African Organic Agriculture Training Manual

A Resource Manual for Trainers

9-21 CITRUS

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Ready for field testing

FiBL

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FACTSHEET 21: CITRUS

Learning targets for farmers:

- Realise the importance of appropriate soil management for short- and long-term productivity
- Understand the relevance of habitat diversification in and around the orchards to promote natural enemies for effective management of most pests
- Recognise the importance of proper crop management and regular monitoring for effective pest and disease management
- Note the value of appropriate irrigation for crop growth and fruit development
- Develop awareness for timely harvesting and proper postharvest handling for high fruit quality

1. Introduction

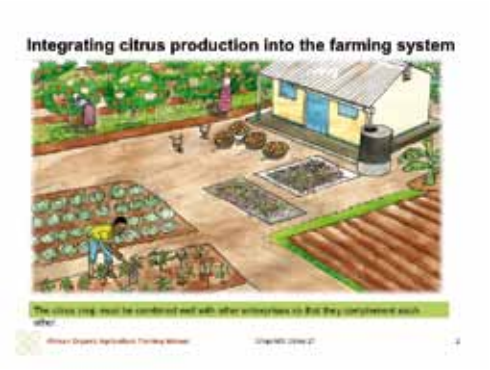
Citrus is widely cultivated in tropical as well as subtropical African countries. While fresh fruit for the market is produced preferably in subtropical climates (e.g. South Africa) and Mediterranean climates (e.g. Tunisia, Egypt, Morocco, Libya), citrus for juice is predominant in tropical climates because of the possibility for higher sugar content. The most important species of citrus fruits are sweet oranges *(Citrus sinensis)*, limes *(C. aurantifolia*), grapefruits *(C. paradisi)*, lemons *(C. limon)* and mandarins *(C. reticulata)*, often called tangerines. This chapter focuses on the management of sweet oranges *(Citrus sinensis)* only.

Common challenges related to citrus production in sub-Saharan Africa

- **Inferior varieties -** Most farmers rely on local varieties that are sometimes very susceptible to infections and low yields. New seedlings are generally raised directly from seeds, hence propagating the low yielding traits of the mother plants. Improved varieties are not easily accessible to farmers due to the limited availability of plant nurseries. As most improved varieties can only be propagated vegetatively by budding or grafting, farmers who lack this knowledge cannot do it themselves.

REQUIREMENTS FOR SUCCESSFUL ORGANIC CITRUS PRODUCTION

INTEGRATION OF CITRUS PRODUCTION IN THE FARMING SYSTEM



› **Poor yields -** Due to drought and poor management, poor yields often result. Most citrus production is done on small gardens mainly for the domestic market. The crops are not irrigated and in most cases suffer from drought stress, delayed flowering, affecting potential yields.
› **Pests and diseases -** Citrus is attacked by many diseases that cause serious losses (e.g. greening disease, anthracnose, damping off, phaeoramlaria leaf and fruit spot). Citrus is also very liable to infestation by pests like aphids, scales and white flies, some of which are vectors of the citrus tristeza virus or the greening disease.
› **High postharvest losses -** Harvesting of immature and overmature fruit, mechanical damage during harvest, transport and distribution, water loss (wilting) due to a poor handling system, and decay either due to blue or green mould and insect damage due to the Mediterranean fruit fly result in high postharvest losses.

To meet the above mentioned challenges and make citrus production more sustainable and profitable, interventions are needed. This chapter introduces organic approaches, which can be adapted to local conditions and can help address some citrus production challenges.

2. Selection of good planting material

Most citrus orchards consist of grafted trees that combine favourable attributes of the scion and the rootstock. However, the choice of the rootstock should depend on the adaptability to local conditions and resistance to common soil borne infections. Sour orange *(Citrus aurantium L.)* is the most widely planted rootstock and is an excellent rootstock for areas free of Citrus Tristeza Virus (CTV). Rough lemon *(Citrus jambhiri)* is also a widespread rootstock, but should be avoided in areas known to have blight and nematodes.

When choosing cultivars for scion production, factors like disease resistance, drought resistance and quality as well as yield performance should be considered. Valencia is an important cultivar for orange juice and this cultivar is known to do well under organic management. Washington navel is used mainly as fresh fruit. Other varieties used in Africa include Hamlin, Tangelo, King Star ruby and Red blush. There are many other local variants, some of which are good for or-

Evaluation of the local situation in citrus production

To better understand the situation of citrus production in the area, you may ask the farmers the following questions:
› What do you know about citrus production?
› How is citrus production done in the area? Have you experienced any of the above or other challenges?
› How have you tried to address them?
› Do you know any specific organic production techniques for citrus?

ganic production. Although they may not be high-yielding, they may be adapted to local production conditions.

Purchased seedlings should be obtained from good nurseries, to make sure they are free of diseases (especially viruses) and pests and for which the authenticity of rootstock and scion cultivars is guaranteed.

Raising seedlings in the nursery

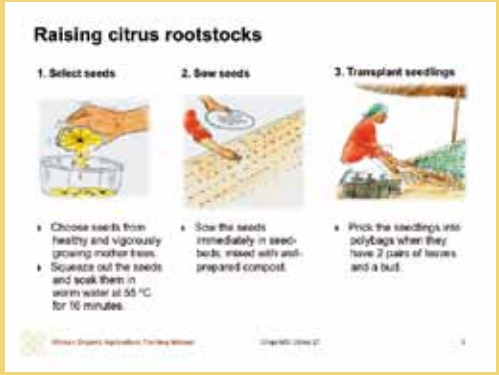
The use of virgin sites for nurseries is very important in organic production. It reduces the risk of soil-borne diseases like Phytopthora, Pythium and pests like nematodes to which citrus seedlings are very susceptible. The site can also be treated to make it safe by covering it with a black polythene sheet for at least two days of full sun or by burning dead plant material over the site.

Citrus trees are normally propagated by grafting (budding) a preferred citrus tree onto an appropriate rootstock. This ensures that the new tree has the same characteristics as the mother plant. T-budding is the most common method of grafting oranges. However, budding should be done during warm months (not during cold periods or during dry conditions). Budded plants are normally ready for transplanting 4 to 6 months after budding. Citrus rootstocks are ready for grafting 6 to 7 months from pricking. If budding is to be done, seedlings are budded 9 to 10 months from pricking.

Recommendations to farmers regarding preparation of rootstocks:

- Choose seeds from healthy and vigorously growing mother trees, which are not grafted or budded. Extract the seeds and subject them to hot water treatment at about 55 °C for 10 minutes.
- Sow the seeds immediately in seedbeds, mixed with well-prepared compost.
- Water the seeds regularly, preferably twice a day until they germinate. Seeds germinate in 2 to 3 weeks. If seedlings appear congested, thin them out so as to produce sturdy and vigorous plants. Thinning also reduces chances of disease outbreaks.
- Seedlings are ready for picking and potting in polybags when they have 2 pairs of leaves and a bud.
- Seedlings are normally ready for budding when they reach pencil thickness or about 6 to 8 months after germination.
- Dumping off is the most serious disease favoured by wet soil, dense shading, and humid environment due to overcrowding. To prevent dumping off,

RAISING CITRUS ROOTSTOCKS



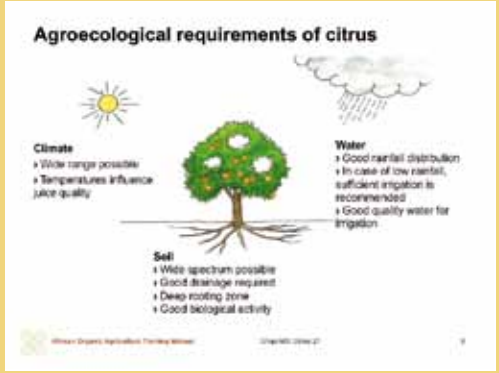
shelter the seedlings to keep rain off. This reduces leaf wetness also and can reduce fungal infections such as cercospora leafspot. Pests like aphids, leaf miners and orange dogs are likely to attack. These can be controlled by applying plant extracts, for example, from neem or tephrosia.

Recommendations to farmers regarding budding of rootstocks:

- Select healthy trees from which to obtain bud graft branches (bud sticks). Cut a number of branches, about 30 cm long, using a very sharp knife.
- Select the seedlings onto which the grafting will be done. They should be above 30 cm tall in order to ensure that the budding takes place at about 30 cm above the ground, not higher. The closer to the ground you insert the graft, the more the graft receives nutrients, water and sap that are undiluted. The higher up you place the graft, the greater the chance is of it either dying off or taking too long to become a strong branch. Before budding, it is good to check if the bark peels easily. A bark that is peeling indicates that the seedling is undergoing active growth and is ready for budding.
- Make a 1½-inch cut in the shape of a 'T' at the grafting location using a sharp knife, opening the bark of the stem. Continue to cut well below the bark into the seedlings wood.
- Pick up the first bud stick and choose the biggest bud. With a sharp knife, gently slice the bud together with the bark and a thick portion of the wood to which it is attached. Take care not to touch the cut side of the bud with your fingers as this may impair the connection of the bud to the rootstock.
- Uncover the wood underneath the 'T' cut in your orange tree by gently lifting up the bark and gently insert the bud into the open wood under the 'T' slice, starting at the top of the 'T' and moving downwards. The bud will be held in place by the wood of the main seedling. Ensure that the bud is put exactly in the same direction as it was oriented on the bud stick.
- Wrap budding tape underneath and above the graft in order to prevent any movement that might hinder the integration of the bud into the actual wood of the orange seedling. The tape also avoids moisture loss and callousing (tissue overgrowth) at the grafting site. The bud should also be entirely covered.
- Remove the budding tape when the buds start sprouting, in about 2 to 3 weeks, and continuously remove all rootstock sprouts (including the terminal bud of the seedling). The new bud will then be able to grow to take over the entire crown of the orange tree.

BUDDING PROCESS

AGROECOLOGICAL CONDITIONS FOR CITRUS PRODUCTION



The objective of budding is to align the cambium layer of both rootstock and bud as closely as possible. Thus, it is important that the bud is removed from the bud stick with a smooth cut, and the bud and rootstock to be tightly pressed together. Farmers can start by practising the budding process on branches of older trees. After they gain experience, then they can do it on young seedlings.

3. Establishing a new citrus orchard

3.1 Selecting suitable growing conditions

Citrus trees can be grown in a wide range of climatic and soil conditions. But proper site selection remains the key to successful organic production. Climate has a significant effect on nearly all aspects of citrus growth and quality development:

- Extremely hot temperatures that exist in some African countries are damaging to citrus. Ideal temperatures range from 13 °C to 38 °C. At higher temperatures, flowers and leaves drop prematurely.
- Rainfall or irrigation throughout most of the year is necessary for citrus, however, dry and hot temperatures during the day and cool temperatures at night are favourable conditions for good colour development.

Although citrus grows in a wide variety of soils all over Africa, it grows best in deep soils of medium texture and moderate depth, with good drainage and high fertility. Moderate pH conditions between 5 and 7 are preferable for citrus, as they generally allow adequate availability of nutrients. Adequate drainage is also needed, as tree growth is reduced in poorly drained soils or where compacted soil layers are present in the root zone. Furthermore, poor drainage causes problems with Phytophthora and other soil borne diseases.

Yields in subtropical climates peak at 20 to 25 years, while yields in tropical regions reach a maximum at 10 to 15 years already because of the higher pest and disease pressure in these regions.

Discussion on site selection

Ask the farmers to build small groups and let them analyse their local climate and soil condi-tions. Let the small groups make proposals how to best adapt the management of citrus crops under these conditions. The small groups can then present their analysis and solution to the ple-num and discuss it again there.

PLANTING OF CITRUS SEEDLINGS

3.2 Transplanting

Some months before planting citrus trees, farmers can sow vigorous legumes like velvet bean *(Mucuna* spp.*)*, sunhemp *(Crotalaria* spp.*)*, or lablab *(Lablab purpureus)*, which are then slashed and mulched shortly before planting the citrus trees. Then the soil will be enriched with organic matter and nitrogen, both stimulating soil microbial activity.

An optimum plant density that permits optimal light interception and aeration is achieved at a tree spacing of around 8 m by 8 m. This leaves some space for intercropping. The citrus seedlings should be planted well, making sure that the budding point remains above the ground to avoid exposing the scion to root rot diseases and to make sure it does not start rooting itself. It is recommended to apply compost into the planting holes to encourage quick establishment of the plants. Depending on the planting season, supplementary watering or irrigation may be required to support the growth of the young seedlings.

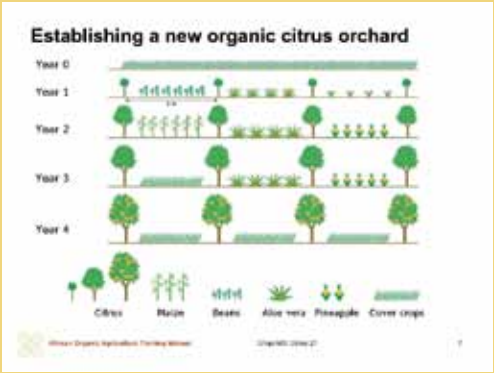
Shoots that grow below the budding union must be removed. These shoots, if not removed, will retard growth or kill the scion part of the budded shoot.

3.3 Field layout of a new citrus orchard

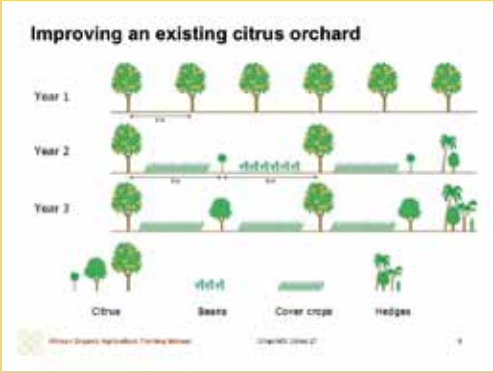
Establishing a new orchard has the advantage that the farmer can create an optimal organic system by applying the following strategies:

- **Creating diversity -** In the citrus orchard, diversity can be created by mixing different cultivars in the same orchard, growing specific cover crops in the alleyways and under the trees, as well as planting hedges and wild flower fallow plots around and in the orchard.
- **Intercropping -** For smallholder farmers, relying on citrus production alone is not sufficient. Citrus in Africa is in most cases intercropped with annual crops, for example maize and beans at establishment stage for about two seasons or with fruit trees such as mangoes or any other long-term trees at a much wider spacing. The space to grow additional crops is limited to alleyways. Successful examples are intercropped beans and maize for subsistence supply, as it is practiced in Kenya, or intercropped with Aloe vera, as practiced in South Africa. The orchard can also be intercropped with legume cover crops in the later stages of growth.

ESTABLISHING A NEW CITRUS ORCHARD



IMPROVING AN EXISTING CITRUS ORCHARD



› **Plant density -** Using a plant density that permits optimal light interception and good aeration is necessary to control fungal infections. Citrus trees need wide spacing of about 8 m to 8 m to offer enough space for intercropping as well as allowing good aeration of the orchard. Sufficient spacing is also necessary to allow for application of compost and management of pests and diseases.

4. Improving an existing citrus orchard

Citrus growing is a long-term investment. Orchards can be productive for up to 50 years or more. The useful economic life span of the plantation depends on climatic and management conditions. Organic farmers aim to achieve tree longevity as part of their sustainable land use strategy.

Almost every orchard can be improved back to full production by applying organic methods. However, these practices also apply to newly established citrus orchards.

4.1 Increase biodiversity

One of the most important organic approaches to start with is to increase biodiversity. A high degree of diversity decreases the risks of disease infestation and enhances ecological pest control through the appearance of a highly diverse bird and insect community.

There are many ways of increasing biodiversity:

› **Intercropping -** in the citrus orchard with annual crops. In existing high density citrus orchards, rows of citrus trees can be removed to increase ventilation and light intercepion. In the remaining spaces legume annual crops like beans or peas can be planted.

› **Cover cropping -** Between the rows legume pasture or cover crops can be planted. Flowering plants such as Alfalfa *(Medicago sativa)*, African blue basil *(Ocinum basilicum), Centrosema pubescens, Desmodium, Cassina obtusifolia, Alysicarpus vaginalis)* provide useful habitats for beneficial insects. They also improve soil conditions without competing with citrus trees.

Field excursion for investigation of field layout

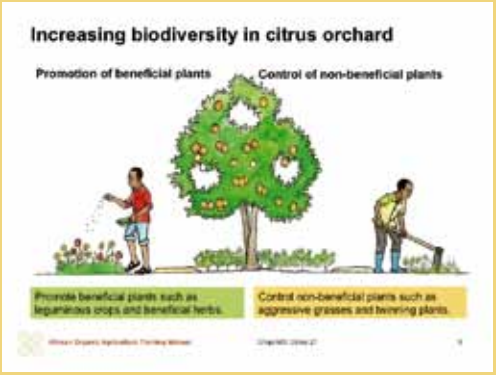
Take the farmers to a citrus orchard. Build groups of 3 to 5 participants. Assign a specific task to each group:

› Group 1: Analysis of the existing field layout and making a proposal for a new layout using larger plant densities.

› Group 2: Analysis of the existing field layout and making a proposal for a new layout ap-plying intercropping.

› Group 3: Analysis of the existing field layout and making a proposal for a new layout, applying agroforestry.

INCREASING BIODIVERSITY IN CITRUS ORCHARD



› **Agroforestry -** In some African countries, citrus trees are mixed with other fruit trees like mangoes, jackfruit, banana, palm trees, coffee, and cocoa, as well as with leguminous trees (e.g. Albizia) or other permanent tree species. In windy areas, the trees act as windbreaks for citrus which is sensitive to strong winds.

4.2 Ensure proper pruning

As the trees grow, the inner and lower branches become shaded. This leaves fruiting to the outer periphery of the canopy whereas the inner parts have poor or no fruit set at all. This problem can become especially severe in high-density orchards. Annual pruning maintains light and air penetration through the canopy of the citrus trees and reduces the humidity around the plants contributing to pest and disease prevention. The tree height should be maintained at less than twice the planting distance in the row.

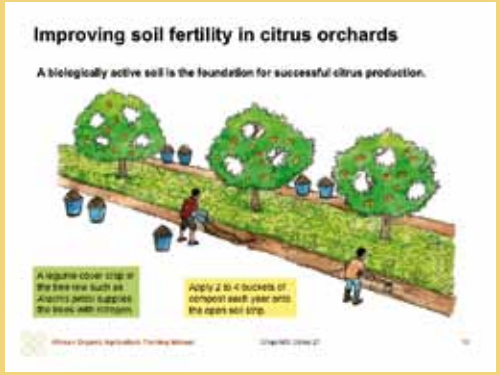
Three major types of pruning include:
› Heading back to control size and form of the tree
› Thinning out to improve aeration
› Selective pruning to cut off infested parts of the tree, especially after Phytophthora infections or citrus greening

Pruning should be done during the vegetative phase (before flowering) of the trees.

Recommendations to farmers regarding proper pruning:
› Maintain a single stem up to a height of 3 feet (100 cm), and pinch or break the main shoot to encourage side branching
› Allow 3 to 4 main branches to form the framework of the tree
› Remove any extra side branches including those growing inwards
› Ensure all diseased and dead branches are removed regularly

Excursion: citrus tree pruning
Take the farmers to a citrus orchard. Inspect some trees and discuss how to prune them

IMPROVING SOIL FERTILITY IN CITRUS PRODUCTION



4.3 Improving soil fertility

The building up and maintenance of a fertile soil is a central goal in organic citrus growing. Careful soil management is especially important in the humid tropics, where heavy rainfall and strong solar radiation accelerate soil degradation, leaching of nutrients and erosion.

The basic tools of organic soil management are interdependent and influence tree health, tree development, fruit yield and quality. Relevant soil management techniques for organic citrus orchards include:

- Soil erosion control
- Use of cover crops (understorey plants) or mulching
- Agroforestry and intercropping methods
- Application of compost

a. Soil erosion control

Especially in sloping areas, soil erosion control structures are very important. Water conservation structures like terraces should be constructed to prevent the loss of topsoil and organic matter.

b. Soil cover systems

A permanent soil cover is an important component of the organic orchard cultivation system. Locally adapted leguminous crops, such as velvet bean *(Mucuna spp.)*, sunhemp *(Crotalaria spp.)* and lablab *(Lablab purpureus)* help restore degraded soils very fast. They successfully suppress weeds, fix nitrogen and prevent erosion. To avoid strong competition between the cover crop and the citrus trees, the cover crop should be regularly cut.

c. Application of compost

Most tropical soils are low in organic matter. To improve soil organic matter content at least 20 kg or 1 bucket of well-rotted cattle manure or compost should be applied to each tree every year. If possible, a handful of rock phosphate should be added. Compost should be added especially 2 to 4 weeks before flowering to encourage good fruit formation and development. According to citrus farmers, application of manure or compost also makes fruit sweeter.

Discussion on soil fertility management in citrus orchards

Discuss with the farmers about their approaches to soil fertility management and plant nutrition. You may ask them the following questions:

- How do you commonly improve soil fertility in your orchards?
- What else do you think needs to be done to sufficiently supply nutrients needed for the proper growth of citrus trees?

4.4 Proper weed management

Noxious perennial grasses such as *Panicum* spp., *Paspalum* spp., *Amaranthus* spp., couch grass *(Cynodon dactylon)* and spear grass *(Imperata cylindrica)* are suppressed by sowing cover crops.

Cover crops must be slashed when they start to compete with citrus trees. Hand weeding may be necessary when specific weeds start to dominate.
If tools or machines are used, injuries on the tree trunks and roots must be avoided, as they may become entry points for soil-borne diseases.

In orchards with newly planted citrus trees, the soil is best when covered with mulch.

Discussion on appropriate weed management

Ask the farmers to propose ways how to manage weeds efficiently in citrus orchards under their conditions. Discuss the different propositions considering their benefits and inconveniences.

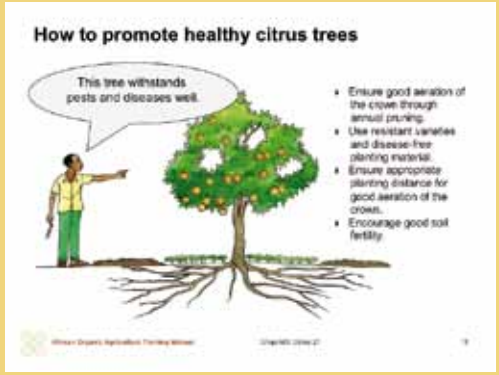
4.5 Pest and Disease management

Citrus are attacked by a wide variety of economically important pests and diseases. Major pests are citrus whitefly, thrips, mites, aphids, ants, black flies, citrus psyllid, fruit flies and false coddling moth. Major diseases include the greening disease, damping off, citrus tristeza virus, anthracnose, phaeoramularia fruit and leaf spot, gummosis, canker and scab.

Effective management of citrus diseases first requires proper implementation of preventive measures to avoid heavy infections:

- Choice of suitable varieties for the scions and rootstocks that are adapted to the local climatic conditions, increases plant resistance to pests and diseases.
- Regular monitoring of the orchard allows early identification of infections and timely intervention before major damage occurs.
- A diverse habitat including organic orchard design, hedges, flower strips and agroforestry trees enhances natural enemies of pests *(see section 4.1 also)*.
- Proper soil fertility management improves nutrition and health of trees.
- Pruning and de-suckering increases aeration of the orchard.
- Removal and destruction of infected plant parts reduces pest and disease pressure in the orchard.

HOW TO PROMOTE HEALTHY CITRUS TREES?



For direct control, natural pesticides such as pyrethrum, derris, neem, soaps, mineral and plant oil as well as mass trapping techniques are used in organic citrus production. Nursery and field plants can be protected by routine sprays with protective copper based fungicides such as Bordeaux mixture or Copper oxychloride. However, such sprays must be approved by the certifier in case of certified organic citrus production.

Major pests and diseases of citrus in Africa:

a. Leaf miner (Phyllocnistis citrella)

This is a very serious pest of citrus direct from the nursery to the field, usually attacking young leaves and shoots. The adult moth deposits tiny eggs on the underside of the leaves. Upon hatching, the larvae enter the leaves, where they remain until they mature. At maturity they come out of the leaves and form a pupation cell by folding over a part of the leaf margin. They mine the underside of young leaves, but attack both sides of the leaves in heavy infestations, and occasionally also the fruit. Feeding of the leaf miner causes serpentine mines that have a silvery appearance. As a result of the leaf mining, the leaves become twisted, show brown patches of dead tissue and eventually fall off.

The leaf miner can be controlled by spraying neem. Application is most useful on young seedlings in the nurseries, as they are most susceptible to leaf miner attacks.

b. Aphids *(Toxoptera citridus and T. aurantii)*

The shiny black or brown insects feed by sucking on new blossoms causing severe curling and deformation of young leaves and stunted growth of leaves and twigs. High numbers are found on the leaf surfaces during the period of flushing (production of new shoots) and stems of attacked young shoots die back. Aphids excrete large amounts of honeydew, leading to the growth of black sooty mould on the leaves. They also transmit tristeza and other virus diseases in citrus.

Aphids are kept in check by natural enemies, especially ladybird beetles, lacewings, hoverflies and parasitic wasps. Therefore, by encouraging natural diversity around and within the orchard, aphids can be well managed. However, in heavily infested plants, neem sprays should be applied around the aphid populations, especially around new shoots and under the leaves.

Field visit for identification of citrus pests and diseases

Take the farmers to a citrus orchard and identify any pests and diseases. Share knowledge on symptoms and preventive management measures.

CITRUS PESTS AND THEIR CONTROL

c. Scales

Scales are small insects, which resemble shells glued to the plant. They suck sap from all plant parts above the ground. Their feeding may cause yellowing of leaves followed by leaf drop, poor growth, dieback of branches, fruit drop, and blemishes on the fruit. Leaves may dry when heavily infested and young trees may die. Some scales (soft scales) excrete honeydew, causing growth of sooty mould. In heavy infestations, the fruit and leaves are heavily coated with sooty mould turning black. Heavy coating with sooty mould reduces photosynthesis and thus plant growth. Fruit contaminated with sooty mould loses market value. Ants feed on the honeydew that is excreted by soft scales, preventing a buildup in sooty moulds, but also protecting the scales from natural enemies.

Scales are attacked by a large range of parasitic wasps and predators. These natural enemies usually control scales in well balanced systems. Botanical sprays should target young stages of the scales. Oil sprays for example should be applied after harvesting and not during flowering or during periods of excessive heat or drought. Heavily affected branches and leaves should also be removed and burnt.

d. Damping off

Damping off is a common infection in recently germinated seedlings of any citrus cultivar, where the seedbed shows poor drainage. Damping off attacks and kills seedlings at the stem zone above the soil level. However, damping off fungi can also cause seed rot or a pre-emergence rot, resulting in sparse stands of seedlings. Damping off is caused by *Rhizoctonia solani, Phytophthora* spp. or *Pythium* spp. Infections can be prevented by avoiding planting into infected soil, by hot water treatment of seeds before planting and by avoiding overwatering of seedbeds. Another successful method for controlling damping off in the nursery involves using a special planting media using manure and sand at a ratio of 1:2. Such a media increases aeration and improves drainage in the seedbed. The media is set to make a bed, and a 2-inch depth of sand is spread on the surface of the bed. The seeds are placed into the sand zone and when they germinate, they plug their roots into the sand manure mixture. But their stems will remain in the sand zone. Sand on the surface will help to drain away water from the stem zone and thus create unfavourable conditions for damping off at the stem.

e. Greening Disease

The greening disease leads affected oranges to completely change colour, leaving patches of green peel. A more typical leaf symptom is a leaf mottling, a blend of light and dark green patches on the leaf that are not bound by veins. Leaves on affected branches usually fall off readily, defoliating the affected trees. Flowering and flushing occur out of season and the fruit on affected branches, if any at all, are small and deformed. Even the maturing fruit colours are different. Healthy oranges start to change colour from the free end, while greening affected fruit start changing from the stalk end. The green patches do not change colour even after picking.

Greening disease is mainly introduced into the orchard from neighbouring infected orchards through vector insects such as *Diaphorina citri* or with infected plant material. Prevention thus bases on good nursery management and use of healthy plants. Bud sticks should not be obtained from trees showing signs of infection. Production of healthy nursery material includes using healthy bud sticks only and protecting the seedlings and plants from insects. Organic farmers are recommended to focus in the control of the vector *Diaphorina*, as control of the HLB Bacterium is nearly impossible. Farmers should, therefore, avoid the proliferation of *Diaphorina* in the orchard and in the region. In organic agriculture, *Diaphorina* can be controlled by application of biocontrol agents such as *Tamarixia radiata* or other natural enemies and predators such as *Cycloneda sanguinea*. Local producers of biocontrol agents may have other solutions also. Neem, tephrosia or pyrethrum botanical mixtures can be used as well.

Heavily infected trees should be removed and replaced by new plants, since the soil is not affected by the greening disease and replanting presents no problem. In orchards with a very low level of *Diaphorina* activity and where only isolated branches are infected, they should be removed with a saw. The cut should be made as close to the trunk as possible.

f. Phaeoramularia fruit and leaf spot

This disease is caused by the fungus *Phaeoramularia angolensis.* It is favoured by wet and cool conditions. The fungus produces circular, mostly solitary (single) spots with light brown or greyish centres on the leaves. Each spot is usually surrounded by a yellow halo. Occasionally, the thin necrotic tissue in the centres of old spots falls out, creating a shot-hole effect. During rains, leaf spots on young leaves often join together ending in a general paling of the leaves or what

CITRUS DISEASES AND THEIR CONTROL

Major citrus diseases

is known as chlorosis. Premature defoliation takes place when the leaf petioles are infected. On fruit, the spots are circular to irregular in shape, which may join together and are surrounded by yellow halos. The disease has been observed on all citrus species including grapefruit, lemon, lime, mandarin, pummelo and orange. Grapefruit, mandarin, pummelo and orange are very susceptible. Lemon is less susceptible and lime is least susceptible.

The disease can be effectively controlled by using fungicides including copper based products such as Bordeaux mixture or copper oxychloride, which are allowed for use in organic farming.

g. Citrus Tristeza Virus (CTV)

The citrus tristeza virus is a major threat to global citrus production. The virus is transmitted through the use of tristeza-infected vegetative material, both scion and rootstocks and through the insect vectors, which is primarily the aphid *Toxoptera citricidus*.

Typical tristeza symptoms in older orange trees include yellowing of leaves with clear veins, yellowing showing poor new growth. As the disease progresses, the older leaves begin to fall, breaking between the petiole and the leaf blade, leaving defoliated twigs or with few young leaves. Twig growth becomes weaker each season until the tree dies, but some trees seem to linger on for many years. In some cases, affected trees quickly collapse after a sudden wilting and drying of the leaves.

Control is achieved by avoiding the use of sour orange rootstock, but using CTV tolerant rootstocks such as sweet orange, mandarin or rough lemon instead. Additionally, infected trees must be removed and destroyed. If these measures are combined with the control of aphid vectors, the multiplication of disease can be significantly reduced.

4.6 Water management and irrigation

Citrus trees can conserve water well and are capable of withstanding long periods of drought, as their leaves are covered with wax. However, even in humid subtropical and tropical regions with sufficient total rainfall, irrigation is important during dry periods, especially during and after flowering, to ensure sufficient water for fruit setting and growth. Regular, moderate irrigation reduces physiologi-

HOW TO MANAGE WATER EFFICIENTLY

cal fruit drop, improves flowering, fruit set, fruit size and juice content.

The water should be of good quality. It should be free of chemicals, heavy metals, toxic bacteria and contain little salts. Regular water analysis is compulsory for organic certification. Soil water conservation practices such as mulching are also very necessary especially in young trees.

A low cost water irrigation practice, especially for newly planted citrus seedlings is the use of a jerrycan, or plastic water bottle placed near the stem of each plant to provide water. The jerrycans/bottles are filled with water and perforated at the bottom or in the lid so the water can drip continuously into the soil around the plant. When the water is finished, the jerrycan or bottle is refilled.

Discussion on water management

Discuss with the farmers the different possibilities of managing limited water resources in citrus production. How can farmers keep water in the soil? How can they irrigate citrus orchards using little water only?

5. Reducing postharvest losses

Postharvest losses in citrus can be important. The main causes for such losses are:

- Immaturity and overmaturity at harvest
- Mechanical damage during harvest, transport and during distribution
- Water loss (wilting) due to poor handling
- Decay due to blue and green mould and insect damage mainly due to the Mediterranean fruit fly

a. Timely harvesting

Citrus fruit do not continue to ripen after harvest. Therefore, they should be picked at optimum maturity. Immature or overmature fruit tends to be of inferior quality. Maturity indices most commonly used by farmers are fruit colour and size.

Harvesting of citrus for the fresh market is done by hand. Normally, fruit are cut with hand clippers and collected in picking bags and then transferred to field containers and then transported to packing houses or collection centres or transferred directly to the market. However, some sorting is usually done during picking to eliminate defective fruit.

b. Proper postharvest handling

Care should be taken to handle the fruit carefully to reduce physical damage. Grading based on quality parameters such as size, colour, and defects is impor-

REQUIREMENTS IN POSTHARVEST HANDLING OF CITRUS FRUIT

tant to satisfy quality requirements of traders. The fruit is washed with a mild detergent and water in order to remove dirt, insects and loosely adhering mould. They should be left to drip dry in a cool area. Fruits are then packed by hand in containers like sacks or wooden boxes for which common types of containers are used.

c. Proper storage

Citrus fruits are moderately perishable with a shelf life ranging between 2 and 20 weeks depending on the type of fruit. Lemons have the longest shelf life, if picked green and stored at the recommended temperature. Citrus fruit can be cold stored at 0 to 4 °C with very little loss of fruit quality. But fruits vary in their relative susceptibility to chilling injury. Grapefruits and lemons are much more susceptible to chilling injury than oranges and mandarins.

Blue mould and green mould are the most important postharvest diseases of citrus fruits in all production areas. Control measures should include minimizing physical damage, the use of rec-ommended storage temperature and relative humidity, and the use of hot water treatment of the harvested fruit. However, application of fungicides is not allowed in organic farming. Since cold storage facilities in most countries are limited, long-term storage is not normally practiced.

6. Marketing and organic certification of citrus production

Present organic citrus production is still less than 2 % of the total global citrus production. However, it is increasing yearly in parallel with the increasing demand for organic products. Organic certified citrus, however, still plays a minor role in domestic markets in Africa and a few countries are exporting organic citrus juices to Europe. Naturally grown citrus with low or no pesticide input is grown in many African countries mostly for the local market. Nevertheless, the market offers good opportunities for future growth. But the decision to certify the citrus production should be based on marketing potential and customer requirements.

Citrus for export has the following requirements:

› The importing countries demand specific varieties and fruits that are harvested at the proper stage of maturity.

Discussion on post-harvest handling of citrus

Inquire among the farmers, how they commonly handle fruit at and after harvest. How do they estimate handling and postharvest losses? Do they see any shortcomings? Are there any ideas for improvement? Together, develop guidelines for proper handling at and after harvest.

MARKETING AND ORGANIC CERTIFICATION OF CITRUS PRODUCTION

› Implementation of organic practices during production and renunciation of synthetic pesticides and genetically modified planting materials. Any pesticide contamination from neighbouring conventional orchards through soil erosion or wind drift should also be avoided.
› Proper cleaning, sorting, sizing, waxing, packing and use of refrigerated transportation done according to the quality standards and regulations of the importing countries.
› The use of fungicides is not allowed to prevent fungal attack when washing citrus fruit .

Some national and international organic standards define additional requirements for production and postharvest handling of citrus. Details are available at the national organic movement or the organic certification body operating in the region or country.

Recommended further reading

› Organic Fruit and Vegetables from the Tropics. Market, Certification and Production Information for Producers and International Trading Companies, United Nations, New York and Geneva 2003. www.unctad.org
› Organic Citrus: Challenges in Production and Trade. http://orgprints.org › Search for kilcher organic citrus

Group work: organic certification and marketing of citrus

Inquire among the farmers about their knowledge and involvement in marketing activities of citrus by asking the following questions:

› Do you know who the main buyers of citrus in the area are?
› What are their quality requirements?
› Are there any organic producers or buyers in the area?