Model Answers

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

Semester	: II (NEW)	Term: II	Academic year : 2021-22
Course No	: H/SSAC-122	Title : Soil Fertility and Nutrient Management	
Credits	: 2 (1+1)		
Day and Date	:	Time : 2 hrs	Total Marks:40

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 Define soil fertility evaluation. State the methods of soil fertility evaluation.

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

Methods:

I. Nutrient deficiency symptoms on plant: Diagnosis of deficiency symptoms of nutrients by visual observations in field.

II. Plant analysis:

1. Total plant analysis: 2. Rapid tissue testing

III. Soil testing:

1. Total nutrients 2. Available nutrients

IV. Biological tests:

A) Indicator plants tests:

B) Microbiological tests:

1) *Azotobactor* 2) *Aspergillusniger* 3) *Cunning hamella* plaque methods

C) Laboratory and greenhouse tests:

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

Q. 2 What are organic manures? Classify the bulky and concentrated organic manures along with suitable examples.

Organic manures: Organic materials prepared mainly from plant and animals refuse used for nutrition of plants.

Classification of organic manures:

A)Bulky organic manures: FYM, Compost, Greenmanures

B) Concentrated organic manures:

a)Animal origin: Bone meal, poultry manure, fish and blood manure

b) Plant origin:

1) Edible oil cake: Groundnut, cottonseed, linseed, sunflower, sesamum.

2) Non edible oil cake: Castor, Karanj, neem.

Q. 3 Define essential plant nutrients and classify the essential plant nutrients.

Essential nutrients: A chemical element required for normal growth of plant without which plant cannot complete its life cycle.

Classification of essential nutrients

1. **Major or Macronutrients**(required in large amount):- two types

C,H,O,N,P,S,K,S,Ca,Mg

a) From air and water(C,H,O)

b) From soil (N,P,K,S,Ca,Mg)—subdivided into two types

1)**Primary nutrients**(required in relatively more amount):- N,P,K

2)**Secondary nutrients**(required in relatively less amount):- S,Ca,Mg

2. **Micro or Minor nutrients**(required in small amount):-

Fe, Mn, Zn, Cu, B, Mo, Cl, Ni

Q. 4 What is luxury consumption? Explain consumption of nitrogen by plant.

Luxury consumption: It is the tendency of some crops to absorb and accumulate nutrients far in excess of their actual needs if it is present in sufficiently large quantity in the soil. Potassium is one of the nutrient elements which is subjected to luxury consumption.

The absorption pattern of different nutrients by plants varies greatly among the plant species and also their age and growth stages.

Consumption of Nitrogen by plants

• Plants absorb the N mostly in nitrate (NO_3^-) form or in ammonical (NH_4^+) form by some plants. Plants usually absorb the N more during active growing period, but they do not always absorb it at the same rate. The amount of nitrogen absorbed is at a maximum when the plants are young and gradually declines as the plants age. Plants can absorb extra nitrogen when it is available and store it to be used later if needed.

• An oversupply of N generally produces dark green, succulent, vegetative growth. In such cases there will be a decline in seed production of grain crops, fruit production in tomatoes and some tree crops. In sugar beets, sugar content decreases and in potatoes, tubers become watery. The negative effects of too much of N on growing plants can be reduced if the P and K supplies are adequate.

The average utilization of applied N by crops is around 50 percent but with proper nitrogen management strategies the efficiency as high as 80 % or more can be increased.

Q. 5 Enlist the problematic soils? Give characteristics of saline, saline-sodic and sodic soils.

Problematic soils: Alkaline soils, Saline soils, Saline-alkaline soils, Acid soils and Calcareous soils

Characteristics of Saline, Saline-Sodic and Sodic soils:-

Characteristics	Saline soils	Saline-Sodic soils	Sodic soils
ECe (dSm^{-1})	more than 4	more than 4	less than 4
pHs	less than 8.5	less than equal to 8.5	more than 8.5 to 10
ESP (%)	less than 15	More than 15	More than 15
Nature of salts	Neutral soluble salt :- Na^+, Ca^{++} Cl^-,SO_4^{--}	Neutral soluble salt and xchangableNa^+Ca^{++}, Cl^-, SO_4^{--}, Mg^{++}, K^+. Vary in dominance of salt and high pH.	High SAR, Na_2CO_3 type salts are n more quantity.

Q. 6 Define fertilizer. Classify the nitrogenous fertilizers with examples.

Fertilizer: Any organic or inorganic material of natural or synthetic origin added to a soil to supply certain elements essential for the growth of plants.

Classification of the nitrogenous fertilizers on the basis of chemical forms:

1. **Nitrate fertilizers:** NO_3^- or Nitrate eg. Sodium nitrate, Calcium nitrate
2. **Ammonium fertilizers:** NH_4^+eg. Ammonium Sulphate, Ammonium phosphate
3. **Nitrate and Ammonium fertilizer:** NO_3^- and NH_4^+ form eg. Ammonium nitrate, Calcium ammonium nitrate.
4. **Amide fertilizer:** Amide form eg . Urea, Calcium cynamide.

Q. 7 Define Integrated Plant Nutrient Management System. What are the components of IPNMS?

IPNMS is the intelligent and combined use of inorganic, organic and biological resources so as to sustain optimum yields improve or maintain the soil chemical and physical properties and provide crop nutrition packages which are technically sound, economically attractive,

practically feasible and environmentally safe. The principal aim of the integrated approach is to utilize all the possible sources of plant nutrition in a judicious and efficient manner.

Components of IPNMS:

1. Mineral fertilizers
2. Organic manures and crop residue.
3. Crop rotations
4. Green manuring
5. Microbial fertilizers i.e. Nitrogen fixing organism(biofertilizers), phosphate solubilizing microorganism, mycorrhizae etc.
6. Animal wastes.

Q. 8 Explain the concept of Soil Test Crop Response and Targeted yield.

CONCEPT OF SOIL TEST CROP RESPONSE (STCR)

- STCR approach is aiming at obtaining a basis for precise quantitative adjustment of fertilizer doses under varying soil test values and response conditions of the farmers and for targeted levels of crop production. These are tested in follow up verification by field trials to back up soil testing laboratories for their advisory purpose under specific soil, crop, and agro climatic conditions. The fertilizers are recommended based on the following criterias.
- Fertilizer recommendations based on regression analysis approach
- Recommendations for certain % of maximum yield
- STCR methodology takes in to account the three factors;

1. Nutrient requirement (NR) in kg/ quintal of the produce
2. Percentage contribution from soil available nutrients (SE)
3. Percentage contribution from added fertilizers towards making effective fertilizer prescriptions for specific yields

i) Nutrient Requirement (NR = $\frac{\text{Total nutrient uptake (grain+straw) kg/ha}}{\text{Yield of grain (q/ha)}}$ (in producing 1 Quintals of grain)

ii) Fertilizer Efficiency (FE in = $\frac{\text{Total nutrient uptake (kg/ha)-soil test value in treated Plot (kg/ha) X soil nutrient efficiency (\%) X 100}}{\text{Ferilizer dose applied (kg/ha)}}$

iii) Soil Efficiency (SE in %) = $\frac{\text{Total nutrient uptake in control kg/ha X 100}}{\text{Soil test value in control kg/ha}}$

- With the help of above parameters, adjustment equations have been developed for a number of crops in various soils.

E.g.: For Rice crop.

a. Fertilizer N = 4.39 T -0.6723 Soil N
b. Fertilizer P_2O_5 = 2.83 T – 6.110 Soil P
c. Fertilizer K_2O = 1.41 T – 0.329 Soil K

Where T= Targeted yield of rice

Targeted yield concepts:

Thisisa soil test based recommendations but given for different yield goals and not for a single optimum yield level. A large variety of fertilizer prescription have been made available by putting soil test values into certain mathematical equations and finding out the quantity of nutrients needed for a given yield target.

Q. 9 Define biofertilizers. Enlist different types of biofertilizers.

Biofertilizers: Generally they are defined as the preparation containing live or latent cells of efficient stains of nitrogen fixing, phosphate solubilizing or cellulytic microorganism used for application to seed, soil or composting areas with an objectives of increasing numbers of such microorganism and to accelerate certain microbial process to augment the extent of availability of nutrients in a form which can be easily assimilated by plants.

Types of biofertilizers:

Rhizobium, Azotobactor, Azospirllum, Azolla, BGA, *Mycorrhiza*,sulpur oxidizing and phosphate solubilizing microorganisms.

Q 10 Short note (Any two)

1. Importance of C:N ratio:

C:N ratio is defined as the ratio of the weight of organic carbon to the weight of total nitrogen in a soil or organic matter. It is the relationship between organic cabon and nitrogen content of soils or plants.

Importance of C:N ratio:

1.C:N ratio mainly controls decomposition rate in soil

2.It is a source of food and energy for plants

3.Influence of C/N ratio on N release

4.The decay of organic matter can be delayed: if sufficient nitrogen to support microbial growth is neither present in the material nor available in the soil

5.Influence of C/N ratio on Soil ecology: The soil ecosystem consists of saprophytic bacteria and fungi and nematodes, protozoa and earthworms that grow rapidly on organic residues as food source

6.It is related to release of available N, total organic content and accumulation of humus

2. Importance of pH in plant nutrition:

The soil pH indicates degree of acidity, alkalinity or neutral condition of soil. The pH has many roles in crop production and particularly in plant nutrition.

1. It significantly influences other chemical as well as biological properties and also affect the availability of most of the chemical elements of importance to plants and microbes
2. The soil pH greatly affects the solubility of minerals
3. The soil pH determines the amount and type of nutrient element availability in soils.

Eg : In strongly acidic soils (pH 4-5) usually have high and toxic concentration of soluble Al andMn

4. The soil pH also influences plant growth by the effect of pH on activity of beneficial microorganisms
5. Better nutrient availability found at neutral pH (6.5-7.5) like N, P, K, S, Ca, Mg but in low pH acid soil toxicity of Fe, Al, Mn etc., and deficiency of P, Mo etc. while in saline and alkaline soils Fe, Mn, Zn and Cu may be deficient. Mo availability is more
6. It helps in recommendation of soil amendments and fertilizer applications
7. Availability and mobility of both macro and micro nutrients in soil is greatly affected by soil pH.

3. Fertilizer use efficiency:

The extent of recovery of applied fertilizer nutrients by a crop indicates the efficiency of fertilizer.

Improvement of nitrogen use efficiency:-

1. Use bio fertilizers to improve the nitrogen use efficiency
2. Apply inorganic fertilizers along with FYM
3. Neem coated urea is used to reduce nitrification
4. Water soluble fertilizers will be helpful for easy availability of plant nutrients
5. Slow release fertilizers, chelated fertilizers use is also helpful for improving nitrogen fertilizer use efficiency

Nitrogen fertilizers spray is also helpful to improve its use fertility

SECTION "B"

Q. 11 Fill in the blanks:

1. Physical mixtures of two or more straight fertilizers are called as **mixed** type fertilizers.
2. According to Fick's law, the rate of **diffusion** is proportional to the concentration gradients.
3. Gypsum amendment is used for reclamation of **alkali** soils.
4. C: N ratio of sawdust is **400:1.**

Q. 12 Match the pairs:

"A"		"B"
1. Single super phosphate	→	**c) 16 % P_2O_5**
2. Criteria for essentiality of element.	→	**a) Arnon and Stout**
3. Feldspar	→	**d) High potassium content.**
4. Whiptail in cauliflower.	→	**b) Mo deficiency**