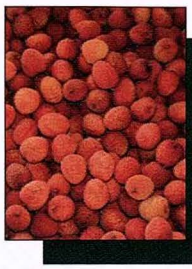


Cultivation of litchi

by Christian Didier

Requirements of litchi

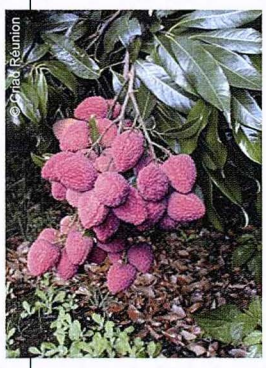
Specific climatic conditions are required for litchi growing but the tree is not very fussy about soils. It is also little susceptible to viral diseases.

Cultivation zones

Litchi requires a warm, humid climate. In order to flower, it needs a vegetative resting period induced by a cool, dry season. A slight fall in temperature and relative humidity may induce flowering in some humid zones. A good supply of moisture is essential from the appearance of the flower spikes until harvesting.

Wind-breaks

The position of the land must allow good lighting. Poorly drained low-lying land should be avoided, as should steep slopes that hinder the mechanisation of maintenance work. The land must be sheltered from the prevailing winds and from sea spray near the coast. If there is no natural protection (relief, vegetation), wind breaks are installed around the field and even inside it if it is large or very exposed. Wind breaks consist of fast-growing trees with good anchorage in the ground (filao, shisham, acacia and others) planted in dense rows and require maintenance (fertilisation, irrigation and pruning). They must be allowed sufficient space.



As far as possible, wind breaks should be installed a year before the litchis are planted to give protection from planting onwards. A wind break provides protection for a distance equal to ten times its height. They should be planted closer together in sloping land. They sometimes do not have any effect in extreme cases.

Soils

Litchi adapts to numerous types of soil but prefers slightly acid soils (pH 5.5 to 6.5 and 8 or higher in some parts of India) that are rich in organic matter, deep and well drained. Although it can stand having 'wet feet' temporarily near rivers, prolonged submersion can be harmful. Drainage is all the more important as litchi is grown in zones with high rainfall and often in low-lying areas protected from wind.

Varieties

***Litchi sinensis* Sonn.**
Sapindaceae
Origin: Southern China (Canton region)

A great number of varieties exist around the world. Only those seen on export markets are mentioned here.

Kwai mi (Mauritius, Tai So)
The fruits are medium-sized (22 to 25 g) and bright red in clusters of 12 to 30. Fruit quality is good. This is the most widespread variety in the Indian Ocean. Production is steady with little alternate bearing. The trees are of medium vigour slender.

Shahi (Muzaffarpur)
The fruits are medium-sized (20 to 25 g), bright pink and in clusters. The pulp is sweet. This is the most common variety in Bihar State in India. It is of very good export quality but susceptible to cracking and sun-scorch. The trees are vigorous with steady production (80 to 100 kg per tree).

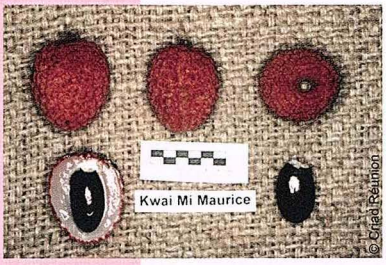
Rose scented
The fruits are medium-sized (16 g), globular and heart-shaped. The pulp is very sweet with an aroma of roses, whence its name. The variety is grown mainly in Uttranchal in India.

Haak Yip (Black leaf)
The fruits are medium-sized (20 g), dark red and in clusters of 15 to 25. The peel is smooth and hard. The pits are medium to large. The flesh is good to excellent, sweet and aromatic and forms 70 percent of the fruit. The trees are of medium vigour, compact, straight and bear well.

The creation of orchards

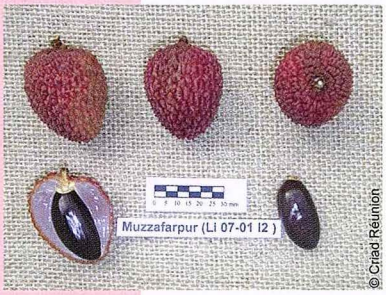
Soil preparation

Planting in recently cleared land in which stump and root debris enhance the development of root rots should be avoided. If necessary, surface drainage is ensured by levelling and subsoil drainage by a network of ditches. If cultivation can be mechanised, deep subsoiling is followed by ploughing, possibly after the application of manure and phosphate and potassium fertiliser (in the light of the results of soil analysis). When the trees are planted in holes, inputs are applied at this stage.



Plants

Propagation is usually by air layering using trees noted for the quality of their production. The layers obtained during the hot, humid season from branches 10 to 15 mm in diameter and 0.50 to 0.70 m long have a small necrotic root point at the cut that heals quickly. The root system is also better balanced with the aerial part. After separation, the marcots are cultivated in pots in a nursery for 3 or 4 months before being transplanted to the orchard.



Planting density

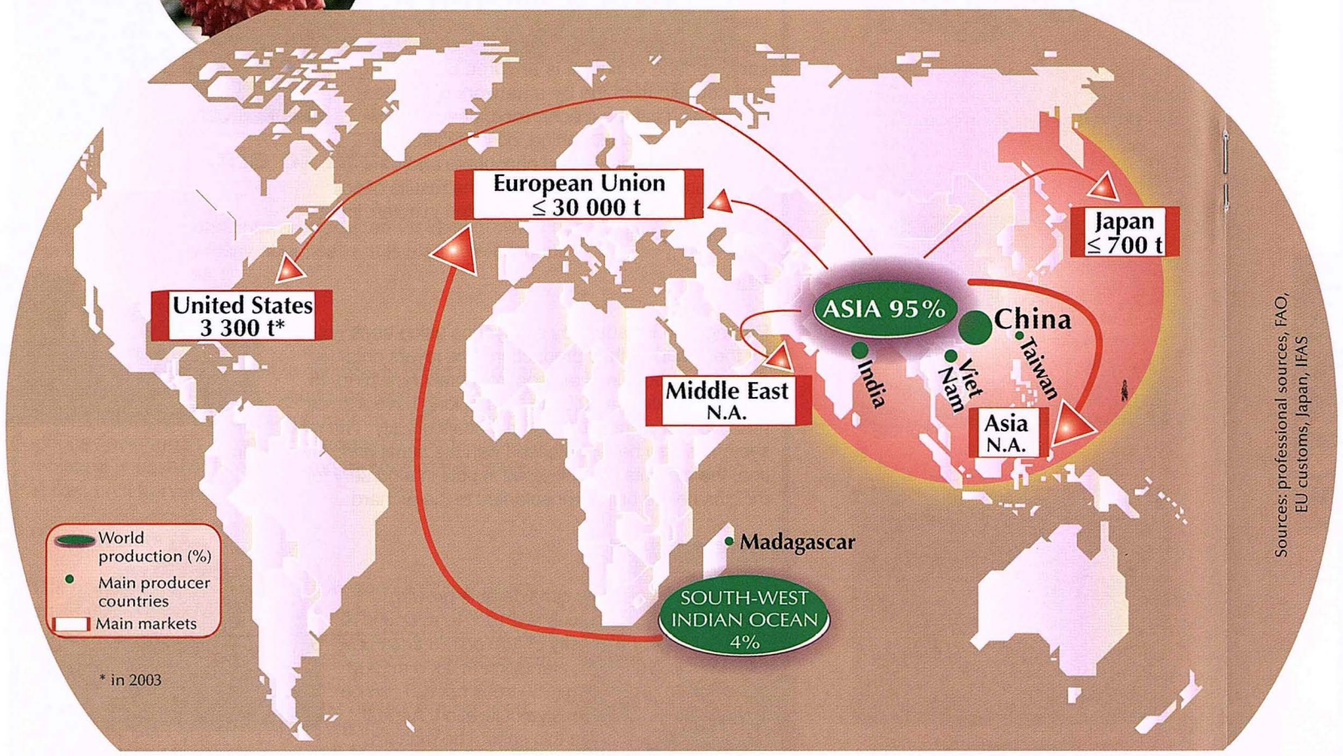
The litchi tree displays considerable growth. Today, planting distances are 10 x 10 m or 8 x 10 m, that is to say a density of 100 or 125 trees per hectare. Nevertheless, plantation at 8 x 6 m (208 trees per ha) or 8 x 5 m (250 trees per ha) can be envisaged in more intensive cultivation. Annual pruning is necessary in this case. The orchard can be thinned by gradually cutting back the trees when they begin to hinder each other and then, in the absence of an effective pruning method, by felling one tree in two along the row.

Planting

Planting must be performed with a strict layout and perfectly aligned in each direction. If cultivation is not mechanised, a 0.8 x 0.8 x 0.8 m (500 litres) hole must be dug at the position of each seedling. The soil removed is then mixed with about 2 kg potassium sulphate + 2 kg natural phosphate + 25 to 30 kg well-rotted manure. The hole is then refilled with this mixture. A slight mound is formed as a result of the manure application and the expansion of the soil. The plants are installed in the mound and staked.

Marcots are planted inclined in the opposite direction to the wind and staked. They are thus less exposed to the wind and root better. The plants must always be watered abundantly after planting. In cool zones, they must be sheltered during the winter following planting.

Litchi... estimated world production: 2.3 million tonnes

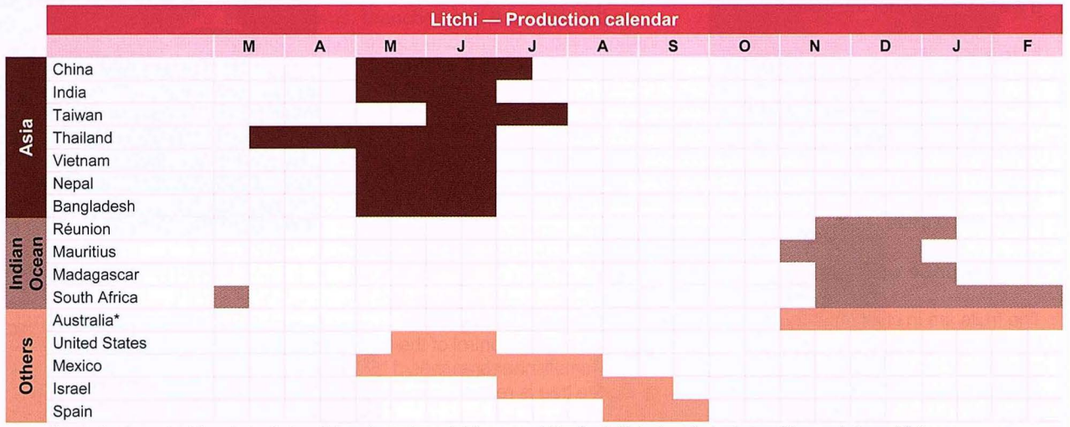


Litchi, tamarind, cashew apple, jackfruit, sapotilla — European Union imports

Tonnes	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Total extra-EU, incl.	**14 088**	**13 108**	**10 495**	**13 023**	**18 886**	**22 700**	**21 756**	**25 347**	**28 397**	**30 114**	**29 454**	**26 989**
Madagascar	10 876	11 178	7 678	10 378	12 448	18 695	16 647	18 178	17 480	20 635	21 121	18 235
South Africa	2 349	784	1 705	1 645	4 240	2 012	3 044	2 977	7 148	5 042	2 787	3 419
Thailand	316	535	456	280	1 070	1 061	890	1 192	1 534	1 578	2 466	2 618
India	37	7	29	27	21	41	78	380	819	763	607	647
Pakistan	-	5	2	-	2	10	4	1 432	86	288	366	532
Israel	172	298	187	303	698	551	621	636	489	873	932	428
Mauritius	50	45	46	114	94	49	143	122	256	117	232	198
China	4	1	25	10	105	39	55	77	38	295	333	131
Kenya	-	-	-	1	1	0	8	13	31	30	18	98
Malaysia	11	14	31	26	30	37	47	50	54	75	99	71
Others	272	241	335	238	178	204	219	291	463	418	494	613

Source: Eurostat , code 08109030 (litchi, tamarind, cashew apple, jackfruit, sapotilla)

Litchi — Production calendar

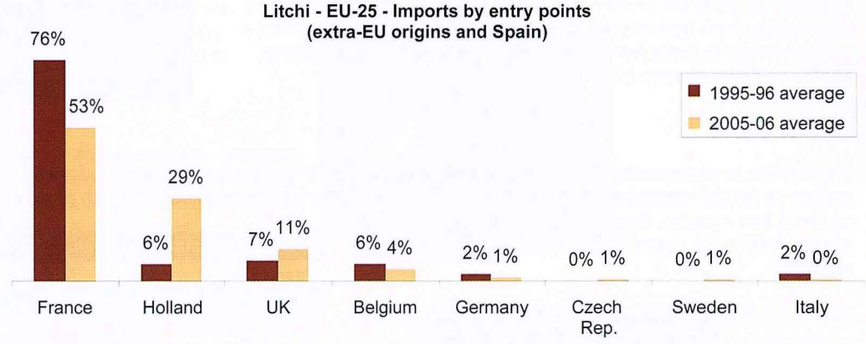


* Australia: Queensland from the beginning of November to the end of January and New South Wales from the beginning of January to the end February

Litchi — World production — Tonnes

Country	Production	Production region	Source
China	1 446 000	South-east (mainly Guangdong, Guangxi and Fujian)	MOA 2006
India	425 000	East and north (mainly Bihar 60 to 70% and western Bengal, 15 to 20%)	Apeda, average 2004-05
Vietnam	156 000	North (mainly Bac Giang, Hai Duong, Quang Ninh)	Professional sources, 2006
Taiwan	80 000	Centre and south	Taiwan Agricultural Research Institute (average 2001-02)
Thailand	43 000	Mainly north (Chiang Mai, Chiang Rai) and centre (Samut Songkhram)	Agricultural Economics Office, 2007
Nepal	14 000	Mainly in the central plain and the west	Ministry of Agriculture Nepal, 1998-99
Bangladesh	13 000	Whole country, mainly along western border	Bangladesh Bureau of Statistics, 1997-98
Pakistan	3 000	Punjab	Ministry of Agriculture, Pakistan, 2005-06
Total Asia	**2 180 000**		
Réunion	10 000	South-east (from Bras Panon to Sainte Rose), south-west (Saint Pierre)	Professional sources
Madagascar	80 000	Mainly Toamasina (between Feonarivo and Brickaville) (Manakara and Fort Dauphin)	Professional sources
Mauritius	3 500	Centre (Plaines Wilhems district), north (Pamplemousse, Flack and Rivières du Rempart districts)	Professional sources
South Africa	4 000	70% Mpumalanga, 24% Limpopo, 5% Kwazulu-Natal	Subtropical Growers' Association, 2006
Total SW Indian Ocean	**97 500**		
Australia	6 000	90% Queensland, 10% New South Wales	Austr. Lychee Growers' Association, 2001
Mexico	4 000	Above all in the centre (San Luis Potossi) and south of the Gulf of Mexico (Vera Cruz, Puebla, Oaxaca)	Professional sources
Israel	1 200	North (between the Sea of Galilee and the coast)	Professional sources
United States	600	Above all in southern Florida (Miami Dade county), Hawaii, California	IFAS, USDA, 2001
Spain	n.a.	Malaga	
Total others	**11 800**		

Litchi - EU-25 - Imports by entry points (extra-EU origins and Spain)



Source: Eurostat

Litchi, rambutan, carambola, passion fruit — Japanese imports

tonnes	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Total	**1 451**	**1 196**	**976**	**1 977**	**1 832**	**1 601**	**1 452**	**332**	**891**	**654**	**697**
China	2	6	129	877	1 010	800	1 150	178	689	426	569
Taiwan	1 280	1 011	718	940	576	286	187	33	162	199	108
Mexico	21	35	26	11	29	33	19	32	8	8	17
Thailand	135	131	97	138	155	349	20	3	0	0	0
Australia	0	0	0	0	52	123	75	84	28	21	1
Others	13	13	5	11	10	11	2	1	4	1	2

Source: Japanese customs, code 81090210

Orchard maintenance

Training pruning

As for other fruit species, it is sought to train the tree on a single trunk with horizontally spaced, regularly distributed main branches. Care must be taken in the early years to prevent the forming of shoots on the trunk or the main branches that have a very closed angle, following the natural tendency of litchi. These shoots are extremely weak points during strong wind.

Soil maintenance

The soil must be bare along the rows or under the foliage in the early years. Spontaneous inter-row vegetation must be kept down. Short-cycle, small growth intercrops can possibly be grown during the first three years and managed in such a way as not hinder the trees.

Irrigation

Litchi is very susceptible to water stress throughout the fruit growth period and the vegetative growth period that follows the harvest. Irrigation is necessary in case of shortage of water. Stress during fruit setting causes substantial fruit drop. Different irrigation systems can be envisaged. Microjet irrigation is satisfactory. At least 200 mm water per month must be applied (according to soil type, the age of the trees, the climate, etc.).

Maintenance pruning

The fruits are in clusters at the extremities of the branches. The latter are broken at harvesting. However, this practice does not enable control of the volumes of the trees. The removal of dead wood, of small inner branches and branches that prevent sunshine from entering the tree is recommended.

Litchi growth is fast and soon becomes exuberant. The trees must therefore be controlled. For this, annual pruning is performed just after the harvest. The trees are usually too dense. The aim is to aerate them by allowing as much light as possible on the foliage and to keep them at a suitable height to make harvesting easier. The final result of pruning should be dome-shaped trees.

Fertilisation

Fertilisation is an important factor. It promotes good vegetative growth after the harvest and makes up for the exporting of minerals in the fruits. After the active vegetative growth period of about four months, litchi needs a short period of stress (nutritional, water, heat or other) to allow flower induction.

Doses are modulated according to the date of application:

- after the harvest: 1/2 of the dose;
- at panicle emergence: 1/4 of the dose;
- after 'June drop': 1/4 of the dose.

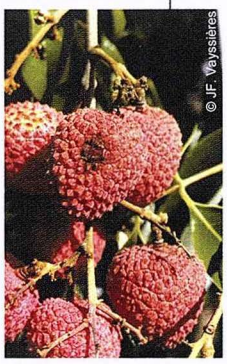
Fertiliser is applied to the ground beneath and at the limit of the foliage. Trace elements are applied by leaf spraying at fruit setting (boron, calcium).

Litchi - Applications recommended - Grams per tree

Year	N	P	K	MgO
1	50	10	40	15
2	80	10	60	20
3	140	30	105	40
4	210	45	160	55
5	230	65	265	80
6	380	85	345	105
7	470	105	430	125
8	570	125	520	155
9	670	150	610	180
10 and +	920	210	840	240

Phytosanitary protection

Warning: treatment must be applied in conformity with the regulations in force in the producer country and in the destination country.



C. Peltastica

Main fruit pests

- ***Cryptophlebia peltastica* and fruitfly**
  Cryptophlebia lays eggs on immature fruits. The small caterpillars bore into the fruit to the seed for the nymph stage. The wound opens the way for other pests, especially fungi and fruitflies.

Main foliage pests

Fruitfly

- **Scales**
  Scales can infest fruits, leaves, stems, branches and the trunk. When numerous, they cause the withering of leaves and shoots. Leaves often display yellow spots where they have been pricked. Scale infestation is often accompanied by sooty mould.

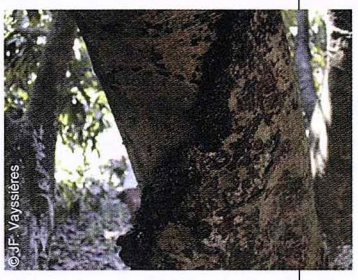
- **Mites: *Aceria litchi* (Erinose mite)**
  This is a serious pest in India and China, attacking flowers and leaves. The leaves crinkle and the undersides acquire a brown coating.

Trunk and branch pests

Leaf-borer caterpillar

- **Bark-borer caterpillars (*Indarbela quadrinotata* and *I. tetroanis*)**
  Very common in India. Damage is caused by the larvae that bore into bark and trunk, reducing sap movement and affecting growth.

- **Bark borer: *Salagena* spp.**
  The larvae feed on the bark and wood of the tree. The tree does not die but the branches wither. Treatment: these larvae can be controlled by stopping the holes with cotton wool soaked in systemic insecticide.



Bark borers

- **Thrips**
  Dolicothrips indicus and *Magalurothrips usitatus* cause damage to flowers. *Selenothrips rubrocinatus*, *Heliothrips haemovoidalis* and *Franklinella cephalica* cause the withering of flowers and leaves.

Diseases

Anthracnosis

- **Root rot**
  This is caused by the fungus *Clitocybe tulescens*. Much damage is reported in Florida. *Botryodiplodia theobromae* can cause sudden death of the tree (Australia).

- **Aerial system**
  Leaf necrosis caused by *Gloeosporium* spp. This is observed in certain poorly managed orchards.

Post-harvest and sulphur treatment

A feature of litchi is that it does not ripen after picking and so it is essential to harvest the fruit when it is fully ripe. However, it deteriorates very rapidly at ambient temperature. The shell browns, dries and becomes brittle in two or three days. Loss of colour results from the oxidation of anthocyanin pigments, an irreversible reaction. The fruit is then more subject to bursting and secondary contamination by fungi.

Litchi before sulphur treatment

To prevent senescence before the fruit is sold, litchi can be fumigated with sulphur dioxide; this inhibits respiration and thus conserves texture and organoleptic qualities for several weeks. Sulphur has a fungicidal, anti-oxidant effect that keeps the shell flexible. This treatment can be applied to destemmed fruits or bunches that are sound, ripe, free of spotting, insects pricking and free of traces of damp on the shell. Sulphur is burned in a closed chamber containing the fruits. It causes the shells to turn yellow, whereas they are naturally pinkish red when the fruits are ripe. The fruits are then sorted again and packed. They remain yellow for as long as they are kept chilled. The colour gradually changes to pink ochre or purplish red when they are under warmer, moist, ventilated conditions allowing the elimination of the sulphur.

Litchi after sulphur treatment

Sulphur treatment is the cornerstone of litchi marketing insofar as it lengthens conservation time, giving access to sea transport and hence large-scale exports. The procedure is used for several other fruits such as table grapes and dried fruits and it is also used for wines. The main difference is that litchi shells are not edible. Sulphur treatment is permitted in Europe under certain conditions. Consumer health protection regulations stipulate that the residual sulphur content must not exceed 250 mg/kg in the shell and 10 mg/kg in the fruit pulp. Numerous experiments have been conducted to define treatment procedures so that these limits are respected. Both professionals and the European authorities pay close attention to the question. Numerous control operations are performed throughout the life of the fruit in order to ensure that the regulations are respected. The gradual setting up of certification by operators should enhance product traceability and the mastery of treatment operations.

The continuation of use of sulphur is called into question from time to time. Indeed, with the general evolution of regulations towards the protection of consumer health, there is a great risk of heading towards a reduction in residue levels at best and at the worst the forbidding of treatment. One of the role of the sector us therefore to pay great attention to changes in the regulations concerning this point. A search for new conservation methods can also be an important approach. Unfortunately, litchi does not have sufficient economic weight to mobilise the resources required for such research, as is the case for other fruits.

Temperature during storage and transport is another key component in maintaining fruit quality in time. Indeed, chilling after harvesting, treatment and packing is performed by the transport facilities used. Here, it will be noted that litchi is one of the few tropical fruits that can withstand low temperatures (1°C ± 0.5°C). The combination of sulphur treatment and chilling allows good conservation of litchi. Fast chilling to the heart of the fruit is important for maintaining quality. Chilling must then be maintained to ensure as long a life as possible for the fruits. Any change in temperature may cause fruit deterioration and senescence.

Harvesting

Traditional harvesting is performed by hand with 'bunches' of fruits of the branch stored in bales or crates containing 10 to 15 kg only so that the fruits at the bottom are not crushed. These hand-made bales conserve good humidity around the fruits, preventing them from drying out. It is better to use slightly ventilated plastic crates to avoid crushing the fruits. The treatment and marketing of fruits are rapid to avoid the peel discoloration resulting from drying. Litchi is not a climacteric fruit and its biochemical characteristics change little after harvesting, except for gradual deterioration. Fruit maturity is generally appraised on the basis of colour, peel texture and tasting. It is considered that a soluble dry matter/acidity ratio of 2.1 to 2.7 corresponds to optimum quality.