MODULE No 9.

Integrated Pest Management

Notes...

Pest problems occur because a system is not in balance.

Most commonly pest problems occur because of:

- Fires, floods and land clearing
- Using large areas of land for only one type of crop
- Introducing pests from one area into another area
- Destruction or removal of a pest predator, usually caused by pesticide use or by damage to pest predator habitats

To manage pest problems, long term solutions should be used with an aim to return the balance of nature. Long term solutions can sometimes take many years, so short term solutions are also needed, such as using natural pesticides. Many different natural techniques for pest management are combined together in Integrated Pest Management (IPM). The main goal of IPM is to avoid pest problems from happening and if pest problems do happen, to manage them by using natural, environment friendly techniques.

Every part of the environment is connected to every other part, including people. What happens to one part of a system will affect every other part of the system. This philosophy is the foundation behind every IPM technique.

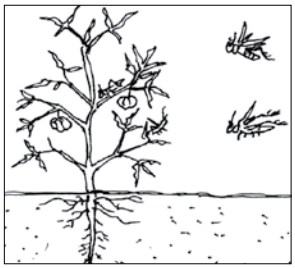
Observe how different parts of a system work and how they affect other parts of the same system. Parts of a system include soil, insects, plants and trees, birds, animals, water, people and technology. If different parts of a system can be integrated to work together it will bring many benefits, including:

- Less resource usage and less expenses because the land will maintain itself and the resources used will mainly be local available resources
- Soil, crop and environmental improvements, not gradual destruction
- Increase in crop resistance to pests, disease and extreme weather
- Increased overall productivity of the land
- Improved health for people

This module will explain IPM techniques which can be used for all scales of agriculture, from small scale home gardens and market gardens, to large scale agriculture, such as rice production, fruit trees and all combined systems.

The Importance of Healthy Soil

Healthy, living soil is soil which contains all the nutrients that plants need to grow. This condition is the most important factor affecting IPM techniques for preventing pest and disease problems.



If a person is healthy, they will usually live longer, not get sick as often and if they do become sick, will recover faster. A healthy person is stronger and more able to work and will produce children who are also healthy. It is the same with plants! The base for good health for plants and humans is also the same:

- A balanced variety of nutrients and minerals (for plants); balanced, healthy and nutritious foods (for people)
- Healthy, living soil (for plants); a clean and comfortable house (for people)
- Water, sunlight and a healthy natural environment (for plants and people)

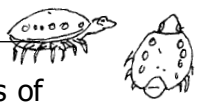
Healthy plants will grow stronger and will be less likely to be attacked by pests and disease. If attacked, healthy plants will suffer less damage and recover more quickly. Providing healthy soil for plants will save time, energy and money later on.

Natural techniques will continuously improve soil quality so plants will be healthier and pest problems can be prevented. (For more information about healthy soil, see Module 4 – Healthy Soil).

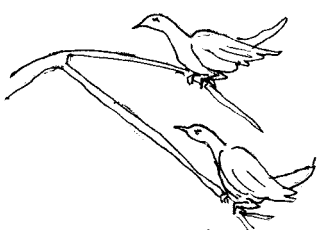
SMART IDEAS!

Compost is good to use on plants because it releases nutrients slowly into the soil. Providing too many concentrated nutrients for plants at one time can cause plants too grow too fast and become weak, leaving them at more risk to insect attacks.

Encouraging Natural Pest Predators



In a healthy, balanced system, different types of plants have different types of pests which like to attack them, and different pests have different types of predators which like to feed on the pests.



This will keep the number of pests in the ecosystem balanced. Natural predators are very effective at controlling pests in the garden.

These natural pest predators include birds, lizards, frogs, bats, dragonflies, wasps, spiders, praying mantis, ladybugs and some types of flies.

Natural pest predators can be encouraged in your garden if you provide what attracts them, such as:

- Ponds: For birds, frogs, dragonflies, wasps, bees and fish (some fish will feed on mosquito larvae)
- Trees: For birds, bats, wasps, bees and spiders
- Rocks, rotting wood: For lizards and spiders
- Flowers, small trees, vine plants: For wasps, bees, spiders, praying mantis and ladybugs

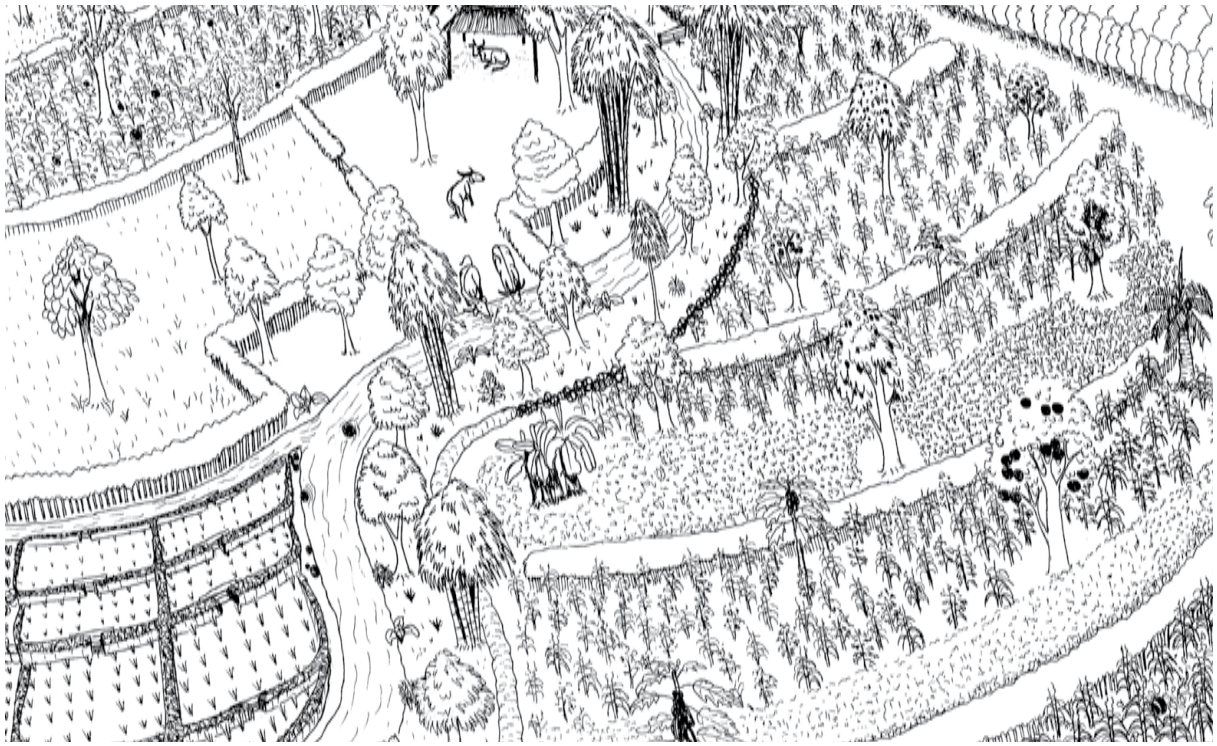
It can take up to a few years to create a balanced pest predator population. While waiting for this process to become established, you may need to use other forms of pest management.

BEWARE!

Chemical pesticides and some natural pesticides will also kill pest predators and other beneficial insects, this will damage their population. Use pesticides very carefully, only when needed and only after you have tried using other safer methods.

Healthy Environment

If the area surrounding your land is healthy and diverse, the chances of pest problems are greatly reduced. A healthy environment is essential for keeping agricultural systems balanced. A healthy environment includes rivers, forest, steep slopes, house areas and so on. Protecting water sources, stopping forest burning and preventing erosion are important steps towards achieving a healthy environment. A healthy environment will enhance the effects of all IPM techniques.



Using Non-hybrid Seeds

Using non-hybrid or good quality local seeds will produce plants which are naturally more resistant to pests and disease. Non-hybrid seeds from open pollination are the best seeds to use because the quality will stay the same from generation to generation, and can even improve if seed saving techniques are used. (For more information about seed saving, see Module 5 – Seed Saving and Nurseries).

Collect seeds from the best plants on your land. The seeds of these plants will be best suited for the climate, local conditions, and be more resistant to pests and diseases. Every family can observe which crops are the best quality on their land. By collecting seeds from these plants, families and groups can exchange or sell seeds.

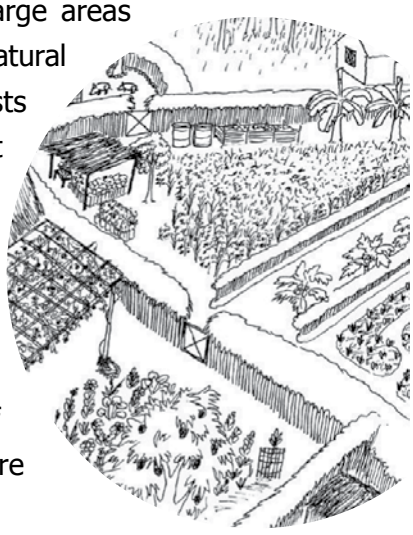
Think about why one crop is more resistant to pests and disease. Some factors could be healthy soil, natural pest predators, compost use, enough water and sunlight, and so on. By understanding this we can breed better, healthier crops every year.

Good Crop Management

Good crop management can be achieved by using techniques such as combining crops, crop rotation, following natural patterns and companion planting.

Combining Crops

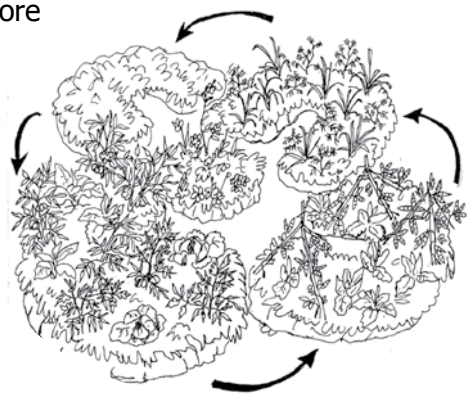
If croplands are planted with only one type of crop in large numbers, there is more chance of pest or disease problems. This is because pests and disease will easily spread from one plant to the next, and with one type of crop there is large amounts of food available in one area so the number of pests can increase drastically. On large areas of land with one type of crop, there is usually not enough natural pest predators available to control pest problems. When pests or diseases spread in large numbers, it can be very difficult to control, especially if the damage caused already covers a large area of land.



By combining different types of crops together, it will reduce the spread of pests from one plant to the next. This will eventually reduce the number of pests. For example, rows of corn can act as a pest barrier to protect the crops which are planted in between the corn rows.

Crop Rotation

Some types of pests and diseases live in the soil and can cause a lot of damage if the same type of crop is planted on the same land over and over again. Crop rotation means regularly changing the type of crop planted with a different type of crop. This will allow pests and diseases of one crop to die out before the crop that they attack is replanted on that land. For example, the fungus that attacks brassicas (cabbage, cauliflower, broccoli etc). This fungus attacks their roots and lives in the soil. By rotating brassica crops with other types of crops the fungus will die out because the plant which they attack is not planted.



Natural Patterns

Using natural patterns will provide more crop and animal diversity in one area, which helps to encourage pest predator populations, and makes it more difficult for pests to spread from one plant to the next.

Companion Planting

Some types of plants grow very well if planted close together. However, there are other plants which do not grow well together. Knowledge about which plants grow well together will help improve plant growth and control pest and disease problems, which will eventually increase the land's productivity. Companion planting will provide many benefits, such as:

- Repel insects. Plants and flowers which have strong scented leaves or flowers, such as garlic, marigolds, daisies and ginger, will confuse and repel pest insects which use their sense of smell to find plants they want to eat. The marigold plant is especially good for repelling nematodes, a type of pest which lives in the soil and can damage plant roots
- Attracts natural pest predators. Besides making the garden look beautiful, flowers will help to attract pest predators. Flowers can be planted around vegetables and fruit trees. Some flowers which will work well are roses, hibiscus, marigolds and some types of legumes
- Slows pest spreading. Crop pests will find it difficult to spread from one plant to the next if there are many different crops growing together

Different types of plants have different types of root growths. Knowledge of the different types root growths will allow plants and trees to be planted closer together. There are some types of plants, like the eucalypt trees, which release a substance (alelopati) from their roots and this can make it difficult for other crops to grow close to them.

This kind of knowledge needs to be collected and shared with other people.

Preventing Pest Attacks

Observation will prevent many pest problems before they arise. When observing, consider:

- Are the plants that are growing healthy?
- Are there pests attacking the plants?
- Where do the pests come from?
- What type of pests are they, insects or other creatures?
- What are the predators of this type of pest?
- What will attract predators?

The earlier we know about pest and disease problems, the easier managing the problems will be. Observe the stages of a pest's lifetime, for example the fruit fly: Eggs, worm, grub, adult. Identifying pests or diseases is very important. If you do not know, discuss it with other groups or NGOs which may be able to help.

Each type of plant has a specific type of pest which will attack it. A pest which attacks one type of plant will not necessarily attack a different type of plant growing nearby. Knowledge about which pests will attack which plants can be used to prevent problems, through using techniques such as crop rotation, companion planting and combining crops.

Use different methods and sprays to control different types of pests. Using a specific pest control spray for a certain type of pest is better than using sprays which kill all types of insects. Observation will help you to choose which type of spray is best to use.

Observation of pest problems and methods of pest control can happen every day while working in the garden. Children can learn about good insects and insects which become pests, and about how to control pest problems. Removing pests by hand is sometimes the most effective method of pest control, especially for home gardens. Insect pests can be collected and fed to chickens and ducks, or killed in a bucket of water. Snails can be cooked as pig or chicken feed. And in some countries, people even eat them!

Pest insects also like to eat weeds. Through observation you can find out which types of weeds attract pests away from your crops. Afterwards, these weeds now filled with pests, can be used as animal feed or turned into compost.

Plant Diseases and Fungus

Trees infected with fungus can be helped by pruning back some branches to let in more sun and wind. Fungus needs moisture to grow, but the sun and wind will help to keep the tree dry. Always remove dead tree branches to reduce chances of fungus and disease. Observe carefully if there are crops or trees infected with fungus, remove the parts which are already infected to reduce chances of the disease spreading.

Examples of Pest Prevention

Pest Prevention for Nurseries

Young seedlings of cabbage, lettuce, green leaved vegetables and eggplant, are favorite foods for snails and slugs. Ants can also damage seedlings and remove seeds. By growing seedlings in a nursery, pest problems will be much easier to prevent. If you use tables in the nursery, place the table legs in containers of water or oil to stop pests from climbing up. A thick layer of grease or vaseline on the table legs will also function well.

Pest Prevention for Trees

A layer of grease or vaseline over the tree trunk will stop pests from climbing up the tree. This method works well for preventing pests which lay their eggs in the soil, like fruit flies, some caterpillars and worms, ants and other insect pests. Some trees that will benefit most from this method include orange, soursop, mango and avocado trees.

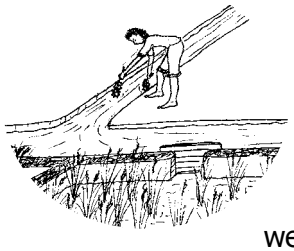
The process of tree greasing:

1. Place a 10 cm band of material, like cloth, thick plastic or tin foil, around the tree trunk and tie it securely. Make sure that insects can't get underneath the wrapping
2. Cover this band with grease. Fold the top over to make sure water won't flow in
3. Check it every 2 weeks to make sure the band of grease is still attached to the tree trunk

BEWARE!

Do not put grease directly on the tree trunk, especially with young trees. The grease can damage or even kill the trees.

Pest Prevention for Paddies



Placing black palm fruit in paddy irrigation water will make mice uncomfortable and deter them from returning. Cut 20-30 black palm fruit and place in the irrigation water which flows into the paddies. The best time to do this is around sunset. Repeat this method 3 times a week while rice grains are ripening.

BEWARE!

- Using too many black palm fruits is dangerous and can affect the health of people harvesting the rice grains and later eating the rice
- Be careful not to use black palm fruits in water irrigation which is used for bathing

Pest Traps

Baits and traps are a good way to prevent pest numbers from increasing, and hence to reduce damage to your crops.

Examples of Pest Traps

Traps for Fruit Flies

Fruit flies usually attack fruit trees, like rose apple, mango, guava, avocado, papaya, orange and many more. A simple trap can be made using plastic water bottles.

1. Cut the top off a bottle and place in the bottle backwards
2. Fill the bottles with liquid bait. This bait can be:
    - A mixture of vinegar, sugar and water
    - A mixture of fermented fruits and water
    - Water smelling of rotten fish or meat
    - Old beer
3. Hang these bottles from the affected tree using strong string or wire. 10 bottle traps for each tree should work well

Another way to handle fruit fly problems is to spray the ground below fruit trees with a liquid neem mixture. Spray once before the fruits begin to grow and again just before the fruits have ripened. This will stop fruit fly larvae from changing into flies. Read the insecticide section in this module for liquid neem recipes.

SMART IDEAS!

Fruit fly traps will work more successfully if neighbors also use them.

Traps for Snails / Slugs

Snail traps can be placed around the garden to attract and kill snails. Place a bowl or container in the ground and fill half way with liquid bait, made of milk and water or old beer. A small amount of finely cut lettuce or cabbage can also be added. The snails / slugs will enter the trap, get stuck in the liquid and not be able to leave. If you use beer bait the snails will be happy because they will die drunk.

Another method is to place old tin roofing or wet sacks on the ground near your vegetable plots. Snails will like to live underneath this. Check the trap every few days. Coffee husks and sawdust can be placed on paths around vegetable plots to help prevent snails from entering. Snails don't like rough surfaces.

Citrus Peel Traps

Use half peels of citrus fruits, like orange, lemon or lime, which still has a small amount of fruit attached to the peel and place on the ground. This fruit will attract insect pests and snails / slugs, and they will become trapped underneath the citrus peel.

Insect Nets

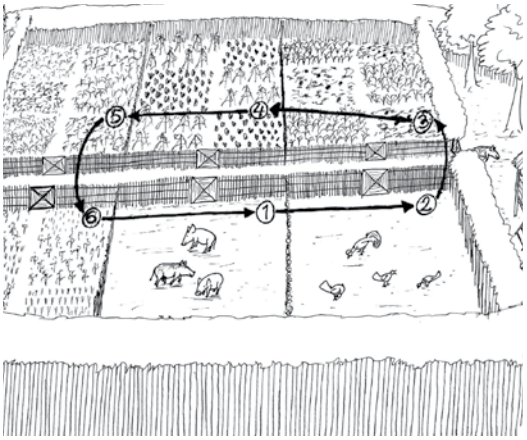
A net can be made to catch insects, like crickets, grasshoppers and more, by simply using bamboo or wood with some old fish or mosquito netting attached. This net can become a fun game for children to see who can catch the most insects, but be careful they don't damage crops or catch beneficial insects.

Using Animals for Pest Control

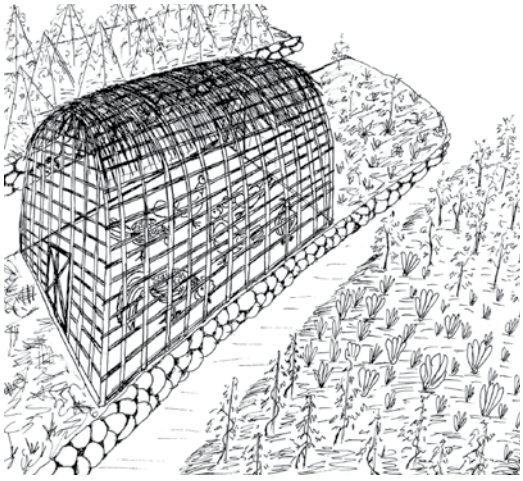
Chicken and ducks are very happy to control pests for you!

Some ideas for integrating animals into other systems:

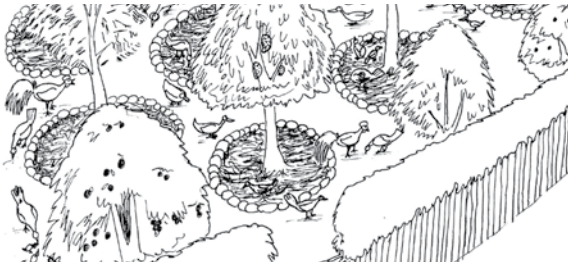
- If chickens or ducks are kept in one area, they will clean under trees by eating all larvae and insects which could damage the tree. Your pest problems then become animal food!
- If chickens or ducks are kept on cropland after harvest, they will eat many pests in the ground which are waiting for the next crop planting. At the same time the chickens and ducks will be fertilizing the land and functioning as 'animal tractors'
- Give insects to animals as their food. If plants infested with pests are given to animals, the plants will become animal fodder, and this will reduce pest numbers



ducks & pigs



chicken 'tractor'



ducks & chickens

Natural Pesticides

Natural pesticides are a short term solution for handling immediate pest problems quickly. Natural pesticides should be a part of pest management, but should only be used when necessary. Do not use natural pesticides if there are no pests or crops are not damaged.

In fact, they should not even be used if only small amount of crops are damaged. Take time to observe if pest predators are eating the pests and if those pests are spreading quickly or slowly, if there are still pest predators, it is best to let them do the work.

Some natural insecticides are very strong and will kill all insects, both damaging and beneficial insects. Be careful, because most insects are not harmful to your crops and killing them can even cause more problems in the future.

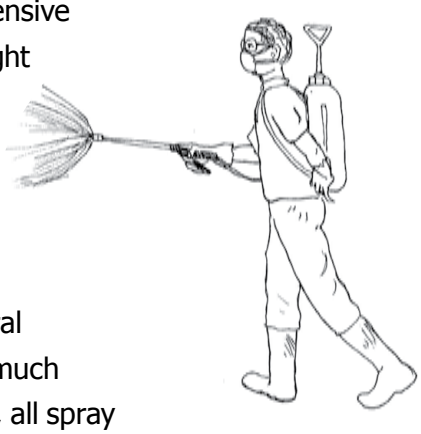
How to Use Natural Pesticides

You can use a palm broom or tree branch as a brush. This is a simple method to use, but sometimes the natural pesticides will not spread evenly. And when using these methods it will be much more likely for the pesticides to get on your skin.

For home gardens and small pest problems, plastic hand sprayers can be used and are effective. An aqua bottle with small holes in the lid will make an easy and cheap sprayer.

A hand sprayer made of bamboo can also be used and is explained in more detail later in this module.

The best way to spray is using a spray pack, but these are expensive and require more maintenance. One spray pack can be bought by a group or as a community owned tool.



When spraying, always wear long pants, long shirts, gloves, shoes and a protective cover for your mouth and nose, especially when spraying stronger natural pesticides. Glasses are also good to use, and remember, some types of natural pesticides can cause skin problems and make you sick if too much gets on your skin, or into your mouth, nose or eyes. After use, all spray tools should be cleaned with water before they are stored.

Hand Picking

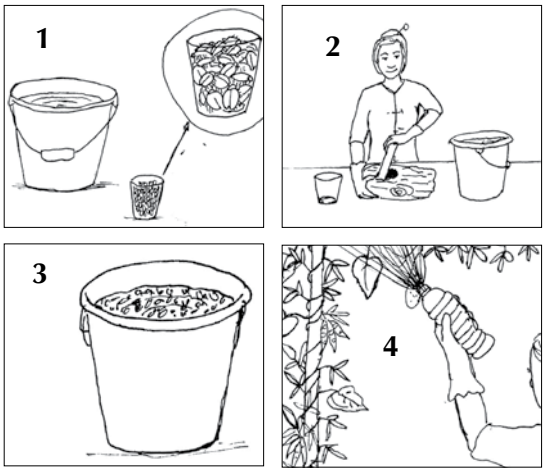
Hands are an excellent natural pesticide! Many pest problems can be controlled by regular observation and hand removal of pests.

SMART IDEAS!

- Stop using natural pesticides at least 2 weeks before harvesting. This is very important to prevent food becoming contaminated with pesticides which could make people sick
- Rotate the type of sprays uses to prevent insects becoming resistant to a any one type of pesticide. Some types of pesticides will work better than others. Experiment for yourself
- Spray in the morning or late afternoon to prevent plants burning in the hot sun
- During the wet season, try to spray at least 3 hours before rain fall, so that the spray can will have maximum effect

Insect Spray (Biological Spray)

Collect a handful of insects which are eating your plants, crush them and mix them into a small bucket of water. Leave for 2 days. Strain the liquid and spray onto the affected crops. The same type of pests as the ones in the spray will be repelled by this liquid. The remaining insect bodies can be put in containers and placed around crops. The smell of this will continue to repel pests.



This spray works well for worms, caterpillars, slugs, snail and various other small pests, but it is less effective for grasshoppers.

Neem Spray

The neem tree can be used to make a safe and effective natural insecticide. Neem can be used on almost all types of insects, including mosquitoes. Sometimes it can take a few weeks for results to show, because with some types of insects neem breaks their breeding cycles. Neem is one of the best plants to use because it is safe for people and will not cause many problems for beneficial insects, especially pest predators. In some conditions, it may even increase production of beneficial earthworms.

Snails / slugs, nematodes, beetles, worms, moths, leaf miners, flies, mosquitoes and grasshoppers are some of the insects which can be controlled by using neem spray.

Methods for using neem:

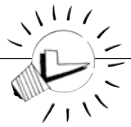
- Crush neem seeds and put into a cloth bag. Place the bag into a bucket or drum filled with water overnight. Use 500 grams neem seeds for every 10 liters of water. Use as a spray on pest insects and affected crops. This method is more effective than using neem leaves

- Collect a large handful of fresh neem leaves, crush into small bits and place in a bucket of water. Leave for 2 days, then remove the leaves and use the liquid as a spray
- Dry a large handful of neem leaves, crush them and place in a bucket of water. Leave for 2 days, strain and then use the liquid as a spray
- Neem spray can also be made by soaking crushed neem seeds in alcohol or making oil from the neem seeds using an oil press. These methods are more expensive but produce a much stronger product

Garlic and Chili Spray

Combine 3 bulbs of peeled garlic with a large handful of chilies and boil in a pot of water. Add ¼ block of soap, stir evenly and leave for one day. Strain and use 2 cups of this liquid each time you spray.

Garlic is an insecticide, fungicide and pest repellent. Chili is also an insecticide and insect repellent. The soap will help the spray stick to plants and pests. Use this liquid for aphids, worms, caterpillars and moths.



SMART IDEAS!

- Garlic and chili plants will naturally repel many insects. Plant them around fruit trees and vegetable plots to help reduce insect problems
- Garlic and chili can also be used separately as sprays

Papaya Spray

Collect 1 kg of papaya leaves (about 1 large plastic bag), crush into small bits and mix into 1 liter of water, then leave for 1 hour. Strain and add 4 more liters of water and 1 large spoonful of soap. Spray onto insect pests. This papaya spray can be used on aphids, termites, bugs and caterpillars. For termites, crush young unripe papaya fruit and collect the juice. Spray this directly onto termites and damaged wood.

Ginger Juice Spray

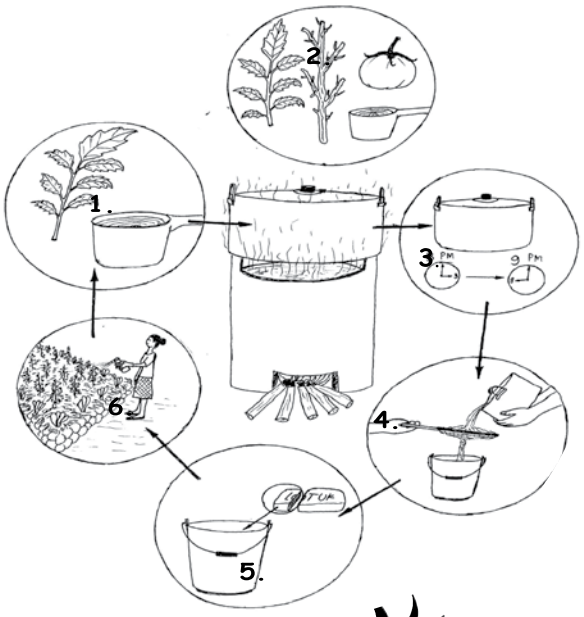
Grate one handful of ginger and put into a bucket of water. Leave for one day, then spray on damaged plants to control larvae of worms and caterpillars.

Taro Leaf Spray

Taro leaves contain lysollic acid. When insect eat this, it feels something like eating broken glass! To make this spray, simply crush 10 taro leaves and place in 3 liters of water (½ bucket), stir well. Spread onto plants using a palm broom. Make sure every plant is covered well with this liquid so they will equally receive protection against insects.

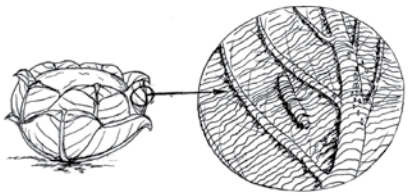
Tomato Leaf Spray

Tomato leaves are a natural insecticide and a mild fungicide, they can be used on aphids, ants, worms, caterpillars, insect eggs, grasshoppers, moths, nematodes, white flies, fungi and bacterial rot. To make the spray, cook 1 kg of tomato leaves in 2 liters of water for 30 minutes, add 2 finely cut handfuls of tomato leaves, stem and fruit, and 2 liters of water. Mix the materials together, then leave for 6 hours (½ day). Strain and add ¼ block of soap. Spray this liquid every 2 days if insects, especially moths, are in large numbers.



BEWARE!

Tomato leaves when used as an insecticide are poisonous to humans. This is because the chemicals in the tomato leaves becomes much more concentrated. Wear gloves and protective materials over your nose and mouth when using this spray.



Glue Spray

Glue spray can be made from water left over from cooking cassava, taro or potatoes. Small insects will stick to the glue end eventually die of suffocation. This spray is good to use for aphids, caterpillars and white flies, but you can also try it on other small insects. To make the spray simply mix the left over cooking water from cassava, taro or potatoes with more water. The strength of this liquid depends on which are used, just estimate. Spray on plants. A good mixture will leave a thin white coating on plants once it has dried.

Soap Spray

This spray is effective for snails, slugs, aphids, caterpillars, small beetles and other leaf eating insects. To make this spray use 1 large spoonful of soap or soap powder per 1 liter of water. Spray only on pests or damaged plants. You can also use left over dish washing or cloth washing water as a pesticide spray.

Betel Nut Juice Spray

Betel nut juice is known as a very effective poison for giant snails and other types of snails! Collect the betel nut juice in a bucket, combine with water and spray directly on snails. This spray can be made of betel nut, lime powder, or a combination of both. Spray outside of your vegetable plots to deter snails from entering. However, this liquid is not recommended for use directly on plants. Use regularly.

Tobacco Leaf Spray

Tobacco leaf spray should only be used as a last option. Wear protective clothing and protective material for hands and face when making and using tobacco spray. Tobacco leaves are very poisonous and can kill beneficial insects as well.

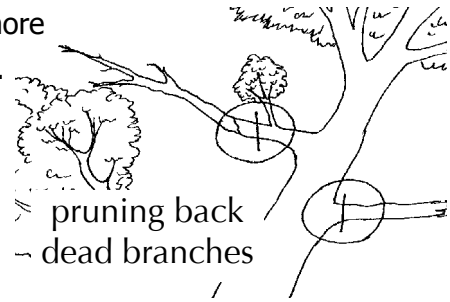
Tobacco spray can be used for most pest insects. To make the spray soak 1 kg (1 plastic bag) of crushed tobacco leaves in 15 liters of water for 1 day and 1 night. Add two large spoonfuls of liquid or block soap and stir well. Strain and use the liquid as a spray. You can also dry the leaves and crush them into a powder. The powder can be used for aphids, slugs, caterpillars and leaf curl virus. Do not use this spray on tomato plants, potato, eggplant, chilli plants or roses.

Ants cause problems through their digging and removing seeds. They can never be removed completely, but their effects can be reduced. For root damage, try using biological, chili, garlic, tomato or tobacco sprays.

Natural Fungicides

Fungus is an organism that lives and grows on the surface of plants, animals, wood, people and even cement and non-living surfaces. Fungus lives best in damp and moist conditions. This can cause problems for plants by covering plant surfaces, which causes rotting and prevents normal growth. The best way to control fungus on plants is by providing them with enough wind, sunlight and air flow. Fungus growth is encouraged by dark and damp conditions, and rotting materials.

For trees, remove all dead wood and prune the tree to allow more wind and sunlight through. Only prune as much as is needed. For vegetables, remove old and dead leaves and provide trellises for climbing plants, like peas, beans and tomatoes. Very badly diseased plants should be removed and burned. Don't let mulch touch tree trunks or vegetable stems.



Neem Spray

You can use neem as a natural fungicide. Make liquid from neem seeds in the same way as used for natural pesticides, then spray this on mildew and rust mildew. This may also work for other fungus, but more research is still being conducted. Experiment for yourself.

Seaweed Tea Spray

Collect some fresh seaweed, rinse with water to remove the salt, then place in a bucket of water. Leave for 2 weeks, then spray on fungus infected plants.

Diluted Urine Spray

Combine 1 part human urine to 4 parts water. Spray on plants or trees damaged from fungus, like vine mildew, powdery mildew, and other types of similar fungus.

Milk Powder Spray

Combine 1 liter fresh milk or powdered milk with 10 liters of water. Spray every 10 days on vegetables or trees that are suffering from fungus, mildew or mosaic virus.

Sweet Potato Leaf Spray

Cut and soak 3 large handfuls of sweet potato leaf in 1 bucket of water. Leave for 1 day, then use as a spray for fungus, especially for rice fungus diseases.

Garlic Spray

Dry garlic and crush into a powder. Combine one large spoon of garlic powder with 1 liter of water and use as a spray for fungus attacking tomato and bean plants.

Papaya Spray

Papaya spray can be used on insects, but can also be used as a mild fungicide for coffee rust, powdery mildew and brown spots on rice leaves.

Evaluating Results

The results of using natural pesticides and fungicides should be continuously observed. Observe how much the pesticides are working and if the treatment needs to be repeated. If pest problems have not stopped, you have a few choices, such as:

- Repeating the spray treatment
- Trying a stronger combination
- Trying a different pesticide
- Combining natural pesticide materials (combine different kinds of materials together)

Making Simple Sprayers

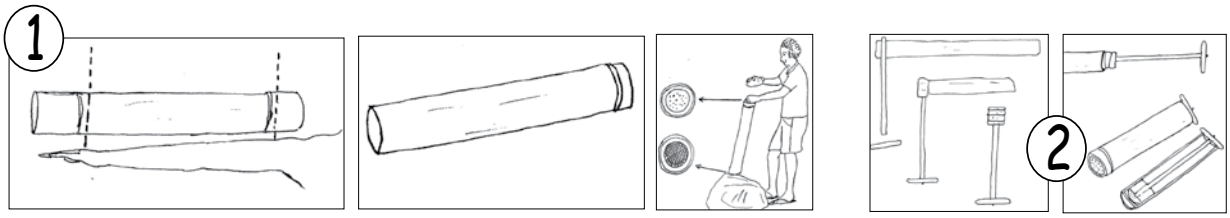
This information is taken from Liklik Buk, a development book compiled by *Lik Lik Buk* information center, Papua New Guinea.

Materials:

- A bamboo pole of adult arm length with nodes 3-4 cm wide
- A wooden rod, about 1 meter long, longer than the bamboo it will fit into. It is best to use a hard wood
- Nails for making holes, a hammer, a saw
- A strip of cloth, about 1 meter long and 10 cm wide
- A small length of wire or strong string

M**ethod:**

1. Cut the bamboo pole so that on one end of the node is closed and the other end is open. There cannot be any other nodes in between the ends. Use the nails and hammer to make lots of small holes on one side (where the node is closed). Wrap with wire or string around the other side to stop it from splitting
2. Wrap the strip of cloth around one end of the wooden rod until it is thick enough to be used as a valve (fits tightly into the bamboo pole), tie with wire or string to hold it in place. Make a handle and stopper at the other end of the wooden rod. The stopper will stop you from pushing the rod through the bamboo node



How to use:

This sprayer is used like a simple pipe or sprayer:

1. Push the rod into the bamboo pole up to the stopper
2. Dip the node end of the bamboo pole into spray liquid, then pull back the rod to its original position. The tube will fill with liquid as you pull it back. Be careful not to pull the rod out of the pole

3. When you want to spray, simply push the rod back into the bamboo pole until the liquid in the bamboo pole is used up. Refill and spray again

This sprayer works similar to a doctors syringe. This sprayer can also be made of plastic or metal pipes instead of bamboo.

Biological Control

Sprays made from insects are a form of biological control. Besides insect sprays, there are some other techniques which are biological control methods, like introducing a pest predator into an area that has large pest problems. However, large scale pest control should be discussed within groups or have government support and involvement. Often the pest problems can be controlled without having to use pesticides.

Remember! Most insects are not harmful to your crops. All insects play specific roles in nature and are needed to keep a balanced ecosystem. In fact, small numbers of pests are also needed to supply food for pest predators. Removing all pests can cause imbalance in the ecosystem and cause you to become dependant on pesticides.

Integrated Pest Management is a strategy which will improve your land and crop productivity, especially for the long term. These techniques naturally combine with Permaculture techniques to help create a strong and resilient agriculture system.

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