AGRICULTURE NOTES

FORM 2 SIMPLIFIED VERSION

QUICK REVISION NOTES

An Updated Well-Organized Detailed Revision Notes for the Current Form 2 Syllabus.

SERIES 1

THIS IS A FREE SAMPLE OF THE ORIGINAL NOTES

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Mr Isaboke 0746 222 000

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Nairobi

0746-222-000

mwalimuconsultancy@gmail.com

Mwalimu Consultancy Ltd.

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SOIL FERTILITY II

(Inorganic Fertilizers)

Introduction

- Plant nutrients occur in the soil in form of soluble substances.
- These substances are taken in by the plants in different quantities depending on their roles in the plant tissues.

Essential Elements

- These are nutrients needed by plants for various uses.
- They are divided into two broad categories namely:
  - Macronutrients
  - micronutrients.

MACRO-NUTRIENTS

- These are also referred to as major nutrients.
- They are required by the plant in large quantities.

They include;

- carbon,
- hydrogen,
- oxygen,
- nitrogen,
- phophorus,
- potassium,
- sulphur,
- calcium
- magnesium.

- Nitrogen, phosphorus and potassium are referred to as **fertilizer elements,**
- Calcium, magnesium and sulphur, are referred to as **liming elements.**

Role of Macronutrients in Plants

NITROGEN (NO_3,$NH4^{++}$)

Sources:

- Artificial fertilizers
- Organic matter
- Atmospheric fixation by lightning
- Nitrogen fixing bacteria.

Role of Nitrogen in Plants

- Vegetative growth
- Chlorophyll formation
- Build up of protoplasm.
- Improves leaf quality in leafy crops such as tea and cabbages.

Deficiency Symptoms

- Yellowing of the leaves/chlorosis.
- Stunted growth.
- Premature ripening.
- Premature shedding of the leaves.
- Light seeds.

Effect of Excess Nitrogen

- Scorching of the leaves.
- Delayed maturity.

Loss of Nitrogen From the Soil:

- Soil erosion.
- Leaching.
- Volatilization.
- Crop removal.
- Used by microorganisms.

PHOSPHORUS ($H_2 P0_4$, HPO^{2-}_4 P_2O_5)

Sources:

- Organic manures
- Commercial fertilizers
- Phosphate rocks

Role of Phosphorus

- Encourages fast growth of the roots.
- Improves the quality of the plant.
- Hastens maturity of the crops.
- Influences cell division.
- Stimulates nodule formation in legumes.

Deficiency symptoms

- Growth of the plant is slow.
- Maturity is delayed.
- Leaves become grey, purple in colour.
- Yield of grains, fruits and seed is lowered.

Loss of Phosphorus From the Soil

- Soil erosion.
- Leaching
- Crop removal
- Fixation by iron and aluminium oxide.

POTASIUM (K^+, K_2O)

Sources;

- Crop residue and organic manures.
- Commercial fertilizers
- Potassium bearing minerals e.g. feldspar and mica.

Role of Potassium in Plants

- Increases plant vigour and disease resistance.
- Increases the size of grains and seeds.
- Reduces the ill-effects due to excess nitrogen.
- Prevents too rapid maturation due to phosphorus.

Deficiency Symptoms

- Plants have short joints and poor growth.
- Plants lodge before maturing.
- Leaves develop a burnt appearance on the margin.
- Leaves at the lower end of the plant become mottled, spotted or streaked.
- In maize, grains and grasses firing starts at the tip of the leaf and proceeds from the edge usually leaving the midrib green.

Loss of Potassium From the Soil

- Crop removal.
- Leaching.
- Soil erosion.
- Fixation in the soil.

CALCIUM ($CA^{2}+$)

Source:

- Crop residues and organic manures.
- Commercial fertilizers.
- weathering of soil minerals.
- Agricultural limes for example ***dolomite, limestone***.

Role of Calcium in Plants

- Improves the vigour and stiffness of straw.
- Neutralizes the poisonous secretions of the plants.

- Helps in grain and seed formation.
- Improves the soil structure.
- Promotes bacterial activity in the soil.
- Corrects the soil acidity.

Deficiency symptoms

- Young leaves remain closed.
- There are light green bands along the margins of the leaves.
- Leaves in the terminal bud become hooked in appearance there is a die-back at the tip and along the margins.

Loss of Calcium

- Crop removal
- Leaching
- Soil erosion

MAGNESIUM (MG2+)

Sources:

- Crop residues and organic manures
- Commercial fertilizers
- Weathering of soil minerals.
- Agricultural limes.

Role of Magnesium in Plants

- Forms part of chlorophyll.
- Promotes the growth of the soil bacteria and enhances the nitrogen fixing power of the legumes.
- Activates the production and transport of carbohydrates and proteins in the growing plant.

Deficiency symptoms

- Loss in green colour which starts from the bottom leaves and gradually moves upwards.
- The veins remain green.
- Leaves curve upwards along the margins.
- Stalks become weak and the plant develops long branched roots.
- The leaves become streaked.

SULPHUR ($S0_4^{2-}$,SO_2)

Sources:

- Commercial fertilizers.
- Soil mineral containing sulphides
- Atmospheric sulphur from industries.
- Rain water

Role of Sulphur in Plants

- Formation and activation of coenzyme-A.
- Sulphur is a constituent of amino acids.
- Influence plant physiological processes.

Deficiency Symptoms

- Small plants/stunted growth.
- Poor nodulation in legumes.
- Light green to yellowish leaves/ chlorosis.
- Delayed maturity.

MICRO-NUTRIENTS

- Also referred to as trace or minor nutrients.
- They are required in small quantities/traces.
- They are essential for proper growth and development of plants.

They include;

- Iron,
- Manganese,
- Copper,
- Boron,
- Molybdenum
- Chlorine.

Role of Micronutrients and Their Deficiency Symptoms

- ***Copper***

➢ Role in oxidation-reduction reactions.

➢ Respiration and utilization of iron

➢ Deficiency symptoms-**yellowing of young leaves**.

- ***Iron***

➢ Synthesis of proteins.

➢ Takes part in oxidation-reduction reactions.

➢ Deficiency symptoms - **leaf chlorosis**

- ***Molybdenum***

➢ Nitrogen transformation in plants.

➢Metabolization of nitrates to amino acids and proteins

➢ Deficiency symptoms **-leaf curl and scathing.**

- ***Manganese*** **-** Same as molybdenum.
- ***Zinc***

➢ Formation of growth hormone.

➢ Reproduction process

➢ Deficiency symptoms - **white bud formation.**

- **Boron –**

➢ Absorption of water.

➢ Translocation of sugar

INORGANIC FERTILIZERS

- These are chemically produced substances added to the soil to improve fertility.

Classification According to:

- **Nutrients contained**
- ***Straight*** **-** contain only one macronutrient.
- ***Compound fertilizers*** **-** contain more than one macronutrient
- ***Time of application***
- Some applied when planting.
- Top dressing after crop emergence
- ***Effects on the soil pH.***
- Acidic fertilizers.
- Neutral fertilizers.
- Basic fertilizers.

PROPERTIES AND IDENTIFICATION OF FERTILIZERS

NITROGENOUS FERTILIZERS

Characteristics

- Highly soluble in water.
- Highly mobile in the soil hence it is applied as a top dress.
- Easily leached because of the high solubility hence does not have residual effect on the soil.
- Has scorching effect on young crops during wet seasons.
- Easy to volatilize during hot season.
- They have a tendency to cake under moist conditions.
- They are hygroscopic hence should be stored in dry conditions.

Examples:

- ***Sulphate of Ammonia*** $(NH_4)\ 2\ SO_4$

Physical appearance:

- white crystals,
- Has acidic effect,
- Contains 20% N.

- ***Ammonium Sulphate Nitrate [$(NH_4)_2 SO_4$+ $NH_4 NO_3$]***

➢ Colour: granules which appear yellow orange,

➢ less acidic,

➢ contains 26% N.

- ***Calcium Ammonium Nitrate (CAN)***

➢ Colour: greyish granules,

➢ neutral in nature,

➢ contains 21 % N.

- ***Urea***

➢ Colour: small whitish granules

➢ Easily leached or volatilized,

➢ contains 45- 46%N.

PHOSPHATE FERTILIZERS

- Has low solubility and immobile.
- Non-scorching.
- Has a high residual effect hence benefit the next season's crop.
- Easy to store because they are not hygroscopic.

Examples;

- ***Single super-phosphate***

➢ Appearance: whitish, creamy white granules,

➢ contains **20-21 %** ***P_2O_5***

- ***Double super-phosphate***

➢ Appearance: dark greyish granules,

➢ Contains ***40-42% P_2O_5***

- ***Triple super-phosphate***

➢ Appearance: small greyish granules,

➢ Contain ***44-48% P2O5***

POTASSIC FERTILIZERS

Characteristics:

- Has moderate scorching effect.
- Moderately soluble in water.
- Most Kenyan soils have sufficient potassium.

Examples;

- ***Muriate of Potash (KCl)***

➢ Contain 60 - 62% K_2O

➢ Slightly hygroscopic.

➢ Appearance amorphous white.

- ***Sulphate of Potash (50% K_2O)***

Compound or Mixed Fertilizers

- These are fertilizers which supply 2 or more of the macronutrients.

Examples;

- ***Mono ammonium phosphate.***
- ***Di-ammonium phosphate***
- ***20:20:20, 23:23:23***

Advantages of application of compound fertilizers

- Saves time and money.
- Mixture gives improved storage properties and better handling.

Disadvantages of compound fertilizers application

- Expensive.
- Wasteful.
- Mixing may not be thorough.
- Incompatibility of the individual fertilizers.

Methods of fertilizer application

- ***Broadcasting*** - random scattering of the fertilizers on the ground.
- **Placement method** - application of fertilizers in the planting holes.

- ***Side dressing*** - fertilizer is placed at the side of the plant within the root zone, in bands or spot-rings.
- ***Foliar spraying*** - specially formulated fertilizer solution applied on the foliage in spray form.
- ***Drip method*** - applied through irrigation water.

Determination of Fertilizer Rates

Contents of fertilizers are expressed as fertilizer grade or fertilizer analysis.

- Fertilizer grade indicate the guaranteed minimum of the active ingredients (N, P_2O_5, K_2O) in the mixture.
- It is expressed as a percentage on a weight to weight basis or percentage by weigh

Example 10:20:0 means for every 10kg of the mixture there are 10kg of nitrogen, 20kg of P_2O_5 and 0kg of K_2O.

Example

A farmer was asked to apply fertilizers as follows:

- 60 kg/ha nitrogen (top dressing)
- 60 kg/ha P_2O_5 (in planting hole).
- 60 kg/ha K_2O.

How much sulphate of ammonia (20%) would be required per hectare?

How much double super-phosphate (40%) P_2O_5would be required per hectare?

How much muriate of potash *(50%* K_2O) would be required per hectare?

Answer/Solution

- Sulphate of ammonia (SA) which gives 60kg/ha N

  $= \frac{60}{20} \times 100 = 300$kg SA

- Double super phosphate (40% P_2O_5)which gives 60kg/ha P_2O_5

  $\frac{60}{40} \times 100 = 150$kg DSP

- Muriate of potash (60% K_2O) which gives 60kg/hK_2O

  $= \frac{60}{60} \times 100 = 100$kg muriate of potash

Example

A farmer was asked to apply fertilizers as follows:

- 200kg/ha of DSP (40% P_2O_5
- 150kg/ha of muriate of potash (60% K_2O)
- 150kg/ha of sulphate of ammonia (20% N)

How much P_2O_5 did the farmer apply per acre?

How much K_2O did the farmer apply per hectare?

How much N did the farmer apply per hectare?

Solution/Answer

- P_2O_5 applied per hectare from 200kg of DSP

  40

  = 100x 200= 80kg/ha P_2O_5

- K_2O_5 applied per hectare from 150kg of muriate of potash

  60

  = 100x150=90kg/ha K_2O

- ***N*** applied per hectare from 150kg/ha sulphate of ammonia

20

= 100 x *150*= 30kg/ha N

SOIL SAMPLING

- Refers to obtaining of small quantity of soil that is representative in all aspects of the entire farm.

Soil Sampling Procedures

- Clear the vegetation over the site.
- Dig out soil at depths of 15-25cm.
- Place the dug out soil in a clean container.
- Mix thoroughly the soil in the container.
- Take a sample and send it to National Agricultural Laboratory for analysis.
- The container carrying the sample should be properly labeled as follows:

➢ Name of the farmer,

- Location,
- District
- Address of the farmer.

Sites to Avoid

- Dead furrows, ditches.
- Swamps
- Near manure heaps.
- Recently fertilized fields
- Ant hills.
- Under big trees.
- Near fence lines or foot paths.
- Do not put them in containers which are contaminated with fertilizers or other chemical containers.

Methods Of Soil Sampling:

- Zigzag method
- Traverse method

SOIL TESTING

- Soil testing is the analyzing of the soil sample to determine certain qualities of the soil.

Importance of Soil testing:

- To determine the value of the soil hence determine the crop to grow.
- To determine the nutrient content hence find out the type of fertilizer to apply.
- To determine whether it is necessary to modify the soil pH for a crop.

How Soil pH affects Crop Production

- Influences the physical and chemical properties of the soil.
- Affects the availability of nutrients.
- Influences the incidences of soil borne diseases.
- Determine the type of crop to be grown at a given area.

Methods of pH Testing

- Universal indicator solution
- pH meter

- Know the course of action to be taken in the event of a disease and maintenance of good health.
- Know the prevalent diseases.
- Calculate the cost of treatment.

- **Marketing Records** show commodities sold, quantities and value of all the sales.

Labour Records - show labour utilization and labour costs.

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CROP PRODUCTION II

(PLANTING)

- Planting is the placement of the planting material in the soil for the purpose of regeneration in order to produce more of the plant species.

Types of planting materials

Seeds

- Seeds are produced by flowering after pollination and fertilization. They contain the part of the plant that germinates and subsequently grows in to new plants.

Advantages of using seeds as planting materials.

- Seeds are easily treated against soil borne pests and diseases.
- They are not bulky therefore storage is easy.
- They are easy to handle during planting making operation easy.
- When planting seeds, it is easy to use machines like seed planters and drillers.
- It is easy to apply manures and fertilizers together with seeds during planting.
- Fertilizers and manures application can be easily mechanized.
- It is possible to develop new crop varieties due to cross pollination.

Disadvantages of using seeds as planting materials.

- Some seeds have long dormancy and they may need special treatment in order to germinate.
- Plants raised from seeds have variations from the mother plant due to cross pollination, This may introduce undesirable characteristics.
- Soil borne pests may damage seeds if left for sometime in the soil before rain falls.
- Some seeds may lose viability if stored for a long time. This leads to gaps in the farm.

1. VEGETATIVE MATERIALS.

- These are plant parts which have the ability to produce roots, they grow and develop in to new plants.
- Plant parts such as leaves, roots or stems can be used for planting as long as they are capable of rooting.

Advantages of using vegetative materials for planting.

- Crops originating from vegetative materials matures faster than those from seeds.
- The crops shows uniformity in such qualities as disease resistance, seed size, colour, keeping or storing quality and chemical composition.
- It is possible to produce many varieties of compatible crops on the same root stock.
- Use of the vegetative materials is easier and faster, especially where seeds show prolonged dormancy.
- The resulting plant has desired shape and size for ease of harvesting and spraying.
- It facilitates the propagation of crops which are seedless or those that produce seeds which are not viable or have a long dormancy period.
- Such crops include sugar-cane, bananas, Napier grass and others.

Disadvantages.

- Vegetative propagation does not result in new crop varieties.
- Keeping the materials free of diseases is difficult.
- Materials cannot be stored for long.
- The materials are bulky and there fore difficult to store and transport.

Plant parts used for vegetative propagation.

i) BULBILS.

- These are tiny sisal plants produced in the inflorescence almost at the end of the plant growth cycle.
- They resemble the mother plant except that they are smaller in size.
- They are produced by the branches of the sisal pole.

- When manure they mature they develop rudimentary roots and fall off to the ground just below the pole.
- They are the collected and raised in the nurseries before they are transplanted t\o the main field.
- One sisal pole may produce as many as 3,000 bulbils. They are usually 10cm long. They make good planting materials and are better than sucke

ii) SPLITS

- These are plantlets divided from the existing mother plant with complete with complete leaves and rooting system.
- They are used to propagate most pasture grasses and pyrethrum.
- Pyrethrum splits are raised first in nursery and then transplanted to the field.

iii) CROWNS AND SLIPS

- These are materials used to propagate pineapples
- Crowns are born on top of the fruits and are broken off and prepared for planting.
- They are more preferred to suckers because they give uniform growth and take two years to reach maturity.
- Slips are borne to the base of the pineapple fruits.
- They are cut and prepared for plantings.
- Their growth rate is faster than for crowns giving average uniformity.
- They take 22 months from planting to maturity.
- Crowns and slips are planted in the nurseries first before transplanting to the main seed bed.

iv) SUCKERS

- These are small plants that grow from the base of the main stem.
- They have adventitious roots which grow quickly when planted to form a new plant.
- They are used to propagate bananas, sisal, and pineapples.
- When planted, suckers give uneven growth leading to maturity at different times. T
- Hay should be planted when they are young.

v) TUBERS

- These are underground food storage organs which are short and thick.
- They are used as vegetative propagation materials because they sprout and produce roots for growth.
- There are mainly two types of tubers, the stem and root tubers.
- Root tubers develop from the thickening of the adventitious roots.
- Root tubers are not commonly used for propagation since they produce weak stems.
- A good example of a root tuber is the sweet potato.
- On the other hand stem tubers have some auxiliary buds which are sometimes referred to as 'eyes'.
- These eyes sprout to produce stems which grow into plants. Stem tubers are therefore swollen stems with scales leaves.
- A good example of a stem tuber is Irish potato.

vi) VINES.

- These are soft wood cuttings which produce roots easily upon planting to give rise to new plants.
- They are cut from the mother plants and planted directly into the field.
- Soft wood cuttings (vines) are taken from rapidly growing shoots.
- The soft upper parts of the shoots are preferred.
- When preparing the cuttings, some leaves and nodes are included.
- Roots are produced from the nodes.

vii) CUTTINGS AND SETTS

✓ Cuttings are portion of plants parts which are cut and then planted.

✓ They may be from stems, roots or leaves.

✓ A stem cutting must have a bud which develops into shoot.

✓ The root cutting must have an eye. Cutting must have an eye.

✓ Cuttings must produce leaves as soon as possible so that they can start making their own food.

✓ Sometimes cuttings are induced to produce roots by use of rooting hormones.

✓ Once the cuttings have developed roots, they give rise to new plants.

- ✓ In some crops, the cuttings are big enough to be planted directly to the main seedbed whereas there are some plants whose cuttings are first raised in special nurseries before they are transplanted to the seedbed.
- ✓ The cuttings of Napier grass and sugar-cane are planted directly on the seedbed but those of tea; have to be raised in special nursery before they are transferred to the seed bed.
- ✓ Examples of crops which are propagated by use of stem cuttings include: tea, cassava, and sugar-cane and Napier grass.
- ✓ The stem cuttings used to propagate sugar-cane are known as 'setts'. Setts are stem cuttings which have 3-5 nodes are usually 30-45 cm long.

Factors affecting rooting of cuttings.

- **Temperature:** for the cuttings to produce roots warm temperatures are required around the root zone while cool temperatures are important for the aerial part of the cuttings. For most species optimum day and light temperatures for rooting are 22 -27°c and 15-21° c respectively.

a) Relative humidity: Proper rooting of cuttings requires high humidity which lower the transpiration rate. It also increases and maintains leaf turgidity all the time. As such, cuttings should be rooted in green houses or under shady conditions, where relative humidity can be regulated. Sometimes the propagation area can be sprayed with water to keep it moist.

b) Light intensity: soft wood cuttings need high intensity light to produce roots. This is because light promotes the production of roots since it affects the rate of photosynthesis. Hard wood cuttings do well in dark conditions since they have high amount of stored carbohydrates and therefore rooting is excellent in darkness.

c) Oxygen supply: plentiful supply of oxygen is required for root formation. The rooting medium used must therefore be capable of allowing proper aeration.

d) Chemical treatment: these rooting hormones which promote the production of roots in cuttings. The common ones include IAA (Indoleacetic acid).

e) Leaf area: Soft woods cuttings require a lot of leaves for photosynthesis while hardwood cuttings will produce roots better without leaves.

Selection of planting materials

When selecting materials for planting the following factors must be considered:

- **Suitability to the ecological conditions** – the selected planting materials should be well adapted to the soil conditions, temperatures and amount of rainfall in the area. There are many varieties of maize, for example, which are suitable to different ecological conditions. Hybrid 622f or example is mainly for the high altitudes areas of Kenya 513 for the medium altitudes and the Katumani composites for the low rainfall areas while the coast composites are suitable for the coastal conditions each variety will grow well and produce high yields if grown under the correct conditions

- **Purity of the materials** - planting materials should be pure and not mixed with other off types the percentage purity of planting materials will affect the seed while higher seeds rates are used for impure seeds.

- **Germination percentage** - This is a measure of the germination potential of seeds it is expressed as a percentage for example a germination percentage of 80 means that for every 10 seeds planted 80 of them are expected to germinate. Germination percentage helps to determine the seed rates of crops lower seed rates are used for crops with higher germination percentage while higher seed rates are used for those with lower germination percentage.

- **Certified seeds** - These are seeds which have been tested and proven to have 100 germination potential and free from diseases and pests they give high yields after the first planting but the subsequent yields decline if replaced therefore in this case it is always advisable to buy new seeds which are certified every time planting is done

In Kenya certified seeds are produced by the Kenya seed company (KSC) and distributed by Kenya Farmers Association (KFA) and other agents.

PREPARATION OF PLANTING MATERIALS.

After the planting materials are selected they are prepared in different ways before they are planted. Some of the methods used to prepare planting materials include the following:

(a)Breaking the seed dormancy.

Some seeds undergo a dormancy period between maturity and the time they sprout. The dormancy period is the stage whereby a seed cannot germinate, the stage of inhibited growth of seed. It should be broken before the seed is planted.

Methods of breaking seed dormancy.

The following methods are used to break seed dormancy**:**

Mechanical method: This is a method**……..**

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0746-222-000

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