MAHARASHTRA COUNCIL OF AGRICULTURAL EDUCATION AND RESEARCH, PUNE
SEMESTER END THEORY EXAMINATION
B.Sc.(Hon.)Agriculture.

Semester : V(New)	Academic year : 2022-23
Course No. : SSAC-353	Title : Manures, Fertilizers and Soil Fertility Management
Credits : 3 (2+ 1)	Marks : 80
Day and Date : 14|10|2022	9.30 to 12.30 Friday

Note- i) Solve any eight questions from **SECTION 'A'**
ii) All questions from **SECTION 'B'** are compulsory.
iii) Draw neat labeled diagram wherever necessary.

Q.No.1 a) State the Arnon's criteria for nutrient essentiality.
b) What is organic recycling? Enlist the sources of organic matter. Give the composition of organic matter.
Q.No.2 a) What is green manuring? State the advantages and disadvantages of green manuring.
b) Define bulky organic manures. Explain the trench method of FYM preparation.
Q.No.3 a) State the factors affecting nutrient use efficiency for availability of potassium.
b) Enlist the methods of nutrient application. Explain in short method of broadcasting
Q.No.4 a) Define soil fertility evaluation. State the different approaches for soil fertility evaluation
b) State the plant usable forms of micronutrients (Fe, Mn, Zn and Cu) along with critical levels in soil.
Q.No.5 a) Define complex fertilizers. Write characteristics and advantages of complex fertilizers.
b) Define INM. State the components of INM with suitable examples.
Q.No.6 a) Write the storage and handling of NPK fertilizers.
b) Define fertilizer. Classify nitrogenous fertilizers with suitable examples.
Q.No.7 a) Write down effects of sewage water on soil and plant
b) Classify the phosphatic fertilizers with suitable examples.
Q.No.8 a) Define micronutrient fertilizers. List out the chelating compounds or agents.
b) Explain the transformation of different forms of nitrogen in soil
Q.9. a) State the objectives of soil testing
b) Enlist the different mechanism of transport of nutrient ions from soil to roots and write in details about diffusion.
Q.No.10 Write short Note (Any four)
1. Factors affecting the process of composting.
2. Biofertilizers.
3. Lime requirement of acid soils.
4. Analytical methods for N,P,K and micronutrient.
5. Top dressing.

(P.T.O.)

MAHARASHTRA COUNCIL OF AGRICULTURAL EDUCATION AND RESEARCH, PUNE
SEMESTER END THEORY EXAMINATION
B.Sc.(Hon.)Agriculture.

Semester : V(New)	Academic year : 2022-23
Course No. : SSAC-353	Title : Manures, Fertilizers and Soil Fertility Management
Credits : 3 (2+ 1)	Marks : 80
Day and Date :	

Note- i) Solve any eight questions from **SECTION 'A'**
ii) All questions from **SECTION 'B'** are compulsory.
iii) Draw neat labeled diagram wherever necessary.

Q.No.1 a) ***State the Arnon's criteria for essentiality of nutrient.***

Arnon's Criteria for essentiality of nutrients

In order to distinguish elements which are essential from those which may be taken up by the plant but are not essential Arnon (1954) has laid down the following criteria

1. The plant must be unable to grow normally or complete its life cycle in the absence of the element.
2. The element is specific and cannot be replaced by another

The element plays a direct role in metabolism.

b) ***What is organic recycling? Enlist the sources of organic matter. Give the composition of organic matter.***

Organic recycling: Returning of plant nutrients removed by the crops from soil through addition of organic material of crop after harvesting crop is referred as an organic recycling

Sources of organic matter:

1. Primary source: e.g. Higher plant tissues
2. Secondary sources: e.g. Animai and microorganisms their remains and waste products.

Chemical composition of organic matter:

1. Carbohydrates – 60 %
2. Proteins- 10 %
3. Fats, waxes and tannins- 5 %
4. Lignin- 25%

Q.No.2 a) ***What is green manuring? State the advantages and disadvantages of green manuring.***

Green manuring : Incorporation of plant material while green or soon after maturity for improving soil properties.

Advantages:

A.D.Jagdhani
Assistant Professor
Soil Science & Agril.Chemistry
College of Agriculture,Dhule

Professor,
Soil Science & Agril Chemistry
College of Agriculture, DHULE - 4

2. Increase in microbial activities
3. Returning of plant nutrients
4. Improves soil physical properties.

Disadvantages:

1. Germination of crop may be affected
2. Loss of one season.
3. More cost of cultivation and cost of nutrient

Increase in pest & disease incidence.

b) ***Define bulky organic manures. Explain the trench method of FYM preparation.***

Bulky organic manures: These manures are bulky in nature having greater volume per unit nutrient.

Trench method of FYM preparation

- This method has been recommended by C.N.Acharya.
- FYM preparation should be carried out in trenches.
- Size of trench 6.09 to 7.62 m long, 1.5 to 1.6 m broad and 0.91 to 1.06 m deep.
- All available dry litter and refuse from the farm and house hold should be heaped near the cattle shed and mixed with earth if available should be spread in the shed @ 2.26 kg per animal for absorption and soaking of urine.
- Urine soaked litter and dung well mixed and taken to the manure trench. A section of 0.91 m length of the trench from one end should be taken up for filling with daily collection of refuse from the cattle shed.
- Filling should be continued up to a height of 46-61 cm above ground. This can take 6 to 10 days depending upon number of animals.
- The top of the heap is made dome shaped and plastered over with cowdung-earth slurry. Three months is required for filling the trench.

Three months is required for complete decomposition

Q.No.3 a) ***State the factors affecting nutrient use efficiency for availability of potassium.***

Soil factors:

1. Soil type
2. Soil moisture
3. Organic matter content
4. Soil pH
5. K content in soil
6. CEC

Fertilizer factors

1. Water solubility of K fertilizer
2. Solid or liquid K fertilizer
3. Nutrient content in K fertilizer
4. Fertilizer characteristics
5. Fertilizer placement
6. Climate

A.D.Jagdhani
Assistant Professor
Soil Science & Agril.Chemistry
College of Agriculture,Dhule

Professor,
Soil Science & Agril Chemistry
College of Agriculture, DHULE - 4

b) *Enlist the methods of nutrient application. Explain in short method of broadcasting*

Methods of fertilizer application

i. Broadcasting
ii. Top dressing
iii. Placement- Plough sole, deep, subsoil
iv. Localized placement - Side dressing, band placement, pellet application, drilling
v. Application of fertilizers through irrigation water. (Drip/sprinkler etc)

Methods of broadcasting fertilizer applications

Broadcating : Application of fertilizer uniformly on the soil surface is known as broadcasting of fertilizer. It is done either before sowing of the crop or in standing crop.

Broadcasting and incorporation:

Generally, the entire dose of phosphatic and potassium fertilizer are applied by broadcasting before sowing, because of their low mobility in soil. These fertilizers are incorporated in to the rooting zone.

Q.No.4 a) *Define soil fertility evaluation. State the different approaches for soil fertility evaluation.*

Soil fertility evaluation : It is the assessment of nutrient supplying capacity of soil.

Different approaches for soil fertility evaluation

I) Chemical methods

A) Soil analysis
- 1) For total nutrients
- 2) For available nutrients (i.e. rapid soil testing)

B) Plant analysis
- 1) Total elemental analysis
- 2) Crop log technique 3) 'A' value technique
- 4) Tissue testing

II) Biological methods

A) Using higher plants
- 1) Neubauer seedling
- 2) Pot culture experiments
- 3) Field experiments
- 4) Mitscherlich's technique
- 5) Jenny's pot culture test
- 6) Sunflower and lettuce technique.

B) Using micro-organisms
- 1) *Azotobactor*
- 2) *Aspersillus niger*
- 3) *Cunninghamella* plaque method.

III) Visual symptom method : Diagnosis of deficiency symptoms of nutrients by visual observations in fields.

A.D.Jagdhani
Assistant Professor
Soil Science & Agril.Chemistry
College of Agriculture,Dhule

Professor,
Soil Science & Agril Chemistry
College of Agriculture, DHULE - 4.

b) *State the plant usable forms of micronutrients (Fe, Mn, Zn and Cu) along with critical levels in soil.*

Micronutrient	Plant usable form	Critical limit in soil
1. Fe	Fe^{++} (Ferrous) and Fe^{+++} (Ferric)	4.5 ppm
2. Mn	Mn^{++} (Manganous) and Mn^{+++} (Manganic)	2.00 ppm
3. Zn	Zn^{++}	0.6 ppm
4. Cu	Cu++(Cuprous) and Cu^{++}(Cupric)	0.2 ppm

Q.No.5 a) Define complex fertilizers. Write characteristics and advantages of complex fertilizers.

Complex fertilizers: The commercial fertilizers containing at least two or more of the primary essential nutrients. When such fertilizers contain only two of the primary nutrients they are designated as incomplete fertilizers, while those containing all three priary nutrients are called as complex fertilizers.

General characteristics of complex fertilizers:-

1. High analysis fertilizers.
2. Have uniform grain size.
3. Cheaper on the basis of nutrient content per Kg.
4. Transport and distribution cost is less
5. Safe for storage.
6. Desirable as these contains balanced nutrient for applications.
7. Non caking and non- hygroscopic

Advantages:-

1.Easy application.
2. Balanced crop nutrition.
3. High fertilizer efficiency.
4. Even distribution of nutrients.
5. Saving of labour and time.
6. Safe for storage.

b) *Define INM. State the components of INM with suitable examples*

INM: INM means the supply of nutrients to the plant from various sources of nutrient for maintenance or adjustment of soil fertility and plant nutrient supply at optimum level for sustaining the desired crop productivity through optimization of benefits from all possible sources of plant nutrients an integrated manner.

Components of INM

Inorganic fertilizers	Various fertilizers for nutrient sources like urea, SSP, MOP, DAP etc.
Crop residues	Bioorganic wastes, far crop waste, town compost

A.D.Jagdhani
Assistant Professor
Soil Science & Agril.Chemistry
College of Agriculture,Dhule

Professor,
Soil Science & Agril Chemistry
College of Agriculture, DHULE - 4.

	a) Compost b) FYM c) Sewage d) Agro industrial waste e) Animal waste
Legumes Green manuring	Legumes should be included in cropping system. Glyericidia, *dhainh* (Sesbania acueata) and sunhemp (*Crotalaria juncea*)
Biofertlizers	*Rhizobium, Azotobacter,* BGA, *Azolla*, PSB, *Mycorrhiza, Effective microbial solution*
Mineral sources	Synthetic and mineral fertilizers, rock phosphates, gypsum/pyrites, dolomite, fly ash etc

Q.No.6 a) ***Write the storage and handling of NPK fertilizers.***

Storage and handling of NPK fertilizers:

1. Protect all fertilizer bags from moisture ,water and rains.
2. Protect bags against excessive sunshine and heat by making use trees, structures and covers .
3. Ammonium nitrate : It is hygroscopic in nature hence bags are firmly tied . As it is fire hazardous handle carefully .It should be bagged in polythene lined jute bags and stored in dry place.
4. Urea: Hygroscopic nature, store in polythene lined jute bags in dry place .
5. Ammonium chloride, ammonium sulphate and sodium nitrate: No difficulty in storage and handling .
6. Single super phosphate : It contains small amount of acid which deteriorate gunny bags, hence it should be stored in polythene lined gunny bags. May form cakes in moist condition.
7. Dicalcium phosphate: Excellent physical condition.
8. Potassic fertilizers :Excellent storage condition for storage and handling .

b) ***Define fertilizer. Classify nitrogenous fertilizers with suitable examples.***

Fertilizer: Any organic or inorganic material of natural or synthetic origin added to soil to supply certain element in available and plant usable form which are essential for plant growth

1. **Nitrate fertilizers**: Nitrogen is an in oxidised form i.e. NO_3 - N e.g. Sodium nitrate – 16% N and Calcium nitrate – 15.5% N
2. **Ammonical fertilizers**: Nitrogen is in reduced form i.e. NH_4 – N e.g. Ammonium sulphate- 20 % N , Ammonium chloride – 26% N and Anhydrous ammonia – 82 % N
3. **Nitrate and ammonium fertilizers**: Nitrogen is in the form of NO_3-N + NH_4-

A.D.Jagdhani
Assistant Professor
Soil Science & Agril.Chemistry

e/c. Professor,
Soil Science & Agril Chemistry
College of Agriculture, DHULE - 4.

N form e.g. Ammonium nitrate – 34 % N , Calcium ammonium nitrate– 26 % N and Ammonium sulphate nitrate- 26% N

4. **Amide fertilizers:** Organic nitrogenous fertilizers nitrogen in amide (NH_2) form e.g. Urea- 46%N , Calcium cynamide- 21 % N

Q.No.7 a) ***Write down effects of sewage water on soil and plant.***

Effect sewage water on soil

1. Increases fertility and productivity of soil
2. Improves physical and chemical properties of soil.
3. Soil is contaminated with disease causing organisms.
4. Accumulation of soil with heavy metals (Cu,Pb, Cr,Co and Cd)
5. Increases concentration of micronutrients in soil above toxic level.
6. Clay and colloidal suspended solids in sewage may cause crust formation which affects seedling emergence.
7. Enhance BOD of soil which causes oxygen deficiency in soil.

Effect sewage water on plant:

1. Accumulation of heavy metals in vegetables
2. High bacterial contamination in vegetables.
3. Luxury uptake of heavy elements affects the quality of crops.
4. Affects germination, tillering, flowering and root growth due to crust formation.

b) ***Classify the phosphatic fertilizers with suitable examples.***

Classification of phosphatic fertilizers

The phosphatic fertilizers are classified in to three groups depending on the form in which orthophosphoric acid or phosphoric acid is combined with calcium

1) **Water-soluble :** Phosphatic fertilizers containing water-soluble phosphoric acid or monocalciumm ohosphate

   Examples: Superphosphate (single) 16 to 18% P_2O_5 and Ammonium phosphate (20% N and 20% P_2O_5 or 16% N and 20% P_2O_5)

2) **Citric acid-soluble:** Phosphatic fertilizers containing citric acid-soluble phosphoric acid or Dicalciumm phosphate

   Examples: Basic slag (14 to 18 % P_2O_5), Dicalciumm phosphate (34 to 39% P_2O_5)

3) **Acid insoluble:** Phosphatic fertilizers containing phosphoric acid which is not soluble in water or citric acid or containing insoluble phosphoric acid, or tricalciumm phosphate

   Examples: Rock phosphate (20 to 40 % P_2O_5), Raw bone-meal (20 to 25 % P_2O_5) or steamed bone meal (22 % P_2O_5)

A.D.Jagdhani
Assistant Professor
Soil Science & Agril.Chemistry

Professor,
Soil Science & Agril Chemistry
College of Agriculture, DHULE - 4

Q.No.8 a) *Define micronutrient fertilizers. List out the chelating compounds or agents.*

Micronutrient fertilizers: Any natural or manufactured material dry or liquid added to the soil or foliar application in order to supply essential micronutrients.

Chelating compounds or agents.

1. EDTA : Ethylene diamine tetra acetic acid.
2. HEDTA : Hydroxyethyl ethylene diamine triacetic acid.
3. DTPA : Diethylene triamine penta acetic acid.
4. EDDHA : Ethylene diamine di-o-hydroxy phenyl acetic acid.
5. NTA : Nitro-triacetic acid.

b) *Explain the transformation of different forms of nitrogen in soil*

There are three forms of nitrogen in soil

1) Organic - N (Proteins, amino acids etc)
2) Ammonium –N (Clay fixed)
3) Nitrate-N (NO_3-N)

Microbes are constantly metabolizing and recycling nitrogen as they breakdown organic matter by following reactions

Mineralization: Biochemical breakdown of organic nitrogen into inorganic nitrogen which can be available to plant.

Ammonification: Biochemical conversion of organic form of N (proteins amino acids) to ammonia

Nitrification: Biochemical conversion of ammonical form of N to nitrate form with the help of *nitrosomonas* and *nitrobacter* NO_3-N which can take up by plants. This form is more prone to leach from soil.

Denitrification: Reduction of NO_3-N to dinitrogen (N_2) loss in the environment. This occurs when soil is totally saturated by flooding and no oxygen is present

Q.No.9. a) *State the objectives of soil testing*

Objectives of soil testing

1. To assess the nutrient status or fertility of soil.
2. To know the of nature of problematic soil and their management.
3. To find out the soil salinity and alkalinity.
4. To estimate the fertilizer requirement of an area based on soil test.

To compare fertility status of two or more areas.

b) ***Enlist the different mechanism of transport of nutrients ions from soil to roots and write in details about diffusion.***

Mechanism of transport of nutrients ions from soil to roots : There are generally three ways in which nutrient ions in soil may reach the root surface.

1) Mass flow
2) Diffusion
3) Root interception.

Diffusion: Diffusion occurs when an ions moves from an area of high concentration to one of low concentration by random thermal coefficient. Most of

A.D.Jagdhani
Assistant Professor
Soil Science & Agril.Chemistry
College of Agriculture Dhule

Professor,
Soil Science & Agril Chemistry
College of Agriculture, DHULE - 4

P and K move to the root by diffusion . As the plant roots absorb nutrients from the surrounding soil solution the nutrient concentration to the root surface decreases compared to the bulk soil solution concentration. Therefore, a nutrient concentration gradient is established hat cause ions to diffuse toward the plant root.

Q.No.10 *Write short Note (Any four)*

1. ***Factors affecting the process of composting***

Factors affecting the process of composting

1) C/N ratio,
2) Fineness of the material,
3) Moisture & aeration,
4) Temperature
5) pH,
6) Micro-organism,
7) Use of inoculants,
8) Calcium phosphate,
9) Destruction of pathogenic organisms

2. ***Biofertilizers***

Biofertilizers : Biofertilizers are defined as preparations containing living cells or latent cells of efficient strains of microorganisms that help crop plants uptake of nutrients by their interactions in the rhizosphere when applied through seed or soil. They accelerate certain microbial processes in the soil which augment the extent of availability of nutrients in a form easily assimilated by plants.

Use of biofertilizers is one of the important components of integrated nutrient management, as they are cost effective and renewable source of plant nutrients to supplement the chemical fertilizers for sustainable agriculture. Several microorganisms and their association with crop plants are being exploited in the production of biofertilizers.

They can be grouped in different ways based on their nature and function.

I. Nitrogen fixing biofertilizers:

a. Free living : Aerobic – *Azotobacter, Beijerinckia, Anabaena*
Anaerobic – *Clostridium*
Faultative anaerobic – *Klebsiella*

b. Symbiotic : *Rhizobium, Frankia, Anabaena azollae*

c. Associative symbiotic : *Azospirillum*

d. Endophytic : *Gluconacetobacter Burkholdria*

II. Phosphorus solubilizers

Bacteria : *Bacillus megaterium* var. *phosphaticum*
B. subtilis, B. circulans
Pseudomonas striata
Fungi : *Penicillium* sp.
Aspergillus awamori

III. Phosphorus mobilizers

a) AM fungi
b) Ectomycorrhizal fungi
c) Ericoid Mycorrhiza

A.D.Jagdhani
Assistant Professor
Soil Science & Agril.Chemistry
College of Agriculture.Dhule

H.C. Professor,
Soil Science & Agril Chemistry
College of Agriculture, DHULE - 4

3. *Lime requirement of acid soils*

Lime requirement of acid soils :

The amount of lime required to be added to acidic soil to raise the pH to a desired value is called acid soil.

Liming materials are :

1. Calcic limestone ($CaCO_3$)
2. Dolomite limestone (Ca Mg $(CO_3)_2$)
3. Quicklime (CaO)
4. Hydrated (Staked) lime (Ca $(OH)_2$)
5. Chalk ($CaCO_3$)
6. Basic Slag
7. Fly ash

4. Analytical methods for N,P,K and micronutrients.
   1. N : Alkaline permagnate method
   2. P : Acidic Soil – Bray's method – Alkaline Soil – Olsen method
   3. K : Amm. Acetate Method/Flame potometer
   4. Fe, Mn, Zn, Cu :DTPA method
5. Top dressing

   Application of fertilizers in standing crop is known as **top dressing**. The most of the *rabi* crops are fertilized at sowing only no splitting of nitrogen due to limitation of soil moisture. However , under irrigated conditions nitrogen is splited up in two-three doses. Generally broadcasting, band placement or side dressing does top dressing. When small quantity of nitrogen or micronutrient is to be applied foliar application should be followed

(P.T.O.)

A.D.Jagdhani
Assistant Professor
Soil Science & Agril.Chemistry
College of Agriculture,Dhule

Asstt. Professor,
Soil Science & Agril Chemistry
College of Agriculture, DHULE - 4

Q.No.11 Define

SECTION 'B'

1) **Beneficial nutrient:** Beneficial elements are the mineral elements which stimulate plant growth but are not essential or which are essential only for certain plant species or under specific conditions. Example – silicon, sodium, aluminium, cobalt selenium and vanadium
2) **Chelate:** An organic compound capable of holding the plant nutrient in a form which prevents it from getting tied with other elements in the soil, thus keeping it more or less in available form for the plant.
3) **Diffusion:** Movement of ions from the area of higher concentration to the area of lower concentration.
4) **Indicator plant:** Certain plants are used as indicators for specific nutrient deficiencies. The indicator plants are susceptible to such deficiency and which develops clear symptoms that are not shown by other deficiency.
   Ex. Nitrogen – Cauliflower and cabbage are the indicator plants
   Phosphorus- Rape seed, boron- sunflower.
5) **Sewage:** Liquid collected from closed drains usually contains urine and washings, the night soil and other household or small scale industrial ingredients .
6) **Vermicompost** : The compost produced by using earthworms and partially decomposed organic matter having greater amount of available nutrients and high percentage of casting. Earthworm casting contains humus, micro organism, hormones, enzymes, auxin and other biomolecules.
7) **Ammonification:** Biochemical conversion of organic form of N (proteins amino acids) to ammonia
8) **Critical level:** The concentration of nutrient level in which added nutrient will not increase yield but increases concentration and below critical level plant shows deficiency symptomes .

A.D.Jagdhani
Assistant Professor
Soil Science & Agril.Chemistry
College of Agriculture,Dhule

Hd. Professor,
Soil Science & Agril Chemistry
College of Agriculture, DHULE - 4

Q.No.12 Match the pairs

" A"	" B"
1.Father of Agricultural chemistry	Justus Von Liebig
2. Father of Soil science	V. V. Dokuchaiev
3.Saw dust	C:N ratio 400:1
4. Soil	C:N ratio 10:1 to 12:1
5.Nitrogen	Mobile element in plant
6.Boron	Immobile element in plant
7.Potassium chloride	Cheapr fertilizer
8. Rock phosphate	Acidic soil

Prof.A.D.Jadhani
Mobile No.- 9421888827
Assistant Professor of SSAC
College of Agriculture, Dhule

Dr. V.P. Bhalerao
Mobile No.- 8830122042
I/c.Professor of SSAC
College of Agriculture, Dhule