Pests and diseases of lemon


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Penicillium

The two fungi *Penicillium digitatum* (green mould) and *Penicillium italicum* (blue mould) cause more than three-quarters of citrus rots. All species and varieties are susceptible. These fungi are present all over the world, differing only in the infection mode and the symptoms generated. *Penicillium digitatum* causes the formation of green spores on the fruit. The spores are easily airborne. It is a wound parasite and incapable of contaminating a sound fruit whose peel is intact. Spread in an infected fruit is characteristic. The outer layer of the peel (flavedo) is always attacked before the deeper layer (albedo). Finally, the whole of the fruit, including the pulp, is infected. In contrast, a peeled fruits (with no flavedo) is not susceptible to attack.

Prevention of attack by this parasitic fungus is based to a considerable extent on fruit handling and the cleanliness of the equipment used during harvesting and at packing and storage stations. Chemical control is possible. This is based on curative and preventive active substances that can act on surface micro-wounds.

Penicillium italicum attacks fruit with intact peel and is thus more to be feared than *P. digitatum*. The spores are easily propagated in the air or by contact between fruits. Postharvest fungicide treatment with curative and preventive modes of action are used. The repeated application of benzimidazole fungicides causes the appearance of resistance. This class of fungicides has been replaced by others, including sterol synthesis inhibitors.


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Mal secco

Phoma tracheiphila (Petri) Kantsch & Gik.

This fungal disease was first observed on the island of Chios in 1894. It is present on the shores of the Black Sea and in the northern and eastern Mediterranean from the Gulf of Genoa to Syria. North Africa is reported to be affected and the Iberian peninsula free of the disease. It can spread to almost all kinds of citrus but lemon is the most frequently and severally infected. The fungus penetrates the tree via a wound and develops in the conducting tissues, hindering the movement of sap. In aerial contamination, the fungus develops downwards and comparatively slowly without necessarily contaminating the whole tree at first. The symptoms associated with mal secco are then seen: chlorotic leaves, withered shoots with pink to reddish wood. In case of contamination of the base of the tree (base of the trunk or roots), the fungus spreads upwards more rapidly and contaminating nearly the whole tree, causing the total withering of the main branches and possiblly the death of the plant.

Control of mal secco is based mainly on prevention: the use of healthy plant material, resistant varieties (such as 'Interdonato'), the use of cultural practices that limit the vigour of the trees and the risk of mechanical wounding (by which contamination starts) and the burning of all infected parts. There is no really effective chemical treatment.


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Phytophthora

Phytophthora fungi are found in the soil in all citrus regions. Some citrus species, such as lemon, are particularly susceptible to the disease. This is one of the reasons why lemon is always grafted on *Phytophthora*-resistant rootstocks such as sour orange, *Citrus macrophylla*, etc. The fungus destroys the living cortical tissues in trunks, branches and roots and can even totally halt the movement of elaborate sap. According to the intensity of the attack, the trees display sectoral leaf yellowing, growth blockages and, finally, the total withering of the plant. In the summer, sap exudation is observed at the level of cortical attacks; for this reason the disease is known as gummosis. Another kind of attack concerns only fruits in the final stage of development. During rainy periods, splashing of soil contaminates the fruits in the lower parts of the trees. These fruits will rot completely on the tree or later after the harvest.

Phytophthora prevention is based on practices that reduce or eliminate the following conditions:

- the closeness of fruits organs to the ground;
- the transporting of soil in the vegetation (feet, ants, etc.);
- the mechanical wounding of susceptible tissues, especially in the lower or underground parts of the trees;
- a humid microclimate and stagnant water at the base of the trunk.

Planting on ridges, grafting at a height of 30-40 cm, the forbidding of climbing with muddy shoes, training pruning avoiding the start of many main branches at the same level, watering a sufficient distance from the trunk, moderate nitrogen fertilisation (resulting in less vigour) and the removal of low branches with fruits too close to the ground are all simple techniques that reduce *Phytophthora* attacks very significantly.


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Citrus flower moth
(*Prays citri*)

This small moth is a microlepidopteran found throughout the Mediterranean area and also in tropical and subtropical citrus zones. Its small size and nocturnal habits make it difficult to identify. Population monitoring has been made easier by the development of pheromone traps. The larvae attack flower buds, perforating them and eating the stamens, pistil and ovaries that they contain. They move from one bud to the next, causing the same damage. Young leaves and very young shoots are affected in very severe outbreaks. Lemon trees can withstand significant attacks without being too penalised unless more than 50% of the flowers are affected. Biological regulation using beneficial insects exists but its impact is limited.

A *Bacillus thuringiensis* biological insecticide can be sprayed at the bud stage, with the treatment repeated weekly. The treatment does not affect bees, which are particular active during the flowering of citrus.


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Bud mite
(*Aceria sheldoni* Ewing)

This mite is not specific to lemon trees but its pricking causes spectacular deformation of lemon fruits. Both leaf buds and flower buds can be damaged. The growth of very young parts is disturbed if they are pricked. The young leaf shoots have a squat appearance (court-noué), buds grow without lengthening and the petals are thick and tough. The ovarian carpels tend to become detached from each other and the fruit has a characteristic digitate appearance. High relative humidity enhances the development of this mite, which is strongly present in coastal areas.

Chemical control is not very easy as the mite is in young plant organs with compact tissues. Intermittent applications of mineral oil or a specific acaricide are used if infestation is too severe.


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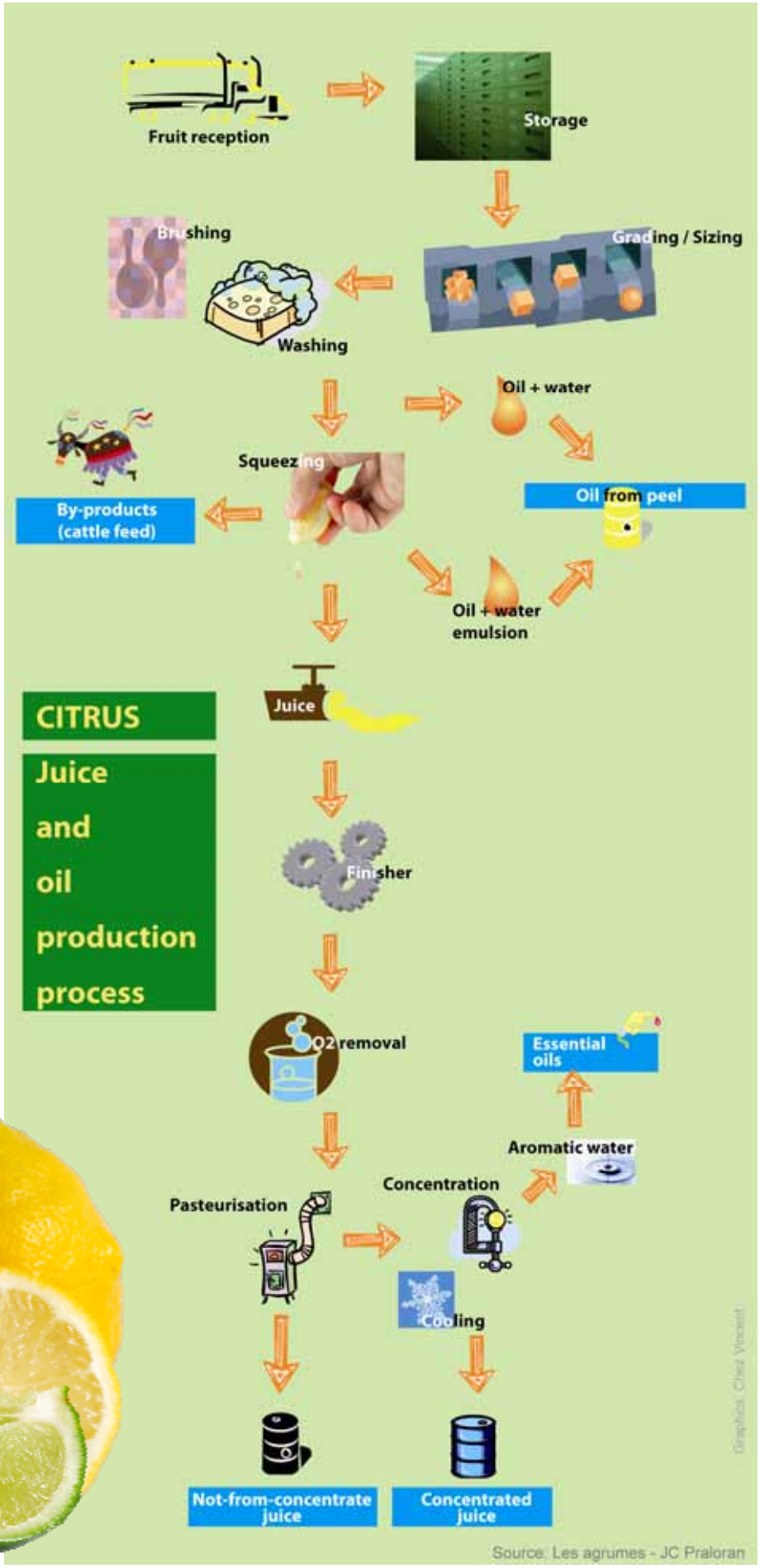
Tristeza

In contrast with numerous citrus species like orange and mandarin, citrus tristeza virus (CTV) does not affect lemon grafted on sour orange. For this reason, citrus plantings traditionally budded on sour orange have not suffered from the decline caused by the virus. They have even figured as survivors when other citrus were badly hit.

Effect of the common rootstocks on the different characters of lemon trees

		Citrange Troyer	Citrange Carrizo	Mandarin Cléopâtre	Citrumelo CPB 4475	*Citrus volkameriana*	*Citrus macrophylla*	Sour orange
Viruses	**Tristeza**	tolerant	tolerant	tolerant	tolerant	tolerant	susceptible	susceptible
Fungal diseases	***Phytophthora***	medium resistant	medium resistant	slightly susceptible	resistant	medium resistant	very resistant	very resistant
Soil and climate	**Lime**	medium susceptible	medium susceptible	resistant	very susceptible	resistant	resistant	resistant
	Active lime (maximum %)	8-9	10-11	12-14	5	12	12	12
	Salinity	susceptible	susceptible	resistant	moderately resistant	moderately resistant	resistant	resistant
	Drought	susceptible	susceptible	average resistance	resistant	resistant	resistant	moderately resistant
	Frost	resistant	resistant	resistant	moderately resistant	susceptible	very susceptible	very resistant
	Start of production	normal	normal	normal	earlier	earlier	earlier	normal
	Productivity	good	good	good	good	high	high	good
	Fruit quality	good	good	very good	good	unfavourable	unfavourable	good
	Maturity	earlier	earlier	later	later	earlier	earlier	normal
	Fruit color	earlier	earlier	later	earlier	later	later	normal
	Rind thickness	increased	increased	reduced	normal	increased	increased	normal



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