USAID | LIBERIA
FROM THE AMERICAN PEOPLE

FOOD AND ENTERPRISE DEVELOPMENT (FED) PROGRAM FOR LIBERIA

SUBTITLE: DISEASES, MITES AND NEMATODE PESTS OF VEGETABLES IN LIBERIA

AUTHOR: DERMOT CASSIDY

JUNE 2012

This report is published by DAI with funding provided by USAID Food and Enterprise Development Program for Liberia. The views expressed here do not necessarily reflect the views of USAID, or the United States Government. For more information on this publication please contact DAI's Chief of Party Agnes Luz—agnes_luz@dai.com. For more information on DAI, please visit www.dai.com.

Table of Contents

Introduction

The purpose of this document is to provide a context for crop protection in peri-urban agriculture in Liberia for extension staff working in the Food and Enterprise Development Project in Liberia (FED). The definition of peri-urban agriculture used in this document is production of vegetables for sale as fresh produce or minimally processed such as drying in the case of chilis. Of necessity the document is far from complete and entire categories of crop pests such as post-harvest diseases and moulds, physiological problems, nematodes and weed species have not been included for lack of time and analytical equipment. As such the document must be treated as a work in progress and the interested reader is invited to help elaborate on and add to the contents. The fact that this document can only be a preliminary draft to a more comprehensive document compiled by all those participating in the FED peri-urban value chain is underlined by the fact that many of the pests and diseases described in this document have not been formally recorded in Liberia before.

All figures and diagrams in this document are those of the author. A major point to make is that a publication such as this one can only carry a small fraction of the information available on the internet so is really just a starting point for internet searches. A particularly important source is that of the Infonet-Biovision which has a vast amount on information on vegetable production in Africa[1]. Any reading on peri-urban crop protection should be done in conjunction with Infonet Biovision website and other sources, some such as the IITA in West Africa.

In the specific context of FED there are two other documents complementary to this one - for pest scouting and chemical/bio-rational crop protection. The first step is the correct identification of living organisms on the crop and what they are doing there which is the specific purpose of this document. Should a crop pest be present it is usually the case that they are present at levels that are not economic to control. Therefore it is necessary to put their present in the context of beneficial organisms over time. Therefore any crop protection activity requires systematic scouting over time. Only if it is demonstrated that a pest has got out of control should agricultural remedies be used and even then only those that are soft on beneficial species. A scouting document has been prepared as well as a set of tables for guidance on the use of agricultural remedies.

[1] http://www.infonet-biovision.org/

Mites

Mites are very small, often less than 1 mm and some such as the adult broad mite are only 0.2 mm long and difficult to see even with a hand lens. They are related to spiders and like spiders, adult mites have eight legs, although the nymphs only have six. Mites that affect vegetable production in Liberia include:

1. Broad mite, (*Polyphagotarsonemus latus*),
2. *Tetranychus evansi*
3. Two-spotted mite (TSM), (*Tetranychus urticae*)
4. *Tetranychus ludeni* Zacher (Acari: Tetranychidae).
5. Tomato russet mite, (*Aculops lycopersici*)

Life cycle

The life cycle of mite consists of the egg, larva, protonymph, deutonymph, and adult. Adults have four pairs of legs while the larva only has three pairs of legs. There is one body segment and the mouthparts

consist of chelicerae similar to those of spiders (Figure 1).

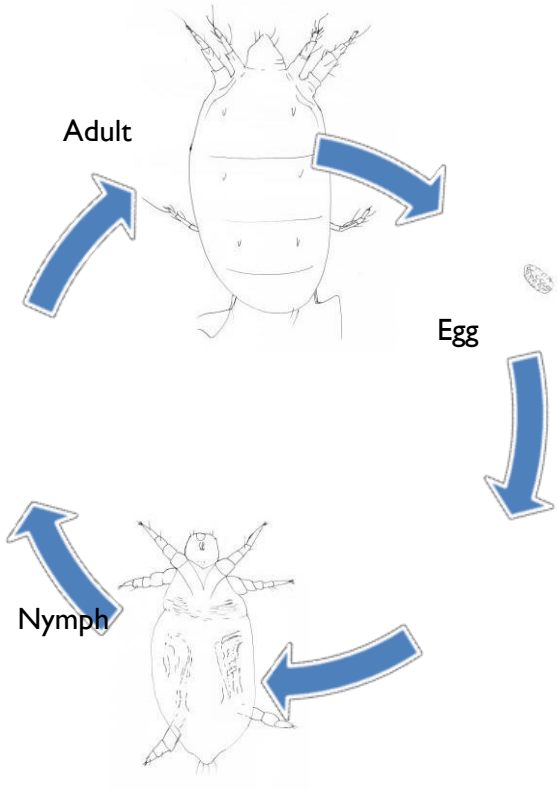

Figure 1; Simplified life cycle of the Broad

Mite

Effects of mite infestations

Mites damage leaves and fruit by sucking out the cell contents causing a range of symptoms including chlorosis (yellowing of foliage), rusetting (scarring of the epidermis), and galls (abnormal swelling of plant tissue). Feeding by the broad mite causes severe leaf distortion which can be mistaken for herbicide or other damage (Figures 2 and 3 and, potentially, Figure 4). Other symptoms and damage includes stippling (fine speckling) and/or distortion of leaves. Heavily stippled leaves may wither at the edges, turn brown and fall off. The tomato russet mite causes the stem to discolor, resulting in a rusty- brown or smoky color. The stem may also develop cracks. Injured fruit turns bronze and can crack longitudinally. Some mites including the broad mite are known to transmit diseases.

Figure 2; Severe broad mite damage to younger leaves in chili's (Bong county, Liberia)

Figure 3; Distortion in growing tip of chili caused by broad mite infestation (Liberia)

Mites are present all year round, but are likely to be more active during warmer, dryer periods. High temperatures of 21° to 27°C coupled with high relative humidity favor the development of broad mites. A small number of mites are not a cause for concern, but high populations can be damaging. TSM feeds on a wide range of plants and is an important pest of cucumbers, tomatoes, capsicums, and bean and also occurs on many common weed species.

Control

Biological controls for mites include the predatory mites. A number of Phytoseiid species have been found to occur naturally in Senegal and other parts of West Africa including *Neoseiulus californicus*, *Amblyseius swirskii*, *Paraphytoseius horrifer*, *Phytoseius amba*, *Amblyseius herbicolus*, *Neoseiulus barkeri*, and *Euseius nyalensis*. It is highly likely that many of these species occur in Liberia as well. The predatory mite, *Neosililus barkeri*, has been successfully used as a natural control agent against broad mites on peppers in Europe and America.

Spraying with insecticides, especially broad spectrum persistent insecticides, may cause an outbreak of mites, as natural enemies that keep mites under control are killed. To treat mites, use selected miticides or horticultural oils that are registered for your crop, and strictly observe the label or permit instructions.

Figure 4; Possible broad mite damage in okra (Liberia)

Fungal diseases

Fungi and fungal-like organisms, such as the 'downy mildews' are the cause of more plant diseases than any other group of plant pest. There are three main groups of plant diseases of potential importance in peri-urban gardens in Liberia.

Damping-off

This term is used to describe the sudden death of seedlings and is associated with a group of fungi which include Pythium, Rhizoctonia, Phytopthora, and Fusarium. Damping-off generally occurs under cool, wet conditions. While there is a range of fungicides registered to control damping-off, an integrated approach is required. The incidence is significantly reduced by planting under good conditions when practical, careful irrigation management, and the use of appropriate fungicides when required.

Downy
mildews

The term downy mildew is a collective one for diseases that affects a wide variety of plants, with different species infecting different plant groups. The downy mildews are not true fungi but related to the brown algae and have a motile zoospore stage.

Alternaria spp.

These species affect a range of crops and are often termed late blights as they have been associated with older crops.

Other common fungal diseases include Sclerotinia, Septoria, grey moulds (often caused by Botrytis species) and powdery mildews.

Diseases of watermelon seen in Liberia

Watermelon anthracnose (*Colletotrichum lagenarium*)

Anthracnose is a common name of plant diseases characterized by black lesions, usually sunken, caused by certain imperfect fungi in the case of watermelon *C. lagenarium*. This fungus infects leaves, stems, and fruits, is seedborne and may first appear as a brown spot on seedling cotyledons. Leaf lesions are angular or irregular, dark brown to black, and usually with a narrow yellow border (Figures 5 and 6). Anthracnose is most severe where high moisture and temperatures coincide. For *C. lagenarium* optimum temperatures for infection ranged from 21 to 24°C. At most temperatures, as little as 2 h of leaf wetness is required for infection. Spore germination, dispersal and infection require relative humidities near 100%. In drier periods disease expression can occur when latent infections are activated through aging or tissue damage. Anthracnose is primarily transmitted through seed, but also in infected plant parts. Rain splash will also disperse spores within crop canopy and the disease persists on and in seed, crop residues, and weed hosts.

Alternaria Leaf Spot (*Alternaria cucumerina*)

Alternaria cucumerina infects the leaves only. Lesions are usually round to irregular, dark brown or black, and frequently occur with concentric rings (Figure 7). Lesions of Alternaria leaf spot can often be confused with young gummy stem blight leaf spots because of the zonate appearance. The pathogen persists between crops on old diseased plant debris. Spores are readily dispersed by wind and rain and can be transmitted on seed.

Figure 5; Watermelon anthracnose anthracnose

Figure 6; Watermelon

Figure 7; Alternaria on watermelon

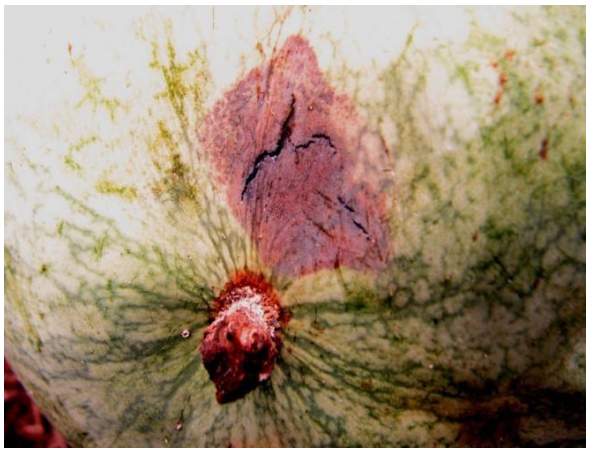

Figure 8; Disease of unknown etiology on watermelon – possibly blossom end rot

Other watermelon disorders

A number of other disorders are often seen on watermelons in Liberia. Most commonly these are splitting of the fully sized fruit and rots near the blossom end (Figure 8). Both of these are most likely physiological problems caused by a range of environmental factors but made worse by uneven irrigation.

Diseases of okra in Liberia

Botrytis rot of fruit

Botrytis species are found almost everywhere. They are weak pathogens generally acting as invaders of dead or dying plant tissue. Healthy plant tissue can be infected by botrytis which then either develops a soft rot or the infection becomes 'latent' on dead tissue such as sepals (Figure 9). Latent infections become an issue post-harvest, especially where fruit is harvested or stored in damp conditions without refrigeration.

Figure 9; Botrytis spp. on okra flower and developing as a latent infection on remnants of the flower parts.

Figure 10; Powdery mildew on upper leaf surface of okra in Liberia

Figure 11; Powdery mildew on lower leaf surface of okra with jassid bug

Figure 12; Unknown physiological disorder on okra causing strappy leaves

Powdery mildew in okra

The main powdery mildew disease in okra is *Erysiphe cichoracearum* affecting mainly the older leaves, petioles, stems, and even fruit of plants[2]. Yields of infected plants are reduced due to premature leaf loss. High humidity and heavy dew can add to the severity of infections. Symptoms appear as blotches of white powdery coating are mainly on the lower surface of the leaves but may appear on the upper leaf surface also (Figure 10 and 11). Younger leaves are largely free of the disease. Spores are easily blown by winds to nearby susceptible plants. Heavily infected leaves become yellow, becoming dry and brown leading to premature defoliation.

[2] Same f. sp. affecting eggplant and bitterball? Not sure and worth looking into. Some references cite *Oidium asteris-punicei* as the causal organism of PM in okra. During dry periods of the okra season, excepting dew, the powdery mildew fungus coats the upper and lower leaf surfaces with a white coating of mycelium.

Unknown disorder in okra

A regular feature of okra seen in Liberian peri-urban gardens are the presence of strap like leaves in older plants (Figure 12). Plants with this symptom appear generally stressed and there is no obvious single cause for the problem though it does resemble broad mite damage in chilis.

Diseases of bitter ball and eggplant in Liberia

Leaf spot (Cercospora abelmoschi).

Cercospora leaf spot is generally a warm weather disease. It generally affects less than 5 percent of the acreage on average, but it is an aggressive fungus once established. The disease expresses itself as brownish spots containing fungal spores on lower leaves. In older infections leaves become yellow and drop. The leaf spots in Figure 13 are provisionally identified as this disease but this is *not* confirmed. However the disease is widespread in West Africa

Fusarium wilt (Fusarium oxysporum f.sp. melongenae)

Affected plants show yellowing of leaves that progressively wilt and die from bottom upwards. Woody stem and root tissue of diseased plants turn brown (Figure 14).

Figure 13; Leaf spotting bitter ball

Figure 14; Fusarium wilt on eggplant

Figure 15; Powdery mildew – bitter ball

Powdery mildew

Powdery mildew in okra is caused by *Erysiphe cichoracearum*. Mainly older leaves, petioles and stems are affected. The leaf surface is covered by the talc-like powder, though this may be brownish as seen in Figure 15, which composed of hyphae and fungal spores. Spores are easily blown by winds.

Other diseases

Lettuce

Lettuce crops in Liberia appear to be remarkably free of diseases. However one infected patch has been seen with symptoms that appear to be similar to those of *Alternaria sonchi* reported from other countries (Figure 16).

Figure 16; Alternaria-like symptoms in lettuce possibly *Alternaria sonchi*

Figure 17; Cercospora leaf spot chili

Cercospora Leaf Spot of chili pepper

The causal organism is *Cercospora capsici* and it is a pepper disease of worldwide significance. It is most important in tropical and sub-tropical warm, wet regions. Symptoms are circular spots with a light gray center and a reddish-brown margin, growing up to 1 cm in diameter which later become tan with a dark ring and a yellowish halo around the ring, resulting in a "frog-eye" (Figure 17).

Wilt of chili pepper

Several microorganisms may be involved in causing wilt diseases in chile all of which exhibit similar symptoms when infection occurs (Figure 18). These include Phytophthora root rot, Verticillium wilt, Rhizoctonia root rot, and Fusarium wilt. Causal organisms include *Verticillium dahlia* and *V. albo-atrum*, *Fusarium oxysporum* and *Rhizoctonia solani*. Collectively, the diseases listed have a significant impact on chile production worldwide though it is not certain which are the most important in Liberia. Successful management of these wilt diseases will be vital to ensure the economic viability of chile production in the country.

Onion purple blotch

Purple blotch is caused by the fungus *Alternaria porri* infecting the bulb and all above-ground parts of the plant. Initial symptoms appear on older leaves which are more susceptible to infection. The disease is most severe when frequent rain or persistent dews occur during moderate (25 to 27°C) temperatures. Almost no infection occurs below 12°C. The fungus is disseminated within and among fields by splashing water and wind, and overwinters in and on infested crop debris. The pathogen may also be seed-borne.

Lesions are elongate, small, sunken and whitish with a purple center (Figure 19). Concentric light and dark zones later appear over part or all of the purple area. These blotches may enlarge (up to four inches long) and become covered with black fruiting bodies (spores). Leaves wilt and die. Bulbs can be infected at harvest if the pathogen enters neck wounds (Figure 20). Cultural controls include the use of high quality seed and transplants free from the pathogen, three-year or longer rotations to non-hosts, eliminating culls, onion debris, and volunteers. In a Liberian context it may be that the only suitable production period is during the dry season – January to April.

Figure 18; Wilt in chili

Figure 19 (above) ; Alternaria in onion

Figure 20 (right): Alternaria infection in onion