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CROP PRODUCTION TECHNOLOGY

UNIT 3

CROP MANAGEMENT

Water requirement of some selected crops

Sl. No.	Crops	Duration (days)	Water requirement(mm)	No. of Irrigations
1.	Rice	135	1250	18
2.	Groundnut	105	550	10
3.	Sorghum	100	350	6
4.	Maize	110	500	8
5.	Sugarcane	365	2000	24
6.	Ragi	100	350	6
7.	Cotton	165	550	11
8.	Pulses	65	350	4

CROP NUTRITION MANAGEMENT

1. Need for supplementation to soil supplied nutrients,
2. Sources, generalized recommendations,
3. Methods and timing of application of supplemental nutrients including fertigation scheduling

NEED FOR SUPPLEMENTATION TO SOIL SUPPLIED NUTRIENTS

Essentiality of nutrient elements

- A mineral element is considered essential to plant growth and development if the element is involved in plant metabolic functions and the plant cannot complete its life cycle without the element.
- Usually the plant exhibits a visual symptom indicating a deficiency in a specific nutrient, which can be normally prevented or corrected by supplying that nutrient. The essentiality is given by Arnon (1956).

- Visual nutrient deficiency symptoms can be caused by many other plant stress factors; therefore cautions should be exercised when diagnosing deficiency symptoms.

Elements required in plant growth

A total of only 17 elements are essential for the growth and full development of higher green plants according to the criteria laid down by Arnon and Stout (1939).

1. **Macronutrients**:

Based on the relative abundance in plants, viz., Nitrogen (N); Phosphorous (P), Potassium (K), Sulfur (S), Calcium (Ca) and Magnesium (Mg)

2. **Micronutrients**:

Their concentration is very small. They are also referred to as minor elements.
Iron(Fe);Zinc(Zn);Manganese(Mg),Copper(Cu),Boron(B),Chlorine(Cl) andMolybdenum(Mo).Insomeplants,otherthantheabove,Sodium(Na), Cobalt(Co),Vanadium(Va),Nickel(Ni)andSilicon(Si)areconsideredas essential micronutrients

Average concentrations of Nutrients in Plants(%)

Sl No	Plantelement	Symbol	Concentration (%)
1	Hydrogen	H	6.0
2	Oxygen	O	45.0
3	Carbon	C	45.0
4	Nitrogen	N	1.5
5	Potassium	K	1.0
6	Calcium	Ca	0.5
7	Magnesium	Mg	0.2
8	Phosphorous	P	0.2
9	Sulphour	S	0.2
10	Chlorine	Cl	100ppm
11	Iron	Fe	100ppm
12	Boron	B	20ppm
13	Manganese	Mn	50ppm
14	Zinc	Zn	20ppm
15	Copper	Cu	6ppm
16	Molybdenum	Mo	0.1ppm

SOURCES, GENERALIZED RECOMMENDATIONS

Sources of plant nutrition

Plant nutrients are generally obtained from soil, atmosphere, plant residues and chemical fertilizers depending upon the field situation.

Manures

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

Fertilizers

Fertilizers are industrially manufactured chemical containing plant nutrients Nutrient content is higher in fertilizers than organic manures and nutrients are released almost immediately

Role of manures and fertilizers in crop production

1. Organic manures bind the sandy soil and improve its water holding capacity.
2. They open the clayey soil and help in aeration better root growth.
3. They add plant nutrients in small percentage and also add micro nutrients which are essential for plant growth the microbial activity is increased which helps in releasing plant nutrients in available for e.g. bulky organic manures- FYM, compost from organic waste, night soil, sludge, sewage, sheep folding, green manures, concentrated organic manures- oilcakes (edible, non-edible), blood meal, fish meal, bone meal.
4. Organic manures should be incorporated before the sowing or planting because of slow release of nutrients
5. Fertilizers play an important role in crop production as the nutrient elements in fertilizer are present in higher concentration and in forms which can be readily utilize by plants directly or after rapid transformation.
6. Their dose can be adjusted to suit the requirement as determine by soil fertility evaluation. Fertilizers applied through straight fertilizers- providing single nutrient or complex and mixed fertilizers- supplies two or more nutrients.
7. While application of fertilizers following consideration should be taken in account

1. Bulky organic manures

Farm Yard Manure

This is the traditional manure and is mostly readily available to the farmers. Farm yard manure is a decomposed mixture of Cattle dung and urine with straw and litter used as bedding material and residues from the fodder fed to the cattle.

Compost Manure

Compost is well rotted organic manure prepared by decomposition of organic matter. It contains relatively higher quantity of major nutrients than that of FYM. Composed is prepared from waste materials like vegetable refuse, farm litter such as weeds, bhusa, sugarcane trash, sewage sludge and animal wastes.

Sheep and Goat droppings

It is also valuable organic manure. It contains about 0.5 to 0.7 % N, 0.4 to 0.6% P_2O_5 and 0.3 –1.0% K_2O. It is effective to all types of crops

Sewage and sludge

The liquid wastes like sewage and sludge contains large quantities of plant nutrients and are used for growing vegetables, sugarcane, and fodder crops near large towns. Use of raw sewage is a danger to health. Sewage is allowed to stand in a septic tank to undergo a preliminary fermentation. Then it is aerated in the setting tank by blowing air through it. The sludge that settles at the bottom in this process is called as 'activated sludge'.

2. Concentrated organic manures

Oil cakes

Oil cakes are quick acting organic manure. Though they are insoluble in water, their nitrogen became quickly available to plants in about a week or in 10 days after application. Oilcakes should be well powdered before application, so that they can be spread evenly and are easily decomposed by micro-organisms. Depending on crops, oil cakes are applied as broadcast, drilled or placed near root zone while earthing up.

Bone Meal

Bones from slaughter houses, carcasses of all animals and from meat industry constitute bone meal, which is the oldest phosphatic fertilizer used. It also contains some N.

Fish meal

Fish manure or meal is processed by drying non-edible fish, carcasses of fish and wastes from fish industry. It contains 4.0-10.0 % nitrogen, 3.0-9.0 % P_2O_5 and 0.3 to 1.5 % K_2O. It has an offensive smell.

Nutrient ingredients of Organic Manures

Name of Manure	N	P_2O_5	K_2O
Farm Yard Manure	0.4-1.5	0.3-0.9	0.3-1.9
Rural compost	0.5-1.0	0.4-0.8	0.8-1.2
Urban compost	0.7-2.0	0.9-0.3	1.0-2.0
Green Manures	0.3-0.9	0.12-0.2	0.5-0.6
Fish Meal	4.0-10.0	3.0-9.0	0.3- 1.5
Dry Sewage and sludge	2.0-3.5	1.0-5.0	0.2-0.5
Activated dry Sewage and Sludge	4.0-7.0	2.1-4.2	0.5- 0.7
Edible Oilcakes	4.0-7.9	1.4-2.9	1.2-2.2
Non edible Oilcakes	4.3-5.2	0.5-1.8	1.2- 1.8
Bone Meal	2.4	20.0-25.0	0

Sheep and Goat droppings	0.5-0.7	0.4-0.6	0.3-1.0

3. Green Manures and Green leaf manures

Green manuring is the act of quick growing crops mostly legumes and ploughing in situ and incorporated into the soil. Whereas green leaf manuring is the incorporation of green matter into the soil collected from elsewhere.. Generally sunhemp (*Crotalaria juncea*) dhaincha (*Sesbaniaaculeata*), guar (*Cyamopsistetragonoloba*), glyricidia (*Glyricidiamaculata*), Karanj (*Pongamiapinnata*) etc. are used as green manures. Legume crops, leaves of bushes and trees is buried in the soil and allowed to decompose in the field.

INORGANIC FERTILIZERS

Inorganic fertilizers are chemicals, which provide plant-food in ample quantities. Fertilizers also have the advantage of smaller bulk, the resultant easy transport. Inorganic fertilizers are grouped into nitrogenous fertilizers, phosphate fertilizers, and potash fertilizers, and so on.

Nitrogenous Fertilizers:

The nitrogenous fertilizers are divided into four groups; nitrate, ammonia, and ammonium salts, chemical compounds containing nitrogen in the amide form, and plant and animal by-products.

Phosphatic fertilizers:

The nutrient phosphorus present in phosphate fertilizers are usually expressed in terms of phosphoric anhydride or simply as phosphorus pentaoxide, P_2O_5, the availability of phosphorus in which it is present. The amount of phosphorus available to the plants depends upon the extent to which the fertilizer supplies HPO_4or H_2PO_4–ions.

S.N.	Fertilizer	%P_2O_5
1	Single Super phosphate (CaH_2PO_4) 16	16%P_2O_5
2	Double super phosphate $CaH_4(PO_4)_2$	32%P_2O_5
3	Triple super phosphate $Ca(H_2PO_4)_2$	46to48%P_2O_5
3	Ammonium phosphate	20%P_2O_5

Potassic Fertilizers:

The potassium content of potassic fertilizers is usually expressed as potassium oxide. K_2O, referred to as potash. These fertilizers are manufactured form minerals and ores. The commercial fertilizers are salts of potassium usually chlorides and sulphates which are soluble hence readily available to the plants.

S.No.	Fertilizer	%K_2O
1	Potassium chloride or muriate of potash(KCI)	48to62%
2	Potassium sulphate or sulphate of potash(K_2SO_4)	48to52%
3	Potassium Magnesium sulphate ($K_2SO_4.2MgS\ O_4$)	22%

4	Potassium Schoenite ($K_2SO_4.MgSO_4.6H_2O$)	22to24%

Micro nutrient fertilizers

Sixteen elements are essential for plant growth out of these Fe, Zn, Mn, Cu, B, Mo, Cl are required in small quantities. They are called tertiary or micro nutrient. The average concentration of these nutrient in soil are Mn 1000 ppm, Cl 480 ppm, Zn 80 ppm, Cu 70 ppm, B 10 ppm, Mo 2 to 3 ppm, iron 140 ppm.

BIO-FERTILIZERS

Bio-fertilizers are the preparations containing live or latent cells of efficient strains of nitrogen fixing, phosphate solubilizing or cellulolyotic micro- organisms used for application to seed or composting areas with the objective of increasing the numbers of such micro-organisms and accelerating those microbial processes which augment the availability of nutrients that can be easily assimilated by plants.

Microbial Inoculants: - In soil the activities of Nitrogen fixation, mobilization of plant nutrients and degradation of ligno- cellulotic wastes are being carried out by a large number of micro-organisms. Artificially multiplied cultures of selected micro-organisms augment the natural recycling of organic resources. There are different types of microbial inoculants.

Nitrogen fixers

1. Symbiotic:-Rhizobium, inoculants for legumes.
2. Non-symbiotic:-For cereals, millets, and vegetables.
    a. Bacteria:-
        i. Aerobic:-Azatobacter, Azomonas, Azospirillum.
        ii. Anaerobic:-Closteridium, chlorobium
        iii. Facultative anaerobes-Bacillus, Eisherichia
    b. Blue green algae-Anabaena, Anabaenopsis, Nostoe
3. Phosphate solubilizing micro-organisms.
4. Cellulolytic and lignolytic micro-organisms.
5. Sulphur dissolving bacteria.
6. Azolla.

1. Rhizobium Inoculant

Agronomic importance: - Response to Rhizobium inoculation has been amply demonstrated with most of the legumes-ahar, urd, mung, gram, soybean, etc. Besides, legume cultivation also leaves behind a naturally nitrogen enriched soil for subsequent cultivators...

2. Azotobacter Inoculants

Crop response: -Azotobacter inoculants on onion, wheat, rice, brinjal, tomato, cabbage, sugarcane, oat, barely, maize, potato can increase 7-12 % crop yields. Azotobacter spp. Increase plant yield primarily by fixing molecular nitrogen in soil, but it is also reported to synthesize auxins, vitamins, growth substances and antifungal antibiotics, which have beneficial effects of this bacterium on seed germination etc.

3. Azospirillum Inoculants

Occurrence in soil:- Soil pH in range of 5.6- 7.2 registers Azospirillum activity with optimum at 6.7 to 7.0; below pH 5.6 the soil is devoid of Azospillium and presence of organic matter in soil generally favours multiplication of this bacterium. Powdered and sterilized FYM+soil, FYM alone or FYM+charcoal are used as carriers.

4. Blue Green Algal Inoculants:

The inoculants are specially recommended for paddy crop grown in wet land conditions which also favour the growth of blue green algae. These algae also possess photosynthetic activity. Besides they excrete vitamin B_{12}, auxins and ascorbic acid which contribute to growth of rice plants.

5. Azolla- an Organic Manure

Methods of application: - It is applied as green manure prior to rice planting and as dual cropping with rice, when fern grows side by side with paddy.

Cropresponse:-Soilapplicationismorebeneficialthandualculturemethod; 10 tonnes fresh Azolla/ha is equivalent to 25-30 kg N/ha and increasing application rate from 5-20 tonnes/ha has direct response in grain yield of paddy.

6. Mycorrhizae (VAM)

Vesicular Arbiscular Mycorrhizae is a fungi used as biofertilizer. Mycorrhizae symbiosis is an intimate association between plant root system and soil fungi. The plant provides energy to fungi and in turn the fungi absorbs the P, Cu, Zn and B from surrounding are and supply to the plant through it's hypae.

TIME, METHODS OF APPLICATION OF FERTILIZERS AND FERTIGATION SCHEDULE TIME AND METHOD OF FERTILIZER APPLIC ATION

The fertilizer should be applied in the soil in such a way that it serves the plant to the best advantage. Fertilizers are applied by different methods mainly for three purposes.

1. To make the nutrients easily available to crops.
2. To reduce fertilizer losses and for ease of application
3. Crops and varieties differ for methods of application.

A. TIMEOFAPPLICATIONOFMANURESAND FERTILIZERS

1. Before the preparatory tillage

Bulky organic manures, green manures and soil amendments are applied

before preparatory tillage for thorough mixing with the soil.

2. Basal dressing

Application of manures and fertilizers before last ploughing or before sowing/planting

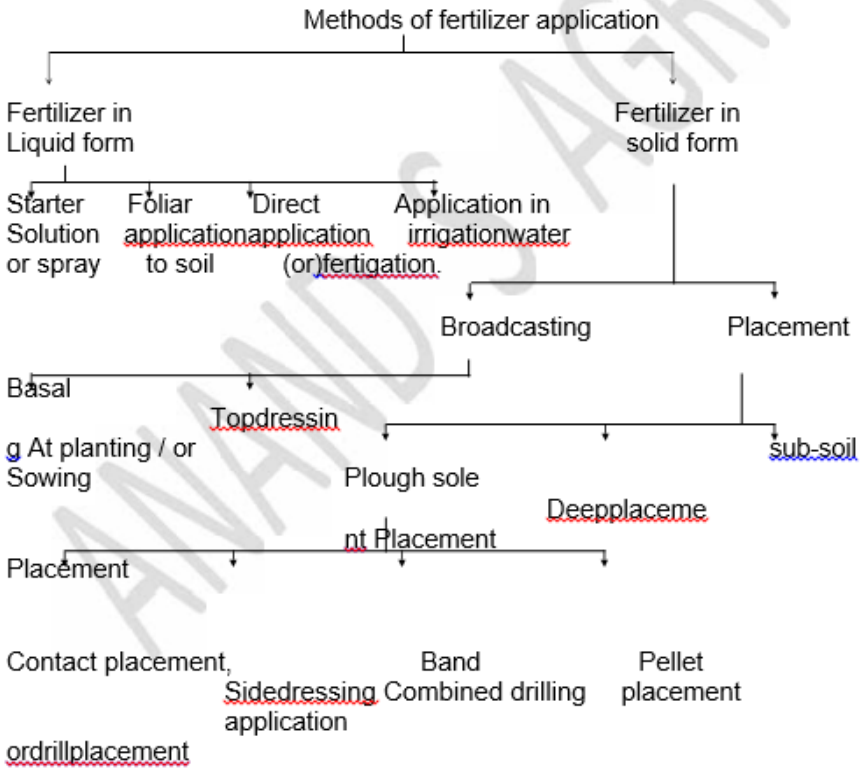
3. At the time of sowing/planting

Concentrated organic manures, readily soluble and highly mobile fertilizers and starter dose of N fertilizers are applied at this time.

4. Topdressing

It is the application of manures and fertilizers to the established crop within the crop duration. Top dressing may be done to the soil or the foliage. Split application of N and K is applied in this way.

B.METHOD OF FERTILIZER APPLICATION



Methods of fertilizer application

I. Soil Application

Application of fertilizer uniformly on the soil surface is known as broadcasting of fertilizers. This is done either before sowing of the crop (basal application) or in the standing crop(topdressing).This is the most widely practiced method in India due to ease in application.

Band Placement:

Application of fertilizers in narrow bands beneath and by the side of the crop rows is known as band placement of fertilizers. Band placement is done under the following situations:

1. When crop needs initial good start.
2. When soil fertility is low.
3. When fertilizer material react with soil constituent leading to unavailability
4. Where volatilization losses are high

Point Placement:

Placement of fertilizers near the plant either in a hole or in a depression followed by closing or covering with soil is known as point placement of fertilizers. It is adopted for top dressing of nitrogenous fertilizers in widely spaced crops.

II. Sub Soil Placement:

It refers to the placement of fertilizers in the sub-soil with the help of high power machinery.

Application to Plant Root

Dipping:

The roots of the seedlings are dipped in nutrient solution before transplanting. In soils deficient in phosphorus, roots of rice seedlings are dipped in phosphorus slurry before planting.

Root Feeding:

This method is popularly followed in coconut plantation. Active roots are selected and are dipped into nutrient solution in a poly bag, which is tied to the root. In a day or two the nutrient solution is absorbed by the root system.

Foliar Spray:

Application of fertilizers to foliage of the crop as spray solution is known

as foliar application of fertilizers. This method is not a substitute for soil application but only a supplement to it. This method is most suited for application of micronutrients, required in small quantities. When deficiency symptoms are visible, nutrients can be sprayed as mid-term correction.

N Fertigation

Urea is well suited for injection in micro irrigation system. It is highly soluble and dissolves in non- ionic form, so that it does not react with other substances in the water. Also urea does not cause precipitation problems. Urea, ammonium nitrate, ammonium sulphate, calcium ammonium sulphate, calcium ammonium nitrate are used as nitrogenous fertilizers in drip fertigation.

P fertigation

Application of phosphorus to irrigation water may cause precipitation of phosphate salts. Phosphoric acid and mono ammonium phosphate appears to be more suitable for fertigation.

K fertigation

Application of K fertilizer does not cause any precipitation of salts.Potassium nitrate, Potassium chloride, Potassium sulphate and mono potassium phosphate are used in drip fertigation.

Micronutrients

Fe, Mn, Zn, Cu, B, Mo could be used as micro nutrients in drip fertigation.

Fertilizers commonly recommended for fertigation

Fertilizer	**N**	**P_2O_5**	**K_2O**
Ammonium nitrate	34	0	0
Ammonium sulphate	21	0	0
Urea	46	0	0
Mono-ammonium phosphate (MAP)	12	61	0
Di-ammonium phosphate (DAP)	18	46	0
Potassium chloride	0	0	60
Potassium nitrate	13	0	44
Potassium sulphate	0	0	50
Mono potassium phosphate	0	52	34
PHOSPHORIC ACID	0	52	0