PROBLEM SOLVING METHODOLOGIES

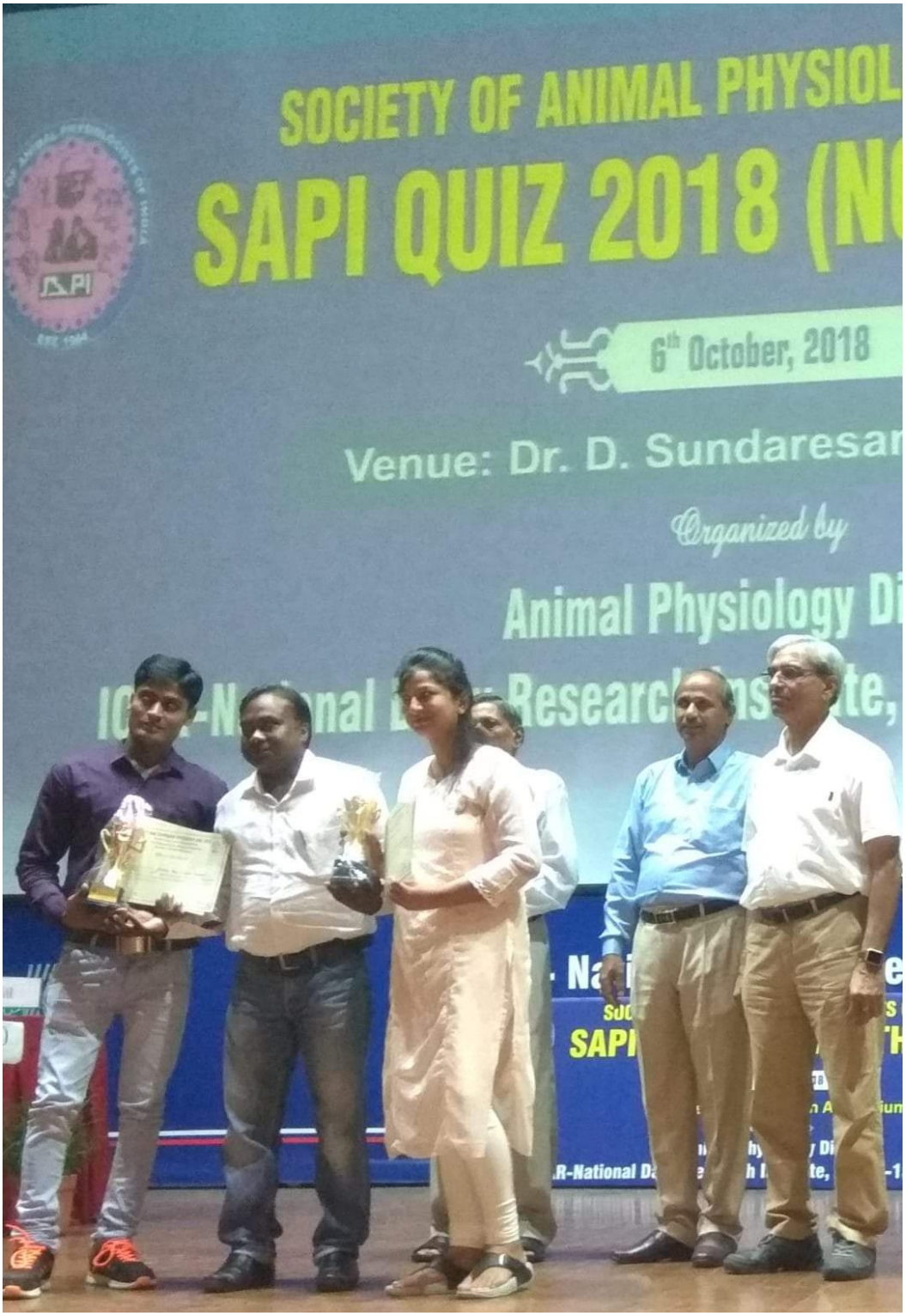
Students Particpating in Eassy Writing Competition

Transplanting of Rice by Students

Harvesting of Rice Crop by The Students

Students Participating in Quiz Competition

Students Receiving Winning Award in Quiz Competition



Students Receiving Awards in Quiz Competition

P.G. Students Monitoring Male Moth Population Trough Pheromone Traps

Student Delivering Seminar on Assigned Topic by The Teacher

ACHARYA NARENDRA DEVA UNIVERSITY OF AG. & TECH, KUMARGANJ, AYODHYA-224229

ASSIGNMENT WORK

TOPIC

STATUS OF BEE KEEPING IN INDIA

SUBMITTED BY

Abhisek Tiwari

ID A-10117/18

SUBMITTED TO

Dr. Umesh Chandra

(Dept. of Entomology)

Introduction

-Beekeeping is an art and a mesmerizing science. In India beekeeping is mostlypractised as a full-time occupation and an engrossing hobby to produce handsomeincome and table honey.

- Honeybees are special gift to mankind because beekeepingcan be done for both their pollination services and their cherished products such ashoney, beeswax, propolis, bee venom, etcused in different smalland large-scale industries in India.

- The only bitter part of bee-keeping is the bee sting. Honeybees sting to defend their colony, but this bitterness.

-So, understanding honey bee science is to know Development of beekeeping for improving crop productivity" was launched by the Ministry of Agriculture in **1994–1995** during the eighth 5-year plan.

-The scheme targets production and distribution of honeybee colonies, organizing trainings and

awareness programmes.

-Right now, approximately there are about 1.5 million beecolonies in India, which produce 55,000 tonnes of honey annually.

- India is one ofthe honey-exporting countries. The major markets for Indian honey are Germany,the USA, the UK, Japan, France, Italy and Spain.

Honeybee Species in India

1. **Rock Bee** ***(Apisdorsata)***

- They are huge and ferocious bees that construct a single comb in the open usuallyabout 3-4 feet tall.

- In hilly regions they construct their nest up to an altitude of 2700 m. Rock bees habitually shift their places.

- Nearly 50–80 kg of honey can besqueezed from a single colony of rock bee per year.

- Colonies of *A. dorsata*may occur singly or in groups. Thelower part of the comb is the energetic area in which the foraging and scout bees willtake off and land. As these bees are aggressive, they will attack the intruders.

- Sometimes these bee stings can turn fatal to the humans. Because of danger involvedin harvesting rock bee honey, it is generally priced high locally.

2. Little Bee *(Apisflorea)*

- Apisflorea or dwarf honeybee is also a wild honeybee spp., but these bees are smalland less ferocious when compared to the rock bees.

- These bees build single verticalcombs. They also construct palm sized combs in the bushes, hedges, buildings, caves, empty cases, etc.

- The honey produced by these bees is dramatically less whencompared to the rock bee as these bees produce only about 0.5kg of honey/yr./ hive.

- These bees are found only in plains andnot in hills above 450 MSL.

- Compared to other honeybees, these bees are attractively coloured with red to brown colouration having white bands.

3 Indian Bee (*Apiscerena indica*)

- Indian honeybee or Eastern honeybee is a well-known bee species in India.
- It isalso found and has been domesticated in Pakistan, Nepal, Burma, Bangladesh.

- These bees construct multiple parallel combs in dark places such as clay pots,logs, wall, tree openings, etc. and produce 7–9 kg of honey per colony per year.

- In India, the subspecies Apiscerena indica is recognized into two morphotypes like “hills bee” (black coloured) and plains bee (yellow coloured)

- Presently beekeeping with Indian bees is mostly done in south Indian and particularly in Kanyakumari district of Tamil Nadu, with more than 50,000beekeepers involved.

-The combs of A. cerana colonyare built parallel to each other and at uniform distance known as the "bee space",

-The queen cellsare built on the lower edge of the comb.

- The honey chamber is in the upperpart of the hive where these bees store honey which helps in easy honeyextraction.

4. European Bee/Italian Bee (*Apismellifera*)

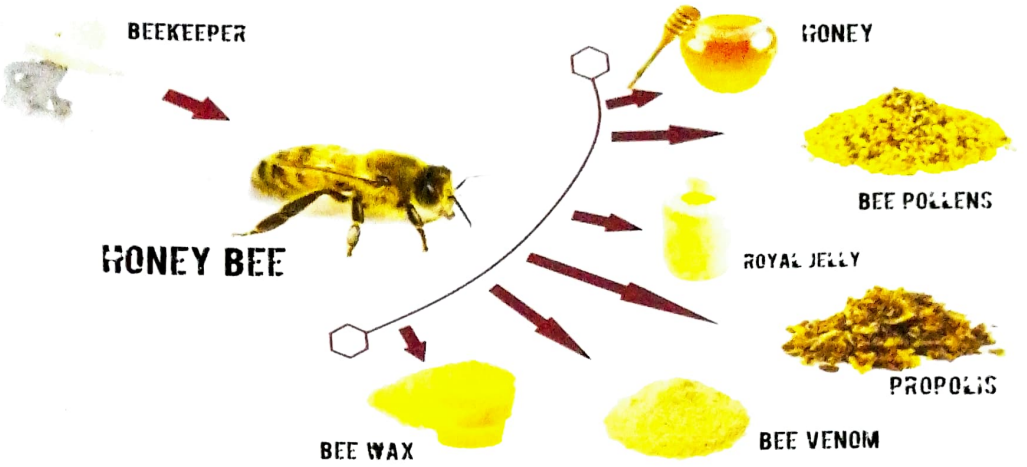
- Italian bee (*Apis mellifera*) isnot native to India and was introduced from Europe during the second half of 20thcentury.

- Presently they are well established inIndia and mostly present in northern India because of the rich flora such as mustard,safflower, sun flower, etc.
- In south India, beekeeping with Italian beesis hardly practised.
- For commercial beekeeping, these Italian bees have to be migrated by floral mapping.
- They build parallel combs in dark places and store honey at the upper portion of their colony.

- They are biggerthan all other honeybees except Apisdorsata.
- They produce 25–40 kg of honey percolony per year.

- **Methods of beekeeping:**
  - **Traditional beekeeping**: It is a natural consequence of forest beekeeping. It is of subsistence level and uses traditional hives like clay pots, empty wooden boxes and woven bamboo baskets. Bees are collected from natural sources and the boxes are kept in fields or on sides of houses.
  - **Modern beekeeping**: Here, bees are kept in man-made hives and reared for commercial honey production. Modern hive made of wooden rectangular boxes are used. The bees are bred in controlled conditions and colonies are periodically replaced to ensure continuous production.

PRODUCTS:



- **Honey**: It is a viscous fluid produced from the flower nectar by the bees. It is a whole food containing sugars, antibiotics, enzymes, acids and minerals and is used as a high energy source. It is a useful carrier for many ayurvedic and unani medicinal preparations. Honey is also recommended for regular consumption in cases of malnutrition.
- **Royal Jelly**: It is a secretion from the bees and contains proteins, lipids, carbohydrates, minerals like iron, Sulphur, copper and silicon. It is used as a general tonic and stimulant improving resistance to fatigue, learning capacity and memory, appetite, and general health improvement.
- **Beeswax**: Beeswax is secreted as a liquid but solidifies when exposed to air. It is chiefly used in the candle industry. Other major places where the bees wax is

important are for making creams, ointments, capsules, deodorants, varnish, shoe polish, etc.

- **Propolis**: Propolis is a mixture of the beeswax and the resins collected by honeybee from plants. It has an adhesive quality and is also used for preparing ointments that treats cuts, wounds, dermatological and cosmetic treatment etc.
- **Bee Venom**: It contains active chemicals like histamine, hydrochloric acid, formic acid, apamin, etc. It is injected into patients suffering from rheumatism. It also helps in curing neuralgia, endoarthritis, necrosis, etc.
- **Pollen**: It is a mixture of flower pollen, nectar, enzymes, honey, wax and bee secretions. It is loaded with nutrients, amino acids, vitamins, lipids and several active substances. Hence it is increasingly being recognised as a medicine.

Present status of Beekeeping in INDIA

- India is ranked 9th in the top ten of the leading manufacturers of honey product.
- Honey producing units-2.64 lakh
- No. of bee colonies - 30 lakhs
- Production of honey - 94500 MT
- Export of honey- 38000 MT
- Import of honey - 400 MT
- Consumption of honey per capita - 70 gm
- Providing employment -3 lakh persons
- 200 million Bee colonies are required for enhancing crop yield
- which will provide employment to 215 lakh persons

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Beekeeping Institutions

- All India Beekeepers' Association
- Agricultural Products Export Development Authority (APEDA)
- Tribal Cooperative Marketing Development Federation of India Ltd (TRIFED)
- Central Bee Research and Training Institute
- Khadi and Village Industries Commission (KVIC)
- Inspection Council (EIC)
- National Bee Board

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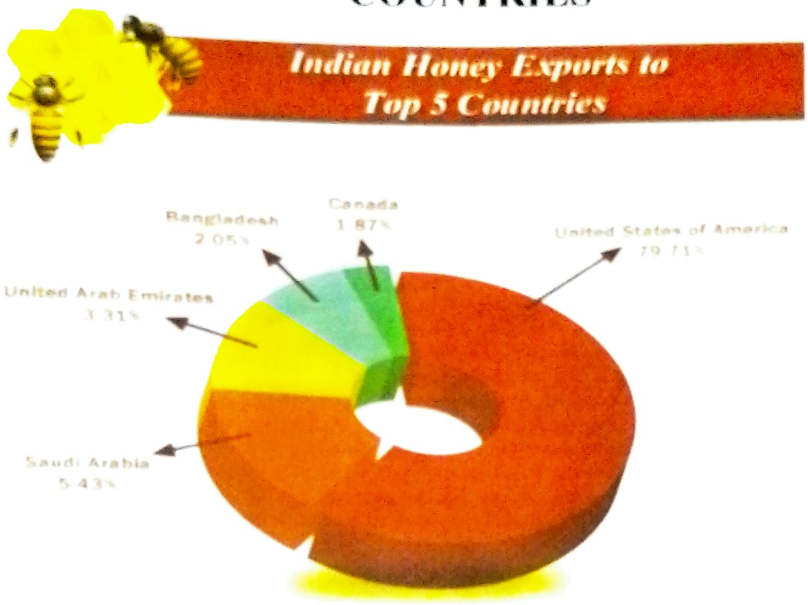
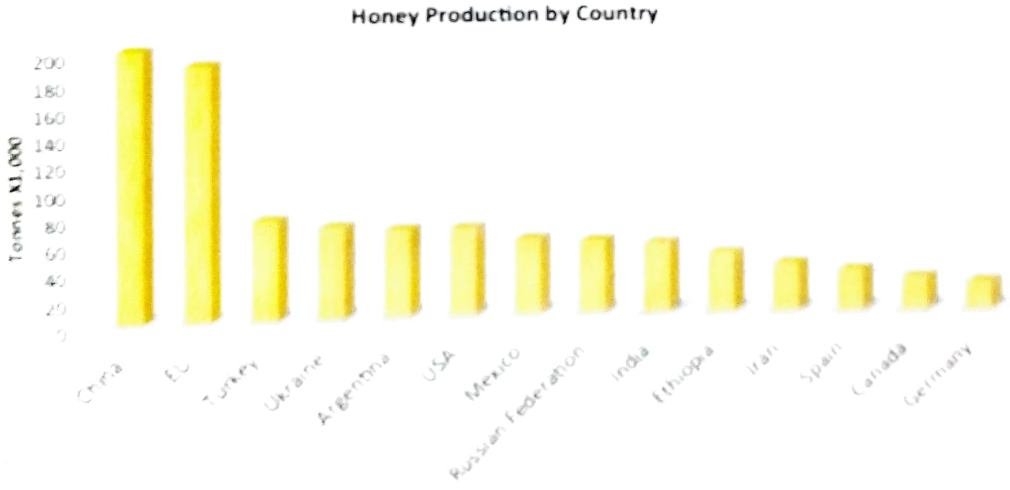
HONEY EXPORTER PARTNERS OF TOP 5 COUNTRIES



HONEY PRODUCTION (COMPARING COUNTRYWISE)



For ex.-

Present status of Beekeeping in Maharashtra-

- **No. of Talukas Covered - 76**
- **No. of Village covered - 1109**
- **No. of Bee-Keepers - 4322**
- **No. of bee boxes**

1. Apiscerana indica - 16442

2. Apis mellifera - 10641

- No. of bee colonies

1. Apiscerana indica - 8185

2. Apis mellifera - 2192

- No. of Bee-Keepers Co-op. Society.-4771

- Honey export -126.50 MT

Major constraints for the development of beekeeping in India-

¬ Lack of Technical Knowledge for Efficient Management of Colonies for High Honey Yields.

¬ Lack of Infrastructure at the Grass Roots and National Level for Beekeeping.

¬ Poor Quality Control for the Production of Honey.

¬ Emphasis on Production of Honey Instead of other Bee Products.

¬ Disease Prevention Control and Analysis.

Reasons for decline honey bee population

REASONS FOR DECLINE IN HONEY BEE PRODUCTION

- Habitat loss - less forage and shelter for bees
- Climate change - disrupting bee behaviour
- Pesticides including neonicotinoids - harming bee health
- Pests and disease
- Invasive species - bad news for bees?
- Cellular effects of mobile radiations
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A.N.D.U.A.T.KUMARGANJ, AYODHYA

ASSIGNMENT

on

TOPIC- Status of Beekeeping in India

COURSE:ELP-425(V)

SUBMITTED TO-

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HOD,Entomology

SUBMITED BY-

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ASSIGNMENT
ON
ELP-425

Submitted by-
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A-10160/18

Submitted to-
Dr. Umesh Chandra

SS-221(2+0)

Assignment topic- Acidic soil and their management

Sumitted to-
Dr. Robin chaudhary

Submitted by-
Piyush Mishra
A-11398/20

2023/7/20 11:57

Acidic soils and their management

Soil acidity is the result of excessive accumulation of H^+ ions over OH^- ions in the soil solution. In other words acidity means low percentage of base saturation. In acid soil regions (ASR) precipitation exceeds the evapo-transpiration and hence leaching is predominant causing loss of bases from the soil. When the process of weathering is drastic, the subsoil and in many cases, the whole profile becomes acidic.

➢ Development of soil acidity :- Soils become acid due to the following reasons :

1) Losses or removal of base from soil :

(a.) Leaching due to high rainfall : Due to heavy rainfall, soluble base salts are dissolve and remove along with the rain water and in the process exchange site become saturated with H+ ions. The precipitation takes the bases like Ca, Mg etc. downward from the surface of soil and due to which plant roots become unable to

utilize such nutrients. In humid regions (with precipitation of 100 cm annually) soils are more susceptible to acidity.

$$CaCO_3 + H_2CO_3 \rightleftharpoons Ca(HCO_3)_2 \downarrow$$

Leachable

(b.)Due to crop removal : Crops remove significant amount of bases from the soil.

2) **Soil formed from the acid parent materials :**

Soils developed form acidic parent materials having granite, rhyolite, sandstone, gneiss etc. are acidic in nature. If soils are formed in insitu, than acid soils are form SiO_2 contain is less than soils will not be acidic.

3) **Use of acid forming fertilizers :**

Ammonium sulphate and ammonium nitrate fertilizers produce acidity when added in the soil. Ammonium ions of these fertilizers replace calcium and magnesium from the exchange complex and the calcium sulphate so formed is lost due to leaching. In case the soils not having free lime, the acidity increases continuously by the use of acidic fertilizers. Residual acidity of different fertilizers produced acidity in the soils.

$(NH_4)_2SO_4$ $2NH4+$ $+$

$SO42-$

NH_4NO_3 NH_4^+ $+$ NO_3^-

(a.) Equivalent acidity refers to the kilogram of pure $CaCO_3$ required to neutralize the acids produced in the soil from the quantity of fertilizer indicated.

(b.) Equivalent basicity refers to the kilogram of pure $CaCO_3$ equivalent to the alkalinity produced in the soil from the quantity of fertilizer indicated.

4. **Microbial activity :** Microbes have been found responsible for many processes like decomposition of organic residues and nitrification. Such microbial activities result in the formation of inorganic and organic acids in soils.

5. **Presence of alumino silicates :** Layered materials containing Al_2O_3 and SiO_2 produce the charges by isomorphous substitution of cations of lower valency like aluminium by silica and by dissociation of H^+ ions from OH^- ions. At low pH values most of the aluminium is present in the soil as hexa hydrated ions (Al^{+++})

$$Al^{+++} + H_2O \longrightarrow Al(OH)^{++} + H^+$$

$$Al(OH)^{++} + H_2O \longrightarrow Al(OH)_2^{+} + H^+$$

$$Al(OH)_2^{+} + H_2O \quad Al(OH)_3 + H^+$$

6. **Hydrous oxide :** The oxides of Fe and Al with colloidal dimensions e.g. gibbsite remain as coatings of soil colloidal particles and block the exchange sites and with the result CEC becomes less. These oxides further on hydrolysis, produce H+ ions.

7. **Contribution from environment :** H_2SO_4 and HNO_3 cause soil acidity. When the electric discharge on the atmosphere during rainy season, atmospheric nitrogen (N), sulphur (S) and oxygen (O) formed acidity in the soil. In industrial area coal is used as energy sources (sulphur dioxide) which produce SO_2 in the environment, this SO_2 react with water (H_2O) in the atmosphere and bring back to the surface as acid rains.

$$N_2 + O_2 \quad 2NO_2$$

$$2NO_2 + H_2O \quad 2HNO_3$$

$$S + O_2 \quad SO_2$$

$$SO_2 + H_2O \quad H2SO4$$

8. **Presence of sulphide** : It is an important source in the coastal regions, where sea water contribute sulphate

sulphur. It contains about two gram sulphate sulphur per litre. In the inland areas coal and parent material may act as a source of sulphide.

$$Fe(OH)_3 + CaSO_4 + 9CH_2O \rightarrow 4FeS + 4Ca(HCO_3)_2 \downarrow + CO_2 + 11H_2O$$

In the above reaction organic matter (CH_2O) is used by micro-organisms as a source of energy, therefore, this material present in the reduced form.

FeS and FeS_2 ploymarize both are present under anaerobic conditions it gives neutral pH but under aerobic condition they oxidized by chemical and microbial processes.

$$4FeS_2 + 15O_2 + 2H_2O \rightarrow 2Fe_3(SO_4)_3 + 2H_2SO_4$$

If $CaCO_3$ or $MgCO_3$ is present than it will be converted into gypsum or $MgSO_4$ otherwise H_2SO_4 there so pH is low may be 2 – 3. These compound further polymeric leaching to the formation of yellow stricked mineral like

Jarosite – $[KFe_2(OH)_6 (SO_4)_2]$

Coquimbite – $[Fe_2(SO_4)_3 * 9H_2O]$

Further, ferric iron co-ordinates with H_2O molecule and behave as an acid i.e. acid sulphate soils.

➢ **Classification of soil acidity :-** Based on the presence of H^+ ions the acidity of soil is three types.

1. **Active acidity** – Hydrogen ions remain freely present in soil solution and produced limited acidity. Therefore, only about 25 g of $CaCO_3$ are sufficient to neutralize it in one hectare furrow slice of an average mineral soil having a pH of 6.0. If pH is 5.0 then $CaCO_3$ required may be approximately 250 g.

2. **Exchangeable acidity (reserve / potential)** – Hydrogen and aluminium ions held on soil colloids referred to as exchangeable or reserve acidity. Reserve acidity may be 1000, 50000, 100000 and still higher than the active acidity in case of sandy, clayey and organic soils, respectively.

   In very acidic soil, exchangeable H^+ and Al^{3+} ions are present in large quantities, but its quantity is quite less in moderately acidic soils.

3. **Residual acidity** – Residual acidity is that which remains in the soils after active and exchangeable acidity has been neutralized. Residual acidity is generally associated with Al^{3+} and H^+ ions and with aluminium and hydrogen atoms that are found in nonexchangeable forms by organic matter and silicate clay. The residual acidity is commonly for greater than either active or exchangeable acidity.

➢Forms of acidity in soil :-

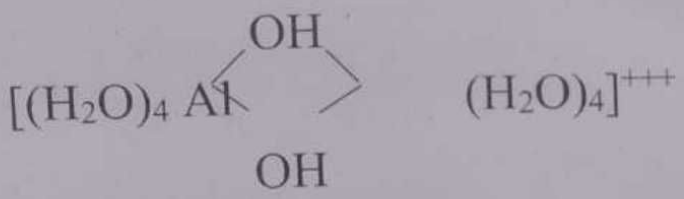
1. **Strong acidity** – This is due to presence of soluble Al and absorbed Al. Aluminium being trivalent preferably adsorbed as compared to H+ ions. This Al undergoes hydrolysis forming Al hydroxide. If pH is < 5.0, than Al may be present in the form of hexa hydrated Al ions and it may occupy more than 40% of exchange capacity.

$$[Al(H_2O)_6] + H_2O \rightleftharpoons [Al(H_2O)_5(OH)]^{++} + H^+$$

$$[(Al(H_2O)_5)OH]^{++} + \rightleftharpoons H_2O\ [Al(H_2O)_4(OH)_2]^+$$

$$+ H^+$$

$$[Al(H_2O)_4(OH)_2]^+ + H_2O\ [Al(H_2O)_3(OH)_3] + H^+$$



Due to this formation effective cation exchange capacity will decreases, but soil pH increases.

2. **Moderate acidity :-** In this case per cent base saturation is higher than strong acidity. Aluminium present not as on Al ion but as hydroxy ions. This hydroxy ion move in between the crystal unit and are tightly adsorbed thereby presenting expension and blocking the exchange site.

3. **Weak acidity :-** It is due to the presence of hydrated Al^{3+} ion and H^+ ions. pH of the weak acidity is 5.2.

4. **Very weak acidity (pH 5.2 – 6.5) :-** This acidity is due to the presence of COOH group of organic origin and hydrogen group of hydroxy Al polymer in the interlayer position and due to carbonic acid and basic Al sulphate.
5. **Very – Very weak acidity :-** This acidity due to phenol group of organic acids, hydrogen group of hydroxy Al polymers. Bicarbonate of Ca and Mg.
6. Extremely weak acidity :- Acidity is due to presence of alcoholic group of organic matter, salicylic acid, gypsic acid etc.

S. No.	Degree of acidity	Soil pH
1	Extreme acidity	4.0 – 4.5
2	Very strong acidity	4.5 – 5.0
3	Strong acidity	5.0 – 5.5
4	Medium acidity	5.5 – 6.0
5	Slight acidity	6.0 – 6.5

➢ Effect of soil acidity on plants growth :-

Soil acidity influence plant growth by the production of organic acid which are produces due to decomposition of organic matter or due to root secretion. Effect of soil acidity may be separated into two group.

Direct –

1. Toxicity effects of H^+ ions are observed in root tissues.

2. Permeability of the plant membranes for cations is affected.
3. Balance between basic and acidic constituents through roots is disturbed.
4. Enzyme changes occur in plants due to pH changes.

Indirect –

1. Availability of some nutrients like phosphorous.
2. Higher availability of Al, Mn, Fe, Zn, Cu etc.
3. Adverse effects on the beneficial activities of micro-organism.
4. Increase of plant diseases.
5. Nutrients like Ca, K, Mo etc. become deficient.

➢ Toxic effect of soil acidity :-

1. **Cell elongation** – Due to the soil acidity reduces the cell elongation because its adversely effected the development of meristmatic tissues of root tip in which maximum water and nutrients are occurred.

2. **Alunimium toxicity** – The toxicity of Al is influence by nature and concentration of accompanying concentration. Example – When muriate of potash (salt of muriatic acid) is used in the acidic soils, Cl^- ion of KCl will aggregate the toxic effect of Al. Aluminium accumulate on the surface of plant root and affected the root permeability. Root permeability will be adversely effected than also accumulates in the cortex particularly nuclei and cell

protoplasm (it is colloidal in nature). If it is accumulates than protoplasm colloidal character present and the result of this cell division or cell growth is checked and form binuceilate cells.

3. **Mn toxicity** – Under acidic condition Mn also show behavior similar to Al and as concentration of solution increases as the pH is decreases. Example – Plant can tolerant upto 1 – 4 µg per ml of Mn, the plant will be suffered from Mn toxicity.

   Sometimes typical occur in the field condition no Mn toxicity observed but in a pot experiment Mn toxicity occur because of the steaming effect appear as a result of which are more Mn comes to the soil solution and at therefore plant can suffer from Mn toxicity. Tolerance of Mn toxicity varies from crop to crop, paddy can tolerant higher concentration of Mn.

4. **Specific effect of soil acidity** – It effects the root tissue resulted in restricted in root growth.

5. **Non-specific effect of soil acidity** – Under acidic condition the presence of more amount of Fe, Mn etc. on the exchange side.
   - Nitrogen economy : Plant absorbs most of their nitrogen in the form of NO3- whose availability depends on the activity of nitrifying bacteria. The organism responsible for nitrification is most active when the pH is between

6.5 – 7.5. Nitrogen is present in two per cent (2%) in inorganic form and 98% in organic form, respectively. Under acidic condition mineralization process will be low and nitrogen avoid reduced. Nitrogen fixing bacteria like Azotobactor also fails to function below pH 6.0. De-nitrification loss is more availability decreases.

- Phosphorous economy : It availability is at its highest when the reaction is below 6.5 & 7.5. In strongly acidic condition (pH is 5.0 or less), Fe, Al and Mn are present in soluble state. These phosphates (Fe, Al and Mn) with water and form insoluble phosphates.

$$Al^{3+} + H_2PO_4^- + 2H_2O \rightleftharpoons 2H^+ + Al(OH)_2{*}H_2PO_4$$

(Insoluble)

The phosphate reacts with hydrated oxides of Fe & Al and form insoluble hydroxy phosphate of Fe & Al. This unavailability of phosphorous is called as P-fixation. The monovalent $H_2PO_4^-$ ions predominant in highly acidic solution (pH 4.0 – 5.0).

- Potassium economy : In acidic soil K is lost through leaching. The unavailability of K is due to the conversion of exchangeable to non-exchangeable K. It is not converted in any organic form in the plant and availability of K is decreases.
- Ca, Mg and S : In acidic soils the availability of Ca, Mg and S is decreases.

- Fe, Mn and Al : In acidic soil these elements creates toxic effect on plants.
- Mo : Its availability increases with increasing soil pH.

➢ *Management of acid soils*

Management of the acid soils should be directed towards enhanced crop productivity either through addition of amendments to correct the soil abnormalities or by manipulating the agronomic practices depending upon the climatic and edaphic conditions.

Soil amelioration

Lime has been recognized as an effective soil ameliorant as it reduces Al, Fe and Mn toxicity and increases base saturation, P and Mo availability of acid soils. Liming also increases atmospheric N fixation as well as N mineralization in acid soils through enhanced microbial activity. However, economic feasibility of liming needs to be worked out before making any recommendation.

Liming materials

Commercial limestone and dolomite limestone are the most widely used amendments. Carbonates, oxides and hydroxides of calcium and magnesium are referred to as agricultural lime. Among, the naturally occurring lime sources calcitic and dolomitic are important carbonates.

The other liming sources are marl, oyster shells and several industrial wastes like steel mill slag, blast furnace slag, lime sludge from paper mills, pressmud from sugar mills, cement wastes, precipitated calcium carbonate, etc equally effective as ground limestone and are also cheaper. Considering the efficiency of limestone as 100%, efficiencies of basic slag and dolomite are 110 and 94 % respectively. Basic slag and pressmud are superior to calcium oxide or carbonates for amending the acid soils. Fly ash, a low- density amorphous ferro-alumino silicate, also improves pH and nutrient availability.

Lime requirement of an acid soil may be defined as the amount of liming material that must be added to raise the pH to prescribed value. Shoemaker *et al.* (1961) buffer method is used for the determination of lime requirement of an acid soil.

Lime requirement scale of an acid soil by buffer method (t ha^{-1}) :

Soil Buffer pH	Lime Requirement	Soil Buffer pH	Lime Requirement
6.7	3.95	5.7	18.77
6.6	5.43	5.6	20.25
6.5	6.92	5.5	21.24
6.4	8.40	5.4	23.47
6.3	9.88	5.3	24.95
6.2	11.12	5.2	27.17
6.1	12.84	5.1	28.90
6.0	14.37	5.0	30.63
5.9	15.81	4.9	32.60
5.8	17.30	4.8	34.58

Crop choice

Selection of crops tolerant to acidity is an effective tool to counter this soil problem and breeding of such varieties is of specific importance for attaining higher productivity, particularly in areas where liming is not an economic proposition. The crops can be grouped on the basis of their performance in different soil pH range.

Relative tolerance of crops to soil acidity **Crops**	**Optimum pH range**
Cereals	
Maize, sorghum, wheat, barley	6.0-7.5

Millets	5.0-6.5
Rice	4.0-6.0
Oats	5.0-7.7
Legumes	
Field beans, soybean, pea, lentil etc.	5.5-7.0
Groundnut	5.3-6.6
Others	
Sugarcane	6.0-7.5
Cotton	5.0-6.5

STUDIES ON BIOLOGY AND DEVELOPMENT OF IPM MODULE AGAINST RICE YELLOW STEM BORER (*Scirpophaga incertulas* Walker) IN EASTERN U.P.

THESIS

SUBMITTED TO THE

ACHARYA NARENDRA DEVA UNIVERSITY OF AGRICULTURE & TECHNOLOGY
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

IN
ENTOMOLOGY

BY

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NARENDRA NAGAR (KUMARGANJ), FAIZABAD-224229 (U.P.)

INDIA
2017

Bio-ecology and eco-friendly management of pulse beetle, *Callosobruchus chinensis* (Linn.) in chickpea, *Cicer arietinum* (*L.*) under ambient condition

THESIS

SUBMITTED TO THE

ACHARYA NARENDRA DEVA UNIVERSITY OF AGRICULTURE & TECHNOLOGY, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE OF

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BY

Ravindra Nath Nishad

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ACHARYA NARENDRA DEVA UNIVERSITY OF AGRICULTURE & TECHNOLOGY, NARENDRA NAGAR (KUMARGANJ), AYODHYA-224229(U.P.)

INDIA

2020

SEASONAL ABUNDANCE OF MAJOR INSECT PESTS AND INTEGRATED PEST MANAGEMENT OF BRINJAL SHOOT AND FRUIT BORER, *Leucinodes orbonalis* Guenee

THESIS

SUBMITTED TO THE

ACHARYA NARENDRA DEVA UNIVERSITY OF AGRICULTURE & TECHNOLOGY
IN PARTIAL FULFILMENT OF THE REQUIREMENTS

FOR THE DEGREE OF

Doctor of Philosophy

IN

ENTOMOLOGY

By

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NARENDRA NAGAR (KUMARGANJ), AYODHYA - 224 229 (U.P.)
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2021

BIOLOGICAL CONTROL OF CONGRESS GRASS (*Parthenium hysterophorus*) IN SPECIAL REFERENCE TO MEXICAN BEETLE (*Zygogramma bicolorata*)

THESIS

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STUDIES ON INCIDENCE OF INSECT PESTS IN CHICKPEA AND BIORATIONAL MANAGEMENT OF GRAM POD BORER, *Helicoverpa armigera* (Hübner)

THESIS

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ACHARYA NARENDRA DEVA UNIVERSITY OF AGRICULTURE & TECHNOLOGY
IN PARTIAL FULFILMENT OF THE REQUIREMENTS

FOR THE DEGREE OF

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JULY, 2021

STUDIES ON BIOLOGY AND EFFICACY OF BIO-RATIONAL INSECTICIDES AGAINST SHOOT AND FRUIT BORER, *Leucinodes orbonalis* GUENEE IN BRINJAL

THESIS

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ACHARYA NARENDRA DEVA UNIVERSITY OF AGRICULTURE & TECHNOLOGY
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2020

STUDIES ON COMPARATIVE BIOLOGY OF RICE MOTH, *Corcyra cephalonica* (Stainton) ON DIFFERENT DIETS AND THEIR EFFECTS OF EGGS ON PARASITIZATION BY *Trichogramma chilonis* (Ishii)

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Master of Science (Agriculture)

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JULY, 2021