UPCATET Agronomy Sample Paper-4

Duration: 20 Minutes **Maximum Marks: 100**

Instructions

- This paper contains **25** Multiple Choice Questions.
- Each correct answer carries **+4** mark. Incorrect answer: **−1** marks. Only **one** correct option.
- Unattempted questions carry **0** marks.
- Use of mobile phones, smartwatches, or any electronic gadgets is strictly prohibited.

Q1. A progressive seed-multiplication facility in Uttar Pradesh aims to achieve maximum genetic purity during the multiplication of Breeder Seed into Foundation Seed for a newly released high-yielding wheat variety. Identify the strictly recommended minimum isolation distance (in meters) to safeguard against mechanical mixtures and rare natural outcrossing under Indian Minimum Seed Certification Standards (IMSCS).

(A) 3 meters

(B) 5 meters

(C) 10 meters

(D) 15 meters

Q2. A researcher observes poor tillering and delayed panicle initiation in late-sown wheat under a rice-wheat cropping system in western UP. If the average ambient temperature drops abruptly to below 8°C during the crown root initiation (CRI) phase, what is the direct physiological bottleneck limiting resource allocation to the synchronous tillers?

(A) Premature lignification of the seminal roots

(B) Impaired sink capacity due to standard microsporogenesis arrest

(C) Restricted nutrient translocation caused by low crown zone metabolic activity

(D) Complete inhibition of gibberellic acid synthesis in the coleoptile

Q3. An agronomist designs a balanced nutrient schedule for a sugarcane crop (*Saccharum officinarum*) in the Terai region. To optimize sucrose synthesis, phloem loading, and subsequent translocation from the leaf blades to the stalks, which specific micronutrient dynamic must be carefully regulated alongside optimal potassium levels?

(A) Zinc, which drives indole-3-acetic acid elongation

(B) Boron, which facilitates sugar-borate complex transport across membranes

(C) Manganese, which accelerates the photolysis of water in lower nodes

(D) Molybdenum, which serves as a cofactor for nitrate reduction in ratoon crops

Q4. In the context of Pigeonpea (*Cajanus cajan*) agronomy, the physiological disorder known as "Flower Drop" drastically limits the harvest index. Under sub-optimal rainfed environments of Bundelkhand, which hormonal interaction and environmental trigger primarily accelerate this abscission layer formation?

(A) High Ethylene coupled with prolonged water logging

(B) Low Abscisic Acid paired with severe atmospheric drought

(C) High Auxin coupled with high relative humidity at night

(D) Low Gibberellins under high solar irradiance

Q5. The critical stage of moisture stress in Groundnut (*Arachis hypogaea*) that directly dictates the ultimate pod yield occurs when the elongated gynophores penetrate the soil surface. Identify this highly sensitive physiological phase.

(A) Seedling establishment phase

(B) Synchronous flowering phase

(C) Pegging and pod development phase

(D) Early vegetative branching phase

Q6. During the cultivation of Rapeseed and Mustard (*Brassica juncea*), farmers often encounter low oil content despite achieving high seed yields. Which nutrient management adjustment is biochemically critical to upregulate acetyl-CoA carboxylase activity and elevate the glucosinolate-fatty acid conversion balance?

(A) Luxury consumption application of Muriate of Potash

(B) Split application of elemental Sulphur or Gypsum

(C) Foliar spraying of chelated Iron at the pre-flowering stage

(D) Basal application of high-dose Calcium Carbonate

Q7. When evaluating the performance of direct-seeded rice (DSR) versus transplanted puddled rice (TPR) in the Indo-Gangetic plains, which primary biochemical phenomenon causes transient iron chlorosis exclusively in young DSR seedlings during early vegetative phases?

(A) Rapid reduction of Fe^{3+} to Fe^{2+} under anaerobic conditions

(B) High persistence of oxidized Fe^{3+} state due to prevailing aerobic soil conditions

(C) Antagonistic immobilization of iron by excessive dissolved organic carbon

(D) Accelerated volatilization of iron complexes due to surface drying

Q8. An intensive intercropping system involving Autumn Sugarcane and Potato is executed in central Uttar Pradesh. To avoid spatial and temporal light-competition metrics, what is the most scientifically sound row configuration and geometric adjustment for maximizing the Land Equivalent Ratio (LER)?

(A) Cross-sowing of both crops at a 1:1 ratio with 45 cm spacing

(B) Paired rows of sugarcane at 90:30 cm with two rows of potato in between

(C) Broad-bed furrow planting with random broadcast of potato seeds

(D) Single rows of sugarcane at 60 cm alternated with three rows of potato

Q9. A commercial malting-barley (*Hordeum vulgare*) crop requires strict agronomic management. If the nitrogen fertilizer application is delayed or overdosed beyond

the jointing stage, what undesirable structural consequence occurs in the grain processing profile?

(A) Drastic reduction in alpha-amylase activation potential

(B) Excessive accumulation of hordein proteins, reducing the malt extract yield

(C) Premature cracking of the lemma and palea structures

(D) Hyper-accumulation of starch grains within the aleurone layer

Q10. Consider a dual-purpose pearl millet (*Pennisetum glaucum*) crop grown under dryland tracts. If the crop experiences a severe dry spell during the late vegetative stage followed by sudden heavy rainfall, which toxic compound dynamics within the young green forage must a livestock farmer be highly cautious of before harvesting for green fodder?

(A) High accumulation of Oxalic acid in the leaf margins

(B) Hydrocyanic acid (HCN / Prussic acid) synthesized in roots and translocated to leaves

(C) High concentration of Coumarin compounds within the node junctions

(D) Excessive accumulation of glucosinolates within the terminal panicle

Q11. The 'Karail' soils found predominantly in the lower plains and specific pocket districts of the Vindhyan region in Uttar Pradesh exhibit distinct self-ploughing properties, high moisture retention, and high clay content ($> 40\%$). Under the USDA Soil Taxonomy system, these soils correspond to which order?

(A) Inceptisols

(B) Vertisols

(C) Alfisols

(D) Entisols

Q12. A computational soil-loss estimation using the Universal Soil Loss Equation (USLE), expressed as $A = R \times K \times LS \times C \times P$, is carried out for the undulating ravinous landscapes of the Yamuna-Chambal system. If conservation tillage reduces structural disturbance and retains 50% crop residue cover, which factor

coefficient decreases most sharply to minimize the computed total soil erosion rate A?

(A) The rainfall erosivity factor (R)

(B) The soil erodibility factor (K)

(C) The crop management factor (C)

(D) The topographic slope length factor (LS)

Q13. In deep black cotton soils or heavy 'Karail' soils of UP, routine intensive conventional tillage using heavy machinery when soil moisture is slightly above the plastic limit creates a severe agronomic constraint. Identify this structural deformation.

(A) Creation of surface crusts that boost seed aeration

(B) Formation of a dense, impermeable subsurface hardpan or plow-sole

(C) Accelerated multi-directional macro-pore connectivity

(D) Excessive increase in the total cation exchange capacity (CEC)

Q14. During a specialized clean-tillage operation for a field heavily infested with perennial deep-rooted weeds like *Saccharum spontaneum* (Kans grass), which primary tillage implement is objectively selected to break, invert, and expose the deep-seated rhizomes to solar radiation?

(A) Tractor-drawn Spring-tine cultivator

(B) Heavy-duty Disc Harrow

(C) Mouldboard Plough (MB Plough)

(D) Rotary Tiller (Rotavator)

Q15. The physical process of wind erosion involves three distinct modes of particle movement depending on the aerodynamic diameter of the soil fractions. Identify the exact mechanism and particle size range responsible for the movement of fine sand grains (0.1 to 0.5 mm) which bounce along the soil surface.

(A) Suspension (< 0.1 mm)

(B) Saltation (0.1 to 0.5 mm)

(C) Surface Creep (> 0.5 mm)

(D) Detrusion (> 2.0 mm)

Q16. The saline-alkali soils widely distributed across central and western Uttar Pradesh, locally classified under 'Usar' lands, exhibit a high Exchangeable Sodium Percentage (ESP > 15%), a high electrical conductivity (EC > 4 dS/m), and an alkaline pH. What is the most scientifically precise chemical remediation protocol to displace the adsorbed Na^+ ions from the soil exchange complex?

(A) Application of Calcium Carbonate ($CaCO_3$) followed by deep drainage

(B) Application of Gypsum ($CaSO_4 \cdot 2H_2O$) followed by heavy flushing/leaching

(C) Heavy surface application of Ammonium Sulfate

(D) Adding crushed quartz sand to break surface tension

Q17. An automated micro-irrigation system is being calibrated for a high-density orchard in western UP. To compute the exact Net Irrigation Requirement (NIR) of the crop, an engineer utilizes the formula NIR = WR − (ER + GW), where WR is total water requirement. What precise field parameter does the variable GW represent in this balanced hydrological equation?

(A) Gross Water loss via deep percolation

(B) Groundwater contribution from a shallow water table via capillary rise

(C) Gravitational water capacity of the top 15 cm soil layer

(D) Gravimetric water percentage at permanent wilting point

Q18. In an arid zone field layout featuring light textured sandy loam soils with a highly irregular topography, which advanced pressurized irrigation system is selected to guarantee uniform water distribution while minimizing deep percolation losses and land-leveling costs?

(A) Surge Irrigation Method

(B) Overhead Sprinkler Irrigation System

(C) Check Basin Irrigation Method

(D) Alternate Furrow Irrigation System

Q19. A waterlogged agricultural field in the Sharda Sahayak canal command area displays high salinity due to prolonged capillary upward movement of salts. To permanently lower the water table below the root zone and leach out toxic chlorides, which engineered subsurface drainage layout is ideal?

(A) Corrugated perforated plastic tile drains installed horizontally at a calculated depth and spacing

(B) Vertical open drainage ditches running parallel to the slope

(C) Continuous contour bunds equipped with stone-pitched outlets

(D) Shallow bamboo-boring skimming wells

Q20. A long-term field trial measures the Water Use Efficiency (WUE) of diverse field crops. Crop X produces 18 kg of economic yield per millimeter of evapotranspired water, while Crop Y yields 8 kg/mm. Which underlying physiological and anatomical adaptations explain why Crop X exhibits a significantly superior WUE over Crop Y under identical semi-arid conditions?

(A) Crop X uses the C_3 pathway with open stomata during midday peak heat

(B) Crop X uses the C_4 photosynthetic pathway with a highly efficient Kranz anatomy

(C) Crop X has a shallow horizontal fibrous root structure minimizing nutrient uptake

(D) Crop X possesses large thin leaf blades that maximize transpiration cooling

Q21. When scheduling irrigation in wheat based on the Climatological Approach (IW/CPE ratio), a farmer maintains a recommended ratio of 0.9. If the cumulative pan evaporation (CPE) from an open pan evaporimeter since the last irrigation reaches exactly 60 mm, what depth of irrigation water (IW) must be applied to the field?

(A) 45 mm

(B) 54 mm

(C) 66 mm

(D) 75 mm

Q22. In zero-tillage wheat systems across Uttar Pradesh, the continuous mono-cropping of rice-wheat has selected for a highly competitive mimicry weed, *Phalaris minor* (Little Canary Grass). What biochemical mechanism explains why this weed evolved widespread resistance to the traditionally used herbicide Isoproturon?

(A) Enhanced degradation mediated by elevated Cytochrome P450 monooxygenase activity

(B) Target site mutation preventing binding at the ATP-synthase complex

(C) Rapid exclusion of the herbicide molecules through specialized leaf trichomes

(D) Permanent downregulation of the acetolactate synthase (ALS) enzyme path

Q23. An herbicide program requires a pre-emergence application of Pendimethalin to control annual grasses and certain broadleaf weeds in a pulse crop field. What is the fundamental mode of action of Pendimethalin at the cellular level of germinating weed seedlings?

(A) Inhibition of amino acid synthesis via EPSP synthase pathway

(B) Disruption of microtubule assembly, halting mitotic cell division in meristems

(C) Destruction of cell membranes via lipid peroxidation at Photosystem I

(D) Total blockade of carotenoid biosynthesis resulting in severe bleaching

Q24. A dryland agro-ecosystem specialist recommends the use of 'antitranspirants' to save a rainfed sorghum crop from terminal drought during an extended dry spell. If the specialist selects 'Phenylmercuric Acetate (PMA)' or 'Atrazine at low concentrations', under which specific functional category do these chemicals operate?

(A) Film-forming types that create a physical barrier to water vapor

(B) Stomatal-closing types that induce partial or complete stomatal closure

(C) Reflectance types that increase leaf albedo and lower thermal load

(D) Growth retardants that modify root-to-shoot allocation ratios

Q25. The biological control of the noxious terrestrial alien weed *Parthenium hysterophorus* (Congress grass) has been widely integrated into the weed management strategies of Uttar Pradesh. Identify the highly specific host-destructive bio-agent (leaf-eating beetle) introduced successfully for this purpose.

(A) *Neochetina bruchi*

(B) *Zygogramma bicolorata*

(C) *Dactylopius tomentosus*

(D) *Cytobagous salviniae*

Detailed Solutions

Q1.

Solution

Concept:

To maintain genetic purity and prevent genetic contamination during seed multiplication, strict seed certification standards govern the isolation distance of fields. Isolation distances prevent mechanical mixing during harvesting and cross-pollination from neighboring fields.

Solution:

Let's analyze the pollination biology and standard isolation requirements for wheat:

(a) Wheat (*Triticum aestivum*) is a highly self-pollinated crop, where natural outcrossing occurs rarely (usually less than 1%).

(b) Under the Indian Minimum Seed Certification Standards (IMSCS), because the risk of cross-pollination is minimal, the isolation distance is primarily designed to prevent mechanical mixtures from adjacent fields during field operations.

(c) For both the multiplication of **Breeder Seed into Foundation Seed** and Foundation Seed into Certified Seed, the strictly mandated minimum isolation distance is **3 meters**.

Final Answer: 3 meters

Answer: (A)

Go Back to Question 1

Q2.

Solution

Concept:

The crown root initiation (CRI) phase is a critical developmental transition in wheat. The crown zone, located just below the soil surface, acts as the primary metabolic and structural junction where nodal (crown) roots emerge and synchronous tillers initiate.

Solution:

Let's analyze the physiological effect of cold stress on this specialized tissue zone:

(a) When temperatures drop abruptly below 8°C during CRI, the enzymatic and metabolic activity within the shallow crown tissue decreases significantly.

(b) This slowdown impairs cell division and reduces root hydraulic conductivity, creating a **physiological bottleneck that restricts nutrient and water translocation** up to the developing shoot meristems.

(c) Lacking an adequate supply of resources from the poorly developing nodal root system, the plant cannot support synchronized tiller growth, leading to weak tillering and delayed development.

Final Answer: Restricted nutrient translocation caused by low crown zone metabolic activity

Answer: (C)

Go Back to Question 2

Q3.

Solution

Concept:

Sucrose accumulation in sugarcane stems relies on an efficient source-to-sink transport system. Photosynthates produced in leaf blades must be loaded into the phloem and moved down the stalk for long-term storage.

Solution:

Let's identify the specific role of boron in sugar translocation:

(a) Potassium (K^+) regulates stomatal activity and provides the osmotic drive needed for phloem loading.

(b) **Boron (B)** plays a complementary role by chemically binding with sucrose molecules to form soluble **sugar-borate complexes**.

(c) These sugar-borate complexes pass through cell membranes more easily than free sucrose, accelerating phloem loading and transport down the stalk to optimize sucrose accumulation.

Final Answer: Boron, which facilitates sugar-borate complex transport across membranes

Answer: (B)

Go Back to Question 3

Q4.

Solution

Concept:

Flower drop in grain legumes occurs when hormonal imbalances trigger the formation of an abscission layer at the base of the flower pedicel, causing flowers to shed prematurely and reducing the harvest index.

Solution:

Let's examine how environmental stress alters hormonal pathways to cause flower drop:

(a) Environmental stresses like waterlogging, severe drought, or poor soil aeration disrupt normal root metabolism, sending stress signals to reproductive structures.

(b) This stress stimulates a sharp increase in the synthesis of **ethylene**, a gaseous plant hormone that promotes aging and cell wall breakdown.

(c) Under conditions like **prolonged waterlogging**, high ethylene levels activate cellulase and pectinase enzymes in the pedicel, creating an abscission layer that causes flowers to drop off.

Final Answer: High Ethylene coupled with prolonged water logging

Answer: (A)

Go Back to Question 4

Q5.

Solution

Concept:

Groundnut displays a unique reproductive habit where flowers are borne above ground, but pod development occurs underground. Maintaining adequate soil moisture during this transition is critical for final pod yield.

Solution:

Let's trace the critical stages of groundnut development:

(a) After pollination, the base of the ovary elongates into a specialized structure called a gynophore (or peg).

(b) These pegs grow downward and must penetrate the soil surface to begin pod formation.

(c) This **pegging and pod development phase** is highly sensitive to moisture stress. Dry or compacted soil can prevent pegs from penetrating the ground or cause them to desiccate, directly reducing the number of pods formed.

Final Answer: Pegging and pod development phase

Answer: (C)

Go Back to Question 5

Q6.

Solution

Concept:

Oil biosynthesis in brassica crops involves complex biochemical pathways where sulfur serves as a major constituent. It is required for the synthesis of sulfur-containing amino acids and acetyl-CoA derivatives.

Solution:

Let's look at the biochemical function of sulfur in oilseed production:

(a) **Sulfur** is an essential component of Coenzyme A, which regulates **acetyl-CoA carboxylase**, the enzyme that catalyzes the initial step in fatty acid synthesis.

(b) Applying **elemental sulfur or gypsum** helps upregulate this enzyme system, promoting the conversion of carbohydrates into fatty acids and raising the oil percentage in seeds.

(c) Adequate sulfur also balances glucosinolate synthesis, ensuring proper oil composition without compromising seed quality.

Final Answer: Split application of elemental Sulphur or Gypsum

Answer: (B)

Go Back to Question 6

Q7.

Solution

Concept:

Iron chlorosis in crops is often driven by the oxidation state of iron in the soil, which determines its solubility and availability to plant roots.

Solution:

Let's compare the soil iron chemistry between different rice establishment methods:

(a) In Transplanted Puddled Rice (TPR), standing water creates anaerobic, reduced soil conditions that convert insoluble ferric iron (Fe^{3+}) into soluble ferrous iron (Fe^{2+}), making it easily accessible to roots.

(b) In Direct-Seeded Rice (DSR), the soil remains unflooded and **aerobic** during the early vegetative phases.

(c) Under these aerobic conditions, iron stays locked in its highly insoluble **oxidized ferric (Fe^{3+}) state**. This low availability causes young DSR seedlings to suffer from transient iron chlorosis until roots expand or fields are flooded.

Final Answer: High persistence of oxidized Fe^{3+} state due to prevailing aerobic soil conditions

Answer: (B)

Go Back to Question 7

Q8.

Solution

Concept:

Intercropping geometries are designed to maximize the Land Equivalent Ratio (LER) by reducing spatial and temporal competition for sunlight, water, and nutrients between component crops.

Solution:

Let's analyze row layouts for a sugarcane and potato intercropping system:

(a) Sugarcane is a long-duration, tall crop, while potato is a short-duration, low-growing crop.

(b) A **paired-row planting system for sugarcane (90:30 cm spacing)** clusters the sugarcane rows together, leaving a wide, open inter-row space.

(c) Planting **two rows of potato** within this wide space allows the potato crop to capture ample sunlight during its early growth phase before the sugarcane canopy closes, minimizing resource competition and maximizing total system productivity.

Final Answer: Paired rows of sugarcane at 90:30 cm with two rows of potato in between

Answer: (B)

Go Back to Question 8

Q9.

Solution

Concept:

Malting barley requires specific grain quality standards, including low to moderate protein content and high starch reserves, to ensure a high yield of fermentable sugars during brewing.

Solution:

Let's review how late or excessive nitrogen applications alter grain composition:

(a) Applying excessive nitrogen late in the growth cycle (past the jointing stage) shifts the plant's metabolic priorities from starch accumulation to protein synthesis in the grain.

(b) This results in an **excessive accumulation of hordein proteins** (the primary storage proteins in barley) within the endosperm.

(c) High hordein levels form a dense matrix around starch granules, restricting the access of hydrolytic enzymes and **reducing the final malt extract yield**.

Final Answer: Excessive accumulation of hordein proteins, reducing the malt extract yield

Answer: (B)

Go Back to Question 9

Q10.

Solution

Concept:

Certain forage crops, such as sorghum and pearl millet, can accumulate anti-nutritional compounds or toxic metabolites when subjected to abrupt weather changes, posing a health risk to livestock.

Solution:

Let's examine the biochemistry of cyanogenic compounds during climate stress:

(a) Severe drought stress causes plants to synthesize higher levels of dhurrin, a cyanogenic glucoside, primarily within their root systems.

(b) When sudden heavy rainfall follows the dry spell, the crop undergoes rapid vegetative growth, and **hydrocyanic acid (HCN or prussic acid)** is quickly translocated up into the green leaves.

(c) Livestock consuming this fresh green forage are at risk of prussic acid poisoning, as HCN blocks cellular respiration by inhibiting cytochrome oxidase enzymes.

Final Answer: Hydrocyanic acid (HCN / Prussic acid) synthesized in roots and translocated to leaves

Answer: (B)

Go Back to Question 10

Q11.

Solution

Concept:

Soil orders are classified based on distinct physical properties, diagnostic horizons, and mineral configurations under the USDA Soil Taxonomy system.

Solution:

Let's evaluate the characteristics of the local 'Karail' soils:

(a) These soils feature a high clay content ($> 40\%$) dominated by expanding lattice clay minerals like montmorillonite.

(b) This mineral mix causes the soil to swell significantly when wet and shrink when dry, forming deep, wide cracks that create a natural "self-ploughing" effect as surface soil falls into the openings.

(c) Under the USDA Soil Taxonomy, soils displaying these shrink-swell dynamics and high clay content belong to the order **Vertisols**.

Final Answer: Vertisols

Answer: (B)

Go Back to Question 11

Q12.

Solution

Concept:

The Universal Soil Loss Equation (USLE) models soil erosion rates based on environmental and management factors:

$$A = R \times K \times LS \times C \times P$$

Solution:

Let's analyze which factor is altered by conservation tillage and residue management:

(a) The rainfall erosivity (R), soil erodibility (K), and slope dimensions (LS) are fixed physical characteristics of the local landscape.

(b) The support practice factor (P) represents structural erosion controls like terracing or contouring.

(c) Retaining a 50% crop residue cover directly shields the soil surface from raindrop impact and alters the vegetative management layer, causing a sharp decrease in the **crop management factor** (C).

Final Answer: The crop management factor (C)

Answer: (C)

Go Back to Question 12

Q13.

Solution

Concept:

Tillage operations conducted outside optimal soil moisture thresholds can cause mechanical compaction and structural damage, particularly in fine-textured clay soils.

Solution:

Let's look at the mechanical structural changes caused by tilling wet clay soils:

(a) When soil moisture exceeds the plastic limit, clay particles slide past one another easily under mechanical pressure rather than fracturing.

(b) Operating heavy machinery or plows under these wet conditions compresses the soil directly beneath the tillage depth.

(c) Over time, this pressure forms a compacted, smeary layer known as a **dense, impermeable subsurface hardpan or plow-sole**, which restricts root penetration and reduces water infiltration.

Final Answer: Formation of a dense, impermeable subsurface hardpan or plow-sole

Answer: (B)

Go Back to Question 13

Q14.

Solution

Concept:

Managing deep-rooted, perennial weeds like *Saccharum spontaneum* (Kans grass) requires specialized mechanical tillage to break apart and bring underground rhizomes to the surface.

Solution:

Let's evaluate the functions of different tillage implements:

(a) Cultivators and harrows perform shallow soil mixing and seedbed preparation but do not invert deeper soil layers.

(b) A **Mouldboard Plough (MB Plough)** is designed for primary deep tillage, providing complete soil inversion.

(c) The MB plough cuts deep into the soil profile, lifting, breaking, and **inverting the deep-seated rhizomes**. This leaves the vegetative structures exposed on the surface to dry out and die under solar radiation.

Final Answer: Mouldboard Plough (MB Plough)

Answer: (C)

Go Back to Question 14

Q15.

Solution

Concept:

Wind erosion moves soil particles through three distinct physical mechanisms—suspension, saltation, and surface creep—depending on wind speed and particle aerodynamic diameter.

Solution:

Let's classify particle movement across different size ranges:

(a) Very fine particles (< 0.1 mm) are lifted into the air and remain suspended in atmospheric currents over long distances (Suspension).

(b) Larger, heavy soil grains (> 0.5 mm) stay close to the ground and roll along the surface (Surface Creep).

(c) Intermediate-sized fine sand grains (0.1 **to** 0.5 **mm**) move through **Saltation**. Wind lift forces cause these grains to rise briefly before bouncing along the soil surface, detaching other particles upon impact.

Final Answer: Saltation (0.1 to 0.5 mm)

Answer: (B)

Go Back to Question 15

Q16.

Solution

Concept:

Reclaiming saline-alkali (*Usar*) soils requires displacing exchangeable sodium (Na^+) ions from clay surfaces and substituting them with divalent calcium (Ca^{2+}) ions to improve soil structure and lower pH.

Solution:

Let's evaluate chemical amendments for sodium displacement:

(a) Calcium carbonate ($CaCO_3$) is highly insoluble at alkaline pH levels (> 8.5) and is ineffective in these soils.

(b) **Gypsum ($CaSO_4 \cdot 2H_2O$)** provides a soluble source of calcium that exchanges with sodium on the clay surfaces:

$$2\text{Na-Clay} + CaSO_4 \rightleftharpoons \text{Ca-Clay} + Na_2SO_4$$

(c) The displaced sodium forms soluble sodium sulfate (Na_2SO_4), which must be **removed from the root zone via heavy flushing and leaching** to complete reclamation.

Final Answer: Application of Gypsum ($CaSO_4 \cdot 2H_2O$) followed by heavy flushing/leaching

Answer: (B)

Go Back to Question 16

Q17.

Solution

Concept:

The Net Irrigation Requirement (NIR) calculates the depth of irrigation water needed to meet crop water demands after accounting for natural water inputs like rainfall and shallow groundwater.

Solution:

Let's analyze the components of the water balance equation:

$$NIR = WR - (ER + GW)$$

(a) WR represents the total water required for evapotranspiration and metabolic processes, while ER represents the effective rainfall captured within the root zone.

(b) The variable **GW** accounts for the **groundwater contribution from a shallow water table**.

(c) In fields with high water tables, water moves upward into the root zone via **capillary rise**, acting as an additional water source that reduces the net depth of irrigation water required.

Final Answer: Groundwater contribution from a shallow water table via capillary rise

Answer: (B)

Go Back to Question 17

Q18.

Solution

Concept:

Selecting an irrigation method depends on soil texture, field topography, and water conservation priorities. Surface methods like check basins often lead to high percolation losses on coarse-textured, unlevelled soils.

Solution:

Let's match the system capabilities to sandy loam soils with irregular topography:

(a) Sandy loam soils have high infiltration rates, making gravity-fed surface irrigation inefficient due to uneven distribution and deep percolation.

(b) An **Overhead Sprinkler Irrigation System** applies water under pressure as a fine spray above the crop canopy, mimicking natural rainfall.

(c) This pressurized delivery ensures **uniform water distribution** across uneven terrains without requiring expensive land-leveling operations, while controlled application rates help minimize deep percolation losses.

Final Answer: Overhead Sprinkler Irrigation System

Answer: (B)

Go Back to Question 18

Q19.

Solution

Concept:

Prolonged waterlogging in canal-command areas can cause secondary soil salinization as dissolved salts move upward via capillary action and accumulate on the surface as water evaporates.

Solution:

Let's analyze engineered solutions for lowering the water table:

(a) Surface ditches can help manage surface runoff but are less effective at lowering deep, high water tables uniformly across large fields.

(b) An optimized solution uses a network of **corrugated perforated plastic tile drains** installed horizontally at a calculated depth and spacing below the water table.

(c) This subsurface drainage network intercepts rising groundwater and channels excess water away, lowering the water table below the root zone and allowing irrigation water to leach salts out of the soil profile.

Final Answer: Corrugated perforated plastic tile drains installed horizontally at a calculated depth and spacing

Answer: (A)

Go Back to Question 19

Q20.

Solution

Concept:

Water Use Efficiency (WUE) measures economic yield produced per unit of water lost through evapotranspiration. Variations in WUE among crops under identical conditions are often driven by differences in photosynthetic pathways and leaf anatomy.

Solution:

Let's compare the efficiency of different photosynthetic pathways:

(a) Crop X achieves a high WUE (18 kg/mm), which is characteristic of plants utilizing the **C_4 photosynthetic pathway**.

(b) C_4 plants feature a specialized **Kranz anatomy** that physically separates initial carbon fixation from the Calvin cycle, concentrating carbon dioxide around Rubisco enzymes.

(c) This carbon-concentrating mechanism allows C_4 plants to maintain high photosynthetic rates even with partially closed stomata, reducing water loss through transpiration and resulting in a higher WUE than C_3 plants under semi-arid conditions.

Final Answer: Crop X uses the C_4 photosynthetic pathway with a highly efficient Kranz anatomy

Answer: (B)

Go Back to Question 20

Q21.

Solution

Concept:

The climatological approach schedules irrigation based on the ratio between the depth of irrigation water applied (IW) and the cumulative pan evaporation (CPE) recorded since the previous irrigation event.

Solution:

Let's calculate the required irrigation depth step-by-step:

(a) State the standard scheduling ratio formula:

$$\frac{\text{IW}}{\text{CPE}} = \text{Target Ratio}$$

(b) Identify the given values: Target Ratio = 0.9 and CPE = 60 mm.

(c) Rearrange the formula to solve for the depth of irrigation water (IW):

$$\text{IW} = \text{Target Ratio} \times \text{CPE}$$

$$\text{IW} = 0.9 \times 60 \text{ mm} = 54 \text{ mm}$$

Final Answer: 54 mm

Answer: (B)

Go Back to Question 21

Q22.

Solution

Concept:

Repeated use of a single class of herbicides can exert high selection pressure on weed populations, leading to the development of herbicide resistance through target-site mutations or enhanced metabolic detoxification.

Solution:

Let's identify the resistance mechanism evolved by *Phalaris minor* against isoproturon:

(a) Isoproturon is a substituted phenylurea herbicide that blocks electron transport in photosystem II.

(b) Multi-resistant biotypes of *Phalaris minor* in rice-wheat cropping systems have developed non-target-site resistance through **enhanced metabolic degradation**.

(c) This detoxification is driven by elevated levels of **Cytochrome P450 monooxygenase enzymes**, which rapidly break down the herbicide molecule into non-toxic forms before it can reach its target site in the chloroplasts.

Final Answer: Enhanced degradation mediated by elevated Cytochrome P450 monooxygenase activity

Answer: (A)

Go Back to Question 22

Q23.

Solution

Concept:

Pendimethalin is a selective dinitroaniline herbicide applied pre-emergence to control annual grasses and select broadleaf weeds by disrupting early seedling growth during germination.

Solution:

Let's trace the cellular mode of action of pendimethalin:

(a) When a weed seed germinates, it absorbs the herbicide through its emerging radicle and coleoptile tissues.

(b) At the cellular level, pendimethalin binds to α-tubulin molecules, **inhibiting microtubule assembly**.

(c) This block prevents the formation of spindle fibers needed for chromosome separation, **halting mitotic cell division** within the root and shoot meristems. This stops elongation and causes the growth points of germinating seedlings to swell and fail.

Final Answer: Disruption of microtubule assembly, halting mitotic cell division in meristems

Answer: (B)

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Q24.

Solution

Concept:

Antitranspirants are chemical compounds applied to plant foliage to limit water loss through transpiration, helping conserve soil moisture reserves during dry spells.

Solution:

Let's categorize the modes of action of different antitranspirant compounds:

(a) Materials like silicone oils create a physical film over the leaf surface, while kaolin clay forms a reflective coating.

(b) Chemical compounds such as **Phenylmercuric Acetate (PMA)** and low concentrations of atrazine function as **stomatal-closing types**.

(c) These compounds alter guard cell physiology, inducing **partial or complete stomatal closure** to increase resistance to water vapor loss while minimizing disruptions to internal metabolism.

Final Answer: Stomatal-closing types that induce partial or complete stomatal closure

Answer: (B)

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Q25.

Solution

Concept:

Biological weed control utilizes host-specific natural enemies, such as insects or pathogens, to suppress noxious weed populations without damaging surrounding crops or native vegetation.

Solution:

Let's identify the bio-agent introduced to control *Parthenium hysterophorus*:

(a) *Neochetina bruchi* is a weevil used to control water hyacinth, while *Dactylopius tomentosus* is a cochineal insect used against invasive cacti.

(b) ***Zygogramma bicolorata*** (commonly known as the Mexican beetle) is a leaf-eating chrysomelid beetle introduced specifically to manage **Parthenium**.

(c) Both the larvae and adults of this beetle feed heavily on *Parthenium* foliage and terminal buds, defoliating the plant and reducing its seed production.

Final Answer: *Zygogramma bicolorata*

Answer: (B)

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Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	A	2	C	3	B	4	A	5	C
6	B	7	B	8	B	9	B	10	B
11	B	12	C	13	B	14	C	15	B
16	B	17	B	18	B	19	A	20	B
21	B	22	A	23	B	24	B	25	B