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PEST AND DISEASE CONTROL IN CITRICULTURE: STRATEGIES FOR HEALTHY PRODUCTION

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Gustavo Arruda de Magalhães[1], José André Junior[2], Carlos Cicinato Vieira Melo[3].

ABSTRACT

The article addresses fundamental aspects of Brazilian citriculture, highlighting its historical origin, economic importance, and evolution in recent decades. It focuses especially on the sour lime 'Tahiti', the main commercial variety of lime grown in Brazil, with an emphasis on the states of São Paulo and Rio de Janeiro. It details the characteristics of this variety and the Rangpur lemon rootstock, widely used for its drought tolerance and rusticity. The text also presents the main pests (such as leaf miner, false rust mite, mealybugs and black aphid) and diseases (HLB/Greening, gummosis, wart, grease spot, rubellosis and coating fungi) that affect citrus, in addition to the symptoms of nutritional deficiencies, such as those caused by lack of nitrogen, phosphorus, potassium, calcium, magnesium, boron, copper, iron, manganese and zinc. Methods of chemical, biological, and cultural control are proposed to preserve the productivity and quality of national citriculture.

Keywords: Brazilian citriculture. Acid lime Tahiti. Citrus pests and diseases. Nutritional deficiencies. Rangpur lemon rootstock.

[1] Graduating in Agronomy
UNITPAC
[2] Doctor
UNITPAC
[3] Doctor in Plant Science
UNITPAC

INTRODUCTION

Citriculture in Brazil began with the introduction of sweet orange seeds in the states of Bahia and São Paulo. Since the ecological conditions in these states were favorable, the plants produced satisfactorily, to the point that the fruits of the 'Bahia' orange were recognized even in Colonial Brazil as larger, juicier, and of excellent quality than those produced in Portugal. However, it was only in the 30s of the last century that citriculture began to be commercially implemented in the states of São Paulo, Rio de Janeiro, and Bahia.

The citrus sector in Brazil occupies a prominent place in the agricultural economy, not only in terms of foreign exchange, but also in the generation of internal income, employment, and contribution in nutritional terms.

Brazilian citrus growing has evolved strongly in the last three decades, both in terms of growth in planted area and production.

CANOPY VARIETY - TAHITI ACID LIME

In Brazil, the Tahiti lime has great commercial importance, with approximately 40 thousand hectares of planted area. The largest producing states are São Paulo, with 70%, and Rio de Janeiro, with 8% of the national production.

The plant has a tall size with green and lanceolate leaves. Flowering occurs throughout the year (mainly September and October). The fruits, usually without seeds, are oval, oblong, or slightly elliptical, with thin, smooth skin and greenish color. When ripe, the fruits have juicy pulp with acidic juice.

The most recommended rootstocks are Rangpur lemon or Rough lemon, which provide fast growth, good production, quality fruits, and greater tolerance to citrus sadness, although sensitive to root rot. In Tahiti lime orchards, it is recommended to use at least two different rootstocks, due to the possible emergence of new diseases.

ROOTSTOCK VARIETY - RANGPUR LEMON TREE

The Limoeiro Rangpur rootstock is recommended for sandy or clayey soils. It induces high vigor, medium to large trees, large fruits, early yields, minimal cold tolerance, high yields, and medium internal quality juice.

The Rangpur lemon tree does not have tolerance to Nematodes and is tolerant to Sadness, but it is affected by other diseases such as Exocortis and Xyloporosis, and is also susceptible to Gomosis, one of the main diseases that may affect it.

In any case, it is considered the main rootstock of our Citriculture due to its characteristic of being drought tolerant, and most of the plantations made in our country are

not irrigated, depending exclusively on the rainfall regime. Other characteristics considered positive in it are its rusticity and precocity in production.

PESTS IDENTIFIED

Leaf Miner - *Phyllocnistis citrella*

This pest consists of nocturnal insects, originating in Asia. The caterpillars, when feeding on the leaves, open the silver mines, causing curling and drying of the leaves of new shoots.

Damage:

a) leaves become twisted, dry up, and fall, there is a reduction in the rate of photosynthesis and productivity depending on the level of infestation of the pest;
b) The lesions can serve as a gateway for the bacterium *Xanthomonas axonopodis* pv. *Citri*, which causes citrus canker.

Control:

a) Monitoring;
b) Chemical control with the use of insecticides;
c) Biological control: predators (lacewings, anthocorids, ants, wasps, and spiders) and parasitoids (*Galeopsomyia* sp., *Cirrospilus* spp., *Elasmus* sp., *Eupelmus* sp., *Conura* sp., *Horismenus* spp., *Ageniaspis citricola*).

Rust mite - *Phyllocoptruta oleivora*

Damage:

a) Oranges are unable to develop normally, becoming rough and grayish to brown;
b) The symptom on the leaves is known as a grease spot, the lesions are not protruding and do not appear on the other side of the leaf;
c) Symptomatic leaves fall off, leaving the trees defoliated.

Control:

a) Monitoring;
b) Elimination of inoculum source;
c) Chemical control with the use of selective acaricides and in correct dosages or mineral oils;
d) Biological control: predatory mites.

Cochineals (pardinha, stem scaly, scaly, stem parlor, black parlatory, and ortézia)

Damage:

a) Direct: sap suction and injection of toxins, which can cause the leaves and even the fruits to detach and fall, the branches and roots can dry up, depreciation of fruits, and death of the plant;
b) Indirect: sooty mold, which hinders the physiological processes of the plant (photosynthesis, transpiration), browning of branches, leaves, and fruits, and dispersion of the pest by ants.

Control:

a) Chemical control: isolated insecticides or mixture with mineral oil;
b) Biological control: parasitoids, predators (ladybugs and lacewings), and pathogens (*Aschersonia, Fusarium, Phialocephala, Beauveria).*

Black Aphid - *Toxoptera citricida*

Aphids are sucking insects that form colonies on shoots. They are the main vectors of the citrus tristeza virus.

Damage:

a) Atrophy and curling of leaves and new shoots by continuous sap suction;
b) Citrus tristeza virus;
c) c) They suck sap;
d) Sooty mold (*Capnodium sp*).

Control:

a) Biological (Ladybugs, hoverflies, wasps);
b) Chemist.

5 DISEASES IDENTIFIED

Greening/ Huanglongbing (HLB) - *Candidatus Liberibacter asiaticus* and *Ca*. L. *Americanus*. The vector of the disease is the psyllid (*Diaphorina citri*).

It is considered one of the most devastating citrus diseases in the world. The transmission of the bacterium can also be through infected pimples. Cultivars and rootstocks immune to the disease have not yet been identified.

Symptoms:

a) The leaves have asymmetrical mottling;

b) The fruits are reduced in size and asymmetrical in shape, with crooked central columella, aborted seeds, and uneven color;
c) The plant shows a reduction in the number of radicellae, accentuated fall of leaves and fruits;
d) Presence of pointers (shoots) with chlorosis that can be seen in some parts of the plant, a characteristic that gave the name of *huanglongbing* (yellow dragon disease or yellow pointer);
e) Economic death (= incapacity for economic production).

Control:

a) Use healthy seedlings produced in a protected environment;
b) Periodically inspect the orchard for immediate elimination of plants with symptoms of HLB;
c) Manage the orchard aiming at the elimination of HLB vector psyllids, applying alternative insecticides to control the insect.
d) Remove the false myrtle plant in the vicinity of the orchard.

Gummosis - *Phytophthora* spp.

It is considered the most important fungal disease in the crop. The rootstocks lemon 'Rangpur', mandarin trees 'Cleopatra' and 'Sunki' are susceptible or moderately susceptible to gummosis. Conditions of high humidity and high temperature, moist soils, and accumulation of organic matter are favorable to the occurrence and development of the disease.

Symptoms:

a) Lesions on the neck of the plant and other parts of the trunk, gum exudation, and discoloration of the affected tissue;
b) Secondary symptoms involve yellowing, wilting, and leaf drop;
c) Fruit rots form a brown, dry lesion.

Control:

a) Plant seedlings free of *Phytophthora* and use resistant or tolerant rootstocks;
b) Avoid planting in humid places, soils subject to waterlogging, and wounds in the root region and in the neck of the plants;
c) Avoid accumulation of organic matter and moisture near the plant neck and improve ventilation under the canopy;

d) Remove the affected tissues by scraping and brushing with Bordeaux mixture paste.

Verrugosis - *Elsinoë fawcettii* and *E. Australis*

It is the most important disease in orchards intended for the production of fruits for *the fresh market*, as the disease depreciates the external quality of the fruits. Leaves are susceptible to the fungus from emergence until it reaches the intermediate stage of its development.

Symptoms:

a) On the leaves and branches, there is formation of lesions in the form of protruding, corticous and irregular crusts, and tissue hypertrophy;
b) Lesions, when in very large numbers, can cause deformation of the leaves;
c) On fruits, the lesions are cortical and protruding, but they are superficial.

Control:

a) Keep the nursery clean, free of crop residues;
b) Avoid sprinkler irrigation in the budding phase;
c) Perform applications with alternative grouts containing copper. The first application to protect the newly formed fruits should be done when there is a fall of 2/3 of the petals, and a second application after four months.

Grease stain - *Mycosphaerella citri*

Grease stain is a disease that occurs in regions with prolonged periods of high humidity and high temperatures.

Symptoms:

a) The affected area is dark brown to black in color and oily in appearance. Note: The symptoms of a grease stain can be confused with the attack of the false rust mite, which causes death of epidermal cells between the oil glands.

Control:

a) Adopt management practices that favor the rapid decomposition of fallen leaves;
b) Apply alternative fungicide mixtures in combination with oil. The oil, although it does not have fungicidal action, makes it difficult for the fungus to penetrate, delaying the development of the disease.

Rubellosis - *Erythricium salmonicolor*

This disease is known as "pink disease" and is important in regions with a humid tropical climate. It is more severe in very dense orchards or very closed canopies.

Symptoms:

a) The base of the branch is coated with white mycelium at first, becoming pink later;
b) Destruction of the bark occurs, causing flaking and cracking, and leading to drought and the death of branches.

Control:

a) Pruning and removal of dry, diseased, unproductive branches and other branches that hinder the aeration of the inner part of the crown;
b) Application of Bordeaux mixture paste on the cuts.

Coating fungi

Symptoms:

a) Sooty mold - *Capnodium* sp.: covers the leaves, branches, and fruits, forming a dark black layer, easily removable, especially in organs where there has been exudation of sugary substances by aphids, mealybugs, or whiteflies.
b) Felt or chamois - *Septobasidium* spp.: coating of different colors, thick, compact, spongy, and easily removable, which occurs on branches and leaves, frequent in humid places, and with high infestation of mealybugs.

Control:

a) Cleaning pruning (removal of affected branches for greater aeration);
b) Control mealybugs and aphids with alternative mixtures that have an insecticidal effect;
c) Spray with copper-based grouts, mixed with oil.

SYMPTOMS OF NUTRITIONAL DEFICIENCIES

Nitrogen

Initially, there is a uniform loss of chlorophyll from the old leaves, and in more severe cases, it causes the fall of mature leaves and drought of the branch tips, which gives the trees a reduced size with sparse foliage; There is a reduction in the number and size of fruits in the plant.

Phosphorus

The old leaves are enlarged, tan in color, dull, leathery, which fall when the deficiency is severe - characteristic in young plants in the first years of planting in the field; the branches become defoliated from the base to the apex given the redistribution of the nutrient from the oldest leaves to the youngest; less frequently, fruits showing the open columella occur

Potassium

Symptoms are not evident on the leaves, but in severe cases, there may be drying up of the limb margins of young leaves; small-sized fruits with smooth, thin skin are frequent and ripen early and fall prematurely.

Calcium

Visual symptoms in the leaves are not common, but the density of leaves in the canopy is not very dense, similar to N deficiency, and leaves lack brightness.

Magnesium

There is an interveinal chlorosis of the old leaves, which is very characteristic and common in Brazilian orchards, whose aspect is an inverted "V", resulting from the loss of chlorophyll.

Boron

It occurs on new leaves, which can be deformed; severe symptoms cause bud death and loss of apical dominance, from which new tuft-shaped shoots grow from the axillary buds. There may also be excessive fruit drop, whose albedo is thicker with gum bags and aborted seeds.

Copper

The most characteristic symptoms occur on the new branches, where bumps appear that develop into gum pockets that coalesce.

Iron

The young leaves have generalized chlorosis, of smaller size, but maintain darker green veins, forming a thin reticulate; in Brazil, it has been frequently observed in nurseries.

Manganese

Young leaves show interveinal chlorosis, are normal in size, and have a thick reticulate appearance, unlike Fe deficiency.

Zinc

The young leaves show interveinal chlorosis, which contrasts with dark green central and lateral veins, are deformed (narrow, lanceolate, and small leaf blade), and occur on branches with short internodes, giving the plant a shriveled appearance.