

September 2009 - No. 170

# FR*ui*TROP

English version

**CLOSE-UP:  
AVOCADO**

**French banana market  
Shrinking? Non!**

**European apples & pears  
Prospects for 2009**

<http://passionfruit.cirad.fr>



# Avocado

A report by Eric Imbert



**A**fter another year of strong production deficit during the winter season, the world market is readying itself for substantial supply in 2009-10 and probably for a long period, given the production dynamics in Chile, Mexico and Israel. In contrast, might we be moving towards smaller summer seasons on the EU market? The possible opening of the US market to Peruvian 'Hass' might change world trade flows considerably at the expense of Europe. But beyond the question of the commercial difficulties inherent in penetrating a new market, important technical problems remain to be solved before this actually happens, while production is not in stand-by mode. In this context, might it be high time for all production sources to make investments downstream in the chain to promote the consumption of avocado in proportion to the investments made upstream in new production structures, as is being done in certain South American producer countries?

## Contents

- p. 15 Review of the 2008-09 avocado winter season in the EU: same pattern as before
- p. 27 2009-10 winter avocado season forecast for the EU: Change of scenery!
- p. 34 Statistic panorama: world, USA, EU, Japan
- p. 37 The European summer avocado market: Peruvian avocados soon to reach US Eldorado?
- p. 48 The main varieties
- p. 50 Post-harvest

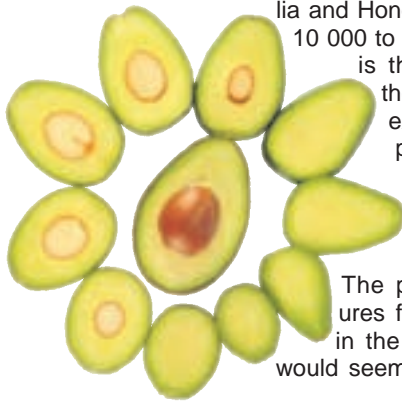
© Régis Domergue



## Review of the 2008-09 avocado winter season in the EU

### Same pattern as before

The world economic downturn does not seem to have had much impact on the volumes of avocado sold at the international level. Cumulated quantities imported by the three main markets in the world, that is to say the USA, the EU and Japan, grew for the fourth year running, flirting with the 600 000-t threshold. Since 2004-05, the figure has increased by about 170 000 t, including 30 000 t in the last season alone. World trade in avocado probably reached 700 000 t in 2008-09 if the other markets are taken into account: Canada, with some 20 000 to 25 000 t, Salvador, Colombia, Australia and Honduras, each with some 10 000 to 15 000 t, etc. Avocado is thus probably third on the list of most-exported exotic fruits, far behind pineapple (2 000 000 t) but just behind the 800 000 t of mangoes shipped.



The preliminary export figures from supplier countries in the southern hemisphere would seem to show that the vol-

umes sold in summer 2009 were down slightly after a long period of uninterrupted increase (see following article). The increase in trade mentioned above would seem more a result of a further increase in exports from northern hemisphere sources.

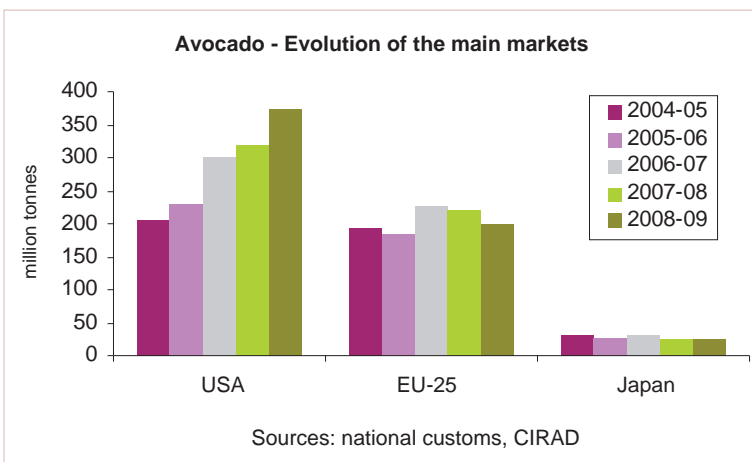


### Major international market suppliers displayed a strong deficit for the second year running

However, the production of certain major stakeholders in international trade who supply the winter market resulted in dubiousness with regard to another year of growth. Chile, the second largest exporter in the world, had a very limited harvest for the second year running in spite of the enlargement of the orchard area (see **Fruitrop 159**). Periods of frost in summer 2007 wiped out not only a large part of the 2007-08 harvest but also a large proportion of the buds that should have fruited in the following season—2008-09. Drought in the Ligua, Cabildo and Petorca valleys aggravated the deficit. Thus, at about 75 000 t, the volumes exported were even down on the preceding light season. Israeli professionals had to face a similar situation. Production in Israel, one of the five largest exporting countries in the world, has not fully recovered from the frost at the beginning of 2008. The harvest was therefore distinctly smaller than normal for the second year running. As in Chile, this limited harvest does not reflect the strongly increasing area under avocado. In addition, the increase in Spanish production has not resulted in an increase in the volumes to be traded. Serious gales in September resulted in the loss of a significant proportion of the crop. This was followed by other less serious windy periods during the rest of the season but the cumulated damage was also very significant.



© Régis Domergue



Avocado — Imports of the main markets					
tonnes	2004-05	2005-06	2006-07	2007-08	2008-09
USA	206 314	231 715	300 375	319 500	371 700
EU-25	193 521	183 783	228 588	220 448	200 018
Japan	28 991	28 150	29 032	24 931	24 073
<b>Total</b>	<b>428 826</b>	<b>443 648</b>	<b>557 995</b>	<b>564 879</b>	<b>595 791</b>

Sources: national customs, CIRAD



**An exceptional opportunity and an ideal season for Mexico**

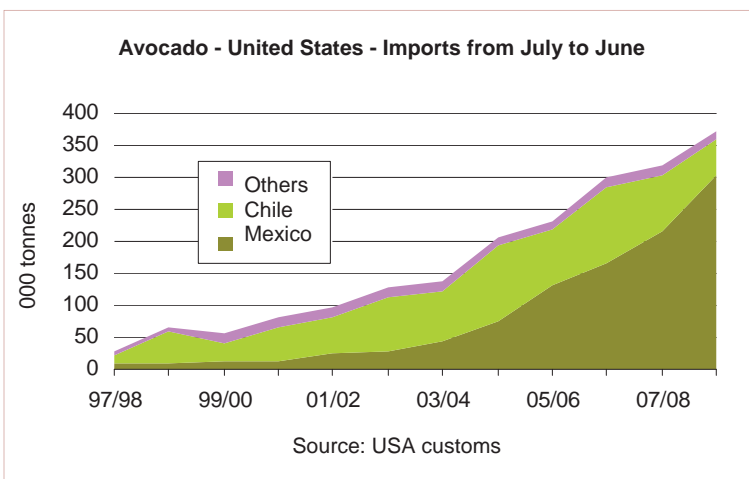
This context was a marvellous opportunity for Mexico, the leading world exporter during the winter season. In addition to the shortfalls from competitive sources present on the international market, operators also profited from an exceptionally open United States market resulting from a record harvest deficit in California. The latter state controls the major proportion of American production—practically all of which is sold on the domestic market. The crop normally oscillates between 150 000 and 200 000 t and had not dipped beneath 100 000 t since the end of the 1990s. Californian growers have had a series of disasters as the heat wave that caused this season's deficit was preceded by devastating frost in 2007, not to mention recurrent drought and the fires of 2008. Finally, exporters in Michoacán had another trump card—a historically large harvest. Their 1 150 000 t of avocado enabled them to meet the requirements of the international market and to leave the other producer countries far behind. Indonesia—in second position in the FAO classification—is reported to have totalled only some 200 000 t. This combination of favourable parameters has enabled Mexican professionals to achieve a record performance: the volumes exported from June 2008 to May 2009 approached 390 000 t, that is to say 55% of world trade and the multiplication by ten of the volumes made available on the international market in ten years. Avocado exports are worth 900 million dollars and this clearly shows the economic importance that the fruit has acquired.

**A strong increase in US imports to keep consumption levels stable**

Did the increase in Mexican volumes make up for the shortage of fruits from the other sources? As last year, the reply is 'No', at least on certain markets like Japan and the EU. In contrast, as would be imagined, the dynamics of American imports continued in the same direction. Arrivals reached a record level, exceeding 370 000 t from July to June, an increase of more than 50 000 t in comparison with last year, with the total representing more than 50% of world trade. However, these additional volumes are probably not synonymous with an increase in consumption but rather a simple compensation for the shortage of Californian fruits. A preliminary estimate indicates that the quantities released on the market should hold at close to 500 000 t, a similar figure to that of 2007-08 and representing about 1.6 kg per person per year. This stable consumption is a pretty good performance and seems to confirm that the market for imported fruits has not been hit by the economic downturn in the United States, at least as regards volumes. Imports of the other major fruits such as banana and pineapple, seem to have held at at least as high a level as last year. In addition, as regards avocado, the downstream part of the chain does not seem to have had to make price concessions to sell the fruits. Retail prices have not been significantly more attractive than in 2007-08. The average level calculated for the period running from September to May was USD1.00 against 1.03 in 2007-08, which is far from the USD0.89 observed in 2006-07.

**Smallest supplies to Europe for a decade**

In contrast with the situation in the United States, the volumes imported into the European Union during the winter season decreased once again. At approximately 92 000 t, the total was in fact the lowest of the last ten seasons. The strong decrease in deliveries of Chilean 'Hass' accounts for this to a considerable degree as some 4 million boxes were delivered to the EU in 2008-09 in comparison with 6.5 million during the previous season and more than 10 millions during the record 2006-07 season. This decrease amounting 10 000 t was not fully compensated by fruits from other sources. The volumes shipped from Israel increased only slightly and did not exceed 30 000 t. Deliveries from



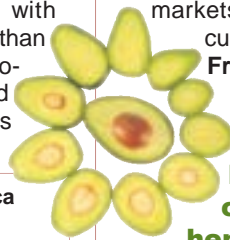
© Régis Domergue

Avocado — European Union — Supply by main origins										
	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09
<b>N. hemisphere</b>	<b>110 866</b>	<b>91 223</b>	<b>106 592</b>	<b>79 480</b>	<b>101 893</b>	<b>109 648</b>	<b>98 408</b>	<b>138 948</b>	<b>104 426</b>	<b>94 224</b>
Israel	44 548	38 841	44 333	26 529	25 299	50 481	26 538	55 931	25 936	30 061
Chile	9	35	528	2 190	4 046	11 532	17 801	40 379	25 692	15 832
Mexico	14 479	13 002	10 139	21 925	18 705	16 516	20 769	10 289	12 695	11 458
Spain*	51 000	39 000	51 000	28 000	53 000	29 854	32 400	30 140	35 300	32 930
Dominican Rep.	830	345	591	195	842	1 264	901	2 209	3 105	2 035
Morocco	-	1	1	641	-	-	-	-	1 698	1 908
<b>S. hemisphere</b>	<b>49 799</b>	<b>57 357</b>	<b>52 190</b>	<b>67 498</b>	<b>60 698</b>	<b>80 509</b>	<b>80 083</b>	<b>85 800</b>	<b>112 121</b>	<b>101 000</b>
South Africa	38 205	38 908	36 266	36 404	29 872	46 955	35 934	37 944	50 451	40 000
Peru	1 299	2 849	4 401	11 266	14 590	18 096	30 508	35 857	49 829	46 000
Kenya	10 294	15 600	11 523	19 828	16 236	15 458	13 641	11 999	11 841	15 000
Others	1 132	1 817	1 883	2 721	2 517	3 364	5 291	3 840	3 901	4 794
<b>Total</b>	<b>161 797</b>	<b>150 397</b>	<b>160 665</b>	<b>149 699</b>	<b>165 108</b>	<b>193 521</b>	<b>183 783</b>	<b>228 588</b>	<b>220 448</b>	<b>200 018</b>

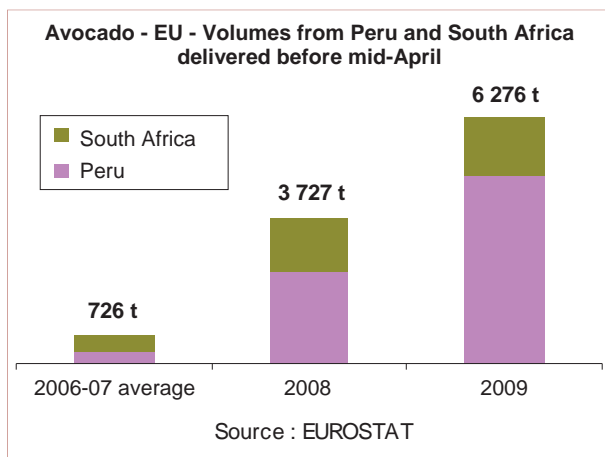
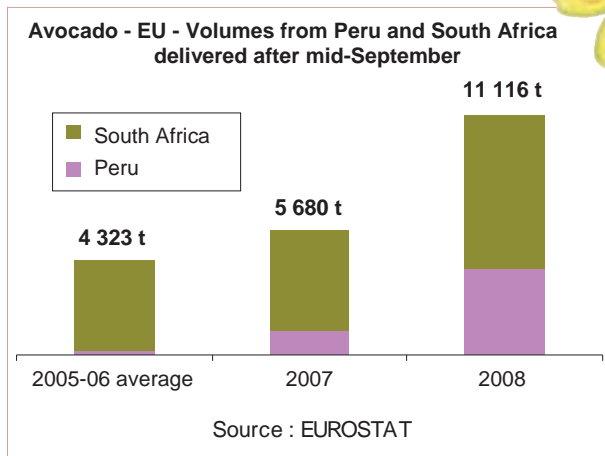
\*Spain: excl. domestic sales / Sources: CIRAD, EUROSTAT

the other sources were practically stable: 30 000 t from Spain and slightly under 12 000 t from Mexico. The outsiders did not balance the situation. The trend for an increase in exports from the Dominican Republic ceased, with hardly 2 000 t in comparison with more than 3 000 t in 2007-08. Deliveries from Morocco continued to increase but totalled only about 2 000 t. Why were the trends

so different in the EU and the USA? Several conjunctural factors related to the economic downturn seem to have had an impact, not to speak of the different basic dynamics of the two markets. This point has already been discussed at length in previous issues of **Fruitrop**.



**Increasingly marked competition from southern hemisphere in the EU during the winter season**



It should be stressed first of all that the supply of the EU market is not as limited as arrivals from the northern hemisphere might indicate. The trade window from southern hemisphere sources is becoming increasingly wide and is making inroads on part of trade with winter sources. The trend can be understood with the help of a few figures. If the period during which arrivals exceed 100 000 boxes per week is considered, the 2009 season started at the end of February for Peru (instead of the beginning of April in 2008 and the end of April in preceding years). The last two south African seasons started at the beginning of April whereas mid-April was previously the general rule. The same feature is observed for the end of the season when weeks when arrivals total less than 100 000 boxes per week are considered. The Peruvian season was two weeks longer, finishing at the beginning of October, and so was that of South Africa, which finished in mid-October during the last two seasons. Overall, these volumes form complementary supply 10 000 t greater than that received during the 2005-06 and 2006-07 seasons (see graph).



© photos Régis Domergue

**Choice of destination less favourable for the EU because of the effect of the slump on exchange rates**

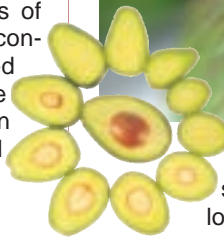
The economic downturn has also played a role—one that is probably more indirect than direct. Consumer interest in the fruit does not appear to have waned. However, trends in exchange rates seem to have played a structuring role. First of all, the euro was slightly weaker against the dollar than in the preceding season. Above all, sterling has lost more than 20% against the euro and so the UK market—the second largest in Europe by volume—has lost much of its attraction. These variables have certainly not been ignored by Mexican and Chilean operators who can adjust the allocation of their shipments between the EU and US markets. Shipments from Chile to the United Kingdom held at about 7 000 t in 2007-08 in spite of the production deficit and then fell by about 3 000 t this year. Israeli exporters also seem to have preferred the euro to the pound, switching a significant proportion of their volumes to the continent. In addition, a large proportion of British retail chains operate on a contract basis and this also led exporters with smaller potential this season to seek other markets. Although the system guarantees a minimum return during plethoric seasons, it limits the possibility of selling produce at a good price during years of production deficit. As a result, apparent consumption in the United Kingdom remained the same as the preceding year, where the total was already down by nearly half in comparison with the figures for 2005-06 and 2006-07.

**Change in demand from large retailers seeking low prices**

The European market was also less attractive than might have been imagined—given the supply deficit, particularly in 'Hass'. The economic downturn led supermarket chains to



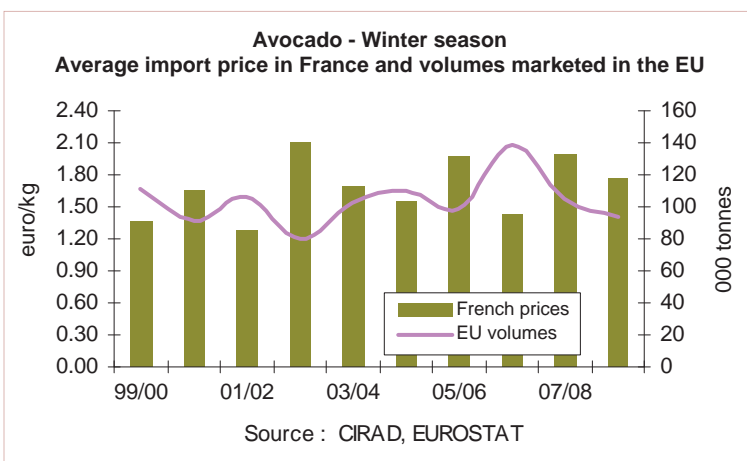
© photos Régis Domergue



change their purchasing habits, seeking to use all means to obtain low prices for consumers. The rate of promotion operations (the percentage of stores running special offers on a product in a given week) increased in France from an average of 12% in 2007-08 to 16% in 2008-09; the figure was similar to that of the 2006-07 season when supply had been extremely large (see box).

Not very original but very effective, the first method used was to increase pressure on suppliers. This factor probably accounts for part of the decrease in the average season price, even though supply was small. In France, the fall was some 12% in comparison with last year even though volumes arriving from northern hemisphere sources were down by 7%—and stable when the additional quantities from the southern hemisphere sold during the winter season are added, as mentioned above.

A large proportion of retail chains, especially in France, also shifted downwards in quality range using two levers. First of all, the weight of the fruits retailed was reduced by numerous chains. Thus, fruit size of 20 fruits per box (200 g each) became the reference rather than 18 (222 g each). This is all the more easy to apply as cus-



tomers notice the price but not the decrease in product weight of more than 10%. Similar movements have affected most items sold per fruit, such as grapefruit.

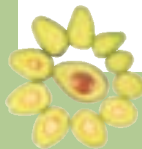
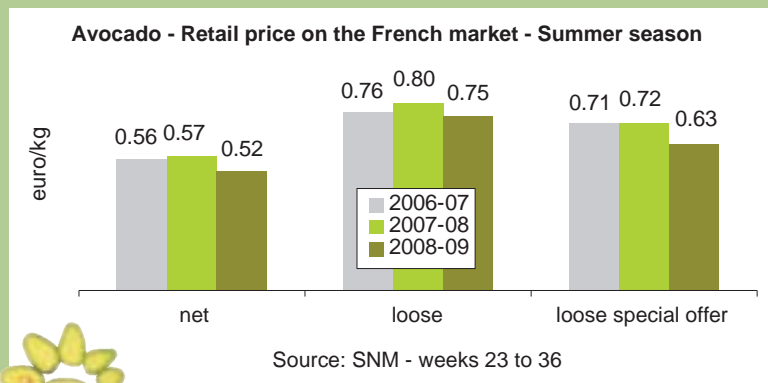
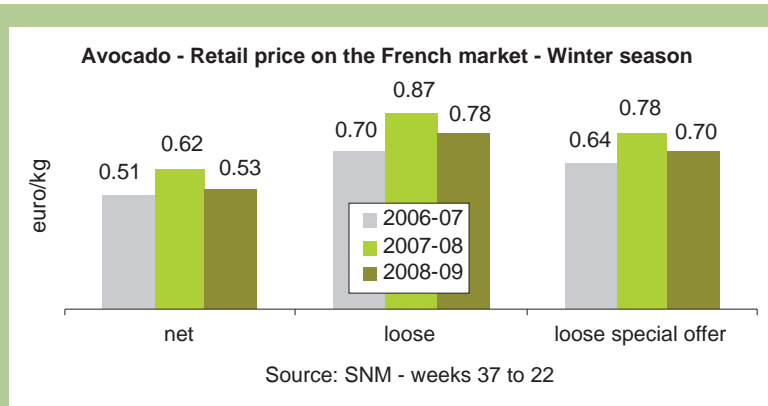
The slump also seems to have completely halted the trend for switching from green variety references to 'Hass'. A fair number of retailers working in France have even gone back to 'Ettinger' and 'Fuerte', whose prices are more attractive than those of 'Hass', especially this season as a result of the strong world-wide deficit in 'Hass'. This change weighed on sales of 'Hass' for much of the season. Excluded from promotion operations, it generally sold slowly and prices were often similar to cost.

### Supermarket chains: a combat for consumers ... or for margins...

However, did this noble struggle by supermarkets really benefit consumers? One might ask the question for the case of avocado in the light of analysis of French market retail indicators supplied by the SNM (market news service). Although the decrease in retail prices is slightly greater than the fall in prices at the import stage for fruits sold in nets (- 15% against - 12%), the situation was not the same for loose fruits. The average price was only 10% lower than last year and this applied to both normal and promotion prices. Margins were therefore similar to last year's in spite of the downward change in range and remained at a level making one want to rush to invest in a self-service store: promotion operations were run with an average price of 70 centimes per fruit, i.e. EUR12.60 for a 4-kg box of 18 fruits, to be compared with average quay price of EUR6.80. The margin is 85% in the case above and approaches 100% for fruits not sold as special offers.

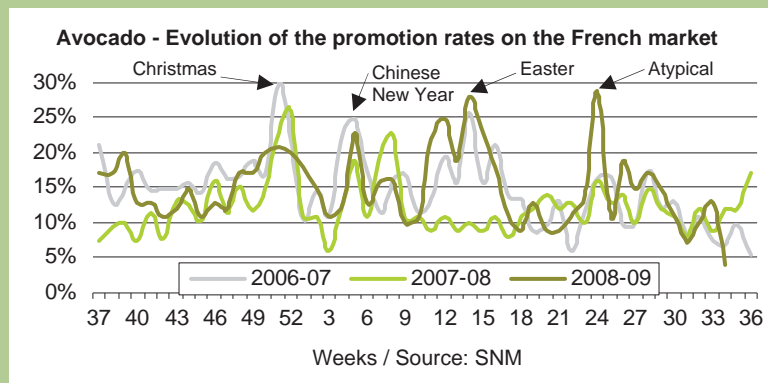
### Consumption still increasing in Scandinavia and eastern Europe

In spite of the winter season – supply deficit, apparent consumption figures seem to confirm that growth is continuing on certain markets. The Scandinavian countries have continued to perform best. The volumes sold in Sweden, Denmark, Finland and Norway exceeded 25 000 t (against 20 000 t in 2007-08 and hardly more than 10 000 t at the beginning of the decade). The markets in the two leading countries—Sweden and Denmark—have doubled in size in five years and handled some 12 000 t and 8 000 t respectively in 2008-09. Consumption in the ten eastern European countries that joined the EU in 2004 and 2008 has remained moderate at hardly 6 000 t but is



### The French market

On the French market, the avocado season is marked by waves of seasonal promotion operations run by supermarket chains. Before, these special offers were run only during the Christmas and Easter periods when stocks switched to festive produce, including avocado as volumes were still small and prices high. The fruit has since become more democratic although the two periods above are still high points as avocado still has a certain quality image. At the end of the 1990s, the Chinese New Year became established as an extra period for selling all the exotics (between 21 January and 20 February, depending on the lunisolar calendar). These periods of dynamic sales are thus more related to retail habits than to peaks in the production cycle. This is a pity. Nevertheless, it can be seen that the 2009 summer season was somewhat atypical. French importers succeeded in mobilising the large retail chains to set up an impromptu week of promotion operations in mid-June when the market was groaning under the weight of Peruvian 'Hass' avocados. This is a fine example and worth reporting, especially as summer—which should be a good season for a fruit like avocado that is widely eaten in salads—is generally a desert as regards promotion operations in France. In order to encourage large retailers, it is perhaps useful to remember that the setting up of promotion operations for avocado in the summer, with SAAGA as the driving force, enabled the British market to emerge.



Photos © Régis Domergue

continuing to increase noticeably (+ 1 700 t since 2005-06, including 900 t last year). The figure now exceeds 2 000 t in Poland, the leading market of the zone.

### But most of the large EU consumer markets are not following

Among the major EU markets, only France, the leading consumer country, has displayed slight growth. In contrast, consumption figures were smaller than last year's in all the other large importing countries (United Kingdom, Germany, the Netherlands). For example, the volumes imported by Germany, with a population of 80 million, are still desperately small at less than 14 000 tonnes. These disturbing signals show the need to re-stimulate consumers because the dynamics of the leading markets must recover in the coming seasons, given the expected increase in the quantities shipped to the EU market ■

Eric Imbert, Cirad  
eric.imbert@cirad.fr



Avocado — European Union — Estimated apparent consumption					
	Estimated consumption in 2008-09* (tonnes)	Population (million)	Volume per person (g)	Variation 2008-09/2007-08 (%)	GNP - PPS** (index)
<b>EU-27</b>	<b>195 402</b>	<b>495</b>	<b>395</b>	<b>- 4</b>	<b>100</b>
<b>EU-15</b>	<b>189 921</b>	<b>391</b>	<b>485</b>	<b>- 5</b>	
France	75 754	63	1 195	5	113
United Kingdom	35 144	61	578	- 9	119
<b>Scandinavia</b>	<b>25 046</b>	<b>25</b>	<b>1 022</b>	<b>+ 21</b>	<b>134</b>
Sweden	12 136	9	1 334	+ 26	120
Denmark	7 961	5	1 474	+ 21	127
Norway (non EU)	3 820	5	813	+ 9	187
Finland	1 129	5	213	+ 19	116
Spain	19 220	45	432	- 6	102
Germany	13 524	82	164	- 6	114
Netherlands	10 830	16	660	- 15	132
Portugal	1 296	11	122	- 71	74
Italy	4 140	59	70	+ 24	104
Belgium	2 430	11	229	+ 5	123
Austria	1 928	8	232	+ 1	129
Ireland	2 065	4	480	+ 14	143
Greece	2 165	11	193	+ 20	97
Luxembourg	202	1	403	+ 6	279
<b>EU NMS</b>	<b>5 481</b>	<b>102</b>	<b>54</b>	<b>+ 20</b>	<b>54</b>
Poland	2 160	38	57	0	53
Baltic states	1 408	7	201	+ 107	60
Czech Rep.	766	10	74	+ 15	79
Slovakia	374	5	69	+ 48	64
Hungary	259	10	26	+ 6	65
Slovenia	169	2	85	- 29	89
Romania	242	22	11	+ 5	38
Bulgaria	103	8	13	- 2	37

\* from June 2008 to May 2009, import-export+production / \*\* purchasing power standard / Sources: professionals, EUROSTAT, FAO





## 2009-10 winter avocado season forecast for the EU

### Change of scenery!

The last two winter seasons were very deceptive. European market supply was particularly limited in spite of strong expansion of the area under avocado in most of the main exporting countries in the world. The quantities available even dipped to their lowest in 10 years in the 2008-09 season as a result of repeated production loss in Chile and Israel and the attractiveness of the US market (see preceding article). Another scenario is taking shape for the 2009-10 season and should apply to subsequent seasons, with just variations resulting from alternate bearing (see box).

### Chilean production back on the rails

Chile will make a strong return to the international scene in 2009-10 as there have been no major meteorological problems. The increase in planted area should begin to be noticeable in the crop figures with production probably larger than the 220 000 t harvested in the record 2006-07 season. Exporters therefore plan to ship about 180 000 t (in comparison with 75 000 t in 2008-09), a figure never previously attained. The increase is not a one-off phenomenon but a reflection of the strong growth of the Chilean orchard observed in recent years. The 39 000 ha planted (according to the 2007 census) lead to thinking that production should soon exceed 300 000 t. Chile's

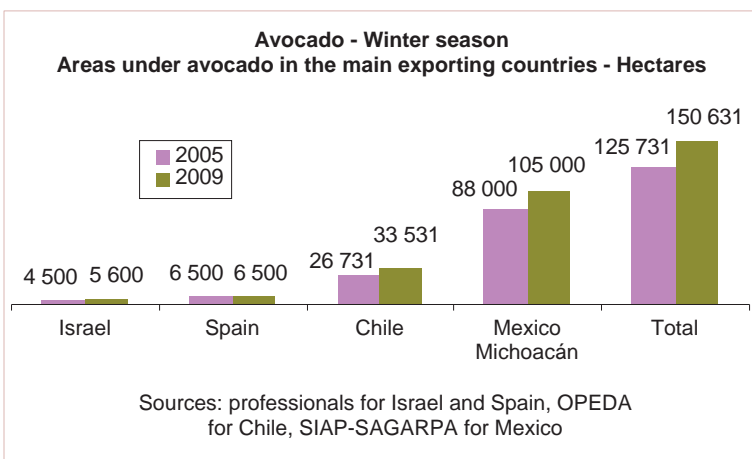
### The alternate bearing phenomenon

The volumes produced in an avocado plantation can vary strongly from one season to the next. At the scale of a country, the alternate bearing phenomenon can result in strong decreases or increases in the volumes to be marketed and this makes management difficult for professionals. As an example, Israeli production has oscillated between 45 000 and 90 000 tonnes in recent seasons. Similar variations have been observed in the past in South Africa, Spain and the other major producer countries. What factors cause the phenomenon?

Physiologically, the avocado tree has a substantial imbalance between its strong blossoming (often more than a million flowers per tree) and the small number of fruits (300 to 500) that the tree can 'feed' until maturity as the photosynthetic efficiency of the leaves is low. Thus, in a bumper year, the plant devotes the largest proportion of its carbon reserves to fruit growth while soft-peddalling considerably on shoot growth and flowers for the next season. The degree of imbalance varies with the variety (it is more marked in 'Hass' and 'Nabal' than in 'Ettinger') and the rootstock used.

To lessen the phenomenon and achieve even production, growers control flowering intensity by means of cultural practices such as pruning and the use of growth regulators or by adjusting water uptake conditions.

However, meteorological events such as a frost or a heat wave may upset this delicate artificial regulation, leaving free reign to the intrinsic physiological imbalance of the trees. Harvest variations between 'on' and 'off' years then become very marked again.



Photos © Régis Domergue

return to the international scene should therefore not be a flash in the pan.

**An average but still colossal Mexican harvest**

In contrast, Mexican production could decrease slightly in comparison with last year's exceptionally large crop but will probably remain large at over a million tonnes. Only early flower production, referred to locally as 'flor loca', seems to suffer a marked deficit—or rather seems to have suffered because sales are now over. Mexican exporters now have sufficient volume to supply the world market from mid-September, and these volumes should increase considerably in future seasons, as in Chile. For years, the proven success of 'green gold' has encouraged growers to plant more avocado, with the area now reaching a comfortably substantial 120 000 ha. Production should increase even more as improved cultural practices resulted in increased yields. The sector is also working on developing its capacity to export avocado to the United States. The list of Michoacán provinces authorised to sell avocado on the US market is continuing to grow. There were no less than 18 in 2008-09, representing nearly 50 000 ha (in comparison with less than 10 000 ha at the beginning of the decade) and four more should be added shortly. There were 25 registered packing stations in 2008-09.

**A change of context in the US market**

Of course, the prime objective of these two supplier countries, Chile and Mexico, will be their traditional market, the United States. Given the large exportable potential, the promotion bodies in the two producer countries are therefore preparing to make unprecedented efforts to increase their shipments to the US in 2009-10 (Chilean producers alone are spending nearly 7 million dollars). These efforts will be all the more useful as the US market will not be as open as it was last year, especially from December onwards when the season starts in California.

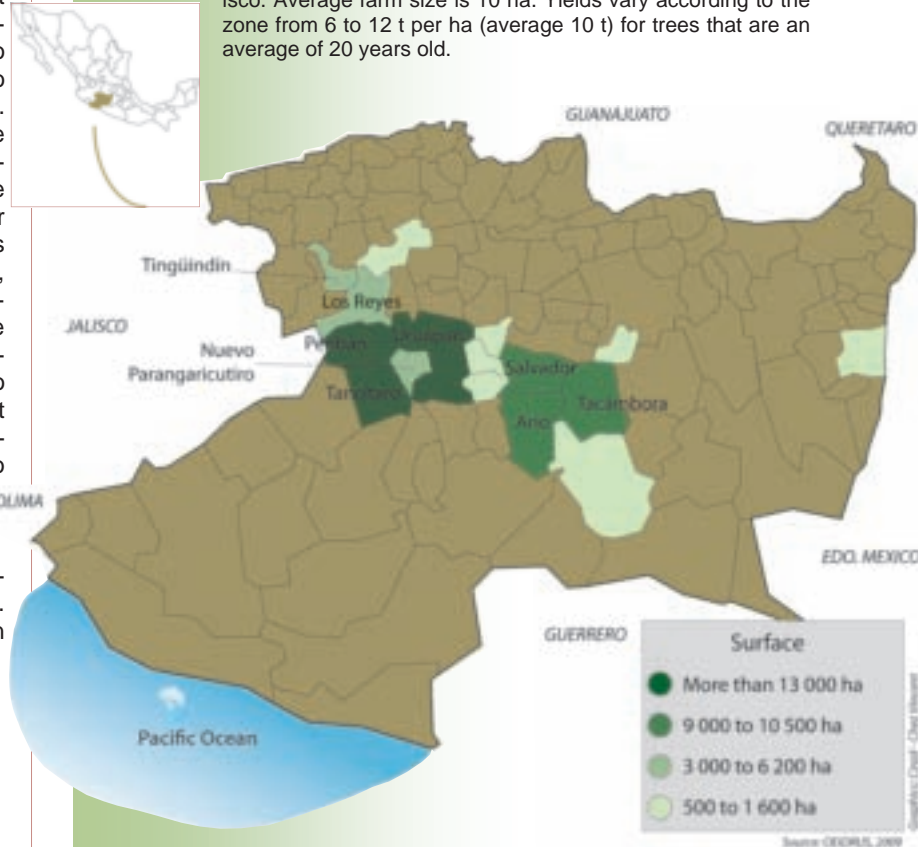
Preliminary production forecasts indicate a record harvest that may be as large as in 2005-06 (270 000 t). In any case, production should be much larger than 2008-09, with a huge deficit and a harvest of only 90 000 t. Prices on the US market may therefore be well down on those of the last



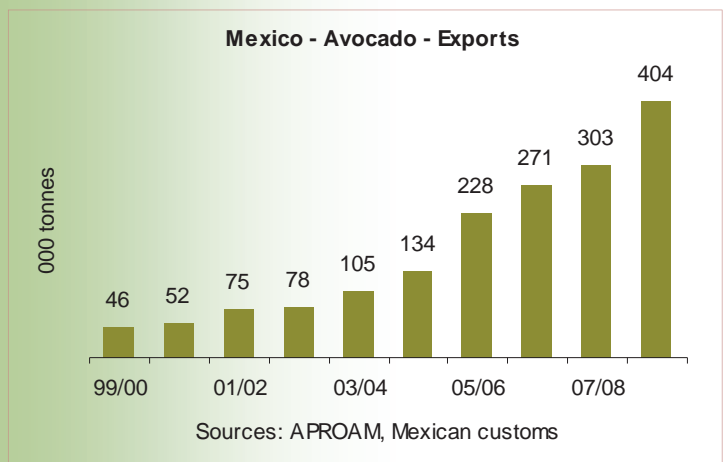
© Régis Domergue

**Mexico**

Nearly 90% of the 120 000 ha under avocado is in Michoacan, a province in the south-west of the country. The advantage of this mountainous region is that production is possible for much of the year as the plantations range in elevation from 1 600 to 2 400 m. In addition, plentiful rainfall from June to September covers half the annual water requirements. 70% of production is in five districts, in the centre of the state: Uruapan, Tancitaro, Periban, Ario de Rosales and Tacambaro. Production is completed by plantations in the states of Nayarit, Morelos, Puebla, Mexico, Sinaloa, Guanajuato and Jalisco. Average farm size is 10 ha. Yields vary according to the zone from 6 to 12 t per ha (average 10 t) for trees that are an average of 20 years old.



Mexico — Avocado — Harvest calendar											
J	A	S	O	N	D	J	F	M	A	M	J
Flor loca			Aventajada		Normal				Marceña		



two seasons. In the last very big season (2005-06), the average annual price was some USD21 per 11.15-kg box in comparison with over USD30 in the last two seasons. In this context, the EU market may recover some of its attractiveness.

### Larger harvests too for some Mediterranean suppliers

The Latin American countries should not be alone on the market. Among traditional suppliers, Israel should make a strong come-back with production approaching 80 000 t (in comparison with about 55 000 t in 2008-09). The export potential should therefore be between 50 000 and 55 000 t; this is slightly smaller than that recorded during the record 2005-06 season. The first 'Ettinger' will be available in Week 40. The area under avocado currently totals about 5 600 ha and should increase by nearly 350 to 400 ha per year. Meanwhile, yields are increasing and approaching 20 t/ha. The total harvest should reach 130 000 t in the middle of the next decade.

Only the Spanish harvest should remain at the medium level observed in 2008-09. Production of 'Hass', accounting for about 75% of the crop, should be similar to that of last year and normal. In contrast, the green variety crop should be slightly smaller, especially for 'Bacon'. As regards forecasts, the area of the Spanish avocado orchard, mainly located in the Malaga region, seems to be fairly stable at some 6 500 to 7 000 ha. New plantings are being carried out, especially in hill zones. However, these generally compensate the grubbing up of ageing orchards or those in plains in soil where the risk of *Phytophthora* is higher. A large proportion of farmers prefer to develop mango growing as mango has generated a better return so far and requires less water. However, avocado production could increase slightly in the coming years thanks to better control of persea mite (*Oligonychus persea*), known locally as 'acaro de cristal', which had had a negative effect on both volumes and fruit size in recent seasons.

### A wave of dynamism among the outsiders too

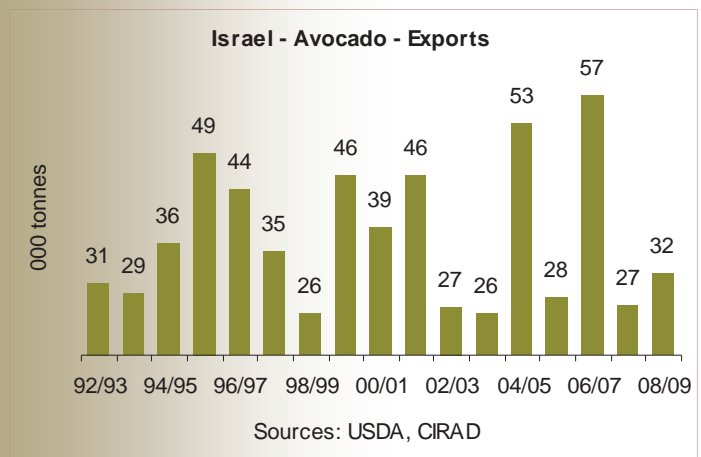
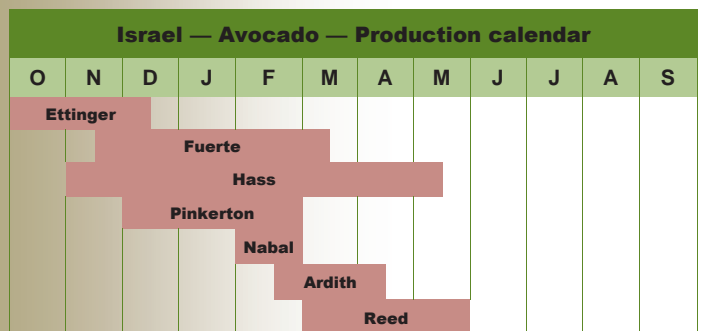
Morocco is certainly one of the most promising of the outsider sources. However, alternate bearing means that the 2008-09 harvest should be similar to last year's, when exports approached 2 000 t. But



© Régis Domergue

## Israel

About 70% of avocado production is in a coastal strip barely 15 km wide running from the north of Tel Aviv to the Lebanese frontier. The plantations north of the town of Acre in western Galilee are along the most reputed. About 20% of the area under avocado is in Upper and Lower Galilee and the Jordan Valley and the remaining 10% is south and east of Tel Aviv. Nearly three-quarters of production is from kibbutzim, cooperative farming organisations. The country has about ten packing stations and two of these alone pack about half of production. Sanitary problems are limited (no *Phytophthora*), in particular thanks to the climate. Rational farming is therefore very widespread and average yields are high. The availability of irrigation water is one of the main limiting factors and water forms a large proportion of production costs.



## Chile

Chile has advantages for fruit growing thanks to the natural sanitary protection formed by the sea, the Andes and the Atacama desert. Yields and earliness depend on the distance from the sea (the cold Humboldt current). Region V accounts for about 55% of 'Hass' production, divided equally between two zones. The Petorca and La Ligua river valleys in the north are a comparatively recent extension but water supplies can be limited there. The avocado orchards in Aconcagua valley, a traditional zone in the heart of the region (where the towns are La Cruz, Quillota, Hijuelas and San Felipe) have been extended into the foothills of the mountains. The recently established plantations in the Metropolitan Region (Maipo, Mapocho and Cachapoal river valleys) account for about 20% of 'Hass' production. The main limiting factors are the salinity of the irrigation water and the risk of frost. Plantations have developed strongly in recent years in region IV, now forming about 17% of the area under avocado (Ovalle zone).

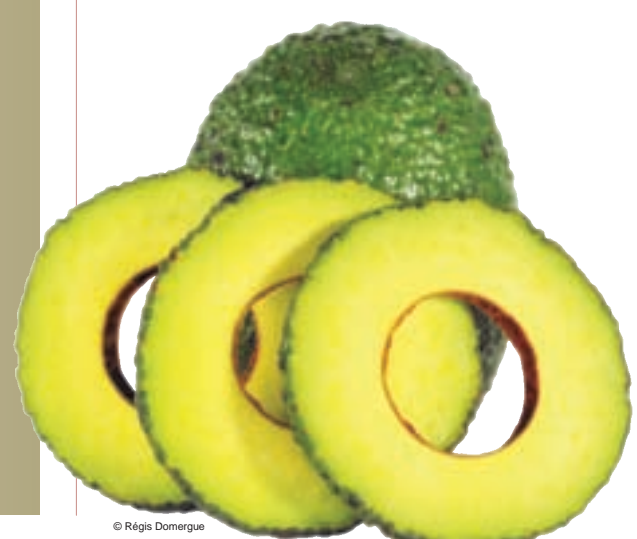
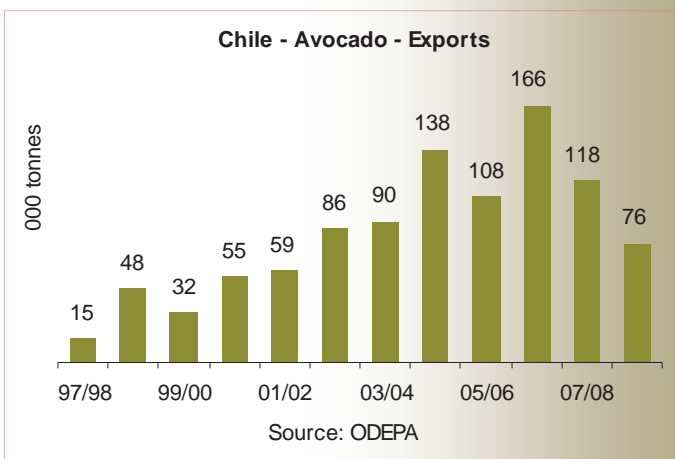
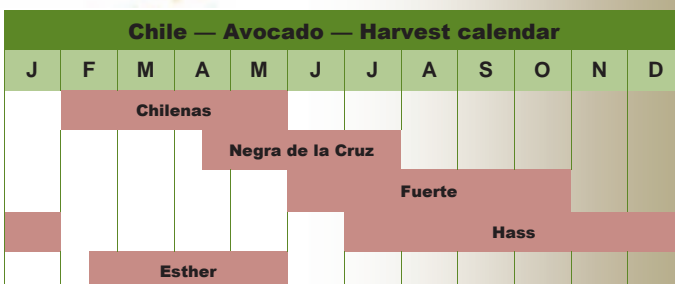
the orchards should be more generous in the coming seasons. Avocado growing is concentrated mainly in the coastal strip between Larache and Kenitra and continuing to increase (see **Fruitrop 159**).

Greece is another outsider making progress. Production is mainly around Chania in Crete and totals some 3 000 to 4 000 t in normal years. 'Fuerte' is by far the most commonly planted variety. Little present on the market last year because of meteorological problems, Greece could be back this season and in the years to come. Substantial planting has been performed since 2004 and the export potential could approach 8 000 to 10 000 t in the medium term according to a recent press article.

### Supply from northern hemisphere countries to increase strongly in the coming decade

The EU market should therefore be strongly supplied during the 2009-2010 winter season, with volumes perhaps matching those of 2006-07. Furthermore, planting dynamics in most of the main northern hemisphere producer countries and in outsider countries shows that supplies to the international market should continue to increase markedly in the coming years. In addition, southern hemisphere producer countries will probably not stop nibbling at the winter market but rather increase this trend to judge by the planting in progress in countries like Peru. Thus the next decade will very certainly be a break in the level of world supplies. Basic investment in promotion operations must follow those made upstream to increase production capacity. Large potential for market growth remains, especially in Europe. They now have to be exploited ■

**Eric Imbert**, Cirad  
eric.imbert@cirad.fr



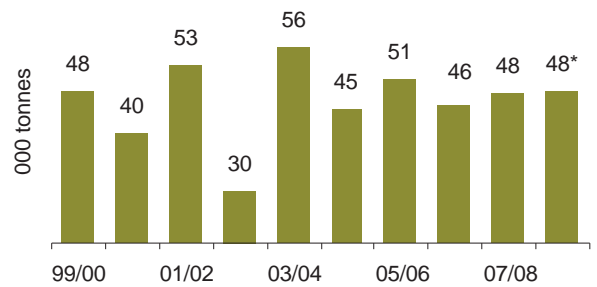
© Régis Domergue

## Spain

About 9 000 ha is planted with avocado, 90% of which is on the Andalusian coast between the sea and the foothills of the Sierra Nevada (Costa Tropical). This coastal strip some 80 km long and 10 km wide between the west of Malaga and Motril enjoys a special climate. Winters are mild and the small rainfall is compensated by the availability of fairly large quantities of good quality water impounded by dams in the Sierra Nevada. Sanitary problems consist mainly of fungal diseases of roots and spider mites. Population and tourist pressure means that the areas west of Malaga are tending to stabilise or diminish. The orchards are mainly in the lower parts of the hills in the Axarquia region where new plantations compensate the decrease in the other zones. The total area under avocado is therefore tending to stabilise at 6 500 ha, especially as some growers favour mango as this requires less water, is easier to manage and has given good returns in recent years. A few pioneer orchards were planted in the Alicante area at the beginning of the decade and more recently in the hot areas in the south of the province of Valencia (Ribera). Most of the remaining plantations are at Las Palmas and Tenerife in the Canary Islands.



Spain - Avocado - Exports/Re-exports



\* estimate / Source: EUROSTAT

Spain — Avocado — Harvest calendar

S	O	N	D	J	F	M	A	M	J	J	A
	Bacon										
		Fuerte									
				Hass							
						Reed					
			Pinkerton								

**RG**  
Reyes Gutiérrez  
frutas tropicales

**SANOS X NATURALEZA**

**AguaCate Hass**  
LA FRUTA DEL COMERCIO

[www.reyesgutierrez.com](http://www.reyesgutierrez.com)  
Camino de Málaga s/n  
Aptdo. de Correos n° 65  
29700 Vélez-Málaga España  
Tel: (+34) 952 505 606 Fax: (+34) 952 506 629

Logos: AECOC, AECA, EUROSPAP BUREAU VERITAS, CAAE, BUREAU VERITAS, BUREAU VERITAS

# Avocado in 2008/2009

production 3 180 000 t  
world trade 700 000 t



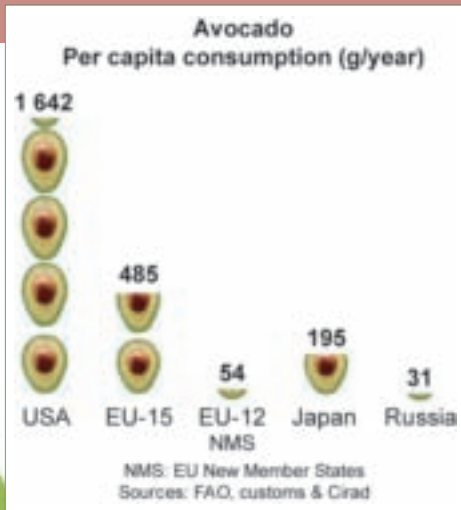
Avocado — United States imports — July to June period											
tonnes	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09
<b>Total, incl.</b>	<b>64 758</b>	<b>55 507</b>	<b>79 944</b>	<b>96 058</b>	<b>126 679</b>	<b>138 928</b>	<b>206 314</b>	<b>231 715</b>	<b>300 375</b>	<b>319 500</b>	<b>371 662</b>
Mexico	10 579	13 067	11 941	24 450	29 612	42 947	73 943	132 040	166 001	217 000	301 695
Chile	48 168	28 903	53 986	57 890	83 877	78 680	120 890	85 200	117 928	85 000	56 363
Dom. Rep.	5 399	10 162	9 550	11 193	10 965	17 067	11 254	14 334	16 434	15 000	13 601
Bahamas	193	180	200	263	236	118	109	0	0	-	0
New Zealand	419	3 147	4 263	2 259	1 882	116	119	57	0	2 500	-
Others	0	48	4	3	107	0	0	85	12	-	-

Source: US customs, code 080440

Avocado — Japanese imports												
tonnes	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
<b>Total, incl.</b>	<b>6 040</b>	<b>8 605</b>	<b>7 491</b>	<b>14 070</b>	<b>10 821</b>	<b>13 648</b>	<b>23 973</b>	<b>28 991</b>	<b>28 150</b>	<b>29 032</b>	<b>24 931</b>	<b>24 073</b>
Mexico	4 416	8 167	7 373	14 035	10 577	13 456	23 405	28 294	26 630	26 553	23 585	23 051
New Zealand	-	-	-	-	14	5	176	386	410	1 476	776	642
Chile	1 624	437	118	36	180	9	78	3	227	800	544	265
United States	-	-	-	-	50	179	313	306	882	203	24	115
Others	-	-	-	-	-	-	2	1	-	-	3	-

Source: Japanese customs, code 080440010



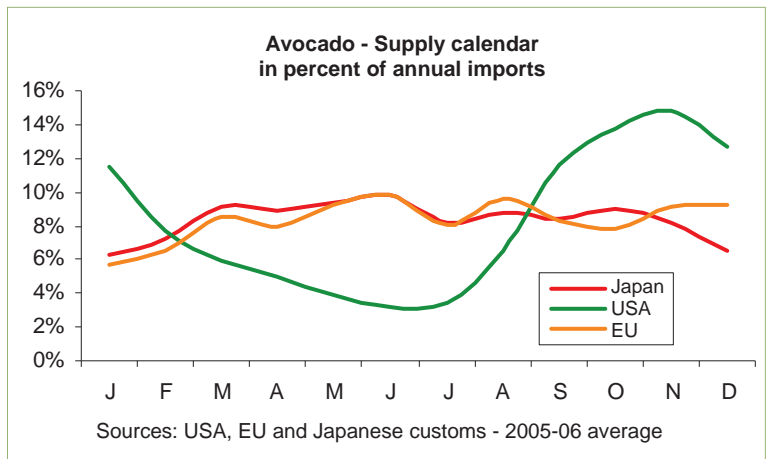


Avocado World production	
2008-2009*	000 tonnes
<b>World</b>	<b>3 180</b>
Mexico	1 150
Indonesia	250
Colombia	200
Brazil	165
United States	116
Chile	107
Peru	136
Dominican Rep.	115
China	96
South Africa	90
Kenya	70
R. D. Congo	62
Venezuela	59
Ethiopia	55

Avocado World exports	
2008-2009	000 tonnes
<b>World</b>	<b>700</b>
Mexico	404
Chile	75
Israel	30
South Africa	43
Peru	50
Spain	31
Kenya	20
Dominican Rep.	16
New Zealand*	15
Guatemala*	5
United States	4
Écuador*	5
Venezuela*	2
Argentina*	2

Avocado World imports	
2008-2009	000 tonnes
<b>World</b>	<b>700</b>
United States	372
EU-25, incl.	200
France	90
Netherlands	79
United States	36
Spain	28
Japan	24
Canada	23
Colombia	11
Salvador	10
Australia*	11
Honduras	9
Costa Rica	7
Guatemala	4

\* 2007-08 or previous data / Sources: FAO, EU, USA, Japan, CIRAD customs



Avocado — EU-25 — Imports and production										
tonnes	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09
<b>Total, incl.</b>	<b>168 797</b>	<b>166 897</b>	<b>174 965</b>	<b>166 699</b>	<b>174 108</b>	<b>210 667</b>	<b>181 383</b>	<b>235 448</b>	<b>230 148</b>	<b>212 088</b>
<b>European imports</b>	<b>110 797</b>	<b>111 397</b>	<b>109 665</b>	<b>121 699</b>	<b>112 108</b>	<b>163 667</b>	<b>151 383</b>	<b>198 448</b>	<b>185 148</b>	<b>167 088</b>
Peru	1 299	2 849	4 401	11 266	14 590	18 096	30 508	35 857	49 829	46 000
South Africa	38 205	38 908	36 266	36 404	29 872	46 955	35 934	37 944	50 451	40 000
Israel	44 548	38 841	44 333	26 529	25 299	50 481	26 538	55 931	25 936	30 061
Chile	9	35	528	2 190	4 046	11 532	17 801	40 379	25 692	15 832
Kenya	10 294	15 600	11 523	19 828	16 236	15 458	13 641	11 999	11 841	15 000
Mexico	14 479	13 002	10 139	21 925	18 705	16 516	20 769	10 289	12 695	11 458
Brazil	156	569	661	715	979	931	1 442	1 447	1 790	2 400
Dominican Rep.	830	345	591	195	842	1 264	901	2 209	3 105	2 035
Morocco	-	1	1	641	-	-	-	-	1 698	1 908
Argentina	58	326	440	460	709	1 224	1 804	1 709	970	1 500
Swaziland	104	112	235	411	252	352	395	178	530	500
Zimbabwe	137	285	207	739	404	599	260	323	128	150
Dominica	71	43	134	116	43	20	18	36	84	100
Others	302	129	135	219	128	176	308	97	100	100
United States	304	354	70	61	3	62	1 064	50	299	44
<b>European production*</b>										
Spain	58 000	55 500	65 300	45 000	62 000	47 000	30 000	37 000	45 000	45 000

\*Not mentioned: Portugal (approx. 2 000 t per year in the Algarve and 1 000 t per year in Madeira), Greece (approx. 1 500 t per year in Crete) and France (approx. 100 t per year in Corsica and the West Indies) / Source: Eurostat, code 080440



## The European summer avocado market

### Peruvian avocados soon to reach US Eldorado?

**E**xplosive! This is doubtless the best description of the growth of the European summer avocado market. Imported volumes have more than doubled since the beginning of the decade, exceeding 110 000 t in 2008, that is to say stronger consumption than in the winter. The still provisional figures for the 2009 season indicate that arrivals continued to exceed 100 000 t, again larger than the winter tonnage. The emergence of Peru, a new supplier, on the world market is practically the only explanation of this exemplary growth. Still totally unknown to avocado professionals in the mid-1990s, this source climbed to the position of third largest exporter in the world in 2007-08, behind Mexico and Chile, exporting more than 12 million boxes to Europe, the only large market open to it.

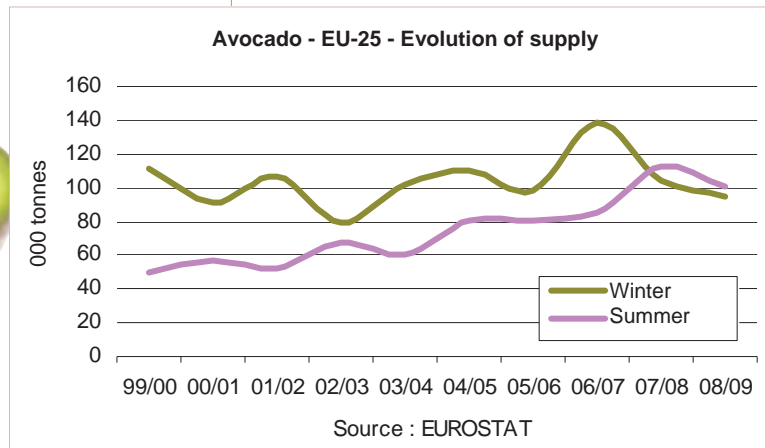
### Satisfactory financial results but slump periods call for questions

The investments made to develop consumption and a favourable context, in particular in 2008 and 2009 thanks to the early end to the winter season, have resulted in decent economic performance in recent summer seasons in the EU. Analysis of the data gathered by our market watch from 2001 to 2008 shows that the average price during the 'Hass' season decreased by about 8.5% after 2004, a year marked by the strong increase in volumes. But the decrease has been amply compensated for operators downstream by an increase in supply of more than 50%!

However, the market has been in difficulty on numerous occasions. June, when the peaks in arrivals from South Africa and Peru often coincide, is often a black month. 2009 was no exception, with 'Hass' prices not exceeding EUR3.50 to 4.50 per box. Going back to the



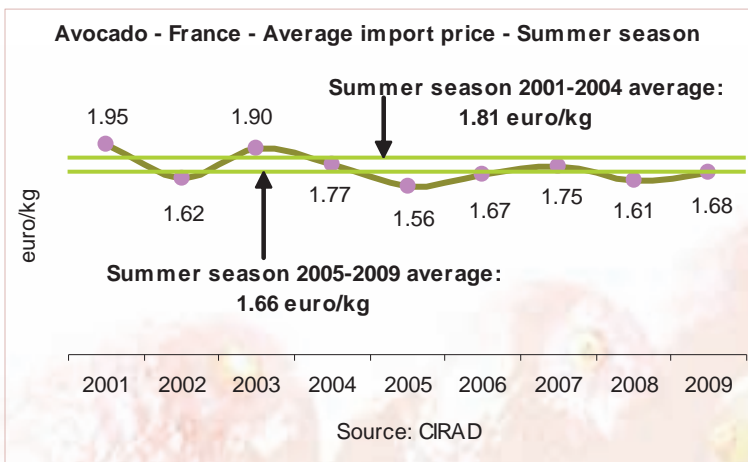
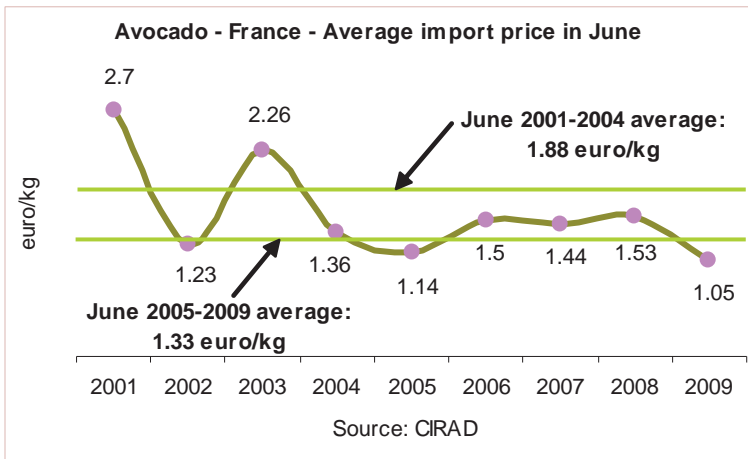
© Régis Domergue



Avocado — European Union — Supply by main origins										
tonnes	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09
<b>N. hemisphere</b>	<b>110 866</b>	<b>91 223</b>	<b>106 592</b>	<b>79 480</b>	<b>101 893</b>	<b>109 648</b>	<b>98 408</b>	<b>138 948</b>	<b>104 426</b>	<b>94 224</b>
<b>S. hemisphere</b>	<b>49 799</b>	<b>57 357</b>	<b>52 190</b>	<b>67 498</b>	<b>60 698</b>	<b>80 509</b>	<b>80 083</b>	<b>85 800</b>	<b>112 121</b>	<b>101 000</b>
South Africa*	38 205	38 908	36 266	36 404	29 872	46 955	35 934	37 944	50 451	40 000
Peru*	1 299	2 849	4 401	11 266	14 590	18 096	30 508	35 857	49 829	46 000
Kenya*	10 294	15 600	11 523	19 828	16 236	15 458	13 641	11 999	11 841	15 000
Argentina*	58	326	440	460	709	1 224	1 804	1 709	970	1 500
Swaziland	104	112	235	411	252	352	395	178	530	500
Zimbabwe	137	285	207	739	404	599	260	323	128	150

\* 2008-09: estimate / Source: CIRAD, EUROSTAT





preceding comparison, a fall of about 30% in 'Hass' prices has been observed in June since 2004.

Might slumps of this type become common if shipments from Peru continue to grow strongly in the coming seasons? In this context, might there be a risk of a serious decline of the Peruvian avocado sector?

### Young and full of hope

Although avocado is an ancient crop in Peru, the 'Hass' variety has only developed recently. Before, only local varieties (such as 'Topa Topa') or Creole types were grown in the foothills of the Andes and in the Amazonian region in the eastern part of the country. Starting from practically nothing in the mid-1990s, Peruvian plantations of 'Hass' reached 6 000 ha in 2008 after very strong growth in recent years. Avocado, under the local name 'palta', as throughout the Conosur, has become a pillar of Peruvian agricultural exports. Worth more than 70 million dollars in 2008, the value of avocado exports was much smaller than that of coffee and asparagus but held an honourable seventh position close to grapes, sweet peppers and

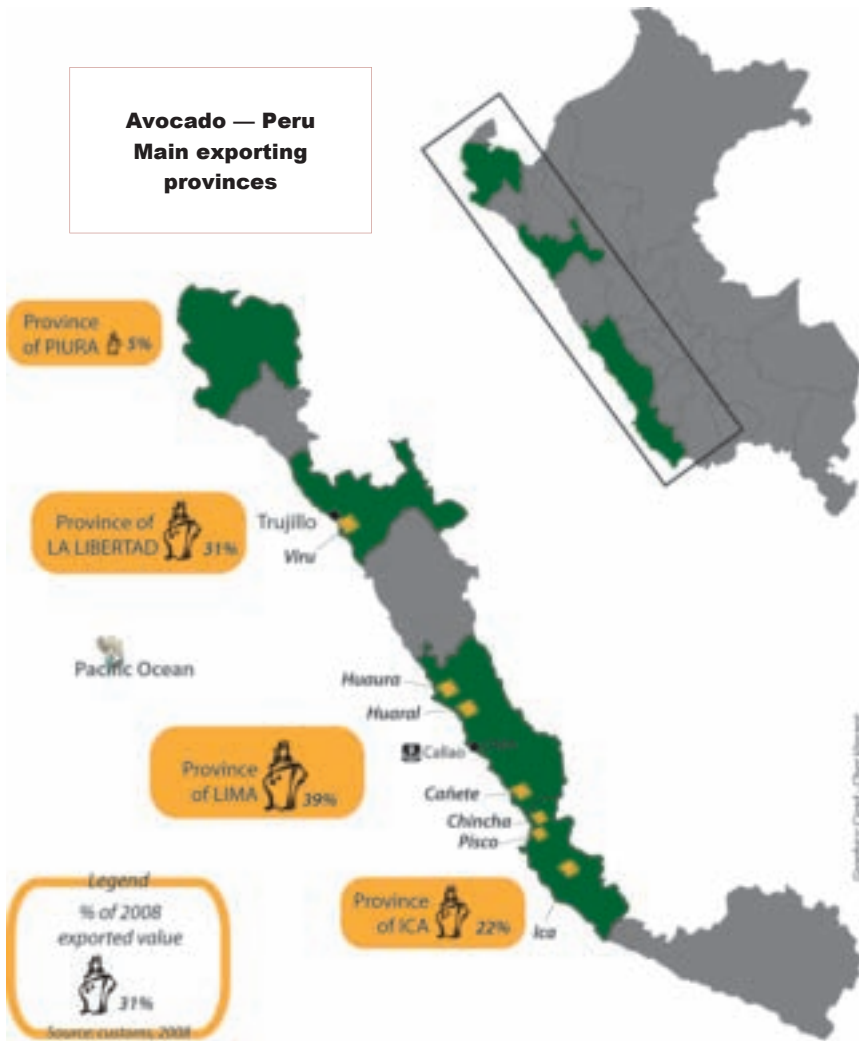
artichokes and was ahead of mango. This obviously did not go unnoticed on the international market. In less than 10 years, Peru rose to the position of third largest avocado exporter in the world, with shipments increasing from 2 000 t at the beginning of this decade to more than 50 000 t in 2008.

### Major assets

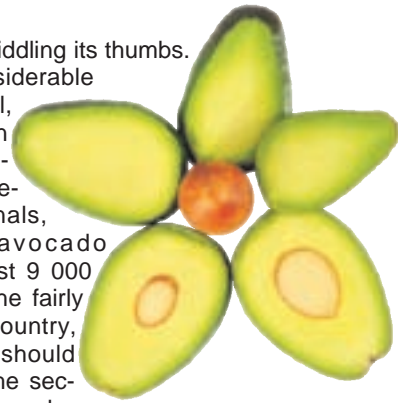
Practically all the export orchards are concentrated in the coastal strip (valleys in the centre of the country, around Lima and Ica, in La Libertad province in the north). Although the region is close to the equator, it has a desert climate in a corridor some 2 500 km long, sandwiched between the cold Humboldt current and the Andes. However, relative humidity and temperature are ideal, with no risk of frost or of heat waves. In addition, the practically total absence of rainfall avoids post-harvest problems. However, irrigation is possible thanks to rivers—often underground—flowing from the Andes. The climatic advantages and inexpensive labour result in comparatively low production costs. Direct cultivation costs estimated in 2007 were USD2 500 to USD4 200 per hectare (according to interviews of professionals cited in a study conducted by students at the Catholic University of Peru). Finally, the marketing calendar is attractive. The first significant volumes can be delivered to Europe in mid-April, that is to say two or three weeks before those from South Africa, and the season can last until the end of September. The plantations being developed east of Lima in the foothills of the Andes could even bring forward the beginning of the marketing season. This source of supply therefore soon gained a position on the EU market in spite of long (at least 17 to 18 days to reach northern or southern Europe) and expensive transport. Proof of this growth is that Peru has markedly dominated the summer EU market since 2006, ahead of South Africa.



**Avocado — Peru  
Main exporting  
provinces**



south Lima, is not twiddling its thumbs. It also plans a considerable increase in potential, like a fair proportion of the other exporters. According to forecasts by professionals, the area under avocado should reach at least 9 000 ha in 2010. Given the fairly high yields in the country, 100 000 t of Hass should be attained during the second half of the next decade.

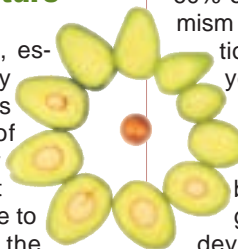


**An enormous diversification market targeted**

Peruvians obviously do not think about Europe alone. The Chilean frontier was opened in 2006, but the Peruvians target above all the enormous United States market. Centred on the association PRO'HASS', they have spared no effort to gain access to the market. After eight years of negotiations, the market should soon be opened officially. The issue is an important one as the need for a diversification market is becoming increasingly urgent in the light of the increase in production and the United States is the only alternative to Europe in terms of capacity for large volumes. The other large world markets consisting of Asia, which is generally difficult to enter for reasons of sanitary requirements, and Canada, take less than 25 000 t per year. The US market is the largest in the world by volume and is the destination for more than 60% of avocados traded in the world. Its dynamism also makes it very attractive. Consumption has been practically stable in recent years for reasons of shortage of supply.

**Strong ambitions for the future**

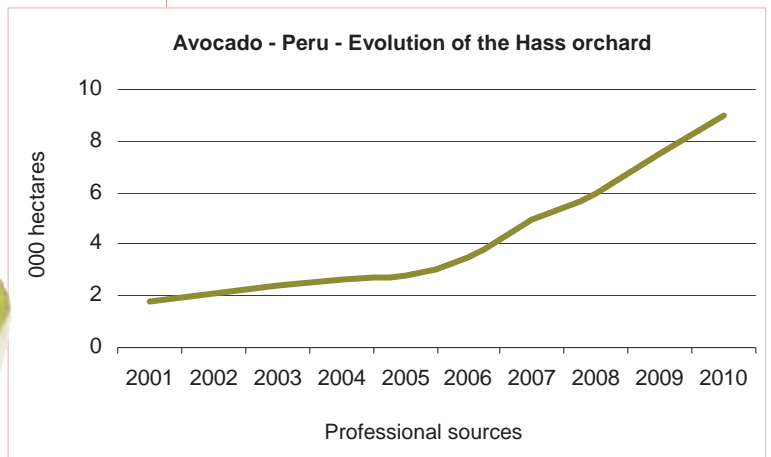
Planting is thus continuing strongly, especially in the north of the country where a large irrigated perimeter has been developed near the town of Trujillo (near Viru). Access to water requires substantial investment but land is cheaper than in the area close to the urban centres in the south of the country. The agroindustrial group Camposol, the export leader with slightly less than a third of the export total in 2008, is currently doubling its already large 1 000-ha orchard area. The second-largest exporter, CPF, a large cooperative grouping about 50 growers in the centre of the coast north and

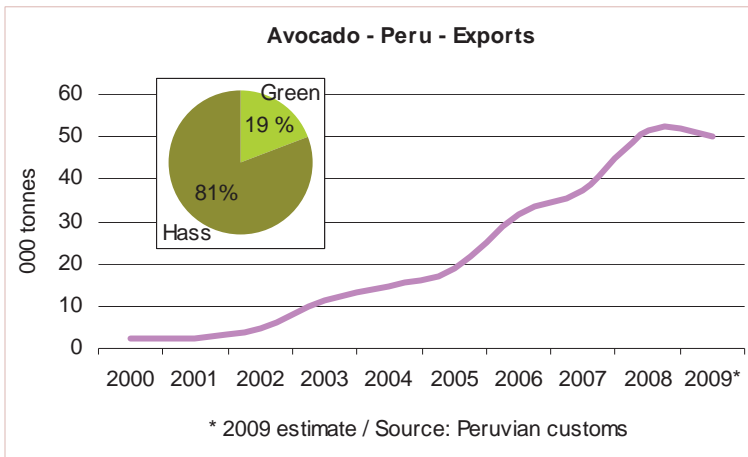


This should not lead to forgetting the two-figure growth period from the end of the 1990s to 2005-06, that resulted in a doubling of the market. The driving forces for growth are intact: substantial scope for development remains (a growing Hispanic population and large consumer 'deserts' on the



© photos Régis Domergue





<b>Avocado — Peru Main exporters</b>	
in 2008	%
Camposol S.A.	31
Consorcio de Productores de Fruta	10
Solis Caceres S.A.C.	8
Agroindustrias Verdeflor S.A.C.	8
Avo Peru S.A.	5
Greenland Peru S.A.C.	4
Corporacion Fruticola de Chincha	4
Procesadora Laran S.A.C.	3

Source: Sistema Integrado de Comercio exterior www.sicex.gob.pe

east coast) and the facilities for developing this have shown their effectiveness (substantial promotion budget via a union of all the production sources trading in the United States). However, the problem of the date of opening of the market is not the only one ...

However, tests show that this causes surface pitting and shortens fruit life. Furthermore, the compound depletes ozone and a ban is coming into operation progressively (as specified in the Montreal Protocol with a total ban in 2015). There does not appear to be an effective alternative disinsectisation process for avocado.

### What conditions for the entry of Peruvian avocado to the US market?

This is a key question and deserves detailed examination as the opening of the market is not necessarily synonymous with the actual exporting of significant volumes of fruits. Peruvian avocados have been forbidden entry to the United for reasons of sanitary restrictions aimed at preventing the introduction of six quarantine pests present in Peru: three types of fruit fly, one lepidopteran and two scales. The main problem to be solved is the presence of fruit fly. APHIS, the sanitary control body reporting to the department of agriculture, only recognises two disinsectisation techniques today. By exposing the fruits to low temperatures for a long period, cold treatment kills fruit fly eggs and larvae. However, the procedure requires maximum temperatures of hardly more than 2°C for 18 days and this is incompatible with the minimum of 4 to 5°C that avocado can stand without suffering chilling injury. The other option is methyl bromide treatment.



© Régis Domergue

Irradiation gives good results for some fruits but discolours avocado pulp, even at a low dosage, and the fruit is too delicate for hot water treatment. But these other treatments are not permitted by APHIS in any case.

### Intermediate solutions... but when?

Intermediate solutions approved by APHIS are currently being studied. They combine fumigation for 2 or 3 hours (instead of 4 hours) and less severe cold treatment at temperatures that do not cause physiological problems. In addition, fumigation on arrival might be a solution but here again how would this affect fruit quality? But in all cases, ongoing tests are likely to confirm that methyl bromide treatment is a strong obstacle. There remains the possibility of

<b>Avocado — Peru — Exports by destination</b>				
000 tonnes	2005	2006	2007	2008
<b>EU, incl.</b>	<b>18 380</b>	<b>30 521</b>	<b>36 129</b>	<b>49 832</b>
Netherlands	5 601	8 011	14 430	23 106
Spain	6 111	12 291	12 362	17 669
United Kingdom	3 378	4 757	5 899	4 953
France	2 934	4 962	3 058	3 957
North America	224	1 035	807	1 013
Chile	-	102	400	453
Others	67	80	271	-
<b>Total</b>	<b>18 670</b>	<b>31 738</b>	<b>37 606</b>	<b>51 298</b>

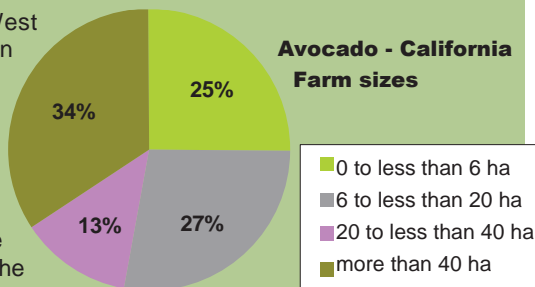
Source: Peruvian customs

## Avocado in the United States

Thanks to the microclimate of its coastal region, California is the only part of the United States where ecological conditions are suitable for growing varieties bred from the Guatemalan race (mainly 'Hass'). It accounts for some 90% of US avocado production. The plantations are concentrated in the hills in the south-west of the state. Two-thirds of avocado orchards are in the zone between Los Angeles and the Mexican border (52% in San Diego country, 13% in Riverside and 2% in Orange). The rest are between Los Angeles and Monterey (21% in Ventura, 12% in Santa Barbara and 2% in San Luis Obispo). A large number of small, little-mechanised farms with less than two hectares of land exist side by side with large commercial operations. The increase in cost prices is weakening the financial status of these small farms. Labour is scarce and expensive. But it is above all three years of drought that worries farmers, especially in the south in the San Diego and Riverside region. Water pumped from the Sacramento-San Joaquin delta in the north of the state is increasingly lacking, especially as measures for the protection of endangered species have resulted in even more drastic restrictions. There have thus been serious cuts in the quotas available for farming since 2007, together with stiff prices increases. As a result, the trend for the increase in the area under avocado observed since 2002-03 has stopped. Devastating fires and a succession of meteorological catastrophes—frosts and heat waves— have also hit the sector. Harvest volumes have decreased noticeably, especially in 2008-09, and this has made growers' financial difficulties worse. Will the record harvest expected in 2009-10 give new courage to small growers who are ready to abandon the crop?



For reasons of climate, West Indian varieties are grown in the other producer states in the country. Florida accounts for 10% of national production and practically all the orchards are in Dade county, south of Miami. Some avocados are grown in Hawaii, mainly for the island market.



the partial, gradual opening of the market in the northern states, knowing that the forbidden states are the largest consumers. Will Peruvian exporters be able to ship large volumes to the United States under these conditions? The investments of more than 10 million dollars made by certain large groups to develop their plantations seem to show that a satisfactory solution can be envisaged, even if it is not available immediately. The most effective method is, of course, eradication of fruit fly. Programmes have been set up in some parts of the country (releases of sterile males, etc.) but time is required for completion.

## Considerable efforts remain to be made

Once the technical aspects have been settled, gaining a foothold on the market will not be easy. Peru will face two giant competitors. The production peak for 'Hass' in Peru runs from early March to the end of August—identical to that of California. If the return of the latter at full strength in 2009-10 is confirmed, production might possibly decrease in the medium term. Water is the most delicate problem, increasing cost prices that are already very high. Some analysts consider that certain small growers who account for a significant proportion of the area under avocado may abandon the crop (see box). In contrast, competition from Mexican avocados that are strongly present on the US market until June does not seem likely to decrease. Competitiveness will be the decisive factor. Although Peru probably possesses assets in terms of cost, the quality aspect will be of capital importance and this will include sanitary procedures.

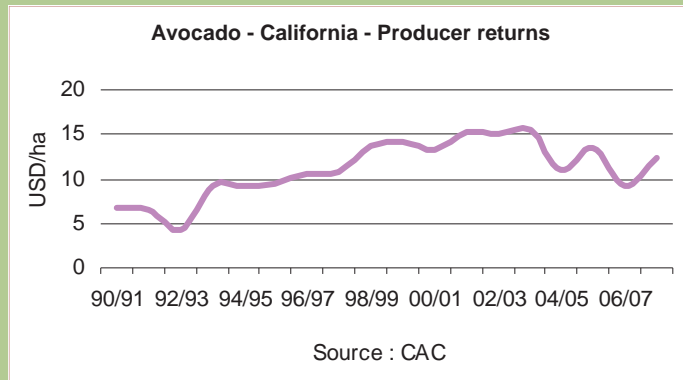
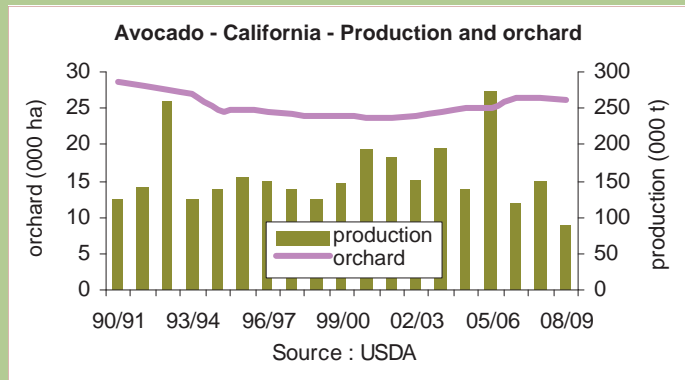
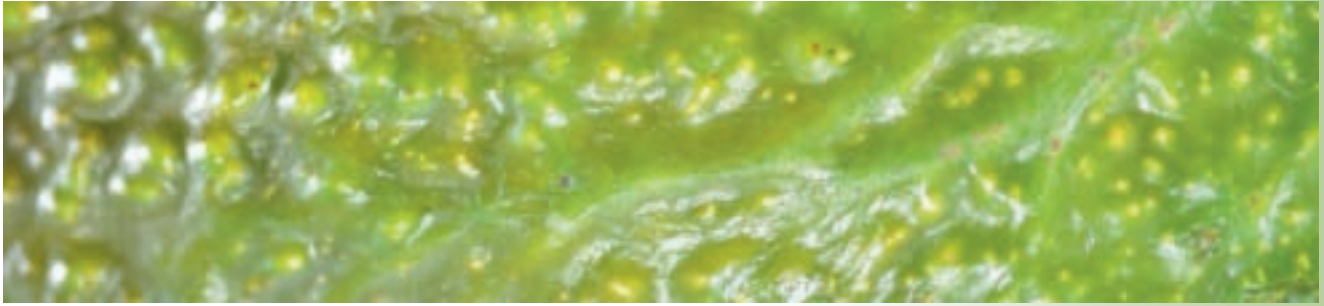


Photo © Régis Domergue



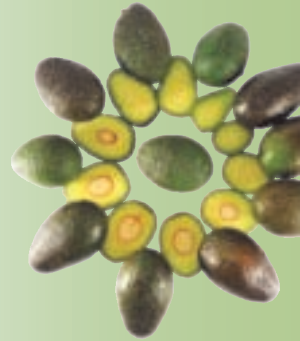
**What are the consequences for the EU market?**



With the questions of sanitary procedures and competition from other sources—especially in 2010—it is clear that the conquest of the US market may well be a long story. However, Peruvian exporters should not forget the European Union. It is true that transport time to the United States is shorter, giving better visibility of the market,

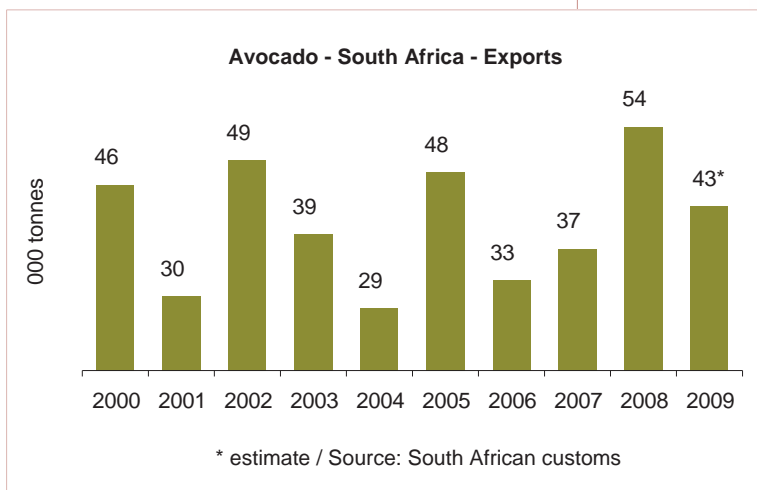
allowing better anticipation of possible changes. However, the protocol will be an additional constraint in all cases. Furthermore, the direct economic returns from the market seem to have been fairly comparable to those from the EU in recent seasons. Using Chile as the reference, analysis of customs values (equivalent to the FOB price) of avocados shipped to these two parts of the world shows that the average prices have been very similar for the last seven years. Thus, a target of 19 000 t shipped to the United States has been announced in the market opening protocol. The rapid finding of a satisfactory solution would have a major impact on the EU market as this 19 000 t is almost half of Peru's 'Hass' export

capacity (about 40 000 t in 2008 and 2009. With stable volumes from other sources, EU supply of all kinds of avocado would decrease by some 15 to 20%, returning to the 80 000-85 000 t recorded in 2004-05 and 2006-07 'Hass' forms nearly 80% of Peruvian export and the decrease in supply of this variety in the EU would reach 30%. In contrast, if the increase in shipments to the US is gradual, as is probable, it is reasonable to consider that the shift of volumes to the US market will be partially compensated by an increase in production. The decrease in shipments from Peru would therefore be fairly short-lived and relatively small. But what about the other EU market suppliers?



**Status quo in South Africa**

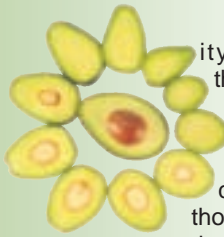
Production volumes in South Africa, a historic player in counter-season international trade, should not change much in the medium term. Avocado is grown mainly in the provinces in the north-eastern part of the country (Limpopo, around Tzaneen and Levubu, and Mpumalanga, around Nelspruit), and the area has been stable at about 12 000 ha since the beginning of the decade. Production should therefore continue to oscillate between 9 and 12 million boxes. However, 'Hass' should continue to gain ground at the expense of the green varieties. The proportion has increased from hardly 45% at the beginning of the decade to 52-53% in the last two seasons.



**Kenyan avocado production increasing**

Conversely, the avocado sector seems to be developing in Kenya. The extent of the trend is difficult to estimate among the small farmers that still account for a large proportion of production as reliable statistics are not available. The improvement in qual-



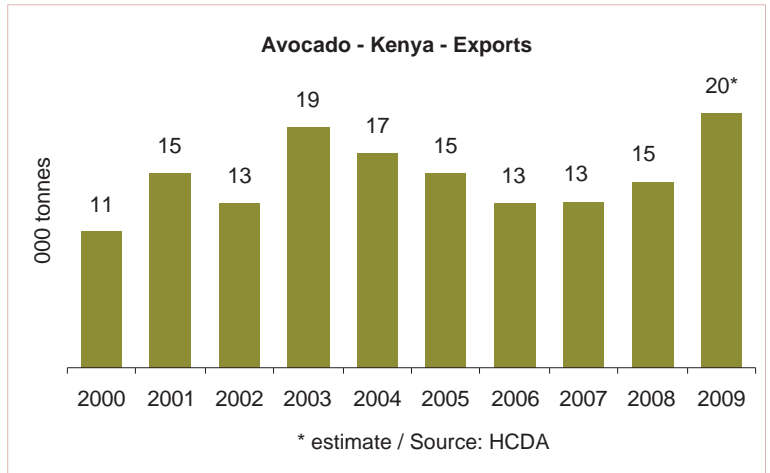


ity is more visible, thanks in particular to the efforts made to structure this part of the chain, encouraged by the authorities and with international aid (agricultural and postharvest monitoring, use of sorting rejects, etc.). Changes among certain stakeholders with commercial plantations is easier to evaluate: the export capacity of the Kakuzi group, which accounts for most of 'Hass' production, should increase to 1.7 million boxes by the middle of the

next decade, in comparison with about 1 million this season. The existence of at least one transshipment continues to make logistics difficult. However, the generalisation of controlled atmosphere makes it possible to guarantee the quality of the fruits on arrival. The impact of the use of this technique on cost prices is also dissuasive for small opportunist importers who often have no established avocado trade. Supply has therefore become reconcentrated in the hands of a limited number of specialised importers that have worked on improving the image of Kenyan avocado. The results have been visible this year. It is true that the context has been favourable but the volumes traded have increased considerably.

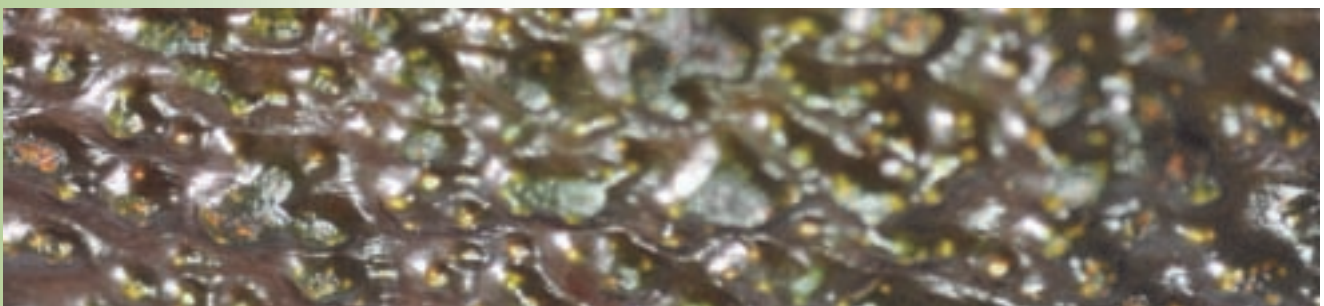
**Supply will probably increase during the summer season**

Peru's entry to the US market may take time while production will continue to increase strongly in the coming seasons. The increase in supply to the EU during the summer season is therefore probably not over. Even with the fairly improbable hypothesis of a rapid, massive entry of Peruvian 'Hass' in the United States, EU supply of 'Hass' should soon increase once again, given the planting that has been carried out in Peru and to a lesser extent in Kenya.



Although one should be aware of this increase in supply, there is not necessarily any reason for alarm as long as it remains fairly gradual. European consumption of avocado during the summer has shown its potential for development, with an increase of some 40 000 t in import in five years. The habit of South American (and South African) professionals to accompany an increase in volumes with substantial promotion budgets leads to considering that market development will not ease off. In addition, potential for development exists in the EU, given the still very small consumption on certain markets (see preceding article) and the small summer consumption in some major consumer countries. As an example, only a third of annual French consumption is recorded during the period running from May to September. The inflow of tourists and a climate favourable for consumption are factors that should not be neglected in the countries of southern Europe, in spite of large production of competing fruits during the summer. But efforts must not be spared either, in particular if the US market remains tight shut, as the least competitive small farms in the countries supplying the world summer avocado market depend on this ■

**Eric Imbert**, Cirad  
eric.imbert@cirad.fr



Photos © Régis Domergue



## The main avocado varieties

Photos variétés © University of California



© Régis Domergue

### 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'.

### 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'.

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 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 fairly 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.

## 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).

## 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.

## 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 post-harvest

*Post-harvest management of fruits is of prime importance. It affects both quality and yield as losses can range from 5 to 50%.*

### The special features of climacteric fruits

Climacteric fruits have special physiological characteristics. They must be harvested after reaching a sufficiently advanced stage of development and hence of maturity. It is only then that they are capable of synthesising sufficient amounts of ethylene to be able to start ripening (a strong increase in respiration that physiologists refer to as the 'climacteric' marks the start of deep-seated physiological changes). Only mature fruits will display satisfactory organoleptic characteristics once they have ripened. Avocado is a singular climacteric fruit. It can only start the ripening process after it has been picked. One of the best ways of storing the fruit is therefore to leave it on the tree. Some varieties can remain on the branch for several months, depending on the season. Suitability for 'tree storage' is generally very small or non-existent for West Indian cultivars but marked for hybrids, especially for Guatemalan x Mexican crosses. Nevertheless, prolonged storage can have a negative effect on production in the following season. These physiological considerations highlight the importance of the harvest date. Several variables that depend on the variety and the producer country concerned are to be taken into consideration to judge the optimum stage of maturity. Visual appraisal, fruit weight and diameter and the number of days after flowering give useful information but this is not accurate enough. Determining the matter content—strongly correlated with the oil content—is the most commonly used method. Appraisal of the stage of maturity is completed by analysis of enzymatic activity, electrical conductivity, aromatic compounds or precursors or by tasting tests when the fruits have ripened.



© Eric Imbert



© Eric Imbert



© Régis Domergue

### Packing

Fruits with the desired maturity index are sorted, washed and graded before packing requirements.

#### Avocado — Europe — 4-kg box 35 x 28.5 x 9 cm

Weight (g)	Size
461-475	8
366-400	10
306-365	12
266-305	14
236-265	16
211-235	18
190-210	20
176-189	22
156-170	24
146-155	26

#### Avocado — United States 11.34-kg box — 43 x 32.6 x 17.5 cm

Weight (g)	Size
422	28
377	32
340	36
298	40
241	48
196	60
156	70
122	84
102	96

#### Avocado — United States 5.67-kg box

Weight (g)	Size
422	14
377	16
340	18
298	20
241	24
196	30
156	35

#### Avocado — Japan — 6-kg box 43.9 x 33.1 x 11 cm

Weight (g)	Size
340	18
298	20
241	24
196	30
156	35

## Storage

### Cooling

The temperature is lowered to slow the metabolism of the fruit so that it can be stored. This slows ethylene synthesis and its effects. It is therefore sought to bring the fruits to the best temperature for storage as rapidly as possible after harvesting (ideally in less than 6 hours). The duration of cooling depends on the initial and final temperature of the fruit and on the ambient air conditions (temperature, wind velocity and relative humidity). The time necessary varies from 8 to 10 hours. It is important to halt the cooling phase 2°C before the final temperature desired to be sure not to reach temperatures that are too low and that might damage the produce.

### Refrigeration

Optimum storage temperatures vary according to the variety, the period of the season (maturity) and the storage period desired. In general, the temperature for mature avocado ranges from 5 to 12°C with atmospheric relative humidity of 85 to 95%. The more delicate end-of season fruits are stored in the lower part of the temperature range. For 'Hass', physiologists advise the maintaining of fruits at 5 to 7°C at the beginning of the season and 4.5 to 5.5°C at the end. More than four weeks of storage at these temperatures is not recommended. The optimum temperature range for 'Fuerte' is 6 to 8°C but not for more than three weeks. In practice, professionals keep all the classic commercial varieties at between 5 and 6°C. Temperatures must be strictly controlled to prevent any fluctuation. Movement of air is also regulated. Heat is released during the starting of the ripening process and this must be taken into account. Respect of the cold chain is of crucial importance.

### Controlled atmosphere

Controlled atmosphere is widely used for long transport and can lengthen the duration of storage. Low O<sub>2</sub> levels combined with high CO<sub>2</sub> reduce respiration and ethylene production. An O<sub>2</sub> content of 2 to 5% and CO<sub>2</sub> at 3 to 10% are generally used. The main classic commercial varieties can thus be stored for 5 to 6 weeks and even longer for 'Hass'. The effects of unsuitable O<sub>2</sub> and CO<sub>2</sub> levels are described in the paragraph entitled 'Main types of post-harvest physiological deterioration' below.

### Alternative technologies for long storage

**Treatment with 1-MCP.** Application of 1-MCP (1-methylcyclopropene) is reported to limit the internal symptoms of chilling injury (dulling of the pulp, vascular browning) in fruits stored for more than four weeks. The technique is said to give good results especially for the green varieties that are less suitable than 'Hass' for long storage (with respect of the standards in force). It has been used on a proportion of the South African harvest for three years.

**Step-down temperature.** This technique has been used in the South African avocado sector for several years to conserve fruit quality and reduce internal symptoms of chilling injury. The storage temperature is lowered in steps (1 to 2°C each week) during transport, with care taken not to descend lower than 3.5°C. There are procedures (temperature and duration) for the different cultivars and regions of South Africa.

## The main precautions to be taken in shops

Avocado fruits are very sensitive to impacts and to pressing by consumers. Ripe and nearly ripe fruits must be stored at lower temperatures (1 to 6°C). Misting is not recommended.



© Eric Imbart



© Fred Meinigis

## Ripening

The ideal temperature for ripening is 15 to 20°C. Above 25°C, ripening is irregular, unpleasant flavours appear and the risk of rot increases. This natural process can also be controlled. Treatment with ethylene (100 ppm at 20°C for 12 to 72 hours depending on the maturity of the fruit) speeds up ripening by 3 to 6 days. It is possible to obtain fruits at an even stage of ripeness in chambers in which temperature, relative humidity and ethylene content are the main parameters controlled. Nevertheless, ripening still depends on the initial stage of maturity of the fruit.

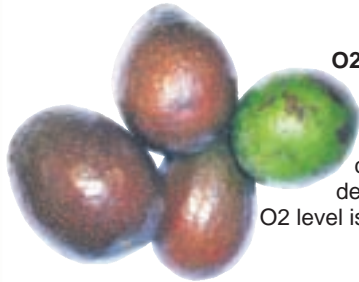
## Main types of post-harvest physiological deterioration of avocado

### Storage-related damage

**Chilling injury.** This damage is caused by low temperatures—generally lower than 3°C—or by prolonged storage. The symptoms may appear three days after packing during storage and more often when the fruits are removed from the cold room. Two forms of chilling injury are observed. The symptom of internal chilling injury is a browning of the pulp starting at the base of the fruit and sometimes vascular browning in the same area. In 'Fuerte', this disorder takes the form of small dark spots in the pulp. The symptoms of external chilling injury are irregular black spots on the epidermis. They may appear during storage and most frequently when the fruits are removed from cold storage.



**O<sub>2</sub> deficit and excessive CO<sub>2</sub>.** Too great a decrease in the O<sub>2</sub> level (in particular to less than 1%) can cause irregular brown spotting of the epidermis that can spread to the pulp. Too high a CO<sub>2</sub> level (over 10%) can cause discoloration of the epidermis and the development of unpleasant flavours, especially when the O<sub>2</sub> level is low.



### Fungal infection in the field revealed during or after storage

The control of fungal diseases requires effective orchard management and appropriate treatments before the harvest. All bruising of the fruits must be avoided at the post-harvest stage, they must be refrigerated rapidly and the cold chain maintained.

**Anthraco**se. This is the most frequent disease during storage and is caused by infection of the fruit by *Colletotrichum gloeosporioides* in the orchard and appears only during ripening. It causes serious necrosis. Ordinary small, scattered injuries develop into large circular brown spots on the epidermis. The underlying pulp blackens and the rot reaches the stone. The rate of development of this rot depends on the transport and storage temperature and above all the state of maturity of the fruits.

**Stem-end rot.** This disease is also caused by infection by a fungus, *Botryodiplodia theobromae*. Small pale brown spots appear initially in the stem zone. The rot spreads rapidly to the rest of the fruit. The pulp is then infected to the stone. Any injury in the epidermis favours infection by the pathogen.



Avocado – Post-harvest diseases caused by pathogenic fungi

Pathogen	Disease
<i>Alternaria</i> spp	Black rot
<i>Botryodiplodia theobromae</i>	Stem-end rot
<i>Botryosphaeria ribis</i> ( <i>Dithiorella gregaria</i> )	Stem-end rot
<i>Colletotrichum gloeosporioides</i>	Anthracose: Black rot
<i>Fusarium</i> spp	Stem-end rot
<i>Penicillium expansum</i>	Blue mould
<i>Pestalotiopsis perseae</i>	Brown spots
<i>Phomopsis perseae</i>	Brown rot
<i>Phytophthora citricola</i>	Small surface injuries
<i>Pseudocercospora purpurea</i>	Soft rot
<i>Rhizopus stolonifer</i>	Corky patches on epidermis
<i>Trichothecium roseum</i>	Pink rot