



Fair Planet

Fair planet`s identification guide for plant pests and diseases in Ethiopia



FAIR PLANET TECHNICAL ASSISTANCE PROGRAM – FDOV14ET01
SECOND EDITION

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General Notes:

The identification guidelines included in this document provide information on the main plant pests and diseases that are prevalent in the Fair Planet project sites in Ethiopia.

Weather conditions (such as temperature, rain, cloud coverage and wind) and soil type might have a major effect on the development and spread of plant pests and diseases, and should be taken into account when considering applications of chemicals.

Pests and diseases should be monitored periodically and treated using the relevant chemicals, according to the chemical's label and the chemical's safety data sheet.

For more details and for information on other plant pests and diseases – contact your local vegetable specialist or plant protection expert.

Disclaimer:

These guidelines are intended to be used as an identification tool only, and Fair Planet is not in any way liable for any decisions and or actions resulting from their use.

The information contained in these guidelines may contain technical inaccuracies or typographical errors. We reserve the right to make changes and improvements to any information contained in these guidelines.

About Fair Planet and project partners

Fair Planet is a non-profit organization. Our goal is to enable smallholder farmers to increase their productivity and income, through access to high quality vegetable seeds, suitable for their needs. Access to such seeds will allow farmers to produce and sell significant yields with minimal changes in their farming practices. To realize this goal, Fair Planet partnered with the world's leading seed companies - Syngenta, Enza Zaden, East-West Seed, Limagrain-Hazera and Bayer.

In each agro-climatic region we perform variety trials to identify vegetable varieties best suited for local farmers' needs and together with our partners, provide these farmers with access to affordable seeds along with agro-technical training and extension visits.

Fair Planet operates a training program in Ethiopia in frame of the FDOV14 ET 01, implemented in collaboration with Haramaya University, Regional Offices of Agriculture, Ministry of Agriculture, Dire Dawa multipurpose Farmers' Union, Fair Planet's Seed partners, JoyTech Plc. KKL-JNF, Netafim, Alterra from Wageningen University and RVO - the Netherlands Enterprise Agency.

We would like to thank all the people (experts and volunteers) who contributed to this edition of the Fair planet`s identification guide for plant pests and diseases in Ethiopia.

General Information on Pest Management

What's in the guide?

Introduction

- *Fair planet's guidelines for plant protection in Ethiopia.*
- *Procedures for chemical application*
- *Principles for monitoring pests and diseases in the field*

A Pocket Guide for identification of:

- *Pests*
- *Diseases*
- *Viruses*

Fair Planet's guidelines for plant protection in Ethiopia

We use robust varieties, resistant to certain diseases and viruses. We therefore endeavor to reduce interventions and the use of chemicals for the following reasons:

- The danger of pests developing resistance to chemicals.
- The costs of materials and labor, and harm to the environment.
- Upsetting the natural biological balance in the field.
- Whenever we spray poisonous chemicals we affect the general biological balance in the field, including essential pollinators and a range of insects and natural enemies.

We therefore endeavor to take several measures that may reduce/prevent the establishment of pests and plant diseases in our fields.

Three basic rules for the correct control of pests:

1. Prevention

- Regular irrigation and fertilization promote the development of healthy, vigorous plants.
- Good airflow along the row, by trellising and proper spacing reduces accumulation of moisture on the plants, which is a major cause of the development of fungal diseases and infection of neighboring plants.
- Clearing the field of weeds that provide habitat for pests will reduce infestations.

2. Sanitation

- Plants, branches and infested fruits must immediately be removed from the field, preferably to be burned at a far-away, controlled site.
- Prevent entry to rows of infected plants.
- If a certain variety is affected; a specific worker should preferably be assigned to maintain that variety. This worker should not enter other rows on the same day.

3. Elimination

- When a certain pest or disease has been identified, we shall try to find out:
 - i. The source. Identify the specific pest and characterize whether it affects a certain variety.
 - ii. Find out whether the whole field is affected, or whether the problem is localized. Is just one or are many plants affected?
- We will try to deal with the problem by the means available to the average farmer. We do not use expensive methods that are not available to the average farmer.
- Specificity: we apply a chemical spray that suits the specific source(s) of the problem and try to treat the entire field uniformly, but perhaps a little more where the pest or disease was first observed.
- Change of materials: to avoid pests developing resistance to chemicals by repeated use of the same material, sprays with different active ingredients should be rotated on a weekly basis.

General comment: According to the characteristics of the pest and the potential damage it may cause, you have to decide whether to act at a low threshold, or wait and decide to treat only later, in case of increasing severity.

Procedures for chemical applications:

Before any spray is applied, carefully read the instructions on the label and the accompanying literature.

The following instructions have to be observed and followed:

- Determine the exact amount of chemical (grams or milliliters) required per a given area of this crop. Quantities must be measured exactly, with a measuring cup (milliliters) or balance (grams).
- Fill the sprayer with 5 liters of water, add the required amount of the chemical, mix well and only then fill up the sprayer. **Never deviate from the instructions.**
- Check if other chemicals can be combined?
- Verify the number of spraying rounds allowed per season?
Never exceed the recommendations.
- Check the latest spraying time before harvest (days before harvest)?
- In case of doubt, consult with your local professionals.
- Always wash the sprayer thoroughly before use, to avoid residues from previous sprays.





Working with hazardous materials

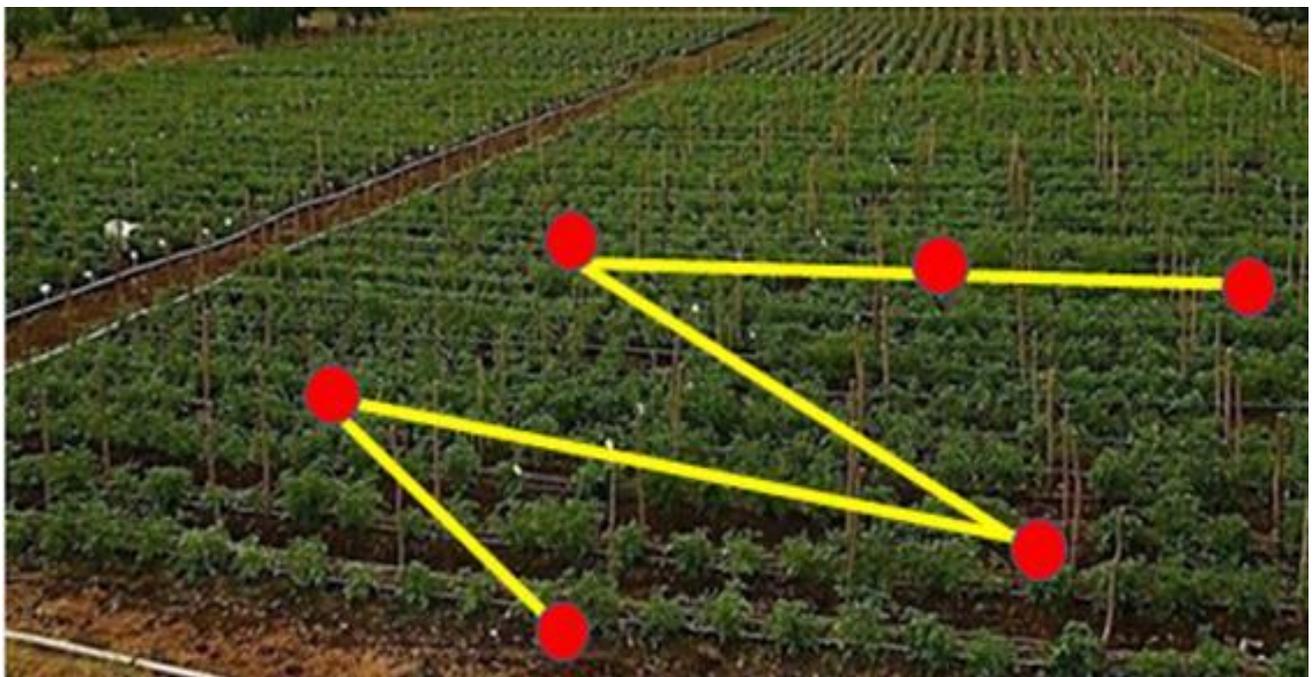
Some chemicals are hazardous to humans, plants and the environment.

All necessary precautions must be observed according to instructions:

- Wash your hands after every contact with chemicals.
- Avoid touching the eyes. In case anything gets into the eye, rinse well for 5 minutes with running water and then get medical attention.
- Do not mix chemicals before consulting instructions.
- Do not use equipment meant for applying chemicals for any other purpose (such as storage or packaging).
- **Safety:** the operator must wear a mask, long sleeved clothes and solid shoes when spraying.
- **Operating hours:** spraying should be done in the early morning or in the afternoon. Do not spray in strong sunlight hours as the spraying may scorch the plants (especially oil-based materials). Also, do not spray when rain is expected or soon afterwards as the moisture on the plants may wash off the chemicals.
- **Spraying the plant:** make sure that all parts of the plant are covered with the spray, including the lower parts and the top of the plant.
- **Cleaning and maintenance:** the spraying equipment is expensive and delicate, and has to be handled accordingly. After every use, all parts must be rinsed thoroughly with clean water. The sprayer should be stored in a closed and locked place.

Principles for monitoring pests in the field

- What to look for? Look for unusual appearances on plants: different form or color of leaves, spots of various colors on or under the leaves, holes in leaves or fruits, shriveling etc.
- How to search? Sample the field at several locations, not at the margins (see picture below).
- Quantitative assessment: evaluate the extent and spread of the problem.
 1. How extensive and how widespread in the field is the infestation and how many of the plants are affected?
 2. What is the extent of the infestation and what is the amount of the pests or the symptoms?
 3. What is the extent of the damage?



Walk the field and sample at several locations, not at the margins

Identification guide for Pests

Cut Worm / Horn Worm

Description	Black or green caterpillar up to 3 cm in length, highly sensitive to sunlight, feeding in the dark on the stem of the plant
Affected parts	The base of the stem, near the roots
Identification	<ul style="list-style-type: none"> - Stems are damaged near the roots - Dig close to the roots and look for the caterpillar - Damaged roots - Thin, torn off stems may be found near the plants - Leaves, branches and whole plants are damaged or missing
Remarks	<ul style="list-style-type: none"> - High potential for damage unless treated - Take care to spray where the stem meets the roots - During daylight the caterpillar hides and is not as active as at night - Only very young plants are attacked, during their first months in the field
Additional information	<ul style="list-style-type: none"> - The eggs are white - Don't confuse with the Bollworm - Cutworm caterpillars affect the stems while the Bollworm damages fruits - If young plants are cut and Cutworm is present, it is recommended to spray immediately



Bollworm / Helicoverpa Armigera

Description	Brown or green, relatively large, caterpillar (3.5-4.2 cm at maturity)
Affected parts	Fruits
Identification	<ul style="list-style-type: none"> - Fruits with holes - The insect eggs look like white grains in or on fruits or on nearby leaves - Entry hole usually larger than exit hole - Sometimes the bollworm eats the whole fruit from inside causing the fruit to rot without an exit hole.
Remarks	<ul style="list-style-type: none"> - When two holes are found on one fruit we assume that the caterpillar is no longer inside - When finding a fruit with holes it should be opened, there may be another caterpillar inside
Additional information	<ul style="list-style-type: none"> - Don't confuse with Cutworm, the Cutworm attacks the base of the stem near the roots whereas the Bollworm attacks the fruits. Compare before you decide. - The Bollworm makes relatively large holes in the fruit compared to small holes made by Tuta - Remove any infected fruit before spraying





Leaf Miner

Description	Tiny fly (2.5 mm.), with yellow spots on a black backside. The fly lays its eggs into the leaf tissue. The larva is yellowish and can be found in the tunnels
Affected parts	Leaves
Identification	<ul style="list-style-type: none"> - White tunnels following the veins of the leaf. - The larva is very lazy (it will hardly move when touched). In contrast, the Tuta larva will move vigorously when touched. - The leaf miner makes tunnels along the leaf veins, whereas Tuta makes “windows” and sporadic tunnels in the leaf.
Remarks	<ul style="list-style-type: none"> - The female fly feeds on the leaf tissue and lays its eggs in it.
Additional information	<ul style="list-style-type: none"> - Important: The leaf miner is a relatively slow developing pest, causing only limited damage. Only if damage is apparent over a large part of the field, control measures should be applied. Most of the chemicals used to control Tuta can be used for the leaf miner.

Leaf Miner - Symptoms



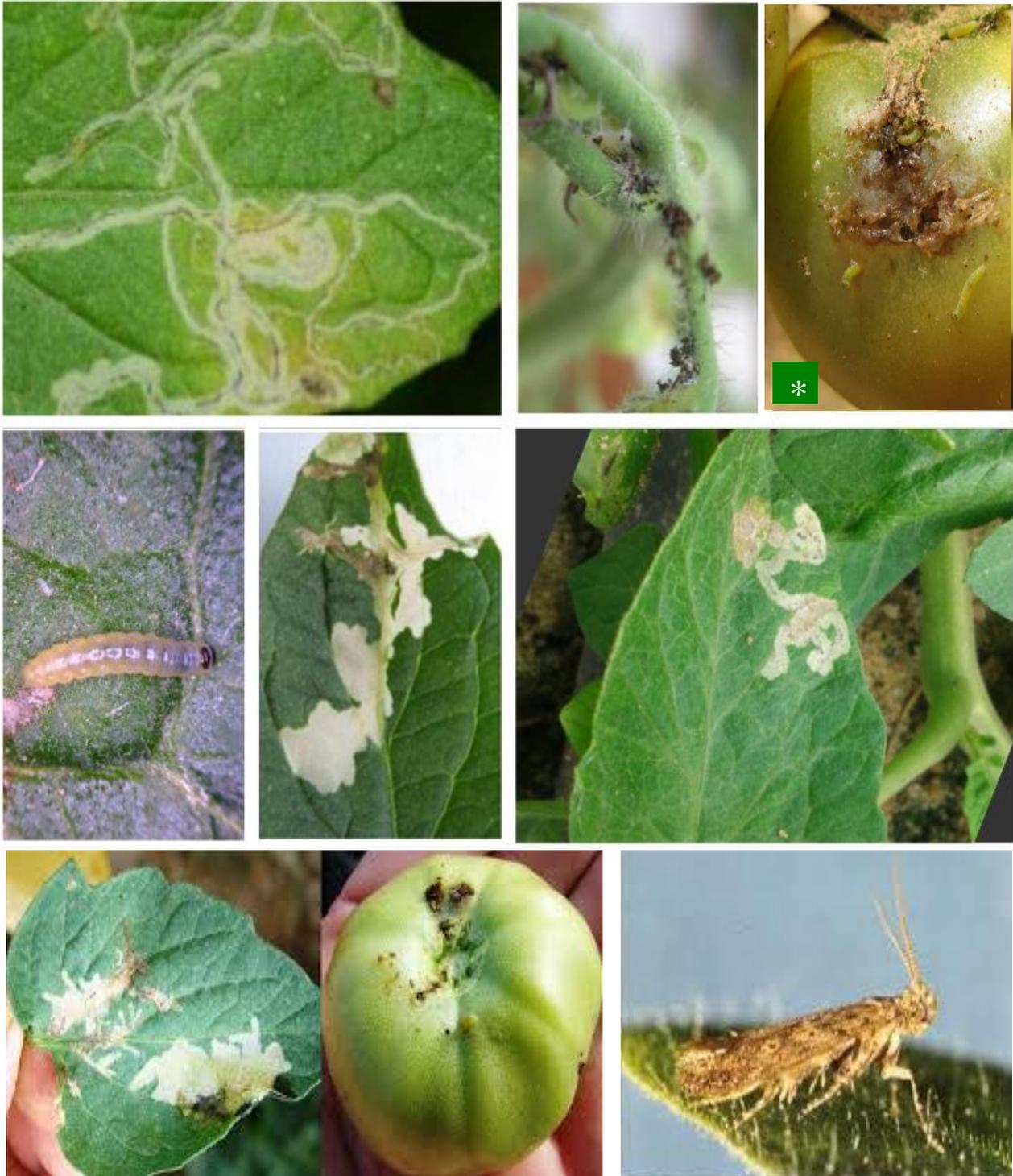
Tuta Absoluta

Description	Creamy white caterpillar with dark head. Measuring almost one cm in length
Affected parts	Leaves and fruits
Identification	<ul style="list-style-type: none"> - Tuta makes transparent “windows” (not holes) and sporadic tunnels in the leaves, usually in the center of the leaf. The damage is visible on both sides of the leaf - Upon opening the tunnels, you may find black spots (excrements) - Leaves become distorted and folded - Small entry holes in fruits - usually near the sepal - and rotting fruits - Green, transparent, very small eggs
Remarks	<ul style="list-style-type: none"> - Tuta is an aggressive, dangerous pest and may destroy an entire field if not treated soon
Additional information	<ul style="list-style-type: none"> - Tuta quickly develops resistance to pesticides, therefore it is advisable to rotate chemicals - Early in the season, we spray at low infestation rates. The Tuta spreads quickly and finding even a few larvae in a field is a cause for immediate spraying - Close to harvest spray only if fruits are affected - Chemicals against Tuta are expensive – spray only after definite identification of the pest - Spray thoroughly (in and around the field). The Tuta multiplies fast and can re-establish if spraying is not comprehensive. - Tuta may be confused with the leaf miner. Make sure before spraying; consult with your local specialist. Tuta makes “windows” and sporadic tunnels whereas the leaf-miner makes tunnels along the leaf veins. - Tuta larva will move vigorously when touched, while leaf miner larva is very lazy (it will hardly move when touched) - Treated Tuta will turn black, this is the sign of an effective spraying, expect the larva to die in 1-2 days after spraying - Tuta has black secretion, inside the ‘window’ - Tuta life cycle is very short - 7-10 days. Plan the spraying protocol accordingly - If Tuta is not inside the leaf “window”, it might be due to its maturity <ul style="list-style-type: none"> - the larva goes out of the leaf. - Larvae hide during the day in between the branches and leaves– spray accordingly



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Tuta Absoluta - Symptoms



*Courtesy of BioBee - Biological Systems Ltd.

Bemisia Tabaci / White Fly

Description	A tiny white insect
Affected parts	Affecting all parts of the plant
Identification	<ul style="list-style-type: none"> - The whitefly is a flying insect. Entering an infested field, especially in the morning and afternoon, will raise a white cloud from infested plants. Individuals can be observed, especially on the underside of the leaf, with a magnifying glass
Remarks	<ul style="list-style-type: none"> - Bemisia tabaci aphids are vectors of the TYLC and TOC viruses, which causes yellowing and distortion of the crown of the plant. Treatment against the aphids is very important where TYLCV or TOCV occur - Eggs are laid on the underside of leaves - The aphid feeds on the plant and produces "honeydew" on which fungi can grow, and thus promotes secondary diseases unless effectively treated - Upon finding a sticky material with a consistency of honey on the plants, the presence of aphids may be assumed
Additional information	<ul style="list-style-type: none"> - Ants and ladybug like beetles presence on the plants frequently indicates the presence of aphids - Eggs are clearly visible, as yellow very little dots (raised from the leaf upwards)



Aphidoidea / Aphids

Description	Small green/black/white aphid, found on leaves
Affected parts	Leaves
Identification	<ul style="list-style-type: none"> - Small green black/white insects attached to leaves. - Relatively fast moving, they are found mainly on the underside of leaves. - Usually causing folding and “humps” on the leaf (visible only when using a magnifying glass)
Remarks	<ul style="list-style-type: none"> - Eggs are laid on the underside of leaves - The aphid feeds on the plant and produces “honeydew” that serves as a growth medium for fungi, thus attracting secondary disease unless effectively treated - If a sticky material with honey like consistency is found on plants, the presence of aphids may be assumed - Aphids cause the leaf to curl and curve, also to become yellowish and lose its green color (due to sucking)
Additional information	<ul style="list-style-type: none"> - Ants and ladybird like beetles on plants indicate the presence of aphids, Check with a magnifying glass - Look at the underside of leaves and shake the plant over a sheet of paper, to identify Aphids presence. - Control using systemic/translaminar insecticides, because the aphids are hiding underneath the plant’s leaf



Spider Mite / Tetranychus Cinnabarinus

Description	The Spider mites looks like very small red-brown spots, moving quickly on the leaf
Affected parts	Leaves
Identification	<ul style="list-style-type: none"> - Symptoms start with the appearance of sucking spots with yellowish surroundings that later turn brown. - Many orange-brown spots are visible, especially at the rear of the leaf and near the petiole, later spreading to the tip of the leaf - At high infestation they form spider web like webs over the leaf - After feeding on the leaf mites leave small yellow-white circles that lead to leaf drying - Yellowish signs might be confused with powdery mildew or some deficiencies. Make sure to use magnifying glass to identify the spider mites.
Remarks	<ul style="list-style-type: none"> - Mites tend to attack weak plants and then spread to other plants. Remove the weak, infected plants from the field to avoid spreading of mites. - Eggs are laid on the underside of leaves - More eggs are produced in high temperatures
Scouting notes	<ul style="list-style-type: none"> - Upon identifying symptoms of feeding on leaves, look for mites and webbing on the underside of older leaves. - To check for mites, sharply tap a plant against your hand while holding it over a white sheet of paper. - You may need a magnifier to see the mites clearly
Additional information	<ul style="list-style-type: none"> - Mites prefer hot, dry conditions, and transfer by dust and wind - In susceptible varieties fruits can also be damaged - You can spread the mites by walking through the field. Scout the areas where you do not see damage first, then the damaged areas, to avoid spreading the mites to new areas of the field. - Wild eggplants are highly preferable for mites, as host plants - Untreated field might be totally devastated within 2-3 weeks! No tolerance!



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Thrips / Ponticulothrips Diospyrosi

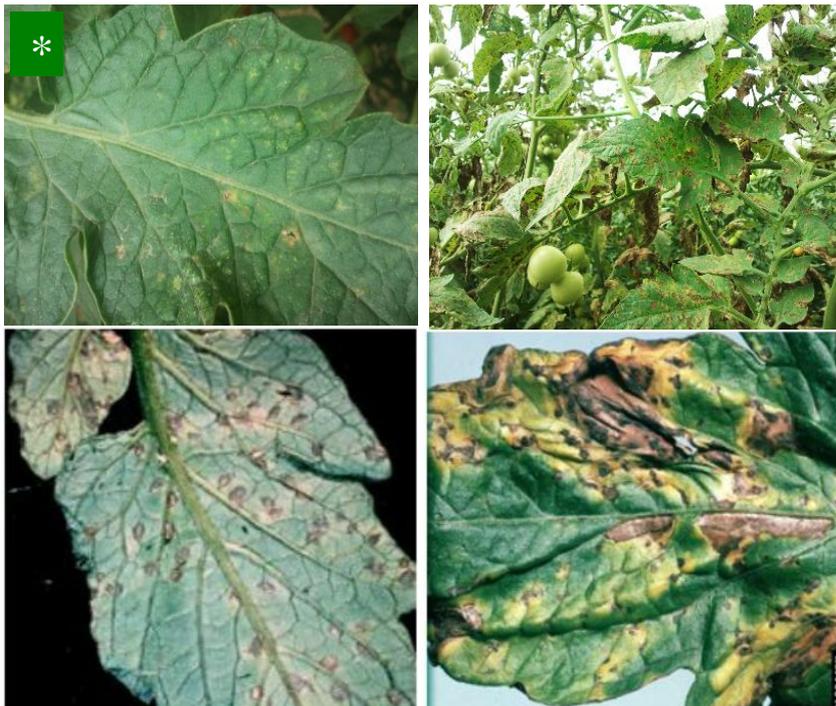
Description	Small black flying insect, mainly hiding in flowers
Affected parts	Flowers, leaves and the crown
Identification	<ul style="list-style-type: none"> - The damage is caused by Thrips sucking out the plant fluids, causing wilting and yellowing. It also serves as the main vector of some viruses - Thrips can be found hiding in the flowers by shaking the flowers over white paper – or over your hand - Symptoms consist of yellowing, folding and extreme distortion of leaves as well as spots on the petals - Yellow Thrips indicate that the trips is young, black for mature Thrips. The cycle from egg to adult may last 10-30 days, therefore – spraying may be programmed according to the color and cycle of the Thrips (10 days and more) - Thrips will cause damage on the fruit maturity - twisted fruits (indication for thrips presence)
Remarks	- Thrips are the vector of the Tomato Spotted Wilt Virus (TSWV)
Additional information	<ul style="list-style-type: none"> - Thrips has many hosts. Therefore, good sanitation is important. Remove potential host plants from the fields, especially pepper and eggplant - Monitoring by shaking flowers over white papers should be done daily in order to evaluate the severity of the infestation. - For onion: highly susceptible! Thrips will hide in between the young leaves. If onion is grown near the field - it must be treated as well.



Identification guide for Diseases

Gray Leaf Spot / Stemphylium Botryosum

Description	<p>Gray leaf spot can be caused by three different fungi</p> <ul style="list-style-type: none"> - Stemphylium solani - Stemphylium floridanum - Stemphylium botryosum
Affected parts	Leaves and fruits
Identification	<ul style="list-style-type: none"> - Round, brown slightly depressed spots of fungal mycelium. - The leaves, especially on the upper parts of the plant, look yellow and dry up (like Early Blight). - The fruits are slightly yellow and distorted, and have round circles with mycelium on them. - The mycelium will initially be light brown turning darker brown as the disease develops - The center of the spot may fall out leaving holes.
Remarks	<ul style="list-style-type: none"> - Most damage occurs on the upper half of the plant
Additional information	<ul style="list-style-type: none"> - In case of rain during the growing season, preventive spraying is advised as soon as the rain stops. - Do not confuse with Bacterial Spot: <ul style="list-style-type: none"> o Gray Leaf Spot stays as brown round spots o Bacterial Spot expands into brown, dry marks with black centers and yellowing of all parts of the leaves especially from the edges inwards.



*Courtesy of BioBee - Biological Systems Ltd.

Early Blight / Alternaria

Description	A fungal disease affecting the leaves
Affected parts	Mainly leaves. At high infestations - stems and fruits
Identification	<ul style="list-style-type: none"> - Infection starts as brown necrotic spots with yellowish margins mostly on older leaves - Heavy infestation may cause yellowing and finally browning of the leaf - Early blight lesions can be distinguished from other lesions on the foliage by the presence of concentric rings. - Usually emerging from the edge of the leaves towards the center.
Remarks	<ul style="list-style-type: none"> - The disease develops under conditions of high temperatures and moisture - The disease spreads easily through the air. - Avoid contact. Remove and dispose of infected leaves at a distant place
Additional information	<ul style="list-style-type: none"> - If only fully-grown leaves are affected no treatment may be required - Watch out for additional foliage diseases (i.e. Powdery Mildews) that may follow on the footsteps of the disease - The infection may look similar to Stemphylium - Grey Leaf Spots. The distinguishing characteristic is that in Early Blight the spots are large compared to the small spots of Stemphylium, and that the latter also attacks young leaves whereas Early Blight is mostly limited to older leaves - Often confused with: <ul style="list-style-type: none"> o <u>Bacterial Canker</u> - Early blight may cause browning of leaf edges, similar in appearance, but a lighter brown than bacterial canker symptoms. o <u>Septoria Leaf Spot</u> - Early blight lesions grow much larger than Septoria lesions, and Septoria has “white eye” shape circle inside of the black dots. - When risk of fungal infection is high, a preventive spraying program is recommended.



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Powdery Mildew / Leveillula Taurica

Description	Fungal foliage disease caused by <i>Leveillula taurica</i>
Affected parts	Leaves and occasionally fruits
Identification	<ul style="list-style-type: none"> - Yellowish spots on the upper side of the leaves - White circles (looking like flour grains) on the underside of leaves. -
Remarks	<ul style="list-style-type: none"> - At low infestations removing and disposing of affected leaves may be efficient measures
Additional information	<ul style="list-style-type: none"> - This "Powdery Mildew" attacks tomato and pepper. On pepper it spreads faster and the danger is greater. It is important to identify and treat promptly. - For positive identification, both sides of the leaf must be inspected. - In this disease "Flour" is detected on the underside of leaves only, Whereas <i>Oidium lycopersici</i> Mildew forms white circles on the upper side of the leaf. This discriminates between these two diseases. - Both kinds of mildew frequently appear together - IMPORTANT! Do not delay treatment as both these diseases spread swiftly and can cause serious damage to the field - Not to be confused with signs of lack of fertilization or damages caused by pests. To make sure look for the "flour" signs as well as yellowish spots on the leaf - Yellowish spots will appear "randomly" – spread all over the leaf, similar to small yellow clouds (no symmetric structure)



*Courtesy of BioBee - Biological Systems Ltd.

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Powdery Mildew / Oidium Lycopersici

Description	Fungal foliage disease caused by Oidium lycopersici.
Affected parts	Leaves and Stem, occasionally fruits
Identification	<ul style="list-style-type: none"> - White circles (looking like flour grains) on the upper side of the leaf only. - The fungus does not penetrate the leaf but stays on the upper side
Remarks	<ul style="list-style-type: none"> - Both kinds of mildew may co-exist on the same leaf
Additional information	<ul style="list-style-type: none"> - Oidium lycopersici mildew attacks tomatoes and peppers and spreads very fast. - IMPORTANT: Identify, and treat immediately as the disease may quickly cause serious damage. - Do not confuse with Leveillula taurica mildew which causes white spots on the underside and yellowing on the upper side of the leaves. - For accurate identification both sides of the leaf must be inspected - The fungal may be hosted by many other plants (Papaya, pumpkin..) therefore, extra caution must be taken and sanitation must be apply when the disease is present around the field



*Courtesy of BioBee - Biological Systems Ltd.

Late Blight / Phytophthora Infestans

Description	Fungal disease caused by Phytophthora infestans
Affected parts	Leaves and stems
Identification	<ul style="list-style-type: none"> - Brown spots surrounded by green halos appear on leaves. - Fungal spores (white, wooly covered) may be seen on the underside of leaves, mainly in the center. - Elongated, dark-brown spots appear on stems and petioles. - The disease proceeds along the leaves towards the petiole, reaches the stem, where it causes peeling and the death of the plants. - Also damaging the fruits, with brown wilting symptoms (not like early bight which doesn't affect the fruits)
Remarks	<ul style="list-style-type: none"> - High humidity and temperatures between 15-25 C are optimal for the development of Late Blight
Additional information	<ul style="list-style-type: none"> - If it rains during the growing period, preventive spraying is advised as soon as the rain stops. - Removing infected plant material and burying it away from the field are a key measure for treating this disease
Scouting notes	<ul style="list-style-type: none"> - Key diagnostic features on foliage are lesions extending from leaf veins. Symptomatic leaves can be sealed in a plastic bag with a damp paper towel overnight, then checked for a gray to white moldy growth on the underside. - Late blight causes the fruit surface to become rough.



Grey Mold / Botrytis Cinerea

Description	Fungal disease caused by Botrytis. cinerea
Affected parts	Affects mainly mature plants, penetrating through cuts and aging tissue on leaves, leaflets, petioles and stems. Can also affect fruits. The fungus may encircle the stem and cause wilting above the infection site.
Identification	<ul style="list-style-type: none"> - A grey downy-like mold often resembling a wooly covering. - The mold usually starts on the inner branches and on older parts of the plant, and in the center of leaves. - Affected stems and leaves weaken - “V-Shape” forms on the edge of the leaf.
Remarks	<ul style="list-style-type: none"> - The fungus prefers relative humidity of 95% and a temperatures of 17 – 23 C. Infection begins during relatively cool weather, under cloudy, humid conditions and spreads by rain, wind and air currents - Distinguishing Botrytis from Late Blight: <ul style="list-style-type: none"> ○ Late Blight usually starts from the top, on young leaves and at leaf margins and gradually spreads downwards ○ Grey mold usually starts on inner branches and older parts of the plant.
Additional information	<ul style="list-style-type: none"> - In case of rain during the growing period, if there already is an infection, spraying should start as soon as the rain stops. Spray until runoff and take care to spray the stems. - At low infestation you may additionally remove infected plant parts and take them out of the field to burn or bury - Botrytis usually enters through wounds and cuts in the plant's parts. Therefore, caution must be taken to avoid wounding the plants while working the plot.



*Courtesy of BioBee - Biological Systems Ltd.

Bacterial Spot / Xanthomonas Campestris

Description	Bacterial diseases caused by Xanthomonas campestris
Affected parts	Leaves and fruits
Identification	<ul style="list-style-type: none"> - Small black spots close together on leaves and fruits. - In late stages they develop into brown spots surrounded by yellow margins, spreading over the entire leaf
Remarks	<ul style="list-style-type: none"> - Carefully check the seedlings received from the nursery. The bacterial disease can be present on young seedlings. If symptoms are seen on seedlings, treat immediately against bacterial spot, and repeat after several days. - This is a highly contagious disease. Be careful when you come into contact and avoid spreading it. - The major sources of infection are seeds and infected crop debris. Bacteria may also be present on contaminated equipment and surfaces (farm machinery, racks, greenhouse structures, tools). - The bacteria are spread primarily by splashing water and wind-driven rain or mists produced during storms.
Additional information	<ul style="list-style-type: none"> - The disease cannot be eliminated but treatments slow its development. - The plant should be kept dry and "happy", well irrigated and fertilized. - Do not confuse with: <ul style="list-style-type: none"> ○ Gray Leaf Spot - small grey spots that do not become yellowish and brown. ○ Septoria leaf spot - white circles inside its black spots ("Bird's eye") ○ Bacterial speck – affects fruits. ○ Bacterial canker - although bacterial spot and speck can cause lesions on leaf edges, dark brown to black leaf margins are an indication of bacterial canker. Early bacterial spot fruit lesions can appear whitish, resembling bacterial canker "bird's eye" spots, but only bacterial canker fruit lesions retain the whitish appearance.



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Septoria Leaf Spot / Septoria Lycopersici

Description	Septoria leaf spot is caused by a fungus, <i>Septoria lycopersici</i> . It is one of the most destructive diseases of tomato foliage and is particularly severe in areas where wet, humid weather persists for extended periods.
Affected parts	Leaves and rarely fruits
Identification	<ul style="list-style-type: none"> - Small, water-soaked, circular spots first occur on the underside of older leaves. Lower leaves become peppered with small, dark, circular lesions which may eventually expand to 5- 6 mm in diameter. - If leaf lesions are numerous, the leaves turn slightly yellow, then brown, and then wilt. Fruit infection is rare. - Spots are generally grey or tan with a dark brown margin. They may have a narrow yellow halo. Within the lesions, small, black, pinhead sized fungal structures appear. These structures (pycnidia) help to distinguish the lesions from early blight.
Remarks	- Characteristically, there are many spots per leaf. This disease spreads upwards from oldest to youngest plant parts.
Additional information	- The fungus overwinters on infected tomato debris or on weeds of the Solanaceae family. The fungus can also survive on equipment such as stakes and crates.



Identification guide for Viruses

TYLCV – Tomato Yellow Leaf Curve Virus

Description	A viral disease spread by whitefly (<i>Bemisia tabaci</i>)
Affected parts	Affecting all parts of the plant
Identification	- Contortion and yellowing of the leaves of the crown. A heavy infection of a young plant will cause stunting.
Remarks	- New leaves developing after infection are small, yellow and contorted - The virus is prevalent especially in the Dire Dawa area, but appears also in other parts of Ethiopia
Additional information	- There is no treatment - It is recommended to verify whether the variety is resistant to the virus. If not, it is important to control whitefly (<i>Bemisia tabaci</i>) population. - Virus will appear on the plant, with the typical yellowing curves at the top, around 1 months after infection. Therefore, it is recommended to control whiteflies immediately when appearing (immediately after planting), and to keep the field clean from flies



*Courtesy of BioBee - Biological Systems Ltd.

TSWV - Tomato Spotted Wilt Virus

Description	A viral disease transmitted by the California Thrips
Affected parts	Affecting leaves, fruits and the whole plant
Identification	<ul style="list-style-type: none"> - On foliage - many round, dark spots, quickly spreading over the entire leaf. - On fruit - large round halo-like spots. Bulging yellow spots can appear on ripe fruits. - On plant - At high infestation the whole plant yellows and stops growing
Remarks	<ul style="list-style-type: none"> - When spraying against the Thrips (see below) spray the ground as well, since Thrips stay there too
Additional information	<ul style="list-style-type: none"> - There is no treatment - Weeding the field can be very useful against the spread of the virus, as it may stay on weeds - It is recommended to verify whether the variety have a resistance to the virus. If not it is important to control Thrips population.



TOCV - Tomato Chlorosis Virus (TICV - Tomato Infectious Chlorosis Virus)

Description	A viral disease spread by whitefly (<i>Bemisia tabaci</i>)
Affected parts	Affecting all parts of the plant
Identification	- Severe stunting, degeneration, upward cupping, distortion and interveinal yellowing of upper leaves, flower abortion
Remarks	- The virus has been observed in the Butajira area in the 2016-2017 season
Additional information	- There is no treatment - It is crucial to maintain whitefly (<i>Bemisia tabaci</i>) population at low levels.



Identification guide for Physiological Disorders

Blossom-end Rot (BER)

Description	Localized calcium deficiency in the blossom end of the fruit
Affected parts	fruits
Identification	<ul style="list-style-type: none"> - A small water-soaked or light brown area appears around the blossom-end of the fruit at mature green or ripening stage. - The lesion darkens and expands rapidly, becoming sunken and black. It may affect over half of the fruit. Secondary infection by pathogens may be observed.
Remarks	<ul style="list-style-type: none"> - Often occurs when dry soil conditions reduce the amount of water movement in the plant, interrupting the movement of calcium to the fruit. Calcium is an important component of cell development. Therefore, BER is caused primarily by dry soil conditions, not by a deficiency of calcium in the soil or plant.
Additional information	<ul style="list-style-type: none"> - May occur in high temperatures and intense sunlight, especially following cooler, overcast weather. - High salinity and ammonium-nitrogen levels in the soil may increase the phenomena. - Avoid deep cultivation, which can prune roots and reduce water uptake. - Soil or foliar applied calcium have not been shown to be effective in preventing BER. - Properly scheduled irrigation will ensure steady movement of water and calcium into the plant.





The Five Golden Rules for safe use of Crop Protection Products

1. Exercise caution at all times

- a) Always keep products under lock and key, out of the reach of children and animals.
- b) Handle and transport products with caution. Transport crop protection products separately from foodstuff or animals.
- c) Always triple rinse emptied product containers and dispose by following local best practice.
- d) Wear a hat and do not spray during the hottest part of the day.
- e) Carry an adequate supply of drinking water to avoid dehydration. Always wash before drinking.

2. Read and understand the product label.

The product label contains important information on product features and on risks relating to product use, together with correct measures to take in the case of an emergency.

- a) Always follow the label instructions for use (crops, targets application rates and water volumes per unit area).
- b) If you cannot understand the label then have it read and explained to you.
- c) Understand the meaning of the pictograms if used.
- d) Read the emergency procedures.
- e) Check that the product has not expired.
- f) Check when purchasing products that the WHO hazard classification color coding band and select the least hazardous.

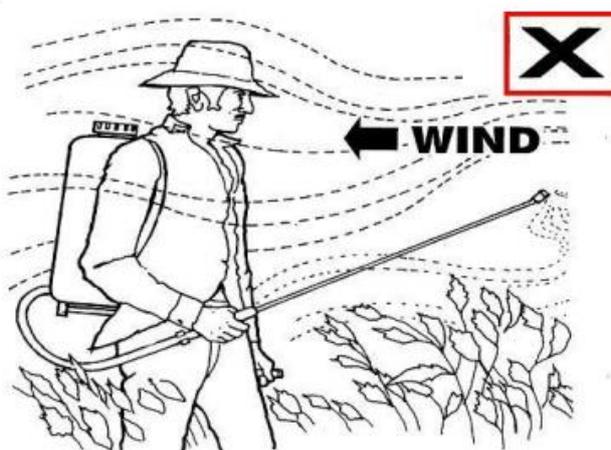
3. Practice good personal hygiene

- a) Always have clean water available when working with chemicals.
- b) Wash any chemical splashes immediately from skin or eyes.
- c) Do not eat, smoke or drink whilst handling, working with or applying crop protection chemicals.
- d) Always wash yourself and clothes after working with chemicals.
- e) Wash spray clothes separately from the domestic washing.
- f) Do not work with chemicals if you feel unwell before you start.

4. **Take care of and maintain application equipment.**
 - a) Check spraying equipment before use; any leaks must be repaired before use.
 - b) Check the nozzle is working correctly, clean or replace if necessary.
 - c) Spraying equipment should be calibrated at least once a season depending on the amount of use.
 - d) Wash spraying equipment after use and store securely away from children, animals and feed.
 - e) Always avoid operator exposure to any spray drift; walk up-wind from the nozzle.
 - f) Do not spray in windy conditions.
5. **Wear appropriate protective clothing and equipment (PPE)**
 - a) Follow the label pictograms for PPE requirements for both mixing and spraying.
 - b) Different products and application methods sometimes require different PPE.
 - c) The minimum requirement is long sleeved shirt, long trousers and non-absorbent footwear when spraying with nozzle at less than waist height. The use of a wide brimmed hat will give protection from both the sun and potential spray drift.
 - d) When mixing liquids, eye and hand protection are also required. A dust mask is required when mixing powder formulations.
 - e) Wash gloves before removal to avoid potential contamination.

Application quality: Never spray against the wind direction

Wind may move drops onto operator. The higher the nozzle, the closer the nozzle is to operator, the finer the spray..... so exposure risks increase.





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Fair Planet field guide for identification of plant pests and diseases

We wish you success!



Fair Planet Ethiopia

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