



Field Guide to

Non-chemical Pest Management



in Peanut Production





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Non-chemical

Pest Management

in Peanut

Production

**for Small Scale Farming in
the Tropics and Sub-tropics**



Pesticide Action Network (PAN) Germany
Hamburg, November 2009

Pesticide Action Network (PAN)

Founded in 1982, the Pesticide Action Network is an international coalition of over 600 citizens groups in more than 60 countries, working to oppose the misuse of pesticides and to promote sustainable agriculture and ecologically sound pest management.

PAN Germany was established in 1984 as part of this global network and has continually been involved in initiatives to reduce the use of hazardous pesticides and to promote sustainable pest management systems on national, European and global levels.

Acknowledgements

First, we want to express our gratitude to the universities and organisations that have given the permission to use their photos for the OISAT project. (For more details see p. 25)

We also wish to thank all the individuals, groups and organizations that have prepared the bases for the most control measures presented in this field guide, may it have been by preserving traditional experience, on field trials, on field research, or in the lab.

Finally we want to thank KEMI/SENSA for supporting this publication through PANAP and also Misereor and Oxfam/Novib for supporting this project.

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Prologue

Pesticides worth more than 38 billion US dollar are intentionally released into the global environment every year. A high proportion of these is highly toxic and has immediate adverse effects on human health, wildlife, local food sources such as cattle or fish, beneficial insects and biodiversity. Some of them have chronic effects including cancers, reproductive problems, birth defects, hormonal disruption and damage to the immune system. Impacts come from direct exposure in use, spray drift, washing work clothes used while spraying, home pesticide storage, pesticide dumps, and persistence in the environment.

Overall aim of the international *Pesticide Action Network (PAN)* is to eliminate the use of hazardous pesticides, reduce overall use, risk and dependence on pesticides, and increase support for community-based control over a sustainably produced food supply. PAN is committed, in its projects, strategies and campaigns to place pesticide concerns in the broad political and economic context in ways that will advance the fight against rural poverty and enhance pro-poor development and ethical trade. PAN aims to help local communities use the initiatives to benefit their day-to-day lives.

PAN Germany is part of the international Pesticide Action Network. It is supporting non-chemical pest management on tropical crops that are commonly grown by small landholder farmers through the project: Online Information Service for Non-chemical Pest Management in the Tropics, OISAT (www.oisat.org).

OISAT is a web-based information system to distribute information on non-chemical pest management in the tropics and sub-tropics that is easy to read and easy to understand. Information provided via www.oisat.org is relevant to small-scale farmers who intend to produce crops using safer and more affordable non-chemical pest management practices. It provides varied information on how to lower the cost of production based on recommended insect/mites pests, disease, and weeds control methods.

The 'Field guide to Non-chemical Pest Management in Peanut Production' is an excerpt taken from the website www.oisat.org. It enables to provide farmers with practical guidance and alternatives to eliminate the use and their dependence on synthetic pesticides for the management of peanut pests. The recommended practices are safer, more affordable, and easy to follow. Most of the farm practices, the farmers can do by themselves and the materials that are needed are found in their backyards or in their kitchens or can be purchased in the local agricultural suppliers.

Carina Weber
(Executive Director PAN Germany)



How to use this field guide

This field guide is designed to let you grow peanut as easy as possible.

It provides you the suggested appropriate management practices on how to grow peanut. In the pest pages, each pest has a brief description of its lifecycle, damage it causes, and its control measures. It is very important to know how the insect/mite pest develops because the adult does not always cause the damage and sometimes it is not even found where the damage occurred. Included in the control measures are cultural practices, physical control, plant extracts, other homemade solutions, and other practical methods. Also, as not to confuse you with the beneficial insects, a separate page with photos of them and their conservation and management are included.

For example, you notice that the peanut leaves are having brown spots when you're out in the field. What would you do? First, have a closer and careful examination of your plant. If you find the pest and can't identify it, turn the following pages and look at the illustration of an insect and/or the damage or symptom in each pest entry. Once you have identified the pest, look into the corresponding control measures on how to eliminate and/or lessen its population density. You have various options like: cultural practices (e.g. removal of weeds); physical control (e.g. handpicking); plant extract (e.g. neem spray); other homemade solution (e.g. soap spray); other method (use of baits).

However, with every effort made to provide you with complete information on the pest control in peanut growing, the recommendations may vary from every location. It is highly recommended that you have to try the various control practices in small scale especially for the plant extracts and other homemade solutions, in order to make adjustments that are adaptable to your local farm conditions before going into large scale application.

Fill up the forms at the end of this manual to have a record of activities each time you grow peanut.



Recommended practices

Throughout this field guide you will find suggestions for stopping or lessening the pests' population before they have control over your peanut field. To make a plan for you to grow a healthy crop, the following tips are the steps you ought to take:

1. Learn to identify the pests and other causal agents and the natural enemies
2. Select the proper peanut variety that is well adapted to your local conditions
3. Always select good and diseased-free planting materials
4. Have a healthy soil, but always keep in mind that over-fertilizing isn't necessarily better
5. Practice crop rotation by planting on the next cropping season- crops of different family group
6. If possible practice intercropping to improve the field's diversity and to encourage natural enemies
7. Follow the recommended planting distances
8. Prepare the soil thoroughly by appropriate tillage
9. Always practice proper field sanitation by removing and pruning infested plant parts, keeping the area free of weeds and other plant residues, and cleaning regularly all farm tools and implements
10. Monitor your plants regularly
11. When in doubt, always ask for assistance from your local agriculturists

When controlling pests using the plant extracts and other homemade solutions, the following are the standard procedures for their preparation and application;

1. Select plants/plant parts that are pests-free.
2. When storing the plants/plant parts for future usage, make sure that they are properly dried and are stored in an airy container (never use plastic container), away from direct sunlight and moisture. Make sure that they are free from molds before using them.
3. Use utensils for the extract preparation that are not used for your food preparation and for drinking and cooking water containers. Clean properly all the utensils every time after using them.
4. Do not have a direct contact with the crude extract while in the process of the preparation and during the application.
5. Make sure that you place the plant extract out of reach of children and house pets while leaving it overnight.
6. Always test the plant extract formulation on a few infested plants first before going into large scale spraying.
7. Wear protective clothing while applying the extract.
8. Wash your hands after handling the plant extract.

I. Introduction

About Peanut

Scientific name: *Arachis hypogaeae*
Family: Legume family
Other names: Earth nuts, goobers, goober peas, ground nuts, ground peas, pinda

Uses

Edible oil, snack foods, edible oil, animal feed, cosmetic ingredients, peanut butter

II. Climatic and soil requirement

Temperature: 30°C is the optimum climatic requirement

Soil: Peanuts grow best in loose, light and well drained sandy to sandy loam soils and grow poorly on clay and poorly drained soils.

Soil pH: 6.0 - 6.5 (slightly acidic soils) but a range of 5.5 - 7.0 is also acceptable. Saline soils are not suitable since peanut has a very low salt tolerance.

III. Selection of planting materials

Select seeds that are intact, unbroken, and free of molds and other pests

IV. Planting materials requirement

Seed requirement

100 – 120 kg seeds/ha (shelled peanuts). There is usually no economical increase in productivity with an increased seeding rate.

V. Land preparation

During the land preparation, choose the tillage practices that will ensure to keep the soil in its best physical condition for a favorable crop's growth and development.

Approximately one month before planting, plow the field to turn under all plants residues. Presence of adequate soil moisture and nutrients is necessary to enhance faster the decomposition of the crop residues. Allow ample time to decompose the crop residues before planting peanuts.

Prior to sowing, plow and harrow the soil to a depth which will physically support the plant and allow the use of sufficient moisture and nutrients; sufficient enough to control weeds; and must leave the soil surface level. A level field improves water use

efficiency, helps control in crop weeds and allows the rapid removal of excess water.

Soil preparation is the crucial aspect in reducing the potential pests of peanuts.

VI. Method of planting

Row spacing

Distance in between furrows

60 cm x 60 cm

90 cm x 90 cm

100 cm x 100 cm

Studies show that a row spacing of 90 cm or 1 m produces more disease-free crops and has higher economic yield than the other recommended spacing.

Planting

Sow 13 - 16 good quality seeds/m (within the row) to achieve an optimum stand. Space the seeds 10 - 15 cm apart at a depth of 4 - 5 cm. Cover lightly with soil. Two weeks after germination, thin the plants by removing the weak and unhealthy ones. Leave 8 – 12 plants/m.

VII. Plant establishment

During the land preparation, choose the tillage practices that will ensure to keep the soil in its best physical condition for a favorable crop's growth and development.

Approximately one month before planting, plow the field to turn under all plants residues. Presence of adequate soil moisture and nutrients is necessary to enhance faster the decomposition of the crop residues. Allow ample time to decompose the crop residues before planting peanuts.

Prior to sowing, plow and harrow the soil to a depth which will physically support the plant and allow the use of sufficient moisture and nutrients; sufficient enough to control weeds; and must leave the soil surface level. A level field improves water use efficiency, helps control in crop weeds and allows the rapid removal of excess water.

Soil preparation is the crucial aspect in reducing the potential pests of peanuts.

VIII. Fertilizer requirements

Peanuts respond better to residual fertility than to direct fertilization. If a well-fertilized crop precedes peanuts, direct fertilization may not increase the yield or quality of the peanuts. If fertilizer is needed,

broadcast and incorporate it with the soil during the land preparation.

A soil test is the best way to determine whether fertilizer or lime is required in peanut growing. **Liming is necessary only when the soil pH is below 5.8.**

However if soil test results are not available, the general fertilizer recommendation is:

NPK kg /ha

25 kg of N - 50 kg of P₂O₅ - 100 kg of K₂O

Do not apply potassium fertilizers after the peanuts have emerged.

Foliar sprays of nutrients are generally ineffective or not economically feasible, except to prevent or correct some micronutrient deficiencies.

IX. Pest management

Refer to pests/mites, diseases, and beneficial insects information.

XI. Weed management

Preventative methods

- Thorough land preparation
- During the seed bed preparation, make sure that the seed bed is free of weeds.
- Place the fertilizer where the crop has the access to it but the weeds do not. This allows the crop to be more competitive with weeds.
- Keep the surroundings of your farm free of weeds, unless they are maintained and intended as habitat for natural enemies

Mechanical and physical practices

Do weeding 4 - 6 weeks after sowing. The weeds are easier to control on their earlier growing period. If

possible, do not let the weeds to flower. Remove them from the field before they start to flower. The weed-bearing seeds that are removed should not be placed in compost pile for the seeds may not be killed in the process of decomposition. The compost might be the source of the reintroduction of weeds into your fields.

The weeds can be killed through off-barring and hilling-up the furrows, hoeing, mowing, cutting with a scythe, or hand weeding. Always prevent that soil stick to the leaves to avoid fungal diseases

X. Harvesting

The optimum time for harvesting is when most pods have a veined surface, seed coats are colored, and 75% of pods show darkening on the inner surface of the hull.

Proper time to harvest is when sunny days are expected ahead, to be able to dry the pods at the desired moisture content.

XII. Yield

2000 kg – 3024 kg per ha

XIII. Handling and storage

Peanut is usually stored in the form of unshelled nuts. Before storing, clean and dry the peanuts (unshelled) to attain a moisture content of 6-10%. Stored peanuts must be kept dry. These must be protected against the infestation of storage pests, like insects and rodents. Make sure that the storage area is clean and well-ventilated

Peanuts when used as seeds for the next cropping are viable up to 7-8 months in storage.

To prevent storage diseases like molds and aflatoxin, the above mentioned practices must be observed.



Insects/Mites

Several pests will infest peanuts during its growth stages.

Table 1 shows the pests that might damage the plant growth.

Table 1. The peanut growth stages and its pests		
Growth stages	Duration of growth stages	Insects/mites
0 Stage <i>Seeds</i>		Ants
Seedling stage <i>Leaves</i> <i>Seeds and developing roots</i>	From germination up to the 3 rd week	Aphids Cutworm Whiteflies Whitegrubs Whiteworms
Vegetative stage <i>Foliage</i>	21 – 60 days	Armyworm Aphids Corn earworm Thrips Whiteflies
Reproductive <i>Flowers and foliage</i> <i>Pegs</i>	The first flowers appear at 4 - 6 weeks after planting and maximum flower production occurs 6 - 10 weeks after planting.	Aphids Leafhopper Spider mites Thrips Whiteflies Wireworm
Maturation <i>Pods</i>	100 – 150 days, depending on the variety and climatic condition	Wireworm

Ants

Damage

Ants take the sown seeds back to their colony and feed on germinating seeds and on young seedlings. They tend insect pests like aphids, scales, whiteflies, mealybugs, and other honeydew producing insects. These actions result in missing hills, thus loss of plant stand, uneven growth distribution in the field, and an increased incidence of diseases caused by the mentioned insect pests.



Description

Eggs are delicate, soft, white, and are laid in clusters of 75-125 eggs. The larva is grub-like, legless, very soft, and whitish in color. It inflicts no damage as it depends on the worker ant (older sibling) for care and food. The pupa is whitish and develops inside the ant's nest. It has visible legs and in some cases, wings.

The *pupa* is a transition between the larva and the adult which emerges during the final molt.

An *adult* ant varies in color, from blackish to reddish-brown depending on its species. It has robust mandibles with strong teeth that could inflict painful bites. It has elbowed- antennae, a thin waist, and if it is winged, the hind wings are smaller than the front wings and have few veins. Ants are also beneficial insects because they prey on termites, eggs, pupa, and caterpillars of other insect pests. Nevertheless, *ants should not be introduced into gardens for insect pest control.*

Control measures

Cultural practices

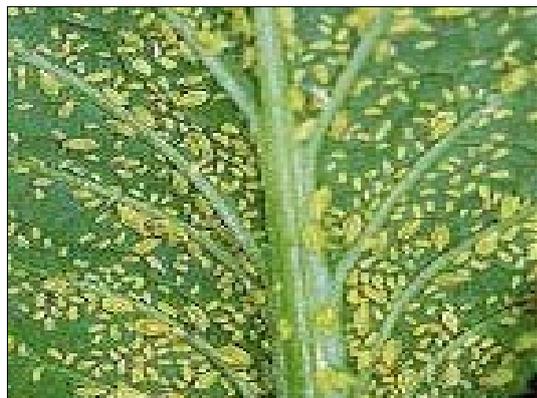
- Increase the seeding rate and thin the plants 3 weeks after sowing. This practice turns out cheaper than with the use of insecticide.
- Control aphid, whitefly and other insects that excrete honeydew. The ants are likely to be found in plants infested by these insects because ants protect them for their food.

Spray solution

Ant oil spray

Mix 2 tbsp dish washing soap, 2 tsp vegetable oil, 2 tbsp salt, and few drops of vinegar into 4 liters of water.

Aphids



Both the nymphs and the adults pierce the plant tissues to feed on plant sap. The infected leaves

Damage

become severely distorted when the saliva of aphids are injected into them. Heavily infested ones will turn yellow and eventually wilt because of excessive sap removal. The aphids' feeding on the plant causes crinkling and cupping of leaves, defoliation, and stunted growth.

Aphids produce large amounts of a sugary liquid waste called honeydew. A fungus, called sooty mold grows on honeydew deposits that accumulate on leaves and branches, turning leaves and branches black. The appearance of a sooty mold on plants is an indication of an aphid infestation.

Description

The *eggs* are very tiny, shiny black, and are found in the crevices of bud, stems, and barks of the plant.

The *nymphs* look like the young adults, mature within 7-10 days, and are then ready to reproduce.

The *adults* are small, 3-4 mm long, soft-bodied insects with two projections on the rear end and two long antennae. Their body color varies from yellow, green, brown, to purple. Females can give birth to

live nymphs as well as can lay eggs. However, the primary means of reproduction for most aphid species is asexual, with eggs hatching inside their bodies, and then giving birth to living young. Winged adults, black in color, are produced only when it is necessary for the colony to migrate, or there is either overcrowding in colonies, or unfavorable climatic conditions.

Control measures

Cultural practices

- Control and kill ants. Cultivate and flood the field. This will destroy ant colonies and expose eggs and larvae to predators and sunlight. Ants use the aphids to gain access to nutrients from the plants.
- Avoid using heavy doses of highly soluble nitrogen fertilizers. Aphids love tender, juicy leaves. Practice split application: during seedling and flowering stage.

Traps

Sticky board traps

Place 1-4 sticky cards per 300 sq m field area. Replace traps at least once a week. To make your own sticky trap, spread petroleum jelly or used motor oil on yellow plywood, 6 cm x 15 cm in size or up. Place traps near the plants but faraway enough to prevent the leaves from sticking to the board. Traps when hung should be positioned 61 cm zone above the plants.

Yellow basin trap

Half-fill yellow pan or basin with soapy water. Place the pan close to the plant but exposed enough so that aphids will see it.

Botanical pesticides

Ginger rhizome extract

Grind 50 g of ginger and make into paste. Mix with 3 liters of water. Strain. Add 12 ml of soap. Mix well. Ten (10) kg of ginger in needed for 1 ha.

Custard apple leaf extract

Boil 500 g of leaves in 2 liters of water until the remaining liquid is about ½ liter. Strain and dilute the filtrate with 10 -15 liters of water.

Spray solutions

Ammonia spray

Mix 1 part ammonia with 7 parts water. This spray also controls flea beetles

Soap spray

Mix 2½ tablespoons of liquid soap to a gallon of water.

Corn earworm

Damage

Larvae feed on leaves, tassels, whorl, silks, and within ears. When larvae feed on corn silks, they clipped these off prior to feeding on the corn ears. The ears are the preferred sites for corn earworm attack. Ear damage is characterized by extensive excrement at the ear tip. They remain feeding in the tip areas until they leave to pupate in the soil.



Description

The eggs are pinhead-size and yellow-green in color. These are found singly laid near the midrib usually underneath the leaf. Hatching occurs within about 2-5 days.

The larvae vary in color from bright green, pink, brown, to black, with lighter undersides. Alternating light and dark bands run lengthwise along their bodies, the heads are yellow and the legs are almost black. Mature larvae vary in length about 3-5 cm. They drop to the ground to burrow into the soil to pupate. The larval stage lasts from 12-24 days.

Pupae are yellowish green and turn brown as they mature. Pupation takes place under the soil. Pupal period is 12-24 days.

An adult male is yellow-brown while a female is orange-brown in color. It has a wingspread size of about 3.8cm. Each female may deposit 200-2,000 eggs in her entire lifetime. Total development period from egg to adult is 34-45 days.

Control measures

Botanical pesticides

Ginger, garlic, and chilli extract

Soak 50 g of peeled garlic overnight in 10 ml mineral oil. Combine garlic, 25 g of green chillies, and 25 g of ginger. Add 50 ml of water to the mixture. Grind them. Add 3 liters of water.

1kg garlic, ½ kg ginger and ½ kg chillies are good enough for ~ ½ ha.

Ginger rhizome extract

Grind 50 g of ginger to make into paste. Add to 3 liters of water. Stir in 12ml of liquid soap. Strain
4 kg of ginger is needed for ~ ½ ha

Leafhoppers

Damage

Larvae feed on leaves, tassels, whorl, silks, and within ears. When larvae feed on corn silks, they clipped these off prior to feeding on the corn ears. The ears are the preferred sites for corn earworm attack. Ear damage is characterized by extensive excrement at the ear tip. They remain feeding in the tip areas until they leave to pupate in the soil.



Description

The *eggs* are laid inside the soft plant tissue on the underside of the leaves. They are elongate or curve, whitish to greenish, and about 0.9 mm long.

Eggs hatch in about 10 days. The nymphs look similar to the adults but are very small, pale yellow-green, and wingless. They undergo five nymphal stages. Their cast skins usually remain on the lower surface of the leaf.

Nymphs have the ability to walk sideways, forward or backward at rapid paces.

Adults are small, elongate, wedge-shaped insects about 3-4 mm long. They hop fast, fly quickly, and can run in all directions when disturbed, hence the name leafhopper. Many leafhoppers look alike and their colors vary; from green, gray, tan, brown, banded, which often lead to misidentification of the different species.

Control measures

Garlic oil spray

Chop finely 100 g of garlic. Soak the chopped garlic in mineral oil for a day.

Add ½ liter and 10 ml of soap. Dilute filtrate with 10 liters of water. Constantly shake the container or stir the extract while in the process of the application to prevent oil from separating.

Spider mites



Damage

Generally, mites feed on the undersides of leaves. They use their sucking mouthparts to remove plant saps. The upper leaf surface has a speckled or mottled appearance while the underneath appears tan or yellow and has a crusty texture. Infested leaves may turn yellow, dry up, and drop in a few weeks. Mites produce large amount of webbing. Heavy infestation will result in a fine cobwebby appearance on the leaves. Plants die when infestation is severe.

Description

The *eggs* are tiny, spherical, pale-white, and are laid on the undersides of leaves often under the webbings. Eggs hatch in 4 or 5 days.

Nymph looks similar to the adult but is only the size of an egg. It has only 6 legs. It molts 3 times before becoming an adult.

The *adult* is also very tiny, maybe yellowish, greenish, pinkish, or reddish depending on the

species. It looks like a tiny moving dot. It has an oval body with 8 legs and with 2 red eyespots near the head of the body.

The male is smaller than the female with a more pointed abdomen. A female usually has a large, dark blotch on each side with numerous bristles covering her legs and body.

Spider mite is not an insect.

Control measures

Botanical pesticides

Coriander seed extract

Pound or crush 200 grams of coriander seeds. Boil in 1 liter of water for 10 minutes. Cool and strain. Dilute extract with 2 liters of water. This extract also prevents fungal diseases.

Basil leaf extract

Pound or grind of 50 g of basil leaves. Soak it overnight in 2-3 liters of water. Add 8 - 12 ml of soap. Stir well. Spray on infected plants.

Thrips

Damage

Thrips have rasping-sucking mouthparts and feed by rasping the surface of the rapidly growing tissues of the leaves and sucking up the released plant fluid. Thrips cause tiny scars on leaves and fruit, called stippling, which can cause stunted growth. Damaged leaves may become papery and distorted.

Infested terminals lose their color, rolled, and drop leaves prematurely.



Description

The egg is very tiny and is impossible to see. A single egg is 0.25 mm long and 0.1 mm wide. It is white when freshly laid and turns pale yellow toward maturation.

The nymph is elongated, elliptical, slender, and is pale yellow in color. It is very small from 0.5-1.2 mm in size. Its eyes have darker coloration and are easy to see. Immature thrips do not have wings.

The pupa appears as an intermediate form between the nymph and the adult. It has short wing buds that

are not functional. At this stage, they do not do any damage to the plant.

The adult has a slender small body, yellowish to dark brown in color, and is cigar-shaped. It is 1-2 mm long with a well-pronounced 5-8 segmented antennae. It can exist in two forms, winged or wingless. The winged form has two pairs of elongated narrow wings which are fringed with long hairs. Female thrips can reproduce both sexually and asexually.

Control measures

Botanical pesticides

Garlic bulb spray

Finely chop 85 g of garlic. Soak chopped garlic in 50 ml of mineral oil for 1 day. Add 10 ml of soap to the

soaked garlic. Dilute with water to make a liter of spray material. Stir well. This spray also controls bacterial and fungal diseases.

Whiteflies

Damage

Both the larvae and adults pierce and suck the sap of the leaves. This causes the weakening and early wilting of the plant resulting in reduced plant growth. Their feeding may also cause yellowing, drying, premature dropping of leaves that result in plant death. Whiteflies produce honeydews that serve as the substrates for the growth of black sooty molds on leaves and fruit. The mold reduces photosynthesis causing the poor plant growth of the plant. They are the most important carriers of plant virus that cause diseases of fiber crops, vegetables, fruit trees, and ornamentals.



Description

The eggs are tiny, oval-shaped, about 0.25 mm in diameter, and stand vertically on the leaf surface. Newly laid eggs are white then turn brownish. They are deposited on the underside of leaves, sometimes in a circle or oval-shaped patterns.

The larvae are transparent, ovate, and about 0.3-0.7 mm in size and they move around on the plants looking for a feeding site upon hatching.

The pupae are dirty-white and surrounded by wax and honeydews. During this stage, the red eyes of the emerging adults are visible.

The adults are about 1mm long with two pairs of white wings and light yellow bodies. Their bodies are covered with waxy powdery materials. They are found feeding on top of the plants. A female can produce as many as 200 eggs in her lifetime and mating is not necessary. It takes about 40 days to develop from egg to adult.

Control measures

Botanical pesticides

Garlic oil spray

Chop finely 100 g of garlic. Soak the chopped garlic in mineral oil for a day. Add ½ liter and 10 ml of soap. Dilute filtrate with 10 liters of water. Constantly shake the container or stir the extract while in the process of the application to prevent oil from separating.

Madre de cacao & neem

Shred 1 kg of Madre de cacao leaves and 1 kg of neem leaves. Soak leaves in 5 liters of water for 3 days. Strain. Add water to make up 20 liters of filtrate. Spraying interval is 4-5 days.

Neem oil extract

Add 15 ml of neem oil into 1 liter of soapy water. Constantly shake the container or stir the extract while in the process of application to prevent oil from separating.

Spray solution

Soap spray

Mix 2 ½ tablespoons of liquid soap to a gallon of water

Potato starch spray

Mix 2-4 tbsp potato flour to 1 liter of water and add 2-3 drops of liquid soap. Shake the mixture and spray thoroughly before spraying.

White grubs



Damage

White grubs feed on the main roots of the plants. They cut the main stems and roots of plants below the surface of the soil. They tunnel into tubers of root vegetables and root crops. These feeding habits affect the underground portion of the stems and roots causing the plant to wilt and eventually die.

Description

The white grubs are the larvae of Japanese and May/June beetles. They are white or yellowish in color, with tan or brown heads, and with 6 spiny

legs. They have fleshy, wrinkled C-shaped bodies. Upon hatching they are quite small but can measure up to 2-4 cm when they mature.

Control measures

Botanical pesticides

Papaya water extract

Pound 1 kg of papaya leaves. Add the pounded leaves in 10 of liters of water. Leave to stand for 2 days. Strain.

Physical methods

Handpick beetles and feed to chickens or place in a pail of soapy water to drown.

Collect the adults (beetles) by shaking the plants to let them fall onto the sheet of old/used papers

placed underneath the plants. Put collected beetles into a bucket of soapy water to drown. The soapy water will prevent them from flying away.

Make bait traps of mashed fruit, sugar, yeast and water. Place these baits on the perimeter of the garden in plastic containers with an entrance hole cut at the top. Beetles love to feed on sweet smelling food. Choose sunny spots and strain the bodies out of traps every day.

Wireworms

Damage

Wireworms destroy the germinating seeds and tiny seedlings by cutting off underground roots resulting in missing stands. They attack the stems of newly set plant by boring into the stems near the soil surface. Some plants may wilt and die within a few days or may have stunted growth. Often, the wireworm is found near the damaged or missing seed or plant.



Description

Wireworms are the larvae of different species of Click beetles. Larvae are slender and hard and feel somewhat like wires. Their bodies are segmented and shiny and are usually cylindrical, but flat on the

lower sides. There are three pairs of legs close together near the head and no prolegs. Some of the most common species are white, yellowish-brown to reddish-brown, although other species may vary in color.

Control measures

Physical control

Corn/wheat seed mixture bait

Soak mixture in water for 24 hours to facilitate germination. Place ½ cup (of a 1:1 corn/wheat seed mixture) in a hole that is 12 cm wide and 30 cm deep. Cover with soil. Cover the topsoil with plastic to warm the surface and to speed up germination. Cover the edges with soil to prevent wind from blowing away the plastic. Remove the plastic, the soil cover, and the bait. Destroy larvae trapped in the baits. This method is also used to monitor white grub population.

Potato/carrot bait

Cut potatoes or carrots into chunks. Remove the potato 'eyes' to prevent from further growing. Make the pieces big enough and put in sticks. Bury "staked potatoes/carrots" at a depth of 3-6 cm in the ground. The stick serves as the handle to easily pull the baits out. Bury randomly in the field. Leave baits in the soil for 2-3 days. Wireworm will feed on the baits. Dispose the baits and the wireworm properly.

Nematodes

Root knot nematodes

Damage

Infected plants have swollen, impaired roots. Severe infestation results in stunted growth, yellowing of leaves, wilting, and poor yield because the galls disturb the roots ability to absorb water and nutrients. They also serve as openings for

pathogens, such as fungi and bacteria, which cause plant diseases. Infected pegs drop off from the plants and its feeding damage on pods is characterized by small tan spots with dark centers.

Description

Nematode's feeding stimulates the production of galls (root knots). Galls are found on the root system both on the primary and secondary roots. Their sizes vary from .02 to 20 cm in diameter. The gall is characterized by smaller swellings and more uniformly distributed infection on the lateral feeding

roots. Inside the gall are shiny white bodies of the female nematodes (about the size of a pinhead). At the root surface, shiny white to yellow egg masses are found. A closer look with a magnifier may show the adults, but mostly they are not seen with the naked eye. Root lesion nematodes feed on pegs and pods.

Control measures

Botanical pesticides

Basil leaf extract

Grind leaves 50 g of basil leaves. Soak overnight in 2-3 liters of water. Strain. Add 8-12 ml soap. Stir well.

Diseases

Aflatoxin

Damage

Infected plant is stunted. The leaves have abnormal colors and the lesions have fungal growth.

Infected seeds have gray-green or greenish-yellow molds, are discolored, and rotten. When they are used for sowing, they have a very poor germination rate.



Damage

Infected plant is stunted. The leaves have abnormal colors and the lesions have fungal growth.

Infected seeds have gray-green or greenish-yellow molds, are discolored, and rotten. When they are

used for sowing, they have a very poor germination rate.

Description

Aflatoxin is a naturally occurring toxic chemical by-product from the fungal growth of the *Aspergillus flavus* and *A. parasiticus* on infected crops. It often occurs in plants in the field during the germination stage and prior to harvest. The pods are infected when drying is delayed and when the seeds' moisture content is high that is not good enough for storage.

Fungal growth and aflatoxin contamination are caused by the following factors:

- warm temperature
- high humidity

- poor soil condition
- water stress
- insect's damage
- high crop densities
- weed competition
- inadequate post harvest and storage practices

Aflatoxin is toxic to animals, poultry, and humans. It can cause cancer of the liver, one of the most common cancers on humans in developing tropical countries.

Early leaf spot



Symptoms

The initial symptom is the appearance of yellow to brown small spots on the leaves. It is characterized by circular spots that are brown to reddish-brown on the upper leaf surface and almost orange on the lower surface. The lesions always have bright-yellow halos.

Late leaf spot



Symptoms

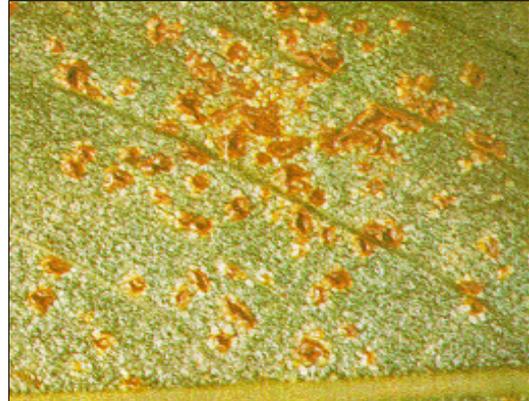
The spots are dark-brown to almost-black with feathery margin. The shape and size are similar to that of early leaf spot making the identification of both diseases difficult to distinguish from each other.

Peanut rust

Symptoms

Peanut rusts are very tiny leaf spots or flecks that can be seen from both sides of the leaf. Powdery mass of orange to reddish-brown spores are found as infection further develops, making the leaves look rusty. The true peanut rust always has pustules filled with spores on the leaf surface. To verify, rub a white tissue across these pustules, the reddish-brown spores will stain the tissue.

Usually, the disease develops in a radiating pattern within the field which is easily spread by air movements and the spread of infections are aggravated by wet and warm weather.



Control Measures

The following are the suggested control measures for peanut diseases:

- Thorough land preparation. The diseases causal organisms are found in the plant residues that are not properly decomposed and are left in the field.
- Use seeds that are whole and intact and free of molds and other pests
- Follow a proper planting distance pattern that will allow air movement among the plants
- Remove the weeds
- Practice crop rotation. Do your best to avoid planting peanut after peanut
- To reduce aflatoxin contamination includes the application of farmyard manure, lime, gypsum, and decomposed cereal crop residues to the soil.

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Basic cultural practices for peanuts

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Tables

Table 2. Monthly cropping calendar of activities

Management practices	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Seed procurement												
Land preparation												
Fertilization												
Irrigation												
Pests monitoring												
Pests control												
Harvesting												
Post harvest												

Table 3. Weekly activities

Field activities	-4	-3	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Care of seedlings																				
Land preparation																				
Fertilizer application																				
Cultivation																				
Irrigation																				
Weeding																				
Control of insect pests and diseases																				
Harvesting																				

Table 4. Crop lifecycle

Growth stages	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	De
Early growth stage												
Vegetative												
Reproductive												
Maturation												





**For more information on
non-chemical pest management see:**

www.oisat.org

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