September 2010 - No. 181

FRuiTROP

English edition

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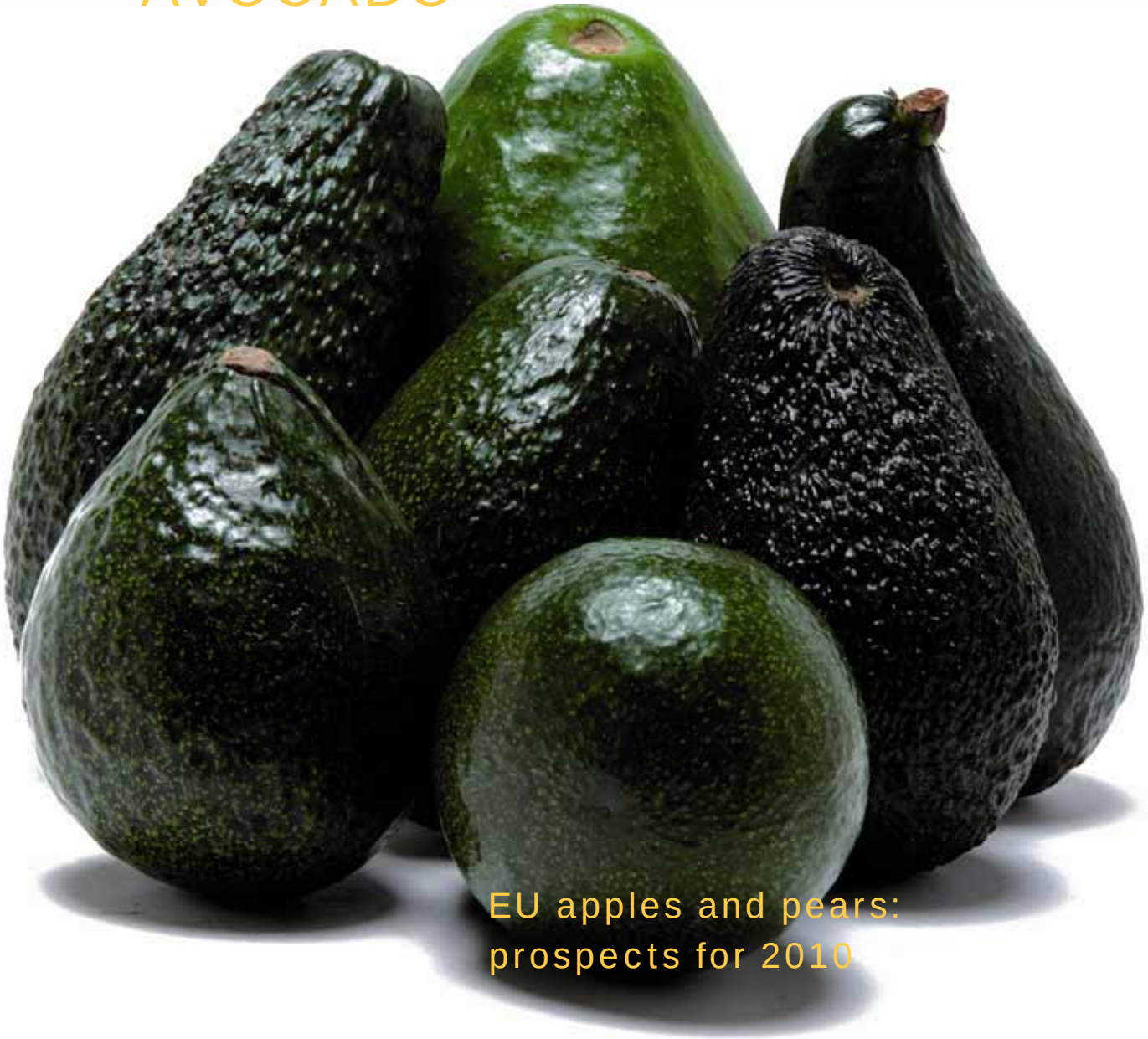
AVOCADO



EU apples and pears: prospects for 2010

Juice and purée prices in Europe

Avocado

A report by
Eric Imbert

Contents

The 2009-10 season merits closer examination than previous ones. It forms a reference and, in the manner of a prophecy, outlines the main trends that the world avocado market should follow in the medium-term. First, production: after two seasons that were deceptive as a result of weather problems, the rapid increase in the planted areas in a large proportion of the major exporting countries is now clearly seen in the record volumes traded, totalling some 900 000 t. Second, trends in the major consumption markets: although the widespread increase is reassuring as regards the renown of avocado throughout the world, the differences in movements reveals sales stimulation models that should be drawn on for inspiration. Finally, the level of functioning of certain markets: in Europe, the trend for the 'South-Americanisation" of supply has effects on other supplier countries. **FruiTrop** reviews a season rich in teachings.

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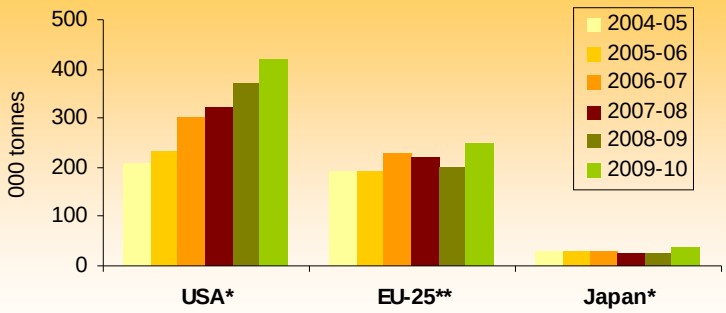
The world avocado market in 2009-10

Growth all round

Ardith avocado

© Guy Bréhinier

Avocado - Evolution of imports of the main markets



* July to June / ** winter season 2009-10 and summer 2010 + Spanish shipments to EU / Sources: national customs, CIRAD

Avocado — Evolution of imports of the main markets

tonnes	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10
USA	206 314	231 715	300 375	319 500	371 700	420 360
EU-25	191 536	190 379	228 588	220 448	199 270	246 500
Japan	29 435	28 342	28 463	25 125	26 054	37 520
Total	**427 285**	**450 436**	**557 426**	**565 073**	**597 024**	**704 380**

Sources: national customs, CIRAD

The world economic downturn seems to have had little effect on the international avocado market. Far from being interrupted, the strong growth in world trade seems to have been amplified in 2009-10. Our Market News Service estimates that the volumes increased by some 100 000 t to reach 800 000 t during the 2009-10 winter season and the 2010 summer season. The international avocado market has gained 250 000 t in four years. This performance might be envied in several other fruits sectors, especially as no major varietal innovation or other factor has changed the situation radically to justify increased consumer interest in the fruit.

Supply back to a normal level on the international market

The acceleration of market growth was first of all permitted by greater world supply. The 2007-08 and 2008-09 seasons were marked by a significant decrease in production in some major exporting countries. Scope for market growth was thus limited for reasons of shortage of produce or the rise in world prices. It must be remembered that the basis of world supply is so narrow (only four countries export more than 30 000 t) that a phenomenon such as the frosts that hit Chile and Israel in 2008 necessarily had serious consequences.

In 2009-10, full production potential was expressed in the orchards in the major exporting countries and professionals were able to measure the scale of the increase in the areas under avocado in certain countries.

Increased orchard area 'visible' in Chile...

It has been possible at last to observe the development of Chilean orchards. Both harvest and exports increased by more than 100 000 t

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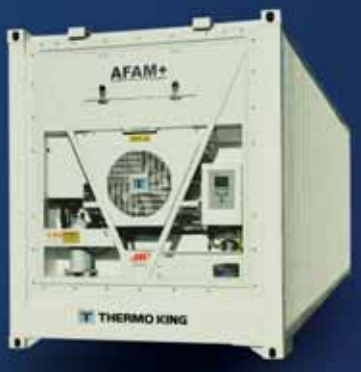

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in comparison with the preceding season, reaching 260 000 t and 194 000 t respectively. These tonnages had never been approached and are still far from reflecting Chile's potential when the 39 000 ha of avocado orchards have reached maturity. Furthermore, yields are still medium at 8 to 10 t/ha but tending to increase.

...and in Israel

The situation in Israel has been fairly similar. Production has increased markedly in comparison with the two preceding seasons, reaching some 80 000 t in comparison with 50 000 to 55 000 t. First, the weather was better and second the orchards are growing rapidly, especially as regards 'Hass'. Thus, as in Chile, the increase in production observed in 2009-10 will probably continue. In contrast, the harvest was average in Spain, as in preceding seasons.

Very good season in Mexico but no records broken

Although there was not a major boom in Mexico, growth continued with production approaching 1.2 million tonnes thanks to favourable weather, positive alternate bearing and an increase in the area under avocado (+ 10 000 ha from 2007 to 2009 according to USDA). The list of communes registered for exports has also been further enlarged. However, the more competitive international context mentioned above means that Mexico was unable to repeat its record exports of more than 400 000 t in 2008-09. But with 380 000 tonnes, the 2009-10 season was the second best year ever in terms of volume for professionals. It should be remembered that Mexico exported hardly more than 100 000 t of avocado until 2003-04.

A southern hemisphere season similar to the preceding one

Supply from the southern hemisphere changed little, especially when fluctuations are compared to the particularly marked differences mentioned above in the northern hemisphere. South Africa remained in cruising mode at 40 000 to 50 000 t. Orchard area and harvest have been fairly stable for several years. In contrast, the Peruvian sector has continued to display very strong dynamism. Although export growth has not been spectacular since 2008 (45 000 to

© Eric Imbert

55 000 t/an), that of the orchard area is still very fast, promising strong increases in production in the coming seasons (see FruiTrop 179). It is noted that exports to the United States were limited in 2010 in spite of the opening of the border in the spring and do not reflect the strong ambitions of Peruvian professionals on the US market. The sanitary protocols are complex and a start-up period is necessary.

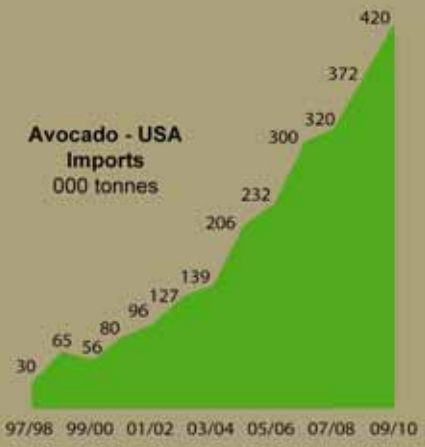
The United States is still the robust driving force behind world growth

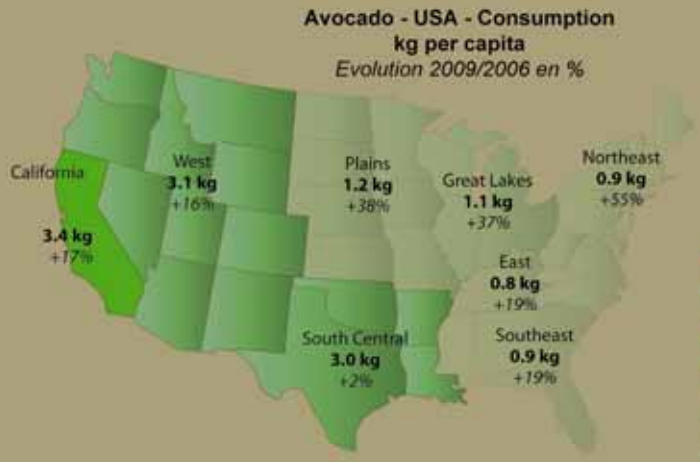
Once again, the United States market made the main contribution to the net increase in world demand. Imports from July 2009 to June 2010 were more than 50 000 t greater than the figure for the preceding season! In retrospect, the performances of the last few years have been amazing. The US market was neck and neck with the EU at 200 000 t in 2004-05 and has doubled in five years, exceeding 400 000 t in 2009-10. The increase in the volumes imported in 2009-10 is even more impressive as competition for Californian production was more intense. The harvest in California was limited in summer 2009 (marked harvest shortfall in 2008-09) but was massive from February 2010 (very large 2009-10 harvest). Consumption thus grew by 80 000 t, exceeding the increase in imports. This season again, the system set up by the Hass Avocado Board (HAB) worked marvels. The 'small' levy of 5 cents on each box sold in the country generated a colossal budget of close to 25 million dollars, used for generic and source promotion. The continuous, targeted campaigns run by the HAB since it was set up in 2002 have led to increasing consumption from a little more than 1 kg per person per year to probably more than 1.9 kg in 2009-10 (estimate to be confirmed).

Consumption increasing in the United States: is the sky the limit?

Is there still scope for growth in the United States? The question is not absurd in the light

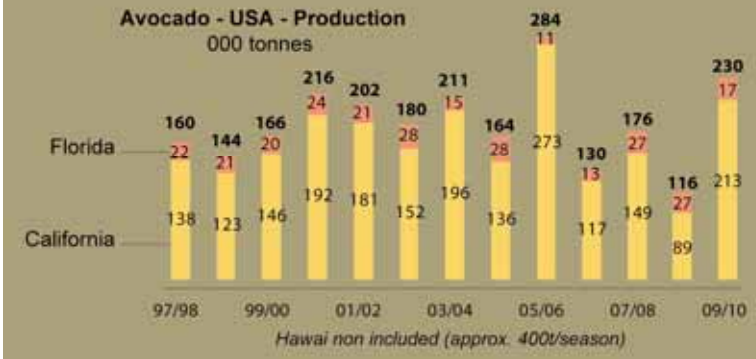
aVOCADO IN THE USA

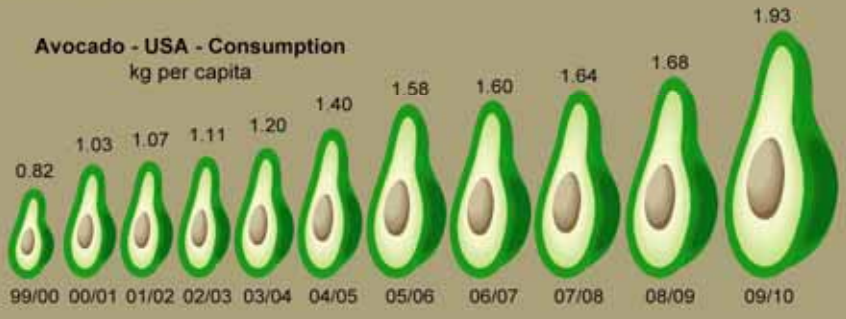




Avocado - USA - Evolution of consumption

	2007/2006	2008/2007	2009/2008
California	-10 %	+2%	+28%
South Central	-15 %	0%	+20%
West	-10 %	+5%	+23%
Great Lakes	+3%	+3%	+28%
Northeast	+14%	+13%	+20%
Southeast	+14%	0%	+5%
East	0%	- 2%	+21%
Plains	+2%	+10%	+23%
Total	**- 6%**	**+3%**	**+22%**





Source: Usda, Amric, Nass, HAB / Note: 09/10 previsional

Graphics: Chez Vincent

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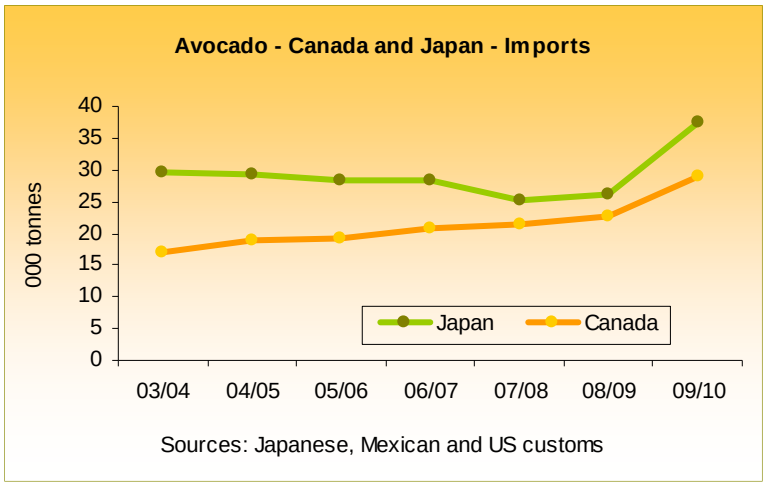
of the market growth observed in recent years. It also concerns all the avocado professionals in the world as demand must match strong, rapid growth in world production. Analysis of consumption studies performed for the HAB between 2006 and 2009 is very encouraging, giving a clearly affirmative reply. First, growth had ceased in the large consumption zones in the west but resumed in 2009. The large low consumption areas in the east have also started to move. The north-east (New York, Philadelphia, etc.), the Great Lakes and the Great Plains (Saint Louis) have displayed steady growth since 2007, with two-figure growth observed in the north-east. This is excellent news for two reasons. First, consumption potential is large as the population of the three zones exceeds 120 million and purchasing power is fairly high in the north-east. Second, it is also a sign that the promotion operation is effective for a public less familiar with avocado than that of the west coast, with a large proportion of Hispanics. The trend is wonderful for Chilean exporters who count strongly on this part of the country where their maritime logistics means that they approach the price competitiveness of Mexico.

The European market is also growing!

Europe, the second largest market in the world, also did better in the 2009-10 season. Imports are reported to have increased by about 50 000 t in comparison with the preceding year and are flirting with the 250 000 t mark, a level never previously attained. It is particularly interesting to observe that the increase is not just in the traditional major consumer countries but is joined by steady growth in certain regions such as Scandinavia and, perhaps, the awakening of Germany, a market with strong potential. The next article provides detailed coverage of the movement of the EU market in 2009-10.



Sources: Japanese, Mexican and US customs

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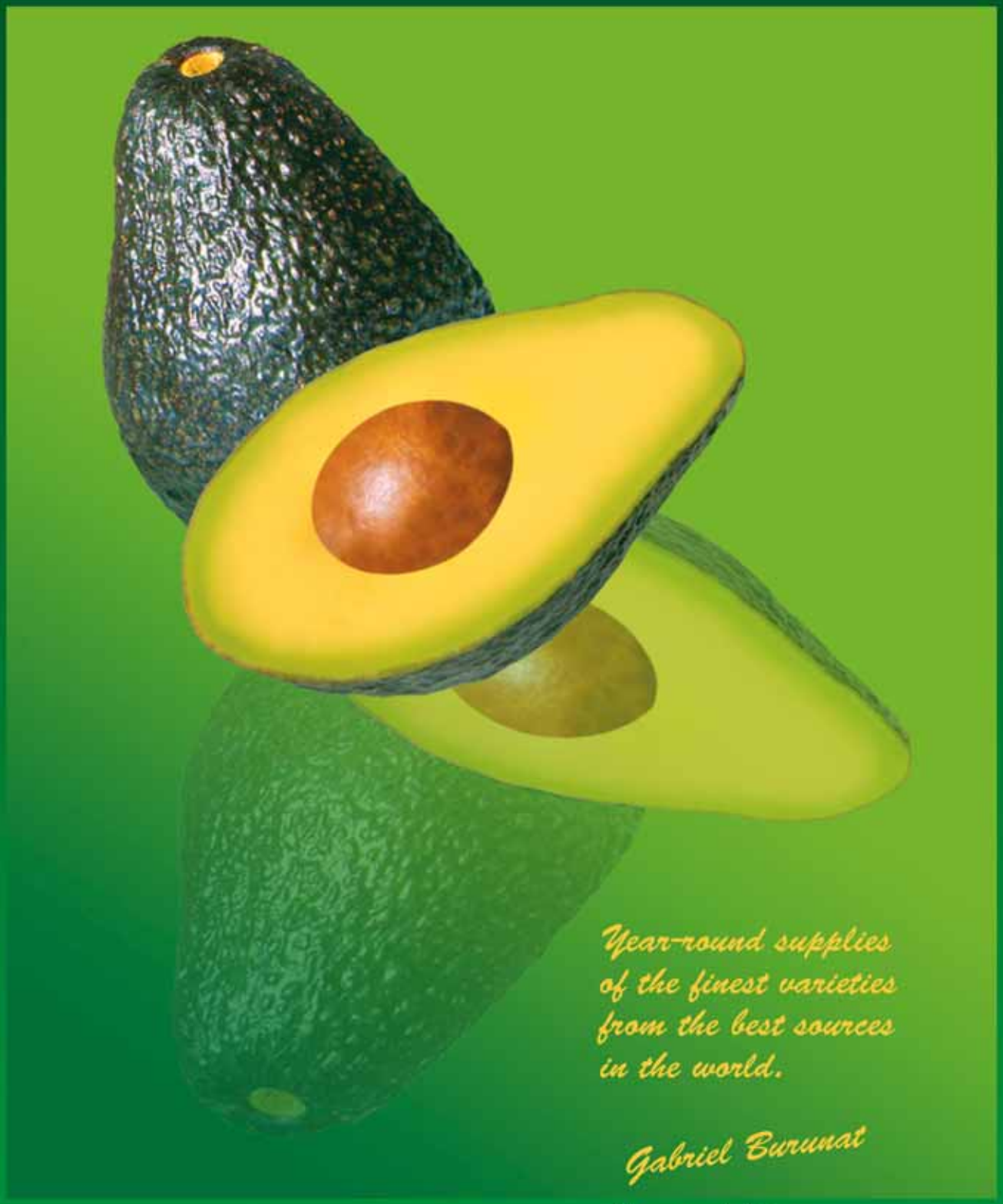
Is the Japanese market emerging from its lethargy?

Avocado imports increased in Japan in 2009-10 after a very dull decade. The trend, which marks an increase in consumption, can be ascribed to the work of the Association of Michoacán Avocado Growers, Packers and Exporters (APEAM), which in autumn 2009 launched a promotion campaign with a budget of half a million dollars. The results have been excellent, especially in the light of the technical difficulties of this market (phytosanitary regulations, complex organisation, etc.) and the conservative attitude of a very large proportion of Japanese consumers. Imports had run at 25 000 to 30 000 t per year since 2003 and approached 40 000 t last season. If it is confirmed, the trend will be excellent news for world trade. Even with the very good figure for the last season, annual consumption remains very small at less than 300 g per person, and the country has a population of nearly 130 million people with strong purchasing power.

Signs of growth in Canada!

Completing this excellent scorecard, the Canadian market—the fourth largest in the world in

AVOCADO AT ITS BEST



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The key points of the 2009-10 season

- Strong return of Chile to the world scene, reflecting the increase in the area under avocado.
- Increased demand on the four leading markets (United States, EU-27, Japan and Canada).
- A new, particularly positive reaction from the US market in both the traditional west coast consumption zones and the emerging zones in the north-east.

Another important point: the opening of the US market to Peruvian avocados.

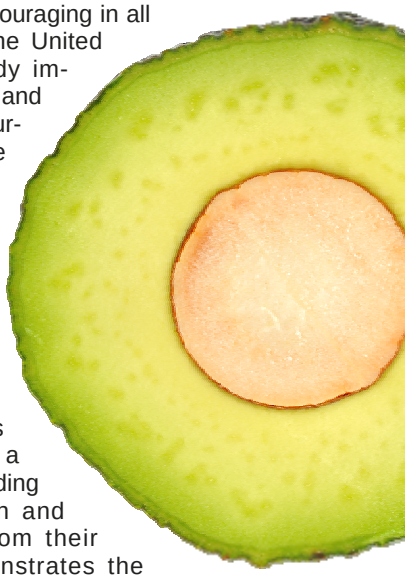
terms of volume—also showed proof of dynamism in 2009-10. After sticking at around 22 000 t in preceding seasons, imports increased to over 27 000 t. As in Japan, this growth is not natural but results from the promotion efforts made by the APEAM. The trend should be monitored here too. The prospects for development are not as large as in Japan as the population is smaller and per capita consumption is already higher. However, the market has a much quicker response as it is easier to work with.

An excellent season for volumes but what about prices?

Did the increase in volumes result in better returns for producers or was it achieved by lower prices? This can be assessed by analysis of customs values. Chilean data are available for a sufficiently long period to afford a general view and are a fairly good reflection of the situation on the world market as Chile exports avocados to both the United States and the European Union, the two major import regions. It is true that the graph shows that the 2009-10 season was not as good as the two preceding seasons that were very special in terms of supply. However, performance was more than honourable and markedly or even very much better than 2005-06 and 2006-07 when supply to the world market was nevertheless 150 000 t to 250 000 t smaller ! Favourable trading conditions in both the United States (the California harvest ended early) and Europe (Peruvian shipments were smaller than forecast) do not account for everything.

Lots of good news as regards demand but a deluge of produce is coming!

The return to higher production levels in the major source countries was a test for the reaction of world demand. Signs were encouraging in all the large markets. The United States market already impressed by its growth and size and developed further thanks to the emergence of east coast regional with high growth potential. The European market is the second largest in the world in terms of volume and also gave positive signs, especially in countries that had not displayed a growth trend in preceding years. Finally, Japan and Canada emerged from their lethargy. This demonstrates the excellent image of avocado around the world. However, it should be stressed that these good performances resulted from effort and investment. In Europe, tailor-made promotion campaigns run by Chilean and Peruvian producers' organisations made a considerable contribution to this good performance. Likewise, the sums invested by the APEAM made it possible to bring the Japanese market to life. The example and even exemplarity of the United States market is yet another demonstration of the great power of regular, long-running promotion operations. This season demonstrates an obvious but, unfortunately, often forgotten point: all investment in promotion works, all over the world.



As world production is increasing, investment further down the chain to stimulate demand is more a condition for survival than just an option ■

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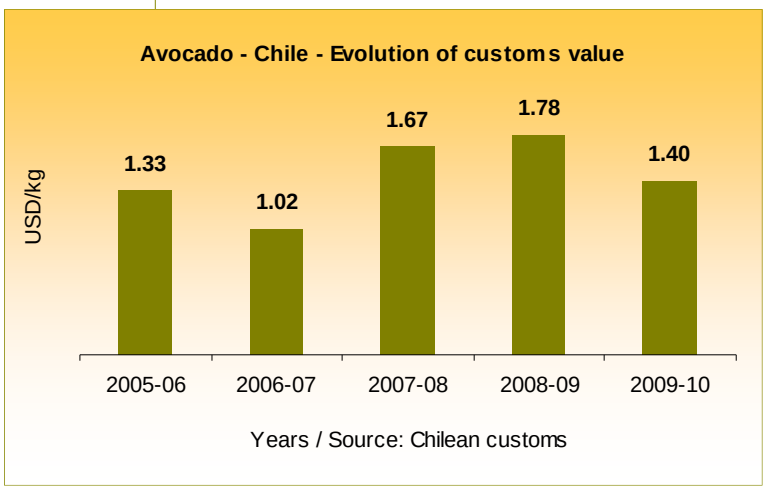

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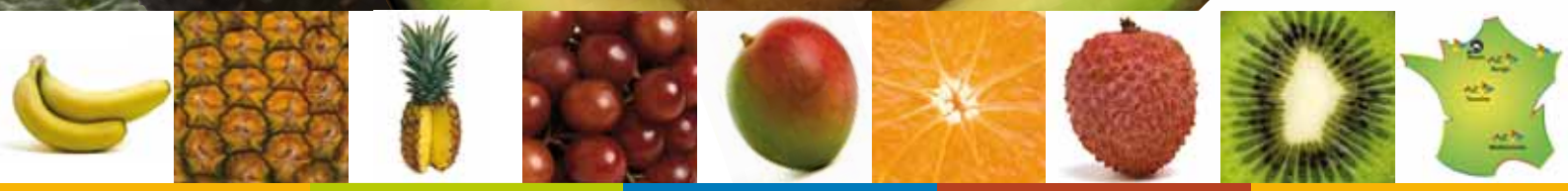

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Review of the 2009-10 avocado season in the EU

A changed situation?

Nabal avocado

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Was 2009-10 a turning-point or just an unusual season? However that may be, Chile's forceful return has stimulated consumption and seriously upset the balance of power between the sources supplying the winter market. FruiTrop examines the season and analyses the possibly structural changes that have taken place.

European supply record broken

As on the other markets in the world, EU-27 received distinctly larger quantities of avocado during the 2009-10 season. The volumes sold reached a record 245 000 to 250 000 t, contrasting strongly with the 200 000 t of the preceding season. The increase in supply seems to have stopped during the summer season when shipments are from southern hemisphere sources. Customs figures are not yet available but they will probably confirm a figure of between 100 000 and 110 000 t, similar to the volumes recorded in 2008 and 2009. This status quo does not call into question the dynamism of a market that has doubled in less than 10 years.

Avocado — EU-27 — Supply

tonnes	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10
Total N. hemisphere	**110 866**	**91 223**	**106 592**	**79 480**	**101 893**	**109 648**	**98 408**	**138 948**	**104 426**	**94 465**	**134 518**
Israel	44 548	38 841	44 333	26 529	25 299	50 481	26 538	55 931	25 936	30 071	38 512
Chile	9	35	528	2 190	4 046	11 532	17 801	40 379	25 692	15 832	51 383
Mexico	14 479	13 002	10 139	21 925	18 705	16 516	20 769	10 289	12 695	11 647	9 326
Spain	51 000	39 000	51 000	28 000	53 000	29 854	32 400	30 140	35 300	32 930	31 420
Dominican Rep.	830	345	591	195	842	1 264	901	2 209	3 105	2 077	2 900
Morocco	-	1	1	641	-	-	-	-	1 698	1 908	977
Total S. hemisphere	**49 799**	**57 357**	**52 190**	**67 498**	**60 698**	**80 509**	**80 083**	**85 800**	**112 121**	**99 076**	***108 500**
South Africa	38 205	38 908	36 266	36 404	29 872	46 955	35 934	37 944	50 451	38 377	45 000
Peru	1 299	2 849	4 401	11 266	14 590	18 096	30 508	35 857	49 829	45 661	52 000
Kenya	10 294	15 600	11 523	19 828	16 236	15 458	13 641	11 999	11 841	15 038	11 500
Total	**160 665**	**148 581**	**158 782**	**146 978**	**162 591**	**190 157**	**178 491**	**224 748**	**216 547**	**193 541**	**243 018**

*estimates / Sources: professionals and customs

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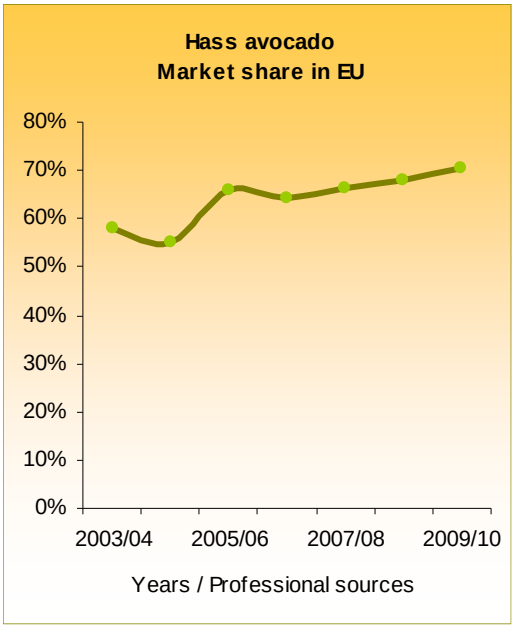


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The booming winter market clearly accounts for the strong growth in the volumes sold in the EU. At over 130 000 t, supply during this period of the year has recovered to the record set in 2006-07 and has increased by more than 30 000 t in comparison with the two preceding seasons.

The 'South-Americanisation' of the winter market is taking shape

The tremendous increase in shipments from a single source—Chile—accounts for the greater part of the increase. Expected since 2007 and postponed by poor weather conditions, it has now reached the EU market. Volumes from Chile approached 40 000 t in 2006-07, fell to between 15 000 and 25 000 t in 2008-2009 in the subsequent seasons and have now exceeded 50 000 t. A 'South-Americanisation' of the market is seeming to take shape during the winter season, similar to the strongly formed movement observed in the summer when Peru, starting from practically nothing at the beginning of the 2000s, now provides nearly 50% of supply. The figures for 2009-10 show the speed with which Chile has gained ground. Its market share has increased from 10 to 40% in five years.

Sufficient produce to go further

Will this dynamics continue or will there be a downturn? As regards volumes, it seems clear that Chile will have the resources to repeat the performance. Even if its historic market, the United States, continues to import increasing volumes, a sizeable alternative is needed, given the rate of production increase (see **FruiTrop** 170 and the next article). The same observation applies to Peru, where the increase in production area should be such as to meet the expectations of both Europe and the United States market opening in 2010 (see **FruiTrop** 179).

Solid anchorage in Europe, in particular thanks to a star variety

The market should continue to welcome Chilean and Peruvian fruits. Both sources have the advantage of being able to ship 'Hass' when their competitors cannot. Large retail chains in

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Colombia, another South American country out to conquer the international market?

It is still too soon to be sure whether Colombia is an emerging force on the international market. After a much-noticed appearance at Fruit Logistica, exports to the EU started in 2010 with a few containers shipped to the Netherlands. However, the country is one of the world's leading avocado producers and has true export potential. Production is some 150 000 to 160 000 t according to the Ministry of Agriculture and consists mainly of West Indian varieties and large green varieties that a little sought-after on the market. However, 'Hass' is present and developing rapidly. A study by the Corporacion Colombiana International reports an area of some 5 500 ha. Most production is in the province of Antioquia (about 2 300 ha, mainly south-east of Medellin). The Tolima orchards are in second position with about 2 000 ha, especially in the north. The rest of the crop is grown in the Cauca (420 ha) and the centre of the coffee belt (780 ha in the Risaldra, Caldas and Quindio). Most of the orchards are young at between 0 and 8 years old. Production is sold on the domestic market, mainly in the two largest cities, Bogota and Medellin, but exports are stated to be an objective. Keep an eye on this source!

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Europe, as on the other large markets in the world, are showing increasing enthusiasm for this variety. The reasons are first of all that marketing managers have done much work to proclaim the reputedly superior taste qualities of 'Hass'. Then, and above all, the variety has other features that match distributors expectations well. 'Hass' skin is more ligneous, reducing the problem of stock loss for reasons of damage, a profitability criterion much appreciated by department managers, especially in Latin countries where potential buyers test produce with their fingers. Another advantage of 'Hass' is that avocado becomes a standard product so that consumers can keep their marks all the year round and supermarket staff can keep their shelf labels and storage and handling practices. Finally, this variety is the leader in 'perfectly ripe' segment that is growing strongly in most major consumer countries in the EU. Supermarket chains in the UK have already switched entirely. In France, certain chains such as Ed and Casino swear by 'Hass' alone. This fever even seems to have reached the German market, with Rewe and the discount chain Penny switching entirely.

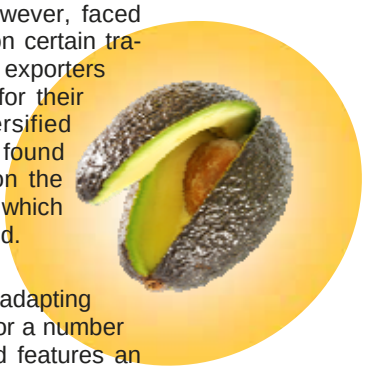
In addition, the EU community market context seems to be been a favourable feature at the start of Chilean growth. Mexican presence is decreasing in the European Union in September-October, to the benefit of the United States. Furthermore, the attractive trade conditions offered by Chilean and Peruvian exporters who are obliged to sell successfully in Europe has played a positive role. Finally, the wisdom of the agreements concluded in particular with Spanish operators who are well-established and seek counter-season supplies has helped to speed up success.

Ongoing structural adjustment on the EU market

The increase in Chilean exports is having an impact on the other supply sources operating in the European Union in the winter. The structure of tomorrow's avocado market has perhaps started to take shape in 2009-10. The supplier countries hit by the change have been first of all those supplying green varieties, and also complementary sources.

Israel diversifies outlets and restructures orchards

The volumes sold by Israeli operators have increased to nearly 40 000 t. However, faced with 'Hass' at competitive prices on certain traditional markets such as France, exporters have sought trading alternatives for their green varieties. They have diversified their outlets in the EU and also found interesting levels of profitability on the domestic market and in Russia, to which some 6 000 t of fruits were exported.



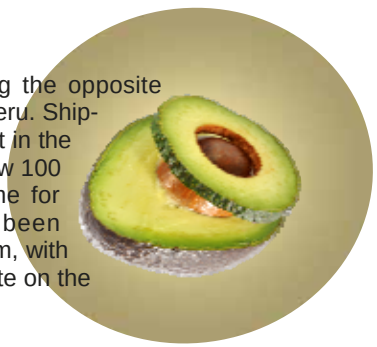
In parallel, producers have been adapting their orchards to market demand for a number of years. Planting is still brisk and features an increasing proportion of 'Hass'. This variety should form nearly 50% of total orchards by 2020 in comparison with a little more than a third today.

A narrower market for 'Fuerte' from Kenya in spite of the groundwork performed

'Fuerte' from Kenya has been struggling. After a fine 15 000 t in 2008-09, crowning the efforts made by certain operators to strengthen the credibility of this source, market releases were probably less than 12 000 t in 2009-10. 'Hass' from competing sources gained market shares in the spring, even in budget range, a market segment heavily targeted by Kenyan 'Fuerte'. Conjunctural reasons were also involved, as sea freight prices are increasing strongly, in particular as a result of higher insurance premiums required for shipping routed through the Gulf of Aden. However, the performance of Kenyan 'Hass' should be better as it is more firmly anchored in the EU, with volumes increasing in 2009-10 and a growing reputation.

Mexican fruits still dwindling

Mexico seems to be following the opposite pathway to that of Chile and Peru. Shipments averaged some 20 000 t in the mid-2000s before dipping below 100 000 t in 2008-09, the first time for ten years. Withdrawal has been both upstream and downstream, with exporters tending to concentrate on the



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nearby United States market and cost price and contractual conditions (firm purchases) that make most European operators nervous. Supply in Europe is concentrated in the hands of an increasingly limited number of specialised operators, who often master the upstream end of the chain.

Great stability for Spain

In spite of a more difficult context, our estimates show that the volumes sold by Spanish operators are reported to have remained stable at slightly more than 30 000 t, although evaluation of Spanish volumes is always difficult as the country also serves as a transit centre. This status quo is first of all a reflection of the stability of the orchard area, with new plantings making up for orchards grubbed up. In addition, Spain was little affected by the shrinking market for green varieties in the west of the EU as some 75% of plantations are now 'Hass'. Finally, the harvest of 'Bacon', 'Fuerte' and other varieties such as 'Reed' were fairly modest in 2009-10.

Outsiders more outsider than ever

Volumes from 'outsider' origins remained limited. Releases by the Dominican Republic were, as in previous seasons at between 2 000 and 3 000 t. The development of avocado orchards in Morocco was not reflected in the 1 000 t exported, a smaller quantity than that shipped in the preceding season for reasons of alternate bearing. We note a few shipments of 'Hass' from Colombia.

A more concentrated sales calendar for Mediterranean 'Hass'

Increasing competition from South American 'Hass' has also had an impact on the sales calendar in Mediterranean countries. The market window is tending to be concentrated from February to April because of the prolonging of the Chilean season and an increasingly early start in Peru. Thus 60% of Israeli 'Hass' exports was sold between the end of February and mid-April in comparison with 35 to 45% in preceding years.

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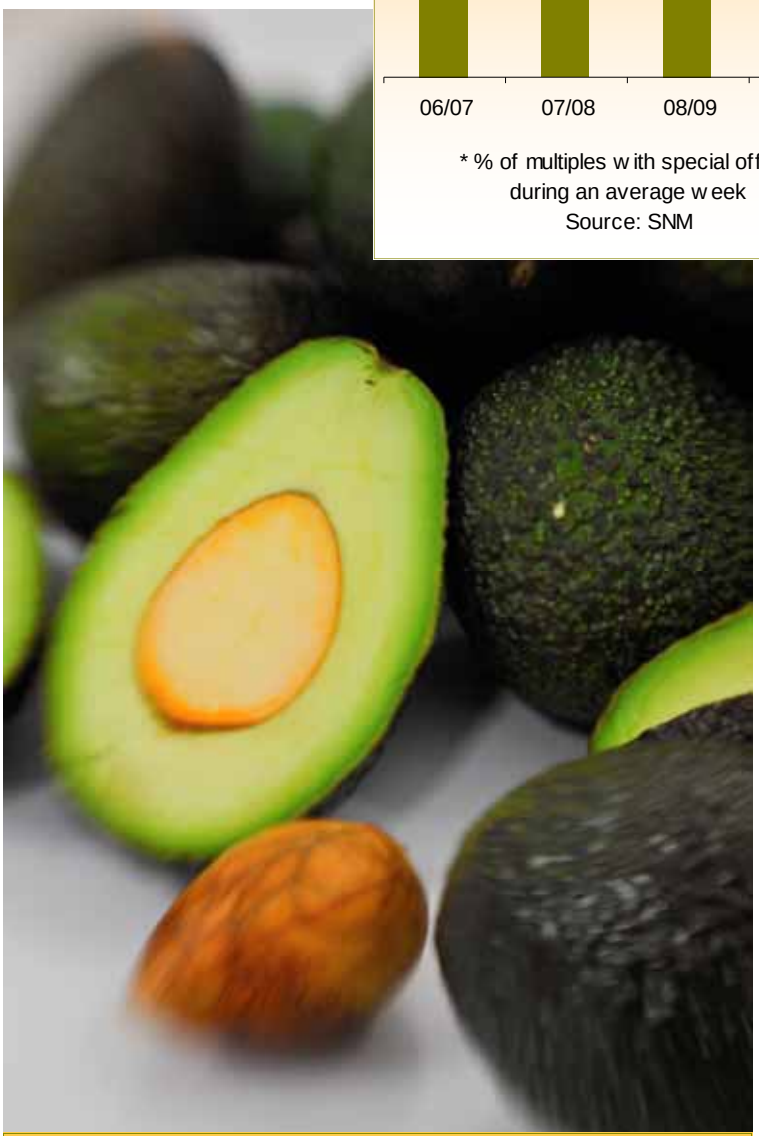
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Average financial returns in spite of the large volumes

The average season price does not seem to have suffered overmuch from the increase in supply in the light of the French market, whose size and redistribution role make it fairly representative of the situation. It is true that the decrease is significant in comparison with the two preceding seasons that were unusual in that supply was small. However, the level is very close to average for both the winter and summer seasons, as can be seen in the table. The context was clearly favourable. First, the early end of the 2009 summer season meant that prices could be kept fairly high at the beginning of the winter season. Second, strikes in South Africa and Peru limited supply in June, a very critical time because of the overlapping of the peaks in exports from both these sources. But the good behaviour of the market is also the result of fundamental features. The efforts made in market supply have paid off, especially in the summer. Volumes were large but a steady supply rate avoided breaks in consumption. It is true that quay prices did not rocket as happens in certain years, but prices remained stable and attractive at the retail stage and the average season price was finally satisfactory for the supply end of the chain.

In addition, supply seems to have been more distributed among the various EU markets, especially in March-April when there was a concentration of 'Hass' from Mediterranean sources. Finally, the sales promotion programmes set up by exporting countries continued to give good results.

Avocado — French Market
Evolution of the main retail indicators

euro/fruit	2006-07	2007-08	2008-09	2009-10
retail price bag	0.52	0.61	0.52	0.52
retail price loose	0.71	0.85	0.77	0.78
average import price (grade 18)*	0.31	0.41	0.37	0.36
Difference retail loose/quay	0.40	0.44	0.40	0.42

Sources: SNM, *CIRAD

A merely stable French market...

Which markets reacted better to this increase in supply? While awaiting customs data for the 2010 summer season, analysis is focused on the period comprising summer 2009 and winter 2009-10. France and the United Kingdom are the EU's two main avocado markets and they continued to play a driving role, accounting for an average 50% of total EU consumption. However, the performance of these two major markets was disappointing in comparison with the previous season.

Consumption increased slightly in France but the 80 000 t sold was just the market ticking over. Point-of-sale action was lacking—the av-

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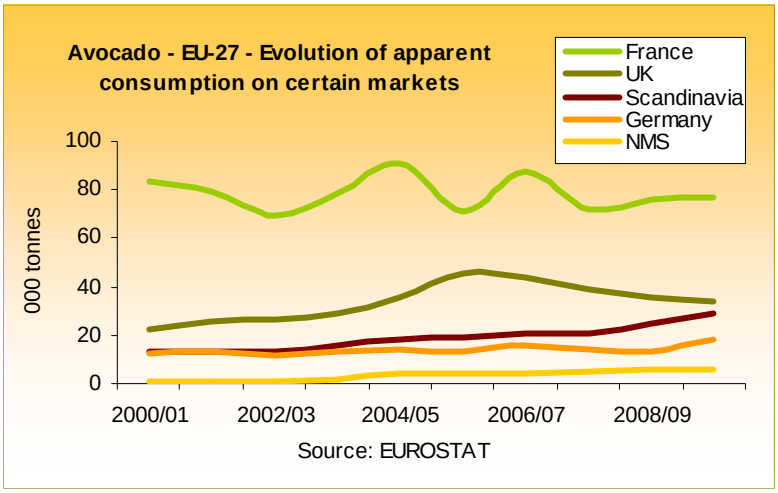

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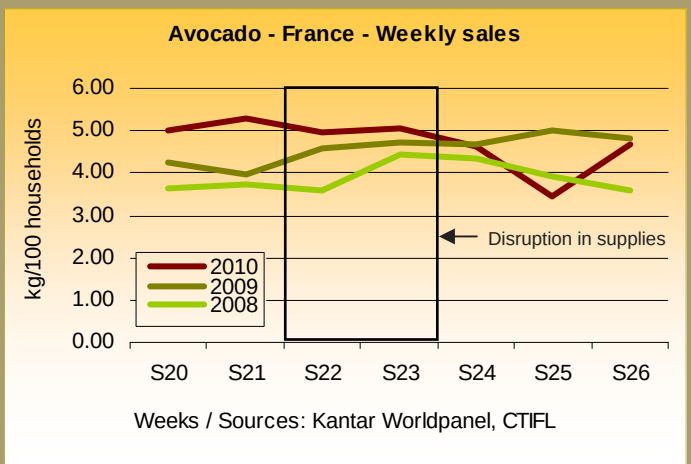
Results of the Peruvian season

Promotion works in France! Consumption panel figures confirm that the Peruvian campaign launched during the summer season gave very tangible results. From mid-May to mid-June, when meetings were held to promote awareness among professionals and the first operations were run in shops, the volumes sold in France increased by more than 15% even though European market supply dipped by more than 30%. The decrease observed in subsequent weeks was the result of the decrease in arrivals in the EU because of strikes in Peru and South Africa. The trend confirms what professionals felt and they observed a clear increase in Peru's market share during the period. It is true that France does not offer the security of contractual markets but the results of the Peruvian campaign confirm its responsiveness and its capacity to take large additional volumes.



erage retail price did not follow the fall in quay price for either loose or packaged fruits. In addition, fewer promotion operations were run in shops. This point should be considered in the defining of the promotion strategies of the major exporting countries in the next seasons with large supply. The market has shown twice in the past that it can take an additional 10 000 t in situations of ample supply comparable to that of 2009-10.

...and the direct impact of the downturn in the United Kingdom and the eastern part of the EU

The performance was more disappointing in the UK where consumption seems to have stuck at the level achieved during the minor 2008-09 season. However, efforts were made on promotion, with a new Chilean campaign. However, sterling was still desperately low against the dollar and this may well have discouraged a fair number of exporters. Here again, the economic downturn seems to account for the lifelessness of the markets in EU countries in Eastern Europe. Growth of consumption had been fairly regular in previous seasons but ceased totally in 2009-10. The weakness of local currencies against the dollar continued to weight on retail prices. The only exception to the rule in Eastern Europe—but outside the EU—was Russia.

Growth still strong in Scandinavia

The medium-sized markets displayed most growth. Unsurprisingly, the finest performance was achieved in countries in which promotion programmes had been organised. Scandinavia is the most revealing example as imports continued to increase markedly in the four countries concerned, approaching a total of 30 000 t. The market has nearly doubled in a little more than five years and Denmark and Sweden, where Chile runs promotion operations, have become European champions in terms of consumption per person, leaving France in third position.

Is the German market ripe for development?

However, the German market is probably the one that displayed the most interesting trend.

Avocado — European Union — Consumption				
	Estimated marketed volume in 2009-10*	Population in million inhabitants	Consumption per capita (gramme)	GNP-PPS (index)
EU-27	**215 613**	**494**	**437**	**100**
EU-15	210 198	391	537	
France	77 085	63	1 216	113
UK	34 168	61	562	119
Scandinavia	28 554	25	1 165	134
Sweden	*12 999*	*9*	*1 428*	*120*
Denmark	*9 734*	*5*	*1 803*	*127*
*Norway***	*4 522*	*5*	*962*	*187*
Finland	*1 299*	*5*	*245*	*116*
Spain***	20 500	45	461	102
Germany	17 907	82	218	114
Netherlands	18 328	16	1 118	132
Portugal***	4 000	11	377	74
Italy	4 835	59	82	104
Belgium	3 122	11	295	123
Austria	2 303	8	277	129
Ireland	2 518	4	586	143
Greece***	1 400	11	125	97
NMS of Eastern Europe	5 415	102	53	54
Poland	*1 966*	*38*	*52*	*53*
Baltic states	*1 427*	*7*	*204*	*60*
Czech Rep.	*534*	*10*	*52*	*79*
Slovakia	*263*	*5*	*49*	*64*
Hungary	*426*	*10*	*42*	*65*
Slovenia	*213*	*2*	*107*	*89*
Romania	*467*	*22*	*22*	*38*
Bulgaria	*119*	*8*	*15*	*37*
Luxembourg	226	1	452	279

* From June 2009 to May 2010: import-export+production / ** non EU / *** estimates
Sources: Eurostat, FAO, professionals

Consumption had been extremely stable at an average of 13 500 tonnes per year since the beginning of the century but now exceeded 18 000 tonnes according customs data. First, the discount chains that handle a large proportion of food retailing have reinvested in their fruit and vegetable departments and reference avocado much more frequently. Second, certain chains have switched to 'Hass' and some professionals feel that this has had a positive effect on consumption.

A season rich in information

The 2009-10 season provides a lot of information. It makes it possible to measure the effects on community market structure of the increase in volumes shipped from Chile and Peru, a trend that will probably continue in the coming seasons. The position of green varieties seems to be increasingly fragile in the western part of the EU, and these fruits are losing ground even where their position had been strong, as in Germany. Fortunately, certain buoyant segments remain and take large volumes, such as low price ranges where green varieties play an essential role at certain times of the year. It is also the case on the high-potential Eastern European markets where attractive retail prices have become a major factor, especially this season marked by the economic downturn. But there is margin for growth, as is shown by the strong increase in the volumes imported to Russia. In addition, there were also signs of the probable increase in consumption in markets with very high potential such as Germany. The promotion programme to be launched by Chile during the next season seems very well timed! However, the sluggishness of the main consumer markets should also be considered. Although the United Kingdom is probably suffering strongly from the economic downturn, promotion operations could probably increase consumption in France. It would be a pity to do without them in the future at a time when world production is still increasing strongly ■

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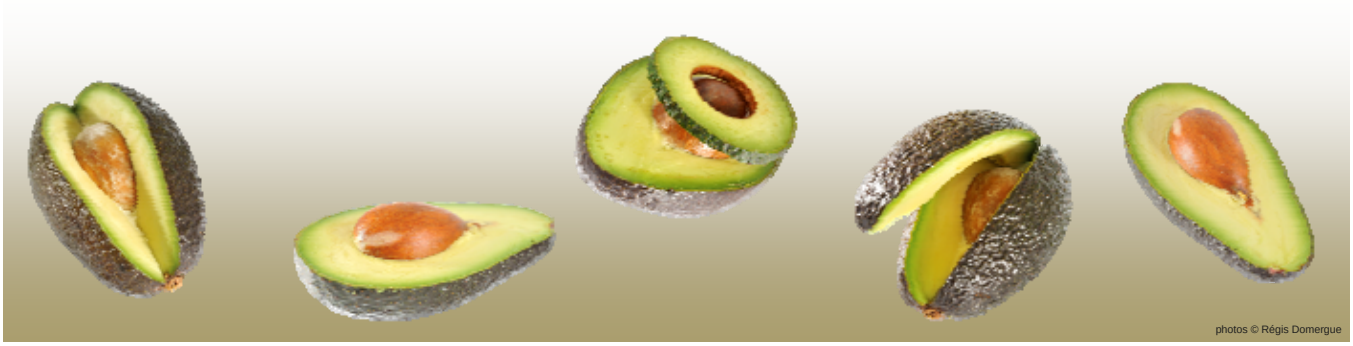

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2010-11 EU winter avocado season forecasts

Meagre supply for the world market after frost in South America

The great charm of the avocado market is that it is never the same from one year to the next! After generous supply for the world market in 2009-10, volumes should be markedly more moderate in 2010-11. Although the Mediterranean harvest should be good, that of the South American sources supplying the winter market will probably be well down.

Wurtz avocado

© Guy Bréhinier

Negative alternate bearing and frost in Chile

The increase in shipments from Chile, the second largest exporter in the world after Mexico, will be halted. First, alternate bearing, a physiological phenomenon, will be marked, especially as a record harvest was achieved in 2009-10. Second, a frosty spell in July 2010 has caused significant losses. The combination of these two factors will probably result in a 30 to 35% production loss. Export potential should reach 120 000 to 125 000 t in comparison with more than 190 000 t in 2009-10. But the decrease is only conjunctural and does not call into question the increase in Chilean avocado production. With 39 000 ha counted in 2007, including more than 8 000 ha of plantations not yet in production, and average yields at 9 to 10 t/ha and increasing, harvests should be large in the years to come unless frost remains frequent (2007 and 2010).

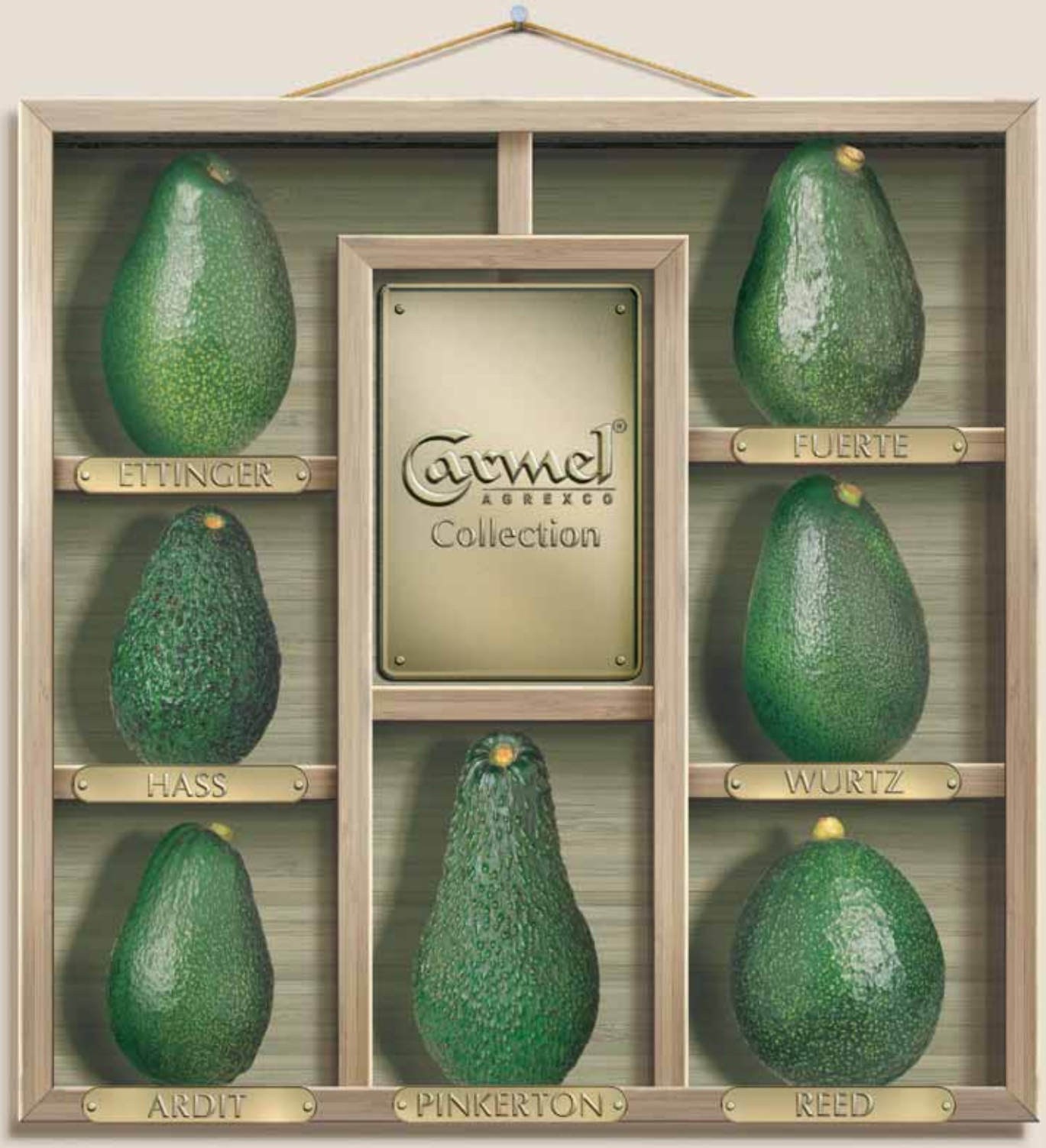
Avocado — Evolution of the main producer countries

tonnes	Production 2009-10	Trend 2010-11/2009-10	Exports 2009-10
Mexico	1 180 000	- 15 to - 20%	380 000
Chile	260 000	- 30 to - 35%	195 000
Israel	85 000	+ 10%	43 000
Spain	40 000	+ 10 to 15%	36 000

Professional sources

Poor form for the Mexican giant, especially at the beginning of the season

The world leader's avocado production will remain colossal at about a million tonnes. However, sources indicate that it should be down by a significant 15 to 20% for several reasons—alternate bearing and



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Avocado — Cultivated areas		
	Areas cultivated (ha)	**Trend**
Mexico (Michoacán)	*104 000	increase: 8 000 ha not yet harvested in 2008
Chile	**39 000	increase: 8 000 ha not yet harvested in 2007
Israel	6 400	increase: 900 ha not yet harvested in 2010, a total of 8 000 ha forecast for 2020
Spain (Malaga)	6 000	stable
South Africa	12 000	stable
Peru	7 500	increase: approximately 50% of the planted area is not yet fully productive

Sources: professional, *2008 SAGARPA and OEIDRUS, **2007 CIREN

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).

Chile — Avocado — Harvest calendar

J	F	M	A	M	J	J	A	S	O	N	D
	Chilenas										
				Negra de la Cruz							
					Fuerte						
						Hass					
	Esther										

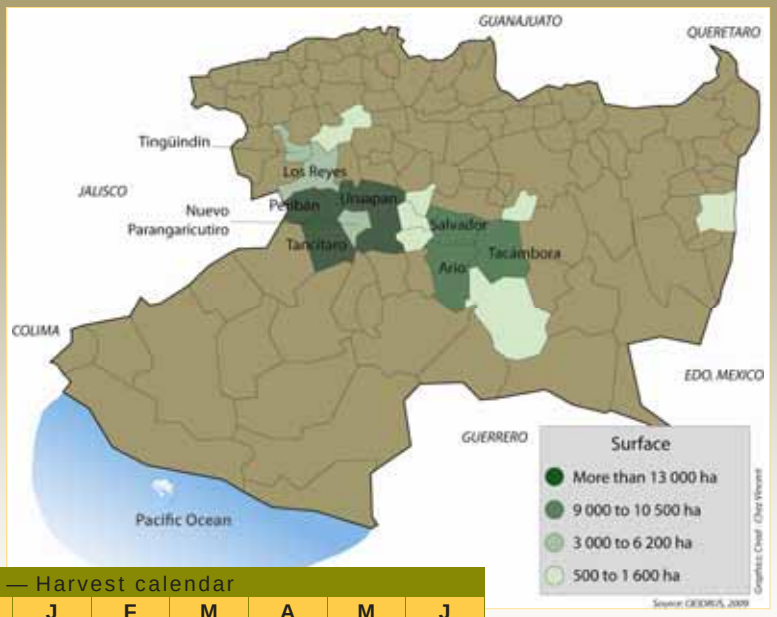
bad weather including a period of frost in February. The impact of the decrease has been particularly marked at the start of the season as production of the first flowering is very small, sometimes as little as a tenth of a normal harvest on some farms. The deficit should continue to be significant throughout the season but will be less marked when fruits from subsequent flowerings arrive (Aventajada since the second half of September). As in Chile, fresh increases in production are to be expected in the future. According to official Ministry of Agriculture figures, the Michoacán orchards increased by 20 000 ha from 2003 to 2008. It is difficult to believe this figure but it seems to be confirmed by professionals in the region. Growth is so strong that politicians stress the need for a framework or even to contain it to limit negative effects on the environment. Indeed, according to a recent study by INIFAP (Instituto Nacional de Investigaciones Forestales y Agropecuarias), the rapid increase in orchards area from 30 000 ha at the beginning of the 1980s to more than 100 000 ha today has caused the loss of 20 000 ha of forest zones. Some places south-east of Uruapan have lost more than 40% of their forests in the last 15 years, considerably reducing the quantity of water available in the region.

Larger harvest and planted area still increasing in Israel

In contrast with the situation in South America, the 2010-11 Mediterranean avocado season will be a generous one. The increase in Israeli production will be even greater than in 2009-10. The harvest will probably reach some 85 000 t, making it possible to increase exports to more than 45 000 t. The planted area is still increas-

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, Pueblas, 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.



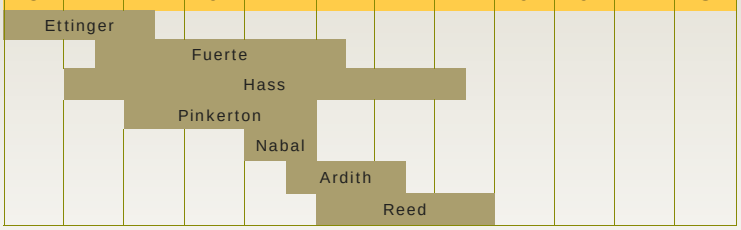
Mexico — Avocado — Harvest calendar

J	A	S	O	N	D	J	F	M	A	M	J
Flor loca											
		Aventajada									
				Normal							
									Marceña		

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, co-operative 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.

Israel — Avocado — Production calendar



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ingly rapidly and has reached 6 400 ha. The announced aim of exceeding 8 000 ha in 2020 seems to be realistic. The increase in planted area is also a movement of reconversion to 'Hass'. This variety accounts for 60 to 70% of the new plantings as the Western European market for green varieties is shrinking. The proportion of green varieties is currently slightly less than two-thirds and should fall to slightly more than half by 2020. The green cultivars used are also changing with 'Pinkerton' developing at the expense of 'Fuerte'.

A good 'Hass' harvest in view for Malaga

The harvest should also be larger than last year's in the Malaga region, with an increase estimated at 10 to 15%, depending on the source. However, like last year, wind and hot summer weather should result in a marked deficit of green varieties. But 'Hass' production seems to be substantial. Exports should be larger than those of the last season even though the domestic market is still growing and thefts of fruit in the fields have reached an alarming scale in recent years. As regards the future, the orchard area has been stable at 6 000 ha for several years and no substantial changes in production seem to be likely in the coming years.

The Moroccan harvest will also be larger than in 2009-10 thanks to positive alternate bearing and the increase in orchard area. Exports should exceed the record 2 000 t reached in 2008-09.

Prices likely to be high on the US market

The supplying of the EU market will depend not only on the production levels mentioned above but also on the proportions of shipments to Europe and North America decided by South American exporters. The United States is already favoured for reasons of proximity and market knowledge but should dip a little more in 2010-11 because of the high prices that will probably be asked.

However, the 2009-10 California season has been a generous one and will not end as early as in 2009 (fair quantities expected until October 2010). Prices should nonetheless remain high as shipments

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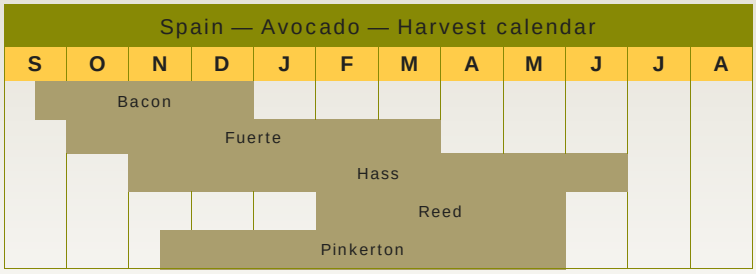
Spain

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.

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from Mexico should be much smaller because of the shortage of early fruits mentioned above. After a return to more generous supply from November to January, supply should be fairly moderate again from February onwards as the California harvest should be smaller in 2010-11. No forecasts in figures have yet been released but professionals consider that alternate bearing should make the harvest distinctly smaller than the large volumes of the preceding one.

Distribution of South American fruits not very favourable for the EU

In this context, the volumes shipped to the EU from Chile should be well down. The stated objective is less than 30 000 t against more than 50 000 t in 2009-10. This decrease in shipments should have a lesser effect on the markets commonly operating on a contractual basis (United Kingdom and Scandinavia) and those for which promotion operations will be run (the two preceding markets and Germany). Likewise, it is very probable that the increase in Mexican shipments to Europe will be only moderate in spite of increased interest from European importers. Cost prices may remain high because of the size of the harvest and the attractiveness of the US market. In addition, the growth of other profitable markets such as Japan or those with logistic advantages such as Canada (see preceding article) is also an aspect to be taken into account.

The European market is more open to green varieties and complementary sources

The context thus seems much more open than last season for Mediterranean sources with larger volumes to sell. Shelf space awarded to green varieties should increase if market prices are right! Indeed, Israeli exporters have a substantial alternative market in Russia, which took 6 000 t last year, that is to say nearly 15% of the volumes. Complementary sources such as the Dominican Republic, Brazil, Kenya ('Fuerte'), etc. should also benefit from renewed interest ■

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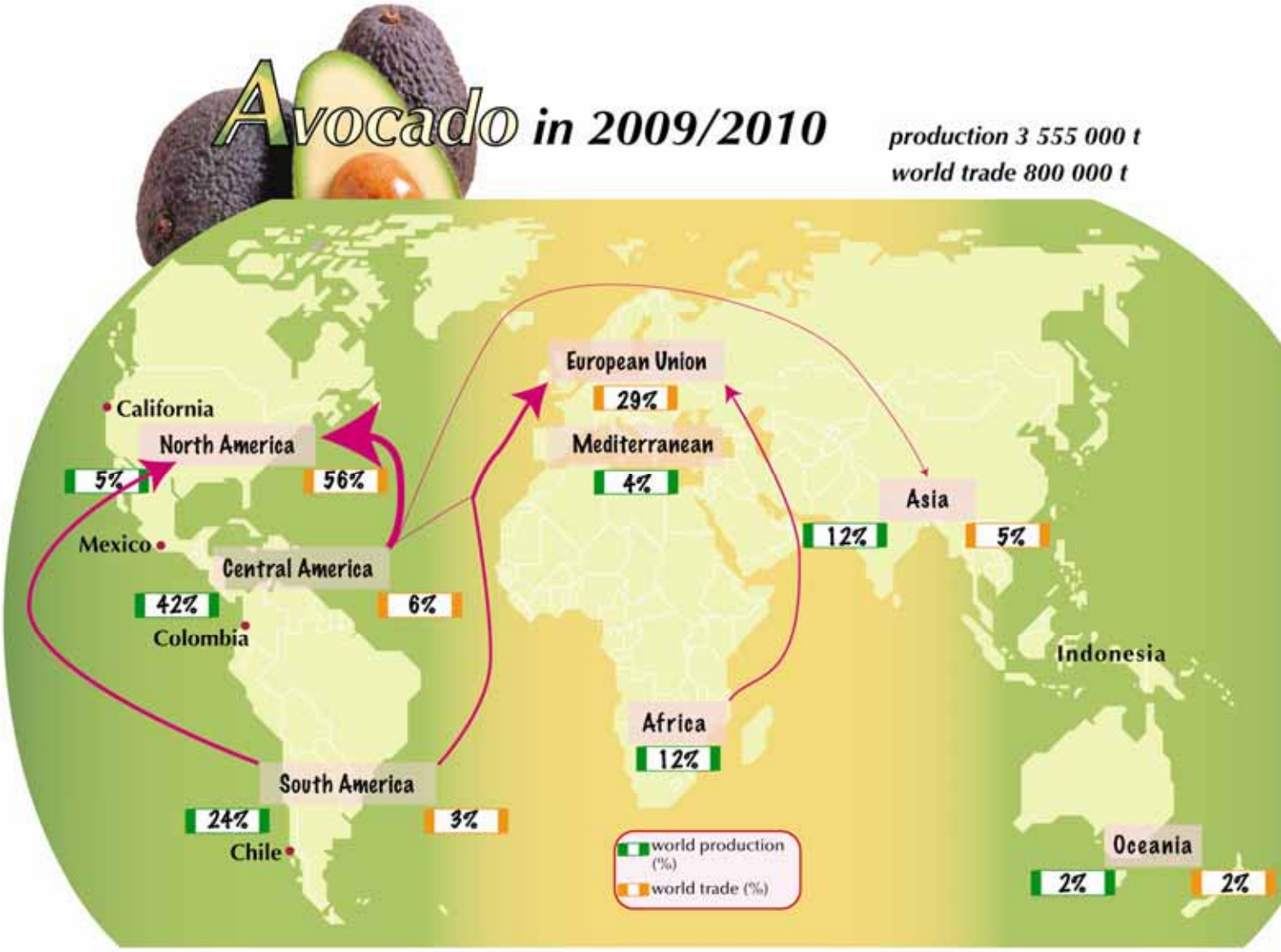
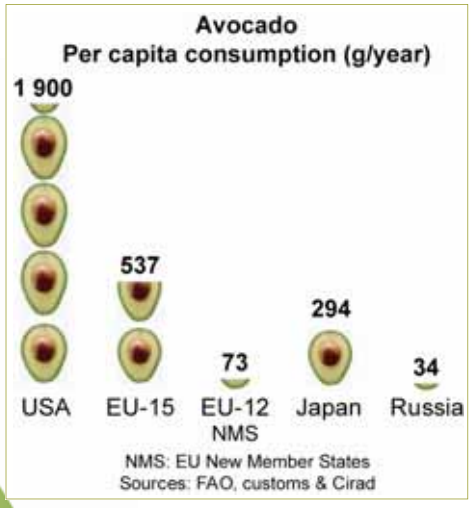


Avocado — United States imports — July to June											
tonnes	**1999-00**	**2000-01**	**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06**	**2006-07**	**2007-08**	**2008-09**	**2009-10**
Total, incl.	**55 507**	**79 944**	**96 058**	**126 679**	**138 928**	**206 314**	**231 715**	**300 375**	**319 920**	**371 662**	**420 360**
Mexico	13 067	11 941	24 450	29 612	42 947	73 943	132 040	166 001	217 000	301 695	270 200
Chile	28 903	53 986	57 890	83 877	78 680	120 890	85 200	117 928	85 199	56 363	133 888
Dom. Rep.	10 162	9 550	11 193	10 965	17 067	11 254	14 334	16 434	15 219	13 584	15 984
Bahamas	180	200	263	236	118	109	0	0	-	0	0
New Zealand	3 147	4 263	2 259	1 882	116	119	57	0	2 500	-	269
Others	48	4	3	107	0	0	85	24	2	3	20

Source: US customs, code 080440

Avocado — Japanese imports — July to June								
tonnes	**2002-03**	**2003-04**	**2004-05**	**2005-06**	**2006-07**	**2007-08**	**2008-09**	**2009-10**
Total, incl.	**15 311**	**29 595**	**29 435**	**28 342**	**28 463**	**24 963**	**26 054**	**37 520**
Mexico	15 092	29 015	28 467	26 826	26 076	23 569	25 220	33 603
Chile	12	169	469	390	1 621	398	224	1 673
New Zealand	195	334	269	951	142	893	533	1 221
United States	12	74	230	176	624	100	77	1 023
Autres	0	2	1	0	0	3	0	0

Source: Japanese customs, code 080440010



Avocado World production	
2009-2010	**000 tonnes**
World	**3 555**
Mexico	1 180
Chile	260
Indonesia	258
United Staes	209
Dominican Rep.	187
Colombia	165
Peru	156
Brazil	147
China	100
Guatemala	96
Kenya	94
Israel	78
South Africa	76
D.R. of Congo	65

Avocado World exports	
2009-2010	**000 tonnes**
World	**800**
Mexico	380
Chile	164
Israel	43
South Africa	45
Peru	53
Spain	36
Kenya	12
Dominican Rep.	19
New Zealand	13
Guatemala	5
United States	7
Ecuador	5
Venezuela	2
Argentina	2

Avocado World imports	
2008-2009	**000 tonnes**
World	**800**
United States	420
EU-25, of which	243
Netherlands	79
France	67
UK	27
Spain	26
Japan	37
Canada	29
Salvador	6
Australia	11
Honduras	8
Argentina	6
Costa Rica	5
Guatemala	4

Sources: FAO, EU, US, Japanese customs, CIRAD

Sources: professional sources, FAO, EU and Japanese customs, IFAS

Avocado — Russian imports							
tonnes	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Total, of which	**1 106**	**1 671**	**2 371**	**3 135**	**4 392**	**4 806**	**5 827**
Israel	423	832	1 345	1 805	2 769	2 016	3 316
South Africa	542	674	875	1 062	1 225	1 923	1 445
Peru	2	11	10	34	42	442	438
Kenya	18	20	7	39	110	150	342
Spain	91	89	77	126	159	164	163
Others	30	45	56	69	87	111	124

Sources: COMTRADE, UN stat

Avocado — Canada imports — July to June								
tonnes	**2002-03**	**2003-04**	**2004-05**	**2005-06**	**2006-07**	**2007-08**	**2008-09**	**2009-10**
Total, of which	**8 745**	**16 889**	**19 013**	**19 215**	**20 931**	**21 528**	**22 527**	**28 928**
Mexico	8 046	16 250	18 293	17 420	18 471	18 143	20 474	25 114
United States	699	639	720	1 795	2 460	3 385	2 053	3 814

Source: Japanese customes, code 080440010

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**	**2009-10**
Total, of which	**168 797**	**166 897**	**174 965**	**166 699**	**174 108**	**210 667**	**181 383**	**235 448**	**230 148**	**205 340**	**258 537**
EU imports	**110 797**	**111 397**	**109 665**	**121 699**	**112 108**	**163 667**	**151 383**	**198 448**	**185 148**	**166 340**	**218 337**
Israel	44 548	38 841	44 333	26 529	25 299	50 481	26 538	55 931	25 936	30 071	38 512
Chile	9	35	528	2 190	4 046	11 532	17 801	40 379	25 692	15 832	51 383
South Africa	38 205	38 908	36 266	36 404	29 872	46 955	35 934	37 944	50 451	38 377	47 000
Peru	1 299	2 849	4 401	11 266	14 590	18 096	30 508	35 857	49 829	45 661	54 000
Kenya	10 294	15 600	11 523	19 828	16 236	15 458	13 641	11 999	11 841	15 038	11 500
Mexico	14 479	13 002	10 139	21 925	18 705	16 516	20 769	10 289	12 695	11 647	9 326
Dominican Rep.	830	345	591	195	842	1 264	901	2 209	3 105	2 077	2 900
Argentina	58	326	440	460	709	1 224	1 804	1 709	970	1 984	0
Brazil	156	569	661	715	979	931	1 442	1 447	1 790	2 797	2 500
Swaziland	104	112	235	411	252	352	395	178	530	313	-
USA	304	354	70	61	3	62	1 064	50	299	44	100
Zimbabwe	137	285	207	739	404	599	260	323	128	131	-
Dominica	71	43	134	116	43	20	18	36	84	151	139
Morocco	0	1	1	641	0	-	-	-	1 698	1 908	977
Others	302	129	135	219	128	176	308	97	100	309	-
European production*											
Spain	58 000	55 500	65 300	45 000	62 000	47 000	30 000	37 000	45 000	39 000	40 200

*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 main avocado varieties

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

The Guatemalan race

Persea nubigena* L. Wins var. *guatemalensis

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

The West Indian race

Persea americana* Miller var. *americana

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

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)

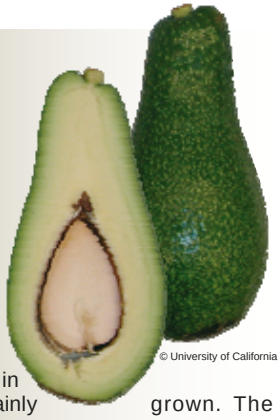
'Hass' has replaced 'Fuerte' as the sector standard. It is currently the most commonly planted avocado in the world. It was selected by Rudolph Hass in California in the early 1920s and registered in 1935. The tree is vigorous and highly productive. The fruits vary in shape in some production regions,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

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)

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).



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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

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.

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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

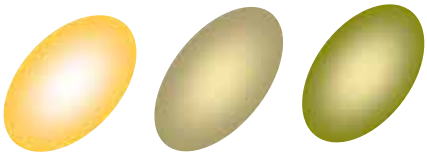
This variety of Californian origin was selected by James Reed. Registered in 1960, the patent expired in 1977. It has succeeded in conserving the qualities of its parents 'Nabal' and 'Anaheim' without their negative features. It is fairly productive and alternate bearing is not marked. Its resistance 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.

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)

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.



Photos © Guy Bréhinier

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.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Packing

Fruits with the desired maturity index are sorted, washed and graded before packing. Each market has its own 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 O2 levels combined with high CO2 reduce respiration and ethylene production. An O2 content of 2 to 5% and CO2 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 O2 and CO2 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.

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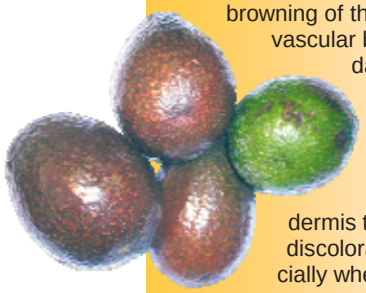
Ripening

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.



O2 deficit and excessive CO2. Too great a decrease in the O2 level (in particular to less than 1%) can cause irregular brown spotting of the epidermis that can spread to the pulp. Too high a CO2 level (over 10%) can cause discoloration of the epidermis and the development of unpleasant flavours, especially when the O2 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.

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