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FRuiTROP

English edition

Close-up

AVOCADO

European apples and pears
Prospects for 2011: good potential in apples, large potential in pears

The banana world is in turmoil. The intensity of the practically traditional summer crisis has been rarely equalled

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Avocado

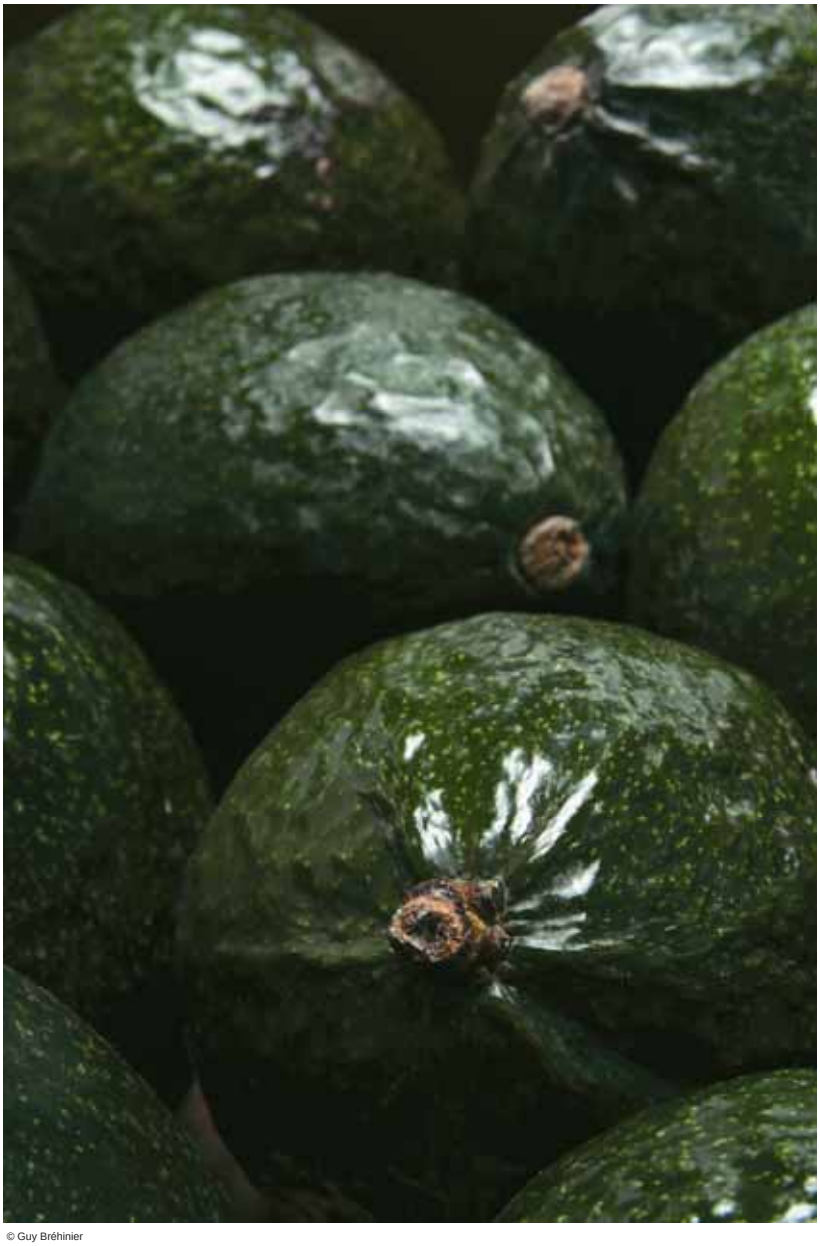
A report prepared by
Eric Imbert

Contents

The second part of the 2000s was marked by a 'South Americanisation' trend on the European avocado market. Growth of arrivals from Chile and Peru was strong and rapid, profoundly changing the landscape by upsetting the balance of power between source countries and stimulating renewed interest in the fruit thanks to the 'Hass' variety, even on markets that had previously shown little interest. But will the movement continue in the coming years? The increasingly affirmed consumption dynamics in the United States, the real possibility for Peru to sell its production there and the likelihood of more moderate growth of Chilean production than expected should probably encourage professionals to ask this question. FruiTrop suggests a few lines for reflection in its annual opus devoted to avocado and also describes the scene set for the 2011-12 season, with a brief discussion of the last season.

The world avocado market

The United States' large appetite puts the world market under pressure



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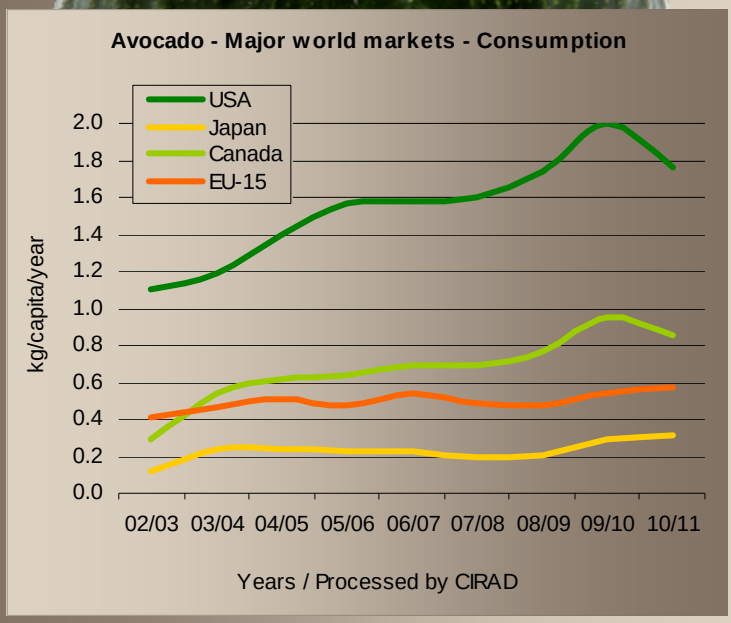
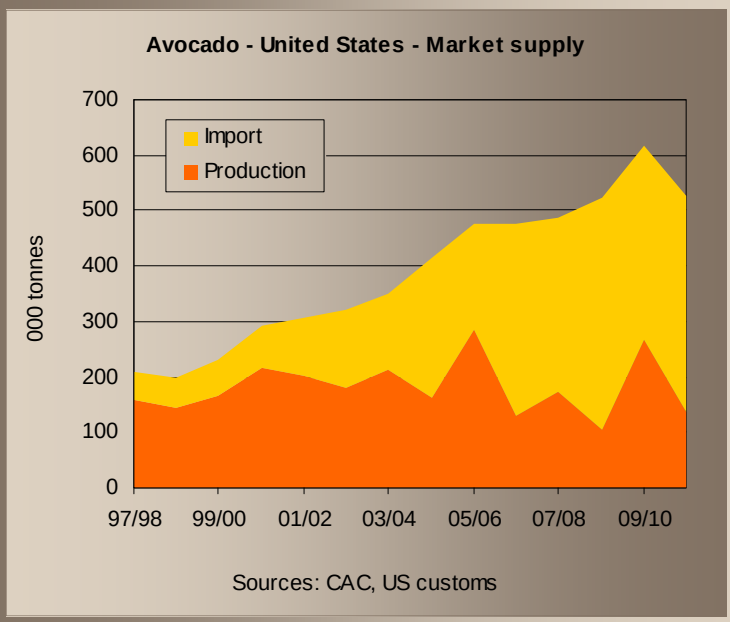
Why refer once again here to the exemplary performances of the US market? First, because we never get tired of discussing fine machines—and the system set up by the Hass Avocado Board (HAB) is undoubtedly one of the best selling machines in the fresh fruit and vegetables universe! It demonstrated this once again in 2010. Field actions conducted with an enormous budget assembled thanks to the levy on each box sold made it possible to clear the symbolic consumption level of 2 kg per person per year for the first time. This record is the second good reason for discussing the US market, especially for readers in Europe where sales peak at a quarter of this level. However, although it is important to take another close look at what is happening on the other side of the Atlantic, the main reason is that of analysing the indirect effects of the strong American dynamics on the world avocado trade and more specifically on the EU market. But before doing this, it is necessary to grasp the past and probably the future scale of the appetite for avocados shown by American consumers.

Solid 10% annual growth in the USA

For Bergson, 'Forecasting means projecting into the future what we have observed in the past'. If we apply this, the American market is not likely to stop growing. Annual consumption per person doubled in the decade starting in 2000 and reached a record 2 kg in 2010, as mentioned above, with annual growth of 10% that was steadier than most present financial investments (see graph). The volumes sold thus increased from some





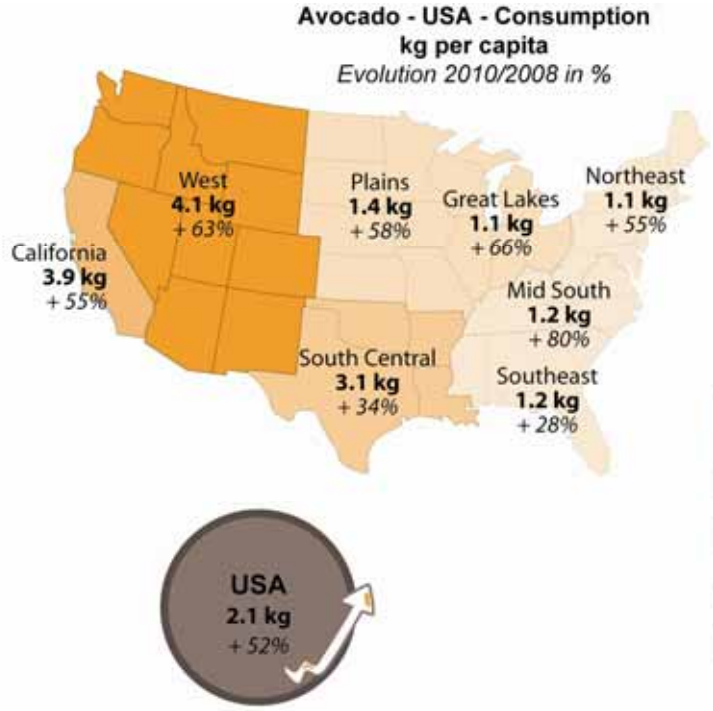
300 000 t at the beginning of the 2000s to nearly 600 000 t in 2009-10. As domestic production generally only covers 40% of supply, imports rocketed, exceeding 400 000 t in 2009-10.

Can the machine go wrong?

Can this dynamics last or will there be a stumbling block in the future that will affect the upward curve? The question has to be asked as although the movement seems to be as regular as the finest performance of Swiss watch making, experience shows that stagnation is inevitable in consumption phenomena when levels become very high, as is already the case in California and in the west of the country more generally. However, the most recent consumer surveys do not reveal any warning signs of a break in the pattern. The volumes sold in these sensitive regions have continued to increase at a rate close to the national average and more than 20% from 2008 to 2009 and from 2009 to 2010. Only the central part of the south is beginning to run out of steam (Texas, Louisiana, Oklahoma, Arkansas). The surveys also confirm that areas of increasing growth are appearing in the north-east quarter of the US where purchases by the 130 million who live there are growing strongly. Finally, the Latino population that plays a driving role in the present growth dynamics should double and exceed 100 million in 2050 if the immigration rate remains stable. It is therefore justified to consider that US market growth should not weaken, at least in the medium term.

A need for a colossal increase in volumes in five year time!

How much additional volume might the US market handle in the medium term? Examination of a 5-year horizon—close enough to avoid the plateau phenomena mentioned above—shows that consumption should increase by about 500 g per person per year. This would require supplying American consumers with an additional 150 000 t to cover their appetite. In 10-year forecasts that are a little more uncertain, the HAB predicts growth of 300 000 t. This would take the US market to 900 000 t, that is to say a greater volume than that traded worldwide today!



Avocado - USA- Regional consumption

	Consumption 000 tonnes	Population millions	Market share
California	146	37	24%
West	126	31	20%
South Central	122	40	20%
Northeast	62	55	10%
Great Lakes	50	46	8%
Southeast	43	36	7%
Mid South	42	34	7%
Plains			4%
Total	**617**	**299**	**100%**

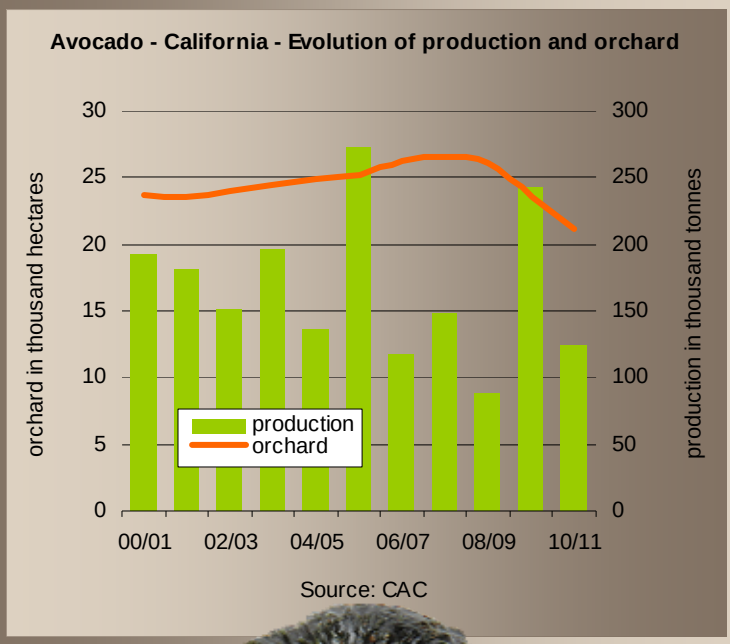
Sources: Usda, Amric, Nass, HAB / Processing and graphics: Cirad-FruiTrop

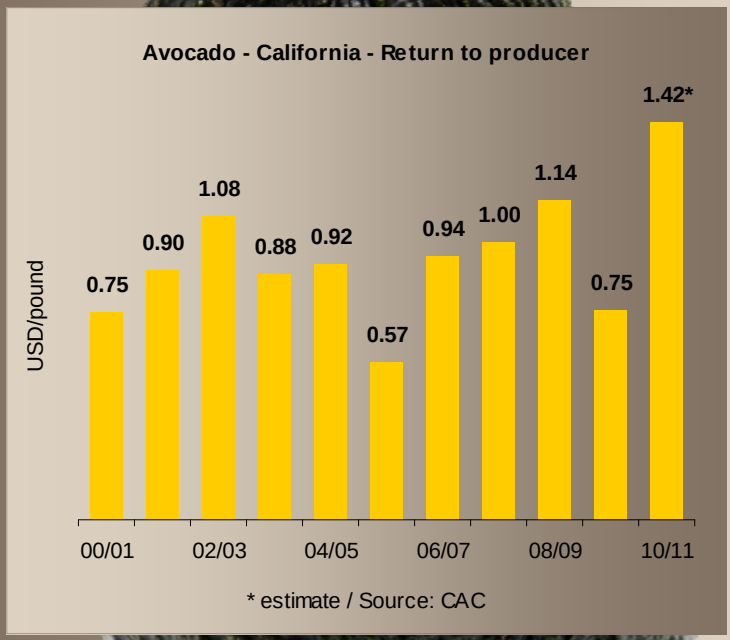
Promotion of 'Hass' in the United States: an example to follow

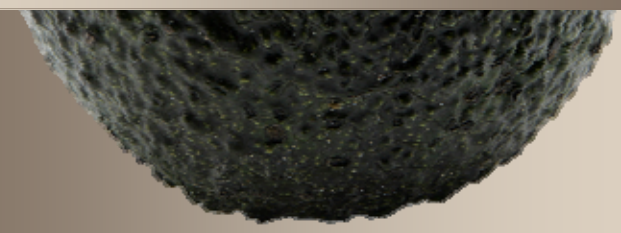
US producers very soon succeeded in becoming organised and in 1961 started in-depth promotion of avocado. The keystone of the system is the levying of a tax on each box of Californian 'Hass' sold in order to finance marketing. The system was strengthened in 2003 in a very simple but brilliant way. Increasing consumption is a joint challenge that outweighs competition between producer countries and so the import sector not only became involved in financing marketing by the extension of the tax to any box sold in the US, whatever the source, but also in the management of the budget and market regulation via the Hass Avocado Board (HAB). The results have been amazing: consumption has more than doubled since the HAB was set up in 2003 and price per box has been kept practically stable at import and shipping stages.

Thanks to the 2.5 cents levied on each lb of avocado sold in the US, the HAB has a USD36.4 million promotion budget in 2011. This is used partly for generic promotion operations and the rest redistributed to all the sources present on the market so that they can run their own promotion. In the years to come, generic promotion is to be focused on the positive effects for health of eating avocado: reduction in the risk of cardiovascular diseases, control of weight and diabetes, enhanced absorption of liposoluble vitamins.

More information on: www.avocadonutritioncenter





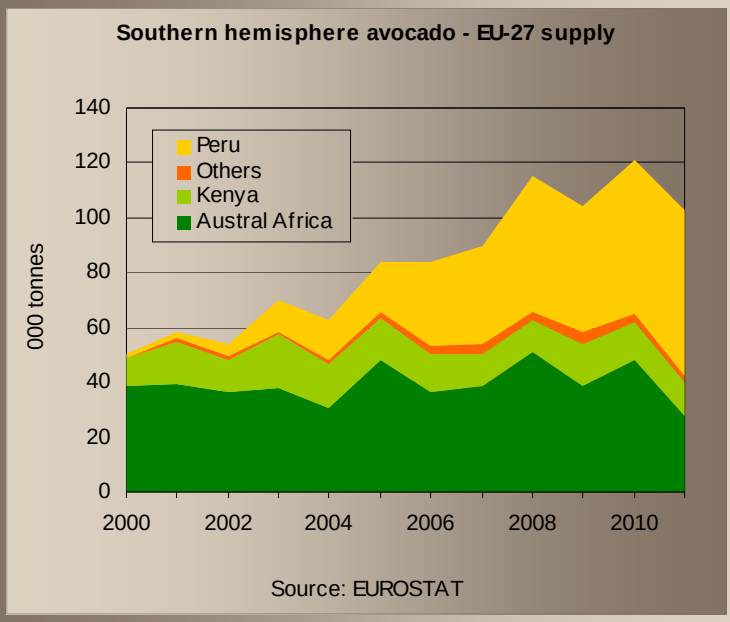


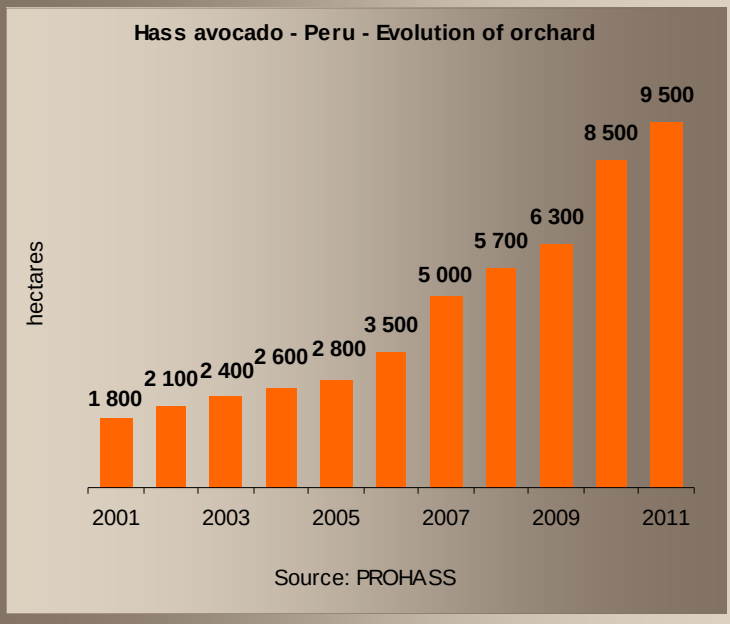
Is the development of other markets in the world hindered by American growth?

Where can such volumes be found and this in a relatively short time, as anybody who knows anything about orchard crops will know? This has serious implications and calls into question a world market development scenario in which rapidly growing South American production may pour into Europe. In the new context, should it not be feared that the development of the EU market and the other world markets may be curbed by US market growth? Once again, the past sheds interesting light on the point but in a slightly worrying way: in the last decade, the United States has 'captured' two-thirds of world export growth.

What can be the share of domestic development?

Will California, the only region in the country to produce 'Hass', play a major role in this development? This is what is wanted by the California Avocado Commission (CAC) which wishes to keep national production at its present share of around 40%. But this is a real challenge! First, the price of agricultural water is major subject for concern, especially in southern California where it has reached about USD 1 per cubic metre and forms nearly 70% of production costs (4 000 to 5 000 cubic metres per hectare per year is necessary). The availability of labour is also very limited and may become even more so if the plan to tighten controls of workers with no papers is adopted without setting up specific reception measures for migrants in the farming sector. These problems are added to the recurrent question of profitability, leading to a decrease in the area under avocado in California in recent years. Is it possible to believe in a trend reversal in this context? It is not impossible as the decent financial results in recent seasons, achieved in particular by the avocado differentiation campaign with the slogan 'Hand grown in California', to which 70% of Americans said they were sensitive, brought back a degree of optimism to the profession. In addition, the CAC is very active in seeking solutions to these major problems with the bodies concerned and also extends technical solutions to reduce cost prices (especially high planting density). Finally, it might be possible to increase the cultivated area in San Joaquin Valley where water and land are cheaper. But the curve has not budged, which means that the increased





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consumption expected in the United States in the next five years will be covered by imports alone.

Towards a slowing of EU market growth in the summer?

What are the consequences for the EU market? The first information for the summer season will be available in 2012. At the end of July this year, Peru, the leading southern hemisphere exporter and the main supplier of the EU market in the summer, obtained the lifting of the disinsectisation obligation for produce shipped to the United States. This opens the US frontier and Peruvian exporters have an alternative market with many advantages in comparison with the European Union. The most obvious is transport reduced by two weeks. In addition to the direct saving involved, faster transport allows better visibility on the market and less commercial risk. What proportion of the volumes will be shipped to the United States? This is a capital question as the substantial European market growth in the summer since the mid-2000s concerns practically only Peruvian fruits: 85% of the additional 56 000 t imported by the EU from 2001-02 to 2009-10 (for lovers of statistics). The Peruvian press and professionals affirm that the 40% planned in 2011 will be repeated in 2012 (1 500 containers announced, that is to say more than 30 000 t of the total forecast of 75 000 t). If this is the case, the additional annual 10 000 t produced by an orchard area increasing by 1 000 ha per year since 2005 should allow the maintaining of the present level of community supply, that is to say some 45 000 to 55 000 t per year. However, it seems difficult at least in the medium term to continue to cover the annual summer market increase of some 7 000 t on the EU market, the case since 2005.

Or a change in tactic in Peru?

But in time might not the volumes shipped to the United States increase well beyond the 40% announced for 2012? The example of Chile, a country in a comparable situation as regards logistics, shows that the risk should not be ruled out. Chilean exporters reserve an average of 65 to 70% of their volumes for the US market, even though the latter is distinctly less profitable than

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during Peru's trade window. Should the fact that competition consists mainly of Californian production be considered an obstacle to the development of Peruvian exports? This is not the case for Mexico. It is true that Peru does not have the close links that unite Mexico and California, but the volumes involved are much smaller. Thus in a far from improbable situation in which Peru might ship a larger proportion of its production to the US market, shipments to the EU would inevitably decrease. The duration would depend on the rate of increase in orchard area in the years to come.

Growth pockets among other summer avocado market suppliers?

Would other sources be capable of covering EU growth if Peru were to cease to be a driving force? It is true that production is increasing in South Africa, the only substantial alternative supplier in the southern hemisphere. However, the increase in planted area of some 200 to 250 ha per year is not at all on the same scale as that in Peru. In addition, the domestic market is beginning to become attractive and South African exporters also wish to profit from US market growth and have been negotiating with the US sanitary authorities for several years.

Areas under avocado are increasing in Kenya and technical support programmes for small producers, aimed at improving quality, make this source more credible. However, logistics are a constraint at the moment.

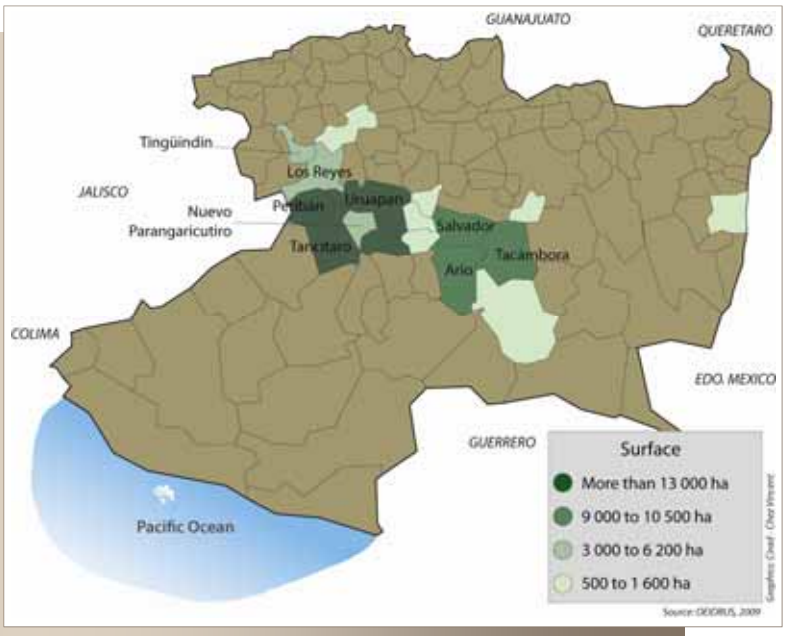
The sector is also developing in Brazil but here again only moderate quantities can be expected in the medium term. Argentina is and will probably remain a minor supplier (soil and climate conditions curb the development of the crop).

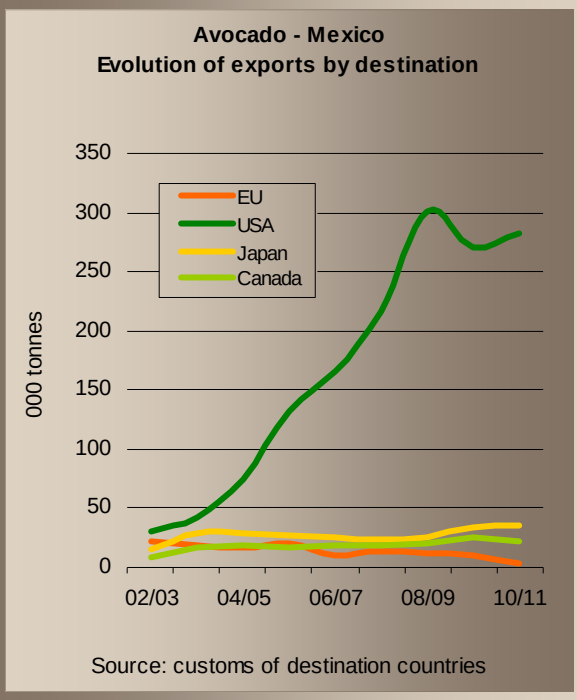
Australia is already a substantial producer and will probably soon be more visible on the international market as the orchard area is increasing rapidly. But the logistic challenge involved in exports to Europe and the Asian alternative markets makes it difficult to envisage Australia becoming a major EU market supplier. To sum up, although greater volumes are to be expected in the medium term, the actual quantities seem fairly modest.

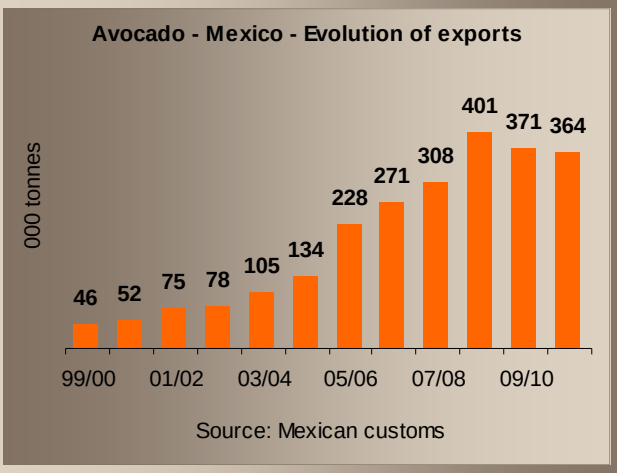
Mexico

Orchard **134 000 ha, increasing**

Production **800 000 to 1 200 000 t**







The widening gap between Mexico and Europe

If the question of competition from the US market may considerably slow the growth of the EU market in the summer, what about the winter season? What will be the direction taken in the coming years by the Chilean and Mexican exporters who supply both the United States and Europe? The 2010-11 season confirmed, as was suspected, that Mexican exporters have clearly decided whose side they are on. It is true that for many good reasons the United States is a natural market for Mexico. Its proximity, especially with the western US where consumption is highest, reduces transport costs and commercial risk. In addition, the large population of Mexican descent forms an interesting market foundation.

Mexico is no longer one of the EU's basic suppliers but a spot source shipping complementary batches when prices are right. The consequences of this change go further than just a decrease in volume, which was hardly more than 3 000 t in 2010-11, that is to say less than 1% of total avocado exports. A large proportion of European importers mention another latent sign of lack of interest: the average quality of the volumes shipped to the EU has tended to worsen in recent years. In this context, we can only praise the 'Mexico calidad suprema' approach that focuses on guaranteeing the quality of Mexican horticultural produce in conformity with

market expectations and that has made avocado one of its priorities. Finally, as regards promotion, Europe is increasingly the poor relation even in comparison with smaller markets like Japan and Canada but where Mexico ships the greater part of supply. In 2010-11, 22 million dollars was devoted to promotion in the United States, 1 million to Japan and Canada and not a single peso to Europe!

A challenge for Mexico that could have serious consequences for the EU market

In spite of the very logical favouring of the United States, can Mexico continue to handle the expected market growth there, given the volumes required? If not, it can be imaged that Chilean operators might no longer consider the development of the EU market to be a priority—they supplied 50% of supplies in 2009-10, the last year in which production was normal. The challenge is all the more difficult to take up for Mexico as it must also supply its own expanding domestic market, if only because of population growth (a population increase of 15 million is forecast in 10 years) and the exceptional amount consumed (6 to 7 kg per year according to official figures and 10 kg according to professionals). So at least 10 000 t per year more must be found for the domestic market alone.

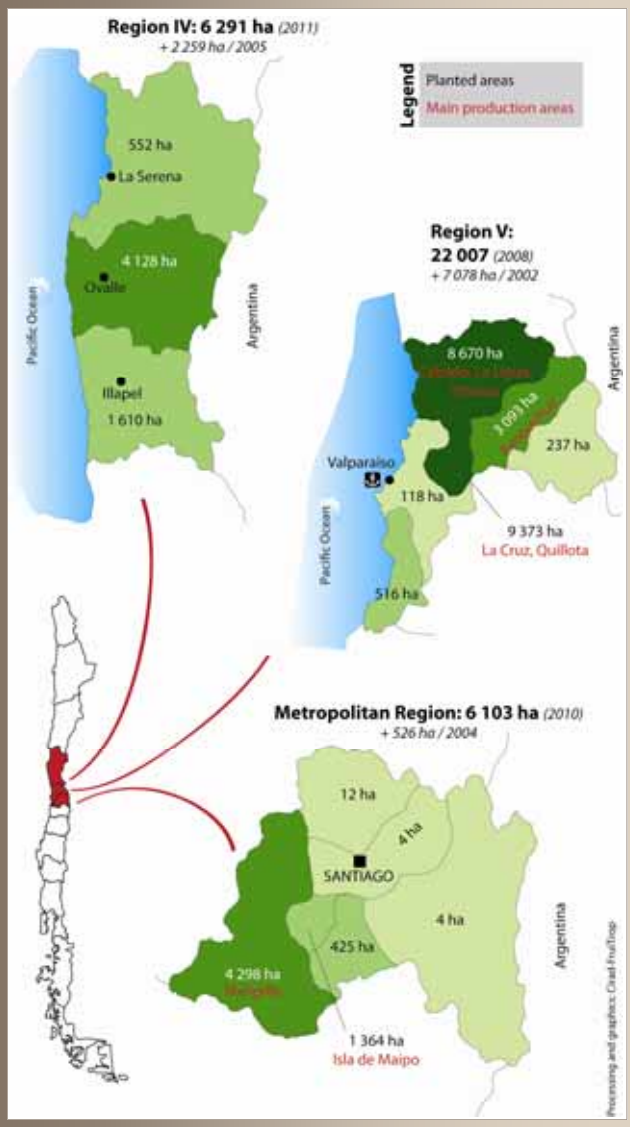
A giant that is still growing

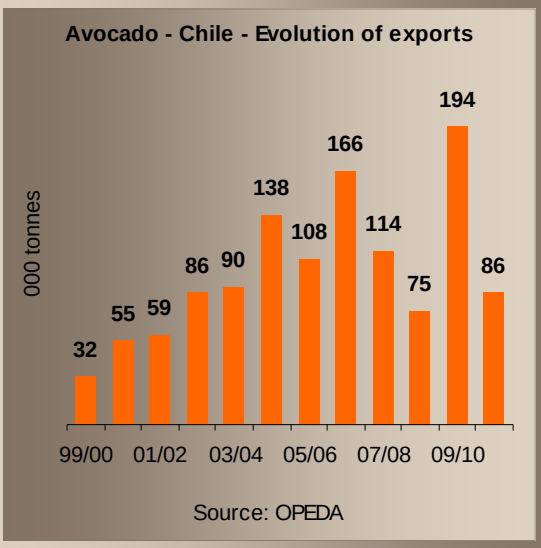
However, Mexico seems to have sufficient capacity to meet the challenge. It is true that there is growing polemic in Michoacán about the impact of avocado growing on biodiversity and water resources. But this is not at the point where the authorities want to curb a sector that is a strong foreign currency earner (700 to

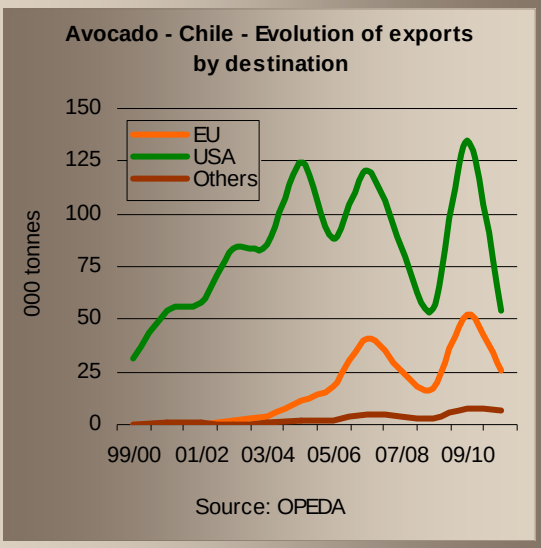
Chile

Orchard **36 400 ha, stable**

Production **150 000 to 250 000 t**







800 million USD in recent years) and job creator (according to a 2007 study the sector counts 11 700 direct jobs and 70 000 temporary jobs). In addition, the financial returns are so satisfactory that growers are very inclined to plant and so the planted areas are increasing very rapidly. According to official figures, the Mexican orchard area that is more than 130 000 ha today increased by 20 000 ha between 2005 and 2010, and 10 000 ha was in Michoacán alone. Even though yields are only moderate at about 9 tonnes per hectare, Mexican growers should continue to generate extra production of about 40 000 t per year; this is sufficient to meet domestic market demand and much of that of the United States during the winter. The sanitary certification of orchards has never seemed to be a limiting factor in recent years and has always moved with market requirements (about 50% of the planted are in Michoacán is certified today).

Anchorage in the EU market will remain a necessity for Chile...

The situation should not change radically for Chile in the years to come as Mexican competition is not truly reduced by the growth of the US market. Only a slight increase in the share of volumes earmarked for the United States—currently 65 to 70%—could occur as a result of the gradual switch to zero customs duty in 2015 and consumption growth on the East Coast where the difference in competitiveness with Mexico is slightly smaller.

Does Chile have other markets that could overshadow the EU? Domestic sales have increased substantially in recent years thanks to the exemplary work of the Comité de Palta and exceeded 70 000 t in 2010-11, making Chile itself the main destination for Chilean avocado during the season. However, it is reasonable to think that as consumption is 5.5 kg per person per year, there is not much room for improvement. Then comes Argentina, with a population of nearly 40 million and one day away by lorry and where sales are no more than 200 g per person per year. The Comité de Palta considers it to be strategic and is making considerable efforts in promotion. Shipments have been about 7 000 t in recent years and should continue to increase but without weighing heavily on supplies for the other destinations. Europe will thus remain an essential market for Chilean exporters.

...but with no serious prospects of an increase in volumes for lack of strong production growth in the medium term

But what growth will be displayed by Chilean production in the medium term? The spectacular increase in area to 34 000 ha in 2008, leads to considering that production

could reach 300 000 t. However this forecast was not borne out as the harvest reached a maximum of some 250 000 to 260 000 t in 2009-10. Why is there such a difference? The devilish frequency of frost periods in recent years seems to some way towards answering the question. It appears that some growers were stimulated by the US market boom in the mid-2000s and decided wrongly to use zones that are at the limit for avocado. Not enough water seems to be available in some parts of the Cabildo, Petorca and La Ligua valleys while some parts of the plain in the Metropolitan Region and Petorca are too often liable to frost. In addition, professionals feel that the area under avocado in Chile is no longer growing, even though this is not confirmed by any recent cadastral figures for Region V, where most of the orchard area in the country is found. It is true that some longstanding growers are continuing to plant avocado. However, the depreciation of the US dollar and increased production costs mean that they are not as numerous as in the mid-2000s. In addition, part of the orchards planted in the zones at the limit mentioned above have been grubbed up and replaced by species that are more cold-resistant or with smaller water requirements. As a result, production should not exceed 150 000 to 250 000 t in the coming years, that is to say close to that observed since 2009-10.

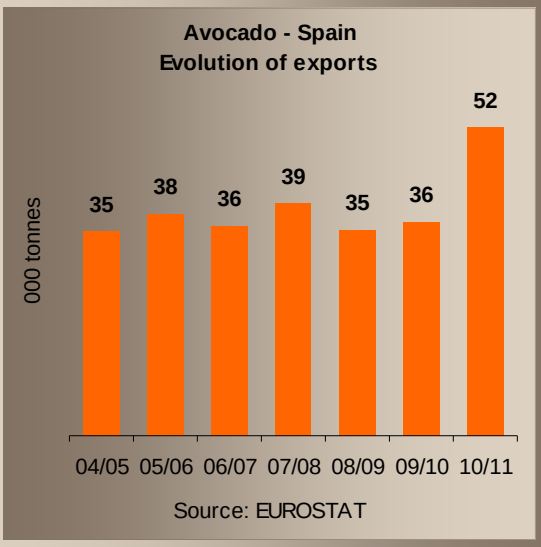
The Mediterranean as the main driving force behind European market growth in the years to come?

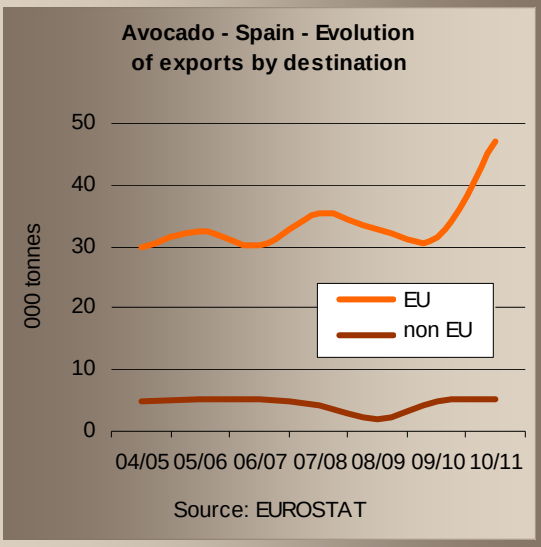
The Mediterranean countries are historical, natural suppliers for logistic reasons and should continue to supply EU growth. Here, Israel is the main force. The planted area is increasing strongly and production should attain 120 000 t by the middle of the decade, that is to say about 30 000 t more than present production. The share of 'Hass' will

Spain

Orchard **8 000 ha, stable**

Production **40 000 to 65 000 t**





Estimate based on exports and shipments from October to April or May.

also increase at the expense of green varieties. The additional volumes will be divided between the EU and Russia, where Israel is dominant in the winter on a market that took no less than 8 000 t in 2010.

In addition, Morocco should considerably increase market releases of avocado (see following article). Spain will remain a key source as regards supply but production should not increase markedly. Planted areas have been stable for several years in the Axarquia, a region close to Malaga and from where most of the crop is shipped. The volumes distinctly greater than average in 2010-11 are explained by favourable weather conditions that allowed the full expression of production potential.

Towards great tension in international trade that is not favourable for the EU

Even if the world prospects for an increase in avocado production are solid, the dynamics of US demand is such that the effects of globalisation may lead more to competition between markets than between suppliers in the coming years. In this new context, the EU market seems to be less well armed to ensure its development than the United States or even medium-sized markets like Japan and Canada, which are better organised and less competitive, with Canada and the United States benefiting from the direct and indirect consequences of their close-

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ness to the precious sources of South American 'Hass'. Even if the development prospects of Chilean production are smaller than forecast, it will be able to assure, together with the natural Mediterranean suppliers of the EU, a level of growth without a break with the present trend. However, the question of maintaining the strong dynamics of the summer market seems to be more complex, starting in 2012. In spite of the increase in volumes from South Africa, Kenya and even Brazil, the prospect of what will at the least be a slowing seems inevitable. Its duration will depend on the rate of planting in Peru in the years to come.

How the necessary development of the seduction potential of the EU market can have virtuous effects!

How can the European end of the chain increase its ability to capture less volatile supplies from South America, at least for a few seasons? The question of financial returns is central of course but the upstream part of the chain must understand its degree of complexity. On the one hand, the EU market has its special features. The presence of large volumes of green varieties alongside 'Hass' during certain periods of the year is a specific feature of the market and a factor in price lowering that should be taken into account. On the other hand, how can value-added be increased without putting off consumers in spite of the context of economic slump and the increase in intermediate costs such as that of transport? It is undoubtedly necessary to use segmentation, especially via packaging and the development of ripe fruits requested by an increasing number of retail distributors. In addition, publicity should remain strong to attract consumers even more. But are these levers powerful enough?

The challenge will have at least one virtue: that of bringing to the front of the stage those avocado specialists with the determination, facilities and financial solidity to invest in the tools needed downstream (packaging, ripening, maturation) in close relation with the upstream end in order to generate volume. This would be a somewhat forced first step towards better organisation of the EU market ■

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2010-2011 winter avocado season

A brief synthesis

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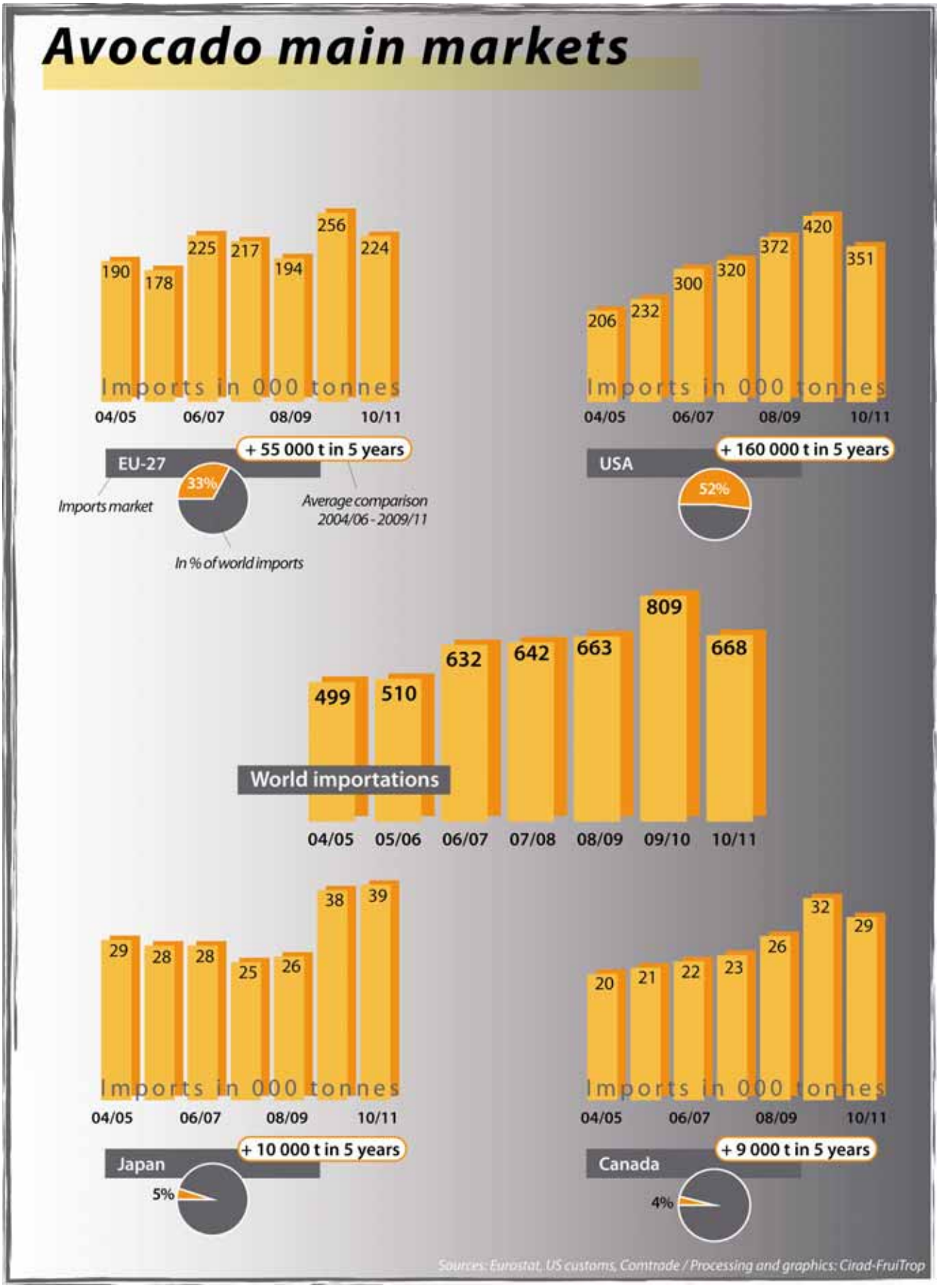
Decreased world production unfavourable for the two major markets in the world

World trade in avocado marked time in 2010-11 after an unprecedented 2009-10 season with more than 800 000 t traded. Unfavourable weather conditions in South America, the source of three-quarters of world supply, brought the volumes traded in the world back to their 2008-09 level, that is to say about 670 000 t. In this context of considerable tension, imports by the United States, the largest market in the world, did not budge for the first time in more than a decade. Price levels remained particularly high, especially from February onwards, showing it was not demand that was lacking but supply. Mexico, with production at its lowest level for at least five years, was unable to compensate for negative alternate bearing in California and the shortage of fruits from Chile, where plantations were hit by frost. Europe also suffered from the decrease in world production and its supply also decreased markedly, as is explained below.

The fine resistance of medium-sized markets

Only the medium-sized markets taking volumes of some 30 000 to 40 000 t, much less than the two leading markets, held out or

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even kept a measure of growth. The status quo of some 30 000 t in Canada should not be underestimated as it consolidates the fine increase in comparison with the preceding season. However, the best performance was undoubtedly that of Japan. After an increase of more than 10 000 t in 2009-10, the market gained a further 2 000 t in 2010-11, with the total imported volume nudging 40 000 t.

High average supply in the EU in spite of the small volumes from South America

EU supply was markedly smaller than that of the substantial 2009-10 season but remained in the upper average bracket. The South American sources caused the decrease. With considerable tension on the US market and small production, professionals expected limited volumes from Mexico. But who could have guessed that shipments from the world's leading exporter to the second largest importer would be hardly more than 3 000 t? But the most marked decrease was undoubtedly in Chilean shipments, with arrivals only half of the record of more than 50 000 t set in the preceding year. However, unlike Mexico, the decrease was purely conjunctural, the small crop resulting from frost. Mediterranean avocado compensated the small volumes of 'Hass' from South America. After excellent weather conditions, arrivals from Spain exceeded 50 000 t, a figure rarely attained since the early 2000s. In addition, the volumes from Israel held at a similar level to that of the preceding season. Among the 'outsiders', the Dominican Republic progressed and Morocco even more so with over 3 000 t, as good as if not better than Mexico!

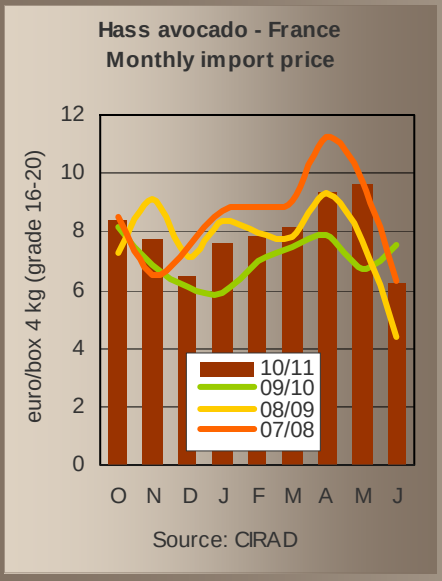
Avocado — European Union — Supply

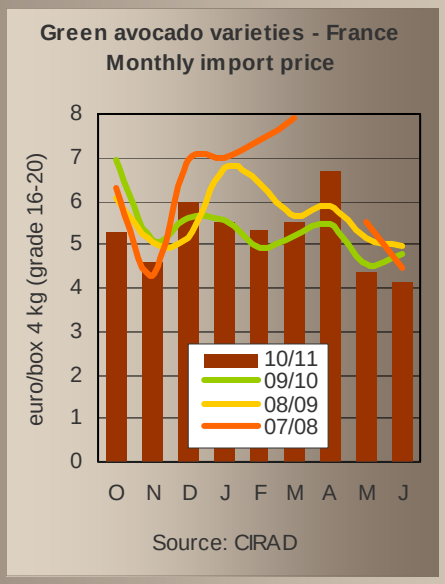
tonnes	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11
Total N. hemisphere	101 893	109 648	98 408	138 948	104 426	94 465	134 644	121 101
Israel	25 299	50 481	26 538	55 931	25 936	30 071	38 522	38 512
Chile	4 046	11 532	17 801	40 379	25 692	15 832	51 383	25 244
Mexico	18 705	16 516	20 769	10 289	12 695	11 647	9 326	3 371
Spain	53 000	29 854	32 400	30 140	35 300	32 930	31 420	47 007
Dominican Republic	842	1 264	901	2 209	3 105	2 077	3 016	3 621
Morocco	-	-	-	-	1 698	1 908	977	3 346

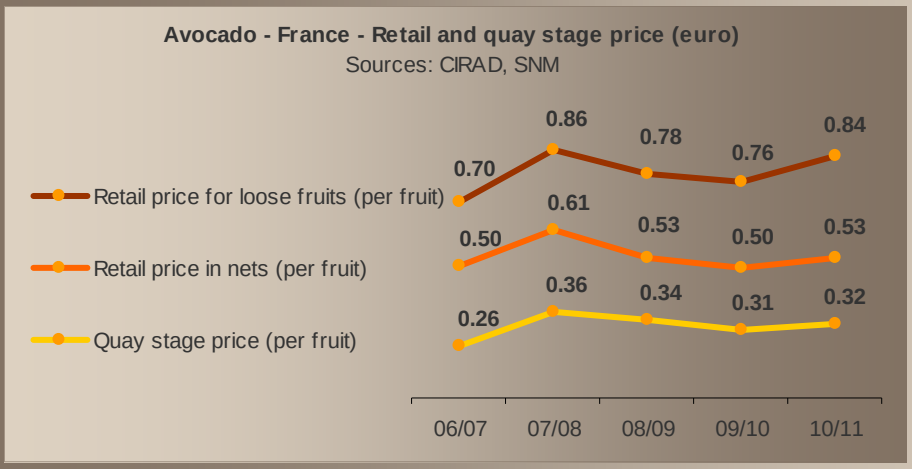
Source: EUROSTAT

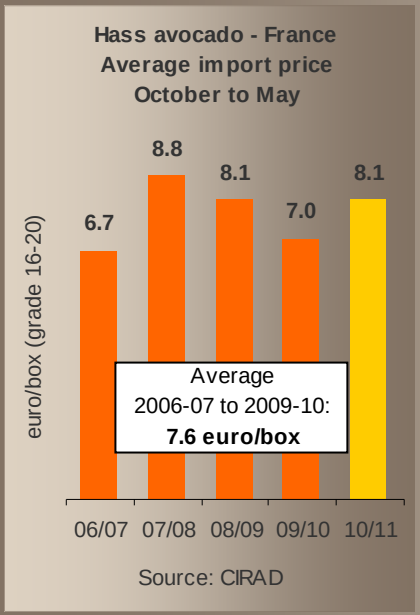
Fairly satisfactory prices

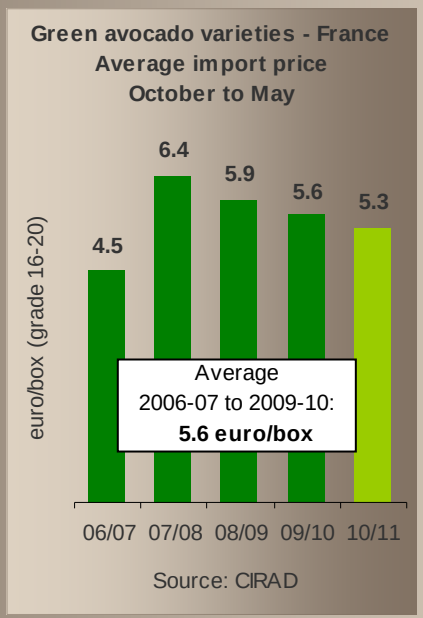
Using the import stage on the French market as a yardstick shows that prices were fairly satisfactory. The volumes sold and the average season price both increased (by 6% and 2% respectively). However, this performance is not proof of good economic profitability for the import sector as the prices upstream and intermediate costs were high—especially that of transport. Differences between varieties were also considerable. To judge by French information again, the price of 'Hass' rose by a little more than 6% while that of green varieties fell by about 5%. The difference partly resulted from the volumes concerned: the decrease in shipments from South America resulted in less 'Hass', which formed only 60% of the total volumes in 2010-11 in contrast with 66% in 2009-10. However, the decrease in the price of green varieties also resulted from the increasingly distinct lack of interest shown year after year by certain retail distributors. This trend is reaching strongholds of green avocado consumption such as Germany.

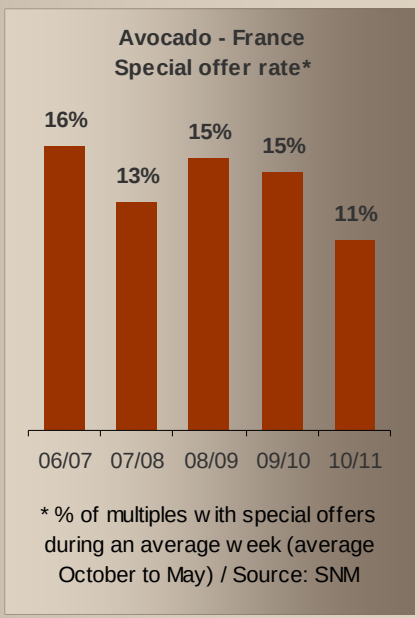












Avocado — Europe (EU-27 + Norway + Switzerland) — Consumption						
	Estimated marketed volume in 2010-11* (tonnes)	Population in millions	Consumption per capita (gramme)	2010-11 compared to		GNP-PPS (index)
				2009-10	2005-06	
EU-27	**235 032**	**494**	**437**	**+ 6%**	**+ 24%**	**100**
EU-15	227 611	391	537	+ 8%	+ 25%	110
France	78 755	63	1 250	+ 2%	+ 11%	107
United Kingdom	34 124	61	559	0%	na	114
Scandinavia	**31 500**	**25**	**1 260**	**+ 10%**	**+ 89%**	**134**
Sweden	14 192	9	1 577	+ 9%	+ 87%	123
Denmark	10 992	5	2 198	+ 13%	+ 93%	125
*Norway***	4 523	5	905	0%	+ 72%	179
Finland	1 793	5	359	+ 38%	+ 137%	116
Spain***	25 004	45	556	+ 21%	+ 48%	101
Germany	22 854	82	279	+ 28%	+ 69%	118
Netherlands	20 969	16	1 311	+ 14%	+ 134%	133
Switzerland**	6 152	8	799	-	-	148
Italy	4 561	59	77	- 6%	+ 46%	100
Belgium	3 688	11	335	+ 18%	+ 65%	118
Portugal***	2 914	11	265	- 9%	- 4%	81
Austria	2 514	8	314	+ 9%	+ 31%	126
Ireland	2 100	4	525	- 17%	+ 83%	127
Greece***	1 949	11	177	+ 48%	+ 60%	89
Cyprus***	1 000	0.8	1 250	- 27%	- 3%	98
Luxembourg	202	1	202	- 10%	+ 21%	283
Eastern Europe NMCs	**7 421**	**102**	**73**	**+ 37%**	**+ 95%**	**54**
Poland	2 572	38	68	+ 40%	+ 80%	62
Baltic states	2 497	7	357	+ 75%	+ 218%	60
Czech Rep.	488	10	49	- 9%	- 10%	80
Slovakia	344	5	69	+ 31%	- 2%	74
Hungary	501	10	50	+ 18%	+ 71%	64
Slovenia	203	2	102	- 5%	+ 26%	86
Romania	433	22	20	- 7%	+ 254%	45
Bulgaria	203	8	25	+ 71%	+ 568%	44

* from June 2010 to May 2011: import-export+production / ** non EU / *** estimates
Sources: EUROSTAT, FAO, professionals

Consumption still increasing on the medium-sized markets

The season confirmed the trends in the main consumer countries. Still flat calm in the two main European markets. France is still the leader by far but volumes increased by only 3 000 t in three years, reaching 78 000 t in 2010-11. The United Kingdom market has remained unchanged at 34 000-35 000 t since 2008-09. Dynamism is to be sought on the medium-sized markets. Germany performed well once again, confirming its ascension. Consumption stagnated at 13 000-14 000 t throughout the second half of the 2000s and then increased by 10 000 t in two years! And there is enormous scope as the population is 80 million and consumption still less than 300 g per person per year. Growth is not weakening in Scandinavia either, where the population of 25 million people consume the same amount of avocado as 60 million people in the UK. Denmark has exceeded 2 kg per person and Sweden 1.5 kg. The Eastern European markets have continued to emerge very slowly, but display a modest 7 500 t for 100 million people after a gain of about 2 000 t of avocado on the market ■

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2011-12 avocado season forecasts

Slightly greater volumes than in 2010-11 but no supply record in view

© Guy Bréhinier

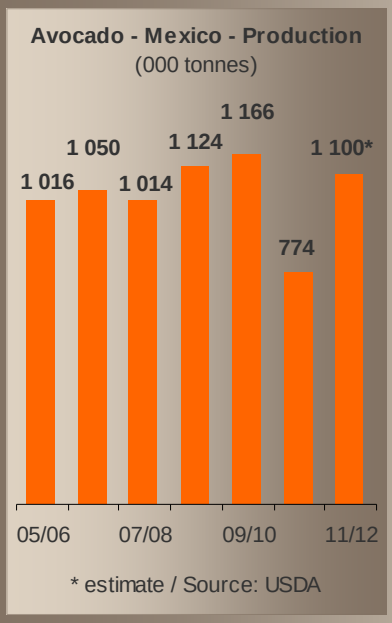
Supply of the world avocado market is generally a series of switchbacks caused by the physiological alternate bearing phenomenon. These swings are often difficult to manage but should not affect operators in 2011-12 as the export potential of the major supplier countries is increasing but still at an average level.

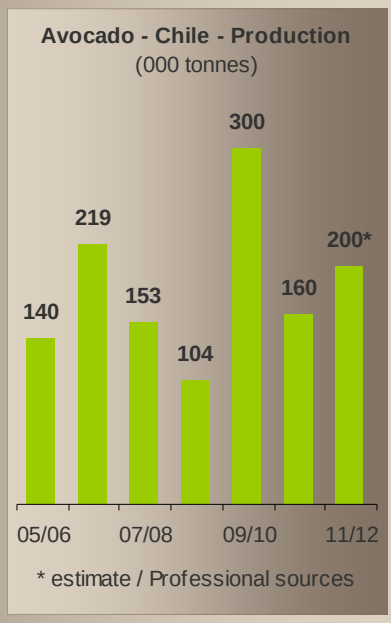
Larger production in South America but no record expected

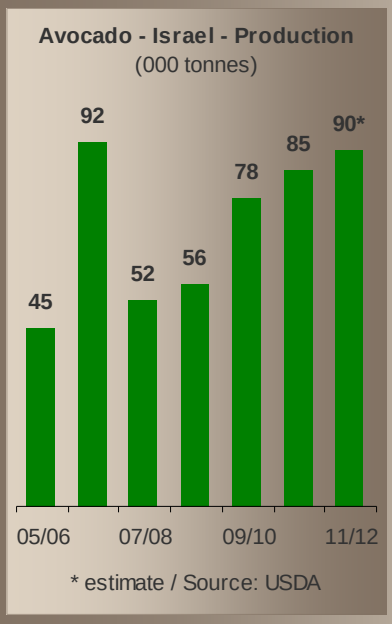
After a 2010-11 season with very short supply, production by the South American giants that control three-quarters of world exports will return to a better level. However, neither of the two players in the zone that supply the winter market is announcing record potential. The 2010-2011 Mexican harvest was distinctly short, and for the first time since the mid-2000s slipped below a million tonnes and probably even below 900 000 t. Production in 2011-12 promises to be more generous. However, the weather conditions have not been favourable for the full expression of potential production. Thus with 1.1 million tonnes forecast, the harvest seems only average and does not reflect the strong increase in orchard areas in recent seasons. The practically total absence of rainfall from autumn 2010 to spring 2011 may affect fruit size at the beginning of the season, with medium to small fruits expected.

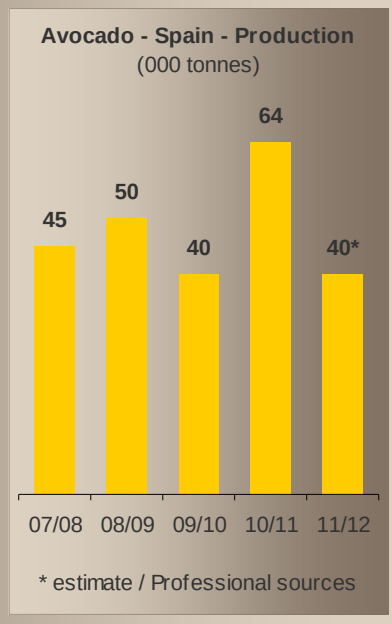
Avocado — Production and exports			
tonnes	**Production 2010-11**	**Trend 2011-12/2010-11**	**Exports 2010-11**
Mexico	774 000	+ 35 to 40%	364 000
Chile	160 000	+ 25%	86 000
Israel	85 000	+ 5 to 10%	44 000
Spain	60 000 à 65 000	- 25 to 35%	52 000
Morocco	9 500	=	3 300

Professional sources









Production in Chile is forecast to be only average even though it is a positive year for the physiological phenomenon of alternate bearing The Comité de Palta's official forecast is for nearly 200 000 t, an increase of about 25% in comparison with last season but the figure is in line with the average for the past four years. As in 2007 and 2010, frost caused significant damage in certain parts of Region IV and the Metropolitan Region, while Petorca, Cabildo and La Ligua were hit by drought. As the domestic market is growing slightly, the export potential should reach about 120 000 t in comparison with 86 000 t last year.

Small decrease in Spain after an exceptional 2010-11 season and alternate bearing in Morocco

The volumes available from Mediterranean suppliers culminated at a record of nearly 90 000 t in 2010-11 and should continue to be fairly substantial. The 2010-11 season was exceptional in Spain as there were no weather problems and rainfall was satisfactory. The various estimates reported exports of between 55 000 and 60 000 t. Although there has been as much rain as in 2010-11, exports should not be as large in 2011-12 as a result of negative alternate bearing and a heat wave in August. Estimates are for 35 000 to 40 000 t. The decrease seems to be fairly marked for green

© Eric Imbert

varieties and especially 'Bacon' in certain zones. 'Hass' should be less affected. Negative alternate bearing is also expected in Morocco. However, the planted area has increased by an annual 200 to 300 ha in recent years and this should compensate to a certain degree. Export potential should therefore hold at the 2010-11 level of approximately 3 500 t.

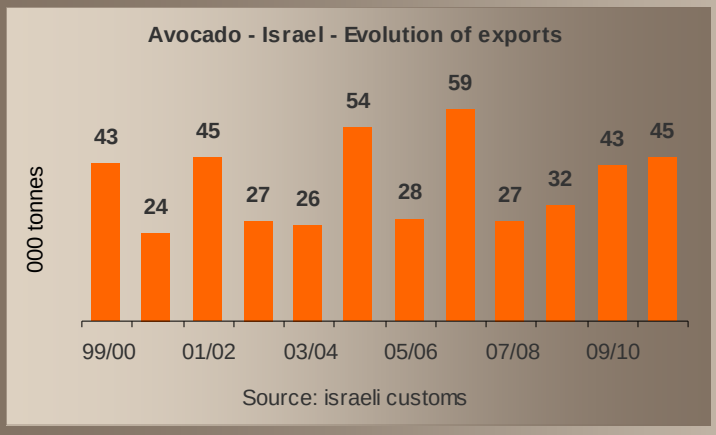
Thunderclap in Israel against a background of slight production increase

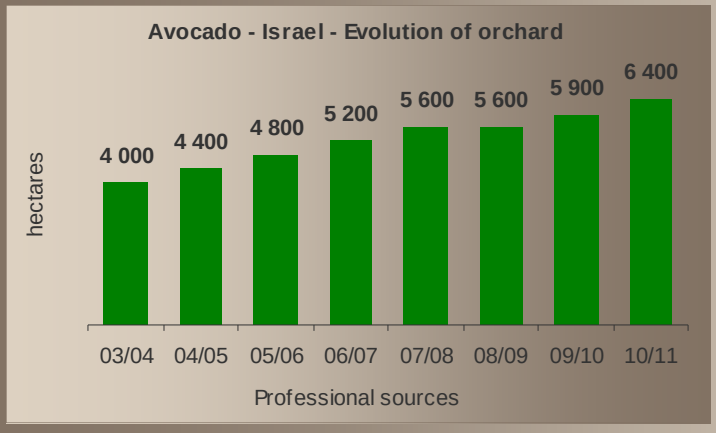
Israel should be the only Mediterranean source whose presence is more affirmed on the international market in 2011-12 than in 2010-11. Some 90 000 t of avocado is forecast, taking the export potential to close to 50 000 t in comparison with about 44 000 t in 2010-11. But the most important point to be mentioned at the beginning of the season is probably not the production potential. A page has been turned on the world avocado scene at the end of this summer. Agrexco, a historical player that was at the origin of the construction of the avocado market in Europe has been placed in receivership. The disappearance of the company raises many questions. First of all, what will be the new export trade organisation of the sector and how will the 60% of the export potential of Israel that the company still held in 2010-11 be shared out? Through its alliance in the spring with Granot, the largest cooperative for avocado in the

Israel

Orchard **6 400 ha, + 300 ha each year**

Production **55 000 to 85 000 tonnes**






© Régis Domergue

country, the leading position has already been promised to the Mehadrin company, which also has its own production. This player should form the core of the sector with at least half of export potential. The former number three, Kedem Hadarim, should also strengthen its position, like the other 'small exporters' such as Guri and Edom in particular. Finally, new stakeholders from the production or packaging world (Milopri) and companies that already export other produce will probably go into avocado sales. The logistics tailored for avocado exports that puts Israel within three days of the western Mediterranean should be maintained. At the time of going to press it seems that the Orsero group has taken over operation of 'Carmel Ecofresh' and 'Carmel Biotop' for regular voyages from Israel to terminals run by the groups at Vado, Tarragona and—very recently—in Sète.

The US market is less profitable but still very attractive

Will the US market be as exceptionally attractive as in 2010-11? Given the very early decline of the season in California, prices should hold at a very good level until the second half of October when Mexican production generally starts to peak. They should subsequently hold at a much more normal level, given the greater potential of Chile and Mexico, and the probable return of a more generous harvest in California from the end of the winter onwards.

But will the allocation decisions taken by South American suppliers be more favourable for the European market? Only marginally it would seem as with no avalanche of produce on the horizon prices should remain attractive in the United States. The president of the APEAM forecasts shipments of no more than 4 000 to 5 000 t of Mexican avocado in 2011-12. As regards Chile, the share of volumes for the EU should remain aver-

© Eric Imbert

age, taking the export programme to 32 000 t against 25 000 t in 2010-11.

Volumes slightly greater than average in Europe

Supply of the European market should remain in the upper average bracket but no plethora is in view. While supply from the Mediterranean is clearly present, arrivals from the southern hemisphere will be only average in spite of a distinct increase in comparison with the very limited volumes of the 2010-11 season. This mix of origins will affect the distribution of supply by variety. Fairly large volumes of green varieties should thus be expected, especially at the beginning of the season. Promotion operations are to be expected during this period, specially as the setting up of a new Israeli trade organisation that will of course require a running-in period will be a factor of instability.

In addition, the trading window available to northern hemisphere sources may be a little larger towards the end of the season that in past years. While the first Peruvian Hass may be delivered at the end of the winter thanks to the plantations established in early zones in recent years, volumes should be more limited than in 2010-11 as a result of the opening of the US market ■

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Israeli freight

A press release that arrived while we were completing this issue provides more information about the new sea freight link set up by GF Group between Israel and the western Mediterranean. Management of the line has been entrusted to COSIARMA, a GF group subsidiary handling sea freight activities. The two specialised ships previously used by AGREXCO, renamed Cala Pira and Cala Paradiso, will provide a weekly service for the ports of Haifa, Ashdod, Sète, Genoa and Naples. An agreement has been concluded with Zim and Cosmed who both already service these destinations so that they can jointly use part of the freight capacity of the ships (4 100 palettes in the hold and 630 equivalent 20' containers on the deck). The first sailing from Haifa is planned for 10 October. The new service should maintain excellent transit times—the strong point of the service that it replaces.

Avocado from Morocco

Big ambitions taking shape

© Eric Imbert

Major soil and climate assets in the Gharb region

Spanish and Israeli professionals have long demonstrated that avocado and the Mediterranean go well together and developed one of the world's leading export businesses. The condition is to have a microclimate that is compatible with the soil and climate requirements of this plant that originated in the tropics. This is the case in the coastal part of the Gharb, the most temperate plain in the country with the most rainfall. Risk of frost is limited, especially as the sea is close and there are lagoons (Merja) in some zones. In addition, the amount of precipitation (400 to 600 mm per year) and the closeness of Wadi Sebou mean that the supply of surface water of good quality is usually satisfactory. Finally, the sandy soil precludes problems of hydromorphy and *Phytophthora* that are common in the areas with heavy soil further from the coast.

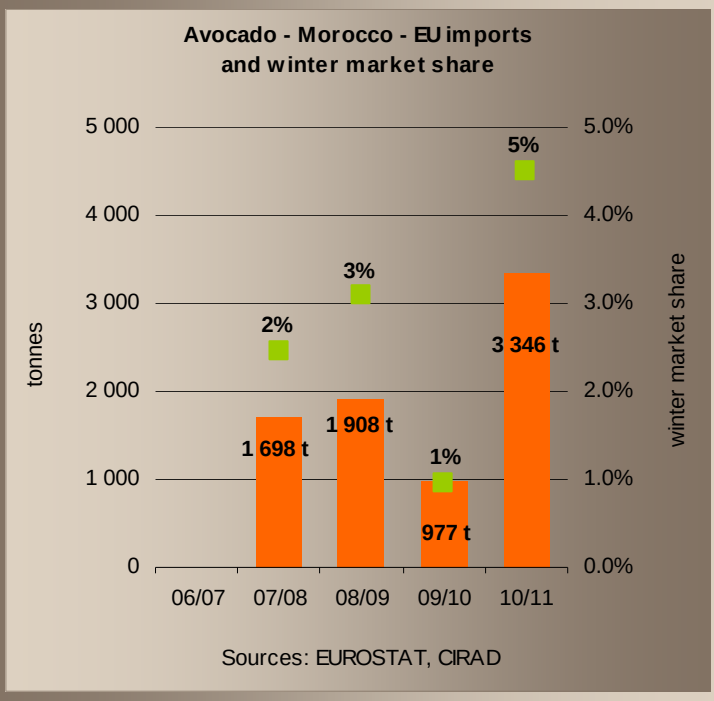
Recent appearance on the international market

Given these advantages, the establishment of the first plantation in the 1950s could have been the start of a success story simi-

Morocco

Orchard **1 500 ha, + 250 to 300 ha each year**

Production **9 500 t**



lar to those of Israel and Spain, especially as road transport from the Gharb to the European countries that are major consumers of avocado takes 48 hours. This did not happen. For nearly 50 years, development of the sector remained limited to a few hundred hectares of mainly green varieties sold on the domestic market where avocado is much appreciated prepared as a milk shake. The scale of the sector has begun to change and the 'Hass' variety gained importance in the early 2000s with the planting of the first areas for growing export fruits. Plantations are concentrated along the coast between Témara and Kénitra and estimated to total 1 400-1 500 ha today, including some 500 ha of 'Hass'. Exports started at the end of the 2000s and reached 3 300 t in 2010-11. Practically all the fruits are shipped to the EU market where Moroccan avocado is not subjected to an entry price system or a quota. Although growth dynamics has taken time to form, the crop now seems to be proceeding well, as the annual planting rate has been 200 to 300 ha in recent years.

A private structure forming the driving force

The ABAZ company, the only producer-exporter in the country, is the main force behind the growth of the sector. Today, it controls about a third of 'Hass' production in Morocco and nearly two-thirds of exports. The remaining exports are handled by two other structures that operate only as intermediaries for avocado. Several recent operations conducted at the initiative of ABAZ or the Moroccan state should enable the sector to speed up its development in the coming years.

A sector with greater national visibility

Well identified for a number of years on the international market, paradoxically the sector suffered from lack of visibility at the national level. Thus the founding of the Association Marocaine des Producteurs et Exportateurs d'Avocat (AMPEA) was announced in March 2010 to promote awareness among local operators, producers and institutions of the technical aspects of the crop and the expectations of the interna-

Morocco: the birth of a new mango supplier

© Pierre Gerbaud

Morocco has been preparing for its entry to the European mango market for a number of years. The prospect is a reality with the first shipments received last week. Mango is thus added to the long list of temperate and subtropical produce exported by this Mediterranean country. Going into the trade segment developed by neighbouring Spain, Morocco ships 'Osteen' in 4 kg cardboard trays. Supply is completed by a few batches of 'Irwin' whole awaiting broader varietal diversification. Although the volumes shipped are still modest, the fruits hold their ground with competitors as regards quality and presentation. Without greatly changing the autumn mango market in Europe, in the future this new source should compete with Spanish produce.

An avocado packing station in Morocco

© Eric Imbert

© Eric Imbert

tional markets. The legal side of this umbrella structure is currently being set up. Today, it groups a little more than 20 members with plantations with areas ranging from 1 to 30 hectares.

Provisions of the Green Morocco Plan should stimulate growth

The provisions of the Green Morocco Plan, one of whose pillars is aimed at developing high added-value farming for export, will also play a driving role by helping to structure the sector. Within this framework, the state has appointed the ABAZ leader in charge of developing a core of growers who wish to start exporting. Membership of the organisation brings many advantages. As in a co-operative, the pooling of volumes increases negotiating power both upstream (with suppliers of inputs, agricultural equipment and credit) and downstream. Furthermore, members also benefit from technical assistance from the leading grower, a particularly important point for a crop so little known in Morocco. Finally, the subsidies awarded by the state in different areas (purchase of farm machinery, irrigation, etc.) are increased by some 10 to 20%. The leader also gains as these additional volumes can help him to attain the critical size required for recognition at the international level while guaranteeing the quality of his wares via the technical assistance provided for members.

Avocado: a substitution crop with strong potential for the Gharb, an underprivileged region

Another capital feature is that the assets of the Gharb for the development of high added-value agriculture seem to be considerably under-used today, to the extent that, paradoxically, the region is one of the poorest in the country. A large proportion of the crops that are dominant in zones where avocado plantations could be established (wheat, groundnut, tomatoes for processing or summer vegetables) display low profitability. In addition, part of the usable agricultural area is occupied by eucalyptus plantations dating back to the first part of the 19th century. Thus the Gharb has excellent features for growing avocado and this could also be an advantage for the farmers there. The development of avocado in the region has a social aspect that fully merits state support.

New tools to accompany the development of the sector

New tools will shortly emerge to accompany this development. The first priority is to enable new growers to get off to a good start! A nursery producing seedlings (clones or not) of good sanitary and genetic quality thanks to the recognised technical assistance of a South African expert is to start up at the beginning of 2012. Its capacity of some 50 000 plants per year (that is to say around 100 hectares) will be increased rapidly according to demand. A packing station with increased capacity is also being designed and should be constructed in the medium term.

The brakes to access to land, organisation and training are still considerable

Serious obstacles remain to be removed. The main one is certainly landholding. Nearly 40% of the land in the Gharb is state-owned and managed collectively. The absence of long-term leases means that growers are not encouraged to go into orchard crops, especially as bank loans are difficult to obtain under these conditions. The strong fragmentation of land in the region is a further difficulty. Even if a basis for solid organisation has been established, the upstream part of the chain is still scattered and heterogeneous as regards technical mastery. In addition, avocado is a new crop and there is no public extension service for the basic production techniques.

Ambitious objectives but a need for more support to gain in stature

When AMPEA was founded, its members set a production objective of 30 000 to 50 000 t after 10 years. Production will certainly increase in the coming years. However, the state, which has already taken the first step by listing avocado as one of the sectors that can benefit from Morocco Green Plan measures, must invest further if the association's target is to be reached. A contract-programme similar to that set up in sectors such as citrus, olive and date palm would help growers to remove existing blockages to the development of this high-potential sector that appears to be of great benefit for the underprivileged Gharb region ■

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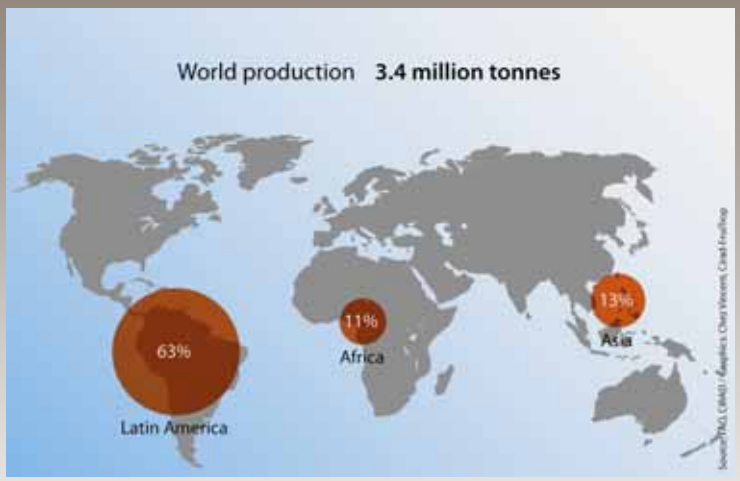
Fresh fruit and vegetables — Morocco — EU-25 then 27 imports

tonnes	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11*
Total fresh fruit and vegetables	788 524	807 720	937 557	902 524	856 988	819 052
Total vegetables	**465 283**	**540 045**	**609 855**	**627 093**	**555 839**	**560 638**
Tomato	212 973	264 274	292 843	367 801	293 371	327 684
French beans	102 884	106 079	120 426	111 763	117 556	93 596
Pepper	44 361	45 535	58 481	62 361	58 313	51 648
Potato	33 877	43 430	56 846	9 506	22 357	17 023
Beetroot, celery, radish, etc.	444	1 151	2 205	2 221	2 121	3 126
Chicory (not endive)	2 648	2 199	2 629	2 021	2 122	2 224
Cucumber	4 528	6 577	3 247	2 940	2 975	2 144
Onion and shallot	2 795	4 690	1 871	1 375	2 231	1 694
Asparagus	1 907	1 647	2 523	2 477	1 760	1 580
Leek	910	1 171	1 503	2 244	1 543	1 260
Brussels sprouts	684	494	742	586	654	1 095
Other vegetables	57272	62800	66540	61800	50836	57565
Total fruit	**323 241**	**267 675**	**327 702**	**275 430**	**301 149**	**258 414**
Easy peelers	93 750	83 160	76 357	79 880	114 501	89 616
Orange	143 103	97 209	138 585	91 165	93 932	77 191
Melon	46 472	46 614	55 279	55 408	54 009	51 498
Strawberry	22 897	20 419	23 883	18 242	16 794	23 433
Watermelon	2 165	5 509	5 572	7 477	3 607	3 789
Avocado	0	0	1 698	1 908	977	3 346
Peach and nectarine	3 388	3 426	3 316	4 693	2 715	2 945
Lemon	3	84	11 006	3 184	1 785	1 749
Strawberry and blackcurrant	105	688	954	903	1 478	1 690
Other berries	0	0	215	621	1 270	1 680
Guava, mango and mangosteen	22	0	0	3	11	859
Grapefruit	398	925	915	797	737	472
Grapes	10 814	9 420	9 695	10 748	9 211	37
Other fruit	126	221	226	402	125	109

from September to August / for *2010-11 from September to May / Source: EUROSTAT

AVOCADO — Production



Avocado — The 10 leading producer countries	
tonnes	**average 2009-10/2010-11**
Mexico	970 000
Indonesia	258 000
Chile	210 000
United States	202 500
Dominican Republic	184 000
Colombia	165 000
Peru	156 000
Brazil	139 000
China	100 000
Guatemala	95 000

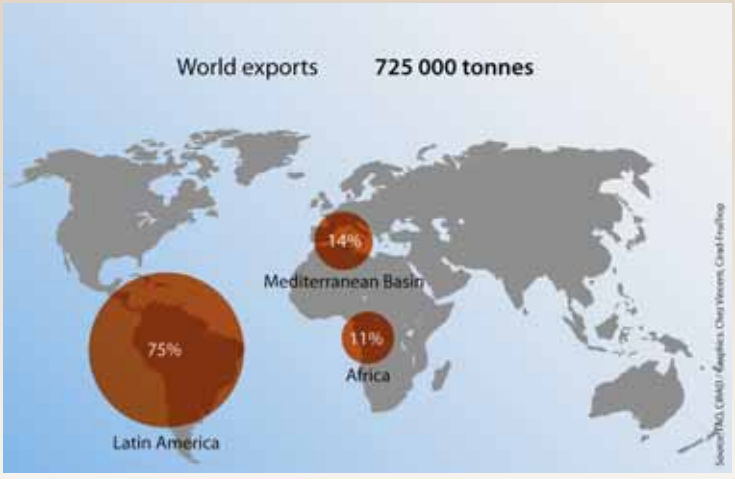
Sources: FAO, USDA, professionals

AVOCADO — Imports

Avocado — The 6 leading importing countries	
tonnes	**2010-11**
United States	351 120
Netherlands	102 342
France	89 596
Japan	39 043
United Kingdom	35 296
Canada	32 176

Sources: national customs

AVOCADO — Exports



Avocado — The 6 leading exporting countries	
tonnes	**2010-11**
Mexico	364 000
Chile	86 000
Peru*	75 000
Spain	52 000
Israel	45 000
South Africa*	30 000

* estimate / Professional sources and national customs

USA — Imports — Main supplier countries						
tonnes	**2005-06**	**2006-07**	**2007-08**	**2008-09**	**2009-10**	**2010-11**
Total	**231 715**	**300 375**	**319 920**	**371 662**	**420 360**	**351 120**
Mexico	132 040	166 001	217 000	301 695	270 200	281 672
Chile	85 200	117 928	85 199	56 363	133 888	54 355
Dom. Rep.	14 334	16 434	15 219	13 584	15 984	14 956
New Zealand	57	-	2 500	-	269	-
Others	85	12	2	3	9	137

Source: USDA

Canada — Imports — Main supplier countries						
tonnes	**2005-06**	**2006-07**	**2007-08**	**2008-09**	**2009-10**	**2010-11**
Total	**20 005**	**22 579**	**22 970**	**24 582**	**32 056**	**32 176**
Mexico*	17 420	18 471	18 143	20 474	25 114	22 687
USA*	1 795	2 460	3 385	2 053	3 814	7 728
Peru	223	891	753	450	1 342	1 266
Chile	464	696	492	1 196	1 340	0
Dom. Rep.	60	29	143	314	314	320
Brazil	25	24	43	75	109	150
Others	18	9	11	21	23	25

Sources: COMTRADE and national customs*

South America — Main markets							
tonnes	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Total	**19 023**	**18 591**	**20 084**	**14 887**	**11 047**	**19 714**	**18 881**
Colombia	16 665	16 668	17 665	11 226	7 507	12 501	9 044
Ecuador	122	5	105	40	512	2 416	1 177
Argentina	994	1 553	1 572	3 221	2 638	3 494	8 357
Chile	1 242	365	741	400	390	1 304	303

Source: COMTRADE

Central America and Mexico — Main markets							
tonnes	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Total	**25 063**	**20 685**	**24 411**	**27 426**	**26 365**	**28 683**	**35 956**
Costa Rica	7 244	5 336	6 773	6 970	7 571	6 809	9 638
Salvador	12 362	9 501	11 593	10 079	9 747	11 163	9 308
Mexico	421	0	2 114	91	393	0	6 598
Guatemala	4 815	5 176	2 821	950	1 087	1 772	1 380
Honduras	221	673	1 110	9 335	7 566	8 939	9 032

Source: COMTRADE

EU-27 — Imports — Main supplier countries						
tonnes	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11
Total, incl.	**178 491**	**224 748**	**216 547**	**193 541**	**255 816**	**224 001**
Total N. hemis.	**98 408**	**138 948**	**104 426**	**94 465**	**134 644**	**121 101**
Israel	26 538	55 931	25 936	30 071	38 522	38 512
Chile	17 801	40 379	25 692	15 832	51 383	25 244
Mexico	20 769	10 289	12 695	11 647	9 326	3 371
Spain	32 400	30 140	35 300	32 930	31 420	47 007
Dom. Rep.	901	2 209	3 105	2 077	3 016	3 621
Morocco	-	-	1 698	1 908	977	3 346
Total S. hemis.	**80 083**	**85 800**	**112 121**	**99 076**	**120 933**	**102 600**
Austral Africa*	36 589	38 445	51 109	38 821	47 800	28 000
Peru	30 508	35 857	49 829	45 661	56 345	60 000
Kenya	13 641	11 999	11 841	15 038	14 123	12 000
Argentina	1 804	1 709	970	1 984	0	200
Brazil	1 442	1 447	1 790	2 797	2 665	2 400
Others	1 390	183	483	504	239	300

* South Africa + Zimbabwe + Zwaziland / Source: EUROSTAT

Other western Europe countries — Main markets							
tonnes	2004	2005	2006	2007	2008	2009	2010
Total	**6 115**	**6 671**	**6 988**	**8 320**	**9 018**	**9 568**	**11 538**
Switzerland	3 784	4 078	4 102	4 936	4 995	5 340	6 152
Norway	2 237	2 467	2 749	3 219	3 841	4 046	5 154
Iceland	94	126	137	165	183	183	232

Source: COMTRADE

Russia — Imports — Main supplier countries							
tonnes	2004	2005	2006	2007	2008	2009	2010
Total, incl.	**1 671**	**2 371**	**3 135**	**4 392**	**4 806**	**5 827**	**8 367**
Total N. hemis.	**921**	**1 422**	**1 931**	**2 928**	**2 180**	**3 479**	**5 318**
Israel	832	1 345	1 805	2 769	2 016	3 316	5 135
Spain	89	77	126	159	164	163	183
Total S. hemis.	**705**	**893**	**1 135**	**1 377**	**2 515**	**2 224**	**2 861**
South Africa	674	875	1 062	1 225	1 923	1 445	1 984
Peru	11	10	34	42	442	438	597
Kenya	20	7	39	110	150	342	280

Source: COMTRADE

Other eastern Europe countries — Main markets							
tonnes	2004	2005	2006	2007	2008	2009	2010
Total	**90**	**308**	**498**	**702**	**884**	**905**	**1 358**
Ukraine	26	209	367	510	691	694	1 026
Belarus	30	42	52	91	97	113	173
Croatia	34	32	46	53	42	61	108
Serbia	0	25	34	48	54	37	51

Source: COMTRADE

Japan — Imports — Main supplier countries						
tonnes	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11
Total	**28 342**	**28 463**	**24 963**	**26 054**	**37 520**	**39 043**
Mexico	26 826	26 076	23 569	25 220	33 603	35 733
Chile	390	1 621	398	224	1 673	334
New Zealand	951	142	893	533	1 221	546
United States	176	624	100	77	1 023	2 430
Others	0	0	3	0	0	0

Source: national customs

Other Asia countries — Main markets							
tonnes	2004	2005	2006	2007	2008	2009	2010
Total	**2 586**	**1 953**	**2 376**	**2 965**	**2 869**	**3 534**	**4 568**
China	1 936	1 015	951	1 305	989	1 293	1 976
Thailand	5	47	129	188	413	664	540
Malaysia	84	100	142	158	228	274	359
Singapore	348	405	545	659	747	978	1 285
South Korea	213	386	610	655	492	325	*408*

Source: COMTRADE

Persian Gulf — Main markets							
tonnes	2004	2005	2006	2007	2008	2009	2010
Total	**669**	**2 819**	**1 529**	**3 118**	**3 759**	**3 696**	**3 727**
United Arab Em.	0	1 956	0	1 735	2 528	*2 132*	*2 330*
Saudi Arabia	374	428	528	542	376	682	*529*
Kuwait	216	0	368	426	371	*398*	*385*
Yemen	10	327	486	180	268	258	*263*
Qatar	70	108	146	235	217	*226*	*221*

Source: COMTRADE

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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 et 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

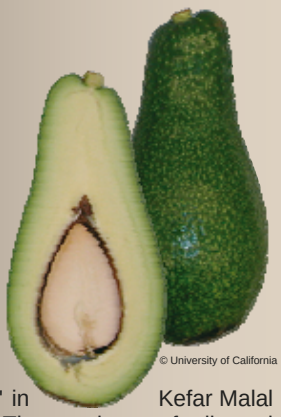
Mexican x Guatemalan hybrid

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).

Ettinger

Mexican x Guatemalan hybrid



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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.

Reed

Guatemalan race

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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 — USA — 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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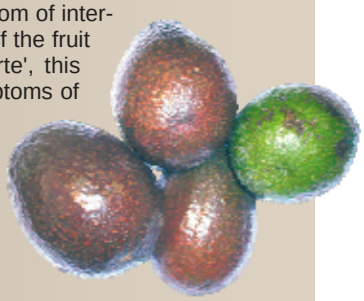
Ripening

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	Diseases
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