

Pack 116, Item

Type: Backgrounder

2021

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**Backgrounder on pest management in market gardening**

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**Introduction**

The Kolda region presents many opportunities in market gardening. Crops vary according to the season, with the most prominent European vegetables including lettuce, cabbage, cauliflower, eggplant, carrot, turnip, gourd, parsley, and several varieties of chili peppers. These are cultivated during the cold season and are better adapted to the agroecological environment with less risk during this period. Fresh and table tomatoes are also grown.

During the hot season, crops include okra, bitter diakhatou, bitter eggplant, sorrel varieties, bissap (hibiscus), and tomato.

Pest control is of paramount importance because each part of the cultivation process in market gardening, including preparation of the soil, establishing nurseries, and many other stages, requires sustained pest control to improve yields. Indeed, it continues to be a challenge post-harvest.

**Importance of the issue for stakeholders**

Market gardening is a good source of income for small-scale farmers in Kolda. As well as pest management, challenges to market gardening include: access to water, lack of modern production equipment, inadequate knowledge of how to store harvests, poor access to credit, and lack of technical supervision.

**Gender aspects of market gardening**

Women in Kolda see market gardening activities as essential for food security and social and economic development. The market gardening sector can provide women with substantial income. But in Kolda, particularly in the women's market garden areas, women are not sufficiently supported in market gardening activities through public policies and agricultural research. Also, modernization of agriculture requires a high level of resources and tends to eliminate small producers and family farmers. As part of market gardening, it is essential to provide women with access to arable land, credit, technical support, and capacity building through regular training sessions. Women working in the market gardening sector in Kolda have great difficulty accessing land, credit, inputs, improved seeds, and other needs.

Women are most often present as labourers in workspaces controlled by men. But the government introduced a law of gender equality in Senegal in 2010 to effectively empower women, so it is required to grant women all their rights. Nowadays, the global economic context linked to the COVID pandemic, and more particularly the situation in Senegal, demonstrates that men can no longer always assume their social roles of paying for expenses related to food, health, etc. that are increasingly the responsibility of women.

Agricultural modernization is the main cause of the unequal access to resources faced by women in Kolda. Women working in the market gardening sector in Kolda report having great difficulty accessing land, credit, inputs, improved seeds, and other agricultural goods.

For this reason, they recommend that they receive more support to enable them to overcome the current constraints and commit themselves fully to meeting the challenges.

**Impact of climate change on market gardening**

Kolda region is particularly vulnerable to the impacts of climate change and experiences other hazards, including storms and wind erosion.

Climate change can greatly affect the productivity of market gardening crops, and thus contribute to increased hunger and malnutrition. Senegal is one of the regions that is most vulnerable to the effects of climate change due to its high dependence on natural resources. Many livelihoods are based on exploitation of natural resources, mainly rain-fed agriculture, while water is the most vulnerable resource.

**Pest and disease management**

**Important pests of market gardening and how to manage them**

1. **Red spider mite**

Most commonly known as the red spider mite, *Tetranychus urticae* is one of the most feared pests by farmers and gardeners. The mites are very small, with four pairs of legs and no antennae, and can only be seen with a magnifying glass or microscope. Females are red in colour and have an oval shape, while males have a slightly more elongated shape and a lighter colour, close to pink. The damage they can cause and the speed at which they reproduce make this pest very dangerous.

*Damage caused by red spider mites*

The red spider mite feeds on the sap of plants, and is attracted to a large number of plant species. Small spots or bright spots on leaves are likely bite marks—small holes through which red spider mites get inside plants to suck up nutrients, weakening the plant. Spots are sometimes black or yellowish. Some specialists claim that a single adult red spider mite can bite plants more than 30,000 bites per day, or more than a million bites per month.

Another kind of damage is caused by the dense woven silk web that creates an ideal microclimate for the pest’s development. With this net enveloping it, a plant loses its capacity to exchange oxygen for carbon dioxide. In severe cases, leaves turn yellow and dry out severely. If left untreated, this leads to plant death.

*Management*

Like the ladybird, the mite *Phytoseiulus persimilis* feeds on the red spider mite on plants at all stages of its development. But it is unlikely that it is either affordable or accessible to farmers to use as a biological control agent. As an alternative, farmers can grow crops which attract *Phytoseiulus persimilis*, including mint, lettuce, parsley, and turnip.

It is sometimes advisable to spray infested plants with mineral oil, but this practice may not achieve good control.

Spraying rosemary essential oil diluted in water seems to be more effective. A decoction of garlic (30 g / litre of water) sprayed on the plant also gives good results. To prevent eggs from hatching and devouring the plant, repeat the spray every third day for two weeks.

Dispose of leaves damaged by red spiders by burying or burning, but do not add them to compost!

1. **Nematodes**

Nematode species live in the soil and are not visible to the naked eye. Rather, it is the damage they cause that testifies to their presence.

Nematodes prefer light soils where they can easily move around and temperatures above 20 ° C. They are very virulent in hot areas and in greenhouses.

If nematode populations are high, yields can decrease dramatically.

*Damage caused by nematodes*

Symptoms are difficult to detect in the first year of infestation. Damage occurs in lowlands and wetlands, and become more and more serious over time.

Nematodes infect plant roots. Over time, infested plants assimilate nutrients less and less well and show signs of nutrient deficiencies.

Leaves also turn yellow and wither. Since these symptoms are often found in other diseases and pest infestations, it is often difficult to know if they are caused by nematodes.

The evidence of nematode infestation is more obvious under the soil surface: small balls form on the roots and many rootlets develop.

There are two main families of nematodes:

* Root-knot nematodes, the most common of which infect plants in the cucumber family, as well as lettuce, tomatoes, eggplants, and peppers.
* Cyst nematodes, which attack potatoes, carrots, beets, and tomatoes.

*Management*

The best way to avoid or contain nematode infestations is good crop rotation. In general, do not replant vegetables from the same family in the same location for four years or more.

If an area is already infested, do not plant nematode-susceptible vegetables for 5-6 years. After that period, nematodes will be unable to find their host plant every year and their numbers will gradually decrease.

After each crop that has been infested, the plot must be cleaned well by removing as much debris and roots as possible so the pests can’t find food.

Plants used as green manure crops can also kill nematodes, including forage radish, crotalaria, moringa, rue, and cosmos.

White mustard is effective against the golden potato nematode (*Heterodera rostochiensis*).

India's eye (marigold) is also used to suppress the development of most species of nematodes when interplanted in rows of susceptible plants. Farmers should plant marigold between crop rows, or plant as much as possible in one bed. However, it’s important to avoid competition with growing crops.

1. **Aphids**

Some aphid species attack many vegetable crops. Aphids which feed on many types of crops include: *Aphis fabæ* (black bean aphid), *A. gossypii* (melon and cotton aphid), *Myzus persicæ* (green peach aphid), *Macrosiphum euphorbia* (green and rose aphid), and *Aulacorthum solani* (Foxglove and potato striped aphid).

*Damage caused by aphids*

Aphids cause various kinds of damage at all stages of plant cultivation, regardless of the areas they cover.

Aphids feed on the sap produced by plants, diverting nutrients necessary for plant growth. The damage caused to the plant varies according to the stage of development of the plant and its degree of sensitivity.

There are two categories of damage:

* direct damage linked to sap sampling and the toxicity of aphid saliva, and
* indirect damage linked aphid activities on the surface of the plant and their role in transmitting viruses.

It is difficult to precisely estimate economic losses due to aphids. Losses vary significantly depending on climatic conditions, the density of aphid populations, and crop varieties. Some studies suggest average yield reductions of 10 to 20% in peas, 10% in wheat, and 5% in Irish potatoes. There are many types of aphids, and each type feeds on different plants. Reductions are much greater when damage is due to viruses which are vectored by aphids, with serious damage to pepper, tomato, Irish potato, and fruit trees such as papaya and citrus fruits.

The type of damage should guide the methods of managing aphids. Generally, direct damage is proportional to the quantity of aphids on a plant, while the extent of viral damage depends mainly on the number of infected plants and much less on the number of aphids per plant. The methods of management are different in the two cases.

Farmers can monitor plants by using yellow sticky traps, visual observation, and by attending to signs which indicate that the pest is present.

*Management*

Preventive spraying with macerated nettle, wormwood, fern, or lemon balm can limit aphid attacks. Infusions of rhubarb leaves also repel aphids. However, the effectiveness of these measures has not yet been scientifically demonstrated.

Black soap products are reported to be very effective against aphids. Farmers can spray diluted flaked black soap or liquid black soap.

Farmers can also plant anti-aphid plants such as wormwood, mint, thyme, and savory near crops to repel aphids.

The number one aid in the fight against aphids is the ladybug, which is capable of eating 800 aphids in two weeks. Lacewing larvae are also very effective. Once you collect the ladybugs, put them in cardboard boxes. By tying small cardboard boxes in the field, you can attract both ladybugs and lacewing larvae, which will quickly multiply in the field. And each time that you see aphids, you can collect ladybugs and lacewing larvae.

1. **Caterpillars**

All butterflies go through four stages: egg, larva, chrysalis and adult. Depending on the species, the shape of each stage varies as well as the life cycle, which can vary from one month to a year. Eggs are very small, round, oval, or cylindrical in shape and some are streaked. They are usually laid on leaves in groups of up to 100 eggs. When the eggs hatch, tiny caterpillars start feeding immediately and grow rapidly until they reach 15 times their original length.

Caterpillars moult several times as they grow, and are typically green to brown in color. They have three pairs of true legs on the thorax and usually four pairs of prolegs on the abdomen. As soon as the caterpillar has reached its final size, it transforms into a chrysalis, then undergoes a complete transformation, called metamorphosis, to emerge as a winged adult. Here are some common species of caterpillars:

* *Autographa gamma* (gamma moth)
* *Cacoecimorpha pronubana* (carnation moth)
* *Chrysodeixis chalcites* (artichoke moth)
* *Clepsis spectrana* (strawberry budworm)
* *Duponchelia fovealis*, *Helicoverpa armigera* (tomato moth or armiger)
* *Laconobia oleracea* (vegetable garden moth)
* *Mamestra brassicae* (cabbage moth or brassicaria)
* *Spodoptera exigua* (beet armyworm or cramped moth)
* *Spodoptera littoralis* (cottonworm, Mediterranean moth, or littoral spodoptera)

*Damage caused by caterpillars*

* Caterpillars damage plants by gnawing at leaves, in some cases up to the main leaf vein.
* Young caterpillars only scratch the lower part of the leaf and leave the transparent upper epidermis intact.
* Larger caterpillars also damage flowers, fruits, and young shoots.
* Some species burrow inside stems and fruits, making it difficult to detect and manage them.
* Damage caused by excrement

*Management*

* Vinegar: In addition to its effectiveness for household chores, white vinegar is very effective in the fight against caterpillars.

*Directions for use*: Mix water and vinegar in equal amounts, and spray the solution on your plants to ward off caterpillars.

* Coffee grounds: Another ecological and economical solution against caterpillars.

*Directions for use*: Collect coffee grounds and place them at the base of plants and flowers to ward off caterpillars, who hate the smell. This solution is also effective against aphids.

* Marigolds and carnations: Marigold is a naturally repellent plant due to its strong peppery and musky odour. If you don't have carnation, you can use chives or basil.

*Directions for use*: macerate about 100g of carnation leaves in two litres of cold water for 24 hours. Then boil the mixture for 30 minutes. Let cool and spray the decoction on plants in your garden to ward off caterpillars, and also flies and aphids.

* Beer: A quick and effective method of controlling caterpillars.

*Directions for use*: Collect a little beer in a glass (or use an old, forgotten beer bottle) and spray the leaves of your garden with a sprayer.

* Garlic: Not only a vampire repellent, but proven to ward off caterpillars.

*Directions for use*: Mix 150 g of garlic in four litres of boiling water. Infuse for 30 minutes. Then, spray your leaves with this homemade mixture.

1. **Thrips**

Thrips are 1-2 mm long insects that bite plant stem and leaf tissues and organs to feed on the contents of cells. Emptied cells then fill with air, resulting in silvery gray spots or mottling.

There are about 3,000 species of thrips, which are more or less harmful. Adults are often winged, and their wings are fringed with bristles, feathery in appearance, and they have a stinging-sucking mouth cone. The larvae are wingless and slow-moving, with elongated, yellow, red, brown, or black bodies.

Like red spider mites, thrips thrive in hot, dry weather. In favourable conditions, thrips populations can expand very quickly; several generations of thrips can succeed one another on the same plant. When conditions are less favourable, larvae leave the aboveground parts of the plant and burrow into the soil to hibernate.

Many plants are affected by thrips, which mainly damage garden varieties. These include lettuce, carrot, green beans, cabbage, green pepper, parsley, pepper, leek, cucumber, onion, tomato, cucumber, eggplant, and bitter diakhatou. They also cause damage to ornamental trees and shrubs, small fruits such as raspberries, and fruit trees such as lemon, orange, guava, papaya, and soursop.

*Damage caused by thrips*

Thrips damage plants by piercing and grating the outer tissue of plants with their mouthparts. Initially, tiny, dark green spots appear on the leaf. These spots gradually turn white or silvery, and if extensive, they can look like silvery streaks. Severely affected leaf tissue withers and collapses from water stress. Thrips are most often found between the youngest leaves or in the inflorescences. \*

*Management*

Prevention is based on a simple principle: humidify! Thrips do not thrive when there is sufficient humidity. In hot and dry weather, regularly spraying the foliage of plants that are not susceptible to fungal diseases may be enough to prevent invasions.

Integrated biological control and traps:

To manage thrips, farmers can use integrated biological control.

Natural predators of thrips include Orius bugs, mites such as *Amblyseius cucumeris*, and a nematode called *Steinernema feltiae*. Sticky traps are also effective in eliminating adults.

For very serious attacks, use natural insecticides: a decoction of garlic added to a solution of black soap, neem oil, infusion of palm leaves and fermented, plants, and manure.

**Definitions:**

*Inflorescence*: Flower cluster or group of flowers, for example, cauliflower, turnip, papaya

**Acknowledgements**

Contributed by: Mr. Amadou Ngom, ICRA (International Centre for development-oriented Research in Agriculture), Montpellier, France; expert in crop production and agro-industry at the Ministry of Agriculture and Rural Equipment, Senegal.

*This resource was produced with the support of the Belgian Development Cooperation, Enabel, and the Wehubit program.*