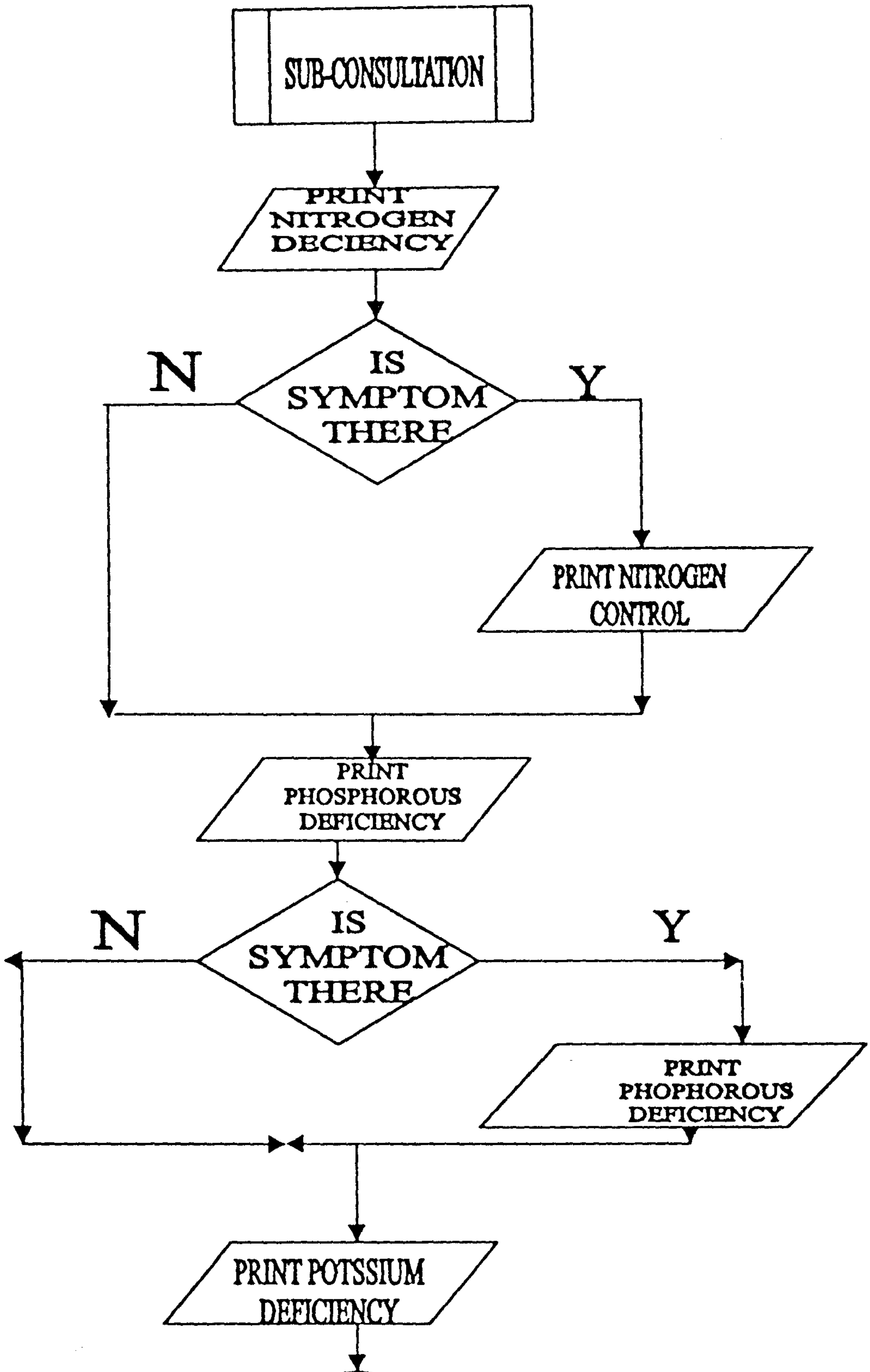
```
STORE LINE4 TO MLINE4

STORE LINE5 TO MLINE5

@8,5 GET MLINE1

@9,5 GET MLINE2

@10,5 GET MLINE3

@11,5 GET MLINE4

@12,5 GET MLINE5

READ

REPLACE LINE1 WITH MLINE1, LINE2 WITH MLINE2, LINE3 WITH MLINE3

REPLACE LINE4 WITH MLINE4, LINE5 WITH MLINE5

USE PHOSCOT.DBF

STORE LINE1 TO MLINE1

STORE LINE2 TO MLINE2

STORE LINE3 TO MLINE3

STORE LINE4 TO MLINE4

STORE LINE5 TO MLINE5

@8,5 GET MLINE1

@9,5 GET MLINE2

@10,5 GET MLINE3

@11,5 GET MLINE4

@12,5 GET MLINE5

READ

REPLACE LINE1 WITH MLINE1, LINE2 WITH MLINE2, LINE3 WITH MLINE3

REPLACE LINE4 WITH MLINE4, LINE5 WITH MLINE5
```

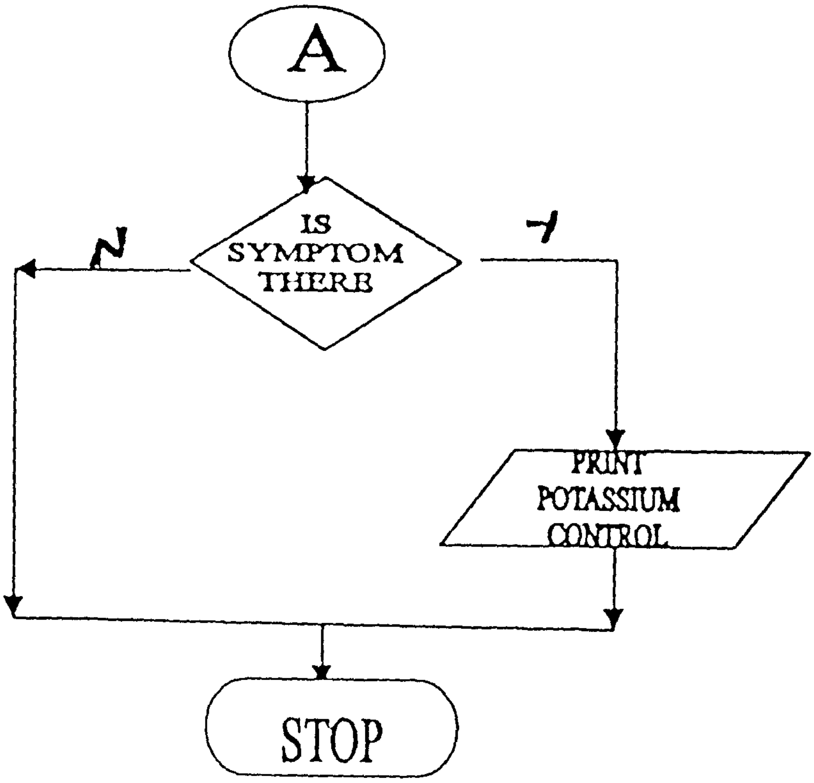
```
WAIT

@7,2 CLEAR TO 20,78
@7,20 SAY "POTASSIUM SYMPTOMS"
USE POTDEF.DBF
STORE LINE1 TO MLINE1
STORE LINE2 TO MLINE2
STORE LINE3 TO MLINE3
STORE LINE4 TO MLINE4
STORE LINE5 TO MLINE5
@8,5 GET MLINE1
@9,5 GET MLINE2
@10,5 GET MLINE3
@11,5 GET MLINE4
@12,5 GET MLINE5
READ
REPLACE LINE1 WITH MLINE1, LINE2 WITH MLINE2, LINE3 WITH MLINE3
REPLACE LINE4 WITH MLINE4, LINE5 WITH MLINE5
USE POTCOT.DBF
@7,2 CLEAR TO 20,78
@7,20 SAY "POTASSIUM CONTROL MEASURES"
STORE LINE1 TO MLINE1
STORE LINE2 TO MLINE2
STORE LINE3 TO MLINE3
```

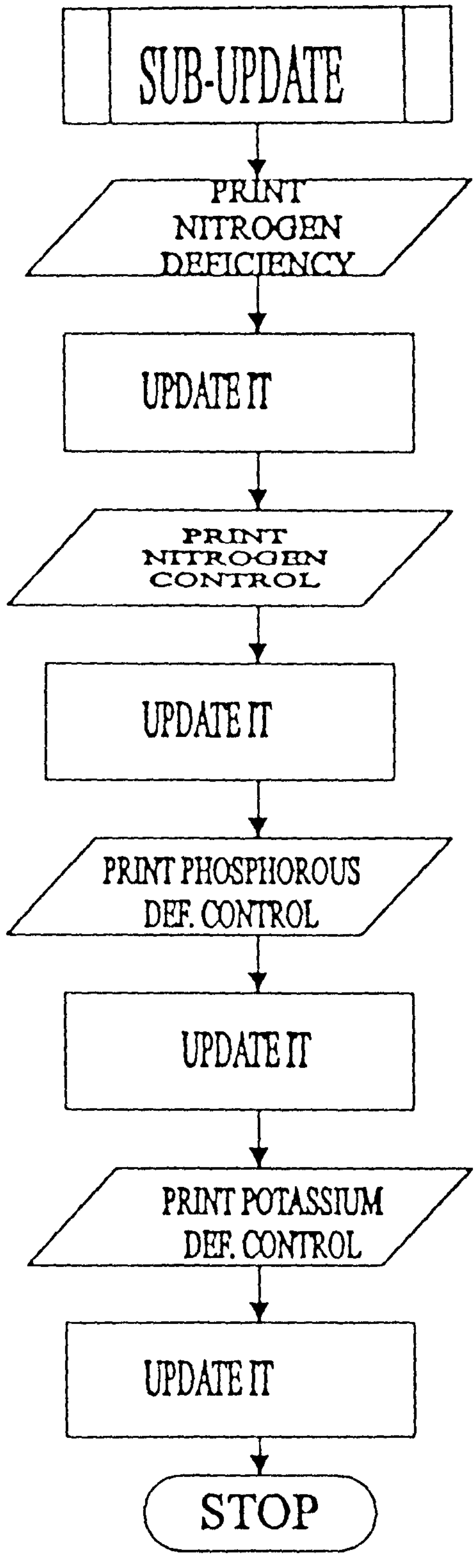
```
STORE LINE4 TO MLINE4
@8,5 GET MLINE1
@9,5 GET MLINE2
@10,5 GET MLINE3
@11,5 GET MLINE4
READ
REPLACE LINE1 WITH MLINE1, LINE2 WITH MLINE2, LINE3 WITH MLINE3
REPLACE LINE4 WITH MLINE4
WAIT
RETURN
```

❑


START
1. CONSULTATION
2. UPDATE KNOWLEDGE
3. EXIT
INPUT ENTER CHOICE
IS CHOICE=1 ?
Y
CONSULTATION
N
IS CHOICE=2 ?
Y
UPDATE KNOWLEDGE
N
STOP


SUB-CONSULTATION
PRINT NITROGEN DECIENCY
IS SYMPTOM THERE
N
Y
PRINT NITROGEN CONTROL
PRINT PHOSPHOROUS DEFICIENCY
IS SYMPTOM THERE
N
Y
PRINT PHOPHOROUS DEFICIENCY
PRINT POTSSIUM DEFICIENCY
A


A
IS
SYMPTOM
THERE
N
Y
PRINT
POTASSIUM
CONTROL
STOP


SUB-UPDATE
PRINT NITROGEN DEFICIENCY
UPDATE IT
PRINT NITROGEN CONTROL
UPDATE IT
PRINT PHOSPHOROUS DEF. CONTROL
UPDATE IT
PRINT POTASSIUM DEF. CONTROL
UPDATE IT
STOP

5:31:21

COMPUTER ASSISTED DIAGNOSIS

OF PLANT NUTRIENT DEFICIENCY SYMPTOM

CASE STUDY OF NITROGEN,PHOSPHORUS

AND POTASSIUM IN MAIZE CROP
WRITTEN BY
BELLO ABDULMUMIN SULAIMAN
PGD/MCS/508/97/98

5:31:22

COMPUTER ASSISTED DIAGNOSIS

OF PLANT NUTRIENT DEFICIENCY SYMPTOM

CASE STUDY OF NITROGEN,PHOSPHORUS

AND POTASSIUM IN MAIZE CROP
WRITTEN BY
BELLO ABDULMUMIN SULAIMAN
PGD/MCS/508/97/98

5:31:22

```
5/2000    COMPUTER ASSISTED DIAGNOSIS                                5:37:06 pm
ëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëë

               ÖááááááááááÇ
               °MAIN MENU °
               âááááááááááál

      ÖáááááááááááááááááááááááááááááááááááááááááááááááááÇ
      °                                                  •
      °     [1]... CONSULTATION                          •
      °                                                  •
      °     [2]... UPDATE KNOWLEDGE                      •
      °                                                  •
      °     [3]... EXIT                                  •
      °                                                  •
      °                                                  •
      °                                                  •
      âáááááááááááááááááááááááááááááááááááááááááááááááááál

           Enter choice (1-3) :  0
```

```
05/2000    COMPUTER ASSISTED DIAGNOSIS                               5:37:07 pm
ëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëë

               ÖááááááááááÇ
               °MAIN MENU °
               âááááááááááál

      ÖáááááááááááááááááááááááááááááááááááááááááááááááááÇ
      °                                                  •
      °     [1]... CONSULTATION                          °
      °                                                  °
      °     [2]... UPDATE KNOWLEDGE                      °
      °                                                  °
      °     [3]... EXIT                                  °
      °                                                  °
      °                                                  °
      °                                                  °
      âáááááááááááááááááááááááááááááááááááááááááááááááááál

           Enter choice (1-3) :  0
```

```
5/2000    COMPUTER ASSISTED DIAGNOSIS                                5:37:07 pm
ëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëë

               ÖááááááááááÇ
               °MAIN MENU °
               âááááááááááál

      ÖáááááááááááááááááááááááááááááááááááááááááááááááááÇ
```

COMPUTER ASSISTED DIAGNOSIS 5:38:10 pm

ëëë

CONSULTATION
============

(1) Stunted growth (Reduction in growth rate and development)

(2) Development of chlorosis in older leaves and spreading to the young leaves (Yellow of leaves)

(3) Stems and leaf veins may take on a red colour.

Does any of the Deficiences symptom occurs(Y/N)?

COMPUTER ASSISTED DIAGNOSIS 5:40:25 pm

ëëë

CONSULTATION
============

THE NUTRIENT ELEMENT IS NITROGEN
THE CORRECTIVE MEASURES ARE

(1) Application of Nitrogenous fertilizer such as N.P.K 15:15:15

Sulphate of Ammonia, CAN

(2) Application of Organic MAnure such as compost

(3) Crop - Rotation

any key to continue...

COMPUTER ASSISTED DIAGNOSIS 5:40:26 pm

ëë

CONSULTATION
============

THE NUTRIENT ELEMENT IS NITROGEN
THE CORRECTIVE MEASURES ARE

COMPUTER ASSISTED DIAGNOSIS 5:41:20 pm

ëë

CONSULTATION
============

(1) Retarded growth in affected plant (Reduced stem extension)

(2) Necrotic spots (death of parts) appear on leaves, fruits or other parts.

(3) Reddish purple leaves (dark green to reddish purple)

(4) Delay fruit ripening.

Does any of the Deficiences symptom occurs(Y/N)?

COMPUTER ASSISTED DIAGNOSIS 5:41:31 pm

ëëë

CONSULTATION
============

THE NUTRIENT ELEMENT IS PHOSPHORUS

THE CORRECTIVE MEASURES :

(1) Application of manure e.g dried animal dung,compost or green

(2) Application of chemical fertilizer such as single super phosphate or Trisuper phosphate.

(3) Use of complete fertilizer 15:15:15 N.P.K.

any key to continue...

COMPUTER ASSISTED DIAGNOSIS 5:41:32 pm

ëë

CONSULTATION
============

THE NUTRIENT ELEMENT IS PHOSPHORUS

THE CORRECTIVE MEASURES :

COMPUTER ASSISTED DIAGNOSIS 5:42:30 pm
ëë

CONSULTATION
===========

(1) Mottled chlorosis (Yellow mottling of leaf surface and later
develops into path network of orange color.

(2) Necrosis of the leaf margins, curling of leaves

(3) A wide spread blackening of the leaves may occur

(4) Breaking of the deficient plant stalk or lodging.

Does any of the Deficiency symptom occur (Y/N)?

COMPUTER ASSISTED DIAGNOSIS 5:42:38 pm
ëë

CONSULTATION
============

THE NUTRIENT ELEMENT I POTASSIUM
THE CORRECTIVE MEASURES:
(1) Application of complete compound fertilizer N.P.K.
(2) Application of murat of potash

(3) Application of compost manure into soil

(4) Incoperation of wood ash into the soil
any key to continue...

COMPUTER ASSISTED DIAGNOSIS 5:42:38 pm
ëë

CONSULTATION
============

THE NUTRIENT ELEMENT IS POTASSIUM