

STANDARD OPERATING PROCEDURES (SOPs)

Newly Introduced Practical

Course	Practical themes	Main instruments/equipment linked
AGRON-112	Farming systems, crop-based production, innovative models, agri-enterprises	Ridge planter, seed-cum-fertilizer drill, DSR drill, weather instruments
AGRON-113	Soil/nutrient management, organic extracts, IPDM, postharvest handling, on-farm inputs	Soil tensiometer, pH meter, shaker, refractometers, oven, freezer
HORT-112	Nursery media, seed sowing, rootstock, propagation, nutrition, seed treatment	pH meter, hot-air oven, microscopes, shaker, hot plate
PBG-121	Seed production, drying, processing, seed treatment, purity, moisture, germination, seed health	Hot-air oven, microscopes, sieve shaker, spectrophotometer, shaker, freezer, seed drills
HORT-121	Packaging, temperature effects, chilling/freezing injury, juices, value-added products, quality evaluation	Refractometers, baking oven, hot plate, freezer, shaker, pH meter, spectrophotometer
SOIL-122	Environmental sampling, water quality, agromet, rainfall/drought observations	pH meter, spectrophotometer, flame photometer, AWS, anemometer, sunshine recorder

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SOP 1. Multi-Crop Ridge Planter



Practical linkage:

1. Survey of farming systems and agricultural based livelihood enterprise.
2. Study of components of important farming based livelihood models/ systems in different agro-climatic zones.
3. Study of production and profitability of crop based, livestock based, processing based and integrated farming-based livelihood models.
4. Field visit of innovative farming system models.
5. Visit of Agri- based enterprises and their functional aspects for integration of production.
6. Indigenous Technical Knowledge (ITK) for seed, tillage, water, nutrient, insect-pest, disease and weed management.
7. Hands on training sessions on preparation of organic extracts and natural farming concoctions, compost preparation and seed treatment.
8. On farm input preparation methods and protocols.

Purpose: To demonstrate mechanized ridge planting and to evaluate field capacity, row arrangement and uniform seed placement for multiple crops.

Principle: Seed and/or planting material is metered and placed at a predetermined depth and spacing while the machine forms or works on ridges. Uniformity depends on metering, ground speed, depth setting and field condition.

Requirements

1. Multi-crop ridge planter with appropriate seed plates/meters
2. Suitable tractor/power source and hitch
3. Calibrated seed/planting material
4. Measuring tape, weighing balance, containers and field notebook
5. PPE: safety shoes, gloves and close-fitting clothing

Safety

1. Stop the tractor and isolate power before adjustments, clearing blockages or changing metering parts.
2. Never place hands near rotating shafts, chains, sprockets or seed meters while moving.
3. Keep bystanders away from the machine path.
4. Do not wear loose clothing near moving components.

Standard Operating Procedure

Inspect frame, hitch, wheels, seed boxes, metering units, chains, furrow openers and ridge-forming components.

Select the crop-specific metering arrangement and check that the seed size is compatible with the metering device.

Fill a small quantity of seed and perform a stationary calibration according to the manufacturer's procedure.

Measure the collected seed for a known number of wheel revolutions or simulated travel distance.

Adjust the metering setting until the target seed rate/spacing is achieved.

Set row spacing and planting depth; tighten all adjustment locks.

Make a short field trial at low speed. Stop and inspect seed placement and ridge formation.

Run the planter at the selected operating speed and record distance covered, time, seed used and number of rows.

At the end, stop the tractor, clean the seed boxes and meters, remove remaining seed and inspect for wear.

Observations / Record

1. Crop and variety
2. Seed rate target
3. Row spacing
4. Planting depth
5. Calibration setting
6. Travel distance
7. Operating time
8. Seed consumed
9. Observed plant-to-plant spacing
10. Ridge condition

Calculations / Interpretation

1. Field capacity (ha h^{-1}) = field area covered (ha) / effective operating time (h).
2. Seed rate (kg ha^{-1}) = seed used (kg) / area covered (ha).
3. Compare observed spacing with the target and calculate percentage deviation if required.

Precautions

1. Use clean, graded seed to reduce metering blockage.
2. Do not make calibration changes while the machine is moving.
3. Record the exact machine setting used for each crop.

After-use Care & Maintenance

1. Brush out seed boxes and meters after use.
2. Lubricate chains/bearings only as specified by the manufacturer.
3. Store under cover and report damaged openers or metering parts.

Basic Troubleshooting

Uneven seed spacing — Check metering mechanism, seed size, speed and blockage.

Excessive seed rate — Recalibrate and inspect the meter/drive ratio.

Poor ridge formation — Check soil moisture, implement depth and ridge-forming parts.

SOP 2. Seed-Cum-Fertilizer Drill



Practical linkage:

1. Survey of farming systems and agricultural based livelihood enterprise.
2. Study of components of important farming based livelihood models/ systems in different agro-climatic zones.
3. Study of production and profitability of crop based, livestock based, processing based and integrated farming-based livelihood models.
4. Field visit of innovative farming system models.
5. Visit of Agri- based enterprises and their functional aspects for integration of production.
6. Indigenous Technical Knowledge (ITK) for seed, tillage, water, nutrient, insect-pest, disease and weed management.
7. Hands on training sessions on preparation of organic extracts and natural farming concoctions, compost preparation and seed treatment.
8. On farm input preparation methods and protocols.

Purpose: To demonstrate simultaneous placement of seed and fertilizer at controlled rates and depth.

Principle: Separate metering mechanisms deliver seed and fertilizer through furrow openers; calibration relates wheel travel to material discharge.

Requirements

1. Drill, tractor/power source, crop seed, approved fertilizer for demonstration, weighing balance, measuring tape, collection trays/bags

Safety

1. Use PPE and avoid skin/eye contact with fertilizer.
2. Do not enter the drill path or touch metering parts during movement.
3. Switch off the tractor before clearing blockages.

Standard Operating Procedure

1. Inspect seed and fertilizer boxes, metering shafts, tubes, furrow openers and drive chains.
2. Clean the metering units and select the correct setting for the crop.
3. Collect discharge from each outlet during a known number of wheel revolutions or known simulated distance.
4. Weigh seed and fertilizer separately and calculate the corresponding rates.
5. Adjust the metering setting until the target rates are obtained.
6. Set row spacing and depth, attach the drill securely and conduct a short field test.
7. Inspect uniformity of seed and fertilizer placement and record the observations.
8. Empty and clean the boxes after the practical.

Observations / Record

1. Crop; target seed rate; target fertilizer rate; calibration distance/revolutions; seed discharge; fertilizer discharge; row spacing; depth.

Calculations / Interpretation

1. $\text{Rate (kg ha}^{-1}\text{)} = \text{material collected (kg)} \times 10,000 / \text{area represented by the calibration run (m}^2\text{)}.$
2. If the calibration is based on wheel circumference and number of revolutions, calculate travel distance first, then area using the effective drill width.

Precautions

1. Do not mix seed and fertilizer unless the crop, fertilizer and manufacturer's instructions specifically permit it.
2. Use only the fertilizer specified by the practical instructor.

After-use Care & Maintenance

1. Clean fertilizer residue promptly to minimize corrosion.
2. Lubricate moving parts as recommended.
3. Keep metering cups/rollers dry and protected.

Basic Troubleshooting

Blocked tube — Stop machine, isolate power and clear blockage with a suitable tool.

Unequal discharge — Check metering parts, tube blockage and drive-chain tension.

SOP 3. DSR (Direct Seeded Rice) Drill



Practical linkage:

1. Planning of seed production, requirements for different classes of seeds in field crops including unit area and seed rate.
2. Seed planting material production in cereal crops like Wheat, Oilseed Crops; Vegetable Crops Such As Tomato and Brinjal; and spice crops including garlic, Chilli, Fennel, Coriander etc.
3. General technique of varietal seed production in important agriculture crop Cereals crop: Wheat, Rice, Barley, Maize, sorghum and Bajra. Pulses: Green gram, chickpea, Lentil. Oilseeds- sesame, mustard. Vegetable crops- Tomato, Brinjal, Chillies and Okra.
4. Survey of farming systems and agricultural based livelihood enterprise.
5. Study of components of important farming based livelihood models/ systems in different agro-climatic zones.
6. Study of production and profitability of crop based, livestock based, processing based and integrated farming-based livelihood models.

Purpose: To demonstrate direct placement of rice seed in rows and to study calibration, row spacing and seed distribution.

Principle: Direct seeding meters rice seed into prepared soil without transplanting; uniformity depends on seed quality, meter setting, soil condition and travel speed.

Requirements

1. DSR drill, suitable rice seed, calibration container/bag, weighing balance, measuring tape, tractor/power source

Safety

1. Stop all moving parts before calibration or cleaning.
2. Use caution around tractor PTO/drive components.
3. Maintain safe distance from rotating parts.

Standard Operating Procedure

1. Inspect metering unit, seed tubes, furrow openers, depth control and drive system.
2. Prepare clean, appropriately graded seed as instructed.
3. Perform a stationary calibration for a known wheel travel/revolution count.
4. Measure seed discharge and calculate the seed rate.
5. Set row spacing and depth according to the practical crop plan.
6. Conduct a short trial and inspect row continuity, depth and seed distribution.
7. Record machine setting and field observations.
8. Clean seed paths and store the drill after use.

Observations / Record

1. Seed variety; seed rate; row spacing; depth; calibration setting; distance; seed consumed; uniformity of rows.

Calculations / Interpretation

1. Seed rate = seed used / area covered. Report in kg ha^{-1} .
2. For row-uniformity assessment, count missing or excessive placements over a defined length and report the percentage.

Precautions

1. Avoid operating in unsuitable soil moisture conditions.
2. Do not use damaged or heavily cracked seed if the practical requires uniform metering.

After-use Care & Maintenance

1. Remove all seed from hoppers.
2. Clean tubes and meters; inspect openers and drive parts.

Basic Troubleshooting

Missing seed — Check seed tube blockage, metering mechanism and seed quality.

Uneven depth — Check depth-control setting and field surface.

SOP 4. Cup Anemometer



Practical linkage:

1. Visit to Agro-met. Observatory, Introduction to AQI, computation of rainfall and drought indices.

Purpose: To measure wind speed for agrometeorological observations.

Principle: Wind rotates cups mounted on a rotor; the rotation rate is converted by the instrument into wind speed.

Requirements

1. Cup anemometer, display/data logger if provided, mounting support, field notebook

Safety

1. Install securely so the instrument cannot fall.
2. Keep away from electrical hazards and unstable structures.
3. Do not climb without approved access equipment.

Standard Operating Procedure

1. Inspect cups, rotor, sensor cable and display/data logger.
2. Install the sensor in an unobstructed location according to the observatory's standard mounting height.
3. Allow the instrument to stabilize and initialize.
4. Check displayed wind speed or recorded output.
5. Record wind speed at defined intervals and note date, time and weather condition.
6. If a data logger is used, verify timestamp and recording interval.
7. Remove or secure the instrument after the observation period if it is portable.

Observations / Record

1. Date/time; location; wind speed; averaging interval; weather condition; instrument status.

Calculations / Interpretation

1. If multiple observations are taken, calculate mean wind speed = sum of observations / number of observations.

Precautions

1. Do not obstruct the cups with hands, vegetation or nearby structures during observation.
2. Do not compare readings from different heights without noting the height.

After-use Care & Maintenance

1. Keep cups clean and check free rotation.
2. Inspect mounting and cables periodically.

Basic Troubleshooting

No reading — Check power, sensor cable, logger and rotor movement.

Fluctuating/unrealistic reading — Check obstruction, sensor damage and averaging settings.

SOP 5. Soil Tensiometer



Practical linkage:

1. Soil and nutrient management: Soil health and organic/natural practices, composting techniques, bio-fertilizers and organic amendments, green manures and cover crops; natural farming concoctions.
2. Indigenous Technical Knowledge (ITK) for seed, tillage, water, nutrient, insect-pest, disease and weed management.
3. Water quality analysis: pH, EC and TDS. Visit to areas affected by natural disaster.

Purpose: To demonstrate measurement of soil water tension and interpretation of soil moisture availability.

Principle: Soil water is drawn through a porous ceramic cup into the tensiometer until the internal pressure balances the soil water potential; the gauge indicates the resulting tension.

Requirements

1. Tensiometer with ceramic cup and gauge/sensor, clean/de-aired water, auger or installation tool, soil sample/field site

Safety

1. Handle the ceramic cup carefully.
2. Keep the instrument clean and avoid contamination of the reservoir.
3. Do not force the cup into hard soil.

Standard Operating Procedure

1. Inspect the ceramic cup, tube, seal and gauge.
2. Saturate the ceramic cup thoroughly and fill the instrument with clean water, removing trapped air as far as the instrument design permits.
3. Select the measurement depth and prepare a hole that gives close soil-to-cup contact.
4. Install the cup at the target depth without creating a large air gap.
5. Allow the reading to equilibrate with the soil.

6. Record the tension reading, depth, soil condition, crop, date and time.
7. After the practical, remove the tensiometer carefully, clean the cup and store it as recommended.

Observations / Record

1. Depth; crop; soil type; date/time; tension reading; irrigation/rainfall status; visual soil condition.

Calculations / Interpretation

1. Interpret the reading according to the crop/soil-specific reference range provided by the instructor.
Higher tension generally indicates drier soil, while a lower tension indicates wetter soil.

Precautions

1. Avoid air bubbles because they interfere with pressure transmission.
2. Ensure good soil contact around the ceramic cup.
1. Do not treat one reading as representative of an entire field; use appropriate sampling points.

After-use Care & Maintenance

1. Keep ceramic cups moist when required by the instrument design.
2. Inspect seals and refill/condition the instrument before reuse.

Basic Troubleshooting

Reading remains unchanged — Check cup-soil contact, trapped air and sensor/gauge function.

Very erratic reading — Check leakage, poor installation and damaged ceramic cup.

SOP 6. Hand Refractometer – 90° Brix



Practical linkage:

1. Quality evaluation of products -- physico-chemical and sensory.
2. Post-harvest management and marketing: post-harvest handling, value added products, marketing and certification, economics of organic horticulture.

Purpose: To estimate soluble solids (°Brix) in fruit/vegetable juice, syrup or other suitable liquid samples.

Principle: A refractometer measures the change in refraction of light caused by dissolved solids. The result is commonly expressed as °Brix for sucrose-equivalent solutions.

Requirements

1. 90° Brix hand refractometer, distilled water, soft tissue/lint-free cloth, dropper, filtered sample juice

Safety

1. Do not look directly into strong light sources through the optical system.
2. Handle the prism gently and avoid abrasive cleaning.
3. Use food-safe sample handling practices.

Standard Operating Procedure

1. Clean the prism with distilled water and a soft lint-free tissue.
2. Check zero using distilled water according to the instrument instructions; the reading should be at the instruments specified zero point.
3. Homogenize the sample and remove large particles or bubbles.
4. Place 1–2 drops or the quantity specified by the instrument manual on the prism.
5. Close the cover plate gently and allow the sample to spread across the prism.

6. Hold the refractometer toward the light and read the boundary on the Brix scale.
7. Record °Brix and sample temperature if relevant.
8. Clean the prism immediately with distilled water and dry gently.

Observations / Record

1. Sample; replicate number; °Brix; temperature; appearance; preparation method.

Calculations / Interpretation

1. For replicate readings, report the mean °Brix.
2. If a sample is diluted before testing, apply the appropriate dilution factor to the analytical result.

Precautions

1. The instrument's scale range is 0–90°Brix; do not use samples outside its range without appropriate dilution.
2. Temperature affects refractive index; use the instrument's ATC feature or temperature correction specified by the manufacturer.

After-use Care & Maintenance

1. Keep prism and cover plate scratch-free.
2. Store dry in its case.

Basic Troubleshooting

Cloudy boundary — Filter/clarify the sample and clean the prism.

Zero error — Clean prism and repeat zero check; inspect calibration condition.

SOP 7. Hand Refractometer – 60° Brix



Practical linkage:

1. Post-harvest management and marketing: post-harvest handling, value added products, marketing and certification, economics of organic horticulture.
2. Quality evaluation of products - Physico-chemical and sensory.

Purpose: To determine soluble solids of fruit and vegetable samples whose expected °Brix falls within the instrument's range.

Principle: Based on refractive index of the sample; the scale reports soluble solids in °Brix.

Requirements

1. 60° Brix hand refractometer, distilled water, dropper, lint-free tissue, sample juice

Safety

1. Use clean sample containers and avoid cross-contamination.
2. Do not scratch the prism.

Standard Operating Procedure

1. Clean and zero-check the prism with distilled water.
2. Prepare a representative, well-mixed sample.
3. Place the required amount on the prism and close the cover.
4. Read the scale against the light source.
5. Repeat for at least duplicate/triplicate measurements when teaching analytical variation.
6. Record the sample and mean value.
7. Wash and dry the prism.

Observations / Record

1. Sample; preparation; °Brix readings; mean; temperature; remarks.

Calculations / Interpretation

1. Mean °Brix = sum of replicate readings / number of replicates.

Precautions

1. Do not exceed the 0–60°Brix scale; dilute high-solids samples only when the method permits and record the dilution.

After-use Care & Maintenance

1. Clean after each sample and store protected from dust.

Basic Troubleshooting

Unclear interface — Use a cleaner sample and ensure full prism coverage.

Different readings between students — Standardize sample mixing, drop volume, temperature and reading position.

SOP 8. Automatic Weather Station (AWS)



Practical linkage:

1. Visit to Agro-met. Observatory, Introduction to AQI, computation of rainfall and drought indices.
2. Study of components of important farming based livelihood models/ systems in different agro-climatic zones.
3. Field visit of innovative farming system models.

Purpose: To demonstrate automated measurement and logging of meteorological variables.

Principle: Multiple sensors convert environmental conditions such as air temperature, humidity, rainfall, wind and radiation into electrical signals that are logged with time stamps.

Requirements

1. AWS with sensors, data logger/display, power supply, mounting structure and data retrieval interface if available

Safety

1. Do not touch exposed electrical connections during rain or while powered.
2. Use safe access procedures for elevated sensors.
3. Protect data logger and power system from moisture.

Standard Operating Procedure

1. Inspect sensors and mounting structure before starting.
2. Confirm date, time, location and sensor status.
3. Check that the rain gauge is level and unobstructed, the wind sensor is free to rotate and radiation/sunshine sensors are unobstructed.
4. Verify that temperature/humidity shields and other sensors are clean.
5. Check the recording interval and available memory.

6. Observe live readings and compare with expected weather conditions.
7. Download/export data using the approved interface when required.
8. Record any missing values, sensor errors or unusual readings.

Observations / Record

1. Date/time; temperature; relative humidity; rainfall; wind speed/direction; solar radiation/sunshine variable where available; battery/power status; data gaps.

Calculations / Interpretation

1. Daily rainfall is the sum of valid precipitation records for the day.
2. Daily mean of a variable = sum of valid observations / number of valid observations, when the variable and data interval justify an arithmetic mean.
3. Use the instrument's native units and metadata when processing data.

Precautions

1. Do not change sensor settings without authorization.
2. Do not clean or reposition a sensor while it is recording unless the activity is part of the practical.

After-use Care & Maintenance

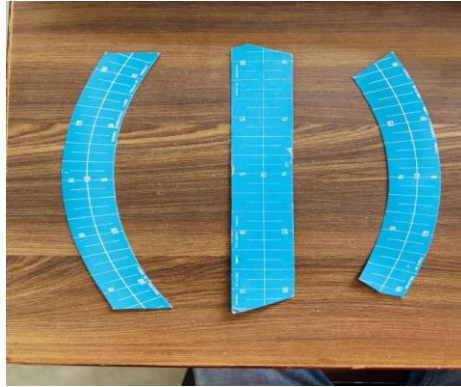
1. Keep sensors unobstructed and clean.
2. Check level, mounting, cables, battery/power and data memory periodically.

Basic Troubleshooting

Missing data — Check power, logger memory, clock, sensor cable and recording configuration.

Rainfall reading abnormal — Check gauge leveling, blockage and tipping mechanism where applicable.

SOP 9. Sunshine Recorder / Sunshine Recorder Charts



Practical linkage:

1. Visit to Agromet. Observatory, Introduction to AQI, computation of rainfall and drought indices.

Purpose: To demonstrate the recording of bright sunshine duration using a sunshine recorder chart and to interpret the daily trace.

Principle: The sun's rays are focused to create a trace/burn mark on a calibrated chart; the trace length corresponds to sunshine duration.

Requirements

1. Sunshine recorder/chart, appropriate chart strip, chart holder, compass/orientation reference, ruler and pencil

Safety

1. Do not stare at concentrated sunlight.
2. Handle glass/spherical components carefully.
3. Do not leave combustible materials close to a focused sunlight path.

Standard Operating Procedure

1. Install/orient the recorder according to the observatory standard for the instrument and latitude.
2. Select and date the appropriate chart.
3. Mount the chart correctly so the time scale aligns with local standard time as required.
4. Ensure the focusing surface is clean and unobstructed.
5. At the end of the observation period, remove the chart carefully.
6. Interpret the continuous or interrupted burn/trace against the time scale.
7. Measure the sunshine intervals with a ruler or the chart's calibrated scale.
8. Add the valid intervals to obtain daily bright sunshine duration.
9. File the chart with date, station and observer details.

Observations / Record

1. Date; chart type; sunrise/sunset context; sunshine intervals; total sunshine hours; weather remarks.

Calculations / Interpretation

1. Daily bright sunshine duration = sum of all valid sunshine intervals recorded on the chart.

Precautions

1. Use the correct chart type for the season/instrument.
2. Do not interpret cloudy gaps as missing data without noting the cause.
3. Follow the station's local time convention.

After-use Care & Maintenance

1. Clean focusing surface and chart holder.
2. Store unused charts dry and protected from moisture.

Basic Troubleshooting

No trace — Check orientation, focusing surface, chart position and sunlight obstruction.

Interrupted/weak trace — Check cloud cover, moisture, chart fit and instrument cleanliness.

SOP 10. UV-Visible Spectrophotometer



Practical linkage:

1. Water quality analysis: pH, EC and TDS. Visit to areas affected by natural disaster.
2. Physical purity test, moisture determination, germination test, seed viability test, Genetic Purity testing, three primary methods: the Grow-Out Test (GOT), a field-based method that assesses morphological traits to detect off-types and calculate genetic purity; Molecular Marker-Based Tests such as SSR, RAPD, and SNP and Biochemical Tests, including isoenzyme and protein profiling (e.g., SDS-PAGE).
3. Methods of examination of seeds to assess seed-borne microorganisms and to quantify infection percentage.
4. Detection and identification of seed-borne fungi, bacteria, and viruses. Identification of storage fungi and control of seed-borne diseases. Maintenance of aseptic conditions and sterilization techniques for seed health testing.
5. Quality evaluation of products - physico-chemical and sensory.

Purpose: To measure absorbance/transmittance of a sample at a selected wavelength for quantitative or comparative analysis.

Principle: The instrument measures the intensity of light absorbed by a sample at a selected wavelength. Quantification commonly uses a calibration curve relating absorbance to known standards.

Requirements

1. Spectrophotometer, suitable cuvettes, blank, standards, samples, pipettes and clean volumetric glassware

Safety

1. Wear lab coat, gloves and eye protection where reagents require them.
2. Handle cuvettes by the frosted/opaque sides where applicable.

3. Use only compatible solvents and cuvettes.

Standard Operating Procedure

1. Switch on the instrument and allow the required warm-up period.
2. Select the validated analytical method and wavelength specified by the laboratory protocol.
3. Prepare reagent blank, standards and samples.
4. Ensure cuvettes are clean, dry externally and free from bubbles.
5. Insert the blank and perform zero/blank correction.
6. Measure standards from low to high concentration and record absorbance.
7. Measure samples under identical conditions.
8. If the method uses a calibration curve, plot absorbance against concentration and determine sample concentration from the validated curve.
9. Clean cuvettes immediately after use and shut down according to the instrument manual.

Observations / Record

1. Wavelength; blank absorbance; standard concentrations; standard absorbances; sample absorbance; dilution factor; replicate readings.

Calculations / Interpretation

1. For a linear calibration, concentration is obtained from the calibration equation or graph. If the sample was diluted, $\text{original concentration} = \text{measured concentration} \times \text{dilution factor}$.
2. Use the method's acceptance criteria for blank and calibration-line quality.

Precautions

1. Do not use scratched or contaminated cuvettes.
2. Do not use a wavelength or reagent system merely because it is common for another analyte; follow the approved method.

After-use Care & Maintenance

1. Keep sample compartment clean and dry.
2. Protect optics from dust and moisture.
3. Perform calibration/verification at the laboratory's prescribed frequency.

Basic Troubleshooting

High blank — Check reagent blank, dirty cuvette and contamination.

Nonlinear standards — Check standard preparation, wavelength, reagent reaction time and instrument condition.

SOP 11. Double Distillation Unit



Practical linkage:

1. Soil and nutrient management: Soil health and organic/natural practices, composting techniques, bio-fertilizers and organic amendments, green manures and cover crops; natural farming concoctions.
2. On farm input preparation methods and protocols
3. Media for propagation of plants in nursery beds and pot.
4. Management practices in Horticulture nursery.
5. Physical purity test, moisture determination, germination test, seed viability test, Genetic Purity testing, three primary methods: the Grow-Out Test (GOT), a field-based method that assesses morphological traits to detect off-types and calculate genetic purity; Molecular Marker-Based Tests such as SSR, RAPD, and SNP and Biochemical Tests, including isoenzyme and protein profiling (e.g., SDS-PAGE).
6. Methods of examination of seeds to assess seed-borne microorganisms and to quantify infection percentage.
7. Detection and identification of seed-borne fungi, bacteria, and viruses. Identification of storage fungi and control of seed-borne diseases. Maintenance of aseptic conditions and sterilization techniques for seed health testing.
8. Water quality analysis: pH, EC and TDS. Visit to areas affected by natural disaster.

Purpose: To prepare distilled water of improved purity for laboratory reagents, rinsing and analytical work.

Principle: Water is boiled and condensed; repeated distillation reduces many dissolved and non-volatile impurities.

Requirements

1. Double distillation unit, feed water, receiving vessel, suitable electrical supply, cooling-water connection

Safety

1. Use heat-resistant gloves when handling hot components.
2. Never operate a boiler dry.
3. Check electrical connections and cooling-water flow before heating.
4. Allow the unit to cool before opening.

Standard Operating Procedure

1. Inspect the unit, seals, glassware/metal chamber and water connections.
2. Fill the feed reservoir to the prescribed level.
3. Start cooling water before applying heat if required by the instrument.
4. Switch on heating and monitor the distillation process.
5. Discard the initial portion if the laboratory protocol specifies this.
6. Collect distilled water in a clean, covered receiving vessel.
7. Continue until the required quantity is obtained.
8. Switch off heating, maintain cooling as recommended, then shut down the water supply after safe cooling.
9. Clean the unit and record date/volume.

Observations / Record

1. Feed water source; volume collected; date; operator; observations on conductivity/quality if tested.

Precautions

1. Do not touch hot surfaces.
2. Do not block vents or outlets.
3. Use only compatible receiving containers.

After-use Care & Maintenance

1. Descale the boiler according to the manufacturer's instructions.
2. Inspect seals and tubing for leakage.
3. Keep the receiving vessel clean and covered.

Basic Troubleshooting

Low output — Check feed level, heater, cooling flow and scaling.

Water contamination — Check cleanliness, carry-over, storage container and need to discard initial distillate.

SOP 12. Vacuum Pump



Practical linkage:

1. Operation and handling of mechanical drying equipment, effect of drying temperature and duration on seed germination and storability.
2. Study of various seed processing equipment and seed treating equipment. Seed treatment methods for improving seed quality. Seed priming techniques for enhancing seed performance.
3. Extraction and preservation of pulps and juices.
4. Preparation of jam, jelly, RTS, nectar, squash, osmotically dried products, fruit bar and candy and tomato products, canned products.
5. Quality evaluation of products -- physico-chemical and sensory.

Purpose: To generate reduced pressure for compatible laboratory operations such as filtration, drying or evacuation.

Principle: Removal of air from a closed system creates a pressure lower than atmospheric pressure, enabling suction or reduced-pressure processing.

Requirements

1. Vacuum pump, vacuum tubing, compatible flask/chamber, trap/filter if required, pressure gauge where provided

Safety

1. Never connect incompatible glassware.
2. Use a trap between the process vessel and pump when vapors/liquid carry-over is possible.
3. Do not block the pump inlet/outlet.
4. Avoid volatile, corrosive or reactive vapors unless the pump is specifically designed for them.

Standard Operating Procedure

1. Inspect tubing, fittings and vessel for cracks/leaks.
2. Connect the pump to the vacuum system using suitable tubing.
3. Ensure the receiving vessel and trap are correctly positioned.
4. Start the pump and gradually apply vacuum.
5. Monitor pressure and process condition.
6. Do not exceed the vessel or pumps rated vacuum.
7. After completion, release vacuum gradually before switching off or disconnecting.
8. Drain/clean the trap as required.

Observations / Record

1. Start/end time; vacuum indication; sample/process; observations; volume recovered.

Precautions

1. Release vacuum before opening any vessel.
2. Use only vacuum-rated glassware.

After-use Care & Maintenance

1. Check oil level/condition for oil-lubricated pumps if applicable.
2. Clean inlet filter/trap and inspect tubing regularly.

Basic Troubleshooting

Poor vacuum — Check leaks, tubing, fittings, trap and pump condition.

Pump overheating — Check operating duration, ventilation and load; stop if abnormal.

SOP 13. Digital Hot-Air Oven



Practical linkage:

1. Operation and handling of mechanical drying equipment, effect of drying temperature and duration on seed germination and storability.
2. Study of various seed processing equipment and seed treating equipment. Seed treatment methods for improving seed quality. Seed priming techniques for enhancing seed performance
3. Physical purity test, moisture determination, germination test, seed viability test, Genetic Purity testing, three primary methods: the Grow-Out Test (GOT), a field-based method that assesses morphological traits to detect off-types and calculate genetic purity; Molecular Marker-Based Tests such as SSR, RAPD, and SNP and Biochemical Tests, including isoenzyme and protein profiling (e.g., SDS-PAGE).
4. Seed treatments for breaking dormancy and inducing vigorous seedling growth.
5. Preparation of plant material for potting
6. Quality evaluation of products -- physico-chemical and sensory.

Purpose: To provide controlled hot-air drying for samples, equipment or validated analytical procedures.

Principle: Air is heated and circulated at a controlled temperature; heat transfers to the sample and removes moisture.

Requirements

1. Hot-air oven, sample containers, balance, thermometer/temperature display, heat-resistant gloves

Safety

1. Use heat-resistant gloves.
2. Do not place flammable materials in the oven.
3. Do not overload shelves or block air circulation.
4. Allow hot samples to cool safely before weighing.

Standard Operating Procedure

1. Check the oven chamber, shelves, fan and door seal.
2. Set the temperature and allow the oven to reach the required set point.
3. Prepare and label samples in suitable containers.
4. Place samples with adequate spacing for air circulation.
5. Start timing only when the method specifies the correct reference point, such as after the oven has reached the target temperature.
6. Dry for the prescribed time using the validated seed/material method.
7. Remove samples with heat-resistant gloves and cool in a suitable dry environment/desiccator if the method requires it.
8. Weigh cooled samples promptly and record data.
9. Switch off the oven after completion and allow it to cool before cleaning.

Observations / Record

1. Sample ID; initial mass; oven temperature; drying duration; final mass; replicate number; remarks.

Calculations / Interpretation

1. Moisture percentage = $(\text{initial mass} - \text{dry mass}) / \text{initial mass} \times 100$, when this formula is appropriate to the validated method.
2. Do not substitute a different temperature/time combination without an approved method.

Precautions

1. Exact drying temperature and duration must follow the applicable seed-testing or product-testing method.
2. Never weigh a hot sample if mass stability is required.

After-use Care & Maintenance

1. Clean chamber after cooling.
2. Check temperature verification/calibration as scheduled.
3. Keep ventilation openings clear.

Basic Troubleshooting

Temperature does not stabilize — Check door seal, load, sensor and heater/fan condition.

Uneven drying — Avoid overloading and ensure air circulation.

SOP 14. Trinocular Microscope



Practical linkage:

1. Methods of examination of seeds to assess seed-borne microorganisms and to quantify infection percentage.
2. Detection and identification of seed-borne fungi, bacteria, and viruses. Identification of storage fungi and control of seed-borne diseases. Maintenance of aseptic conditions and sterilization techniques for seed health testing.
3. Visit to a tissue culture laboratory.
4. Visit to Horticultural laboratory.
5. Integrated Pest and Disease Management (PDM).

Purpose: To observe and document microscopic structures of seeds, fungi, plant tissues and other practical specimens.

Principle: Visible structures are magnified by objective and eyepiece optics; the trinocular port permits image capture where a camera is attached.

Requirements

1. Trinocular microscope, slides, cover slips, prepared specimens, immersion oil only where the objective requires it, lens tissue

Safety

1. Use clean hands/gloves for biological specimens as appropriate.
2. Do not touch lenses with fingers.
3. Use immersion oil only with an oil-immersion objective.

Standard Operating Procedure

1. Place the microscope on a stable surface and connect illumination safely.
2. Clean optics with lens tissue.
3. Place the prepared slide on the stage and secure it.

4. Start with the lowest-power objective.
5. Use coarse focus only at low power and keep the objective from contacting the slide.
6. Move to higher power and use fine focus.
7. Adjust illumination, condenser and diaphragm for a clear image.
8. If a camera is connected, focus the specimen through the imaging path and capture labelled images.
9. After use, return to low power, remove the slide and clean any immersion oil.

Observations / Record

1. Specimen; magnification; structures observed; sketch/image; date; slide ID.

Precautions

1. Never use coarse focus at high power.
2. Do not force objective or stage controls.
3. Dispose of biological material according to laboratory procedure.

After-use Care & Maintenance

1. Cover the microscope after use.
2. Clean optics only with approved lens tissue/cleaner.
3. Keep stage dry and controls free from debris.

Basic Troubleshooting

Image blurred — Clean optics, adjust condenser/diaphragm and refocus.

Uneven illumination — Check lamp alignment/intensity and condenser position.

SOP 15. Flame Photometer



Practical linkage:

1. Water quality analysis: pH, EC and TDS. Visit to areas affected by natural disaster.
2. Soil and nutrient management: Soil health and organic/natural practices, composting techniques, bio-fertilizers and organic amendments, green manures and cover crops; natural farming concoctions.

Purpose: To estimate concentrations of selected alkali/alkaline-earth elements such as sodium or potassium using emission intensity.

Principle: When a sample is introduced into a flame, atoms emit characteristic light. Emission intensity is related to concentration over the validated working range.

Requirements

1. Flame photometer, standards, blank, samples, distilled water, aspirator tubing, fuel/air supply as applicable

Safety

1. Use only the fuel and pressures specified by the instrument.
2. Check for gas leaks before ignition.
3. Keep flammable materials away from the flame.
4. Wear eye and lab protection.

Standard Operating Procedure

1. Prepare a blank and a series of standards covering the expected sample range.
2. Start ventilation and gas/air supply according to the instrument manual.
3. Ignite the flame using the approved procedure.
4. Allow the instrument to stabilize.
5. Aspirate blank and set zero; then use the standard as required for calibration.
6. Run standards and establish the calibration relationship.

7. Aspirate samples and record readings.
8. Run a check standard during the batch to verify stability.
9. At the end, aspirate distilled water to clean the system, then shut down gas and instrument in the prescribed sequence.

Observations / Record

1. Element; standard concentration; standard reading; sample reading; dilution factor; check-standard result.

Calculations / Interpretation

1. Determine concentration from the calibration curve or validated instrument scale, then apply dilution factor.
2. Do not extrapolate beyond the validated calibration range without appropriate dilution/recalibration.

Precautions

1. Never ignite with an unknown gas configuration.
2. Do not leave the flame unattended.
3. Follow the exact gas shut-down sequence.

After-use Care & Maintenance

1. Clean burner/aspiration system as specified.
2. Inspect tubing and nebulizer for blockage.

Basic Troubleshooting

Unstable flame — Check gas/air supply, burner cleanliness and ventilation.

Low/zero sample response — Check aspiration, standards, wavelength/filter setting and sample concentration.

SOP 16. Hot Plate



Practical linkage:

1. Preparation of jam, jelly, RTS, nectar, squash, osmotically dried products, fruit bar and candy and tomato products, canned products.
2. Quality evaluation of products -- physico-chemical and sensory.
3. preparation of organic extracts
4. Hands on training sessions on preparation of organic extracts and natural farming concoctions, compost preparation and seed treatment.
5. On farm input preparation methods and protocols.

Purpose: To provide controlled surface heating for sample preparation, extraction and food-processing demonstrations.

Principle: Electrical heating transfers heat from the plate to a vessel or sample.

Requirements

1. Hot plate, heat-resistant vessel, thermometer if required, stirring device, PPE

Safety

1. Do not heat sealed containers.
2. Use heat-resistant gloves/tongs.
3. Keep liquids away from electrical controls.
4. Never leave heating unattended.

Standard Operating Procedure

1. Inspect the plate and electrical cord.
2. Place the compatible vessel centrally on the plate.
3. Set a low initial temperature and increase gradually as required.
4. Stir the sample if the method requires uniform heating.
5. Monitor temperature and time.

6. Switch off heating before removing the vessel.
7. Allow the plate to cool before cleaning.

Observations / Record

1. Sample; vessel; set temperature; actual temperature if measured; heating time; observations.

Precautions

1. Use vessels suitable for the temperature and chemistry.
2. Avoid sudden temperature changes in glassware.

After-use Care & Maintenance

1. Wipe the cooled surface after use.
2. Do not immerse the electrical unit in water.

Basic Troubleshooting

Uneven heating — Check vessel contact and use stirring where appropriate.

No heating — Check power supply and control setting.

SOP 17. Deep Freezer



Practical linkage:

1. Effect of temperature on shelf life and quality of produce.
2. Demonstration of chilling and freezing injury in vegetables and fruits.
3. Principles of hybrid seed production in various important agriculture crops Cereals crop: maize, including detasseling, identification and removal of rogues and pollen shedders. Pollen collection, storage, viability testing, and assessment of stigma receptivity. Rice, Bajra, cotton Pulses:
4. Pigeonpea, chickpea, Oilseeds- mustard and sunflower Vegetable crops- Tomato, brinjal, chillies and okra.
5. Physical purity test, moisture determination, germination test, seed viability test, Genetic Purity testing, three primary methods: the Grow-Out Test (GOT), a field-based method that assesses morphological traits to detect off-types and calculate genetic purity; Molecular Marker-Based Tests such as SSR, RAPD, and SNP and Biochemical Tests, including isoenzyme and protein profiling (e.g., SDS-PAGE).
6. Methods of examination of seeds to assess seed-borne microorganisms and to quantify infection percentage.
7. Detection and identification of seed-borne fungi, bacteria, and viruses. Identification of storage fungi and control of seed-borne diseases. Maintenance of aseptic conditions and sterilization techniques for seed health testing

Purpose: To provide low-temperature storage and controlled freezing exposure for samples and practical demonstrations.

Principle: Lowering temperature slows biological and chemical processes; freezing can produce ice formation and cellular injury in susceptible produce.

Requirements

1. Deep freezer, labelled sample containers/bags, thermometer/data logger where available, insulated gloves

Safety

1. Wear insulated gloves for prolonged handling.
2. Do not block ventilation inside the freezer.
3. Do not store incompatible hazardous materials.

Standard Operating Procedure

1. Verify set temperature and freezer status.
2. Label samples with ID, treatment and date.
3. Precondition control and treatment samples according to the practical design.
4. Place samples with sufficient space for air circulation.
5. Record start time and temperature.
6. After the specified exposure, remove samples and evaluate appearance, texture, leakage, mass or other assigned quality parameters.
7. Return or dispose of samples according to the practical protocol.
8. Clean spills promptly after safe thawing if required.

Observations / Record

1. Sample ID; treatment temperature; exposure duration; control/treatment; mass; visual injury score; texture/colour/juice leakage observations.

Calculations / Interpretation

1. Percentage weight loss/gain = $(\text{initial mass} - \text{final mass}) / \text{initial mass} \times 100$, with sign interpreted according to the experiment.
2. For injury scoring, use the department's defined scale and report mean score for replicates.

Precautions

1. Do not repeatedly open the freezer unnecessarily.
2. Do not refreeze samples when the practical design requires a single freeze-thaw event.

After-use Care & Maintenance

1. Defrost according to manufacturer's schedule.
2. Keep door gasket clean and intact.
3. Record temperature excursions.

Basic Troubleshooting

Temperature rising — check door closure, load, frost accumulation, power and alarm.

Ice/frost excessive — Check gasket, door opening frequency and defrost requirement.

SOP 18. Digital Rotary Shaker



Practical linkage:

1. Preparation of organic extracts.
2. Hands on training sessions on preparation of organic extracts and natural farming concoctions, compost preparation and seed treatment.
3. On farm input preparation methods and protocols.
4. Methods of examination of seeds to assess seed-borne microorganisms and to quantify infection percentage.
5. Detection and identification of seed-borne fungi, bacteria, and viruses. Identification of storage fungi and control of seed-borne diseases. Maintenance of aseptic conditions and sterilization techniques for seed health testing

Purpose: To mix or extract components uniformly by controlled rotary agitation.

Principle: Rotary motion creates repeated agitation, improving contact between liquid and solid phases or maintaining homogeneous mixtures.

Requirements

1. Digital rotary shaker, labelled bottles/flasks, sample and solvent/water as prescribed, clamps/platform

Safety

1. Balance vessels symmetrically.
2. Secure containers before starting.
3. Do not open moving clamps or touch moving parts while operating.
4. Use sealed containers only when the method permits and pressure buildup is impossible.

Standard Operating Procedure

1. Inspect platform, clamps and speed control.
2. Prepare equal or balanced loads.
3. Secure containers firmly.
4. Set the required speed and time according to the practical protocol.
5. Start the shaker and observe for excessive vibration.
6. Stop before removing any container.
7. Label and transfer the extract/sample for the next step.

Observations / Record

1. Sample ID; volume/mass; container; speed; duration; temperature if relevant; extraction yield/appearance.

Calculations / Interpretation

1. Extraction yield, if required, = mass of recovered extract/initial material mass $\times$ 100 (use the method-specific definition).

Precautions

1. Do not exceed the rated speed or load.
2. Avoid volatile materials unless the shaker is designed for them.

After-use Care & Maintenance

1. Clean spills immediately after safe shutdown.
2. Inspect clamps and platform for looseness.

Basic Troubleshooting

Excessive vibration — Rebalance load and check platform/clamps.

Speed fluctuates — Check load and controller; report persistent fault.

SOP 19. Baking Oven



Practical linkage:

1. Preparation of jam, jelly, RTS, nectar, squash, osmotically dried products, fruit bar and candy and tomato products, canned products.
2. Quality evaluation of products -- physico-chemical and sensory.
3. Post-harvest management and marketing: post-harvest handling, value added products, marketing and certification, economics of organic horticulture.
4. Hands on training sessions on preparation of organic extracts and natural farming concoctions, compost preparation and seed treatment.

Purpose: To provide controlled heating/baking for food-product practicals.

Principle: Controlled dry heat causes moisture loss and thermal changes such as setting, browning and texture development.

Requirements

1. Baking oven, trays, weighing balance, thermometer/display, appropriate food-grade utensils and PPE

Safety

1. Use heat-resistant gloves.
2. Keep electrical components dry.
3. Avoid overcrowding the chamber.
4. Do not place unsuitable plastic or combustible materials inside.

Standard Operating Procedure

1. Preheat the oven to the temperature specified in the validated recipe/practical protocol.
2. Prepare and label samples/trays.
3. Place trays with adequate spacing.

4. Start timing as specified by the practical method.
5. Monitor colour, texture and mass where required.
6. Rotate trays only if the oven protocol calls for it.
7. Remove with heat-resistant gloves.
8. Cool products before sensory/physico-chemical evaluation when required.
9. Switch off and clean after cooling.

Observations / Record

1. Product; batch; oven set temperature; time; initial mass; final mass; colour; texture; sensory observations.

Calculations / Interpretation

1. Moisture loss (%) = $(\text{initial mass} - \text{final mass}) / \text{initial mass} \times 100$, when applicable.
2. Product yield (%) = $\text{final product mass} / \text{initial raw-material mass} \times 100$.

Precautions

1. Follow the recipe's specified temperature and time.
2. Avoid opening the door repeatedly.

After-use Care & Maintenance

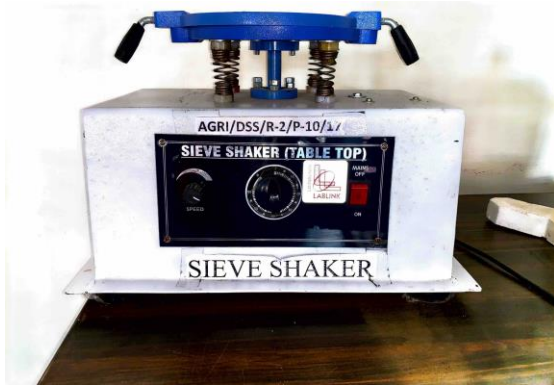
1. Clean crumbs and residues after cooling.
2. Check door seal and temperature display.

Basic Troubleshooting

Uneven baking — Check tray spacing, load and heating elements.

Excessive browning — Verify temperature and product position.

SOP 20. Sieve Shaker



Practical linkage:

1. Study of various seed processing equipment and seed treating equipment. Seed treatment methods for improving seed quality. Seed priming techniques for enhancing seed performance.
2. Physical purity test, moisture determination, germination test, seed viability test, Genetic Purity testing, three primary methods: the Grow-Out Test (GOT), a field-based method that assesses morphological traits to detect off-types and calculate genetic purity; Molecular Marker-Based Tests such as SSR, RAPD, and SNP and Biochemical Tests, including isoenzyme and protein profiling (e.g., SDS-PAGE).
3. Soil and nutrient management: Soil health and organic/natural practices, composting techniques, bio-fertilizers and organic amendments, green manures and cover crops; natural farming concoctions.
4. On farm input preparation methods and protocols.

Purpose: To separate seed or material fractions by particle size and support physical purity/size grading observations.

Principle: Mechanical shaking moves particles across sieves of known aperture size; particles are retained or pass according to size.

Requirements

1. Sieve shaker, clean sieves of appropriate mesh/aperture, lid and pan, balance, sample

Safety

1. Ensure sieves are locked securely.
2. Do not overload.
3. Avoid inhaling dusty seed/soil/organic material; use appropriate respiratory protection where required.

Standard Operating Procedure

1. Clean and stack sieves from larger to smaller aperture, with pan at the bottom.
2. Weigh the sample and record initial mass.
3. Place the sample on the top sieve and fit lid.
4. Set time/amplitude according to the instrument protocol.
5. Start shaking and stop before opening.
6. Weigh material retained on each sieve and in the pan.
7. Calculate percentage distribution and check mass recovery.
8. Clean sieves with a soft brush.

Observations / Record

1. Initial sample mass; sieve aperture; mass retained on each sieve; pan fraction; time; shaker setting.

Calculations / Interpretation

1. $\text{Fraction (\%)} = \text{mass retained in fraction} / \text{initial sample mass} \times 100.$
2. $\text{Mass recovery (\%)} = \text{total recovered mass} / \text{initial mass} \times 100.$

Precautions

1. Use clean, dry sieves for seed purity work.
2. Do not force particles through the mesh.

After-use Care & Maintenance

1. Brush and inspect mesh after each use.
2. Do not use damaged or deformed sieves for quantitative work.

Basic Troubleshooting

Poor separation — Check overload, sieve order, mesh cleanliness and shaking time.

Low mass recovery — Check material remaining on sieves, pan, lid and instrument chamber.

SOP 21. Monocular Microscope



Practical linkage:

1. Methods of examination of seeds to assess seed-borne microorganisms and to quantify infection percentage.
2. Detection and identification of seed-borne fungi, bacteria, and viruses. Identification of storage fungi and control of seed-borne diseases. Maintenance of aseptic conditions and sterilization techniques for seed health testing.
3. Visit to a tissue culture laboratory.
4. Visit to Horticultural laboratory.
5. Integrated Pest and Disease Management (PDM).

Purpose: To examine prepared seed, fungal or plant specimens at suitable magnification.

Principle: Optical lenses magnify structures so that morphological features can be observed and recorded.

Requirements

1. Monocular microscope, prepared slides, cover slips, lens tissue, optional immersion oil for oil objective

Safety

1. Handle slides carefully.
2. Do not touch optics with fingers.
3. Use biological safety procedures for suspected pathogens.

Standard Operating Procedure

1. Place the microscope securely and clean the optics.
2. Place the slide on the stage.
3. Begin with low-power objective and locate the specimen.
4. Use coarse focus at low power only; use fine focus at higher power.
5. Adjust illumination and diaphragm.

6. Record specimen structures and magnification.
7. Clean any immersion oil after use and cover the microscope.

Observations / Record

1. Specimen; magnification; structures; sketch/photo; remarks.

Precautions

1. Avoid contact between objective and slide.
2. Do not use coarse focus at high power.

After-use Care & Maintenance

1. Cover and store dry.
2. Clean optics only with approved lens material.

Basic Troubleshooting

Dark field — Increase illumination and adjust condenser/diaphragm.

Poor focus — Clean optics and refocus systematically.

SOP 22. Binocular Microscope



Practical linkage:

1. Methods of examination of seeds to assess seed-borne microorganisms and to quantify infection percentage.
2. Detection and identification of seed-borne fungi, bacteria, and viruses. Identification of storage fungi and control of seed-borne diseases. Maintenance of aseptic conditions and sterilization techniques for seed health testing.
3. Visit to a tissue culture laboratory.
4. Visit to Horticultural laboratory.
5. Integrated Pest and Disease Management (PDM).

Purpose: To provide comfortable binocular observation of seed, plant and biological material with stereoscopic depth where applicable.

Principle: Two optical paths provide binocular viewing; stereo microscopes use separated optical paths to give depth perception at low magnification.

Requirements

1. Binocular/stereo microscope, specimen tray, forceps, lens tissue, illumination source

Safety

1. Use forceps for small specimens.
2. Avoid touching lenses.
3. Dispose of biological specimens according to laboratory procedure.

Standard Operating Procedure

1. Set the instrument on a stable surface and switch on illumination.
2. Adjust interpupillary distance until a single circular field is seen.

3. Focus using the recommended control sequence.
4. Place specimen on the stage and observe at low magnification.
5. Increase magnification as required.
6. Record diagnostic structures, scale/magnification and specimen ID.
7. Clean the work area and cover the microscope.

Observations / Record

1. Specimen; magnification; observed features; sketches/images; remarks.

Precautions

1. Do not force zoom or focus controls.
2. Keep samples free from loose soil/dust that can enter the optical system.

After-use Care & Maintenance

1. Cover after use and keep optics dust-free.

Basic Troubleshooting

Double image — Adjust interpupillary distance and focus.

Poor contrast — Adjust illumination and clean optics.

SOP 23. Digital pH Meter



Practical linkage:

1. Soil and nutrient management: Soil health and organic/natural practices, composting techniques, bio-fertilizers and organic amendments, green manures and cover crops; natural farming concoctions.
2. Media for propagation of plants in nursery beds and pot.
3. Plant nutrition and management in nursery.
4. Quality evaluation of products -- physico-chemical and sensory
5. Water quality analysis: pH, EC and TDS. Visit to areas affected by natural disaster.

Purpose: To measure hydrogen-ion activity expressed as pH in soil suspensions, water or food/product samples using the appropriate method.

Principle: The glass electrode develops a potential related to hydrogen-ion activity; the meter converts the signal to pH.

Requirements

1. Digital pH meter with electrode, standard buffer solutions, distilled/deionized water, sample beakers, tissue

Safety

1. Handle the glass bulb carefully.
2. Use appropriate PPE for sample/reagent handling.
3. Do not let the electrode dry if the manufacturer requires storage solution.

Standard Operating Procedure

1. Inspect the electrode and meter.
2. Select the calibration buffers specified by the instrument/method.
3. Rinse the electrode with distilled/deionized water and blot gently without rubbing the glass bulb.

4. Calibrate using fresh buffers, following the instrument's multi-point calibration procedure.
5. Prepare the sample using the method appropriate to soil, water or food product.
6. Rinse electrode, immerse to the required level and stir gently or allow stabilization as specified.
7. Record the stable pH value and temperature if displayed.
8. Rinse between samples.
9. After use, store the electrode in the manufacturer's recommended storage solution.

Observations / Record

1. Sample; preparation ratio/method; buffer values; calibration status; pH; temperature; replicate readings.

Calculations / Interpretation

1. Mean pH = average of replicate readings when replicate analysis is required.
2. For soil pH, report the soil:water or soil:solution ratio and extraction method because pH depends on the method.

Precautions

1. Do not calibrate with contaminated/expired buffers.
2. Do not wipe the glass bulb aggressively.
3. Do not compare pH values generated by different sample preparation methods without noting the method.

After-use Care & Maintenance

1. Keep electrode junction clean.
2. Replace storage solution as required.
3. Perform periodic electrode condition checks.

Basic Troubleshooting

Slow response — Clean/condition electrode and check storage solution.

Calibration failure — Use fresh buffers, check electrode condition and verify temperature compensation.

SOP 24. Digital Refractometer



Practical linkage:

1. Quality evaluation of products -- physico-chemical and sensory.
2. Visit to organic and natural farms to study various components and operations of organic and natural farming principles.

Purpose: To obtain a digital refractive-index or soluble-solids reading quickly and reproducibly.

Principle: Light passing through the sample undergoes refraction; the instrument converts the optical response to the selected measurement scale, commonly °Brix.

Requirements

1. Digital refractometer, distilled water, lint-free tissue, sample, pipette/dropper

Safety

1. Keep the optical well clean and dry.
2. Use food-safe sampling practices.
3. Do not scratch the optical surface.

Standard Operating Procedure

1. Power on the refractometer and select the required scale.
2. Clean the sample well.
3. Zero/calibrate with distilled water or the instrument's specified reference.
4. Place the required sample volume on the optical surface.
5. Close the cover if the model has one and allow the reading to stabilize.
6. Record the displayed value and temperature.
7. Repeat for replicates when required.
8. Rinse/clean the sample well and dry gently.
9. Store the instrument protected from dust.

Observations / Record

1. Sample; scale; temperature; replicate readings; mean; remarks.

Calculations / Interpretation

1. Mean value = sum of valid replicate readings / number of replicates.
2. Apply dilution correction only when the analytical method requires it.

Precautions

1. Use representative, homogeneous samples.
2. Avoid bubbles and suspended solids on the optical surface.

After-use Care & Maintenance

1. Clean after each sample.
2. Keep the optical surface protected and dry when stored.

Basic Troubleshooting

No stable reading — Clean sample well, remove bubbles and allow temperature equilibration.

Unexpected reading — Repeat zero check and verify the selected scale and sample preparation.

SOP 25. Supporting Baking Utensils and General Food-Processing Accessories



Practical linkage:

1. Extraction and preservation of pulps and juices.
2. Preparation of jam, jelly, RTS, nectar, squash, osmotically dried products, fruit bar and candy and tomato products, canned products.
3. Quality evaluation of products -- physico-chemical and sensory.

Purpose: To standardize hygienic handling, weighing, heating, mixing and sensory preparation during postharvest practicals.

Principle: Accurate measurement and hygienic handling reduce experimental variation and contamination.

Requirements

1. Food-grade knives, cutting boards, stainless-steel vessels, ladles, strainers, measuring cylinders, weighing balance, thermometers, labels and clean containers

Safety

1. Follow food hygiene and heat safety.
2. Separate raw and finished-product utensils where required.
3. Use heat-resistant gloves for hot vessels.

Standard Operating Procedure

1. Wash and sanitize work surfaces and utensils.
2. Calibrate/check weighing and measuring equipment before starting.
3. Prepare raw material according to the practical protocol.
4. Measure ingredients accurately and record batch formulation.

5. Carry out extraction, heating, filtration, concentration or filling as specified.
6. Label each batch with date, formulation and treatment.
7. Cool/store products under the assigned condition before quality evaluation.
8. Clean and sanitize all utensils after use.

Observations / Record

1. Batch ID; raw-material mass; ingredient quantities; processing time/temperature; yield; packaging; storage condition; sensory/physico-chemical results.

Calculations / Interpretation

1. Product yield (%) = final product mass / raw-material mass $\times$ 100.
2. Record formulation on a mass or volume basis so batches can be reproduced.

Precautions

1. Do not use damaged or corroded food-contact utensils.
2. Prevent cross-contamination between treatments.

After-use Care & Maintenance

1. Dry utensils completely before storage.
2. Inspect for cracks, rust and damaged handles.

Basic Troubleshooting

Variable product quality — Standardize raw material maturity, formulation, heating time and weighing.

Contamination — Review cleaning/sanitization and storage practices.

General Do's and Don'ts

1. Read the instrument label and model-specific operating manual before first use.
2. Record calibration/verification status before collecting quantitative data.
3. Use clean, labelled samples and avoid cross-contamination.
4. Record units, sample preparation method, temperature and replicate number with every result.
5. Stop equipment immediately if there is smoke, burning smell, unusual vibration, electrical sparking, gas leakage or abnormal heating.
6. Do not bypass safety interlocks or operate equipment with damaged cords, glassware, guards or covers.
7. Clean and return every instrument to its designated storage position after the practical.
8. Report faults instead of attempting unauthorized electrical, gas or mechanical repairs.

Instrument-to-Practical Quick Reference

Instrument/equipment	Primary practical use	Related course
Multi-crop ridge planter	Ridge planting, field calibration, farming-system demonstration	AGRON-112
Seed-cum-fertilizer drill	Seed/fertilizer rate and placement	AGRON-112, PBG-121
DSR drill	Direct seeding and calibration	AGRON-112, PBG-121
Cup anemometer	Wind-speed observation	SOIL-122
Soil tensiometer	Soil water tension	AGRON-113, SOIL-122
Hand refractometers 90/60°Brix	Soluble solids / fruit quality	HORT-121, AGRON-113
Automatic weather station	Agrometeorological observations	SOIL-122
Sunshine recorder/charts	Bright sunshine duration	SOIL-122
Spectrophotometer	Colorimetric/optical analytical assays	SOIL-122, PBG-121, HORT-121
Double distillation unit	Purified water for laboratory work	AGRON-113, HORT-112, PBG-121, SOIL-122
Vacuum pump	Vacuum filtration/drying support	PBG-121, HORT-121
Digital hot-air oven	Drying/moisture determination	PBG-121, HORT-112
Microscopes	Seed health, pathogen/plant specimen observation	PBG-121, HORT-112, AGRON-113
Flame photometer	Selected nutrient/water-quality analysis	SOIL-122, AGRON-113
Hot plate	Heating/extraction/processing	AGRON-113, HORT-121
Deep freezer	Freezing injury and low-temperature treatments	HORT-121
Digital rotary shaker	Extract preparation and mixing	AGRON-113, PBG-121
Baking oven	Value-added product preparation	HORT-121
Sieve shaker	Seed processing/physical purity/size separation	PBG-121
Digital pH meter	Soil, water and product pH	AGRON-113, HORT-112, HORT-121, SOIL-122
Digital refractometer	Digital °Brix/soluble solids	HORT-121, AGRON-113