

Field Guide to
**Non-chemical
Pest Management**



in Cowpea Production

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

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We also wish to thank all the individuals, groups and organizations that have prepared the bases for most of the 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.

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Prologue

Pesticides worth more than 47 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 the overall use, risk and dependence on pesticides, and to 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 Cowpea Production' is an excerpt taken from the website, www.oisat.org. It provides farmers with practical guidelines and alternatives to eliminate the use and their dependence on synthetic pesticides for the management of cowpea 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 cowpea as easy as possible.

It provides you with the suggested appropriate management practices on how to grow cowpea. 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 practical methods. Also, as not to confuse you with the beneficial insects, a separate page with photos of them and their conservation and management is included.

For example, you notice that the cowpea leaves are having large holes 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 cannot 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 cowpea growing, the recommendations may vary from location to location. It is highly recommended that you 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 cowpea.



Recommended practices

Throughout this field guide, you will find suggestions for stopping or lessening the pests' population before they have control over your cowpea 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 cowpea variety that is well adapted to your local conditions.
3. Always select good and disease-free planting materials.
4. Have a healthy soil, but always keep in mind that over-fertilizing is not necessarily better.
5. Practice crop rotation by planting in the next cropping season crops of a 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 pest-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 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. About Cowpea

Scientific name: *Vigna unguiculata*

Family: Leguminaceae

Other names: Blackeyed pea, Caupi, Crowder pea, Frijole, Southern pea

Uses

As vegetables, forage, cover crop or green manure

II. Climatic and soil requirement

Cowpea adapts well to the tropical climatic conditions. It tolerates dry and warm conditions and is drought resistant.

III. Selection of planting materials

Select seeds that are robust, properly dried and free from pests and diseases.

IV. Planting materials requirement

25 - 30 kg seeds/ha

V. Land preparation

Plowing the field once and twice harrowing. During the last harrowing, prepare the furrows with the desired distance for easier sowing of the seeds.

VI. Method of planting

2 seeds/hill

Distance of planting for erect varieties is 20cm in between hills and 50cm in between rows or 20cmx60cm

VII. Fertilizer requirement

Cowpea grows well in good soil. Incorporate compost during the last harrowing.

The general recommendation is up to 10kg N from 40-70kg P-K/ha.

To ensure the soil requirement, ask assistance from the local agriculturist office for soil testing.

VIII. Pest management

See pests/mites, diseases, and beneficial insects information.

IX. Weed management

First weeding is done after 2 weeks of sowing. When using animal drawn plough, off-barring after 2 weeks of sowing and 2 weeks later, hilling-up. This is also recommended times with manual weeding.

X. Harvesting

Harvesting starts 90-140 days after sowing or when the pods are fully ripened



Insects

Several pests will infest cowpea during its growth stages. Table 1 shows the pests that might damage the plant growth.

Table 1. The cowpea growth stages and its pests

Growth stages	Insects/mites
0 Stage Seeds	Ants Seedcorn maggot
Seedling stage Leaves	Seedcorn maggot Cutworm Aphids
Vegetative stage - - Leaves -	Aphids Leaf miner Thrips
Reproductive Flowers	Aphids Bean fly Bean pod borer
Leaves	Leaf miner Thrips
Maturation Pods, beans	Bean pod borer Lygus bug Stink bug

Ants



Damage

Ants take the sown seeds back to their colony and feed on germinating seeds and on young seedlings. These actions result in missing hills, thus loss of plant stand, uneven growth distribution in the field.

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. 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 can 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.

Spray solution

Ant oil spray

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

Aphids



Damage

Both the nymphs and the adults pierce the plant tissues to feed on plant sap. The infected leaves become severely distorted when the saliva of aphids is 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.

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 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

1. 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.
2. 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 60cm above the plants.

Yellow basin trap

Half-fill a 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 is 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.)

Bean fly



Damage

Larva feeds on leaves, stems, and taproots that lead to wilting and sometimes death of affected parts. There may be wilted or dead seedlings, and the leaves of older plants may become yellow and stunted. In case of heavy infestation, many plants will die in the scattered areas of the field. Insect damage on young plants is confined mostly on the main stem of the young plant just above the soil line. Plants will wilt or will eventually die if damage is severe. The larval feeding on leaves causes holes with corresponding light-yellow spots and larval mines with silvery curved stripes. At the later stage, the damage is clearly visible as the holes and the larval mines turned dark-brown. In cases of severe attack, infested leaves become blotchy and later hang down. Infested leaves may dry-out and may eventually shed. Insect damage on mature plants is confined to the leaf petioles which become swollen and at times the leaves may wilt. When a larva is about to pupate, it feeds downward into the taproot and pupates inside the stem close to the soil surface. The damaged stems are thicker than normal and they cracked lengthwise just above the soil.

Description

The eggs are oval, clear, and milky-white in color. These are laid in holes of leaves near the petiole. The maggot is small and white in color with brown head.

The pupa is barrel-shaped, yellow with a brownish-tinge and distinctly darker ends. It has

well-defined segments with black anterior and posterior breathing organs. It becomes dark-brown before the adult emergence.

The adult has metallic-black color about 1/4 in size than that of a common housefly.

Control measures

Cultural practices

1. Intercropping cowpea with corn lessens the attack of bean fly.
2. Mulching plants with rice straw and with cut weeds.
3. Hilling-up or ridging of young plants 4-5 weeks after planting.
4. Crop rotation with non leguminous crops.
5. Avoid late planting if infestation is prevalent in the area. Plant at the same time as with the other farmers in the area.
6. Plow-under all plant residues from the field after harvest.

Bean pod borer



Damage

The larval feeding causes round holes in the corolla of the flowers, distorted pods associated with the inflicted holes, webbed flowers and young pods, and presence of frass. Damaged flowers become a mass of brownish-frass a day after infestation

Description

The eggs are ovate, clear, and pale yellowish-white in color. Eggs are either laid individually or in small batches on flowers or flower buds, and on terminal shoots of young plants. A single egg looks like a small droplet of water and is seldom recognized as a pest egg. The egg development lasts for about 3 days.

The larva has a whitish to pale-green or pale-brown body with irregular brownish-black spots. These spots become indistinct immediately before pupation. Its head capsule is light to dark-brown with a dark-brown plate which is divided dorsally. Newly hatched larvae are found clustered together in the flowers. They later disperse singly to feed from one flower to the next. A larva can consume 4-6 flowers. Matured larvae web together flowers and young pods, feed, and pupate inside the webs. When fully fed, they reach a length of 1.7-2.0 cm. A larval stage has five instars.

The pupa is enclosed with a silken cocoon found inside the web. The pupal stage lasts for 5-7 days.

The adult has brownish-black wings with a clear-white marking. It rests during the day with its outspread wings under the lower leaves of the host plant. An adult has a life span of 6-10 days.

Control measures

Cultural practices

1. Crop rotation with non leguminous crops.
2. Intercropping cowpea with surghum lessens the attack of bean fly.

Cutworm



Damage

Seedlings are often cut off at ground level. Cutworm larvae can be found in the soil (up to a depth of about 5 cm) near the plant host. They always curl-up when disturbed. Cutworms feed only at night. Generally, they are not found on plants or on the soil surface during the day.

Young caterpillars eat the soft leaves of the plant. The fully grown caterpillars are capable of eating the entire plant. The newly hatched larvae feed from the base towards the tip of the leaf. At this

stage, they first feed on the epidermis and may discolor the entire leaf surface.

The yellowing of the leaves is a typical symptom of Spodoptera when they cause damage to thick-leaf plants.

Description

Eggs are tiny pearl white, round, and have a ridged surface.

The newly hatched Spodoptera larvae are greenish and about 1 mm long. The full-grown larva has a cylindrical body, brown or brownish-black with a tinge of orange. The thoracic segments have one to two dark spots near the base of the legs. The abdominal segments generally have two light brownish lateral lines on each side, one above and one below the spiracles. Above the top lines are broken lines composed of velvet semi-crescent patches that vary in color among cutworms.

The pupa is black or brown in color and measures about 22.5 mm long and 9.2 mm wide.

The adult has dark brown forewings with distinctive black spots and white and yellow wavy stripes. The hind wings are whitish with grayish margins. The total developmental period from egg to adult is about 35-40 days.

Control measures

Cultural practices

1. Removal of weeds in and around fields will reduce egg-laying sites and will help in the prevention of cutworm infestation. Do this at least 2-3 weeks before planting to reduce the incidence of cutworm larvae transferring to newly planted crops.
2. Plow and harrow fields properly before planting. This will destroy eggs and expose larvae to chicken, ants, birds, and other predators.
3. Interplant main crops with onion, garlic, peppermint, coriander, or garlic every 10-20 rows to repel cutworms. Sunflowers and cosmos can also be planted as a trap crop in or around fields.

Physical methods

1. Protective collars made of plastic or paper cups, plastic drink bottles with ripped-out bottom, sturdy cardboard, and milk cartons. Place the collar around the young plant and push into the soil to prevent the cutworm from attacking the stem.



2. Sticky substances such as molasses, saw dust, or crushed eggshells placed around the base of each plant. When the cutworm emerges to feed, it will come in contact with the trap, get stuck, harden, and die.

Leaf miner



Damage

Larvae make long, slender, winding, white tunnels in leaves. Severely mined leaves may turn yellow, disfigured, and drop. Severely mined seedlings are stunted and eventual death occurs.

Description

Eggs are laid under the surface of leaf epidermis, are ovate, creamy-white in color, and tiny- about 0.10-0.15 mm in diameter. The eggs hatch after 2-5 days.

Larva is legless, whitish to yellow-green with a darker head. It has a mouth-hook structure that is retractable into the body. A newly hatched larva tunnels through the mid-leaf tissues leaving its characteristic wavy lines that are visible on top of the leaf. It undergoes 3 larval stages that lasts for 4-7 days. When the larva is ready to pupate, it cuts a hole where it stays and feeds and usually drops to the soil to pupate.

Pupa varies in color, from yellowish-brown to almost black, and distinctly segmented. It is oval-shaped, becoming narrow at the end. The pupal stage lasts for 10-12 days.

Adult is a small fly, about 2.5 mm long. It is grayish to black with yellow markings. Female flies are slightly larger than males.

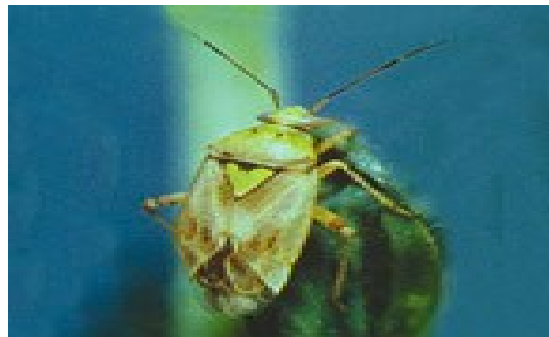
Control measures

Physical control

Yellow plastic gallon containers mounted upside down on sticks coated with transparent automobile grease or used motor oil. These should be placed in and around the field at about 10 cm above the foliage. Clean and re-oil when traps are covered with flies

1. Yellow sticky boards To use, place 1 to 4 yellow sticky cards per 300 square meter field area. Replace traps at least once a week. It is difficult to determine the population of newly trapped whiteflies on a sticky card from those previously trapped ones. To make your own sticky trap, spread petroleum jelly or used motor oil on yellow painted 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 60-70 cm zone above the plants.
2. Yellow plastic trapping sheets. A 2 m long x 75 cm wide yellow plastic sheet coated with motor oil, both ends attached to bamboo or wooden poles and carried by 2 persons through the field to mass capture adult flies.
3. Plastic trays placed under the plants to monitor and catch pupating larvae as they leave the plants to pupate in the soil.
4. An inverted kitchen funnel capped with a plastic vial to monitor adults' emergence from the seedbeds.
5. Yellow plastic drinking cups coated with adhesives and stapled on stakes above plant canopies to trap flies.

Lygus bug



Damage

Lygus bugs feed on the young apical leaves, flowers and flower buds, tender stems, and

developing seeds. The feeding damage causes stem or leaf death, aborted flowers, and/or distorted seeds.

Description

The eggs are tubular and tiny about 1 mm long, and are laid partly inside the leaf and bud tissues. An egg hatches in about 10 days.

The nymph is ovoid and 1-4 mm long. Newly hatched, it is similar to an aphid, but it moves quickly when disturbed. The nymph has reddish tips on its antennae. Its legs are mottled-brown at all stages. An older nymph is pale to medium-brown and has 5 black spots on its back. It looks like the adult, only wingless.

The adult varies in color from a pale yellowish-green to dark reddish-brown. It is about 6-7 mm long, flattened, and oval. The distinguishing characteristics are the yellowish, V-shaped markings on top of the body and membranous wingtips. It is very active and promptly flies away when disturbed.

Control measures

Cultural practices

1. Plant trap crops such as cotton and alfalfa
2. Get rid of the broadleaf weeds in and around the field as they provide alternate homes for the bugs.
3. Remove all plant debris after harvest as the bugs may continue feeding and breeding on these.

Physical control

Use nets to traps flying adults

Seedcorn maggot



Damage

The maggot burrows into the seeds and the seedlings, proceeds into the lateral roots, then tunnels into the taproot, and sometimes bores into the base of the stem. Damaged plants will wilt, stunt, and/or eventually die.

Description

Eggs are elongate and pearly white with a diagonal pattern. They are deposited near the seeds or seedlings, especially those grown in soil with abundant organic matter.

Larvae are small maggots, yellowish-white to dirty-yellow, and legless. They undergo three larval stages. Larval development lasts for about 12-16 days.

Pupae are tan to brown in color. They are situated near the host plant. The pupal stage is about 7-20 days.

The adult flies are grayish-brown and look like small houseflies. The female adults prefer to lay their eggs in newly harrowed fields. They can lay about 100 eggs over a 3-4 week period. Life span is about 1-2 ½ months.

Control measures

Cultural practices

1. Plow-under crop residues immediately after harvest. Plowing destroys the pest and exposes pupae to ground predators and sunlight. Maggots can survive for some time in crop residues.
2. Root flies prefer to lay eggs in the soil that is moist and with high organic matter. Do not plant susceptible crops unless the plant residues are dry and/or completely decomposed.

Physical control

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 60cm above the plants.



Stink bug



Damage

Adults and nymphs suck plant sap from leaves, flowers, bolls, buds, fruits, and from the seeds of a wide array of crops. Feeding on fruits causes scarring and dimpling known as cat-facing. Feeding on the developing grains of rice at the milking stage causes shriveling and empty seeds with brown spots. Feeding on cotton bolls prevents bolls to open or stains the lint or causes bolls to drop.

Description

The eggs are yellow and barrel-shaped. These are laid on the lower surface of the leaves in clusters of 20-130 in 5-8 parallel rows.

The nymph has heterogeneous colors (green, tan, brown or gray). It is oval-shaped, wingless but looks similar to an adult counterpart. The first nymphal instars do not feed. The nymphs form clusters at the natal site. The second and third instars are also found in clusters but they disperse when disturbed. The fifth nymphal instars are sensitive to day length, which also causes the adults to begin diapauses. The nymphal development lasts for about 8 weeks.

The adult is shield-shaped and green, tan, brown or gray in color. Most of the adults are shiny, but some species are spiny and rough-textured. The female starts mating one week after emergence and lives for about 30 days.

Stinkbug emits a foul odor when disturbed, hence the name.

Control measures

1. Remove and control weeds from fields and also in the adjacent fields. Weeds serve as the pests' alternate hosts.
2. Plant small flowering plants to attract native parasitic wasps and flies.

3. Plow-under all plant debris after the harvest to destroy all possible breeding sites.

Parasitoids

Native parasitic wasps

Trichopoda pennipes is a Tachinid fly species that is as big as the housefly. The adult fly is brightly colored with a gold and black thorax and an orange abdomen. It has a fringe of feather-like black hairs on the outer side of the hind legs. The fly develops in the nymph and adult stink bug or squash bug. The female tachinid fly lays its eggs on the body of the bug, completes its cycle inside the bug's body, and the bug dies upon the fly's emergence.

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

Physical control

Bright blue or royal blue sticky traps. Thrips are attracted to these colors. To make your own sticky trap, spread petroleum jelly or used motor oil on a blue shade painted plywood, 6 cm x 15 cm or up in size. Place traps near the plants with enough distance that the leaves from sticking to the board (Thomas, 2002). The traps when hung should be positioned at a 60-75 cm zone above the plants

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.



Diseases

Bean anthracnose



Anthracnose on beans appears on leaves at all the growth stages of a plant but often appears in the early reproductive stages on stems, petioles, and pods. It generally appears first as small and irregular yellow, brown, dark-brown, or black spots. The spots can expand and merge to cover the whole affected area. The color of the infected part darkens as it ages. The disease can also produce cankers on petioles and on stems, causing severe defoliation.

Bean rust

The initial symptom is a yellow mosaic discoloration on the undersides of the lower leaves on the onset or during the flowering stage. The small lesions gradually increase in size and become tan or brown in color. The lesions are slightly raised and consist of small pustules, with a small hole on top where the spores emerge. The pustules become plentiful and eventually coalesce to form larger pustules that break open, releasing masses of spores. During pod formation, the disease spreads rapidly to the middle and upper parts of the plant. Lesions are found on petioles, pods, and stems but are most abundant on leaves.

Chocolate spot, bacterial brown spots on beans

Infected leaf has ovate-shaped spots of dead tissues surrounded with yellow-green to lemon-yellow margins. As the spots enlarge, they may join together often having torn out dead tissues,

developing a shot-hole appearance. An infected pod has initially tiny water-soaked spots that later enlarge and join together, become sticky, and develop tiny crusty area on its center during rainy days. Later, the infected area turns brown and dies causing the pod to twist or bend.

Powdery mildew



Powdery mildew is characterized by a dusty-white to gray coating and talcum powder-like growth commonly infecting plant's leaves. It begins as circular, powdery-white spots that turn yellow-brown and finally black. In most cases, the fungal growth can be partially removed by rubbing the leaves.

Powdery mildew is commonly found on the upper side of the leaf. It also infects the underneath surface of the leaf, young stem, bud, flower, and young fruit. The infected leaf becomes distorted, turns yellow with small patches of green, and falls off prematurely. Infected buds fail to open. Other injuries include stunting and distortion of leaves, buds, growing tips, and fruits. Infected seedlings will eventually die.

Mosaic virus

The common symptom of an infected plant is alternating spots of yellowish and light or dark green mottled leaves. The mottled areas often appear thicker and somewhat elevated giving the leaves a blister-like appearance. Other symptoms include curling and yellowing of the leaves, stunted growth, and malformed beans.

Conditions that favor diseases' development

1. Infected seeds and infected plant debris left in the field after harvest

2. Moist and warm weather during the reproductive stages. Plants are most susceptible during the flowering stage from bloom to post harvest
3. Badly drained soil. Wet periods of about 12 hours or more favors the occurrence of infection
4. Nutritionally stressed or unhealthy crops

Cultural control

1. Plant resistant cultivars when available
2. Practice a wider spacing between the hills and the rows to increase air flow among plants, and light penetration
3. Practice crop rotation
4. Remove infected plant materials and alternative hosts
5. Overcrowded plants to increase air circulation, reduce the relative humidity, reduce infection, and increase the light penetration
6. Plow under all plant residues or remove plant residues after harvest. Do not place infected plant materials on the compost pile.



Beneficial insects

The following are some beneficial insects that are indigenous on your fields and gardens or can be introduced for the control of pests.



Damsel bug	Diadegma	Lacewing	Spider
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Hoverfly	Ground beetle	Ladybird beetles	Tachinid flies
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Rove beetles	Trichogramma	Braconid
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Conservation of the beneficial insects

1. Provide hiding sites and alternative habitats such as mulches and other ground covers.
2. Plant small flowering plants on borders, hedges, and other perennial habitats as source of food and shelter
3. No indiscriminate use of synthetic pesticides.

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For more information
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