

Plant Health Management and Disease Control (Level 2)

LNS-GNM-2014-1.1

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In the unlikely event of an emergency; remain calm and take instruction from the trainer.

Take note of the following:

- Exit door locations
- Location of first aid equipment
- Location of fire extinguishers and fire alarms
- Assembly area

Pests are commonly classified into two broad categories:

1. Sucking Pests

- Suck on sap and feed on plant nutrients
- Result in distorted and yellowing leaves

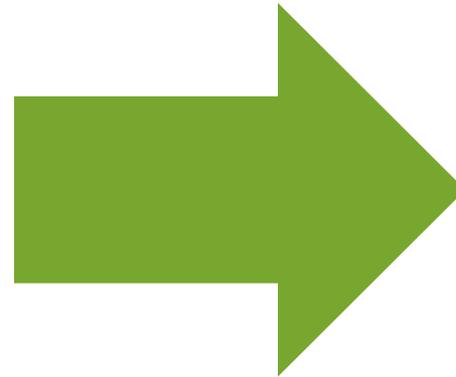
2. Chewing Pests

- Chew and make holes in leaves, stems, branches and trunks
- Result in wilting of leaf tissue and weakening of plant's health

LG 2

Sucking Pests

Mealybugs

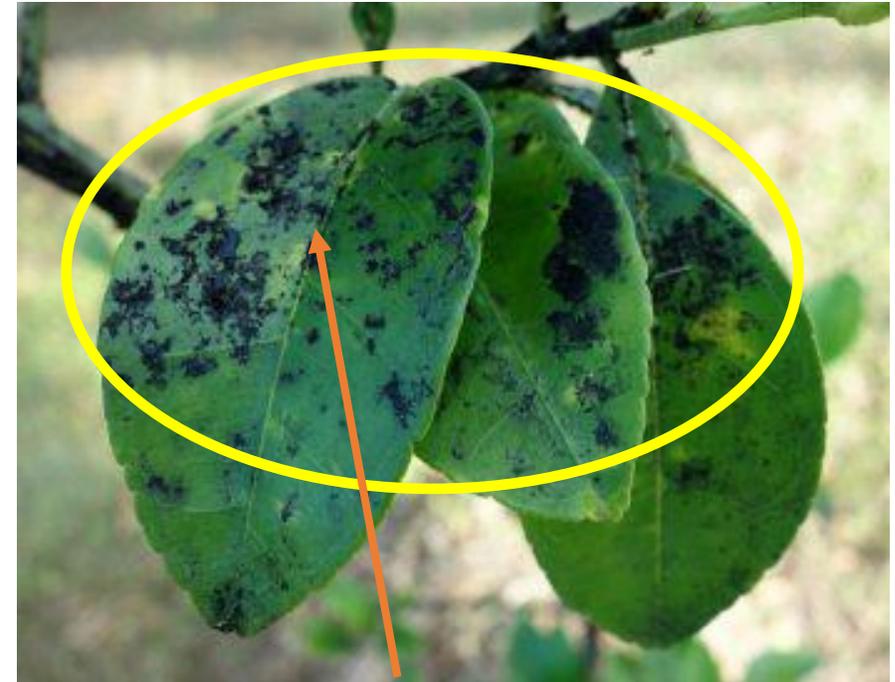
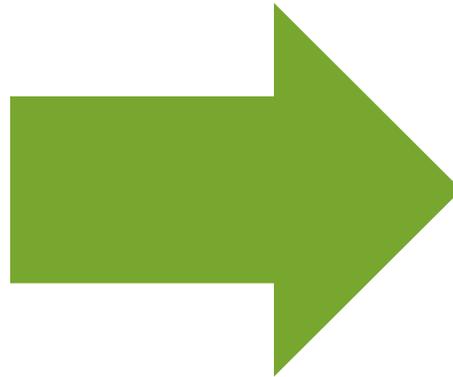


Secrete a powdery layer
which is used for protection

LG 3

Sucking Pests

Scale Insects

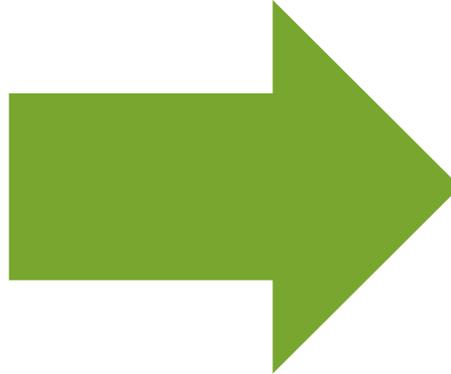


Black sooty mold,
a black-coloured fungus

LG 4

Sucking Pests

Aphids

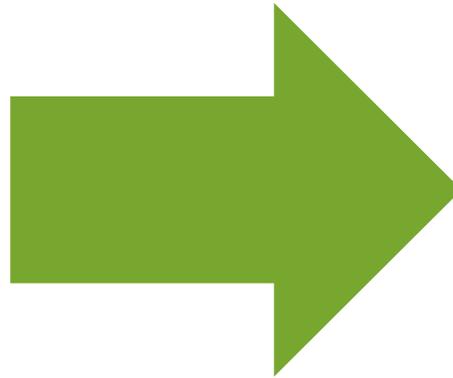


Mottled or yellowing leaves

LG 5

Sucking Pests

Thrips

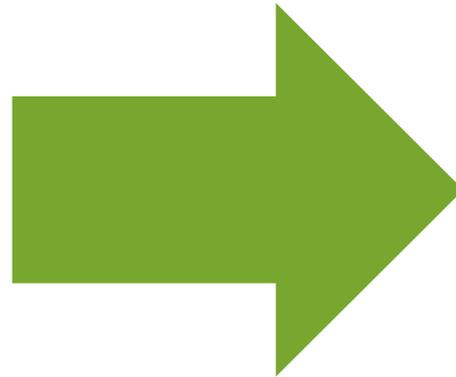


Feed on leaves,
puncturing the plants' cell

LG 6

Sucking Pests

Whiteflies

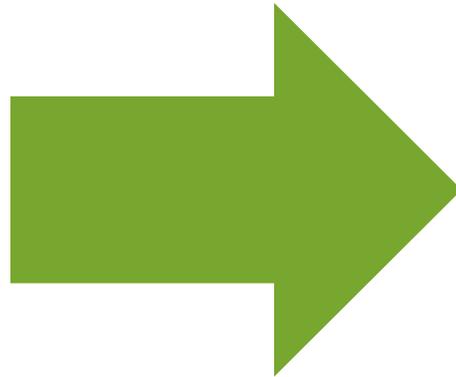


Feeds on new growth,
especially near the veins

LG 6

Sucking Pests

Mites

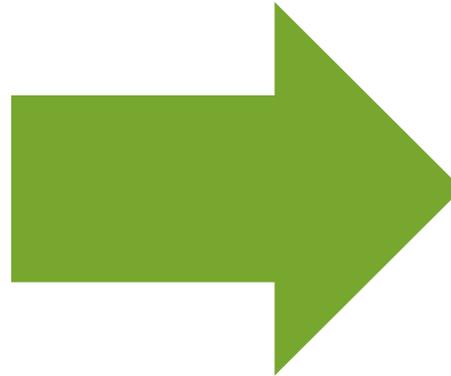


Spin a silky webbing to protect
from predators

LG 7

Chewing Pests

Beetles

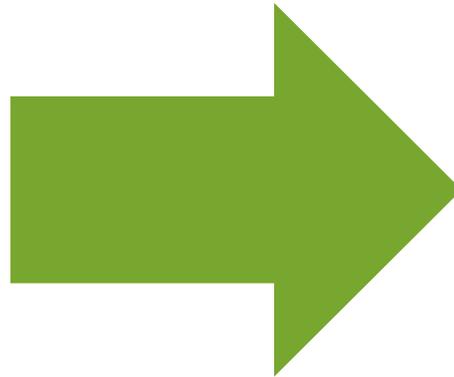


Palm damaged by
Rhinoceros Beetle

LG 8

Chewing Pests

Grasshoppers

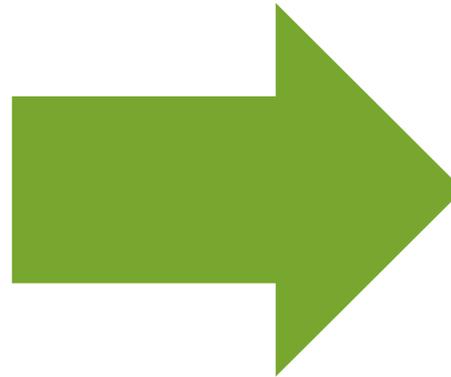


Rough holes edges marked
with bite and chew marks

LG 9

Chewing Pests

Caterpillars

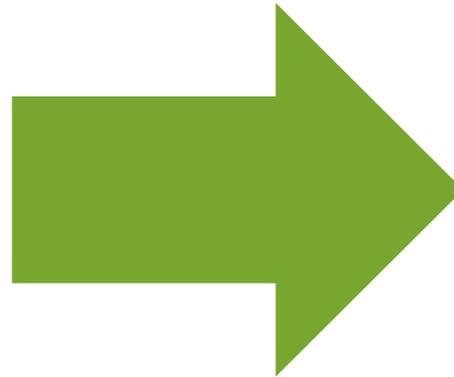


Caterpillars and their droppings on damaged leaves

LG 10

Chewing Pests

Bagworms



Damages by Bagworm

LG 10

Chewing Pests

Snails and Slugs



Leaves damaged by slugs

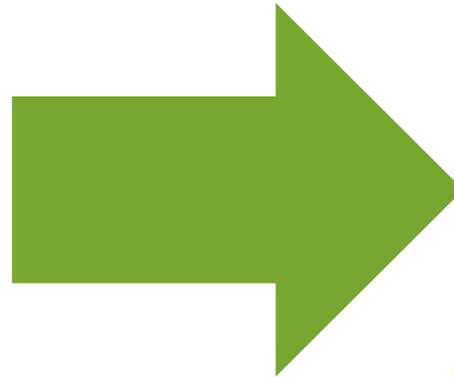


Leaves damaged by snails

LG 11

Chewing Pests

Leaf Miners



Clear winding tunnels in leaves

Caused by plant pathogens:

1. Fungus
2. Bacteria
3. Viruses

Symptoms:

Visible changes in colour, shape and abnormal plant growth.

Leaf Spots



Characteristics

- Spots vary in size and shape
- Usually brown, black, tan, or reddish in colour. Some may have a darker red or black border.

Impact

- Destroy leaf tissue once the fungus enters the leaves
- Leaf spots can spread quickly and cause the plant to wilt or die

Rust



Characteristics

- Easily identified by small spots found on the underside of leaves.
- Upper leaf surface will develop yellow patches and lower leaf surface, small yellow-reddish pustules.

Impact

- Causes spots and blisters on leaves.
- May cause cankers and galls on branches and the main stem.

Powdery Mildew



Characteristics

- White fluffy cotton-strands on both the upper and lower leaf surfaces which can cover the whole leaf.
- Tends to affect plants in shady areas more than those in direct sun.

Impact

- Leaf discolouration.
- Cause plant to show early signs of aging, and leaf falling.

LG 15

Fungus

Soft Rot



Characteristics

- Symptoms of soft rot include soft, wet, rotted, tan or cream-coloured leaves.
- Rotting tissue develops a bad smell.

Impact

- Degrade plant cell, eventually cause plant structure to fall apart
- Stem and leaves will eventually die off
- Rotten plants will tend to attract flies and ants

Sooty Mold



Characteristics

- Grow from the secretion of honeydew produced by aphids, whiteflies or mealybugs
- Plant's twigs, branches or leaves will be covered in a dirty, black soot

Impact

- Cause indirect damage
- In some severe cases, cause stunted growth or early leaf drop



Characteristics

- Enters plants through an opening, usually from insect damage
- Infections tend to show watery symptoms; when an infected plant part is cut, slimy bacterial will ooze out

Impact

- Once it penetrates into the plant, bacteria restrict the plant's ability to access water and nutrients.



Characteristics

- Viruses are parasites, they require a living host in order to grow and multiply
- Spread by the movement of sap infected by viruses

Impact

- Cause leaf infections, resulting in wilted leaves

LG 19

Reporting Pests and Diseases

Information to include:

1. Location of plants
2. Plants name
3. Plant disorders / abnormalities
4. Surroundings



Leaf spot



Caterpillar



Location: Infront of Blk 656 Bt. Batok West
Shrub: *Ficus nitida*
Height: 1 meter



Mealybug

LG 20



Learning Activity 1

At the worksite, form groups of 2-3 to:

1. Conduct an inspection at the worksite to identify pests and diseases using the Plant Inspection Checklist on page 20 of the Learner Guide.
2. Report your group's findings to the trainer.

LG 21

Characteristics of Invasive and Noxious Plant Species



Unwanted and harmful plants that compete for nutrients and water with other plants.

Characteristics:

- Tend to grow fast under harsh environment
- Extensive roots system that spread above or underground
- Fight for growth space and nutrient from surrounding plants

LG 22

Common Invasive and Noxious Plant Species



Mimosa pudica
(Touch-Me-Not or Shame Plant)

Spread by:



Rhizomes

LG 22

Common Invasive and Noxious Plant Species



Imperata cylindrica
(Lalang)

Spread by:



Rhizomes

LG 22

Common Invasive and Noxious Plant Species



Paspalum conjugatum
(Buffalo Grass)

Spread by:



Rhizomes

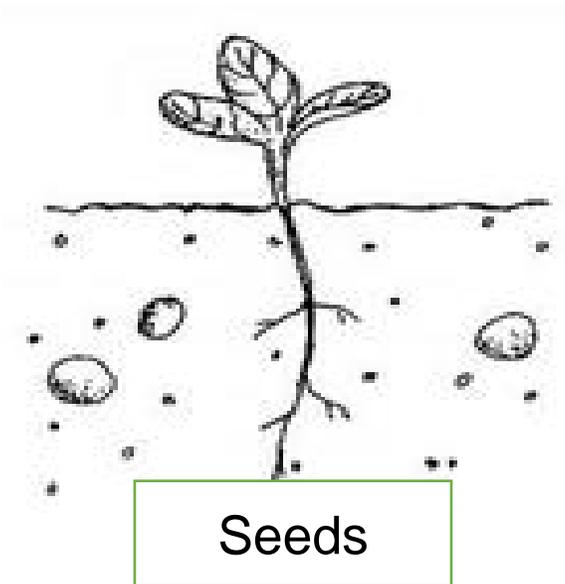
LG 23

Common Invasive and Noxious Plant Species



Plantago major
(Broadleaf Plantain)

Spread by:



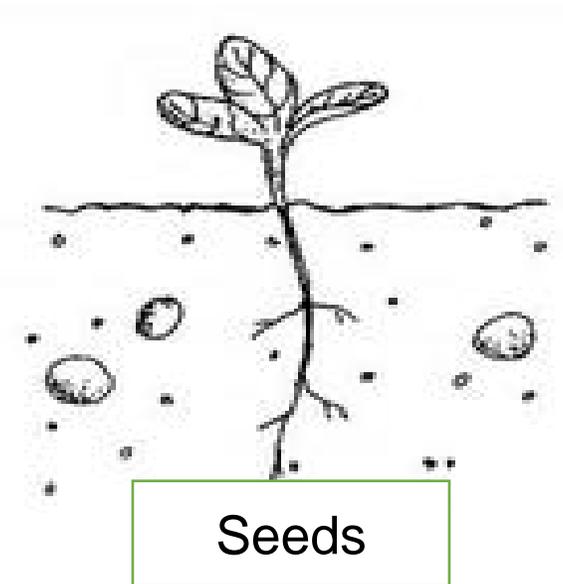
LG 23

Common Invasive and Noxious Plant Species



Tridax procumbens
(Coat Button)

Spread by:



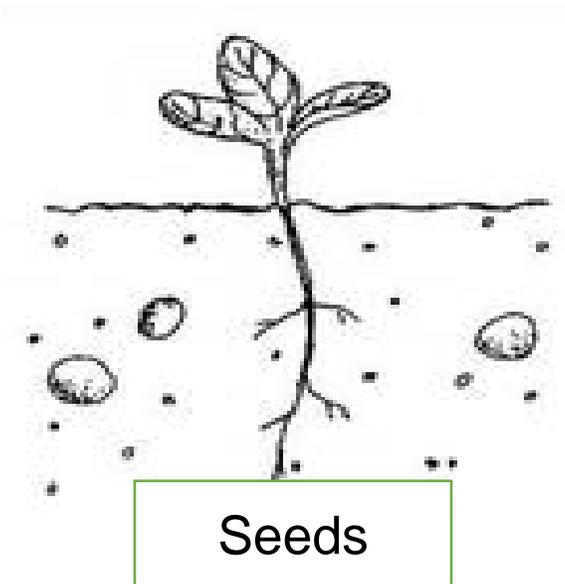
LG 23

Common Invasive and Noxious Plant Species



Euphorbia hirta
(Hairy Spurge, Snake Weed)

Spread by:



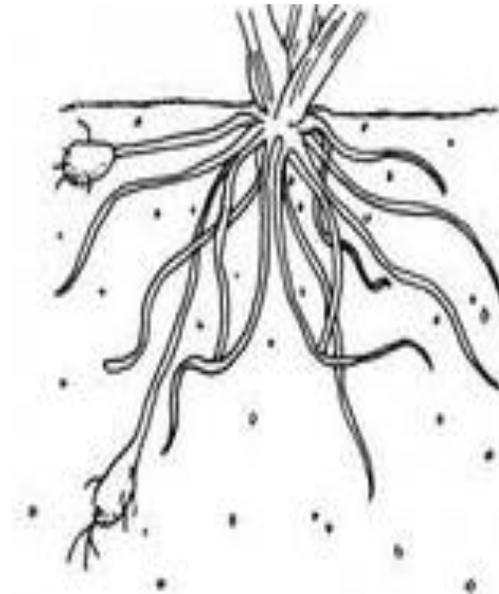
LG 24

Common Invasive and Noxious Plant Species



Cyperus javanicus
(Javanese Flatsedge)

Spread by:



Tubers

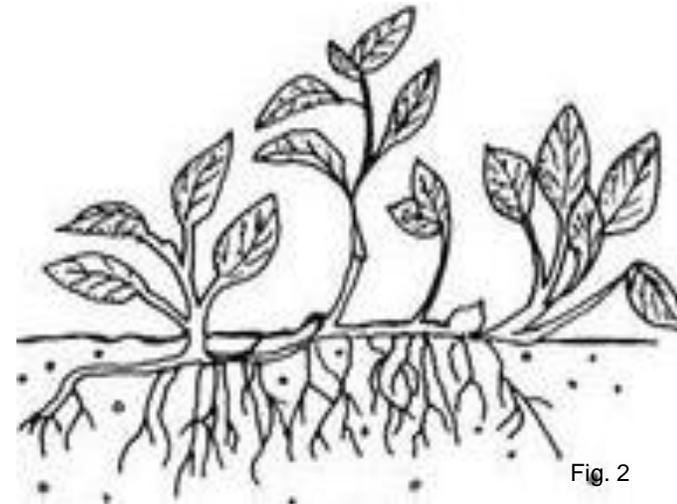
LG 24

Common Invasive and Noxious Plant Species



Chrysopogon aciculatus
(Love Grass)

Spread by:



Stolons

Four main weed control methods:

1. Prevention
2. Cultural
3. Mechanical/Physical
4. Chemical

Prevention

- Do not spread fertilisers or dried grass contaminated with weed seeds on amenity grass.
- Clean machinery to avoid the transportation of weed seed, rhizomes, tubers, and roots.
- If “new” or unfamiliar weed appear, have them identified quickly and take appropriate control measures if necessary.
- Kill “new” weeds that appear.

Cultural

- Use ground covers or canopies to shade out weed species.
- Include re-planting, irrigating, or fertilising to encourage the establishment of a healthy ground to control invasive plants.

Mechanical / Physical

- **Mulching** – prevents the germination of weed seeds
- **Weeding** – manual removal of weeds
- **Mowing** – mow turf to cut off the weeds' reproductive structures and/or reduce food storage and nutrients supply
- **Tillage** – disrupt vegetative and seed reproduction
- **Rotary hoeing** – kill emerged weeds

LG 27

Chemical

Herbicides are used to cut-off or kill weeds.

- ❗ The use of pesticides, which include herbicides, in the cultivation of plants must be supervised by a pesticide operator certified by the Director-General under the Control of Plants Act.



LG 27



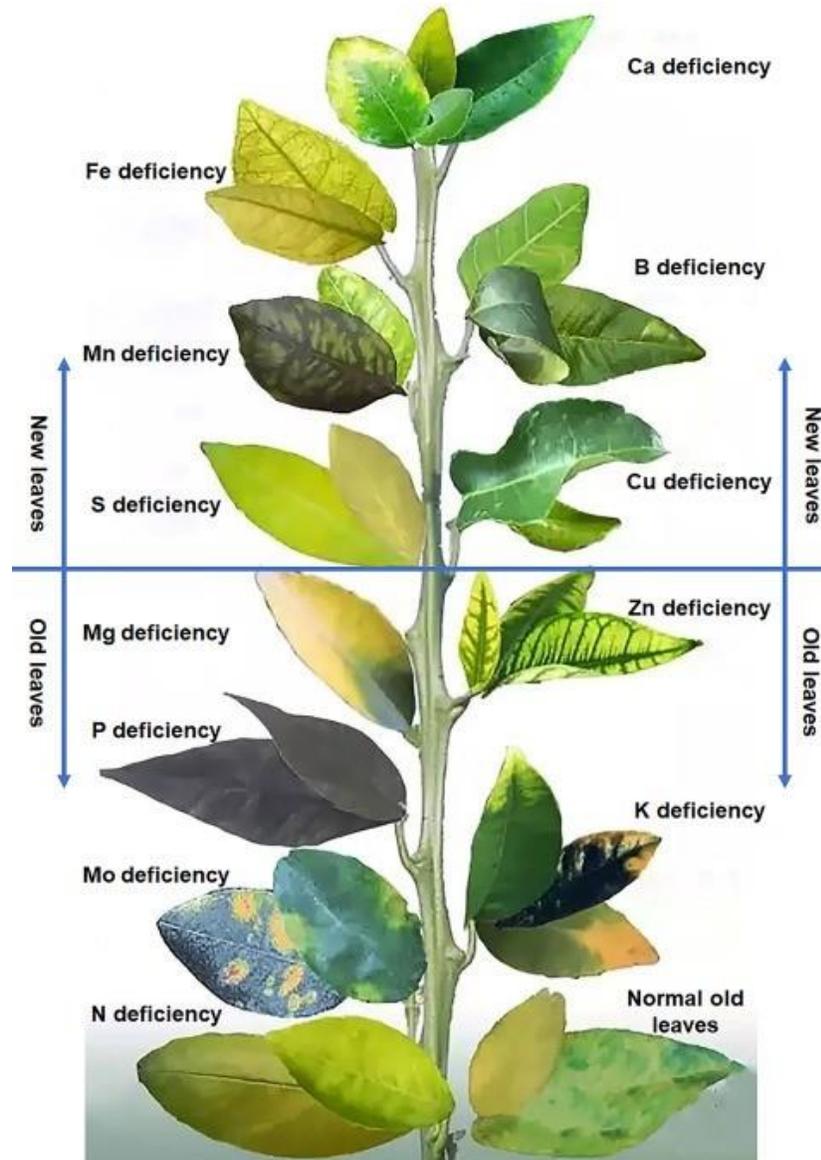
Learning Activity 2

Form groups of 2-3 at the worksite to:

1. Identify two types of weeds
2. Suggest the appropriate remediation measures based on the extent of spread

LG 28

Nutrient Deficiencies in Plants



Plants lacking in nutrients will not grow well and will show different signs to indicate the deficiencies.

Plants require the following essential nutrients for healthy growth:

Macronutrients Plants require a relatively large amount of these	Micronutrients Plants require minimum quantities of these
Nitrogen (N)	Boron (B)
Potassium (K)	Copper (Cu)
Phosphorus (P)	Iron (Fe)
Calcium (Ca)	Manganese (Mn)
Sulphur (S)	Molybdenum (Mo)
Magnesium (Mg)	Zinc (Zn)

LG 29

Signs of Nutrient Deficiencies

Nitrogen (N)

For vegetative growth and production of lush foliage

Signs of Deficiency:

- Leaves turn yellow
- The plant has poor or stunted growth



LG 29

Signs of Nutrient Deficiencies

Phosphorus (P)

- For stronger roots
- Promotes flowering
- Increase stem strength

Signs of Deficiency:

- Purple or bronze discolouration in the upper and lower sides of older leaves



LG 29

Signs of Nutrient Deficiencies

Potassium (K)

- For larger fruit growth
- Increase resistance to diseases

Signs of Deficiency:

- Browning or yellowing on leaf edges of newly matured leaves



LG 29

Signs of Nutrient Deficiencies

Magnesium (Mg)

- Helps plant absorb sunlight for photosynthesis

Signs of Deficiency:

- Older leaves yellowing or whitening between their leaf veins (pale leaves with dark green veins)



Fertilisers are added to plants to:

- Increases the amount of nutrients in the soil
- Help counter soil fertility problems
- Enhance plant growth

Two broad types of fertilisers:

1. **Organic Fertilisers** - made from decaying plants or animal matter
2. **Inorganic Fertilisers** - manufactured artificially from minerals or synthetic chemicals

LG 31

Organic Fertilisers

- Release nutrients as they break down, improving the condition of the soil and its ability to hold water and nutrients.
- Make soil and plants healthier and hardier over time.
- Renewable and biodegradable, therefore, sustainable and environmentally friendly.

Types of Fertilisers



Compost



Bone meal



Seaweed



Chicken manure



Blood meal



Soybean meal

LG 32

Types of Fertilisers

Inorganic Fertilisers

- Provide fast and exact doses of nutrients to meet the specific needs of plants.



Urea



Magnesium Sulphate



Super Phosphate



Potassium Chloride

HEALTHY FOLIAGE	N	
STRONG ROOTS	P	
HEARTY GROWTH	K	

LG 33



Learning Activity 3

At the worksite, form groups of 2-3 to:

1. Identify two plants with nutrient deficiencies
2. Suggest the type of fertilisers that would be appropriate to feed the unhealthy plants

LG 34

Plant Spacing



Plants should be spaced:

- According to their expected width at maturity
- To allow for the plant to develop a well-established root system
- To allow for the plant to receive enough sunlight and not be shaded by other plants that are too close

LG 35

Tools and Equipment to Remove Infested and Diseased Parts

Secateurs

For pruning small branches and stems of up to 2cm thick



Lopper

To cut thicker branches up to about 4cm in diameter



LG 35

Tools and Equipment to Remove Infested and Diseased Parts



Keep pruning tools in good condition by:

- Sharpening them at least once a year
- Clean and oil tools after use to keep them free from rust
- Disinfect tools using alcohol after use on diseased plants
- Store your tools in a dry and protected area, preferably by hanging them on a wall

LG 36 & 37

Personal Protective Equipment (PPE) for Pruning



Safety Helmet



Cotton Gloves



Safety Reflective Vest



Safety Glasses



Safety Boots with steel toe caps

LG 38

Set up a Safe Work Zone

- ⚠ Before commencing work, check that the worksite is cleared of obstacles, obstructions and hazards.

Place barricades around the worksite to prevent unauthorised personnel from entering.



Red-White Tape



Safety Cone



Warning Signages

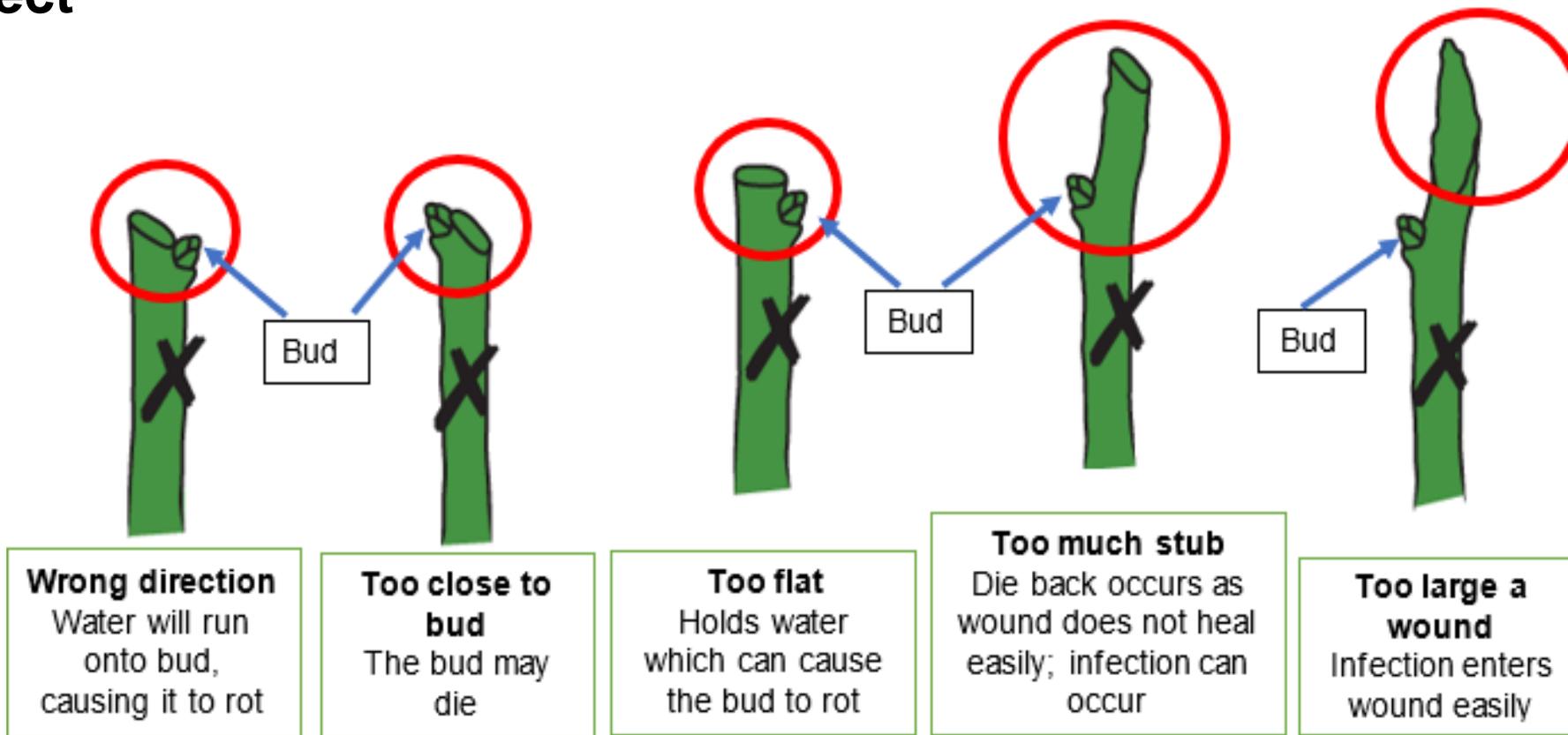
LG 39 **Perform Pruning to Remove Diseased and Infested Parts of Plants**

- Know what to prune and remove from the plant.
- Make clean cuts to remove diseased or infested parts.
- Do not over prune as this may damage the plants or stunt their growth.



Techniques of Cutting Stems and Branches

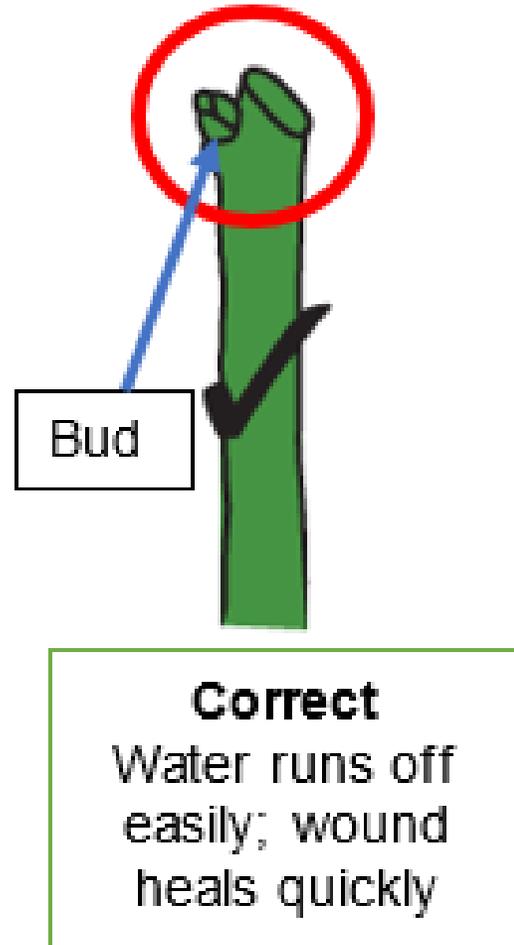
Incorrect



LG 40

Techniques of Cutting Stems and Branches

Correct



LG 41

Proper Disposal of Diseased Plant Waste

Do not mix diseased plant waste with other horticultural waste to avoid cross-contamination.

All diseased plants waste in disposal bags will be collected and dispose off at a Waste-To-Energy Incineration Plant for processing.



Rake



Disposal bag

LG 41



Learning Activity 4

At the allocated worksite, work individually to prune and remove infested portions of plants using the following tools:

1. Secateurs
2. Lopper

Types of chemicals used in landscape maintenance include:

1. Contact Chemicals

Chemicals that kill pest directly upon contact e.g. *fungicides* and *insecticides*

2. Systemic Chemicals

Chemicals that are absorbed by a plant and circulate through the plant's tissue, killing the insects that feed on them e.g. *herbicides*

- Selective herbicides – target specific weed species
- Non-selective herbicides – kill all plants on contact

LG 43

Types of Horticultural Chemicals



White Summer Oil

Kill aphids,
mealybugs, scales
and whiteflies



Malathion

Kill aphids,
mealybugs, mites



Diazinon

Treat leaf spots



Captan

Treat leaf spots,
fruit rots

 All chemicals sold or supplied must come with a Safety Data Sheet (SDS).

LG 44 & 45

Use of Pictograms

Pictogram

Symbol that conveys message without using words.

The Globally Harmonised System of Classification and Labelling of Chemicals (GHS) pictograms are the most commonly used on pesticide labels.



Oxidizers



Flammables, Self Reactives, Pyrophorics, Self-Heating, Emits Flammable Gas, Organic Peroxides



Explosives, Self Reactives, Organic Peroxides



Acutely Toxic (severe)



Burns Skin, Damages Eyes, Corrosive to Metals



Gases Under Pressure



Carcinogen, Respiratory Sensitizer, Reproductive Toxicity, Target Organ Toxicity, Mutagenicity, Aspiration Toxicity



Toxic to aquatic environment



Acutely toxic(harmful), Irritant to skin, eyes or respiratory tract, Skin sensitizer, Hazardous to the Ozone layer.

LG 46

Storage of Pesticides

- Refer to the Safety Data Sheet (SDS) of the chemicals for proper storage and handling
- Store in dry and well-ventilated areas, away from heat and direct sunlight
- Containers should be properly labelled and covered when not in use
- Safety equipment such as fire extinguishers and washing facilities and PPE should be provided in the vicinity of the storage area
- Chemicals should be stored under lock and key, with access given to authorised personnel only



Chemical Application Guidelines

1. Weather Considerations

- Spray during the cooler part of the day
- Do not apply chemicals during hot sunny weather
- Do not apply chemicals before the rain

2. Off-Target Chemical Spraying

- Read and understand the manufacturers' labelled instructions and safety precautions
- Check surrounding areas
- Use the right equipment
- Check weather conditions

LG 48

Prepare for Chemical Spraying

Personal Protective Equipment (PPE)



LG 48

Prepare for Chemical Spraying

Set-up a Safe Work Zone



Red/White Tape



Safety Cones



Warning Signs

Tools and Equipment



Hand held sprayer



Measuring jar



Pail



Horticultural chemical

LG 49 & 50

Steps for Chemical Spraying



Check all equipment

1. Wear appropriate PPE
2. Check that equipment are safe
3. Inspect the plants
4. Make sure the sprayer is in working condition
5. Prepare (mix) the chemicals
6. Pump the sprayer
7. Spray evenly from waist height
Do not spray off-target
8. Do not walk on the sprayed areas
9. Rinse sprayers after use
10. Wash hands with soap

Biological control is a method of controlling pests and diseases using other organisms.

Advantages	Disadvantages
<ul style="list-style-type: none"> • Environmentally friendly, safe for the applicator • Leave no residues • Lasting; no need for continuous reapplication • Host specific • Pests do not become resistant to biological control agents 	<ul style="list-style-type: none"> • Slow acting • Do not completely eliminate pests Possibility of feeding on other plants or insects (non-target species) • Can be costly, e.g. research needs to be done prior to the implementation of the biocontrol strategy

LG 51



Learning Activity 5

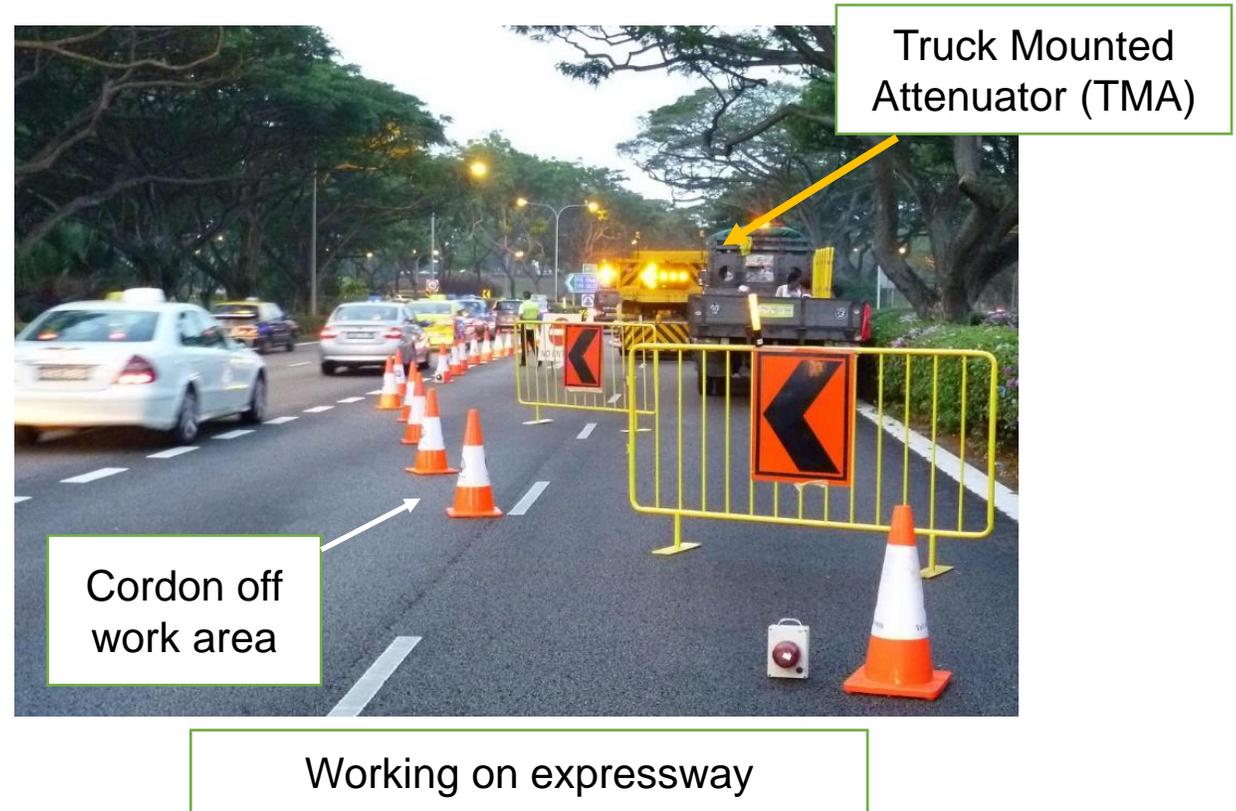
At the worksite, work individually to:

1. Apply chemicals to treat plants for pests and diseases
2. Dispose of used chemicals properly
3. Clean up equipment after use

LG 52

Working at Roadsides

- Cordon off the work area
- Re-direct traffic flow
- Install TMA (for expressway) and placement of warning lights and signages
- Workers must wear luminous vests to enhance their visibility
- Establish the work zone and its removal, especially near fast lanes, expressways, and major roads



LG 53

Heat Stress

- Drink plenty of water
- Wear cooling and protective clothing
- Wear soft hat and sunglasses to block out direct sunlight contact
- Monitor yourself and your co-workers for symptoms of dehydration or heat exhaustion

LG 54

Chemical Exposure

The improper handling or application of chemicals can cause irritation, burns and even affect internal organs.

Observe the following when handling chemicals:

- Read the chemical label and follow manufacturers' instruction on usage, quantity, storage and disposal.
- Put on the appropriate PPE, especially when working with liquid chemicals.
- Ensure there is a first aid box available at the worksite.

Practical Exam (90 minutes)

- a. Identify and report one pest infestation or disease.
- b. Identify one invasive species, assess the extent of spread and recommend an appropriate remediation method.
- c. Identify one plant with nutrient deficiency; suggest the possible nutrient that is lacking.
- d. Put on the appropriate PPE, set up a safe worksite and select the appropriate tools, equipment for plant pruning and chemical application.
- e. Perform plant pruning and chemical application.
- f. Reinststate the worksite and dispose of horticultural waste and leftover chemical.
- g. Clean and store tools and equipment properly.

Oral Questioning (30 minutes)

- 10 questions