

Skills Sheets

Seed Sterilisation	4
Sowing Seed	5
Transplanting Seedlings – Germination Trays to Seedling Trays	6
Transplanting Seedlings – Seedling Trays to Planting Bags	7
Sterilising and Maintaining Equipment	8
Budding	9
Growth Medium Sampling	12
Measuring Electrical Conductivity (EC) of Growth Medium	13
Leaf Sampling	14
Scouting	16
Disposal of Empty Containers	17
Emergency Procedures in Case of Poisoning	18
Procedures for Spills and Leakages	19
Mixing Spray Material	20
Applying Spray Material – Handguns	21
Cleaning Spray Equipment	22
Water Sampling	23
pH Testing	24
EC Testing	26
Sampling for Pathogen Analysis	27
Pre-Start-Up Inspection	29
Priming Pumps	31
Starting Up Irrigation System	32
Shutting Down Irrigation System	33
Measuring Pressure	34
Determining Daily Water Consumption	35

Seed Sterilisation

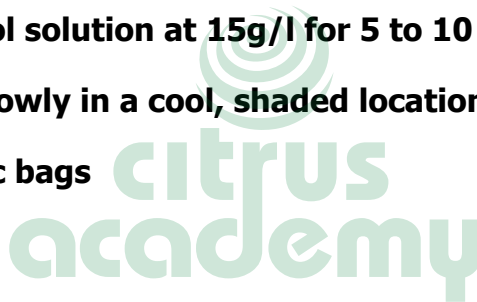
WARNING: PLEASE TAKE CARE
This procedure involves handling chemical substances

Requirements

- ☐ Hot water
- ☐ 8-hydroxy-quinoline sulphate (1% a.i.) (Chinosol)
- ☐ Gloves

Method

1. Heat treat seeds in water at 51.5°C for 10 minutes
2. Dip seeds in Chinosol solution at 15g/l for 5 to 10 minutes
3. Surface dry seeds slowly in a cool, shaded location
4. Pack seeds in plastic bags
5. Store at 10°C



Sowing Seed

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Requirements

- ☐ Seed germination trays (5cm deep, wooden frame, gauze / shade cloth base)
- ☐ Seed
- ☐ Growth media (recommended: vermiculite – medium grade)
- ☐ Fungicide (copper oxychloride at 200g/100l)
- ☐ Clean water

Method

1. Soak seeds in water for ± 5 hours
2. Wash seed germination trays with clean water
3. Sterilise trays with fungicide (copper oxychloride at 200g/100l)
4. Soak growth media (vermiculite) in clean water
5. Fill trays to three-quarter level with a growth media (vermiculite)
6. Spread and arrange seeds so that all seeds can germinate with as little obstruction as possible
7. Spread a thin layer of dry growth media (vermiculite) over seeds
8. Water to field water capacity
9. Place trays on racks in germination room, ensuring enough space between racks for air movement and artificial light

Transplanting Seedlings – Germination Trays to Seedling Trays

Requirements

- ☐ Seedling trays (recommended size: minimum 5x5x10cm) or poly-tubes
- ☐ Seedling growth medium (_____)
- ☐ Dibber to make whole in growth medium
- ☐ Clean water
- ☐ Hose with watering rose

Method

1. Sterilise growth medium
2. Fill seedling trays / poly-tubes to the top with growth medium
3. Water growth medium to field water capacity
4. Pack seedling trays / poly-tubes in greenhouse / tunnel
5. Select seedlings from germination trays in germination room:
 - ✓ More than 2 differentiated leaves
 - ✓ Roots without U-bends
 - ✓ Discard zygotic seedlings with off-type leaves
 - ✓ Select seedlings of same size
6. Pack seedlings in container with water or in wet paper to prevent drying
7. Take to tunnel / greenhouse
8. Use dibber to make holes in growth medium of one tray
9. Carefully plant seedlings one per cavity
10. Do not to bend roots – push seedling in slightly deeper and pull it out again to straighten the roots
11. Cotyledons should be just above growth medium surface

Transplanting Seedlings – Seedling Trays to Planting Bags

Requirements

- ☐ Planting bags
- ☐ Growth medium (_____)
- ☐ Dibber to make holes

Method

1. Sterilise growth medium
2. Fill planting bags with growth medium
3. Pack planting bags in shade house
4. If a permanent irrigation system is used, it must be installed at this time
5. Water growth medium in bags to field water capacity
6. Select seedlings from seedling trays (uniform seedlings, transplant largest seedlings first, then second size group, etc.)
7. Take selected seedlings to green house in cavities / seedling trays
8. Water seedlings in cavities to field water capacity
9. Carefully remove seedlings with growth media from cavities
10. Use dibber to make holes in growth medium in planting bags
11. Carefully plant seedlings one per bag
12. Take care not to plant seedling too deep; ensure that seedling growth media is visible on surface of growth media in planting bag after planting
13. Irrigate by hand-held hose with water rose to field water capacity, ensuring that plant bags are draining well

Sterilising and Maintaining Equipment

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Requirements

- ☐ Clean water
- ☐ Sterilisation liquid

Method

1. Clean tools thoroughly with clean water
2. Wipe blades with a solution of 10% chlorine bleach (Jik)
3. Keep solution out of direct sunlight (out of direct sunlight the solution can be preserved for five days)
4. Keep a wetted cotton swab in a capsule to periodically sterilise propagation tools during nursery operations
5. Bleach solution (Jik) is corrosive to most metals; therefore rinse sterilised tools in clean tap water
6. Dry thoroughly
7. Apply a light coating of protective oil at the end of the day to prevent rust
8. Apply a mixture of 390ml clean tap water, 100ml clear vinegar, and 10ml oil for long-term protection from rust
9. Sharpen blunt knives and pruning shears with a sharpening stone

Budding

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Requirements

- ☐ Budding knife
- ☐ Budding tape
- ☐ Sterilisation liquid

Method

1. Make an inverted T-cut into the bark on the stem of the rootstock



2. Cut a very thin slice of bark and a piece of wood beneath the bud evenly and smoothly from the bud-wood with a knife
3. Place the upper end of the bud piece beneath the bark flaps at the bottom of the inverted T-cut
4. Gently but firmly push it upward with the thumb
5. Wrap the join with budding tape to hold the bud in place



- 6. Wrap the bud from below the incision, making several overlapping turns around the stem until the entire bud and incision are covered**
- 7. Tuck the end of the tape beneath the last turn**
- 8. Maintain firm pressure on the tape, but not so hard that it breaks – if the tape breaks it has to be removed and the wrapping started over again with a new strip**



14 to 20 days later:

- 1. When healing and union has occurred, remove the tape**
- 2. Make a vertical cut through the tape behind the budded area of the rootstock**
- 3. Check that the bud is still live (green) and calloused**

5 days later:

- 1. If the bud is still alive, cut the seedling 1cm above the bud union**
- 2. Insert a treated stake (wooden cleat, bamboo stick, twisted thick wire) alongside the plant extending 20cm into the medium and about 80cm above**
- 3. Tie the seedling to the stake**

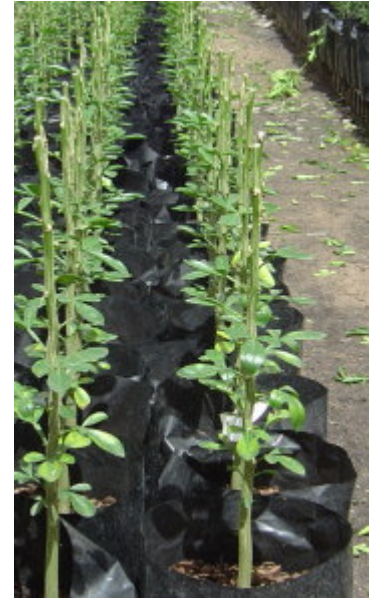


Seedling Manipulation

- 1. Trim side-shoots as soon as they appear on the rootstock**
- 2. Tie the plant to the stake as it grows for stability and directed growth**
- 3. As the plant grows, tie it continually up until it reaches the top of the stake**

Topping

- 1. If it is required by the grower, cut off the seedling at the required height (minimum 80cm), as long as the wood is round at that height**
- 2. Otherwise the tree is topped when it leaves the nursery to prevent scaffold branches from breaking off during transport**



Growth Medium Sampling

Requirements

- ☐ Sampling tube
- ☐ Plastic bucket(s)
- ☐ Mixing stick

Method

1. Identify areas to be included in representing the purpose of the sampling
2. Collect sub-samples from the very surface to the bottom of the container, using the sampling tube
3. To investigate accumulation of salts, divide the samples into top, middle and bottom and keep the different layers as separate samples
4. Take total of between 15 and 20 sub-samples
5. Put all sub-samples into a clean bucket
6. Mix the sub-samples in the bucket
7. Remove a sample for analysis of approximately
 - ✓ 500ml for in-house testing
 - ✓ 500ml for chemical laboratory analysis
 - ✓ 2,000ml for physical or biological laboratory analyses
8. Put into a clean new plastic bag and dispatch
9. Tie a label to the bag (do not write on the bag) and put all relevant details on the label
10. For in-house tests a shade house number should suffice, but when dispatched to a laboratory show full name and address of nursery, name and telephone number of contact person, and reference numbers on the label

Measuring Electrical Conductivity (EC) of Growth Medium

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Requirements

- ☐ 100ml growth medium sample
- ☐ 150ml (1.5 parts) deionised / distilled water
- ☐ Sealable container
- ☐ An appropriate EC meter (handheld or desktop version)
- ☐ Washing bottle with demineralised water
- ☐ Glass or plastic beakers
- ☐ Reagents
- ☐ Standard solution of e.g. 1,000g potassium chloride per litre water

Method

1. Place 100ml growth medium inside sealable container
2. Add 150ml deionised / distilled water and seal the container tightly
3. Shake the container for 1 minute
4. Let the container stand for 60 minutes
5. Shake the container for 1 minute
6. Standardise the instrument according to the instructions of the manufacturer using the standard potassium chloride solution
7. Rinse the electrode of the EC meter in demineralised water
8. Insert it into the supernatant of the growth medium
9. Note the reading
10. Rinse the electrode of the EC meter in demineralised water and store according to protocol

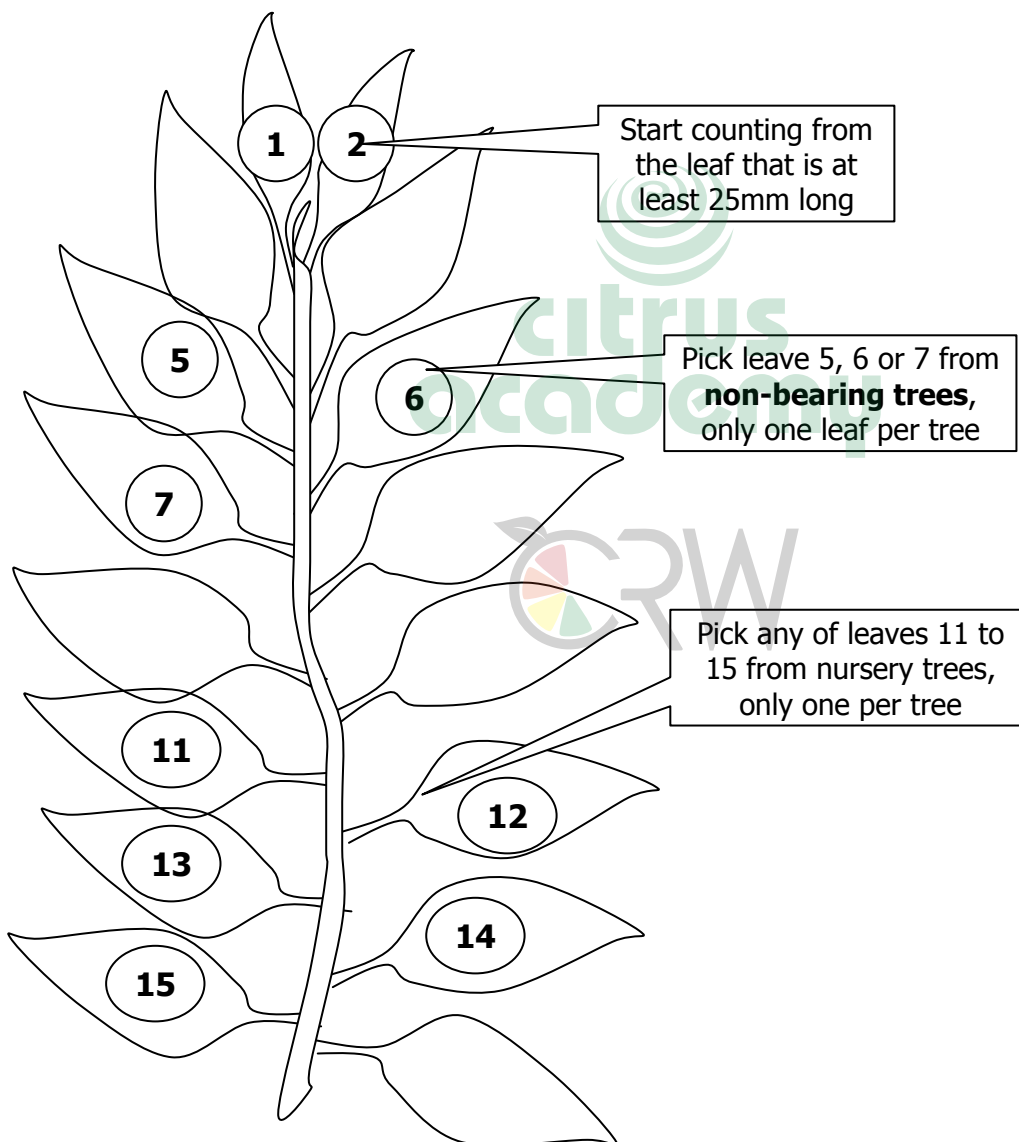
Leaf Sampling

Requirements

- ☐ Clean plastic bag

Method

1. Collect 10 to 15 leaves per sample
2. Collect leaves as indicated in the sketch below (non-bearing trees – leaf numbers 5 to 7 and nursery trees leaf numbers 11 to 15)



- 3. Collect only one leaf per tree**
- 4. Put leaves in a clean plastic bag**
- 5. Squeeze out all air and knot tight**
- 6. Tie a label to the sampling bag**
- 7. Supply full details of the nursery on the label**



Scouting

Requirements

- ☐ Pest identification manual
- ☐ Scouting form
- ☐ Pen
- ☐ Magnifying glass

Method

1. Walk down selected row
2. Divide the row into ten observation points
3. Stop at each point and observe the plants to the right and left
4. Record the presence of pest insects and disease symptoms on the scouting form
5. Use the magnifying glass for closer inspections

Disposal of Empty Containers

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Requirements

- ☐ Clean water
- ☐ Puncture implement
- ☐ Incinerator

Method

1. Fill container about a quarter with clean water
2. Close the container properly
3. Shake it well
4. Empty container
5. Repeat at least three times
6. Puncture container so that it cannot be reused
7. Flatten containers in bulk, and bury at a approved disposal site
8. Burn waste bags, paper and mildly contaminated items
9. Dispose of severely contaminated items and redundant chemicals in a high-temperature incinerator
10. DO NOT burn containers of highly flammable chemicals – contact a professional waste disposal company

Emergency Procedures in Case of Poisoning

Requirements

- ☐ Label of chemical product
- ☐ First aid kit
- ☐ Clean water
- ☐ Soap
- ☐ Blankets

Method

1. Determine which chemical caused the poisoning
2. If the product is known, consult the label for the specific first aid procedures
3. Ascertain how the chemical was absorbed, being by mouth, through the skin or by inhalation
4. Make sure that the breathing tract is open
5. Start artificial respiration if the person is not breathing
6. If the patient is unconscious, turn him or her onto their stomach
7. If the patient absorbed the chemical via the skin, remove the patient from the contamination point, remove all contaminated clothing and wash affected areas with soap and water
8. If the eyes have been affected, wash with clean water for at least 15 minutes
9. If the chemicals have been swallowed do not induce vomiting unless it specifically stated on the product label
10. Keep the patient warm

Procedures for Spills and Leakages

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Requirements

- ☐ Two sets of protective clothing, including respirators and facemasks
- ☐ Two brooms
- ☐ Two shovels
- ☐ 50kg powdered lime
- ☐ Open-top drums in which to place spilled chemicals

Method

1. Give first aid to anyone affected by the chemical and obtain medical attention immediately
2. Isolate spill area and keep all unauthorised people away
3. Attempt to contain the spill or leakage as far as possible by constructing an absorbent barrier of sand, soil or lime around the spilt material
4. Place leaking containers, if any, into open-top drums and label the drums clearly for future reference and disposal
5. Collect the spilt material and absorbent substance using the shovels and brooms, and place it into open-top drums for disposal
6. Ventilate the building as much as possible by opening all doors and windows
7. If the spillage is on soil or gravel, dig up the area and remove the contaminated material
8. If the spillage is on concrete neutralise the chemical with lime or a 10% solution of sodium carbonate (Na_2CO_3) or alternatively, with 5% sodium hydroxide (NaOH)
9. Clean all equipment used during the clean-up operation thoroughly, including laundering protective clothing, and store it for future use
10. Dispose of the open-top drums and its contents

Mixing Spray Material

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Requirements

- ☐ Pre-application plan
- ☐ Plant protection products
- ☐ Measuring equipment (scales, graduated measuring jug)
- ☐ Mixing equipment
- ☐ Protective gear and clothing (rubber gloves, cotton overall, rubber boots or gumboots, plastic apron, eye protection (goggles), facemask or respirator (if indicated))
- ☐ Clean water and soap

Method

1. Check product identification and expiry dates
2. Check toxicity and safe handling procedures
3. Use appropriate equipment to accurately measure the chemical ingredients (all ingredients except water)
4. Run half the volume of water to be used into spray tank through a coarse filter (an orifice filter is part of a spray machine)
5. Check label to see if premixing is necessary, if yes: add chemical ingredients to a 10ℓ bucket of clean water
6. Mix thoroughly
7. Add the 10ℓ mixture to the spray tank containing half the volume of water to be used
8. If premixing is not necessary, add the chemical ingredients directly to the spray tank containing half the amount of water to be used
9. Add the remainder of the water to the spray tank through the filter, agitating (stirring) the mixture continuously
10. Thoroughly wash and clean all protective clothing and all equipment that was used

Applying Spray Material – Handguns

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Requirements

- ☐ Application equipment
- ☐ Mixed spray material
- ☐ Protective gear and clothing

Minimum: cotton overall, gum boots, rubber gloves

Maximum: cotton overalls, rain hat, rain coat and trousers, gum boots, goggles, respirator (with appropriate cartridge), rubber gloves

Method

1. Park spray tank and tractor outside shade house or tunnel
2. Attach dragline hose with handgun to spray tank
3. Adjust pressure of pump to deliver required volume of spray material, either by changing speed of tractor engine or by opening or closing valves on spray tank
4. Before entering shade house or tunnel, ensure that you have on all prescribed safety gear and protective clothing
5. Start at first row of trees, spraying trees on the one side; walk back up row when reaching the end
6. Move handgun constantly in a circular motion while spraying to set leaves in motion, ensuring that leaves are covered on the top and the bottom
7. Enter between first and second rows, and spray other side of trees in first row
8. At end of row, walk back spraying one side of trees in row two
9. Repeat this procedure until all trees in shade house or tunnel have been sprayed on both sides
10. Remember to complete and sign the necessary spray records after application have been completed

Cleaning Spray Equipment

Requirements

- ☐ Clean water
- ☐ Liquid soap

Method

Spray Equipment

1. Park the spray tank at a filling point with a good French drain at least 50m away from any water source
2. Remove the filter normally situated near the pump
3. Rinse the filter out with clean water so that all residues are removed
4. Fill the spray tank rapidly with water while the agitator is running, causing water to pour out of the open filter, until all poison residues have been removed
5. Wash the outside of the spray tank with a cloth, removing all spray residue
6. Park the tank in the designated area

Protective Clothing and Equipment

1. Wash with soap and water
2. Examine for damage, especially for holes or tears in clothing
3. If damaged, repair or replace
4. Store in the designated area

Other Equipment (Brushes, knapsacks, and mixing equipment)

1. In a suitable, well-drained area, wash with liquid soap
2. Rinse well
3. Store in the designated area

Water Sampling

Requirements

- ☐ Sampling container
- ☐ Label

Method

1. Rinse the container and cap three times with the water to be sampled
2. Fill the bottle to capacity and screw the cap on, leaving no air at the top
3. In a storage dam the sample must be taken away from the sides or wall of the dam and 50cm below the surface
4. To label the container, never write directly on the bottle, stick a label onto the container or tie it to the neck of the bottle
5. Write all relevant information on label with a waterproof pen, including:
 - The name of the nursery or nursery owner
 - The identification number or name of the water source
 - If only one sample is submitted: write the contact information of the nursery or nursery owner on the label
 - For more than one sample: write all the relevant information on at least one label, and on the rest only the nursery or nursery owner's name and the name or number of the water source
6. Put aside in the shade and dispatch as soon as possible to the laboratory

pH Testing

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Requirements

- ☐ pH meter (handheld or desktop instrument)
- ☐ Alternatively, special pH sensitive paper strips (not Litmus paper)
- ☐ Glass or plastic beakers
- ☐ Washing bottle with demineralised water
- ☐ Reagents
- ☐ pH buffer solutions for pH7 and pH4 (or another two with pH ranges that include the pH of the water to be tested)

Method

Handheld pH meter

1. Switch pH meter on and let it warm-up according to manufacturer instructions
2. Rinse electrode with demineralised water
3. Mark two beakers pH4 and pH7
4. Pour appropriate pH buffer into each beaker
5. Insert electrode into buffer solution pH4; set pH meter to read pH4
6. Remove electrode from buffer and rinse with demineralised water in separate beaker
7. Insert electrode into buffer solution pH7; set pH meter to read pH7
8. Remove electrode from buffer and rinse with demineralised water in separate beaker
9. Repeat process with buffer solutions until instrument reads 4 and 7 when inserted into buffer solutions
10. Rinse electrode well with demineralised water

- 11. Insert electrode into water sample, allow reading to stabilise before it is noted on the report as Reading A**
- 12. Rinse electrode and take a reading of one of the buffer solutions, note the reading as Reading B**

pH sensitive paper strips

- 1. Pour either pH buffer solution of pH 4 or pH 7 into a marked beaker**
- 2. Insert paper strip into beaker, keep there for required period according to product instructions**
- 3. Verify colour of paper strip with the colour chart (compares to reading B in the previous procedure)**
- 4. Insert another paper strip into water sample, keep there for required period**
- 5. Compare colour of paper strip with pH colour chart, note pH according to colour (compares to reading A in the previous procedure)**



EC Testing

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Requirements

- ☐ appropriate EC meter (handheld or desktop version)
- ☐ Washing bottle with demineralised water
- ☐ Glass or plastic beakers
- ☐ Reagents
- ☐ Standard solution (e.g. 1,000g potassium chloride per litre water)

Method

1. Standardise instrument according to the manufacturer instructions using standard potassium chloride solution
2. Rinse electrode of EC meter in demineralised water
3. Insert electrode into water sample
4. Note reading as Reading C
5. Rinse electrode of EC meter in demineralised water
6. Insert it into standard solution
7. Note reading as Reading D

Sampling for Pathogen Analysis

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Requirements

- ☐ Water spore trap
- ☐ Sterilisation solution

Method

Before installing water spore trap

1. Sterilise water spore trap
2. Pick leaves from old flush from a citrus tree in the nursery
3. Use a paper punch to punch out leaf discs
4. Place at least 20 leaf discs in water spore trap

Installing water spore trap: Untreated water

1. Find connection in water supply line before second storage dam where untreated water can be tapped
2. Place spaghetti tube into hole in lid of water spore trap; ensure that water is running freely into container
3. Once container has filled excess water will drain through holes in sides
4. Do not place water spore trap in direct sunlight – place it in shade, or wrap it with foil
5. Leave trap in place for minimum of three irrigation cycles

Installing water spore trap: Final point of delivery

1. Place spore trap between nursery trees in greenhouse or shade house
2. Insert spaghetti tube and dripper through hole in lid of spore trap; ensure that water is running freely into container
3. Once container has filled up, excess water will drain through holes in sides of spore trap
4. Leave trap in place for minimum of three irrigation cycles

After minimum of three irrigation cycles

- 1. Remove leaf discs from trap with tweezers**
- 2. Place leaf discs on tissue paper to dry**
- 3. Complete label on Petri dish; ensure to state whether discs are from untreated or treated water**
- 4. Place dry leaf discs with tweezers on medium in Petri dishes**
- 5. Close Petri dishes**
- 6. Carefully package Petri dishes and send to diagnostic centre**



Pre-Start-Up Inspection

Method

Assess water availability

1. Check that the inlet is a minimum of 500mm below surface
2. If not, report to irrigation manager

Checking and preparing pump

1. Remove the dipstick and check the oil level; check that oil is clear
2. If necessary, grease bearing with grease gun until old grease is expelled from casing
3. Clean nipple before greasing and wipe off old grease with rag
4. Check for excessive water inside the pump house (locate source if present)
5. Inspect pump for leaks at flanges and on pump body
6. Inspect gland packing around the pump shaft
7. Check rubber coupling at pump and motor shaft
8. Check for loose mounting bolts
9. Turn the pump with hand to ensure that it rotates freely
10. Check that the motor and starter panel is not wet
11. Check for signs of vandalism

Checking and cleaning filters

1. If instructed by irrigation manager, remove suction strainer from water, check for damage and clean
2. Check filter valves
3. Check that the filter lids are bolted or clamped down
4. Check lid-seal or rubber ring for cracks
5. Check flanges for leaks
6. If filter is fitted with hydraulic valves, check small inline filter and clean

Checking gate and butterfly valves

- 1. Check that valves open and close as they should**
- 2. On gate valves, check whether spindle rises or drops**
- 3. Check if spindle keeps on rotating**
- 4. Check for leaks at gland packing, spindle seal, flanges and casing**
- 5. Check for signs of vandalism**

Checking hydraulic valves

- 1. Check to see if 3-way valve is able to turn between open, close and auto; return to original setting**
- 2. Check rest of valve for damage to tubing, fittings, solenoids and wires**

Complete the pre-start-up inspection checklist and hand it to the supervisor or manager

Report any matters requiring urgent attention verbally as well



Priming Pumps

Method

Priming pump with funnel

1. Ensure that delivery valve is closed
2. Open the valve below funnel
3. Pour water into funnel using bucket; water go into pump and air is expelled through funnel
4. Continue to fill pump until funnel is brimming with water and no more air is expelled
5. Pump is now primed; valve below the funnel can be closed

Priming pump with vacuum pump

1. Ensure that delivery valve and all other valves are closed
2. Open valve below the vacuum pump
3. Use handle of vacuum pump to pump all air out
4. Pump is now primed and valve below vacuum pump can be closed

Starting Up Irrigation System

Method

1. Perform pre-start-up inspection
2. Check that pump is properly primed
3. Close delivery valve
4. Start pump by pushing start button
5. Stay at panel until pump runs smoothly (10-20 seconds)
6. If any unusual noise or vibration occurs, immediately press stop button
7. If pump runs normally, open delivery valve slowly



Shutting Down Irrigation System

Method

1. If required, take pressure readings on filter bank and back-flush filters
2. Close delivery valve slowly to prevent water hammer
3. As soon as valve is closed, switch off pump



Measuring Pressure

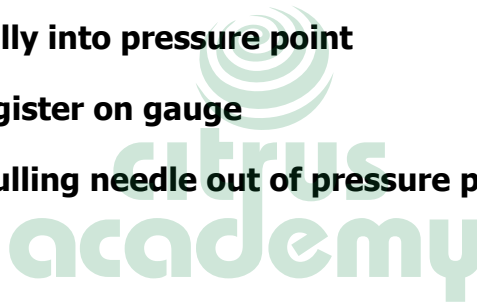
Method

Measuring pressure with hydromatic

1. Fit pressure gauge to pipette that fits into the hydromatic
2. Insert pipette with gauge into hydromatic
3. Make sure latch on pipette locks on to hydromatic
4. The pressure will register on gauge
5. To release pipette, push it down, unlock latch and remove

Measuring pressure with pressure point

1. Insert needle carefully into pressure point
2. The pressure will register on gauge
3. Remove gauge by pulling needle out of pressure point



Determining Daily Water Consumption

Requirements

- ☐ 5 citrus trees in containers that will retain enough water for at least one day
- ☐ Scales

Method

1. Identify trees in nursery
2. Choose a high water requirement period (between November and March)
3. Saturate substrates in afternoon
4. Let water drain freely overnight
5. Weigh containers next morning about 60 minutes prior to sunrise
6. Weigh the containers again about 60 minutes after sunset
7. Calculate average water loss of 5 trees
8. Express water loss as a percentage of 35% of water holding capacity (WHC) of growth medium
9. $100 \div \% \text{ loss per day} = \text{interval between irrigations}$
10. Refine method for various months of year and various trees sizes