UPCATET Agronomy Sample Paper-3

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 precision agronomist is assessing the physiological maturity of *Sorghum bicolor* under terminal drought conditions. Which of the following micro-structural indicators on the seed provides the most definitive evidence of absolute physiological maturity, marking the cessation of dry matter accumulation into the grain?

(A) Disappearance of the green stylar tip

(B) Formation of a black/dark layer in the hilar region

(C) Hard dough stage with 35% moisture content

(D) Disappearance of the coleorhiza sheath

Q2. The critical nutrient base requirement for structural integrity in sugarcane (*Saccharum officinarum*) cultivation involves managing the "luxury consumption" of potassium (K^+). When optimizing the cane quality for maximum commercial cane sugar (CCS) percentage, excessive K^+ application directly antagonizes the uptake of which pair of essential divalent cations?

(A) Ca^{2+} and Mg^{2+}

(B) Fe^{2+} and Zn^{2+}

(C) Mn^{2+} and Cu^{2+}

(D) NH_4^+ and Na^+

Q3. Consider the unique lodging resistance mechanisms in deepwater rice ecosystems of Uttar Pradesh. The rapid internodal elongation of these cultivars is biochemically triggered by the entrapment of which specific endogenous gaseous plant hormone under submerged conditions?

(A) Abscisic acid (ABA)

(B) Methyl jasmonate

(C) Ethylene

(D) Gibberellic acid (GA_3)

Q4. Analyze the structural matrix layout of the standard systemic plant canopy below, which represents the dynamic nitrogen (N) reallocation gradients during the reproductive transition phase of an indeterminate pulse crop (*Cajanus cajan*):

Upper Canopy Layer High N Flux $\rightarrow$ Rapid Pod Filling Sink
$\uparrow$ Vascular Xylem/Phloem Translocation Pathway
Lower Senescing Layer Proteolytic Breakdown $\rightarrow$ High Remobilization Zone

Identify the primary chemical form in which this nitrogen is remobilized through the phloem from the lower senescing vegetative source pools to the upper developing seed sinks:

(A) Free NO_3^- ions

(B) Reduced NH_4^+ ions

(C) Amides and Amino Acids

(D) Nucleic Acid polymers

Q5. A detailed pedological survey of the Indo-Gangetic plains of Eastern Uttar Pradesh reveals a highly localized, sodium-saturated soil profile classified as an *Natrustalf* (Usar soil). To initiate chemical reclamation, an agronomist calculates the Gypsum Requirement (GR). The fundamental ion-exchange reaction relies on replacing exchangeable Na^+ with Ca^{2+}. What is the direct byproduct that must be leached out safely from the root zone post-amendment?

(A) Na_2SO_4

(B) NaCl

(C) NaOH

(D) Na_2CO_3

Q6. During a critical mechanical stress analysis of dynamic tillage configurations in a typical heavy clay *Karail* soil (Vertisols) of Bundelkhand, UP, the soil moisture threshold plays a defining role. Under what precise physical state does a mouldboard plough induce the highest degree of soil structural pulverization with minimum draft requirement?

(A) Solid state

(B) Semi-solid state

(C) Plastic state

(D) Friable state

Q7. The mathematical derivation of Universal Soil Loss Equation (USLE) models water erosion via $A = R \times K \times L \times S \times C \times P$. If an agronomist transitions a sloppy landscape from continuous up-and-down cultivation to a strict contour strip-cropping system of pulses and cereals, which specific parameter of the USLE equation is altered directly?

(A) K factor

(B) R factor

(C) P factor

(D) C factor

Q8. Review the conceptual phase diagram representing the mechanical responses of structured soils under heavy tractor traffic loads:

[Applied Wheel Load]	$\longrightarrow$	**[Compacted Pan Formation]**
$\downarrow$		$\downarrow$
Macroporosity Destruction		Hydraulic Conductivity (K_{sat}) Drops

Which component of soil bulk density (D_b) and total porosity (S_t) values matches this compaction phenomenon over a long-term commercial tillage cycle?

(A) D_b decreases, S_t increases

(B) D_b increases, S_t decreases

(C) Both D_b and S_t increase

(D) Both D_b and S_t decrease

Q9. An advanced irrigation network computes the Crop Water Requirement (ET_c) using the Penman-Monteith equation. If the reference crop evapotranspiration (ET_0) is 6.5 mm/day and the crop coefficient (K_c) for wheat at the critical crown root initiation (CRI) stage is 1.15, what is the exact net depth of irrigation required for an operational interval of 10 days, assuming effective rainfall (P_e) is completely zero?

(A) 56.5 mm

(B) 74.75 mm

(C) 7.47 mm

(D) 65.0 mm

Q10. The thermodynamic status of soil water is governed by the total soil water potential (ψ_t). In an unsaturated saline alluvial soil profile of Central Uttar Pradesh, which two components of ψ_t dominate the total energy status, effectively restricting water uptake by the roots of a non-halophytic crop?

(A) Matric (ψ_m) and Osmotic (ψ_o) potentials

(B) Gravitational (ψ_g) and Matric (ψ_m) potentials

(C) Pressure (ψ_p) and Gravitational (ψ_g) potentials

(D) Hydrostatic (ψ_h) and Matric (ψ_m) potentials

Q11. In a highly subsurface-waterlogged saline patch, a tile drainage system is laid down. According to the Hooghoudt's equation for steady-state drainage design, the spacing between parallel subsurface tile drains (S) varies directly as the square root of which soil hydrodynamic property?

(A) Saturated hydraulic conductivity (K)

(B) Infiltration rate (I)

(C) Porosity fraction (ϕ)

(D) Air-entry value (ψ_a)

Q12. Consider the thermodynamic system layout below tracking the dynamic path of water potential changes along the Soil-Plant-Atmosphere Continuum (SPAC):

Soil Matrix	→	Root Xylem	→	Mesophyll Leaf	→	Atmosphere
$\psi_{\text{soil}} = -0.3$		$\psi_{\text{root}} = -0.6$		$\psi_{\text{leaf}} = -1.5$		$\psi_{\text{atm}} = \mathbf{X}$

Values are given in megapascals (MPa). To maintain continuous, non-disrupted upward water movement via the cohesion-tension theory, what is the most scientifically sound value for **X** under standard daylight field conditions?

(A) -0.1 MPa

(B) 0.0 MPa

(C) -95.0 MPa

(D) $+1.2$ MPa

Q13. The biochemical mechanism of the herbicide *Glyphosate* revolves around the competitive inhibition of the enzyme 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS). This disruption completely shuts down the synthesis of which group of vital plant compounds?

(A) Long-chain fatty acids

(B) Aromatic amino acids

(C) Branched-chain amino acids

(D) Porphyrin ring structures

Q14. A major constraint in dryland farming sectors of Bundelkhand is severe atmospheric drought coupled with high transpirational loss. To induce stomatal closure artificially without harming the metabolic framework of the crop, which physiological anti-transpirant compound should be applied at low concentrations?

(A) Kaolin clay formulation

(B) Celite powder

(C) Phenylmercuric acetate (PMA)

(D) Liquid paraffin emulsion

Q15. The physiological phenomenon of "weed-crop competition" is most fierce during the Critical Period of Weed Control (CPWC). For direct-seeded puddle rice (DSR) compared to conventional transplanted rice (TPR), the CPWC window behaves in which manner?

(A) Delays significantly to late growth phases

(B) Narrows down to just 5 days post-sowing

(C) Advances earlier and extends for a longer duration

(D) Remains identical across both establishment methods

Q16. Observe the biochemical metabolic pathway configuration for herbicide detoxification within tolerant plant families:

[Active Herbicide Molecule]	$\xrightarrow{\text{Enzyme } \mathbf{Y}}$	**[Hydrophilic Inactive Conjugate]**

Which specific enzyme family (**Y**) is primarily responsible for the rapid degradation and structural detoxification of Atrazine in tolerant maize crops via glutathione conjugation?

(A) Acetolactate Synthase (ALS)

(B) Glutathione S-Transferase (GST)

(C) Acetyl-CoA Carboxylase (ACCase)

(D) Protoporphyrinogen Oxidase (PPO)

Q17. While formulating a contingency crop plan for a late-onset monsoon scenario in the semi-arid zones of Western Uttar Pradesh, an agronomist shifts from long-duration pearl millet to short-duration grain legumes. This practice leverages which specific drought adaptation strategy?

(A) Drought Avoidance via desiccation tolerance

(B) Drought Escape via developmental plasticity

(C) Drought Resistance via high osmotic adjustment

(D) Drought Endurance via structural sclerophylly

Q18. The classical paradigm of "Allopathy vs Allelopathy" is critical in weed dynamics. Infestations of *Parthenium hysterophorus* in crop fields release highly toxic sesquiterpene lactones. What is the primary molecular target site of these allelochemicals that directly suppresses neighboring crop seed germination?

(A) Disruption of gibberellin-induced α-amylase synthesis

(B) Inhibition of mitochondrial ATP synthase complexes

(C) Acceleration of cuticular wax dissolution

(D) Blocking of phloem loading mechanisms

Q19. When evaluating the thermal unit requirement for wheat varieties in Northern India, the Growing Degree Days (GDD) equation is formulated as $\sum\left[\frac{T_{max}+T_{min}}{2} - T_{base}\right]$. If the base temperature (T_{base}) for wheat is 4.0°C, and on a given day the maximum and minimum temperatures are recorded as 28.0°C and 12.0°C respectively, what is the daily thermal heat unit contribution?

(A) 16.0

(B) 20.0

(C) 24.0

(D) 12.0

Q20. Review the nitrogen transformation profile map across soil zones:

Oxidized Surface Layer	$\longrightarrow$	Ammonium conversion to Nitrate (NO_3^-)
Sub-surface Reduced Layer	$\longrightarrow$	Nitrate conversion to Nitrogen Gas (N_2, N_2O)

To minimize nitrogen losses through the sub-surface pathway shown above in a low-land rice ecosystem, deep placement of urea briquettes must target which specific structural micro-zone?

(A) Oxidized surface zone exclusively

(B) Sub-surface reduced zone exclusively

(C) Boundary interface film layer

(D) Water-sediment floating layer

Q21. The physiological phenomenon of "luxury consumption" of potassium by structural crops is often accompanied by an increase in crop resistance against biotic stress factors. Mechanistically, how does an optimized tissue concentration of potassium (K^+) decrease insect-pest susceptibility?

(A) It thickens the outer silicated epidermal layer

(B) It decreases the synthesis of low-molecular-weight soluble N compounds

(C) It functions as a direct neurotoxin to sucking pests

(D) It decreases the cellular osmotic potential, freezing the insect stylet

Q22. An experimental field trial analyzes the Land Equivalent Ratio (LER) of a sugarcane + mustard intercropping system. If the sole crop yields of sugarcane and mustard are 80 t/ha and 2.0 t/ha respectively, while their respective intercrop yields are 64 t/ha and 0.8 t/ha, calculate the LER value and state its biological significance.

(A) $LER = 1.0$; No biological advantage

(B) $LER = 1.2$; Biological yield advantage of 20%

(C) $LER = 0.8$; Yield disadvantage of 20%

(D) $LER = 1.4$; Biological yield advantage of 40%

Q23. Under conservation agriculture frameworks, "stale seedbed technique" is highly recommended. What is the fundamental operational principle of this weed management practice before the main crop is sown?

(A) Applying high-dose pre-emergence residual herbicides to sterile fields

(B) Inciting weed seed germination with light irrigation followed by chemical/mechanical destruction

(C) Solarizing the soil with clear plastic sheets for 6 weeks to destroy weed seeds

(D) Deep inversion tillage to bury weed seeds below the active sprouting depth

Q24. Examine the diagram detailing the chemical transformation of nitrogen stabilizers added to agricultural fertilizers:

Urea Matrix	$\xrightarrow{\text{Inhibitor Zone } \mathbf{Z}}$	**Delayed Ammonium Production**

Which specific commercial chemical agent represents inhibitor category **Z** to slow down the hydrolysis of urea, thereby avoiding rapid volatilization losses in high-pH calcareous soils?

(A) Dicyandiamide (DCD)

(B) N-(n-butyl) thiophosphoric triamide (NBPT)

(C) Nitrapyrin

(D) 2-chloro-6-(trichloromethyl)pyridine

Q25. In dryland agro-ecosystems, the term "Moisture Availability Index" (MAI) proposed by Hargreaves is defined as the ratio of dependable precipitation at a specific probability level to which environmental parameter?

(A) Actual Evapotranspiration (AET)

(B) Potential Evapotranspiration (PET)

(C) Open Pan Evaporation (E_p)

(D) Soil Moisture Storage Capacity (S_c)

Detailed Solutions

Q1.

Solution

Concept: Physiological maturity in grain crops represents the stage where maximum dry matter accumulation in the seed is achieved. Once reached, the physical connection (vascular attachment) between the maternal plant and the developing embryo breaks down, halting any further translocation of photosynthates.

Solution:

Let's evaluate the structural indicators of maturity in sorghum:

(a) The formation of a **black/dark layer** (often termed the hylum or placental black layer) in the hilar region at the base of the sorghum grain is the definitive anatomical marker.

(b) This discoloration indicates the tissue cellular collapse and suberization of the vascular connection supplying sugars to the endosperm.

(c) While grain moisture content decreases and dough stages progress, they are highly dependent on atmospheric humidity and weather fluctuations. The formation of the black layer remains the only immutable structural proof of absolute physiological maturity.

Final Answer: $\boxed{\text{Formation of a black/dark layer in the hilar region}}$

$\boxed{\textbf{Answer: (B)}}$

Go Back to Question 1

Q2.

Solution

Concept: Nutrient uptake by plant root systems is governed by selective carrier proteins, electrochemical gradients, and ionic competition. Cation antagonism occurs when an excess concentration of one ion suppresses the transport and cellular absorption of other similar ions.

Solution:

Let's look at the specific competitive interactions of monovalent potassium (K^+):

(a) Plants frequently exhibit **luxury consumption** of potassium, absorbing levels far beyond their structural needs.

(b) Because K^+ ions are highly mobile and have a high affinity for common cellular transport pathways, an excess of K^+ strongly inhibits the uptake of major **divalent cations**.

(c) The specific target pair of this chemical antagonism consists of calcium (Ca^{2+}) and magnesium (Mg^{2+}). Suppressing these elements disrupts cell wall stability and chlorophyll assembly, lowering the commercial cane sugar (CCS) percentage.

Final Answer: $\boxed{Ca^{2+} \text{ and } Mg^{2+}}$

$\boxed{\textbf{Answer: (A)}}$

Go Back to Question 2

Q3.

Solution

Concept: Submergence-tolerant and deepwater rice cultivars alter their vegetative morphology when floodwaters rise. This survival strategy is managed by gas exchange physics and internal hormonal pathways.

Solution:

Let's analyze the biochemical signaling sequence during flooding:

(a) When water covers the plant, the diffusion rate of gases into the surrounding environment drops by roughly 10,000-fold.

(b) This physical barrier traps **ethylene**, a gaseous plant hormone continuously produced by internal tissues, inside the submerged aerenchyma cells.

(c) The localized buildup of ethylene acts as the primary signal that activates downstream gene networks (such as the *SNORKEL* genes in deepwater types), driving rapid cellular elongation of the upper stem internodes to keep the leaves above water.

Final Answer: $\boxed{\text{Ethylene}}$

$\boxed{\textbf{Answer: (C)}}$

Go Back to Question 3

Q4.

Solution

Concept: During the reproductive phase of pulse crops like pigeonpea, senescing lower vegetative leaves serve as nutrient source pools. In these leaves, functional proteins (especially Rubisco) are broken down by proteolytic enzymes to support seed growth.

Solution:

Let's look at how nitrogen is reallocated through the vascular pathways:

(a) Free inorganic nitrogen forms like nitrate (NO_3^-) and ammonium (NH_4^+) are typically reduced or assimilated within root or leaf tissues, as free ammonium is toxic.

(b) The breakdown products of proteins are converted into stable organic transport compounds.

(c) These compounds are reallocated through the phloem primarily as **amides** (such as asparagine and glutamine) and **amino acids**. This organic nitrogen flows directly toward the rapidly developing pods to build storage proteins.

Final Answer: $\boxed{\text{Amides and Amino Acids}}$

$\boxed{\textbf{Answer: (C)}}$

Go Back to Question 4

Q5.

Solution

Concept: Sodic soils (*Natrustalfs*) are characterized by high amounts of exchangeable sodium (Na^+) on clay surfaces, which damages soil structure and raises pH. Chemical reclamation requires replacing this exchangeable sodium with calcium (Ca^{2+}) ions.

Solution:

Let's review the chemical exchange reaction using gypsum ($CaSO_4 \cdot 2H_2O$):

(a) When gypsum is mixed into wet sodic soil, it releases soluble calcium ions into the soil solution:

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

(b) The calcium ions displace the exchangeable sodium from the clay surface, binding the clay particles together.

(c) The displaced sodium reacts with the remaining sulfate to form **sodium sulfate** (Na_2SO_4). This highly soluble byproduct must be leached out of the root zone via irrigation to complete the reclamation process.

Final Answer: $\boxed{Na_2SO_4}$

$\boxed{\textbf{Answer: (A)}}$

Go Back to Question 5

Q6.

Solution

Concept: Soil consistency states change across a moisture gradient, altering the mechanical behavior of heavy clay soils (such as *Karail* or Vertisols) when subjected to tillage implements.

Solution:

Let's look at how tillage properties map across soil moisture states:

(a) In solid or semi-solid states, the soil is dry and hard, requiring high draft power and breaking into large clods.

(b) In the plastic state, the soil is wet and sticky, causing it to smear and puddle rather than shatter.

(c) The ideal condition occurs within the **friable state**, where the soil crumbles easily under mechanical stress. Tilling at this moisture level yields optimal soil pulverization, forming a balanced seedbed with minimal draft resistance on the plough.

Final Answer: $\boxed{\text{Friable state}}$

Answer: (D)

Go Back to Question 6

Q7.

Solution

Concept: The Universal Soil Loss Equation (USLE) predicts annual soil loss (A) based on rainfall, soil, topography, and management factors:

$$A = R \times K \times L \times S \times C \times P$$

Solution:

Let's evaluate the impact of shifting to a contour strip-cropping system:

(a) The rainfall erosivity (R), soil erodibility (K), and slope dimensions ($L \times S$) are fixed physical characteristics of the landscape.

(b) The crop management factor (C) accounts for the type of vegetative cover.

(c) **Contour strip-cropping** is an engineered erosion control practice. It works by establishing physical barriers along the natural contour lines of a slope to slow down runoff water, which alters the **Support Practice Factor (**P**)** in the equation.

Final Answer: $\boxed{P \text{ factor}}$

Answer: (C)

Go Back to Question 7

Q8.

Solution

Concept: Heavy machinery traffic applies compressive mechanical forces to the soil profile. This stress rearranges soil particles and alters the internal pore space arrangement.

Solution:

Let's analyze the structural changes associated with soil compaction:

(a) Compaction squeezes soil particles closer together, which destroys larger structural macropores and reduces the **total porosity** (S_t).

(b) Because the same mass of dry soil now occupies a smaller total volume, the dry **bulk density** (D_b) increases.

(c) This combined shift—an increase in D_b and a decrease in S_t—creates a dense plow pan layer that restricts root growth and reduces saturated hydraulic conductivity (K_{sat}).

Final Answer: $\boxed{D_b \text{ increases, } S_t \text{ decreases}}$

Answer: (B)

Go Back to Question 8

Q9.

Solution

Concept: The net depth of irrigation required (d_n) represents the total water depth consumed by crop evapotranspiration (ET_c) over a given operational interval, minus any water supplied by effective rainfall (P_e).

Solution:

Let's calculate the values step-by-step:

(a) First, determine the daily crop evapotranspiration rate (ET_c):

$$\mathrm{ET}_c = \mathrm{ET}_0 \times K_c = 6.5 \text{ mm/day} \times 1.15 = 7.475 \text{ mm/day}$$

(b) Next, calculate the total crop water requirement over the 10-day operational interval:

$$\text{Total ET}_c = 7.475 \text{ mm/day} \times 10 \text{ days} = 74.75 \text{ mm}$$

(c) Since effective rainfall (P_e) is zero, the net irrigation depth required matches the total evapotranspiration depth:

$$d_n = \text{Total ET}_c - \mathrm{P}_e = 74.75 \text{ mm} - 0 = 74.75 \text{ mm}$$

Final Answer: $\boxed{74.75 \text{ mm}}$

Answer: (B)

Go Back to Question 9

Q10.

Solution

Concept: The total soil water potential (ψ_t) dictates the energy status of water and its availability to plants. In unsaturated, saline soils, water movement and availability are restricted by distinct chemical and physical forces.

Solution:

Let's break down the primary potentials active in this environment:

(a) In an **unsaturated** soil profile, water is held tightly within small pores and on particle surfaces by capillary and adsorptive forces, creating a significant negative **Matric Potential** (ψ_m).

(b) In a **saline** soil profile, high concentrations of dissolved salts lower the free energy of water, creating a negative **Osmotic Potential** (ψ_o).

(c) Together, these two components lower the total water potential ($\psi_t = \psi_m + \psi_o + \dots$), increasing the energy roots must exert to extract water and inducing physiological drought in non-halophytic crops.

Final Answer: $\boxed{\text{Matric } (\psi_m) \text{ and Osmotic } (\psi_o) \text{ potentials}}$

$\boxed{\textbf{Answer: (A)}}$

Go Back to Question 10

Q11.

Solution

Concept: Subsurface drainage design relies on steady-state flow equations to determine optimal drain spacing (S). Hooghoudt's equation describes the relationship between drain spacing, soil properties, and water table height.

Solution:

Let's examine the mathematical form of Hooghoudt's equation:

(a) The standard steady-state spacing equation is written as:

$$S^2 = \frac{8K_1dD + 4K_2D^2}{q}$$

(b) Solving directly for the spacing parameter (S) gives:

$$S = \sqrt{\frac{8K_1dD + 4K_2D^2}{q}}$$

(c) This demonstrates that the drain spacing (S) varies directly with the square root of the soil's **saturated hydraulic conductivity** (K). Soils with higher hydraulic conductivity allow water to move more freely, permitting wider spacing between parallel drainage tiles.

Final Answer: $\boxed{\text{Saturated hydraulic conductivity (K)}}$

$\boxed{\textbf{Answer: (A)}}$

Go Back to Question 11

Q12.

Solution

Concept: Water movement through the Soil-Plant-Atmosphere Continuum (SPAC) is driven by a continuous, decreasing gradient of water potential (ψ). According to the cohesion-tension theory, water moves spontaneously from areas of higher (less negative) potential to areas of lower (more negative) potential.

Solution:

Let's analyze the water potential gradient across the system:

(a) The given values establish a clear downward path: $\psi_{\text{soil}} = -0.3$ MPa $\rightarrow$ $\psi_{\text{root}} = -0.6$ MPa $\rightarrow$ $\psi_{\text{leaf}} = -1.5$ MPa.

(b) For water to transpire out of the leaf mesophyll cells and into the surrounding air, the atmospheric water potential (**X**) must be significantly lower (more negative) than the leaf potential.

(c) Under typical daylight field conditions, relative atmospheric humidity is less than 100%, dropping the atmospheric potential to very low levels, such as -95.0 **MPa**. This steep gradient drives the transpiration stream across the plant.

Final Answer: $\boxed{-95.0 \text{ MPa}}$

Answer: (C)

Go Back to Question 12

Q13.

Solution

Concept: Glyphosate is a broad-spectrum systemic herbicide that targets the shikimic acid metabolic pathway, which is unique to plants, bacteria, and fungi.

Solution:

Let's look at the biochemical consequences of inhibiting the EPSPS enzyme:

(a) The enzyme 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS) catalyzes an essential step in the shikimate pathway.

(b) Blocking this enzyme halts the synthesis of chorismate, a key precursor needed to produce **aromatic amino acids** (phenylalanine, tyrosine, and tryptophan).

(c) Shutting down the production of these amino acids prevents protein synthesis and cell division, leading to the gradual death of the treated plant.

Final Answer: $\boxed{\text{Aromatic amino acids}}$

Answer: (B)

Go Back to Question 13

Q14.

Solution

Concept: Antitranspirants are chemicals applied to crop foliage to reduce water loss through transpiration, helping conserve soil moisture under dryland or drought conditions.

Solution:

Let's classify the different types of antitranspirants:

(a) Materials like Kaolin and Celite form a reflective coating on leaves, while liquid paraffin creates a physical film over the surface.

(b) **Phenylmercuric acetate (PMA)** acts as a **stomatal-closing** antitranspirant.

(c) When applied at low, non-toxic concentrations, PMA triggers partial closure of the guard cells. This increases resistance to water vapor diffusion out of the leaf, reducing transpiration losses while minimizing disruptions to carbon dioxide uptake.

Final Answer: $\boxed{\text{Phenylmercuric acetate (PMA)}}$

$\boxed{\textbf{Answer: (C)}}$

Go Back to Question 14

Q15.

Solution

Concept: The Critical Period of Weed Control (CPWC) is the window during a crop's growth cycle when weed competition causes the greatest yield loss. If weeds are managed during this period, the crop can typically tolerate later flushes without significant losses.

Solution:

Let's compare weed dynamics between direct-seeded and transplanted rice:

(a) In conventional Transplanted Rice (TPR), older seedlings are planted into standing water, giving them a structural advantage over emerging weeds.

(b) In Direct-Seeded Rice (DSR), rice seeds and weed seeds germinate simultaneously in unflooded soil, eliminating this early size advantage.

(c) Because direct-seeded seedlings grow slowly at first and face immediate competition from fast-growing weeds, the CPWC window **advances earlier and extends for a longer duration** compared to transplanted systems.

Final Answer: $\boxed{\text{Advances earlier and extends for a longer duration}}$

$\boxed{\textbf{Answer: (C)}}$

Go Back to Question 15

Q16.

Solution

Concept: Selectivity in modern herbicides often depends on the crop's ability to metabolize and detoxify the active chemical before it can damage vital cellular pathways.

Solution:

Let's review the detoxification pathway for atrazine in maize:

(a) Maize crops are naturally tolerant to triazine herbicides like atrazine due to high levels of specific protective enzymes.

(b) The enzyme family responsible for this detoxification is **Glutathione S-Transferase (GST)**.

(c) GST catalyzes the conjugation of the active atrazine molecule with reduced glutathione (GSH), converting it into a hydrophilic, non-toxic compound that is safely stored away in the vacuole.

Final Answer: Glutathione S-Transferase (GST)

Answer: (B)

Go Back to Question 16

Q17.

Solution

Concept: Plants use different evolutionary adaptations to survive drought conditions, categorized into drought escape, drought avoidance, and drought tolerance.

Solution:

Let's evaluate the agronomical strategy of shifting to short-duration crops:

(a) Shifting from a long-duration crop to a short-duration legume helps manage late-onset monsoons by compressing the vegetative and reproductive phases.

(b) This approach utilizes **Drought Escape**.

(c) Rather than relying on physical adaptations to endure dry soil, the short-duration crop completes its lifecycle quickly using available seasonal moisture, ensuring grain maturity before severe terminal drought sets in.

Final Answer: Drought Escape via developmental plasticity

Answer: (B)

Go Back to Question 17

Q18.

Solution

Concept: Allelopathy involves the release of secondary metabolites (allelochemicals) by one plant that suppress the growth, development, or germination of neighboring plants.

Solution:

Let's analyze how *Parthenium hysterophorus* toxins affect seed germination:

(a) *Parthenium* releases sesquiterpene lactones (such as parthenin) into the surrounding soil matrix.

(b) During seed germination, the embryo secretes gibberellins to trigger the synthesis of α**-amylase** in the aleurone layer, which breaks down stored starch into simple sugars to feed the growing seedling.

(c) These allelochemicals **disrupt gibberellin-induced α-amylase synthesis**. Without this enzyme, the seed cannot mobilize its energy reserves, halting germination and seedling establishment.

Final Answer: $\boxed{\text{Disruption of gibberellin-induced } \alpha\text{-amylase synthesis}}$

$\boxed{\textbf{Answer: (A)}}$

Go Back to Question 18

Q19.

Solution

Concept: Growing Degree Days (GDD) quantify the accumulation of thermal heat units required for crops to progress through their developmental stages.

Solution:

Let's calculate the daily thermal contribution using the provided formula:

(a) Use the standard GDD equation:

$$\text{GDD} = \left[\frac{T_{max} + T_{min}}{2}\right] - T_{base}$$

(b) Substitute the recorded values ($T_{max} = 28.0°\text{C}$, $T_{min} = 12.0°\text{C}$, and $T_{base} = 4.0°\text{C}$) into the formula:

$$\text{Average Temperature} = \frac{28.0 + 12.0}{2} = \frac{40.0}{2} = 20.0°\text{C}$$

(c) Subtract the base temperature to find the daily thermal heat unit contribution:

$$\text{GDD} = 20.0 - 4.0 = 16.0$$

Final Answer: $\boxed{16.0}$

$\boxed{\textbf{Answer: (A)}}$

Go Back to Question 19

Q20.

Solution

Concept: Lowland rice soils develop two distinct chemical zones: a thin, oxygenated surface layer and a deeper, oxygen-depleted (reduced) subsurface layer.

Solution:

Let's track nitrogen transformations across these soil layers:

(a) If urea is applied to the surface, it dissolves and nitrifies into nitrate (NO_3^-) within the thin oxidized zone.

(b) As water moves through the profile, this nitrate leaches down into the deeper **sub-surface reduced zone**. Here, denitrifying bacteria convert the nitrate into volatile nitrogen gases (N_2 and N_2O), leading to nitrogen loss.

(c) To minimize these denitrification losses, compressed urea briquettes are placed **deep into the sub-surface reduced zone**. In this oxygen-poor environment, nitrogen remains stable in its ammonium (NH_4^+) form, which binds to clay particles and stays accessible to rice roots.

Final Answer: $\boxed{\text{Sub-surface reduced zone exclusively}}$

$\boxed{\textbf{Answer: (B)}}$

Go Back to Question 20

Q21.

Solution

Concept: Potassium (K^+) functions as a key osmotic and metabolic regulator within plant cells. Maintaining optimal potassium levels helps reduce crop susceptibility to insect pests through physiological changes.

Solution:

Let's look at how potassium levels affect plant metabolism and pest resistance:

(a) When potassium is limited, plant protein synthesis slows down, causing an accumulation of **low-molecular-weight soluble nitrogen compounds** (like free amino acids and amides) in cell sap. These soluble compounds are primary food sources for chewing and sucking pests.

(b) Adequate potassium levels accelerate the conversion of these simple compounds into high-molecular-weight proteins.

(c) This **decreases the concentration of soluble nitrogen compounds** in the tissue, making the plant less nutritious for insects and reducing pest populations.

Final Answer: $\boxed{\text{It decreases the synthesis of low-molecular-weight soluble N compounds}}$

$\boxed{\textbf{Answer: (B)}}$

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Q22.

Solution

Concept: The Land Equivalent Ratio (LER) measures the relative land area required under sole cropping to produce the same yields achieved in an intercropping system.

Solution:

Let's calculate the value using the intercrop and sole crop yields:

(a) Use the standard LER formula:

$$\text{LER} = \frac{Y_{I,\text{cane}}}{Y_{S,\text{cane}}} + \frac{Y_{I,\text{mustard}}}{Y_{S,\text{mustard}}}$$

(b) Substitute the given values into the equation:

$$\text{LER} = \frac{64 \text{ t/ha}}{80 \text{ t/ha}} + \frac{0.8 \text{ t/ha}}{2.0 \text{ t/ha}}$$

$$\text{LER} = 0.8 + 0.4 = 1.2$$

(c) An LER = 1.2 indicates a **20% biological yield advantage** (LER − 1.0 = 0.2), meaning an intercrop area of 1.0 hectare produces as much as 1.2 hectares of sole crops grown separately.

Final Answer: $\boxed{\text{LER} = 1.2\text{; Biological yield advantage of 20\%}}$

Answer: (B)

Go Back to Question 22

Q23.

Solution

Concept: The stale seedbed technique is a cultural weed management practice used to reduce the weed seedbank in the top layer of soil before planting the main crop.

Solution:

Let's look at the operational steps of this technique:

(a) The field is prepared ahead of time and given a light irrigation or left to absorb early rainfall to **encourage weed seed germination** in the upper soil layer.

(b) Once the weed seedlings emerge and grow for a few days, they are destroyed using a non-residual, non-selective herbicide (like glyphosate) or light, shallow tillage.

(c) This process removes the active weed flush before the main crop is sown, allowing the crop seedlings to establish with less weed competition.

Final Answer: Inciting weed seed germination with light irrigation followed by chemical/mechanical destruction

Answer: (B)

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Q24.

Solution

Concept: When urea is applied to high-pH calcareous soils, it undergoes rapid hydrolysis catalyzed by the urease enzyme, converting into volatile ammonia gas (NH_3) which can lead to significant nitrogen losses.

Solution:

Let's evaluate the chemical inhibitors used to manage these losses:

(a) Dicyandiamide and Nitrapyrin are nitrification inhibitors that slow down the conversion of ammonium to nitrate.

(b) **N-(n-butyl) thiophosphoric triamide (NBPT)** is a structural **urease inhibitor**.

(c) NBPT binds to the active site of the urease enzyme, temporarily blocking its activity and slowing the hydrolysis of urea. This delays ammonium production and helps minimize ammonia volatilization losses.

Final Answer: $\boxed{\text{N-(n-butyl) thiophosphoric triamide (NBPT)}}$

Answer: (B)

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Q25.

Solution

Concept: The Moisture Availability Index (MAI) is a climatological metric used to assess water availability and risk in dryland farming systems.

Solution:

Let's review Hargreaves' formulation for MAI:

(a) The index compares dependable precipitation against the atmosphere's evaporative demand.

(b) MAI is calculated as the ratio of dependable precipitation (typically at the 75% probability level) to the **Potential Evapotranspiration (PET)** of the environment.

(c) An MAI value below 0.33 during a growth phase indicates severe water deficit, helping agronomists select suitable crop varieties for dryland conditions.

Final Answer: $\boxed{\text{Potential Evapotranspiration (PET)}}$

Answer: (B)

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Answer Key

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