MAHARASHTRA AGRICULTURAL UNIVERSITIES EXAMINATION BOARD, PUNE
SEMESTER END THEORY EXAMINATION
B.Sc.(Hons.) Agriculture

Semester	: V (New)	Term	: First	Academic Year	: 2023-24
Course No.	: SSAC 353	Title	: Manures, Fertilizers and Soil Fertility Management		
Credits	: 3 (2+1)				
Day & Date	: Friday, 8.12.2023	Time	: 14:00 to 17:00 hrs.	Total Marks	: 80

Note :
1. Solve **ANY EIGHT** questions from **SECTION 'A'.**
2. All questions from **SECTION 'B'** are compulsory.
3. All questions carry equal marks.
4. Draw neat diagram wherever necessary.

SECTION 'A'

Q.1 a) What is mixed fertilizer? Give its advantages and disadvantages.

b) Explain potassium fixation in soil.

Q.2 a) Define Soil fertility. What are the advantages of soil testing and state various approaches for fertilizer recommendation on the basis of soil test?

b) Discuss about losses during handling and storage of fertilizers.

Q.3 a) What are handling and storage losses of FYM?

b) Give sources of phosphorus to soil and classification of phosphatic fertilizer.

Q.4 a) Explain manufacturing process of Urea.

b) Explain the mechanism of transport of ions from soil to roots.

Q.5 a) What is Integrated Nutrient Management? Enlist the advantages of INM.

b) Describe in detail nitrogen fixation in soil.

Q.6 a) Define Nutrient use efficiency and explain factors influencing it.

b) State Arnon's criteria of essentiality of nutrients.

Q.7 a) Define Manures and classify them with suitable examples.

b) Define Composting. Enlist methods of composting.

Q.8 a) Write down in detail about sewage and sludge along with their composition.

b) Define C : N ratio and state its importance.

Q.9 a) Define FYM. Explain improved method of FYM preparation.

b) State elemental and chemical composition of organic matter.

Q.10 a) What is organic recycling? Enlist the sources of organic matter.

b) Give short notes on (Any Two):

i) Chelates ii) Nano fertilizers iii) Complex fertilizers

(P.T.O.)

SECTION 'B'

Q.11 Fill in the blanks:

1) John B Lawes of the Rothamsted Experiment Station, England was first to make and use Super phosphate on his farm.
2) Chemical formula of Citrate soluble Phosphate is $CaHPO_4$
3) There are 17 essential nutrients for plants present in soil.
4) C : N ratio of saw dust is 400:1
5) Rhizobium are symbiotic bacteria.
6) Feldspar primary mineral is a rich source of potassium.
7) Bowsingault was the first to start field plot experiment on his farm.
8) Toxicity of Calcium may lead to iron chlorosis.

Q.12 Match the pairs:

'A'		'B'
1) Stunted growth of plant	(C)	a) Arnon and Stout
2) Single super phosphate	(E)	b) Thaer
3) Beneficial nutrient	(F)	c) Nitrogen deficiency
4) Muriate of potash	(H)	d) Dr. C.N. Acharya
5) Immobile nutrient in soil	(G)	e) 16% P_2O_5
6) Humus Theory	(B)	f) Silicon
7) Improved method of FYM preparation	(D)	g) Zinc
8) Essentiality of nutrient	(A)	h) 60% K_2O

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05

SEMESTER -END EXAMINATION

B.Sc (Hons.) Agriculture

Semester	: V (New)	**Aca. Year**	: 2023-24
Course No	: SSAC-353	**Title**	: Manures, fertilizers and Soil Fertility Management
Credits	: 3 (2+1)	**Total marks**	: 80
Day and Date	:	**Time**	: 3 hrs

Note.: 1. Solve any EIGHT questions from section "A"

2. All questions from section "B" are compulsory

3. All questions carry equal marks.

4. Draw neat diagrams wherever necessary.

SECTION "A"

Q.1 a) What is mixed fertilizer? Give its advantages and disadvantages Marks

A mixture of more than one straight fertilizer which can supplymore than one plant nutrient element . 4

For over hundred years the mixed fertilizers are in use besides straight fertilizers. Many fertilizer mixtures are made available now and this account for a major portion of the consumption of N, P and K. Present day statistics show that numerous grades of fertilizers mixtures are manufactured and the fertilizer mixing industry is being considered as one of the major agro-industry.

Advantages

All the three major plant nutrients are made available in one and the same material. There is saving of time and labour. The residual effects will not be there. The fertilizer mixtures are usually prepared taking into account the acidic or alkaline nature of the ingredients, and other chemical reactions. Hence, some of the residual effects like acidity will not be there. Usually mixed fertilizer are prepared to suit a group of crops and soils.

Disadvantages

- Specific needs of crops and deficiency of individual nutrient elements cannot be satisfied by using mixed fertilizers as efficiently

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as in the case of straight fertilizers.

- The use of mixed fertilizer in such cases of specific needs will be a waste as other nutrients are also added to the soil.
- Unit cost of the various nutrients contained in the mixed fertilizer will always be higher when compared to the unity cost of nutrients contained in the straight fertilizers.

Improper mixing and storage of fertilizers can result in large nutrient losses.

Q.1 b) Explain potassium fixation in soil. 4

The various forms of K in soils can be classified on the basis of availability in three general groups a) unavailable (feldspars, micas etc), b) readily available (exchangeable and in soil solution) and c) slowly available (non-exchangeable=fixed). The potassium removed by crops is supplied by largely from non-exchangeable forms. Several soil conditions markedly influence the amounts of K fixed. Among the factors are (a) the nature of the soil colloids, (b) wetting and drying, (c) freezing and thawing and (d) the presence of excess lime.

Q.2 a) Define Soil Fertility.What are advantages of soil testing and state various approaches for fertilizer recommendation on the basis of soil test? 4

Soil Fertility- It is defined as inherent capacity of soil to supply nutrients to plant in adequate amount and in suitable proportion.

Advantages of Soil Testing-

- To Maintain Soil Fertility
- To enhance crop yield
- To maintain Soil health
- To avoid indiscriminate use of fertilizer
- To reduce expenditure on fertilizer

Approaches for Fertilizer Recommendation on the basis of Soil Test

- General Recommendation adjusted to soil test rating
- Critical level Approach
- Targeted Yield Approach

Q.2 b) Discuss about losses during handling and storage of fertilizers. 4

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Fertilizer differ in their ability to become moist or hygroscopic, as such they have to be handled during rainy season.

Nitrogenous Fertilizer-

i. Ammonium chloride - Excellent, no difficulty in storage and handling

ii. Ammonium nitrate - Storage properties are satisfactory but fertilizer is hygroscopic. So bags are firmly tied. As it is fire hazardous handle carefully. It is bagged in polythene lined jute bags as it is hygroscopic.

iii. Urea- Storage properties satisfactory. Hygroscopic, store in polythene lined jute bags in dry place.

iv. Ammonium sulphate & Sodium Nitrate- Storage properties good, no difficulties in handling & storage.

Phosphatic fertilizers:

i) Single super phosphate:

- It contains small amount of acid which deteriorate gunny bags, hence it should be stored in polythelene lined gunny bags.
- Cakes formation in moist condition.

ii) Dicalcium phosphate - Excellent physical condition.

Potassic fertilizers:

i.Potassium sulphate- Excellent physical condition for storage and handling.

ii.Potassium chloride- Excellent physical condition for storage and handling.

Protect all fertilizer bags from molsture, water and rains. Protect bags against excessive sunshine and heat by making use to shade of trees structures & covers.

Q.3 a) What are handling and storage losses of FYM. 4

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Handling and Storage Losses-

Handling losses-

Losses of liquid portion- Soaking loss, Gaseous loss

Losses of Solid Portion- through cakes for burning, grazing.

Losses during storage-1.By leaching 2. By Volatization

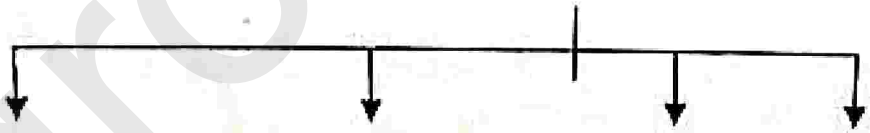
Q.3 b) Give sources of phosphorus to soil and classification of phosphatic fertilizer. 4

Sources : a) Commercial fertilizers b) Native compounds of P in Soil i.e. i.e. apatite and rock phosphate c) Plant residues, animal manures and green manures d) Human, industrial and domestic wastes.

Forms : **1) Organic :** a) Inositol phosphates
b) Nucleic acids
c) Phosphates of calcium (Apatite)

2) Inorganic : a) Phosphates of calcium (Apatite)
b) Iron phosphate (strengite)
c) Aluminium phosphate (Variscite)

1. Based on nature of source or manufacture Phosphatic materials



Natural Phosphates	Treated or Processed phosphates	Industrial by product	Synthetic Phosphates
1. Bones	1. Super phosphate	Basic stage	Ammonium phosphates
2. RP	2. Bone ash		

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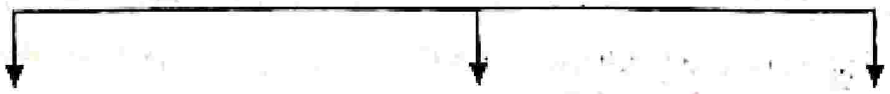
3. Bone super

2.Based on the solubility of the phosphate



Water soluble phosphates Phosphate	Citric soluble	Insoluble
Monocalcium phosphate	**Dicalcium phosphate**	**phosphate**
1. Super phosphate 16 % P_2O_5	1. Basic – slag 14-18 % P_2O_5	1. Rock phosphate 30-40 % P_2O_5
2. 3Concentrated SP 48 % P_2O_5	2. Dicalcium phosphate 34 -38 % P_2O_5	2. Raw bone meal 20-25 % P_2O_5

Q.4 a) Explain manufacturing process of Urea. 4

Manufacturing of urea $\underline{CO(NH_2)_2}$(42 to 46% N)

The main principle involved in the process of manufacture is combining pure ammonia with pure CO_2 and removing one molecule of H_2O from the resulting NH_4CO_3 to form Urea. The CO_2 and NH_3 are allowed to react in the liquid phase under greatly elevated pressure and temperature and this process requires highly specialized equipment. The CO_2 and NH_3 are compressed and heated as they enter the converter where urea is formed. A large excess of NH_3 is used in order to increase the conversion rate. The un reacted NH_3 and CO_2 are removed by means of an evaporator still and are then recycled. The urea solution is pumped to the crystalizer where cooling and crystallization take place. The urea crystals are centrifuged and dried.

Q.4 b) Explain the mechanism of transport of ions from soil to roots. 4

1) Mass flow 2) Diffusion 3) Root interception

1)Mass flow: Movement of solutes along with water to root surfaces in response to hydraulic gradients.

2)Diffusion: Orginally conceived by Grahm and Fick. It is the process of transport of ions or molecules in response to concentration gradient. It is expressed by following equation.

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3)Root Interception : Ions in soil that are intercepted by the growth of roots through the soil and hence cannot have to move to the root before absorption

Q.5 a) What is Integrated Nutrient Management? Enlist advantages of INM. 4

Integrated nutrient management is a system approach and give equal emphasis to use of chemical fertilizers , biological sources and systems of nutrients and soil fertility enhancing cropping pattern

Advantages

1.Increase soil organic matter through application
2. Efficiently cycle the nutrients and solubilities unavailable nutrients , fixes atmospheric nitrogen
3.Reduces leaching losses of nutrients
4.Increase number of favourable microorgnanisms
5.Improve physico-chemical and biological condition of soil
6. Reduces erosion hazards.

Q.5 b) Describe in detail nitrogen fixation in soil. 4

Nitrogen Fixation-

The process in which atmospheric nitrogen is converted to formused by plant and micro-organism is called nitrogen fixation.

A. **Non biological fixation-** During lightening storm and electrical discharge, extreme temperature and pressure created which oxidizes dinitrogen of atmosphere to nitric oxide or nitrite.

B.**Biological Fixation**-Major amount of nitrogen is fixed by biological sources. Among the biological sources two groups are mainly involved in nitrogen fixation.

Nonsymbiotic nitrogen fixation- Free living organisms exist independently in soil, which fix nitrogen in their body in form of organic molecules.Thenon symbiotic organism obtain energy from decomposing organic matter of soil

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or from photosynthesis.

Anaerobic organism-Clostridium spp.

Aerobic organism- Azotobacter

Photosynthetic-Rhidospirilium rubrum

Algae

Symbiotic nitrogen fixation- In system first , the nitrogen fixing micro-organisnm are either bacteria belonging to genera Rhizobium or Actinomycetes.

Associative nitrogen Fixation – In case of association the partnership is more casual and nitrogen transfer move indirect. This bacteria use root exudates from the host plant as source of energy. Azospirillium, Azotobacte rand Pseudomanas genera

Q.6 a) Define nutrient use efficiency and explain factors influencing it. ... 4

Nutrient Use efficiency-It is defined as the amount of dry matter produced per unit
of applied.

Factors affecting nutrient use efficiency-

a)Crop characteristics

b)Soil characteristics

c)Mangement practices

d)Climate

Q.6 *b)* State Arnon's Criteria of essentiality of nutrients. 4

Criteria for essentiality (Arnon, 1939):

1.The plant must be unable to grow normally for completing its life cycle in absence of the nutrients.

2.The role of nutrient element is specific and cannot be replaced by another.

3.The element plays direct role in metabolism.

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Q.7 a) Define manures and classify it with suitable example. 4

MANURES

Manures are plant and animal wastes that are used as sources of plant nutrients. They release nutrients after their decomposition. Manures can be grouped into bulky organic manures and concentrated organic manures based on concentration of the nutrients.

Bulky organic manures : Organic material of natural origin having greater volume per unit nutrient content. C/N ratio may be about 20 : 1 examples - FYM, compost and green manuring.

Concentrated organic manure : Organic material of natural origin having small volume per unit nutrient content. These are generally undecomposed having C:N ratio may be less than 10 : 1.

Examples - oil cakes, blood meal, meat meal, fish and bonemeal.

Concentrated organic manures :

Types: 1. Plant origin – oil cakes : Edible and non edible,

2. Animal origin - Bone meal, fish & blood meal, poultry manure.

Edible oil cakes ; Suitable for feeding to cattles also. e.g. groundnut, cotton seed, linseed: sunflower, sesamum.

Non edible oil cakes : Not suitable for feeding to cattle. e.g. caster oil cake, Karanj cake, Mahua cake, neem cake.

Q.7 b) Define composting? Enlist method of Composting. 4

Composting : It is largely a biological process in which aerobic and anaerobic micro-organisms decompose the organic matter and lower the C/N ratio of the refuse.

1. 1. ADCO process (Agricultural Development Company) 2. Activated

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compost process 3. Indore process 4. Bangalore process 5. Coimbatore process 6. Rural compost 7 Urban compost 8. Mechanical compost and 9. Vermicompost

Q.8 a) Write down in detail about sewage and sludge along with their composition 4

Sewage : Liquid collected from closed drains usually contains urine and washings, the night soil and other solid ingredients.

Composition : N - 6 to 10%, P_2O_5 3 to 4% & K_2O 3 to 4%

Sludge : Settled sewage solids combined with varying amounts of water and dissolved materials removed from sewage by screening sedimentation. Chemical precipitation or bacterial digestion.

Composition:

N - 1.5 to 3.5%, P_2O_5 0.75 to 4.00 % and K_2O 0.3 to 0.6%.

Q.8 b) Define C/N ratio and state its importance. 4

C/N ratio: The ratio of the weight of organic carbon to the weight of total nitrogen in soil or organic material. 4

C/N ratio in plants & Microbes and soil :

Legumes and farms manures	- 20:1 to 30:1
Straw residues	- About 100 :1
Saw dust	- 400 : 1
Microorganism	- 4:1 to 9 :1
Soil	- 10:1 to 12:1.

Significance of C/N ratio:

1. Effect on soil colour
2. Influence on physical properties.
3. High cation exchange capacity

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4. Supply and availability of nutrients.

5. Effect on carbon cycle

Q.9 a) Define FYM. Explain improved method of FYM preparation.

Farmyard manure refers to the decomposed mixture of dung and urine of farm animals along with litter and left over material from roughages or fodder fed to the cattle. On an average well decomposed farmyard manure contains 0.5 per cent N, 0.2 per cent P_2O_5 and 0.5 percent K_2O. The present method of preparing farmyard manure by the farmers is defective. Urine, which is wasted, contains 1% N and 1.35% K. Nitrogen present in urine is mostly in the form of urea which is subjected to volatilization losses. Even during storage, nutrients are lost due to leaching and volatilization. However, it is practically impossible to avoid losses altogether, but can be reduced by following improved method of preparation of farmyard manure.

Trenches of size 6 m to 7.5 m length, 1.5 m to 2.0 m width and 1.0 m deep are dug. All available litter and refuse is mixed with soil and spread in the shed so as to absorb urine. The next morning, urine soaked refuse along with dung is collected and placed in the trench. A section of the trench from one end should be taken up for filling with daily collection. When the section is filled up to a height of 45 cm to 60 cm above the ground level, the top of the heap is made into a dome and plastered with cow dung earth slurry. The process is continued and when the first trench is completely filled, second trench is prepared. The manure becomes ready for use in about four to five months after plastering.

If urine is not collected in the bedding, it can be collected along with washings of the cattle shed in a cemented pit from which it is later added to the farmyard manure pit. Chemical preservatives can also be used to reduce losses and enrich farmyard manure. The commonly used chemicals are gypsum and superphosphate. Gypsum is spread in the cattle shed which absorbs urine and prevents volatilization loss of urea present in the urine and also adds calcium and sulphur. Superphosphate also acts similarly in reducing losses and also increases phosphorus content.

0.9 b) State elemental and Chemical composition of organic matter. 4

Chemical composition of undecomposed organic matter:

1. Carbohydrates - 60 % , 2. Proteins - 10 % 3. Fats, Waxes& tannins - 5%,

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4. Lignins - 25 %

Elemental composition : 1. Carbon - 44 %, 2. Oxygen - 40 % 3. Hydrogen - 8 %, 4. Ash - 8 %

Q.10 a) What is organic recycling ? Enlist the sources of organic matter. 4

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: Higher plant tissues
2. Secondary sources: e.g. Animal and microorganisms their remains and waste products.

b) Give short note on: (Any Two) 4

i) 1)Chelates

ii) 2)~~Soil conditioners~~ Nano Fertilizers

iii) 3)Complex fertilizers

i) **1) Chelates :** It is a term applied to compounds which tightly hold certain cations that are attracted towards them and release them slowly for utilisation by plants. Chelates are generally organic compounds that combine with cations like Fe, Mn, Zn, Cu in complex ring structure. Chelating compounds or agents : EDTA, DTPA, EDDHA, CDTA, NTA Natural chelates : FYM and other organic manures contain the organic substances which acts as chelating compound. Therefore micronutrient salts applied through FYM and manures are slowly released and made available to plants. Effects on crop growth : 1. Essential nutrients for life & growth of plants 2. Help to form enzymes or vitamins 3. Aid in keeping another element reduced or oxidised. 4. Increase the resistance to diseases 5. Interact with secondary and major plant nutrients. 6. Directly influence the activity of micro organisms. 7. Excess of micronutrients may create toxicity in plant.

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ii) **2) Nano fertilizers:** are synthesized or modified form of traditional fertilizers bulk materials or extracted from different vegetative or reproductive parts of the plant by different chemical, physical, mechanical or biological methods with the help of nanotechnology used to improve soil ferlity, productivity and quality of agriculture produces. Nano particles can made from fully bulk materials.

Advantages of nano fertilizers 1. Nanofertilizer facilitates higher nutrient use efficiency. 2. Nutritional value and health. 3. Seed germination and growth parameters of the plant. 4. Yields.

Desirable properties 1. Controlled release formulation. 2. Solubility and dispersion for mineral micronutrients. 3. Nutrient uptake efficiency. 4. Controlled release modes. 5. Effective duration of nutrient release. 6. Loss rate of fertilizer nutrients.

iii) **3} Complex fertilizers:** The commercial fertilizers containing atleast two or more of the primary essential plant nutrients (N, P, K) are called complex fertilizers. When the fertilizer contains only two of the primary nutrients it is designated as incomplete complex fertilizer, while one containing all three primary major nutrients (N, P and K) is designated as complete complex fertilizer. These fertilizers are manufactured in general by : a) Chemical reaction and b) Purely mechanical mixing of straight fertilizers.

Characteristics of complex fertilizer: 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 contain balanced nutrients for applications. 7. Non caking and non hygroscopic.

Advantages of complex fertilizers : 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

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SECTION "B"

Q.11 Fill in the blanks

1 John B. Lawes of the Rothamsted Experiment station, England was first to make and use Super phosphate on his farm.

2. Chemical formula for citrate soluble phosphate is $CaHPO_4$

3. There are 17 essential nutrient for plant present in soil.

4. C:N ratio of saw dust is 400:1

5. Rhizobium are symbiotic bacteria.

6 Feldspar primary mineral is rich source of potassium.

7 Boussingault was first to start field plot experiment on his farm.

8 Toxicity of calcium may lead to iron chlorosis

Q.12 Match the pairs

1. Stunted growth of plant- Nitrogen deficiency. (c)
2. Single super phosphate-16% P_2O_5 (e)
3. Beneficial nutrient- Silicon (f)
4. Muriate of potash-60% K_2O (h)
5. Immobile nutrient in soil -Zinc (g)
6. Humus Theory - Thaer (b)
7. Improved method of FYM preparation –Dr. C. N Acharya (d)
8. Essentiality of nutrient-Arnon and Stout (a)

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