Item 1: Plant Biology (Element of Construct 2)

Understand how plants obtain and use nutrients to meet their requirements, during which raw materials and products are transmitted to and from various organs involved.

Assessable Areas include;

- General plant cells and specialized plant cells.
- Uses of Plant structures: roots, stems, leaves, flowers, fruits, seeds, etc.
- Adaptations of plant structures to their functions
- Effect of damage of plant structures on plants
- How plants overcome the challenges they face
- How farmers can manage challenges faced by plants
- Plant viruses; cassava mosaic.
- Nutrition in plants and mineral nutrients.
- Gaseous exchange and respiration in plants.
- Osmosis, diffusion, and active transport.
- Absorption of water and mineral salts.
- Transpiration is a necessary evil.
- Translocation of manufactured food through phloem.
- Germination Sexual reproduction in plants
- Effect of Overgrazing, Mono-cropping, dust, water logging and dry spell on plants.
- Pollination and fertilization in plants

Types of items and scenarios

The items focus on challenges that affect plants and therefore limit their quality or harvests in the case of food crops. These challenges include;

- Destruction of plants by wild animals like elephants.
- Destruction of crops by domestic animals like goats, cows, pigs, etc
- Effects of wild fire and burning on plants.
- Challenges of shading crops by big trees and other light barriers.
- Effect of water logging on plants.
- Mudslides /Hailstorms on different crops.
- Salty soil environment. Locusts, etc.
- Pollination and fertilization in plants

GUIDANCE ON ITEM APPROACH

- Study/ read and understand the scenario and tasks
- Understand the condition affecting the plant or plant structures in the scenario
- Highlight the challenges caused by the condition(s) on the plant
- On part (a) usually plant processes or effect of the condition plant re assessed.

❖ On how the conditions affect plant functioning, state the challenges caused by the condition and explain how the challenge affects the plant/ plant processes for a ***Ue***.

❖ Identification of the challenge caused by condition from the scenario alone =***Ul***

❖ Giving more than a single point on the same challenge caused by the condition in the scenario is considered a repeated point and scored as ***//.***

❖ Any challenge identified outside the scenario is rejected i.e., ***O***

- In case of a process, state the structures involved and their roles in the process e.g., In case of a process like fertilization in plants;

  - Stigma facilitates germination of the pollen grain under favorable conditions.***Ue***
  - The pollen grain divides into the generative and the tube nuclei. ***Ue***
  - Pollen tube nucleus develops a route through the style to the embryo sac. ***Ue***
  - The generative nucleus divides into two male nuclei. ***Ue***
  - One male nucleus fuses with the egg cell to form a zygote that develops into an embryo. ***Ue***
  - The other male nucleus fuses with the two polar nuclei to form an endosperm in endospermic seeds. ***Ue***
  - The fertilized ovule forms a seed and a fertilized ovary forms a fruit. ***Ue***

- Part (b) normally has items among others on solutions to challenges/ adaptations for survival usually stated in the scenario.

a) To approach it better, mention the characteristic and its benefits on the plant/ how it helps the plant to survive for an ***Ae***.

b) E.g., Development of large green leaves for photosynthesis. ***Ae***

c) If only the characteristic is identified from the scenario and stated=***Al***

Development of large green leaves. ***Al***

SAMPLE EOC ITEMS

Item 1

Mr Kadimba a farmer in Mityana district intercropped beans within a mature Banana plantation. When the beans were flowering and bananas bearing fruits, the area experienced a heavy hail storm that left the entire garden destroyed. Many bean flowers, leaves and stems were broken to the ground and some banana plants were even uprooted. Mr kadimba did not harvest any beans. Two months later, he observed that the remaining banana plants developed an extensive root system, produced numerous suckers with broad green leaves and straight stems. The banana plantation was restored.

Task

Explain how;

a) the hail storm affected the beans leading to no harvest that season.

- Flowers structures like anthers, stigma and others where damaged which prevented successful transfer of pollination, fertilization and fruit formation. ***Ue***
- Leaves were broken, which reduced surface area for light absorption by chlorophyll hence limited photosynthesis rand growth resulted in no yields. ***Ue***
- Broken leaves provided a small surface area for diffusion of CO2 through the few remaining stomata hence limited photosynthesis and no yields. ***Ue***
- Breaking of stems destroyed vascular bundles which prevented translocation of food, water and mineral salts thereby preventing photosynthesis and growth. ***Ue***

Scoring rubric: 4Ue = 6; 3Ue = 5; 2Ue=4; 1Ue = 2; Ul = 1

b) the banana plantation was restored two months after the hail storm

- Banana plants developed an extensive root system with more root hairs which increased surface area enabling absorption of water that were used to carry out more photosynthesis, produced enough food leading to high growth rate. ***Ae***
- Formation of more root hairs enabled active absorption of more mineral salts like nitrates used to form more proteins which enabled growth of new plant tissues to replace damaged ones. ***Ae***
- Banana plants had underground lateral buds which underwent mitotic cell division and specialisation which enabled asexual formation of new suckers. ***Ae***
- The broad leaves increased surface area for more light and CO2 absorption by chlorophyll and stomata respectively. This enabled a high photosynthetic rate forming more food used during plant growth. ***Ae***
- The upright stems provided best positions for optimal light absorption which led to high rate of photosynthesis providing food for growth. ***Ae***

Scoring rubric: 4-5Ae = 6; 3Ae = 5; 2Ae=3; 1Ae = 2; Al = 1

Item 2

Mr. kagoro prepared his garden well and planted beans which were looking healthy for the first three weeks. Suddenly, a dry spell set in and most beans had their leaves turning yellow, and some wilted. At flowering stage though, the garden was invaded by numerous bees for some time. After the visit by the bees, the bean pods started forming and finally the beans gave some yields.

Task

a) Explain the internal processes that took place in the bean plants from the time bees visited until when the yields were realized.

- The visiting bees transferred pollen grains from the anthers to the stigma of flowers that caused pollination. ***Ue***
- On the stigma, pollen grains absorbed nutrients and germinated to form pollen tube(s) that grew to the embryo sac via micropyle. ***Ue***
- Before pollen tube entered embryo sac, generative nucleus divided into 2 male nuclei. ***Ue***

- Upon penetration into through wall of embryo sac, the tip of pollen tube burst, and the 2 male nuclei entered the embryo sac. ***Ue***
- One male nuclei fertilized the egg cell to form diploid zygote that formed seed embryo, ***Ue*** the second male nucleus fused with the polar nuclei to form triploid primary endosperm that form seed endosperm. ***Ue***
- Ovules formed seeds ***Ue*** and ovaries produced fruits to give yield. ***Ue***

Scoring rubric: 5+Ue = 6; 3-4Ue = 5; 2Ue=4; 1Ue = 2; Ul = 1

b) How did the beans overcome the prevailing conditions to give some yields?

- The drooping of leaves reduced surface area exposed leading to reduced water loss and improving water conservation. ***Ae***
- Hairs on bean leaves trapped moist air around the leaf surface reducing concentration gradient between inside and outside of leaf hence minimizing transpiration. ***Ae***
- Developed more roots with more root hairs which increased surface area for osmotic absorption of water from the soil. ***Ae***
- Increased root hairs also enabled increased absorption of mineral salts like magnesium that was used by plants to synthesise more chlorophyll hence more light was absorbed enabling more photosynthesis. ***Ae***
- The beans developed brightly coloured flowers that attracted bees which carried out pollination hence enabling fertilisation and fruit formation. ***Ae***

Scoring rubric: 4-5Ae = 6; 3Ae = 5; 2Ae=3; 1Ae = 2; Al = 1

Item 3

Mr. Ogoya is a farmer. He planted beans in his farm which were looking healthy. Suddenly a dry spell set in and most plants stunted in their growth, had their leaves turning yellow and could wilt. After sometime, the rains returned but Ogoya wanted to replant and as he uprooted some plants, he observed that they had developed many small branching roots with numerous nodules and new green leaves developed, so he left them. At flowering stage, the garden was visited by numerous bees for some time. After the visit by the bees, the bean pods started forming and finally the beans produced low yields.

Task

(a) Explain how the processes in the bean plants were affected leading to low yields

- Stunted of the beans causes development of small leaves reducing surface area for trapping sunlight reducing rate of photosynthesis/ development of few and weak roots reducing amount of water and nutrients absorbed by the plant roots. ***Ue***
- Yellowing of leaves reduces amount of light trapped by the bean reducing rate of photosynthesis. ***Ue***
- Wilting of leaves reduced surface area exposed to light reducing photosynthesis/ causes closure of stomata reducing carbon dioxide fixation which reduced rate of photosynthesis. ***Ue***

(b) Explain the internal processes that took place in the bean plants from the time the bees visited to formation of pods.

- Bees carried pollen grains onto the stigma of bean flowers. ***Ue***
- On the stigma, pollen grain absorbs water, nutrients and then germinates to form a pollen tube and generative nuclei. ***Ue***
- The pollen tube develops a route through the style in which the generative nucleus passes into the embryo sac. ***Ue***
- On reaching the embryo sac, the generative nucleus divides mitotically to form two male nuclei. ***Ue***
- One of the male nucleus fuses with the egg nucleus to form a zygote ***Ue*** which divides mitotically to form embryo and divides mitotically followed by growth and development resulting into an embryo. ***Ue***
- The other male nucleus fuses with two polar nuclei to form a triploid endosperm which develops into endosperm. ***Ue***
- The ovules develop into seeds. ***Ue***
- The integuments become the seed coat. ***Ue***
- The ovary develops into a fruit/ bean pods and ovary wall develops into a fruit wall which protects the seeds. ***Ue***

Scoring rubric (a)+ (b): 7+Ue = 6; 5-6Ue = 5; 3-4Ue=4; 1Ue = 2; Ul = 1

(c) How did the beans overcome the prevailing conditions?

- Development of many small branching roots increased surface area for water and mineral salt absorption. ***Ae***
- Development of numerous nodules on roots enabled nitrogen fixation by rhizobium bacteria into the soils improving fertility of the soils leading to high yields. ***Ae***
- Development of new green leaves increased surface area for trapping sunlight/ carbon dioxide fixation increasing rate of photosynthesis. ***Ae***
- Development of flowers enabled pollination by the bees and formation of pods enabling Ogoya to get some yields. ***Ae***

Scoring rubric: 4Ae = 6; 3Ae = 5; 2Ae=3; 1Ae = 2; Al = 1

Item 4

Mr. Matovu is a farmer in Kigungu Village. He borrowed money from PDM and used it to plant his beans on a full acre of land in hopes of making profits and paying back the loan. A few weeks later, the beans had sprouted and formed their first foliage leaves that came out of the ground. A few weeks after sprouting, the leaves developed yellowish patches, and some were being eaten by the caterpillars. Matovu's friend Jonah felt bad for his friend and gave him a pesticide to eradicate the pests that later all died after being sprayed. Unfortunately, the leaves remained yellowish and the bean plants showed retarded growth. And at the end of the season some bean pods were formed and other plants never yielded anything.

Task

a) Explain how the challenges faced by the beans affected the life processes that were affected within the plant.

- Development of yellowish patches on leaves reduces magnitude of trapping sunlight energy reducing rate of photosynthesis. ***Ue***

- Eating of leaves by caterpillars reduces surface area for trapping sunlight energy/ reduces carbon dioxide fixation through the stomata reducing rate of photosynthesis. ***Ue***
- Stuntedness of the beans reduces surface area for trapping sunlight energy due to small size of the leaves reducing photosynthesis/ reduces absorption of water and mineral salts due to small size of the roots. ***Ue***

b) Suggest other possible measures Mr. Matovu can put in place to prevent such tragedies from happening again next season.

- Spraying with fertilizers containing Nitrogen, phosphorus. ***Ae***
- Soil testing to determine the pH and nutrients lacking and apply them accordingly. ***Ae***
- Plant disease resistant crop varieties. ***Ae***
- Practicing integrated Pest Management, by using an combination of techniques substrate Biological control, crop rotation. ***Ae***
- Mulching the garden to conserve fertility and break insect pest lifecycles. ***Ae***
- Application of fertilizers to improve soil fertility. ***Ae***

Scoring rubric: 4-6Ae = 6; 3Ae = 5; 2Ae=3; 1Ae = 2; Al = 1

c) Describe the events that occurred within the seeds from the time they were planted to when the first foliage leaves were formed.

During germination, the bean seeds take in water from the soil by imbibition through the micropyle. ***Ue***

The water makes the cotyledons swell and the testa to split, activates enzymes ***Ue*** that breakdown stored food reserves e.g. starch and protein which are stored in the cotyledons or endosperm ***Ue*** into soluble nutrients. ***Ue*** The soluble food materials are trapped to the growing points of the embryo where they are used to provide energy and making of new cells. ***Ue*** The radical is the first to emerge, it grows down wards between soil particles, and root hairs develop a short distance from the root cap ***Ue*** and start absorbing water and mineral salts. ***Ue*** Absorption of water from the soil results into increase in the size of the seed and growth of the radicles and plumule which had the apical meristems, producing the first foliage leaves. ***Ue***

Scoring rubric (a)+ (c): 7+Ue = 6; 5-6Ue = 5; 3-4Ue=4; 1Ue = 2; Ul = 1

Item 5

Ddembe of recent bought a piece of land. He planted maize and ground nuts at the onset of the rainy season. After some time, the plants were showing stunted growth, having yellow small leaves, while some leaves had fallen off prematurely. On investigation, he found out that plants had very short poorly developed roots. On consultation from the agriculturalist, he was given a chemical which he mixed with water and sprayed on the crops. After two weeks, the plants had improved with many broad long leaves, many long roots and started flowering. Ddembe is very happy.

Task

a) Identify and explain how the plant nutrients that were likely present in the chemical led to the increase in plant yields.

- Calcium is used by plants for activation of enzymes and formation of new cells leading to rapid growth of roots and overall plant growth. ***Ue***
- Nitrogen is used to make Chlorophyll which traps sun light energy leading to increase in the rate of photosynthesis/ formation of proteins (enzymes) leading to rapid growth. ***Ue***
- Phosphorus promotes development of roots which absorb water and mineral salts from the soil which are transported to the leaves for use in Photosynthesis/ formation of energy and Proteins used for growth by the plant. ***Ue***

Scoring rubric: 3Ue = 5; 2Ue = 4; 1Ue = 2; Ul = 1

b) How did the plants overcome the challenges during growth?

- Ground nuts have root nodules which harbor Nitrogen fixing bacteria which fix Nitrogen into nitrates used by the plants. ***Ae***
- Presence of meristematic tissues that divided by mitosis enabled Plants to grow taller to obtain sufficient light for photosynthesis. ***Ae***
- Closing of stomata during the day to avoid excessive water loss. ***Ae***
- Producing chemicals which discourage herbivores and pests. ***Ae***
- Possession of buds that developed into new leaves. ***Ae***

Scoring rubric: 4-5Ae = 6; 3Ae = 5; 2Ae=3; 1Ae = 2; Al = 1

Item 6

An Irish potato farmer in swampy area had his garden flooded for a long time during prolonged rains experienced in the area. He made the following observations about his garden during the season; the leaves of the potato plants turned yellow, the crops became stunted with weak stems and some potato plants wilted others had rotten roots When the rains reduced and the flooding was no more, the Irish potato plants revived, having greener leaves, upright stems and numerous roots. The plants managed to produce Irish potatoes for the framer.

Task

a) Explain the observations made by the farmer during the rainy season.

- During the flooding, there was leaching of mineral salts like magnesium and nitrates making them unavailable for absorption causing chlorosis and reduced photosynthesis. ***Ue***
- The lack of plant nutrients like nitrates and calcium caused failure of proper cell wall formation resulting in plants with weak stems. ***Ue***
- Excess water in soil displaced soil oxygen causing limited aerobic respiration and less energy. The plants could not actively absorb sufficient mineral salts further causing chlorosis and reducing plant growth. ***Ue***
- Lack of soil oxygen led to death and rotting of plant roots since they lacked energy to carry out vital life processes. ***Ue***

Scoring rubric: 4Ue = 6; 3Ue = 5; 2Ue = 4; 1Ue = 2; Ul = 1

b) How did the potato plants finally manage to produce Irish potatoes for the farmer?

- This occurred due to mitosis, surface area for absorption of sunlight and photosynthesis increased food production that was used for growth and production of Irish potatoes. ***Ae***
- Because production of more roots increased surface area for absorption of more water, cells became turgid straightening the stem. ***Ae***
- Leaves became more exposed to sunlight so much sunlight was absorbed that increased photosynthesis to produce more food for growth and formation of Irish potatoes. ***Ae***

Scoring rubric: 3Ae = 5; 2Ae = 4; 1Ae = 2; Al = 1

Item 7

Alisha a farmer in Muhoro sub County planted sun flower at the start of the rains, two month after their emergency, the crops were eaten by his neighbor's goats. The goats ate the leaves and damaged the stems. Aisha advised the neighbor to put his goats on Zero grazing. A week later, the sun flower started developing new buds, leaves and flowered enabling the Alisha to get some yields however lower than expected. On onsulting the community agriculture officer, she was told that the destruction of leaves, stems and flowers by the goats affected greatly the plants.

Task

a) Explain how the sun flower plants were able to develop fruits after formation of flowers enabling the farmer to get yields.

- Mature flowers produced pollen grains on their anthers. ***Ue***
- Wind or insects transfer pollen grains onto the stigma of the flower.
- On the stigma, pollen grain absorbs water, nutrients then germinates ***Ue*** and divides to form a pollen tube which grows through the style creating a route through the style in which the generative nucleus passes into the embryo sac. ***Ue***
- The generative nucleus that divides mitotically to form two male nuclei. ***Ue***
- One of the male nucleus fuses with the egg nucleus to form a zygote which divides mitotically to form embryo. ***Ue***
- The other male nucleus fuses with two polar nuclei to form a triploid endosperm which develops into endosperm. ***Ue***
- The ovules develop into seeds. ***Ue***
- The integuments become the seed coat. ***Ue***
- The ovary develops into a fruit and ovary wall develops into a fruit wall which protects the seeds. ***Ue***

Scoring rubric: 6+Ue = 6; 4-5Ue = 5; 2-3Ue = 4; 1Ue = 2; Ul = 1

b) Explain to Alisha how the structures that were destroyed by the goats are very significant to the plant.

- Stems hold leaves in the best position for receiving enough sun light needed in the process of photosynthesis/ conduct water and mineral salts from roots to leaves and manufactured food from leaves to other parts/ hold flowers and fruits in good position so that they can be easily pollinated or dispersed and young green stems photosynthesize thus making food for the plant/ lenticels on stems facilitate gaseous exchange. ***Ae***

- Leaves manufacture food for the plant during photosynthesis/ stomata on leaves allow exchange of gases i.e. O_2 and CO_2./ facilitate transpiration enabling movement of water by transpiration pull up the plant and cooling of the plant. ***Ae***
- Flowers are reproductive organs thus allows fertilization/ production of seeds and fruits in plants. ***Ae***

Scoring rubric: 3Ae = 5; 2Ae = 4; 1Ae = 2; Al = 1

Item 8

Oneni a farmer of cassava in Isimba vallage planted cassava in his newly purchased plot of land with light soils near a sand mining site a few meters away from his farm. The soils dry easily after rains. He has been planting cassava and attaining low yields since he started using this plot of land. Recently his farm was attacked by a new species of caterpillars that damaged the leaves and some parts of the stem.

Task

a) Explain how Oneni's practices and the conditions faced by his crops in the garden are responsible for the low yields.

- Light soils have low humus content/ have low water retention which reduced rate of growth of cassava leading to low yields/ have high rate of leaching depriving crops of nutrients causing poor growth and low yields. ***Ue***
- Dryness of the soils reduces absorption of water and mineral salt s by cassava crops affecting growth of the plants leading to low yields. ***Ue***
- Planting of cassava alone reduces soil fertility leading to low yields. ***Ue***
- Damage of leaves by caterpillars reduces surface area for photosynthesis affecting plant growth leading to low yields. ***Ue***
- Damage of some parts of the cassava stems by caterpillars also damages the xylem reducing movement of water and mineral salts to the leaves/ damages the phloem reducing translocation of manufactured food to points of utilization and storage. ***Ue***

Scoring rubric: 4-5Ue = 6; 3Ue = 5; 2Ue = 4; 1Ue = 2; Ul = 1

b) Advice the farmer on what may be done to improve his soils and the prevailing conditions faced by the crops for a better yield in the next growing season without shifting to a new farm land.

- Addition of organic matter to increase water-holding capacity and nutrient retention/ Use mulch to help retain moisture and suppress weeds/ Planting of drought-tolerant crops/ plants adapted to sandy conditions/ irrigation method to supply water to crops. ***Ae***
- Application of fertilizers to compensate for low nutrient retention. ***Ae***
- Spraying using insecticides to kill caterpillars/ use of biological control measures to feed on caterpillars/ physical hand picking of caterpillars to avoid destruction of crops by caterpillars. ***Ae***
- Crop rotation to conserve soil fertility and break insect pest life cycles. ***Ae***

Scoring rubric: 4+Ae = 6; 3Ae = 5; 2Ae = 4; 1Ae = 2; Al = 1

Item 9

Badru a farmer in a particular area, acquired an agricultural loan from a microfinance institution, prepared his garden well and used the loan to procure and planted cassava in his gardens. At the time of weeding, the loan was used up and this delayed the weeding. During the course of the season, a dry

spell set in and his crops were invaded by pests destroying most leaves, stems and even the roots. This left John confused about how he would be able to clear the loan. After about two month of serious drought, it started raining again and the cassava plants rejuvenated but he still obtained low yields after the 6month.

Task

a) Identify and explain how the prevailing conditions in John's farm that may have affected his crop yields.

- Delayed weeding of crops created competition for nutrients/ light/ space, e.t.c. between crops and the weeds leading to low yields.***Ue***
- The dry spell caused increased evaporation and loss of water from the soils affecting absorption of nutrients and plant metabolism leading to poor growth and low yields. ***Ue***
- Destruction of leaves by pests reduced surface area for trapping sunlight energy hence reduced rate of photosynthesis. ***Ue***
- Destruction of stems by pests damaged the xylem affecting movement of water up the plant hence reduced rate of photosynthesis. ***Ue***
- Destruction of roots by pests affected nutrient absorption from the soil leading to poor growth and low yields. ***Ue***

Scoring rubric: 4-5Ue = 6; 3Ue = 5; 2Ue = 4; 1Ue = 2; Ul = 1

b) Suggest what may be done by the farmer so as to obtain high yields in the next growing season without relocating to a new farm land.

- Spraying with insecticides/ use of biological control to control pests. ***Ae***
- Practice controlled irrigation to provide water to crops. ***Ae***
- Practice crop rotation to break insect pest life cycles and maintain fertility. ***Ae***
- Timely planting to prevent crops from being caught up by drought. ***Ae***
- Plant drought resistant crop varieties so as to maintain high yields in drought conditions. ***Ae***
- Plant early maturing crop varieties not to be caught up by drought conditions. ***Ae***

Scoring rubric: 4+Ae = 6; 3Ae = 5; 2Ae = 4; 1Ae = 2; Al = 1

Item 10

Moses a renowned farmer in Masindi cleared part of his land that was previously occupied by anthills and shrubs as an extension of his maize farm. The farmer planted maize seeds slightly late after the start of the rains due to delays in clearing the extension portion. The maize established poorly, emerged out of the soils but was seemingly stunted. However, shortly after a dry spell set in and his maize garden was invaded by caterpillars that ate and destroyed most of the crops in the garden. Their leaves were bored through with visible large holes, and their stems equally damaged and most plant roots were found cut by termites. Most crops in the extended part started wilting and dried.

Task

a) Explain how Moses' maize seeds were able to establish and until when they were attacked by pests.

- Seeds absorb water by imbibition through the micropyle. ***Ue***

- The water expands and spits the testa, dissolves stored food reserves, stimulates synthesis of enzymes in the cotyledons. ***Ue***
- Enzymes/ amylase convert starch to maltose and maltase converts maltose to glucose. ***Ue***
- Glucose is translocated to the embryo and used in respiration to generate energy for growth. ***Ue***
- The radical emerges first and growths downwards to form the root system. ***Ue***
- Then plumule emerges and grows upwards to form the shoot system. ***Ue***
- The epicotyle elongates faster and the cotyledon remains under the soil. ***Ue***
- First foliage leaves are formed and photosynthesize making food for continued growth. ***Ue***

Scoring rubric: 5+Ue = 6; 3-4Ue = 5; 2Ue = 4; 1Ue = 2; Ul = 1

- Suggest strategies that can be implemented by Moses to manage the condition in order to be able to attain some yields.
- Spraying using pesticides/ biological control measures/ crop rotation to control pests/ termites and caterpillars. ***Ae***
- Timely planting at the start of the rains to avoid exposure of crops to dry-spells/ to ensure early mature before onset of the dry spell. ***Ae***
- Application of manure/ fertilizers to improve soil fertility/ boost plant growth. ***Ae***
- Practice irrigation method to provide water to crops for proper growth during dry spells. ***Ae***

Scoring rubric: 4Ae = 6; 3Ae = 5; 1-2Ae = 3; 1Al = 2

Item 11

Mwama a farmer and vegetable vendor in Hoima Central market usually plants his crops through the year. During the rainy seasons, the farmer plants his cabbages in an open field to obtain enough light and be able to make food and develop more leaves. However, during the dry seasons, he plants his cabbages in a greenhouse and waters the crops often throughout the growing period to have reasonable harvests.

Task.

Explain how the;

(a) cabbages are able to obtain light and use it making of food so as to develop more leaves.

- Light is absorbed by the chlorophyll found in the chloroplasts of the cabbage leaves and used in photosynthesis. ***Ue***
- Photosynthesis occurs within the chloroplasts abundant in the palisade mesophyll layer of the leaves. ***Ue***
- During the process, water absorbed by plant roots root hairs ***Ue***combines with carbon dioxide ***Ue*** fixed through the stomata ***Ue*** in presence of sunlight energy trapped by chlorophyll that facilitates opening of stomata ***Ue*** and suitable temperature that activates photosynthetic enzymes ***Ue*** that facilitate the combining of carbon dioxide and water forming glucose/ carbohydrates and oxygen. ***Ue***
- The glucose is used in respiration to generate energy/ converted to cellulose and becomes part of cell walls/ combined with nitrogen and used to synthesize amino acids/ converted to fats and oils/ converted to nucleic acids and excess converted to starch for storage ensuring proper growth of the plant. ***Ue***

(b) water that Mwama supplies to his crops during the dry seasons is obtained by the cabbages.

- Water is absorbed by **root hairs** which are found near the tips of roots by **osmosis** ***Ue*** because the cell sap of the root hair cells is usually highly concentrated compared to the soil solution enabling water to move from the soil into the root hair cells. ***Ue***
- The water then moves across the intermediate cells of the cortex by osmosis into the xylem in the stem. ***Ue***
- The xylem then transports water to all parts of the plant by the forces of capillarity/ transpiration pull/ tension-cohesion forces, adhesive forces and root pressure ***Ue*** and used in photosynthesis and other cellular functions. ***Ue***

Scoring rubric: 8+Ue = 6; 5-7Ue = 5; 3-4Ue = 3; 1-2Ue = 2; Ul = 1

(c) Explain why Mwama should continue planting his crops in a greenhouse and watering them during dry seasons.

- Water is absorbed by seeds and used in dissolution of stored food/activation of enzymes during germination. ***Ae***
- Water is raw material for photosynthesis. ***Ae***
- Water provides turgidity to vegetable leaves enabling then spread and absorb light. ***Ae***
- Water enables translocation of nutrients in cabbages/ plants. ***Ae***
- Water dissolves nutrients in the soil for easy absorption by cabbage roots. ***Ae***
- Transpiration of water enables cooling of cabbage plants. ***Ae***

Scoring rubric: 4+Ae = 6; 3Ae = 5; 1-2Ae = 3; 1Al = 2

Item 12

A farmer planted crops in a well prepared garden. Before flowering, the plants were attacked by some insect larvae which destroyed most of the young leaves, terminal buds and the outer layer of stems. The farmer noticed that the plants had become stunted as they were not growing at the expected rate. After some time, the larvae disappeared and the plants resumed growing, produced many branches, leaves, flowers and fruits to the surprise of the farmer. At the time of harvest, the farmer was able to get some yields.

Task

(a) Explain the effect of the insect larvae on the plants.

- Insect larvae destroyed young leaves, reducing surface area for photosynthesis
- /gaseous exchange.***Ue***
- Destroyed terminal buds, reducing primary growth/formation of new leaves/development of flowers. ***Ue***
- Destroyed the outer layer of the stem/phloem, reducing transport/translocation of manufactured food. ***Ue***
- Destroyed young leaves affecting transpiration, reducing water and mineral salts uptake. ***Ue***

Accept: (Reducing photosynthesis/gaseous exchange (without S.A))

Scoring rubric: 3+ Ue = 6; 2Ue = 3; 1Ue = 2; Ul = 1

(b) Explain how the plants managed to behave the way they did when the insect larvae disappeared.

- Resumed growth due to elongation of terminal buds/photosynthesis by leaves/translocation of the manufactured food. ***Ae***
- Produced many branches due to growth of buds. ***Ae***
- Produced many leaves due to growth of buds. ***Ae***
- Produced many flowers from growth of buds. ***Ae***
- Produced many fruits from flowers upon fertilization/pollination. ***Ae***

Scoring rubric: 4+Ae = 6; 3Ae = 5; 1-2Ae = 3; 1Al = 2

Item 13

Mr. Oneni a farmer in Bulindi planted beans in his farm which were looking healthy. Suddenly a dry spell set in and most plants stunted in their growth, had their leaves turning yellow and could wilt. After sometime, the rains returned but Oneni wanted to replant and as he uprooted some plants, he observed that they had developed many small branching roots with numerous nodules and new green leaves developed, so he left them. At flowering stage, the garden was visited by numerous bees for some time. After the visit by the bees, the bean pods started forming and finally the beans produced low yields.

Task

(a) Explain how the processes in the bean plants were affected leading to low yields.

- Yellowing of leaves reduces amount of light trapped by the plant reducing the rate of photosynthesis. ***Ue***
- Wilting of leaves causes closure of stomata reducing amount of carbon dioxide fixed by the plant reducing the rate of photosynthesis. ***Ue***
- Stuntedness reduces amount of light trapped due to small leaves/ reduces amount of absorbed by the plant due to short roots reducing rate of photosynthesis. ***Ue***

(b) Explain the internal processes that took place in the bean plants from the time the bees visited to formation of pods.

- Bees transfer/ carry pollen grains from the anthers to the stigma of the bean plants. ***Ue***
- Stigma facilitates germination of the pollen grain under favorable conditions. ***Ue***
- The pollen grain divides into the generative and the tube nuclei. ***Ue***
- Pollen tube nucleus develops a route through the style to the embryo sac. ***Ue***
- The generative nucleus divides into two male nuclei. ***Ue***
- One male nucleus fuses with the egg cell to form a zygote that develops into an embryo. ***Ue***
- The other male nucleus fuses with the two polar nuclei to form an endosperm in endospermic seeds. ***Ue***
- The fertilized ovule forms a seed and a fertilized ovary forms a fruit. ***Ue***

Scoring rubric (a) and (b): 7+ Ue = 6; 4-6Ue = 5; 2-3Ue = 3; 1Ue = 2; Ul = 1

(c) How did the beans overcome the prevailing conditions?

- Development of many small branching roots increased surface area for the beans to absorb more water. ***Ae***

- Numerous nodules to increase nitrogen fixation into the soils used n synthesis of chlorophyll increasing rate of photosynthesis. ***Ae***
- Development of new green leaves increased surface area for trapping sunlight increasing photosynthesis. ***Ae***

Scoring rubric: 3Ae = 6; 2Ae = 5; 1Ae = 3; 1Al = 2

Item 14

Okone, a farmer of food crops in Serere district has a 2-acre farmland near the swamp. The day he planted maize grains was followed by a heavy down pour which made part of his farm flooded for a week. Most of the maize grains failed to germinate in the flooded part of the farm and a few maize seedlings remained stunted with small leaves. In the unflooded part of the farm, the maize plants had proper growth but later were invaded by insect larvae which destroyed most of the leaves and stems. After sometime, the insect larvae disappeared and the affected maize plants developed new leaves and flowers which resulted into low yields.

Task

(a) Describe how the conditions in Okone's farm affected his plant processes leading to low yields.

- Flooding deprived soils of air/ oxygen making most of the maize seeds fail to germinate. ***Ue***
- Small size of the leaves in stunted seedlings reduced surface area for trapping sun light energy reducing rate of photosynthesis. ***Ue***
- Destruction of leaves by caterpillars reduced surface area for trapping sunlight/ reduced carbon dioxide fixation through stomata on leaves reducing rate of photosynthesis. ***Ue***
- Destruction of stems by caterpillars damages the xylem hindering movement of water to other parts of the plant through the xylem/ damages the phloem reducing translocation of manufactured food to points of utilization and storage. ***Ue***

Scoring rubric: 3+Ue = 6; 2Ue = 5; 1Ue = 3; Ul = 1

(b) Explain how the;

(i) plants managed to produce some yield

- Disappearance of insect larvae enabled regeneration and repair of damaged parts of maize plant. ***Ae***
- Development of new leaves enabled the maize plants to trap enough sunlight energy/ improved carbon dioxide fixation increasing rate of photosynthesis. ***Ae***
- Flowering of affected maize plants enabled maize plants to form cobs providing some yield to the farmer. ***Ae***

(ii) Farmer could overcome the challenges.

- Construction of channels in flooded areas to improve drainage/ prevent flooding. ***Ae***
- Spraying using insecticides/ crop rotation/ use of biological methods to control pests/ caterpillars. ***Ae***
- Application of fertilizers/ manure to improve soil fertility/ boost plant growth. ***Ae***

Scoring rubric: 4+Ae = 6; 2-3Ae = 5; 1Ae = 3; 1Al = 1

Item 15

Jonah planted maize and mixed beans on his plot along a dusty road side. As a way of obtaining good yields, prepared his garden well and planted quality seeds in closely packed columns and rows, applied fertilizers, sprayed to prevent any pests and removed weeds. He planted maize earlier and planted beans later after the maize were already tall. His maize yielded poorly and beans remained stunted with no yields. He is very worried about the outcomes yet he spent a lot of money on the garden.

Task

a) Describe the causes of the outcomes.

- There was closed spacing, growing of the plants very close to each other which caused stiff competition for growth factors like nutrients, light, air required by the plant to grow and carryout photosynthesis. ***Ue***
- There was also a wrong pattern of planting; when the maize plants were planted earlier which led to rapid exhaustion of nutrients in the soil such as Nitrogen, ammonium ions required for proper growth of the plants. ***Ue***
- The garden being close to a dusty road caused the dust to accumulate on the leaves of the plants which reduced on the rate of absorption of light energy by the chlorophyll of the leaves which reduced on the rate of formation of starch by the plants. ***Ue***
- Late planting of the beans caused the beans to be shaded and covered by the already tall long maize plants which reduced the photosynthetic rate of beans of the beans thus stunted growth. ***Ue***

Scoring rubric: 3+Ue = 6; 2Ue = 5; 1Ue = 3; Ul = 1

b) Advice Jonah on how he can plant the same plants in the same garden in other seasons with minimal losses.

- Beans should be planted earlier in the garden or together with the maize since they are leguminous plants with root nodules with nitrogen fixing bacteria that fix nitrogen to form nitrate ions need by the plant for proper growth. ***Ae***
- Thinning out of some plants especially maize to create more space and light penetration to all plants for efficient photosynthesis to improve yields. ***Ae***
- Trees can be planted alongside the roads to trap some dust from the dusty road in the future and reduce on soil erosion. ***Ae***
- Irrigation to remove dust on leaves and moisture needed for proper germination of seeds. ***Ae***

Scoring rubric: 4Ae = 6; 3Ae = 5; 2Ae = 3; 1AE = 2; Al = 1

Item 16

Nancy and Catrine who are farmers in Kamu sub county both planted the same type of beans. Nancy planted her beans near the dusty road while Catrine planted her beans far away from the road. At flowering stage the garden was invaded by numerous bees for some time. After the visit by the bees, the bean pods started forming and finally the beans gave some yields. At the harvest

time Nancy's yields were to low while Catrine's harvest were relatively higher this left the two confused as they were unable to understand the cause of the differences in the yields.

Task

a) Explain;

(i) the major challenges faced by the bean plants in Nancy's garden.

- Nancy's garden was next to a dusty road leading to accumulation of dust onto the leaves, covering the surface and stomata reducing the surface area for trapping sunlight and fixation of Carbondioxide respectively, hence reducing the rate of photosynthesis.***Ue***

(ii) the internal processes that took place in the bean plants from the time bees visited until when the yields were realized.

- Bees acted as pollinators and carried pollen grains from the anther heads to the stigma of bean flowers. ***Ue***
- When the pollen grains landed on mature stigma, they germinated and produced pollen tubes which grew via the micropyle to the embryo sac. ***Ue***
- Its generative nucleus divided by mitosis to form two male nuclei. ***Ue***
- One male nucleus fused with the egg cell to form the seed embryo comprising the plumule and radicle. ***Ue***
- The second male nucleus fused with the polar nucleus to form the seed primary endosperm. ***Ue***
- The fertilized ovule formed the seed and the ovary formed the fruit/ pods. ***Ue***
- The ovary wall formed the fruit wall ***Ue*** and the integuments formed the seed coat. ***Ue***

Scoring rubric: 6+Ue = 6; 4-5 Ue = 5; 2-3Ue = 3; 1Ue=2'; Ul = 1

b) How did the beans overcome the prevailing conditions to give some yields?

- They developed root nodules where the nitrogen-fixing bacteria converted nitrogen to form nitrates used by the plants to grow. ***Ae***
- Possessed broad leaves which trapped sunlight for photosynthesis. ***Ae***
- They formed deeper roots to increase surface area for water absorption and anchorage. ***Ae***
- Production of more root hairs to increase surface area for water absorption. ***Ae***

Scoring rubric: 4Ae = 6; 3Ae = 5; 2Ae = 3; 1AE = 2; Al = 1

Item 17

In the village of Kigungu located in Entebbe, local farmers predominantly cultivate Bananas and Cassava. However, the village recently faced a prolonged dry spell followed by strong winds which brought a significant amount of dust that settled on the leaves and stems of banana and cassava crops. The farmers are worried that if this problem persists, it could lead to severe losses in their harvests. ***Task***

Explain;

a) how the functioning of these plants is affected.

- There was accumulation of dust onto the leaves, covering the surface and stomata reducing the surface area for trapping sunlight and absorption of carbon dioxide respectively reducing the rate of photosynthesis leading to poor yields.***Ue***

Scoring rubric: 1Ue = 3; Ul = 1

b) solutions that the farmers of Kigungu could implement to overcome the challenges posed by dust on their crops.

- Regularly spray cassava plants with water to remove dust. ***Ae***
- Use irrigation systems that minimize dust accumulation. ***Ae***
- Plant windbreaks or use row covers to reduce dust settling on crops. ***Ae***
- Mulch around plants to reduce dust stirring up from the soil. ***Ae***
- Consider planting dust-tolerant crop varieties. ***Ae***

Scoring rubric: 4+Ae = 6; 3Ae = 5; 2Ae = 3; 1Ae = 2; Al = 1

Item 18

Sarah a maize famer in a particular area, extended her farm into a hilly area where water from the hill top flow into the river in the valley. Sarah often attains high yields despite her habit of not weeding regularly and over reliance on selective herbicides. Her crops on the extended part grew short and she attained low yields than expected.

Task

a) Identify and state the major challenges that affected Sarah's crops leading to low yields.

b) Explain how the challenges experienced affected plant processes leading to the low yields Sarah attained.

c) Advice Sarah on what may be done for improved yields in the next season without shifting to a new area.

Item 19

Badru is a pumpkin farmer in Kitumba village. The village experiences a lot dry seasons characterized by high temperatures, the hairy pumpkin leaves would droop (bend downwards) and flower petals remained closed for a longer part of the day but would straighten and open during early morning hours respectively. Badru had a very poor yield of pumpkins.

Task

a) Describe how the conditions experienced affected the functioning of the pumpkin plants which led to poor yields.

b) Explain how the pumpkins in Badru's garden managed to overcome the conditions and be able to give some yield.

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