UPCATET Agronomy Sample Paper-7

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. The dynamic process of soil formation in the semi-arid regions of Southwestern Uttar Pradesh, often characterized by the upward movement of soluble salts during the dry season, is primarily classified as which of the following?

(A) Podzolization

(B) Calcification

(C) Laterization

(D) Gleization

Q2. A farmer is cultivating a medium-duration pigeonpea (*Cajanus cajan*) variety under rainfed conditions in the Bundelkhand zone. Which of the following row spacing and optimum plant population combinations will maximize light interception and yield potential under normal sowing conditions?

(A) 45 cm × 10 cm with 2.2 lakh plants per hectare

(B) 60 cm × 20 cm with 83,333 plants per hectare

(C) 90 cm × 20 cm with 55,555 plants per hectare

(D) 30 cm × 10 cm with 3.3 lakh plants per hectare

Q3. For a heavy clay soil found in the lowland areas of eastern Uttar Pradesh, which of the following drainage systems is most effective for removing excess surface

water rapidly during a high-intensity monsoon event to prevent waterlogging in sugarcane?

(A) Deep tile drainage installed at 2 meters depth

(B) Perforated corrugated plastic pipes with gravel envelopes

(C) Open parallel surface ditches with shallow field drains

(D) Vertical drainage wells equipped with high-capacity pumps

Q4. An emulsifiable concentrate formulation of Pendimethalin is applied as a pre-emergence herbicide in direct-seeded rice. What is its primary biochemical mechanism of action that leads to susceptible weed mortality?

(A) Inhibition of acetolactate synthase (ALS) enzyme

(B) Inhibition of microtubule assembly during cell division

(C) Disruption of Photosystem II by binding to the Qb-binding niche

(D) Inhibition of protoporphyrinogen oxidase (PPO) pathway

Q5. The physiological phenomenon known as 'flushing' in late-sown wheat under western Uttar Pradesh conditions is heavily influenced by high thermal units during the reproductive phase. Which growth stage is most critically vulnerable to terminal heat stress, leading to a drastic reduction in test weight?

(A) Crown root initiation (CRI) stage

(B) Jointing stage

(C) Early milking to dough stage

(D) Tillering stage

Q6. In a sandy loam soil profile typical of the Indo-Gangetic plains, if the field capacity is 22% (on a dry weight basis) and the permanent wilting point is 10%, what is the depth of available water per meter depth of soil, assuming the bulk density of the soil is 1.5 g/cm^3?

(A) 120 mm

(B) 150 mm

(C) 180 mm

(D) 240 mm

Q7. Which type of tillage practice involves minimal disturbance to the soil surface, retains at least 30% crop residue cover on the soil surface to mitigate water erosion, and relies heavily on chemical weed control?

(A) Conservation tillage

(B) Clean tillage

(C) Intensive rotational tillage

(D) Blind tillage

Q8. Under the zero-tillage system for establishing wheat after rice harvesting in Western UP, which of the following weeds has emerged as a major, highly competitive problem due to the altered micro-environment and lack of soil inversion?

(A) *Phalaris minor*

(B) *Chenopodium album*

(C) *Convolvulus arvensis*

(D) *Rumex dentatus*

Q9. A progressive farmer wishes to irrigate a field of mustard crop during the critical physiological stage using the border strip method. If the inflow rate is increased while keeping the strip length and soil texture constant, how will it affect the water distribution uniformity along the strip?

(A) It will increase deep percolation losses at the upstream end.

(B) It will significantly decrease the advance time, improving downstream uniformity.

(C) It will cause severe water stagnation exclusively in the middle of the strip.

(D) It will decrease the application efficiency without changing advance velocity.

Q10. Which of the following processes represents the primary mechanism of mechanical water erosion on the sloping, unprotected fallow lands of the Vindhyan region in Mirzapur and Sonbhadra districts during early monsoon showers?

(A) Saltation induced by turbulent surface sheet flow

(B) Splash erosion caused by kinetic energy of falling raindrops breaking soil aggregates

(C) Scouring action of concentrated channel flow in deep gullies

(D) Soil liquefaction due to prolonged subsurface water pressure

Q11. Consider a field cropping system where groundnut (*Arachis hypogaea*) is grown. At which developmental stage does the crop require the most critical moisture availability, where a deficit causes the maximum percentage of unfertilized flowers or blind pods?

(A) Pegging and early pod development stage

(B) Early seedling emergence stage

(C) Main stem elongation and branching stage

(D) Physiological maturity and senescence stage

Q12. The physiological maximum water use efficiency (WUE) in dryland agriculture systems is achieved by adopting which of the following field management methodologies?

(A) Frequent shallow inter-cultivation to encourage high evaporation rates

(B) Application of antitranspirants like kaolin (reflectant type) to reduce transpiration losses

(C) Heavy application of nitrogenous fertilizers at the late vegetative phase

(D) Deep flooding during early morning hours to saturate the root zone

Q13. When evaluating the performance of a high-yielding variety of sugarcane (*Saccharum officinarum*) in Rohilkhand zone, what is the optimum planting time for the 'Autumn crop' and its associated seed rate requirement compared to the spring crop?

(A) February–March; lower seed rate

(B) October–November; higher seed rate

(C) September–October; lower seed rate

(D) June–July; identical seed rate

Q14. A field soil sample collected from a topsoil layer in the Central Alluvial Plain of Uttar Pradesh has a wet weight of 210 g, a dry weight of 175 g, and a total volume of 130 cm^3. What is the dry bulk density of this soil?

(A) 1.15 g/cm^3

(B) 1.35 g/cm^3

(C) 1.52 g/cm^3

(D) 1.61 g/cm^3

Q15. Which of the following irrigation scheduling techniques uses an instrument placed directly inside the active root zone to measure the soil moisture tension, and at what tension (in bars) should irrigation ideally be triggered for a potato crop grown in sandy loam soils?

(A) Tensiometer; 0.25 to 0.35 bar

(B) Infrared thermometer; 0.85 to 1.0 bar

(C) Neutron moisture probe; 1.5 to 2.0 bars

(D) Piezometer; 0.0 to 0.1 bar

Q16. What is the recommended scientific approach for calculating the precise fertilizer dose of Nitrogen, Phosphorus, and Potassium for target yields of hybrid maize in Uttar Pradesh?

(A) Blanket state recommendations based on geographical zones

(B) Soil Test Crop Response (STCR) equation-based targeted yield approach

(C) Visual deficiency symptom matrix analysis during the seedling phase

(D) Fixed ratio application tracking the organic carbon percentage blindly

Q17. The 'critical period of weed competition' in a long-duration crop like transplanted rainy-season lowland rice typically occurs within which of the following timeframes after transplanting?

(A) 0 to 10 days after transplanting

(B) 60 to 75 days after transplanting

(C) 15 to 45 days after transplanting

(D) 80 to 100 days after transplanting

Q18. The critical nutrient deficiency symptom known as 'Khaira' disease in rice, which is widely prevalent across the Tarai region of Uttar Pradesh, can be economically corrected by the foliar application or soil amendment of which chemical compound?

(A) Ferrous sulfate

(B) Borax

(C) Zinc sulfate

(D) Manganese chloride

Q19. Which specific implement is classified as a secondary tillage tool that is uniquely designed for breaking clods, pulverizing the soil, cutting weeds, and mixing organic manures simultaneously in a prepared seedbed?

(A) Disc plow

(B) Moldboard plow

(C) Disc harrow

(D) Subsoiler

Q20. For the management of a parched, crusted soil surface layer formed after a heavy downpour followed by intense sunshine in a pearl millet (*Pennisetum glaucum*) field, which agronomic practice is recommended to ensure proper seedling emergence?

(A) Deep moldboard plowing across the rows

(B) Blind cultivation with a spike-tooth harrow or rotary hoe

(C) Immediate heavy application of urea pellets

(D) High-volume herbicide spray of Paraquat

Q21. The irrigation method that is most scientifically suited for undulating topography with high wind velocity areas, where water scarcity is severe and the crop being grown is a high-density close-spaced crop like mustard or alfalfa, is:

(A) Furrow irrigation method

(B) Drip or trickle irrigation method

(C) Sprinkler irrigation method

(D) Check basin method

Q22. Under the classification of parasitic weeds, *Striga asiatica* (witchweed) behaves as which type of parasite, and which specific cash crop group in Uttar Pradesh does it heavily parasitize?

(A) Total stem parasite; Lucerne

(B) Partial root parasite; Sorghum and Sugarcane

(C) Total root parasite; Mustard

(D) Partial stem parasite; Mango

Q23. What is the optimum planting geometry, seed rate, and depth of sowing for timely sown dwarf wheat varieties under the agro-climatic conditions of the Indo-Gangetic Plains?

(A) 22.5 cm row spacing, 100 kg/ha, and 4–5 cm depth

(B) 15.0 cm row spacing, 150 kg/ha, and 8–10 cm depth

(C) 30.0 cm row spacing, 75 kg/ha, and 2–3 cm depth

(D) 25.0 cm row spacing, 125 kg/ha, and 6–7 cm depth

Q24. The scientific practice of 'nipping' or 'topping' in chickpea (*Cicer arietinum*) is performed primarily to accomplish which physiological modification in the architecture of the plant?

(A) To arrest the primary root growth to avoid wilt disease infection

(B) To remove apical dominance and promote prolific lateral branching and podding

(C) To reduce the transpiration rate under hyper-arid atmospheric conditions

(D) To induce early synchronous flowering by depleting nitrogen stores

Q25. When assessing the quality of irrigation water, a high Residual Sodium Carbonate (RSC) value poses a hazard. What is the critical upper limit of RSC (in meq/L) beyond which irrigation water is considered hazardous and unsafe for long-term agricultural use on normal soils?

(A) 2.50 meq/L

(B) 1.25 meq/L

(C) 0.50 meq/L

(D) 1.75 meq/L

Detailed Solutions

Q1.

Solution

Concept:

Soil formation in arid and semi-arid regions is heavily driven by climatic conditions where evaporation far exceeds precipitation. This moisture deficit leads to the upward capillary movement of water carrying dissolved salts from lower layers to the soil surface.

Solution:

(a) Calcification is the prominent soil-forming process in semi-arid and arid climates, including Southwestern Uttar Pradesh. The process is characterized by the accumulation of calcium carbonate and soluble salts in the surface and subsurface soil horizons.

(b) During dry spells, high evaporation rates draw water upward through capillary action. As this moisture evaporates at the surface, it leaves behind dissolved salts, leading to salinization and the formation of calcic horizons.

(c) In contrast, podzolization occurs in cool, humid climates under coniferous forests, leading to the leaching of iron and aluminum oxides.

(d) Laterization takes place in hot, humid tropical climates characterized by intense leaching of silica, leaving behind iron and aluminum oxides.

(e) Gleization is associated with waterlogged or poorly drained conditions, causing anaerobic reduction of iron and giving the soil a characteristic bluish-gray color.

Final Answer: Calcification.

Answer: (B)

Go Back to Question 1

Q2.

Solution

Concept:

Optimizing yield in rainfed pigeonpea requires balancing the spacing between plants to maximize solar radiation interception while managing intra-crop competition for finite soil moisture reserves in rainfed ecosystems like Bundelkhand.

Solution:

(a) Medium-duration pigeonpea varieties possess an architecture that requires sufficient row spacing to facilitate lateral branching and continuous reproductive node development.

(b) The optimum recommended layout for these varieties under standard rainfed conditions is a row-to-row distance of 60 cm and a plant-to-plant distance of 20 cm.

(c) Mathematically, the plant population can be derived by dividing the total area of one hectare by the individual area allocated per plant: Population $= 10,000\ \text{m}^2/(0.6\ \text{m} \times 0.2\ \text{m}) = 83,333$ plants/ha.

(d) Spacings like 90 cm $\times$ 20 cm lower the population unnecessarily to 55,555 plants, which fails to utilize resources optimally, while 45 cm $\times$ 10 cm creates extreme vegetative crowding that induces mutual shading and low harvest index.

(e) Maintaining 83,333 plants per hectare ensures an ideal leaf area index for peak photosynthesis while keeping canopy transpiration within sustainable limits for the Bundelkhand region.

Final Answer: 60 cm $\times$ 20 cm with 83,333 plants per hectare.

Answer: (B)

Go Back to Question 2

Q3.

Solution

Concept:

Heavy clay soils, such as the 'Karail' soils of Eastern Uttar Pradesh, exhibit low hydraulic conductivity and low infiltration rates. Managing waterlogging from intense monsoons requires mechanisms that remove standing surface water rapidly before anaerobic stress impairs crop roots.

Solution:

(a) Because clay particles pack tightly together, internal drainage is naturally constrained. Subsurface tile systems or corrugated plastic pipes require high soil hydraulic conductivity to function efficiently, making them economically and physically unviable for rapid drainage in heavy clays.

(b) Open parallel surface ditches integrated with shallow field drains create a direct, unimpeded physical pathway for excess runoff to escape gravity-driven ponding on the soil surface.

(c) Sugarcane can tolerate brief waterlogging, but severe surface ponding during peak vegetative phases restricts gas exchange, leading to root rot and chlorosis.

(d) Layouts featuring open surface networks capitalize on surface gradients to dispose of large water volumes before the root zone undergoes prolonged oxygen depletion.

(e) Vertical drainage wells are technically sophisticated solutions tailored mainly to lower localized water tables or alleviate artesian pressure rather than gathering heavy surface runoff quickly during monsoonal downpours.

Final Answer: Open parallel surface ditches with shallow field drains.

Answer: (C)

Go Back to Question 3

Q4.

Solution

Concept:

Pre-emergence dinitroaniline herbicides like Pendimethalin are applied to control annual grasses and certain broadleaved weeds. Understanding their biochemical mechanism clarifies how they halt weed growth before emergence.

Solution:

(a) Pendimethalin targets the structural components of plant cells, specifically binding to the protein tubulin within the weed seedlings.

(b) This chemical binding inhibits the polymerization of tubulin, which completely disrupts microtubule assembly during cell division (mitosis). Without functional microtubules, the spindle apparatus cannot form, halting chromosome movement and cell wall development.

(c) Consequently, emerging weed seedlings experience an arrest in cell division within their root and shoot meristems, leading to swollen, club-shaped roots and eventual mortality before they can break the soil surface.

(d) It does not target the acetolactate synthase (ALS) enzyme, which is the mechanism characteristic of sulfonylurea herbicides.

(e) It also does not interfere with Photosystem II electron transport (like triazines) or protoporphyrinogen oxidase (PPO) pathways (like diphenyl ethers), acting purely as a mechanical cell division inhibitor.

Final Answer: Inhibition of microtubule assembly during cell division.

Answer: (B)

Go Back to Question 4

Q5.

Solution

Concept:

Terminal heat stress is a major constraint for late-sown wheat in Western Uttar Pradesh. When temperatures spike abruptly in early spring, the plant's reproductive development accelerates rapidly, truncating critical growth phases.

Solution:

(a) The developmental window extending from early milking to the dough stage is dedicated to starch synthesis and translocation into the developing grain, known as the grain-filling period.

(b) High ambient temperatures during this reproductive phase induce premature leaf senescence and denature the enzymes responsible for converting sucrose into starch within the grain endosperm.

(c) This heat-induced inhibition drastically shortens the grain-filling duration, preventing the grain from filling to capacity, which results in shriveled grains and a severe reduction in test weight.

(d) Early vegetative stages like Crown Root Initiation (CRI) and tillering are highly vulnerable to moisture deficits, affecting canopy structure and tiller survival rather than direct seed weight.

(e) The jointing stage establishes plant height and spikelet number per spike, whereas terminal grain development determines the ultimate physical mass of the harvestable product.

Final Answer: Early milking to dough stage.

Answer: (C)

Go Back to Question 5

Q6.

Solution

Concept:

Available water capacity represents the volume of soil moisture held between field capacity (FC) and permanent wilting point (PWP). Calculating its equivalent depth requires factoring in the bulk density and total depth of the targeted soil profile.

Solution:

(a) First, determine the percentage of available water by computing the mathematical difference between the field capacity and the permanent wilting point: Available Water (%) = 22% − 10% = 12%.

(b) Next, utilize the standard agronomic formula to convert this mass percentage into an equivalent depth of water: Depth of water (d) = (FC − PWP)/100 × Bulk Density × Soil Depth.

(c) Substitute the given parameters into the equation, keeping the depth of the soil profile at 1 meter (which equals 1000 mm): Depth = (12/100) × 1.5 × 1000 mm.

(d) Simplifying the mathematical terms yields: Depth = 0.12 × 1.5 × 1000 = 180 mm.

(e) This indicates that for every 1-meter column of this sandy loam profile, the soil matrix can store up to 180 mm of plant-available moisture before experiencing moisture deficit stress.

Final Answer: 180 mm.

Answer: (C)

Go Back to Question 6

Q7.

Solution

Concept:

Conservation agriculture balances resource conservation with production requirements. Its primary engineering directive revolves around minimizing direct mechanical disruption of the topsoil while exploiting crop residues to create an erosion barrier.

Solution:

(a) Conservation tillage is explicitly defined by agricultural engineers as any tillage sequence that retains a minimum of 30

(b) This protective organic mulch absorbs the kinetic energy delivered by falling raindrops, dampens surface runoff velocity, and preserves structural aggregates against water-driven soil erosion.

(c) Because mechanical weed destruction is intentionally restricted to prevent soil disturbance, this management model relies extensively on selective and non-selective chemical herbicides to suppress weed flushes.

(d) Clean tillage represents the opposite approach, turning over the soil entirely to bury all residue and leave the field completely bare and exposed to weathering elements.

(e) Blind tillage describes shallow mechanical harrowing performed right over the crop rows after sowing but before seedling emergence, which does not prioritize structural residue retention.

Final Answer: Conservation tillage.

Answer: (A)

Go Back to Question 7

Q8.

Solution

Concept:

Adopting zero-tillage systems eliminates the conventional plow layer inversion, fundamentally altering the weed seed bank dynamics, soil temperature profile, and light availability at the soil surface interface.

Solution:

(a) In traditional wheat cultivation, intensive tillage buries the small seeds of *Phalaris minor* (little canary grass) deep into the soil column, where dark-induced dormancy or physical depth limits their germination capacity.

(b) Under zero-tillage, the soil remains undisturbed, allowing the previous season's dropped *Phalaris minor* seeds to remain concentrated in the top 0–2 cm layer, an ideal micro-environment for germination.

(c) This shallow positioning, combined with optimal moisture retention from the previous rice crop residue, triggers rapid, highly synchronous flushes of *Phalaris minor* that outcompete young wheat seedlings.

(d) Other broadleaved weeds like *Chenopodium album* and *Rumex dentatus* do increase, but they are easier to manage chemically and less aggressive than *Phalaris minor*, which mimics wheat morphologically.

(e) *Convolvulus arvensis* is a deep-rooted perennial whose dominance is less linked to shallow surface seed accumulation and more dependent on root stock survival.

Final Answer: *Phalaris minor*.

Answer: (A)

Go Back to Question 8

Q9.

Solution

Concept:

Surface irrigation methods rely on gravity to advance a sheet of water across a field. The uniformity of water distribution depends on the relationship between the water advance time and the tail-end recession characteristics.

Solution:

(a) When a farmer increases the inflow rate into a defined border strip, a larger volume of water moves quickly across the field surface, accelerating the front advance velocity.

(b) This increase in flow velocity significantly shortens the time required for water to travel from the upstream inlet to the downstream end of the border strip (the advance time).

(c) Reducing the advance time minimizes the difference in water intake opportunity time between the top and bottom sections of the field.

(d) Consequently, the soil at the downstream end receives water closer to the same duration as the upstream end, which drastically improves overall water distribution uniformity.

(e) Lower advance times reduce, rather than increase, deep percolation losses at the upstream end because water is not allowed to pond excessively at the inlet before reaching the end.

Final Answer: It will significantly decrease the advance time, improving downstream uniformity.

Answer: (B)

Go Back to Question 9

Q10.

Solution

Concept:

Soil erosion by water progresses through sequential mechanical phases. Dislodging soil particles from their consolidated matrix is the necessary prerequisite before detachment converts into down-slope transport.

Solution:

(a) Splash erosion serves as the initial, critical phase of water-driven soil degradation on unprotected sloping terrains, such as the Vindhyan region.

(b) Unprotected fallow fields lack a vegetative canopy to intercept rainfall, leaving the bare soil aggregates fully exposed to the direct impact of high-velocity monsoon raindrops.

(c) The kinetic energy delivered by these falling droplets breaks down soil aggregates, detaching individual soil particles and launching them into the air.

(d) These detached, loose particles clog the surrounding macro-pores, generating a surface crust that reduces infiltration rates and accelerates subsequent sheet and rill runoff.

(e) Saltation describes a specific method of particle transport restricted primarily to wind erosion or coarse bed-load movement in streams.

(f) Scouring actions in gullies represent advanced structural stages of erosion that occur later in the cycle, after large volumes of runoff have already consolidated into channels.

Final Answer: Splash erosion caused by kinetic energy of falling raindrops breaking soil aggregates.

Answer: (B)

Go Back to Question 10

Q11.

Solution

Concept:

Moisture stress at critical growth phases of groundnut directly determines reproductive success. Groundnut exhibits a unique geotropic growth habit where flower fertilization on the surface must be followed by subterranean elongation to form pods.

Solution:

(a) Following successful pollination, the base of the ovary elongates into a stalks-like structure called a peg. This peg must penetrate 2 to 5 cm deep into the soil profile to begin subterranean pod development.

(b) The pegging and early pod development stage represents the absolute peak moisture consumption window for the groundnut crop cycle.

(c) Severe soil moisture deficit during this phase hardens the surface crust, physically preventing the fragile, downward-growing pegs from penetrating the soil matrix successfully.

(d) Furthermore, drought conditions disrupt the calcium absorption required by the developing shell walls, which directly induces the formation of empty shells, known agronomically as blind pods or pop formation.

(e) While moisture stress during early vegetative phases reduces total canopy development, a deficit during pegging irreversibly suppresses the harvest index by directly limiting total harvestable sink capacity.

Final Answer: Pegging and early pod development stage.

Answer: (A)

Go Back to Question 11

Q12.

Solution

Concept:

Water use efficiency in dryland environments relies on minimizing non-productive water losses from the soil and crop canopy. Since transpiration accounts for the majority of moisture loss during peak sunshine hours, mitigating canopy water loss preserves soil moisture reserves.

Solution:

(a) Dryland farming systems operate under chronic, severe atmospheric water demands. To maximize the quantity of dry matter produced per unit of water consumed, agronomic interventions must restrict luxury transpiration.

(b) Applying reflectant-type antitranspirants, such as kaolin clay suspensions, forms a thin, white, non-toxic coating across the leaf surfaces.

(c) This reflective film increases the solar albedo of the crop canopy, reducing net radiation absorption and lowering internal leaf temperatures without completely closing the stomatal apertures.

(d) By lowering the leaf temperature, the water vapor pressure gradient between the leaf interior and the surrounding atmosphere drops, effectively minimizing non-productive transpiration losses.

(e) Frequent inter-cultivation practices actually destroy surface roots and expose moist subsoil layers to direct wind action, increasing cumulative soil evaporation rather than reducing it.

Final Answer: Application of antitranspirants like kaolin (reflectant type) to reduce transpiration losses.

Answer: (B)

Go Back to Question 12

Q13.

Solution

Concept:

Sugarcane planting windows in northern India are closely tied to thermal variations. Autumn planting allows the crop to establish a deep root network before winter dormancy, giving it a distinct physiological advantage over spring-sown crops.

Solution:

(a) In the Rohilkhand agro-climatic zone, autumn sugarcane is optimally planted during the September to October window. This timing allows the primary tillers to establish fully before low winter temperatures restrict germination.

(b) Because the autumn crop enjoys an extended vegetative timeframe of nearly 15 to 18 months, individual plants exhibit prolific tillering and develop high initial stalk populations naturally.

(c) This naturally robust tillering capacity reduces the total initial seed cane requirement, meaning a lower seed rate is needed compared to the short-duration spring crop.

(d) Spring planting, which takes place during February and March, faces a shorter overall growing season and lower natural tillering efficiency, requiring a higher initial seed rate to achieve the target stalk density.

(e) Selecting the autumn window optimizes light interception and vertical canopy development, resulting in significantly higher cane yields and improved sugar recovery percentages at harvest.

Final Answer: September–October; lower seed rate.

Answer: (C)

Go Back to Question 13

Q14.

Solution

Concept:

Dry bulk density is a foundational physical property of soils that describes the mass of solid mineral and organic particles per unit of total volume. It excludes the weight of soil water from the mass calculation while keeping the total pore volume intact.

Solution:

(a) To calculate the dry bulk density, the mass of the moisture within the sample must first be completely discounted, leaving only the oven-dry mass of the soil solids.

(b) The problem directly provides the oven-dry weight of the soil sample as 175 g, while the total volume occupied by the soil matrix is given as 130 cubic centimeters.

(c) Using the mathematical definition of dry bulk density: Bulk Density = Mass of Oven-Dry Soil/Total Volume of Soil Sample.

(d) Substituting the values into the formula yields: Bulk Density = $175\ g/130\ cm^3$ = $1.3461\ g/cm^3$.

(e) Rounding this value to two decimal places gives 1.35 grams per cubic centimeter, which represents a typical, healthy structural value for cultivated sandy loam topsoils in the Central Alluvial Plain.

Final Answer: $1.35\ g/cm^3$.

Answer: (B)

Go Back to Question 14

Q15.

Solution

Concept:

Precision irrigation scheduling uses direct physical measurements of soil matric potential to avoid visual crop stress. Potato crops have shallow, fibrous root architectures that are sensitive to even minor moisture deficits.

Solution:

(a) A tensiometer is an instrument consisting of a porous ceramic cup connected via a water-filled tube to a vacuum gauge, designed to measure the physical tension with which water is held by the soil matrix.

(b) For shallow-rooted, moisture-sensitive crops like potato grown in coarse-textured sandy loam soils, maintaining low soil moisture tension is necessary to prevent stomatal closure.

(c) Agronomic trials show that irrigation for potatoes should be triggered when the tensiometer reading reaches 0.25 to 0.35 bars of tension.

(d) Allowing the tension to rise toward 0.85 bars causes significant matric resistance, making it difficult for the shallow roots to extract moisture, which leads to reduced tuber elongation and malformed shapes.

(e) Instruments like infrared thermometers assess leaf canopy temperature rather than directly measuring matric tension within the active root zone.

Final Answer: Tensiometer; 0.25 to 0.35 bar.

Answer: (A)

Go Back to Question 15

Q16.

Solution

Concept:

Modern nutrient management avoids general, blanket recommendations by focusing on site-specific soil resource realities. It matches the native nutrient-supplying capacity of the soil with the nutritional demands of a specific target crop yield.

Solution:

(a) The Soil Test Crop Response (STCR) approach uses field-validated mathematical equations tailored for specific crops and soil types across Uttar Pradesh.

(b) This methodology relies on unique calibration constants: the nutrient requirement per quintal of grain, the percentage efficiency of the soil available nutrients, and the percentage efficiency of the added fertilizer inputs.

(c) By inputting specific field data from a standard soil test report, the STCR equations calculate the precise fertilizer dose needed to achieve a realistic, high-yielding target for hybrid maize.

(d) This prevents over-application of nitrogenous fertilizers, reducing environmental runoff risks while avoiding under-application of essential secondary or micronutrients.

(e) General blanket recommendations ignore individual field histories, while relying on visual deficiency symptoms is a reactive approach that only addresses nutrient shortages after structural physiological damage has occurred.

Final Answer: Soil Test Crop Response (STCR) equation-based targeted yield approach.

Answer: (B)

Go Back to Question 16

Q17.

Solution

Concept:

The critical period of weed competition is the specific growth window during which weed presence causes maximum interference with crop development, leading to irreversible yield reductions at harvest.

Solution:

(a) In transplanted lowland rice, the crop undergoes a brief transplanting shock followed by active tillering and canopy establishment phases.

(b) The critical period of weed competition is concentrated between 15 and 45 days after transplanting, matching the crop's maximum tillering stage.

(c) During this 30-day window, weed species rapidly deplete available nitrogen, phosphorus, and moisture from the muddy surface layer, which limits the formation of productive rice tillers.

(d) Weeds allowed to remain in the field past 45 days cause irreversible damage to the crop architecture, as the critical yield-forming nodes have already been determined.

(e) During the first 10 days after transplanting, weed biomass remains small, while after 60 days, the established rice canopy naturally suppresses new weed flushes through shading.

Final Answer: 15 to 45 days after transplanting.

Answer: (C)

Go Back to Question 17

Q18.

Solution

Concept:

Micronutrient deficiencies are common in the highly leached calcareous or coarse soils of the Tarai region. The high pH and low organic matter content in these soils reduce the bioavailability of critical metallic cations.

Solution:

(a) Khaira disease of rice is a physiological disorder caused by a severe deficiency of available zinc in the soil solution, commonly found across the Tarai belt of Uttar Pradesh.

(b) The visual symptoms include chlorotic lesions and a characteristic rusty-brown discoloration on the older leaves of young rice seedlings, along with severe stunting of root growth.

(c) This physiological disorder can be corrected by applying zinc sulfate ($ZnSO_4$) either as a soil amendment before transplanting or as a foliar spray combined with lime.

(d) Providing soluble zinc restores carbonic anhydrase enzyme activity and aids auxin synthesis, helping the stunted seedlings recover normal vegetative growth within 10 to 14 days.

(e) Correcting this deficiency with iron, boron, or manganese salts does not resolve the symptoms, as Khaira is caused specifically by a lack of zinc.

Final Answer: Zinc sulfate.

Answer: (C)

Go Back to Question 18

Q19.

Solution

Concept:

Tillage implements are categorized by their operational depth and structural purpose. Primary tools break and loosen compacted soil, while secondary tools focus on pulverizing clods and preparing a clean seedbed.

Solution:

(a) A disc harrow is an implement equipped with sets of rotating steel discs that cuts through rough clods left behind by primary plowing operations.

(b) It functions as a secondary tillage tool, designed to pulverize the soil, cut up and incorporate weeds, and mix organic manures or fertilizers into the upper seedbed layer.

(c) The cutting and shearing action of the discs creates a fine, level soil tilth that ensures optimal seed-to-soil contact after sowing.

(d) In contrast, moldboard plows and disc plows are heavy primary tillage tools used for deep soil inversion, breaking open compact fields, and burying dense surface vegetation.

(e) A subsoiler is a specialized deep-working tool used to break up dense hardpans below the normal plow layer without turning up the subsoil.

Final Answer: Disc harrow.

Answer: (C)

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Q20.

Solution

Concept:

Rain-induced soil crusting presents a physical barrier to emerging seedlings, especially for small-seeded crops like pearl millet. Breaking this crust is necessary to ensure uniform seedling emergence.

Solution:

(a) When a heavy downpour is followed by intense solar radiation, fine clay and silt particles on the bare soil surface settle into a hard, dense crust as they dry.

(b) Small-seeded crops like pearl millet (*Pennisetum glaucum*) lack the physical force needed to push through this hardened surface layer, which can lead to poor field stand establishment.

(c) Performing blind cultivation using a light spike-tooth harrow, tined harrow, or rotary hoe breaks up this thin surface crust without disturbing the underlying germinating seeds.

(d) This mechanical fracturing opens up the soil surface, allowing the young coleoptiles to emerge freely into the light.

(e) Deep primary plowing would uproot the buried seeds entirely, while applying nitrogen or herbicides does not address the physical compaction blocking seedling emergence.

Final Answer: Blind cultivation with a spike-tooth harrow or rotary hoe.

Answer: (B)

Go Back to Question 20

Q21.

Solution

Concept:

Selecting an appropriate irrigation methodology requires evaluating environmental and physical constraints. Undulating terrains make uniform surface gravity flow impossible without extensive land leveling, while high wind velocities disrupt open spatial water droplets.

Solution:

(a) Sprinkler irrigation pressurizes water through a network of pipes and releases it through small nozzles, creating a rainfall-like distribution over the landscape.

(b) This method adapts effectively to uneven, undulating topologies because it completely eliminates the dependency on gravity-driven overland flow channels.

(c) For close-spaced, high-density field crops like mustard or alfalfa, overhead sprinkler systems ensure uniform wetting of the entire canopy zone quite efficiently.

(d) However, in micro-climatic zones experiencing high wind velocities, the fine water droplets discharged from the nozzles are highly prone to drift, distorting the spray pattern.

(e) Under such combinations of undulating topography and severe water scarcity, drip or trickle systems remain localized to widely spaced row crops rather than dense fields, leaving sprinkler systems as the preferred method despite wind drift vulnerabilities.

Final Answer: Sprinkler irrigation method.

Answer: (C)

Go Back to Question 21

Q22.

Solution

Concept:

Parasitic weeds lack complete metabolic autonomy and must physiological attach to host plants to withdraw essential nutrients, organic solutes, or water through specialized root structures called haustoria.

Solution:

(a) *Striga asiatica*, commonly known as witchweed, contains minor amounts of chlorophyll but relies on its host for water and mineral nutrients, classifying it as a partial root parasite.

(b) The seeds of *Striga* germinate in response to chemical exudates released by the roots of specific graminaceous host plants within the soil matrix.

(c) Upon germination, the weed develops haustoria that penetrate the host root cortex, establishing a structural connection to the xylem vessels to divert resources.

(d) This parasitic relationship causes severe stunting, nutrient chlorosis, and dry-weight reduction in key cash and cereal crops like Sorghum, Pearl Millet, and Sugarcane across Uttar Pradesh.

(e) In contrast, total stem parasites like *Cuscuta* attack crops like lucerne, while total root parasites like *Orobanche* heavily target cruciferous oilseeds like mustard.

Final Answer: Partial root parasite; Sorghum and Sugarcane.

Answer: (B)

Go Back to Question 22

Q23.

Solution

Concept:

Sowing geometry and depth optimization for dwarf wheat varieties maximize early vegetative development, tillering capability, and uniform stand establishment while preventing mechanical lodging.

Solution:

(a) Dwarf wheat varieties exhibit a highly specific coleoptile length that limits their safe seedling emergence depth to between 4 and 5 cm below the soil surface.

(b) Sowing dwarf wheat deeper than 5 cm causes the coleoptile to untangle before reaching the soil surface, resulting in poor field stand establishment and weaker seedlings.

(c) Agronomic trials across the Indo-Gangetic Plains show that the optimum row spacing for timely sown irrigated wheat is 22.5 cm apart.

(d) This row spacing allows adequate solar radiation penetration into the lower canopy layers while leaving enough room for inter-cultivation and mechanical weed management.

(e) Combining this spacing with a standard seed rate of 100 kg/ha creates the ideal plant population density required to produce the maximum number of productive tillers per unit area.

Final Answer: 22.5 cm row spacing, 100 kg/ha, and 4–5 cm depth.

Answer: (A)

Go Back to Question 23

Q24.

Solution

Concept:

Plant canopy architecture can be modified through targeted pruning to redirect endogenous hormone flows, altering the balance between vegetative growth and reproductive yield components.

Solution:

(a) Chickpea plants exhibit a naturally high level of apical dominance driven by the continuous synthesis of auxins in the terminal buds of the primary stems.

(b) The agronomic practice of nipping or topping involves plucking or cutting off these terminal growing vegetative tips when the plant reaches a height of about 20 to 25 cm.

(c) Removing the primary apical meristem lowers localized auxin levels, which breaks the dormancy of the lateral buds located at lower nodes.

(d) This hormone redistribution promotes prolific lateral branching, resulting in a more compact, bushy plant architecture with a significantly higher number of flower-bearing nodes.

(e) This structural change directly increases the total number of pods per plant, improving the overall harvest index under both irrigated and rainfed conditions.

Final Answer: To remove apical dominance and promote prolific lateral branching and podding.

Answer: (B)

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Q25.

Solution

Concept:

Residual Sodium Carbonate (RSC) is an index used to evaluate the long-term structural hazards of irrigation water, measuring the tendency of carbonate and bicarbonate ions to precipitate solution calcium and magnesium.

Solution:

(a) Mathematically, Residual Sodium Carbonate is calculated using the milliequivalents per liter of carbonate and bicarbonate ions relative to alkaline earth metals: RSC = $(CO_3^{2-} + HCO_3^-) - (Ca^{2+} + Mg^{2+})$.

(b) When irrigation water with high RSC values is applied to soil, the excess carbonate ions react with dissolved calcium and magnesium, precipitating them out of the soil solution as insoluble carbonates.

(c) This chemical precipitation increases the relative proportion of sodium ions on the soil exchange complex, leading to clay dispersion and soil structural breakdown.

(d) Water with an RSC value below 1.25 meq/L is considered entirely safe, while values between 1.25 and 2.50 meq/L are marginal, requiring careful management.

(e) An RSC value exceeding 2.50 meq/L is classified as hazardous and unsafe for continuous irrigation, as it causes severe alkalinization and restricts root water uptake.

Final Answer: 2.50 meq/L.

Answer: (A)

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Answer Key

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