September 2008 - No. 159

FRuiTROP

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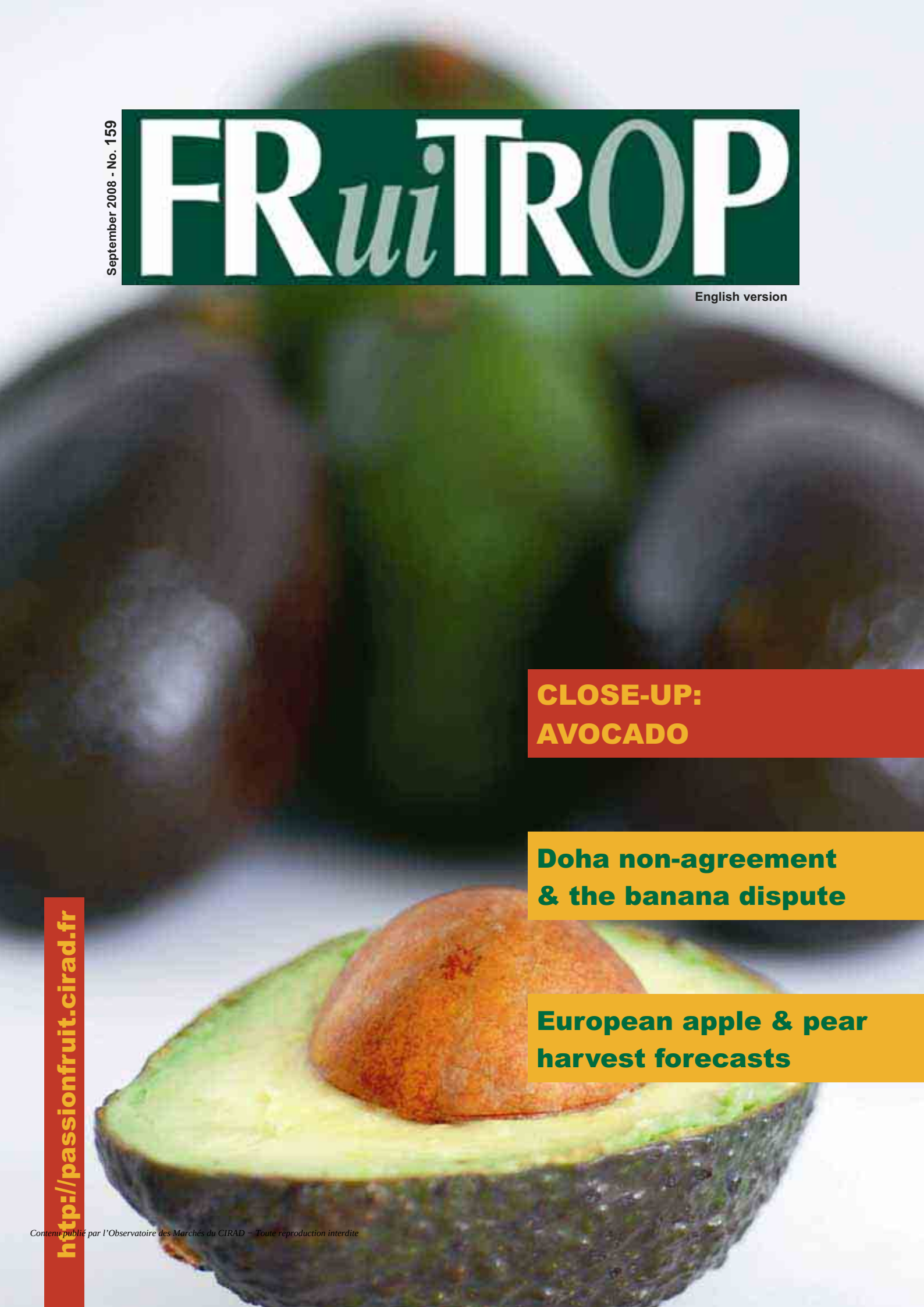

CLOSE-UP: AVOCADO

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Avocado varieties

Photos © University of California

Avocado is a dicotyledon of the genus Persea *of the Lauraceae family. More than 200 varieties are divided between three races. The Mexican race is of little commercial interest as most of the fruits are too small. However, its agronomic qualities mean that it is widely used as rootstock or as a parent. Practically all sales of fruits of the West Indian race are on domestic markets. International trade handles mainly varieties belonging to the Guatemalan race or crosses between the Guatemalan and Mexican races.*

The Guatemalan race

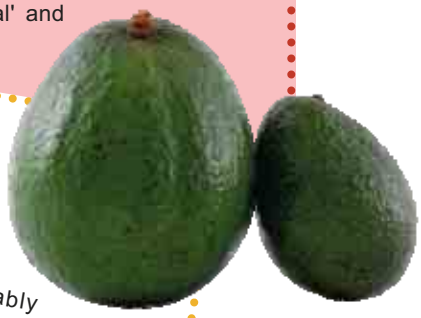
Persea nubigena L. Wins var. *guatemalensis*

This race probably originated not only in the highlands of Guatemala but also in the Chiapas in Mexico. The leaves are large and uniformly dark green on both faces. Although it is not as tolerant to cold as the Mexican race, it is useful for marginal cultivation zones. The fruits are roundish and have thick, very hard warty skin. The size may vary considerably but they are generally larger than fruits of the Mexican race. The seed is fairly small and almost always clings. Pulp oil content is medium at 10 to 20%. Flowering to harvest time is 8 to 10 months. It can be longer in the cold parts of California (12 to 14 months). The race is a good parent for crosses (contributing genes for small seeds). Nearly 40% of avocados belong to this race, including 'Anaheim', 'Corona', 'Sharwil' and the major commercial varieties such as 'Edranol', 'Gwen', 'Hass', 'Nabal' and 'Reed'.

The West Indian race

Persea americana Miller var. *americana*

In spite of its name, this race probably originated in Colombia. It is well suited to humid tropical regions where it is used to supply local markets. The tree has large green leaves. The fruits are elongated, usually large and weigh 400 to 900 g. The epidermis is fairly thin (0.8 to 1.5 mm) and is smooth and shiny, soft green or greenish yellow or reddish when mature. The pulp is watery with a low oil content (< 10%). The seed—often free—is large and has a more or less corrugated surface. All these characteristics make the fruits delicate. They often display pulp browning (caused by chilling injury) at the temperatures generally used for the storage and refrigerated transport of fruits of the other races (+ 6°C, + 8°C). The race is the most sensitive one to cold and aridity but the most tolerant to salinity. The flowering to harvest time is only 5 to 7 months. The West Indian race groups about 15% of avocado varieties and the best known among them are 'Peterson', 'Pollock' and 'Waldin'.



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The Mexican race

Persea americana Miller var. *drymifolia* Schlecht and Cham

This fairly hardy race that is adapted to low temperatures originated in the Mexican highlands. It differs from the two other races in several botanical characters:

- the leaves are generally small and release a characteristic anise odour when crumpled;
- flowering is earlier than in the other races and the flowering to harvest time is 7 to 9 months;
- the fruits are small and elongated and rarely weigh more than 250 g. The skin is very thin and smooth.

The pulp is often fibrous and has a high oil content (> 15%). The seed is generally large and sometimes free. This race is very sensitive to salinity. In contrast, it tolerates high temperatures and comparatively low relative humidity. Furthermore, it has greater tolerance to *Phytophthora cinnamomi* than the other races. It thus forms good rootstock and its genetic potential is well exploited in hybridisation breeding programmes. Finally, its high lipid content is an interesting feature when the fruits are used for oil production. About 20% of varieties belong to this race. The best known include 'Duke', 'Gottfried', 'Mexicolo', 'Topa Topa' and 'Zutano'.

Hybrids

A large proportion of the varieties of interest for international trade are hybrids. These are generally natural crosses and in rarer cases are the result of breeding exploiting the inter-fertility of the three races. The main selection criteria are agronomic (resistance to pests and diseases, especially *Phytophthora,* tolerance to salinity and cold, productivity, etc.) and those related to fruit quality (size, high pulp percentage, flavour, absence of fibres, oil content, etc.). 'Bacon', 'Ettinger', 'Fuerte' and 'Lula' in particular are natural Mexican x Guatemalan hybrids. Guatemalan x West Indian hybrids, mainly from Florida, include the varieties 'Ajax', 'Booth', 'Choquette', 'Collinson' and 'Simpson'. Mexican x West Indian hybrids such as 'Indian River' are very rare. Other varieties resulting from inter-race crosses are possible.

Hass

Guatemalan race

Flowering type: A
Fruit shape: pyriform
Skin: dark green and brown at maturity, not very thick, warty
Oil content: 18 to 20%
Average weight: 250 to 350 g
Seed:skin:pulp ratio: 16:12:72 (small seed)

Observations
'Hass' has replaced 'Fuerte' as the sector standard. It is currently the most commonly planted avocado in the world. It was selected by Rudolph Hass in California in the early 1920s and registered in 1935. The tree is vigorous and highly productive. The fruits vary in shape in some production regions, ranging from pyriform to ovoid. Average fruits size is fa i rly small in hot regions. Good capability for conservation on the tree. The skin turns from dark green to purplish brown at maturity. It is easy to remove from the pulp. The organoleptic qualities are excellent. Rich flavour (nutty taste) and buttery nonfibrous pulp.

Reed

Guatemalan race

Flowering type: A
Fruit shape: spheroid
Skin: medium thickness, slightly rough, pliable
Oil content: 19 to 20%
Average weight: 400 to 500 g
Seed:skin:pulp ratio: 17:11:72

Observations
This variety of Californian origin was selected by James Reed. Registered in 1960, the patent expired in 1977. It has succeeded in conserving the qualities of its parents 'Nabal' and 'Anaheim' without their negative features. It is fairly productive and alternate bearing is not marked. Its resistance to cold is comparable to that of 'Hass'. The fruits are large and a singular round shape. They keep well on the tree. The organoleptic qualities are excellent and the buttery pulp has a slight nutty taste and does not blacken after slicing. Peeling is also easy.

Fuerte

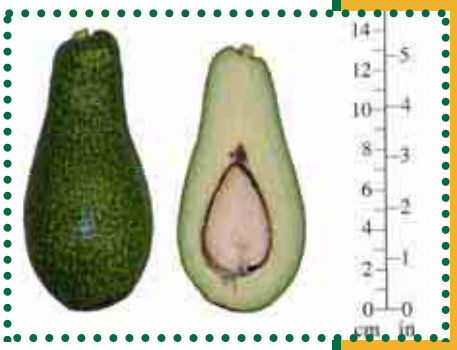
Mexican x guatemalan hybrid

Flowering type: B
Fruit shape: obovate
Skin: green, matt, smooth, medium thickness. Pliable and tough, it is easy to remove
Oil content: 16 to 18%
Average weight: 250 to 400 g
Seed:skin:pulp ratio: 15:10:75 (large seed)

Observations
This variety was long the most commonly planted in the world and originated in Mexico (Atlixco). The tree is vigorous with fairly good resistance to frost (to 4°C), but is particularly temperature- sensitive during the flowering period. Productivity is generally good in temperate zones but it displays strong alternate bearing. The fruits are easy to peel and have excellent organoleptic qualities (buttery pulp).

Ettinger

Mexican x guatemalan hybrid

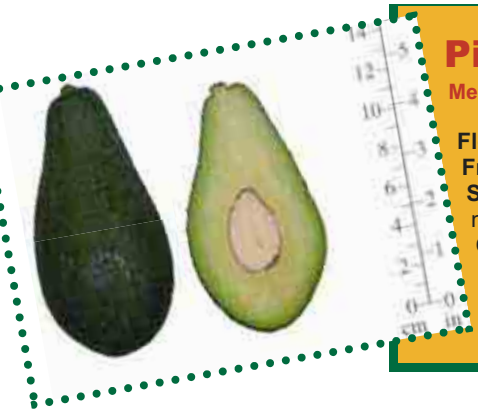


Flowering type: B
Fruit shape: narrowly obovate
Skin: bright green, fine, fairly smooth
Oil content: 18 to 22%
Average weight: 250 to 350 g
Seed:skin:pulp ratio: fairly large seed

Observations
This variety was bred from 'Fuerte' in Kefar Malal in Israel, where it is mainly grown. The tree is very fertile and vigorous with an erect habit. The fruits are similar to those of 'Fuerte'. The skin is susceptible to problems of corky areas and tends to adhere to the pulp. The pulp is buttery and fibreless and has good organoleptic qualities.

Pinkerton

Mexican x guatemalan hybrid



Flowering type: A
Fruit shape: pyriform
Skin: dark green, rough, tough and pliable, medium thick, easy to peel
Oil content: 18 to 25%
Average weight: 270 to 400 g
Seed:skin:pulp ratio: 10:13:77 (small seed)

Observations
A recent variety bred in California by John Pinkerton and registered in 1975. It is probably the result of a Hass x Rincon cross. The tree is very vigorous and tolerates temperatures of -1/-2°C to 30°C. Production is good and alternate bearing is little marked. The fruits may suffer from ring-neck if the tree is under conditions of stress. The organoleptic qualities of this variety are excellent (nutty taste). The pulp is smooth, buttery and fibre-less.



Avocado diseases	Phytophthora *Phytophthora cinnamomi*	Anthracnose *Colletotrichum gloeosporioides*	Cercospora spot *Cercospora purpurea*
Symptoms	Small, pale yellowish leaves. They wilt, fall and are not replaced. The foliage becomes thin. Small withered branches at the top of the tree, death of the tree. The trees wither; roots and base of trunk attacked affecting trees of all sizes and ages.	Round brown necrotic spots on leaves and early fall. Shoots wither. Young fruits blacken and fall. The pathogen can infect young fruits as soon as they have set by conidia carried by rain water from leaf necroses or stem cankers.	Pale yellow spotting of the epidermis of fruits, then turning black.
Attacked part	Root system, but early symptoms on foliage.	Leaves, branches and fruits.	Fruits and leaves.
Cause	Heavy soil and poor drainage.	Rainy season disease.	Rainy season disease.
Spread	Nursery or poorly cultivated soil.	Spores carried by rain.	Fruit necroses caused by *Cercospora* form entry points for *Colletotrichum*.
Measures to be taken	Good cultural practices.	Avoid areas that are too moist and prune the trees. Spraying will be found to be essential in case of attack.	A programme of fungicide treatments is essential for susceptible varieties during periods propitious for the development of the disease.
Prevention	Use well-drained soils.	Prune for good aeration of the canopy.	Rain, dew and moist winds play an important role in spreading the disease. Insects (thrips) and mites can carry spores from the spots to healthy parts of the leaves and fruits.
Economic impacts	The most serious problem in orchards.	The most important post-harvest problem as the fruits unsaleable.	Fruits unsaleable.



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Avocado pests	Giant whitefly *Aleurodicus dugesii*	Thrips *Selenothrips rubrocinctus* Giard *Scirtothrips perseae*	Red spider mite *Oligonychus* spp.
Symptoms	Whitefly suck sap from the leaves. The honeydew secreted by the nymphs collects dust and sooty mould develops, attracting ants that can reduce the effectiveness of biological control.	Mature leaves suffer the most serious attacks once their tissues have started to harden. Pricking causes discoloured chlorotic spots and leaf tip browning and rolling. Nutritional pricking of fruits starts near the calyx and gradually spreads over the whole fruit, whose skins becomes 'tanned' and brown.	Circular, yellowish necrotic patches form, covered by a dense web, often running along leaf veins. These attacks can cause defoliation.
Attacked part	Leaves.	Leaves and fruits.	Leaves.
Measures to be taken	Natural enemies attack whitefly at the immature stage and provide biological control if they are not disturbed by spiders.	If necessary, applications of insecticides such as abamectin, spinosad and thiamethoxam.	These mites are often controlled by natural predators and parasites. Washing the leaves of young trees with a high pressure water jet destroys spider mites.
Prevention		A slightly damp climate favours the development of thrips.	Spider mites are spread by the wind for great distances; they can also travel for short distances.
Economic impacts	Reduction of exchanges via leaves and decrease in tree vigour.	Pricking causes scarification, suberisation and the discolouring of fruit epidermis. This reduces the commercial value of the fruit.	Premature leaf fall. Spider mites are thought to cause more damage to the 'Hass' variety whereas the Mexican varieties such as 'Fuerte' are less seriously affected.