LESOTHO NATIONAL FARMER UNION

Make farming a business enterprise
Elsa temo khoebo

Vegetable And Fruit Tree pest and disease Compendium

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الاستثمار في السكان الريفيين

Acknowledgements

We would like to thank Famers Organization For Africa, Caribbeab and Pacific Countries for supporting the production of this manual.
Our gratitude also goes to EU, IFAD, and ACP for the financial support to the farmers organization.

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August, 2022

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Integrated Pest Management (IPM)

• IPM considers all available pest control techniques and other measures that discourage the development of pest populations, while minimizing risks to human health and the environment.

• It involves pest monitoring, selection and combination of control measures and judicious use of pesticides.

Intergratede Pest Management Approaches And Strategies

1. Scouting for pests

- Farmers are required to regularly scout for the presence of pests and diseases, and their damage /symptoms.

- They should also monitor whether the pest population is increasing or not.

- Early detection of the pests helps the farmer to minimize the pest outbreak.

- Scouting can be done through crop assessment and observations.

- Farmers can use sampling if the field is big by moving in a zigzag manner in the field.

- Farmers should properly identify the pest. This manual should be used as a guide to pest identification.

2) Monitoring Traps

• Traps can be used for detection of pests, monitor pest population and to reduce pest population.

PHEROMONE TRAPS

Delta trap

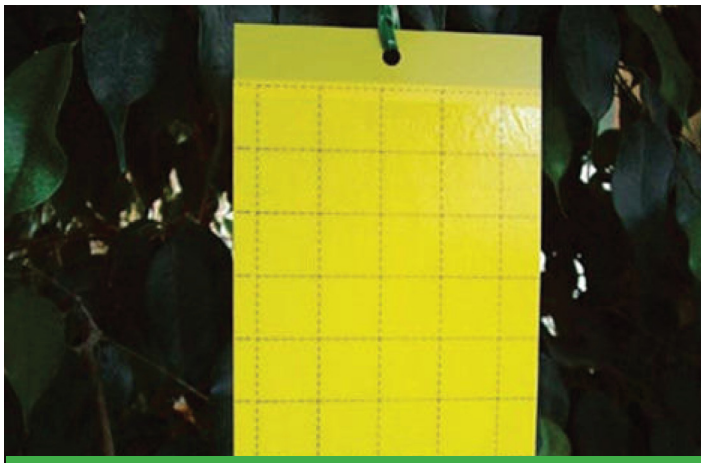
Funnel bucket trap

• Pheromone traps are available for monitoring some insect species such as army-worm, *Tuta absoluta*, fruit fly and others.

• The traps are baited with a lure that mimics the odor given off by female insects to attract males for mating.

• Therefore, these traps attract and trap male insects. Trapping of males does not only reduce the population of males but they also disrupt mating leading to fur-ther reduction of pest population.

Sticky Traps



Netted sticky trap

Different insect pests caught in the sticky trap

• Some insects are attracted to bright yellow or other colours.

• Coloured sheets of plastic or cardboard are coated with a glue.

• These traps are normally used in protected structures where glue is not exposed to harsh environmental factors that may reduce its efficacy.

• Sticky traps attract both males and females.

NB: The numbers obtained from scouting and traps must be used in pest control decision making.

3) Cultural control

• It involves management practices that make an ecosystem less friendly to the pest and diseases.

They include:

A. Sanitation

- It involves the removal of weeds and volunteer crops as they harbour insect pests and diseases.

B. Irrigation and fertilization

- Improve crop health and vigor which help crops to have better tolerance to pest damage.

C. Certified pest-free plants and seeds

- It is very important to plant healthy disease free plants and seeds from reliable sources.

D. Crop rotation

- The rotation of vegetable crops helps to control many insects and diseases such as club root on cabbages.

4) Physical / Mechanical control

- Mechanical may include tilling of land to expose eggs, pupa and larva to harsh climatic conditions.

- Physical control includes hoeing for weeds, hand picking insects placing traps and creating barriers such as protected structures (plastic tunnels and shade nets).

5) Ecological pesticides

- These are pesticides that are not synthetic therefore they are less harmful to the environment.

They include:

- Repellents(crushed hot peppers/ garlic sparys)

- Soaps such as green bar soap (They deter insects from feeding)

- Microbial insecticides like Bt pesticides

6) Chemical control

In chemical control, different synthetic pesticides are used to control pests and diseases.

Pesticides should be used when it is absolutely necessary and it should be based on:

1. The type of pest

- Major pests may require chemical control even if their numbers are low. For example, *Tuta absoluta* ,Bagrada bug, diamond back moth, aphids and others.

- Minor pests populations do not increase drastically and they cause insignificant or indirect damage; therefore, they may not require chemical control.

These insect pests include; stinging bug and others.

2. Season of planting

Some insects that are considered as major pests, may not require chemical control because of the environmental conditions which may not favour their development. For instance; Bagrada bug populations are high in summer vegetable production and lowest in late fall. Therefore, growing leafy vegetables such as mustard in late fall won't require the use of chemicals for this insect pest management.

Examples of synthetic pesticides

• Synthetic chemicals that controls insect pests include, lambda, methomex, karate zion, attake, malathion, garden ripcod, karbadust, alphathrin, avalanche, bulldog, snaiban, chloropyfos, cypermethrin and others.

• Those that are used to control plant diseases include folicur, bravo, dithane, virikop, mancoceb, lime sulfur, zineb, thiram and others.

Pesticides must be used judiciously as they can:

- Cause diseases and complications such as cancer, infertility, children born with disability, respiratory diseases, dermatological diseases and others.

- They pollute the environment and kill non-target organisms such as fish, earth worms and beneficiary insects.

- Insects can develop resistance against some of these pesticides.

Management Of Pesticide Resistance Development.

Causes of resistance:

1. Prolonged use of single insecticide.

2. Using higher doses than recomended.

3. Frequent use of insecticides.

Proper use of insecticides to avoid resistance:

1. Spray only when necessary based on monitoring and scouting.

2. Use cultural, physical mechanical, behavioral (traps) and ecological pesticides to management tactics to minimize the use of synthetic pesticides.

3. Rotate synthetic pesticides with different active ingredient and mode of action.

4. Use the recommended dosages of pesticides.

Safety precautions when using pesticides:

- Always wear protective clothing when using pesticides.

- Read the label on the required protective clothing and safety measures.

- Don't eat or smoke during spraying.

- Don't spray pesticides on windy days.

- Don't re-use pesticide containers.

- Don't decant pesticides into food containers.

- Don't leave pesticide containers in the fields after spraying.

- Don't use children for spraying pesticides.

Diseases of vegetables

- For a disease to develop there should be a virulent pathogen, a susceptible host and conducive environment.Due to high altitude of Lesotho the environment does not support or partially support disease development of most pathogens hence there are less chances of disease outbreaks
- Farmers are urged to prioritize on preventative measures of disease management than control measures since for some diseases there are few or no chemicals locally to control them.
- Always read the seed package for the information regarding disease tolerance and resistance of the seed before purchasing.

Black leg

Affected Leaves

Affected Roots

Host vegetables: cabbage

Crop stage affected: at any stage but more critical at seedling stage.

Symptoms:

• The leaves of infected seedlings will have grey lesions with pinprick black spots.

• Crops will develop a reddish colour and eventually topple over.

• Stem just above the ground will be purplish, when cut diagonally towards the root and a blackening under the skin will become visible.

Favourable conditions: it prefers moist, warm and humid conditions.

Prevention:

• Use of resistant cultivars

• Certified seeds

• Manage weeds as they can act as alternative host.

• Practice crop rotation

Control:

• Burn or burry deep infected crops

• Spray seedlings with the systemic fungicide like benomyl and others

Black rot

Black rot symptoms

Damage

Host vegetables: cabbage, kale, broccoli, cauliflower.

Crop stage affected: maturity stage

Symptoms:

• Yellow v-shaped lesions that goes towards the base of the leaf resulting into wilting.

• Blackening of the veins within lesions
Favourable conditions: it prefers warm and wet conditions and it is more prevalent in late summer.

Prevention:

• Use of resistant varieties

• Control insect pests as they transmit the disease.

• Increase space between the crops to allow air circulation.

• Avoid planting late maturing varieties.

• Clean tools after using

Club Root

Wilting Leaves

Infected Roots

Host crops: cabbage, chinese cabbage

Crop stage affected: at any stage

Symptoms:

- Wilting of crops in patches during the day when it is hot.
- The roots are grossly swollen and mis-shapen when uprooted.
- Infected young plants die.
- Older plants become unproductive

Favourable conditions: acidic soils with high soil moisture and warm temperature.

Prevention:

- Use certified seeds
- Use resistant varieties
- Apply agricultural lime to reduce soil acidity.
- Clean farm implements before using them on another field.
- Uproot infected crops before they rot.
- Practice crop rotation

Bacterial Leaf Spot

Bacterial leaf spot Symptoms on leaves

Host plant: lettuce, beetroot, eggplant, carrots, peppers, pumpkins.

Crop stage affected: all growth stages

Symptoms:

- Water-soaked lesions mainly on older leaves.
- Later they develop into irregular brown to dark blotches or spots with a lighter border.

Favourable conditions:

It prefers warm and humid weather conditions and swampy croplands. It is a problem in late summer.

Prevention:

- Avoid overhead irrigation since it promotes the spread the disease.
- Use certified seed
- Application of copper fungicide before the infection occurs.
- Control weeds.
- Practice crop rotation

Control:

- Remove infected crops or leaves.
- Burn infected crop residues or bury them deep.

Damping Off

Infected Seedling

Infected Seedling falling over

Host: cabbage, lettuce, cauliflower, tomato
Crop stage affected: seedling stage

Symptoms:

- Poor emergence
- Stunted young seedlings
- Leaves and seedling stem show signs of wilt.
- Newly emerged seedlings are discoloured to greyish or brownish.
- Seedlings may emerge but fall over and die.
- Some infected seedlings fail to emerge after germination.

Favourable conditions: moist, warm and humid weather conditions

Prevention:

- Use certified seeds
- Avoid crowded seedling seedbeds
- Avoid over watering seedlings and using overhead irrigation.
- Clean garden tools thoroughly after use.

Bacterial Soft Rot

Infected pepper

Damaged Cabbage

Host crops: cabbage, chinese cabbage, lettuce, onion, sweet pepper.

Crop stage affected: all growth stages.

Symptoms:

- Infected heads and fruits are watery and often have complete head rot.
- The affected area becomes soft and mushy and turns dark in colour.
- Eventually the whole plant rots and decays.

Favourable conditions: it is active over a wide range of temperatures but prefers warm, moist weather conditions.

Prevention:

- Tools should be washed after use
- Frequent over-head irrigation during head formation should be avoided.
- Avoid waterlogged soils.
- Use certified seeds.
- Reduce mechanical operations such as weeding during wet conditions.
- Practice crop rotation.
- Control insects as they transmit the disease.

Downy Mildew

White downy growth

Chlorotic Spots

Host plants: most vegetables.

Crop stage affected: seedling, vegetative, reproductive and post-harvest stage.

Symptoms:

- Downy growth which is normally white or grey bloom underside the leaf.
- Chlorotic spots on the leaves.
- Necrosis of the leaves.

Favourable conditions: cool and moist weather conditions.

Prevention:

- Use of resistant varieties.
- Avoid overhead irrigation.
- Make enough space between plants to allow air circulation.
- Control weeds.
- Practice crop rotation.

Control:

- Applications of fungicides such as funginex, kumulus and virikop.
- Destroy infected plants

Powdery mildew

Powder on the leaf

Pots and stems infected

Leaves dying

Host plants: peppers, pumpkins, tomato, beans and most vegetables

Crop stage affected: seedling, vegetative and reproductive stage

Symptoms:

- Appearance of spores or patches of white greyish powdery
- Powder covers the entire leaf and even other organs
- As the disease progress they turn yellow brown and finally black

Favourable conditions: they are severe in warm dry climates with high humidity. Usually severe in autumn and in tunnels.

Prevention:

- Use resistant varieties
- Use certified seeds
- Practice crop rotation
- Irrigate crops regularly to avoid water stress

Control:

- Remove and destroy crop debris after harvest
- Apply recommended fungicides such as funginex, kumulus and virikop

Mosaic Virus

Infected tomato leafs are mottled with yellow spots and malformed tomato fruits

Host plants: cucumber, tomatoes, cauliflower, lettuce, common bean

Crop stage affected: all growth stages

Symptoms:

- Infected leaves are mottled with yellow, white and light or dark green spots and strikes, which appear to be elevated
- Stunted growth or poor growth
- Leaves maybe crinkled or wavy,
- Malformed fruits

Favourable conditions: symptoms are more severe at moderately warm temperatures

Prevention:

- Use certified seeds
- Control insect pests and weeds
- Use resistant varieties
- Clean and disinfect tools after use

Control:

- Remove infected plants and destroy them.

Leaf Roll Virus

Potato Leaves Rolled Upwards

Tuber With Internal Necrosis

Host: sweet potato, tomato

Crop stage affected: seedling and vegetative stages.

Symptoms:

- The leaves curl or roll upwards
- Stunted growth
- Reduced tuber size and number per plant.
- It causes internal necrosis of tubers

Favourable conditions: it prefers warm weather conditions. It is mostly prevalent in spring and summer.

Prevention:

- Control insect pest that transmit the disease (aphids).
- Grow quality or certified seeds
- Practice crop rotation
- Control weeds

Control:

- Roguing that is uprooting plants exhibiting symptoms before disease can spread further

Fusarium wilts

Tomato leaves turned yellow

One sided wilting of tomato plant

Host plants: tomato, sweet potato, legumes

Crop stage affected: seedlings but mostly during reproductive stage

Symptoms:

- The leaves turn yellow and the lower ones die first
- Wilt is one sided
- If the stem is cut the tubes appear brown or reddish

Favourable conditions: it thrives in warmer dry weather conditions,

Prevention:

- Use certified seeds
- Grow resistant varieties
- Practice crop rotation
- Plant crops in well drained soils

Control:

- Apply farm yard or manure
- Rouge out and destroy crops that show early symptoms
- Clean and disinfect farm tools after use

Bacterial wilt

Rapid wilting of the whole eggplant

Roots turned brown

Host: eggplant, tomato, irish potato, peppers

Crop stage affected: vegetative and reproductive stages

Symptoms:

- The first signs of wilting show on the youngest leaves
- It causes rapid wilting of the whole plant
- It usually collapses and dies without any yellowing or spotting of the leaves
- Extra roots may develop at the stem,
- Roots turn brown
- May become soft and slimy in wet conditions

Favourable condition: warm weather, temperatures above 18oC, sandy and gravel soils are more preferred, high soil pH, and it is prevalent in summer

Prevention:

- Grow resistant varieties
- Apply sanitation measures such as removal weeds and use clean irrigation water.
- Plough under residues immediately after harvest.

Control:

- Remove wilted plants to avoid the spread of the disease

Purple Blotch

Purple blotches

Leaves folding and decaying

Host: onion, leek, garlic

Crop stage affected: all growth stages

Symptoms:

- Water-soaked spots on the leaves, which become oval and turn brown or purple
- Older leaves fold due to damage

Favourable conditions: it favours warm and moist conditions

Prevention:

- Use certified seeds or disease free seeds
- Practice proper spacing of plants
- Weed regularly
- Avoid excessive nitrogen fertilizer applications
- Practice crop rotation for at least three years before growing onions or susceptible host again on infected field
- Control insect pest (onion thrips) as they vector the disease

Control:

- Remove and destroy infected plants
- Burry deeply infected debris

Common Scab

Infected tubers

Scab on potatoes

Host: Potato

Crop stage affected: all growth stages

Symptoms:

- It makes rough, sunken lesions on the tubers or shows deep or shallow scabs on tubers
- The tissue become corky and warty with shallow to deep holes and are necrotic as the infection progress

Favourable conditions: warm, dry weather conditions.

Prevention:

- Plant only certified seeds
- Irrigate often to keep the soil moisture at a level good for plant growth
- Practice crop rotation of 3 to 6years with legumes
- Avoiding using wood ashes, fresh animal manure or excessive lime as it prefers alkaline soils

Black scurf

Infected Potato Tubers

Host: Potato

Crop stage affected: vegetative stage

Symptoms:

- Raised, hard, black patches on the tubers
- Irregular size or shape, on the surface of the tuber

Favourable conditions: it favours cool, moist conditions but, it can also be prevalent in dry light soils and tends to occur late summer and autumn

Prevention:

- Use certified seed tubers
- Harvest early
- Practice crop rotation
- Irrigate plants during dry periods

Early blight

Early stage

Advanced stage

Diseased tuber

Host: potato, tomato

Crop stage affected: all growth stages

Symptoms:

• The disease starts at the base of the crop going upwards

• Infected leaf has circular lesions, dark, concentric circles are found within the lesions.

• Infected leaves eventually wilt, die and fall off.

• Infected stem has small, dark slightly sunken areas that enlarge to form elongated spots with lighter coloured centres.

• In tomatoes during flowering stage it causes the blossom to drop.

• Fruits that are infected have dark leathery sunken spots.

• Infected tuber surface lesions that appear a little darker.

Favourable conditions: it requires high relative humidity, moist, warm temperatures for its development. More prevalent in summer

Prevention:

• Use disease free seeds and seed tubers

• Practice crop rotation at least two cropping season after having infection.

• Remove weeds

• Harvest potatoes when the soil is not wet

• Practice recommended spacing

Control:

• Burry deeply infected plant residues
• Spray Dithane M45 and copper as mixture

Late blight


Infected leaves


Infected tomato


Infected potato

Host: Potato, tomato (alternative host, eggplant and peppers)

Crop stage affected: seedling, vegetative and productive stages

Symptoms:

• Newly infected leaves have dark-green water-soaked small lesions as the disease progress appear as brown spots, with each spot surrounded by yellow green margin

• Infected potato tuber has irregularly shaped and slightly depressed brown to purplish lesions on skin.

• Infected young tomato fruits have brown bumps with lesions that are large, irregular and greenish brown

Favourable conditions: moist and cool temperatures and high relative humidity. Most prevalent in autumn

Prevention:

• Grow potato tubers that are resistant to disease
• Plant disease free seeds and tubers

• Practice recommended spacing of plants

• Control weeds

• Properly remove infested potatoes or tomatoes and destroy volunteer plants

• Use bravo, mancozeb and dithane as prevantetive sprays

Common blight

Infected leaves

Infected pods

Host: green beans, common beans, peas

Crop stage affected: All growth stages

Symptoms:

- Water soaked, often angular shaped spots on leaves, they gradually grow into large brown spots of dead tissue
- On pods spots are circular, slightly sunken, water-soaked and dark green in colour
- On stem water-soaked spots turn red brown in colour, stems maybe girdled, leading to wilting
- On seeds they become yellow or brown coloured spots

Favourable conditions: warm, humid weather, with or without rain and it is most prevalent in mid-summer but it can still infect plants in autumn

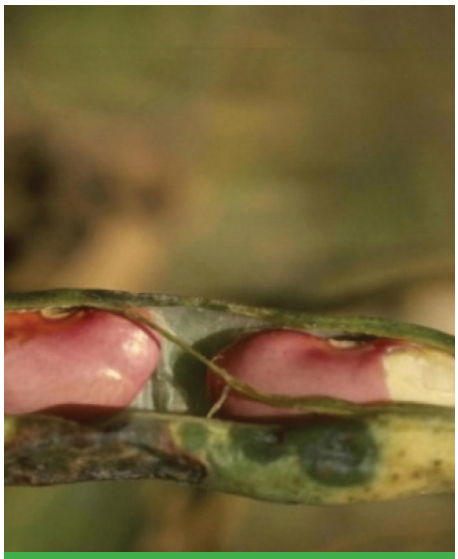
Prevention:

- Use certified seeds
- Crop rotation of 2 or more years between bean crops
- Avoid overhead irrigation
- Control weeds and insect pest
- Clean and disinfect garden tools after use.
- Burn or burry deeply infected crop debris

Halo blight

Infected leaves

Leaves dying



Infected bean pod

Host: green beans, beans

Crop stage affected: all growth stage

Symptoms:

- It starts as small necrotic water-soaked lesions that become surrounded by prominent light green halos
- The newly emerging leaves take on light green to yellow colour
- Heavily infected plants maybe defoliated
- Pods show circular water-soaked spots
- Seeds in infected pods can be discoloured, shriveled and small

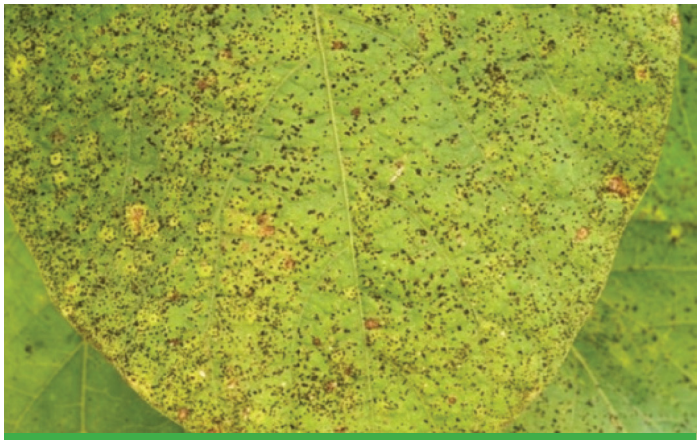
Favourable conditions: humid, moist conditions and moderate temperatures and it is prevalent in late summer to autumn

Prevention:

- Plant certified seeds or disease free seeds.
- Avoid overheard irrigation
- Practice crop rotation of 2years or more with non-legume crop
- Grow resistant varieties
- Control weeds and control insect pest
- Burn or deep plough infected debris

Rust

Light coloured spots



Brown postulates

Host: green beans, beans

Crop stage affected: vegetative stage

Symptoms:

- It starts as light-coloured spots mainly on the underside of the leaves and later develops into brown postulates
- Leaves fall off and pods get deep dark pits

Favourable conditions: frequent rains, cool or mild weather conditions and high relative humidity and poor sanitation, and it appears between late summer and autumn

Prevention:

- Practice crop rotation
- Use certified seeds
- Control weeds
- Clean and disinfect garden tools after use

Control:

- Remove infected leaves
- Remove and destroy infected crop debris or burry them deep
- Spray fungicides like Folicur and Abacus at the early development of the disease

Bacterial Canker

Infected plant

Symptoms on stem

Symptoms on ripe fruit

Host: tomato, sweet pepper, peppers

Crop stage affected: all crop stages

Symptoms:

- Wilting and dying of older leaves that stay attached to the plant
- Cut infected stems will show yellowish-brown discolouration in the tissue
- On the fruits there are light-coloured spots with a brown centre

Favourable conditions: it is most active when it is moist and warm temperature and it is prevalent in summer

Prevention:

- Use certified seeds
- Practice crop rotation of at least 3years after infestation
- Avoid overhead irrigation where possible as it helps in spread of the disease
- Avoid working in tomato fields when is wet
- Clean tools thoroughly after use
- Rogue out affected plants and burn them
- Destroy or burry deeply other crop residues

Anthracnose

Infected pepper

Infected Tomatoes

Host: tomato, potatoes, peppers

Crop stage affected: all plant growth stages

Symptoms:

- Small, slightly sunken circular spots develop on the ripe fruit, as the disease spread, the spots crack and open
- Leaf and stem of the infected plant do not show any clear symptoms

Favourable conditions: moist and warm weather conditions

Prevention:

- Use certified seeds
- Remove lower leaves and mulch the soil to avoid splash
- Avoid overhead irrigation as this lead to spread of the disease
- Harvest fruits before they are fully ripened
- Remove severely infected plants

Vegetables Insects

Cabbage Aphid

Aphid Colonies

Rolled Leaves

Type of pest: It is a sap sucking insect pest.

Host: Cauliflowers, broccoli, cabbage, English giant and kale

Damage: Suck cell sap and their feeding may cause rolling, twisting or bending of leaves. Heavily attacked leaves can turn yellow and eventually wilt.

Stage of crop attacked: All stages.

Environmental condition: They are most abundant in dry and warm seasons.

Prevention

- Remove alternate hosts, such as mustards and related weeds around field borders.

- Destroy crop remnants immediately after harvest

- Be sure transplants are pest-free before taking them to the field.

- Remove and destroy infested plants in the field early in the crop cycle.

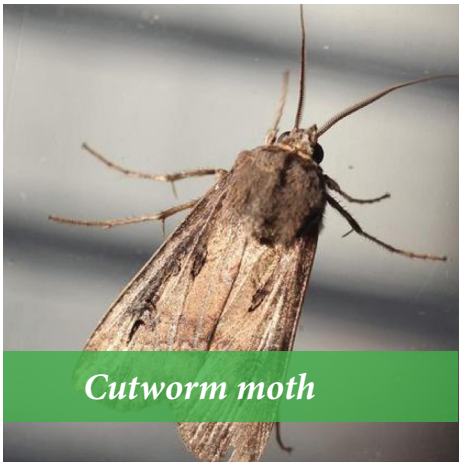
Control measures (IPM measures)

-Use soap-ash sprays

-Conserve and maintain natural enemies such as the ladybird beetle by avoiding usage of broad-spectrum pesticides.

- Use pesticides such as malathion, methomex, Aphicide, malasol, and others however they might kill the natural enemies.

Cutworm



Cutworm moth

Cutworm larvae

cut cabbage seedling

Type of pest: Chewing pests that emerge at night, causing serious damage by cutting young plant stems at the base.

Host: Almost all cultivated crops.

Damage: Feed on the seedling stem just above ground and cut the plant.

Stage of crop attacked: Seedling stage

Environmental condition: Thrives well in warm conditions. Its abundant in late spring to autumn.

Prevention

- Destroy crop remnants immediately after harvest.

- Fields need to be prepared and weeds eliminated at least two weeks before planting to reduce cutworm numbers.

- Winter ploughing help to expose the larval and pupal stages to predation and desiccation.

Control measures (IPM measures)

- Small infestations can be controlled by digging near the damaged seedlings to find and kill the individual larvae.

- Use pesticides such as , attacke, cypermethrin, Karate, lambda, and others.

Cabbage web worm

Moth

Larvae

Damaged cabbage

Types of pest: Chewing pest that often hides behind a web of silk and masses of frass (insect faeces).

Host: cabbage, broccoli, kale, mustard, radish, turnip.

Damage: Feeds on buds and growing tips and this prevent head formation as illustrated above.

Stage of crop attacked: Seedlings and mature plants

Environmental condition: Prefers warm weather conditions.

Prevention

- Destroy crop remnants immediately after harvest.

- Fields need to be prepared and weeds eliminated at least two weeks before planting to reduce cutworm numbers.

- Winter ploughing help to expose the larval and pupal stages to predation and desiccation.

Control measures

- Hand picking and squashing larvae can prevent crop damage on small plots.

- Use pesticides such as , attacke, cypermethrin, Karate, lambda, and others.

Snail and slugs

Slug

Slug and snail damaged cabbage

Types of pest: Chews holes in the leaves and the feeding is most intense at night or during rainy days.

Host: Cabbage, lettuce, Beans and tomatoes.

Damage: They create irregular holes with smooth edges on leaves and flowers.

Stage of crop attacked: Vegetative stage

Environmental condition: Thrives well in cool to warm condition. They prefer swampy and shady areas.

Prevention

- Swampy areas should be avoided for cabbage production.

- Use drip irrigation to reduce humidity and moist surfaces, making the habitat less favorable for these pests.

Control measures (IPM measures)

- Use insecticide snail bait if infestations are high and affecting yield. Place a deep trap (yogurt container) with the rim at ground level baited with either beer or yeast and sugar mixture. Empty and refill every couple of days.

- Hand-picking on regular basis.

-Use the following pesticides; sluggem pellets, snailban and snailflo.

Grasshoppers and locusts

Adults and nymphs

Damage

Type of Pest: Chewing pests hop from plant to plant

Host: Cabbage, lettuce, beans

Damage: they tear away plant tissue; they chew large holes in leaves. When populations are high they can devour garden plant

Crop stage attacked: all crop stages

Environmental conditions: they prefer warm and humid weather conditions. They are abundant from early summer to late automn

Prevention:
- Control grassy weeds as they are preferred as alternative host plants by the grasshoppers

- Keep green border of tall grass plants around the garden to trap insects and divert them from vegetables

- Cultivate in spring three times before planting to destroy overwintering eggs

- When numbers are low, they can be hand picked

- Apply garlic spray (blend two cups of garlic with 10 cups water, boil the mixture, and let sit)

- Apply insecticides in case of outbreak overnight

Pumpkin fly

Pumpkin fly

Fly maggots

External damage

Type of pest: It lays the eggs in the fruit and upon hatching they produce destructive larva.

Host: Squash, pumpkin, and watermelon, cucumber.

Damage: Oviposit in ripening fruit resulting into fruit infestation by larvae (illustrated) and can cause the pumpkin to rot.

Stage of crop attacked: Fruiting stage

Environmental condition: Pumpkin fly prefers warm conditions.

Prevention

• Remove debris and old squash plants serve as shelters for the flies.

• Deep ploughing in winter is recommended as this will damage pupae in the soil.

Control measures (IPM measures)

• Chemical control of squash bug nymphs, can be achieved with foliar applications of pyrethroids such as cypermethrin and lambda-cyhalothrin and others.

Squash Vine Borer

Adult vine borer

Larvae

Attacked Pumpkin

Types of pest: Destructive chewing pest

Host: Squash, pumpkin, and watermelon, cucumber

Damage: Squash vine borer larvae tunnel into vines to feed. The larval feeding destroys plant vascular tissue and interrupts the flow of water and nutrients from the roots to the developing fruit. This results into wilting and death of the plant

Stage of crop attacked: All stages of the crop cycle

Environmental condition: They prefer warm weather and emerge in Spring.

Prevention

- Grow resistant varieties such as butternut squash.
- Remove or burry deeply the squash debris to avoid pest buildup.

Control measures (IPM measures)

- Pheromone traps can be used to disrupt mating.
- Use insecticides such as cypermethrins, and attacke to control the borer. Spray timing is critical because the larvae begin to tunnel into the stem within hours of hatching from eggs.

Squash bug

Adult bug

Bug and eggs

Damage on leaves

Type of pest: Piercing and sucking insect

Host: Squash, pumpkin, and watermelon

Damage: Inject toxins as they suck the sap. The toxins can cause the complete wilting of young plants. Bugs prolonged feeding on the plant results in leaf necrosis, fruit rot, and plant death.

Stage of crop attacked: All stages of the crop cycle.

Environmental condition: Squash bugs are most abundant in warm seasons.

Prevention

• Field sanitation should be practiced to reduce debris and old squash plants serving as shelters for squash bugs.

• Crop rotation with non-host crops is important in the management of this pest since it eliminates host plants on the farm.

Control measures (IPM measures)

• For chemical control of squash bug nymphs, can be achieved with foliar applications of pyrethroids such as cypermethrin, lambda-cyhalothrin, and attacke and others

Bagrada Bug

Male (Small) & Female (Big)

Mild Damage

Severe Damage

Types of pest: Destructive piercing and sucking pest mostly found mating as illustrated above.

Host: Broccoli, cauliflower, cabbage, mustard, kale, turnips, radishes, English giant.

Damage: The feeding result into small puncture marks and the plant become stunted. Affected leaves wither and young plants may even be killed if the attack is severe.

Stage of crop attaked: All crop stages

Environmental condition: This pest thrives well in warm conditions. In young Cole crop fields, bugs may be found at the plant or soil interface during early morning and late afternoon when temperatures are cooler.

Prevention

• Remove and destroy debris or sprouting stumps left in the field as they can provide refuges for previous infestations

• Rotate crops so that susceptible plants are not grown in successive seasons.

Control measures (IPM measures)

- Bugs can be removed by hand and destroyed in low infestations or small plots.

- Watering and irrigation will discourage bugs.

- Growing repellent plants such as garlic, onion or parsley near the crop

-Pesticides that can be used are malathion, methomex, karate zion, lambda, attacke and others (rotate or keep on changing the products to avoid resistance development

Diamond back moth (DBM)

Moth

Larvae

Damage

Type of pest: This moth produces aggressive and very destructive larvae.

Host: Broccoli, cabbage, cauliflower, kale, mustard, radish, and turnip.

Damage: Mine in the leaf tissue, feed on all plant parts and often feed around the growing bud of young plants. They create irregular holes, sometimes leaving the upper surface of the leaf in place a type of damage known as windowing.

Stage of crop attacked: All crop stages are affected.

Environmental condition: This pest prefers dry and warm seasons. Most prevalent in spring and early summer.

Prevention

• Crop remnants should be buried or removed immediately after harvest.

• Avoid production of crucifers in spring when DBM is most active.

• Control weeds as they can harbor the pest

Control measures (IPM measures)

• Yellow delta traps with sticky cards helps in reducing the population of DBM. The males become trapped and die.

• Hand-picking and squashing larvae can prevent crop damage on small plots.

• Pesticides that can be used are malathion, methomex, karate zion, lambda, attacke and others (rotate or keep on changing the products to avoid resistance development

Plusia Lopper

Larvae

Damage

Types of pest: chewing pest very destructive at larvae stage.

Host: Cabbage green peas, Carrots, green beans, Swiss chard, Tomato.

Damage: Young larvae feeds on the underside of leaves, and the mature ones' chew leaves producing large, irregular holes throughout the plant. They also produce large amounts of dark, brown-green frass which stains cauliflower heads,and make cabbage and broccoli unmarketable.

Stage of crop attacked: Vegetative stage

Environmental condition: This pest thrives well in warm conditions

Prevention

Field sanitation should be done by destroying crop remnants immediately after harvest.

Control measures (IPM measures)

- Hand-picking and squashing larvae can prevent crop damage on small plots.

- Pesticides that can be used are malathion, methomex, karate zion, lambda, attacke and other (rotate or keep on changing the products to avoid resistance development.

Wire worm

Beetle

Wire worms

Damage

Type of pest: it is a chewing pest that produce soil-dwelling larvae. Most of the time is spent in the larval stage, but all stages may be present at once during the growing season.

Host: Potatoes, carrots, onions, beet-root.

Damage: It feeds on the crop root system. Affected plants often display wilted leaves. Larvae can cause severe damage to potatoes by creating tunnels in tubers as they feed.

Stage of crop attacked: Tuber or root development and enlargement for root crops

Environmental condition: Wireworm damage is often worst in cool, wet weather.

Prevention

- Fields that were previously used as pasture should be avoided since they are higher risks of worm populations.

- Proper selection of rotated crops can reduce problems with wireworms

Control measures (IPM measures)

Wireworm populations can be reduced by ploughing three or more times during late spring and early summer to expose larvae to desiccation and predation.

Thrips

Adult thrip

Thrips on onion

Damage

Type of pest: This pest feed on the crop by piercing crop cell wall and suck the cell sap.

Damage: Heavy infestations may cause wilting or even death of the plant. Attacked crops will lose vigor and affecting appearance and quality.

Host: onion, garlic, leek, cabbage, cauliflower, bean, tomato, cucumber, and asparagus.

Stage of crop attacked: All stages.

Environmental condition: This pest thrives well in warm conditions.

Prevention:

- Destroy crop remnants immediately after harvest.

- Rotate onions with non-host crops.

- Avoid growing onions on the field next to maize field especially for spring production.

Control measures (IPM measures)

- The use of Yellow sticky traps help in reducing the population of thrips as the adults are attracted, trapped and die. This method reduces the population of thrips to tolerable numbers.

- Use malathion, methomex, lambda and others to control thrips

Tuber moth

Moth

Larva

Turnels in the tubers

Type of : This is a destructive chewing pest that tunnels just below the potato skin, causing distinct mines, but sometimes goes deeper.

Host: Potatoes, eggplant. Sweet peppers and tomatoes.

Damage: Larvae feed on potato leaves, stems, petioles, and more importantly potato tubers in the field and in storage.

Stage of crop attacked: All crop stages

Environmental condition: It prefers dry and warm weather conditions.

Prevention

- Remove the piles of culled potatoes and, destroy volunteer potato plants.

-During ridging make sure that bulking potatoes are covered with at least 5cm soil to provide a barrier between tubers and larva.

- Irrigate the land if it is too dry to prevent cracks on the soil since the cracks enables larvae and potato to get in contact.

Control measures (IPM measures)

- Insecticides such as malathion, Attacke, karate can be applied at weekly intervals starting when the first potato tuber moths appear.

- Delta traps can be used to monitor moths activity

Millipedes

Host: Potato, carrots, Beet root

Damage: feed on the tubers but normally the damage is first initiated by other soil dwelling organisms

Stage of the crop attacked: Tuber development

Environmental conditions: Cool and moist environment

Prevention

- Early tillage prior to planting may help bring millipedes to the surface where they are susceptible to desiccation and predation

- Avoid practices that increase soil moisture above that required by the crop.

- Remove crop residue after harvest to reduce additional food sources and possible overwintering sites.

Bean foliage beetle

Adult

Damage on leaves

Damage on pods

Type of pest: This pest is destructive chewing pest to pulses

Host: Beans, cowpea, black-eyed pea, and soybean, velvet bean, ford hook giant.

Damage: The insect in both the larval and adult stages will feed upon the leaves, flowers, and pods of the bean plant, but the greatest amount of injury is done to the leaves.

Stage of crop attacked: Seedling stage, vegetative and pod filling stage.

Environmental condition: The eggs and larvae develop in warm conditions.

Prevention

• Post harvest tillage exposes the dormant adults in the soil to the heat of the sun and increases mortality.

• Crop rotation with non-host (e.g. maize or sunflower) breaks the development cycle and reduces the emerging population.

• Delayed sowing of beans helps to avoid susceptible stages of the crop coinciding with peaks in the pest population cycle.

Control measures (IPM measures)

• For the control in outbreak circumstances, several insecticides are currently available and they include malathion, methomex, Aphicide, malasol, attacke, cypermethrins, and others

Pod borer

Moth

Larvae and damage

Type of pest: Has destructive chewing larva

Host: Beans and peaes.

Damage: The larvae feed from inside flower buds, flowers and pods and often plug the entry hole with fecal frass to protect themselves against natural enemies.

Stage of crop attacked: Flowering, pod filling.

Environmental conditions: Warm and relatively mild humidity

Prevention:

- Do not plant next to already infested crops.
- Collect and destroy crop debris after harvest.

Control

- Hand-picking and squashing larvae can prevent crop damage on small plots or low infestations

- Use insecticides such as attacke, cypermethrins, lambda and others.

Mexican bean Beetle

Beetle

Grub

Damage

Type of pest: Destructive Chewing pest. Their larvae are often found underneath the leaves of pulses.

Host: Beans, spinach, cow pea, velvet beans.

Stage of crop attacked: Seedling stage, vegetative and pod filling stage.

Environmental condition: They prefer warm and dry conditions

Prevention

- Destroy crop remnants immediately after harvest because remmants can serve as overwintering sites for the pest

- Remove alternate hosts, and related weeds around field borders.

Control measures (IPM measures)

- For the control in outbreak circumstances, several insecticides are currently available and they include Malathion, methomex, aphicide, attacke and malasol and others.

Black Bean aphids

Adult Aphid

Infested bean

Damage

Type of pest: This piercing and sucking pest is destructive and aggressive on beans.

Host: Beans, apple trees and cauliflower.

Damage: Their feeding cause rolling, twisting or bending of leaves. Heavily attacked leaves can turn yellow and eventually wilt.

Stage of crop attacked: All stages

Environmental condition: They are most in abundant warm seasons (late summer to autumn).

Prevention

• Remove alternate hosts, such as mustards and related weeds around field borders.

• Destroy crop remnants immediately after harvest.

• Be sure transplants are pest-free before taking them to the field.

Control measures (IPM measures)

• Remove and destroy heavily infested plants in the field.

• Use soap-ash sprays to control aphids.

• Conserve and maintain natural enemies such as the ladybird beetle by avoiding usage of broad-spectrum pesticides.

• Use methomex, aphicide, and malasol, and others.

Fruit Fly

Fruit fly oviposition on apples

Maggots on infested peach

Infested fruit drop and rot

Type of Pest: Destructive and prolific pest and it has been declared as quarantine pest in the SADC and other regions .

Host: Attacks most fruit trees and fruit vegetables. Fruit trees include peaches, apples, plums, apricots and grapes.

Damage: Oviposit in ripening fruit resulting into fruit infestation by larvae (illustrated) and can cause the fruit to drop and to rot.

Stage of the fruit tree attacked: Mostly at the onset of ripening but can still attack unripe fruit.

Environmental conditions: Prefers warm conditions.

Prevention and Control: The proven method is by practicing the principles of Integrated Pest Management (IPM)

• **Monitoring**

Populations must be monitored using lure-baited traps. Several options of lures are available and these are most often loaded into yellow bucket traps. Delta traps with sticky cards can also be used. Traps help in determining fruit fly population and the decision to control is usually based on the counts.

• **Prevention**

Orchard sanitation through removal and destruction of fallen fruits.

Control measures (IPM measures)

Use of Yellow bucket traps and Delta traps with sticky cards help in reducing the population of fruit flies as they are attracted to the pherolure and the yellow bucket. The pherolure attracts males and this reduces the males in the population hence interfering with mating.

• Attract and kill' bait stations have proved to be a safe, practical way of reducing populations in gardens and other hotspots. These typically consist of a sponge treated with a protein attractant and insecticide. The most commonly used insecticide is spinosad in GF120 bait.

• Other chemicals used as sprays are Malathion, gardern ripcord malasol and other.

Codling Moth

Codling Moth adult

Codling moth caterpillar

Infested apple

Type of Pest: Internal fruit feeders

Host: major hosts are Apples and pears and minor ones are apricot, peach, plum, prune and cherry.

Damage: Damage is classified as stings (shallow entries where the larva damages the surface of the fruit before dying or trying another point of entry) or deep entries (when the larva tunnels into the core of the fruit and feeds on the seeds).

Stage of crop production: Fruit infestation can take place from fruit set to harvest.

Favorable conditions: The first spring moths begin to emerge in September. Moths are most active prior to and just after sunset. They Prefer worm condition.

Prevention: All infested and damaged fruit should be collected from orchard floors and destroyed.

Bagging: Young fruits can be enclosed in bags to physically prevent the moth from laying their eggs on the fruit.

Control:

• Pheromone traps can be used to disrupt mating.

• Carbaryl should be applied as soon as first sting in young fruits are seen in spring. A second application might be needed 21 to 28 days later, to cover the prolonged spring emergence.

• **Spinosad** The first spring generation requires three sprays applied at 10-day intervals when the first stings are found. For any subsequent summer generations, two sprays should suffice. No more than six sprays should be applied per season, and they shouldn't be applied within seven days of harvest

Peach Aphid

Curled leaf due to infestation

Peach aphid (Adults and nymphs)

Type of pest: Sucking insect

Host: Peaches, nectarine and plum.

Other Hosts: bean, cabbage, lettuce, pea, potato, lambsquarters and pig-weed.

Stage of fruit tree attacked: can infest at any time from flowering.

Damage:

• Feed on plant sap resulting in retarded growth and deformed leaves. If the infestation occurs early in the season, it may result in the death of young plants.

•They spread viruses.

• Secrete a sticky honeydew on which black sooty mold (a fungal mold) develops.

Environmental conditions:

• Temperatures in autumn and spring are optimal for aphid survival and reproduction.

Prevention:

• Numerous beneficial insects (e.g., lady beetles, lacewings, and syrphid flies) help suppress aphid populations. Control through insecticides can be ignored unless the populations are extremely high.

• Control weeds in and around the orchard

• Inspect crops often and regularly; destroy leaves heavily infested with aphids by hand

Apple Woolly Aphids

Infested stem with applewolly aphid

Apple wolly aphid

Damage

Type: Sucking insect

Host: Apples and Pears.

Stage of fruit tree attacked: All stages of tree production (leaves, stem and fruits are affected).

Damage:

• In winter the aphid feeds on the roots and in other seasons on the aerial parts.

• The feeding causes the formation of galls which destroy developing buds and damage the wood.

Enviromental conditions:

Apple woolly aphid prefers warm and humid conditions.

African Bollworm

Moth: Active at night

Larval stage

Damage symptoms

Type of pest: Chewing pest.

Host: Apple, peach, plum, apricot, grapes, maize, beans.

Stage of fruit tree attacked: From flowering to harvest

Damage:

- Feeding results in holes bored into fruits and reproductive structures of the plants.

- Secondary fungal or bacterial infections may occur on areas around the bored holes.

- The pest status of African bollworm is exacerbated by its broad host range.

Environmental conditions:

The numbers start increasing in August to October as the temperatures start increasing.

Fruit Trees Diseases

Peach Leaf Curl

Peach leaf distorted by peach leaf curl

Peach Leaf Curl at Its Worst

Fruit under severe infection

Host: Peaches, nectarines, apricots

Fruit tree stage affected: All stages of fruit tree

Symptoms:

• Leaves are entirely or partially curled, distorted and are initially pale green in colour before turning red or purple.

• Shoots are thickened, distorted and yellow-green in colour. Heavily infected shoots might be killed.

• Fruit with raised, irregular rough patches are often red in colour. Such fruit often falls prematurely.

Favorable conditions:

• Cool, wet conditions during leaf emergence in spring.

• Continued cool, wet weather favors further cycles of the disease.

• However, high summer temperatures stop the development of the disease.

Powdery Mildew

Infected grapes

Infected peach

Infected peach leaves

Host Trees: Most fruit trees including grapes, peaches, apples, apricot, nectarines and plums

Crop stage affected: All stages of fruit tree

Symptoms:

• Symptoms can be seen on the terminal leaves of shoots, which are covered in powdery, white fungal growth.

• Leaves become misshapen and puckered, and fruits develop powdery, white spots that can scar over as the fruit mature.

Favorable conditions:

• High relative humidity favors spore formation. Low relative humidity favors spore dispersal, which explains why powdery mildew tends to be a problem when the days are cool and the nights are humid.

• Powdery mildew can occur all season long, but it is less common during the summer when it's hot.

Good Agricultural Practices (GAP) For Reduction Of Pests And Diseases In Fruit Trees

1. Pruning

- Diseased branches are cut eliminating the disease.

- Pruning increase light and air circulation between the branches of the tree to reduce disease.

- Mummies are removed during pruning. These act as source of inoculum and harbor insects pests' eggs.

2. Irrigation

- Increases yields, fruit size and fruit quality and can lengthen tree life and improve tree growth and photosynthesis. Improving the tree general well being increases its diseases and pests tolerance

3. Sanitation

- Tilling underneath the trees, hoeing and removal of diseased or insects infested dropped fruits helps in deterring and eliminating pests and diseases.

4.Use of resistant varieties

- Farmers are advised to use rootstock that are resistant to pests and diseases. For instance woolly aphids can be managed by using resistant rootstock which cannot support its survival during winter like M106 and M111.

5. Addition of manure

- Decomposed kraal manure improves tree nutrition and healthy trees are better able to fend off pests. Please be aware that you don't use fertilizers high in nitrogen as they make the tree leaves more softer and susceptible to insect attack

PESTS AND DISEASE SPRAYING SCHEDULE

TIME	CROP	INSECTS PESTS AND DISEASES	PESTICIDE
August	Apples, peaches,nectarlines, pears and plums	Powdery Mildews and other fungal disesses	Lime Suphur
		Prevention of cold-ling moth before flowering	Ripcord, malathion
			Ripcord,malathion, Rotenone, Spinosad
September	Apples and pears	Powdery mildew	Dithane,captain
	Peach, nectarines and plums	Aphid	Methomex, malathion, aphicide, ripcord
October	Apples	Codlng moth	Ripcord, malathion,Rotenone, spinosad
Dec	Peaches	Prevention of fruit fly and codling moth on fruits that ripen in january	Ripcord, malathion, Rotenone,spinosad
January	Peaches and Apples	Prevention of fruit fly and codling moth on fruits that ripen in February	Ripcord,malathion,Rot enone,spinosad
February	Peaches and Apples	Prevention of fruit fly and codling moth on fruits that ripen in March	Ripcord,malathion,rote none, spinosad
February - April	Apple,peaches, nectarline,pears and plums	For prevention of dis-eases after harvest	Copper fungicides

GALLERIES









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