ORGANIC PEST AND DISEASE MANAGEMENT

Organic farming is an agricultural system which deliberately renounces the use of synthetic and dangerous inputs. They usually include high risks: long-term contamination of land and water resources and intoxication risks for farmers and their families. Organic farmers therefore prefer practices which prevent the building up of high pest and disease populations. They try to avoid direct and potentially harmful control measures.

Always first: preventive measures!

Practise crop rotation. It is one of the most effective techniques to prevent accumulation of diseases and weeds which are associated with most crop families.

Sustain soil fertility. Use organic fertilizers like compost and manure to support soil and crop health.

Chose disease-resistant varieties. They do not require much additional plant protection.

Encourage natural enemies. They often control pests effectively. Be aware that pesticides and fungicides usually also eliminate beneficial insects and fungi.

Direct measures (pages 2-4)

There is a range of efficient insecticides and fungicides of plant and mineral origin which can be used in organic farming. Not all of them are harmless, but with the exception of copper, they usually break down more rapidly than common chemicals.

Some plant extracts and other sprays against pests and diseases can easily be prepared by small-scale farmers. Please also see The Organic Farmer's "Plant Extracts Special".

Against seed-borne diseases, seeds may be treated in hot water.

Pest control: natural enemies are farmers' friends

In a natural farm environment, you find not only pests, but also many beneficial organisms which help farmers to control pests. It is very difficult for one species to build up large populations if organisms which feed on it are also present.

Ladybird beetles for example and their larvae feed almost exclusively on aphids. Spiders, predatory bugs or praying mantids catch mites and insects.

Tiny wasps lay their eggs into other insects. For instance into diamond-back moth caterpillars that just started to ruin the cabbage you want to sell later. The wasps' larvae feed on the pests' larvae, killing them, and saving your cabbage while you may not even have noticed anything.

There are also nematodes, fungi and other micro-organisms which can infect and kill pests, for example whiteflies, caterpillars, beetles or grasshoppers.

Eggs

hatched larvae

big larva

pupa

adult beetles

Most people can't identify many insect species and their different stages: egg, larva, pupa, and adult insect. Here you see the different life stages of the ladybird beetle.

What you can do to keep a natural balance

- Choose crop cultivars that are not highly susceptible to pests and diseases.
- Encourage natural enemies on your farm. It is not necessary to know them all, but it is good to know they are there and how to promote them.
- Hedges and trees not only provide fodder, poles and firewood, they also provide shelter for beneficial insects. Grassy spots, flowering plants, unsprayed fields and wild areas are places where a wide variety of useful species can develop.

Use pesticides wisely

- and only when absolutely necessary. This is why:

Where chemical pesticides are used frequently and the same type of product is used for long periods, pests usually develop resistance and spraying becomes less and less effective - pests just survive.

Most insecticides are also toxic to beneficial species. But some of them do less harm than others. It is wise to try to inform yourself about the available products and buy less harmful ones, if you have a choice!

Bio-pesticide: Bt (Bacillus thuringiensis)

Bt can be used against most pests which feed on plants. Bt is a naturally occurring soil bacterium which produces a fatal toxin.

Bt-products are commercially available from most agricultural suppliers. In Kenya, they are sold under the following commercial names: Thuricide, Dipel, Javelin, and Xentari.

The advantages of Bt-products are low cost, easy application, high efficiency. There are no toxic effects, neither for humans nor for any species besides pests!

How to use Bt

1. Apply when larvae are still small. Bt works best on young larvae (e.g. caterpillars).
2. Bt is more effective in slightly acidic water. Add a few tablespoons of vinegar to a gallon (4 litres) of water before adding the Bt concentrate.
3. Spray Bt in the late afternoon, when the hottest hours are over. Bt survives better in cooler temperatures and can then remain on the leaves longer.
4. Spray thoroughly, covering all the plant surfaces

Mineral insecticide: Diatomite

Use in control of storage pests

Diatomite kills weevils and other storage pests and protects stored grains and beans from further damage. Diatomite is not toxic, but grains should still be washed before cooking.

Application:
- To treat stored grains or beans, apply 500 g (1/2 kg) of diatomite to each sack of grain (maize, rice, wheat, sorghum, etc.) and mix with a shovel.
- For larger containers, apply 3 kg Diatomite to every tonne of grains.

Use in livestock parasite control

External parasites

Poultry: Against mites and soft ticks, dust the chicken regularly with diatomite and add it to dust bath areas.

Cattle, pigs, goats, rabbits, dogs, etc.:
To control ticks, fleas, lice, mites, rub the dust regularly into the animal's coat. Beddings should also be dusted.

Internal parasites

Diatomite can be mixed with animal feed.

• Cows/Horses:	30 – 60 g per day
• Sheep/Goats/Hogs:	15 g per day
• Chickens / other poultry:	2% of the feed weight (e.g. 10 kg feed is mixed with 200g Diatomite).

The efficiency against internal parasites is not really clear. Diatomite may help in light cases. Heavy infestations and dangerous parasites (e.g. liver flukes) need correct treatment by a veterinarian.

Use in crop protection

Diatomite may be used to control aphids, mites, caterpillars, weevils, leaf hoppers, ants, termites, cutworms, slugs, snails and others.

Application:
For dry application of diatomaceous earth, use a duster. Dust it directly on the insects. Against cutworms or snails, place Diatomite around the base of the plants. When cutworms emerge to feed, they may come in contact with the powder and die.

Diatomite is best appiled when there is dew or after a light rain. It needs to be re-applied after rain.

Diatomite, a non-chemical insecticide

Diatomaceous earth consists of the fossils of diatoms, tiny algae-like water plants. They once accumulated in millions of billions on the ground of lakes and seas worldwide. Their shells have very sharp edges and splines, but these structures are so small that they can only be seen under a microscope.

When diatomite rock is milled, a white powder is obtained. Its insecticidal properties were discovered only about 40 years ago. It is supposed that f insects come into contact with this powder, the sharp, microscopic edges injure their skin, allowing the body fluids to escape. Because diatomite also absorbs liquids, insects dehydrate quickly and die.

Diatomite acts physically and not chemically. There is no chance that insects can develop resistance or immunity.

Non-toxic, safe, universal

Because of the small size of diatoms, the structures do not harm larger organisms. It is non-toxic to humans and animals if ingested, but the fine dust should not be inhaled.
It can be used as insecticide for almost all purposes.

Diatomite is mined by the Diatomite Industries at Kariandusi in Gilgil along the Nakuru-Naivasha road. Always ask for the type of diatomite which is used against insects.
A 20 kg bag retails at Ksh 350.

Interested farmers can get in touch with the company's Sales and Marketing Manager:

Mr Roger Oluchiri
African Diatomite Industries
P.O.Box 32, Gilgil
Tel. 050-401 5209 Mobile 0722 277 120

Soap spray (Sabuni)

Soap spray can be used against aphids, mealy bugs, spider mites, leaf miners, thrips, whiteflies, armyworms and caterpillars.

Soap concentration:

5-8 g soap per litre of water kill aphids and small caterpillars
8 g soap per litre will kill larger caterpillars
10 g soap per litre can kill plants

Never use powder detergents (like Omo): they can burn plant leaves and reduce soil fertility!

Preparation and application

1. Dissolve 1 tablespoon of mild soap (Gun soap, sunlight, Ushindi, Snowflake etc.) in 3 litres of water (exact dosages see previous paragraph).
2. Test the strength on a few infested plants. Be careful with sensitive plants like kale.
3. Apply on the infested plants thoroughly, including the undersides of the leaves.

Spray early in the morning or in late afternoon.

Soap solutions are only effective as long as they are wet.

Plant extract: Neem (Azadirachta indica)

Neem products are effective against a wide range of pests. The pesticidal compounds are especially concentrated in the seeds. In spite of their broad-spectrum action, neem products generally do not harm natural enemies seriously.

Neem acts as a repellent and as a poison. It suppresses the insect's appetite and inhibits its ability to moult and lay eggs. Neem extracts do not kill insect pests immediately. Effects are often visible only 10 days after application. For a satisfying control, neem extracts must therefore be applied at an early stage of pest attack.

Watery extracts from seeds and leaves are excellent against beetle larvae and caterpillars, and good against stalk borers and adult beetles.

Neem products with a high oil content can be toxic to plants and cause burnings. Side effects on non-target organisms are generally stronger. Oil-based products should therefore be applied with restriction.

They are effective against aphids, whiteflies, bugs, beetles, leafhoppers, grasshoppers and others.

Neem oil, extracted from seed kernels, protects stored beans, cowpeas, and other legumes effectively. Neem oil based emulsions can also be used as fungicides.

Neem pesticides available in Kenya

- Neemros® and Neemroc® :
  Locally produced by Saroneem Biopesticides Limited.
  Babadogo road, opposite Catholic Church.
  P. O. Box 64373-00620 Nairobi.
  Contact: Mr. Dorian Rocco, Mobile: 0728592478
  Email: saroneem@yahoo.com
- Achook: Made in India, available in Agrovet shops.

Precautions during preparation of neem extracts

Leaf or seed extracts can easily be prepared by small-scale farmers. Although they are almost non-toxic to mammals, seeds or seed extracts are poisonous when consumed. Take the following precautions:

- Place the neem extract out of reach of children and pets while preparing, using and storing it
- Avoid direct contact with the crude extract at any time
- Do not use utensils and containers for food preparation and for drinking for the preparation of neem extract.
- Clean all the utensils properly before and after use.
- Wash your hands after handling the plant extract.
- Always test the plant extract on a few infested plants first before going into large scale spraying.
- Use protective clothing when applying the solution.

How to prepare neem water extracts from seeds

1. Collect fallen neem fruits from underneath the trees.
2. Remove the flesh from the seeds and wash away any remaining shreds.
3. Dry the seeds in bags or baskets. Avoid mould formation.
4. For the preparation of extract, shell the seeds.
5. Grind 500 g of neem seed kernels in a mill or pound them in a mortar or grate them finely. Mix the crushed neem seed with 5 to 10 litres of water. Soak them overnight.
6. Strain the liquid before use.

Application of neem water extracts

- Spray the neem water directly onto the plants using a sprayer or straw brush.
- Neem works fastest during hot weather. Heavy rains may wash off the protective cover of neem on plants. Repeat the treatment if pest infestation is high.
- Neem water will remain effective for 3 to 6 days if it is kept in the dark. All neem preparations loose their power rapidly when exposed to sunlight.

Plant extract: Pyrethrum

Pyrethrum and Pyrethrins

Pyrethrum is derived from Chrysanthemum flowers. Pyrethrins, its insecticidal compounds, are broad spectrum nerve poisons and efficient against most insects (including beneficial species!).

Since pyrethrum is a contact poison, flying insects like cucumber beetles should be sprayed early in the morning when they are slow and bee pollinators are not yet active.

Pyrethroids

In contrary to natural Pyrethrum extracts, Pyrethroids are very persistent pesticides which are not used in organic production. Pyrethroids (e.g. Permethrin) include Ammo®, Ambush®, Aztec®, Pounce® and Warrior ®.

Preparation and Application of Pyrethrum Extracts

Take the same precautions as with neem extract. Pyrethrin and pyrethrum insecticides are mildly toxic to mammals. Prolonged contact with the skin can produce a rash, and inhaling dust or spray can cause headaches, sickness or allergic reactions.

Pyrethrum powder and spray

Pick the flowers when they are fully open, dry them in the shade and store them in a dark place. Pyrethrins are rapidly broken down by sunlight. They work best at lower temperatures and cloudy conditions, and their efficiency is reduced when applied at midday on a hot day. If you observe that the pests recover after some time, a higher concentration is needed.

Pyrethrum spray:
Pour 1 litre of boiling water over 2 cups of fresh flowers (or half a cup of powder) and soak for a few hours. Strain, add some soap and dilute with 2 to 5 litres water. For best results, spray in the evening.

Pyrethrum powder:
Grind dried flowers to a fine powder. Use it pure or mix it with a carrier like talc, lime or diatomaceous earth. Sprinkle over infested plants.

Flour and soap preparation

Flour dissolved in water is effective against aphids and spider mites.

- 2 cups of fine white flour is well stirred into 5-10 litres of water.
- Add 2 tablespoons of soap and dissolve.

Stir the filtrate prior to application. Apply in the morning taking care to spray also underside of leaves. During the day, the mixture dries out, the insects shrivel and die.

More plant extracts
In The Organic Farmer's "Plant Extracts Special", you can find more useful extracts and recipes for pest and disease control.

Fungicides

Note: - When applying fungicides, safety procedures and use of protective clothing must be strictly followed.
- Read instructions carefully. Dosages and prescribed pre-harvest intervals have to be kept.
- Ask your local agricultural extensionist on locally registered fungicides and for information on products.
- Do not eat, drink or smoke when handling and applicating synthetic pesticides including copper.

Mineral fungicide: Sulfur

Sulphur is used in horticulture for vegetables and for perennial fruit crops to control powdery mildews, certain rusts, leaf blights and fruit rots. It also acts as an insecticide against spider mites, psyllids and thrips.

Sulfur is non-toxic to mammals, but it may irritate eyes and skin. It can cause plant injury in dry hot weather above 32°C. It is also incompatible with other pesticides. Sulfur reacts with spray oils, producing phytotoxic substances.

Lime Sulfur
This mixture is used on fruit trees to control some fungi and insects. It is highly toxic, may burn skin and eyes, can injure plants if applied when temperatures exceed 26°C, and has a rotten-egg smell. Take all precautions when using lime sulfur!

Mineral fungicide: Copper

Copper compounds are powerful fungicides. Copper fungicides are still tolerated in organic farming but application rates are restricted, as copper accumulates in the soil and acts toxic there.

Bordeaux mixture controls bacterial leaf spots, bacterial blight and late blight, wilts, anthracoses, downy and powdery mildews, rusts, cankers and others. It also repels many insects. It is used for vegetables, tree fruits and nut crops. Like sulfur, it can be phytotoxic to plants, especially if applied in cool, wet weather.
If the ingredients are available, it can be easily prepared at home. Take all the precautions described for neem extract.

Bordeaux mix spray
- 3 ½ tablespoons of copper sulphate
- 10 tablespoons of hydrated lime
- 1 gallon (4 liters) of water in a plastic container

Add copper sulphate and hydrated lime to the water and stir well using a wooden stick. Protect yourself from direct contact with the solution.

Application
- Shake the sprayer repeatedly to prevent the solution from clogging
- Spray plants thoroughly, preferably early in the morning of a dry and sunny day. In this way, the plants have the time to dry and the solution cannot penetrate into the leaves' tissues

Hot water treatment of seeds

Hot water treatment of own seeds prevents seed borne diseases such as black rot, black leg, black spot and ring spot of crucifers.

To maintain seed viability, time intervals and temperatures must be followed strictly and carefully! You need a good thermometer to do this, or ask for assistance from qualified extension personnel.

1. In a large pot put plenty of water and heat it to the required temperature (see table below).
2. Place the seeds in a loose cotton bag and submerge it in the water. Constantly stir the water while soaking the bag. The bag should never touch the hot pot bottom.
3. After the required time (see table below), remove the bag and immediately place it in clean cold water to stop the heating.
4. Spread the seeds on a clean dry paper to cool and dry.
5. The seeds should be sown immediately on well-prepared seedbeds.

Recommended temperatures and times for hotwater treatment of seeds

Seeds	temperature	Time interval
Potato tubers	55°C	10 min
spinach, brussels sprouts, cabbage, pepper, tomato, eggplant	50°C (122°F)	30 minutes
Broccoli, cauliflower, carrot, collard, kale, kohlrabi, turnip	50°C (122°F)	20 minutes
Mustard, cress, radish	50°C (122°F)	15 minutes
Lettuce, celery, celeriac	47°C (118°F)	30 minutes
banana suckers (weevils, nematodes)	52-55°C	20 minutes
pineapple plantlets for transplanting (mealybugs, Phytophthora and nematodes)	50°C	30 min

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