HASS AVOCADO BOARD

2018

Market Review: World

Producer country profile produced by *CIRAD, The Centre De Cooperation International En Recherche Agronomique Pour Le Développement.*

Avocado

Avocado

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A report by
Eric Imbert

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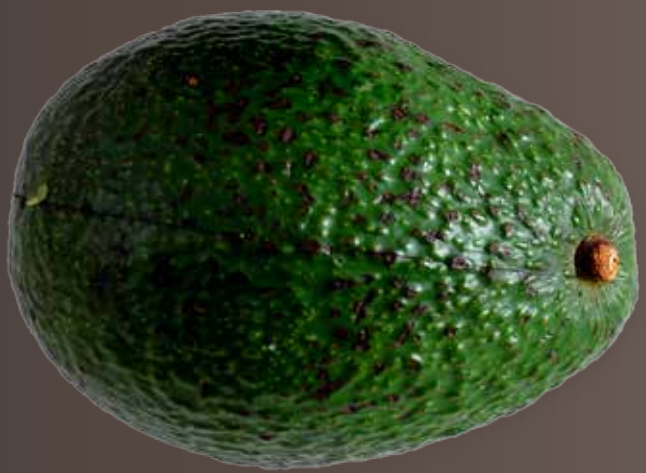

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Avocado
World market in 2017-18

A still extraordinary dynamic!

The 2017-18 campaign confirmed the rude health of the world's two main markets, the USA and the European Union. They managed to rise in terms of volume while maintaining price levels ranging from good to excellent. Conversely, while the enormous growth potential of the Asian markets is continuing to reveal itself, this is only occurring very gradually.

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Record world Hass production, thanks to the Americas

It is a practically immutable rule in the avocado industry: a lean season is followed by a season of higher production. And when the Mexican giant is the one which flags, as was the case in 2016-17, the recovery is all the more striking. So there was nothing astonishing in seeing world avocado production peak at historic levels in 2017-18. According to the estimate by our Market News Service (Hass variety only, exporter countries only – under certain assumptions), it was slightly in excess of the 3-million tonnes mark for Hass. This record production, approximately 25 % greater than in 2016-17, can be explained by very fine harvests in both Latin America and North America.

After a 2016-17 season marked by alternate bearing and unfavourable weather, Mexico came back in better form than ever, thanks especially to the immense surface area expansions in Michoacán as well as Jalisco (respectively + 9 000 ha and + 2 000 ha per year on average over the past four years according to official sources). Similarly, in Peru, the expansion of the cultivation area, of 2 500 ha per year on average over the past four years, helped counterbalance the adverse consequences of another very wet year (La Niña). Furthermore, the spectre of drought, which has for so long choked the country's potential, seems increasingly distant, with production maintaining a high level. Finally, the alternate bearing effect and more generous rainfall had a positive impact on the Californian harvest.

Conversely, the other world production areas were less well off. The Mediterranean harvest was only meagre, with Morocco's rude health not managing to offset a major shortfall in Spain and in Israel. South Africa suffered from alternate bearing and a spell of drought. These trends can explain the very uneven supply levels to the two main world markets, with the USA getting much bigger volumes than Europe.

Avocado

Main suppliers export dynamic

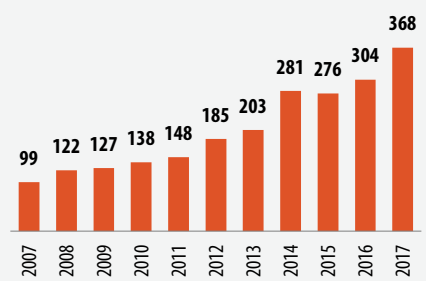
Summer season

Export calendar mainly centred on spring and summer

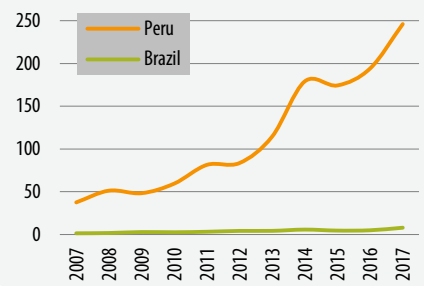
370 000 t

20 %
of world market

Avocado - World exports in the summer season
(in 000 tonnes / professional sources)



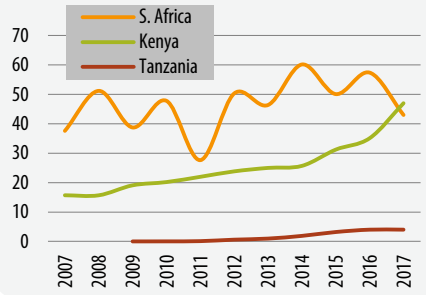
Avocado - Latin America - Exports in summer
(in 000 tonnes / professional sources)



254 000 t

69 %
of summer market

Avocado - Africa - Exports in summer
(in 000 tonnes / professional sources)



94 000 t

26 %
of summer market

Avocado – Main supplier countries – Exports in the summer season

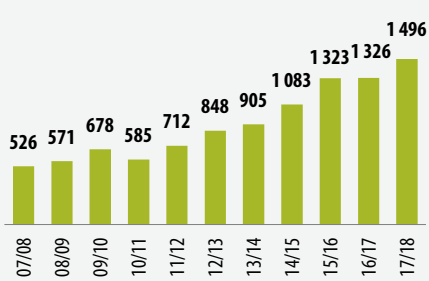
in 000 tonnes	2012	2013	2014	2015	2016	2017
Total summer season	**185**	**203**	**281**	**276**	**304**	**368**
Latin America	**87.8**	**118.9**	**184.9**	**178.9**	**199.1**	**254.0**
Peru	83.6	114.5	179.0	174.3	194.1	246.0
Brazil	4.3	4.3	5.8	4.6	5.0	8.0
Africa	**74.7**	**72.4**	**87.8**	**84.5**	**96.5**	**94.0**
South Africa	50.3	46.4	60.2	50.1	57.4	43.0
Kenya	23.8	25.0	25.7	31.2	35.1	47.0
Tanzania	0.6	1.0	1.9	3.2	4.0	4.0
California	22.5	11.5	8.4	12.8	8.0	20.0

Professional sources

Winter season

Export calendar mainly centred on autumn and winter

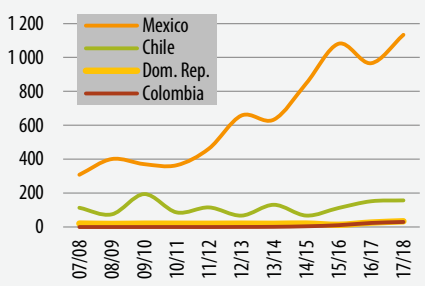
Avocado - World exports in the winter season
(in 000 tonnes / professional sources)



1 500 000 t

80 %
of world market

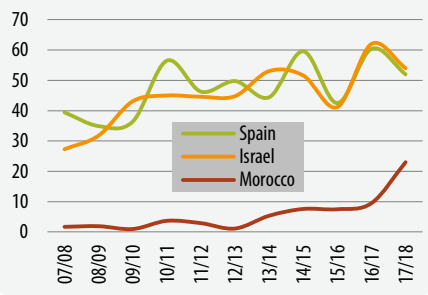
Avocado - Latin America - Exports in winter
(in 000 tonnes / professional sources)



1 354 700 t

91 %
of winter market

Avocado - Mediterranean - Exports in winter
(in 000 tonnes / professional sources)



129 000 t

9 %
of winter market

Avocado – Main supplier countries – Exports in the winter season

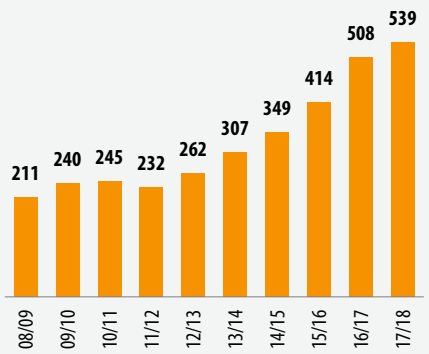
in 000 tonnes	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Total winter season	**848**	**905**	**1 083**	**1 323**	**1 326**	**1 496**
Latin America	**745.2**	**784.8**	**939.6**	**1 217.6**	**1 168.3**	**1 354.7**
Mexico	657.4	633.4	847.1	1 081.0	966.0	1 134
Chile	67.5	131.3	67.6	112.5	152.0	157
Dominican Rep.	19.8	18.9	20.4	13.2	26.3	34
Colombia	0.5	1.2	4.5	10.9	24.0	30
Mediterranean	**95.7**	**102.9**	**118.8**	**91.2**	**131.9**	**129.0**
Spain	49.8	44.4	59.6	42.5	60.4	52
Israel	44.8	53.1	51.6	41.2	62.0	54
Morocco	1.1	5.4	7.6	7.5	9.5	23
New Zealand	6.7	17.3	24.7	14.0	26.0	12

Professional sources

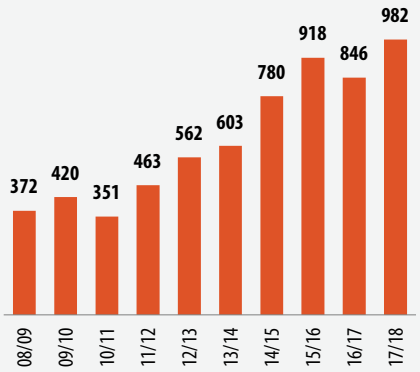
Avocado

Main import markets

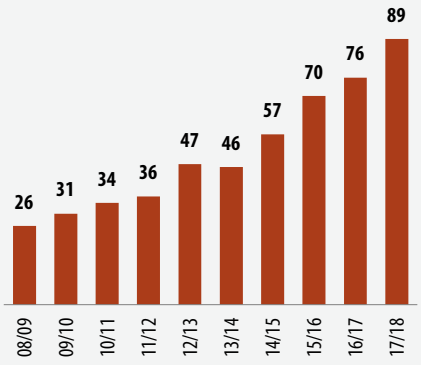
Avocado - EU-28 - Imports
Summer: year Y + spanish shipments
Winter: year Y/Y+1
(in 000 tonnes / source: Eurostat)



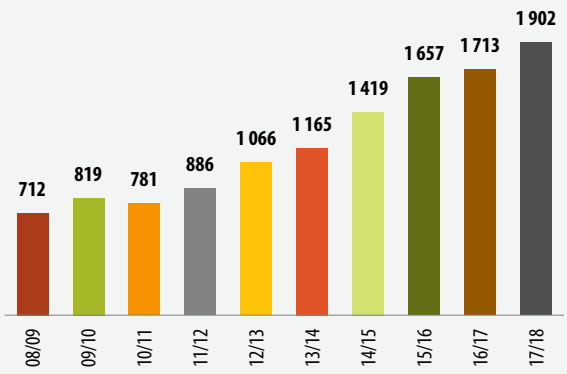
Avocado - USA - Imports
From July to June (excl. Peru: calendar year)
(in 000 tonnes / source: US customs)



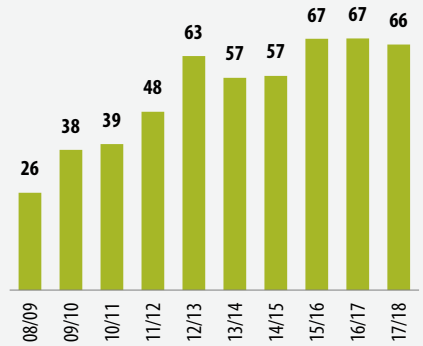
Avocado - Canada - Imports
From July to June (excl. Peru: calendar year)
(in 000 tonnes / sources: Trademap, other Customs)



Avocado - World imports
Summer: year Y
Winter: year Y/Y+1
(in 000 tonnes / various Customs sources)

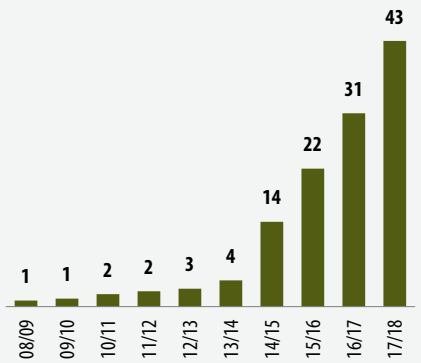


Avocado - Japan - Imports
From July to June (excl. Peru: calendar year)
(in 000 tonnes / source: Japanese Customs)



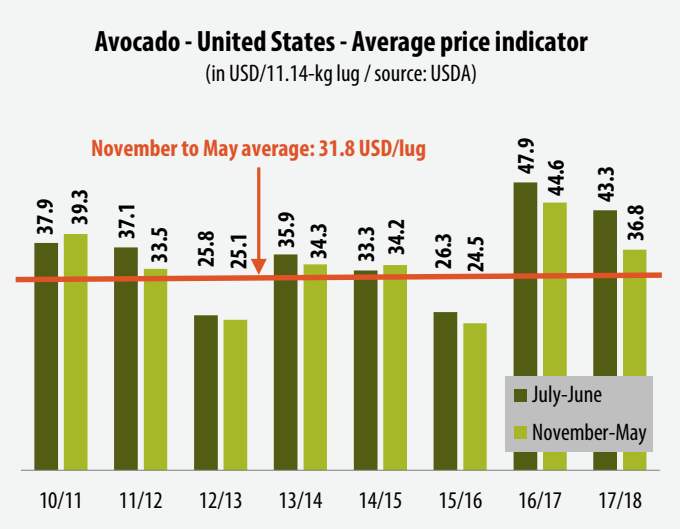
Photos © Guy Bréhinier

Avocado - China and Hong Kong - Imports
From July to June (excl. Peru: calendar year)
(in 000 tonnes / source: Trademap)



The indefatigable US market!

So US professionals had volumes available to feed the growth of their market, and they did not refrain from using them! Despite the good local Californian production level, imports for the first time approached the one million-tonne mark. Mexico, with a stronger presence than ever, supplied more than 860 000 t on its own. Note that among certain minor players, the ongoing decent Chilean presence (approximately 30 000 t, almost entirely shipped during the Mexican supply trough in August/September) and the good reception reserved for Peruvian fruits (return to the 2014-15 record volumes with approximately 65 000 t, after two difficult years). The 2018 campaign seems to confirm that the Peruvian graft has –finally – taken, with shipments of more than 80 000 t. Overall, the supply during the period from July 2017 to June 2018, was more than 11 % bigger than last season. Hence consumption per capita beat a new record, nearing 3.5 kg.



A strong consumption dynamic in all parts of the country

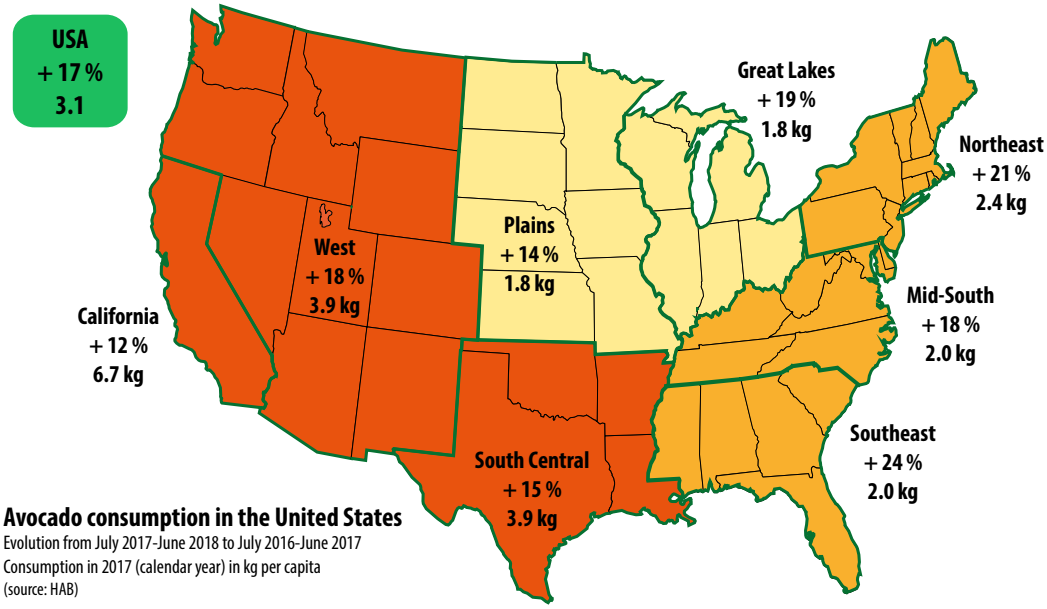
Demand was there to meet this influx of volumes, as is shown by the good response by rates throughout the season. This is confirmed by our average price indicator, though this is exaggerated since it encompasses the under-supply of summer 2017 and the high supply levels from the rest of the season. Yet even if we focus only on the abundant period from November to May, it is still a very respectable performance (34.4 USD/lug, i.e. + 7 % on the four-year average). A detailed geographic analysis, relating solely to the supermarket sector, shows two-figure growth across all regions. True, it could hardly be otherwise given the downturn seen in 2016-17 because of the supply shortfall, but these developments remain sig-

Avocado – United States – Supply

in tonnes	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Mexico	281 672	360 924	515 143	512 276	686 404	853 617	764 680	862 596
Peru	137	9 157	15 860	21 617	64 448	46 284	31 573	64 420
Chile	54 355	74 701	14 721	53 305	10 600	10 362	29 354	29 454
Dominican Rep.	14 956	17 204	16 150	15 958	15 548	7 393	20 805	25 757
Others	-	791	18	4	3 412	11	2	-
Total	**351 120**	**462 777**	**561 892**	**603 160**	**780 412**	**917 667**	**846 414**	**982 227**

Source: US Customs

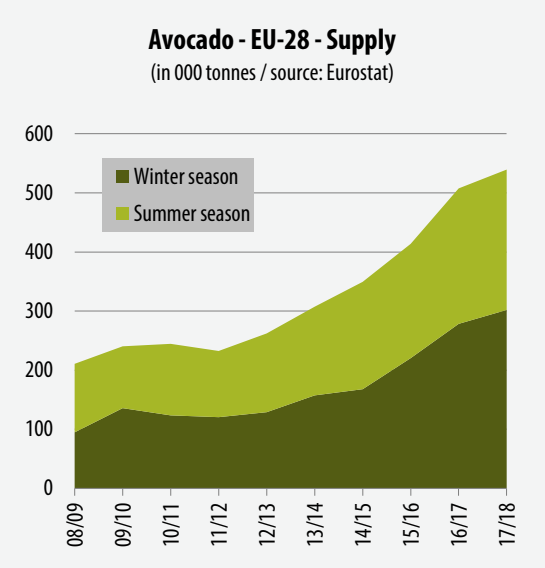
nificant nonetheless by virtue of their scale. Even California, which was already consuming nearly 7 kg per capita in 2017, apparently continued to rise in 2017-18, though at a rate below the national average. All regions on the Eastern Seaboard and Great Lakes region, currently the lowest consuming (between 1.8 kg and 2.4 kg/capita in 2017), continued to make giant strides forward with 18 to 24 % growth, above the national average. Conversely, the two regions in the centre of the country (Centre South and Plains) saw less clear progress, despite the distinctly below-average consumption level for the Plains. This dynamic, disparate but overall very strong, augurs well for the coming years. Growth in consumption is far from over in the US!



Avocado consumption in the United States
Evolution from July 2017-June 2018 to July 2016-June 2017
Consumption in 2017 (calendar year) in kg per capita
(source: HAB)

EU-28: a new supply record despite slack growth

As in the USA, the supply to the EU-28 beat records by exceeding 540 000 t in 2017-18, despite much slacker growth than in previous campaigns, due to lack of volumes. There was only a single-digit rise in the supply in both the winter season (+ 8 %) and summer season (+ 4 %). Despite this very relative failure, it has to be observed that the market has made immense progress in five years, doubling its size. A complete analysis of the dynamic of all the big EU-28 countries can be found in the following article.



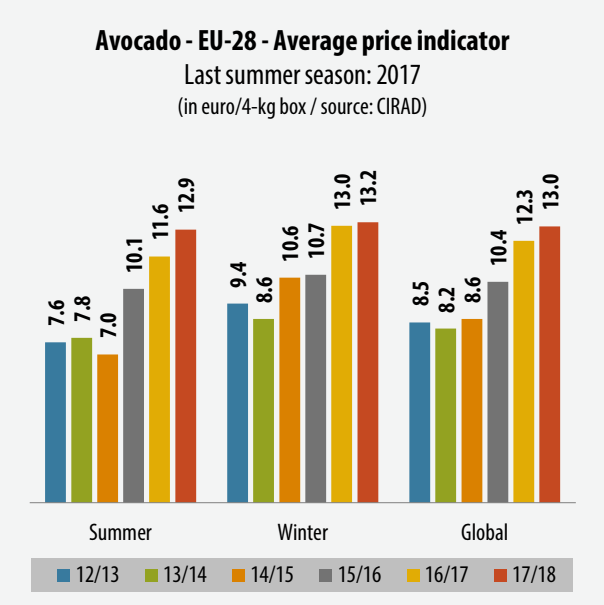
Morocco and Mexico the big winners of this 2017-18 campaign in the EU-28

The analysis of procurement by supplier reveals some interesting trends, excluding the seasonal shifts already mentioned in the introduction to this article. Mexico registered a remarkable rise (a record at more than 60 000 t). Maybe we should talk about the Mexicos, since this leap should definitely be credited to Jalisco, whose production is seeing rapid progress though still an "origin non grata" in the USA. Similarly, the surge in Moroccan shipments should be highlighted, with exports to the EU-28 leaping up to more than 22 000 t. This figure reveals the extent of the expansion of this country's cultivation area, which had previously gone unnoticed because of climate incidents.

Avocado – European Union – Supply

in tonnes	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Total	**120 414**	**240 845**	**290 557**	**317 833**	**402 004**	**471 750**	**531 084**
Total N. Hemisphere	**120 414**	**128 824**	**157 266**	**167 741**	**220 318**	**278 351**	**301 853**
Chile	32 637	41 074	62 968	42 797	78 244	90 138	92 467
Mexico	2 909	9 085	6 293	12 918	45 593	36 884	60 993
Spain	38 900	38 500	36 700	50 600	37 700	55 200	48 600
Israel	40 448	35 175	42 844	46 086	34 995	56 600	41 567
Colombia	121	486	1 142	3 740	11 189	24 024	28 000
Morocco	2 803	840	4 766	7 798	7 115	9 552	21 746
Dominican Rep.	1 467	2 503	1 810	3 034	4 445	5 527	7 345
Others	1 129	1 161	743	768	1 037	426	1 135
Total S. Hemisphere	**-**	**112 021**	**133 291**	**150 092**	**181 686**	**193 399**	**229 231**
Peru	66 155	62 618	86 260	101 971	114 321	144 367	157 744
Southern Africa*	27 375	49 083	45 165	56 713	50 962	54 095	43 984
Kenya	15 028	17 078	13 313	15 604	20 728	23 444	25 425
Brazil	3 006	3 959	3 928	5 265	3 535	3 908	7 189
Tanzania	6	133	968	1 643	3 278	2 948	2 987
Others	451	420	458	490	575	470	283

* South Africa, Zimbabwe, Swaziland / Source: Eurostat

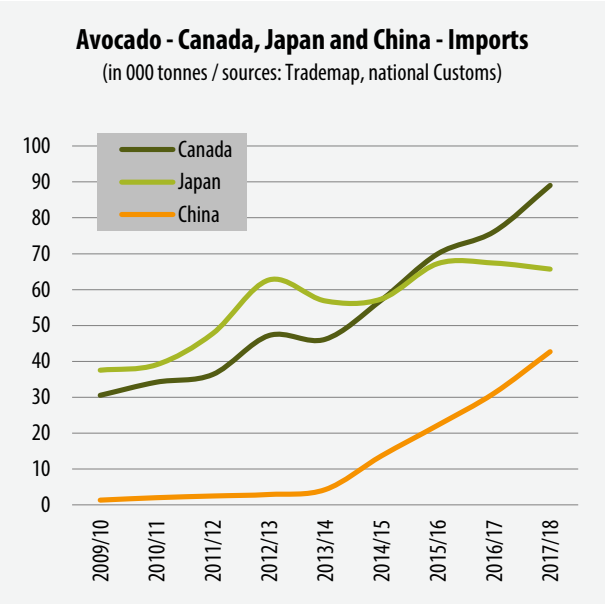


Prices peaking and varying less and less

As could be expected in such a limited procurement context, the performance was unambiguous in economic terms. Our quayside price indicator is registering a record level of 13 euros/box, up by 5 % from 2016-17. This is a remarkable increase for the summer season (+ 16 %), with rates for the first time equalling those charged during the winter season, which were practically stable. Analysis of price variations throughout the campaign shows an increasingly linear trend. The standard deviation, which describes the width of the price range, for the first time fell below the symbolic one-euro mark (as opposed to more than 1.30 euros four years previously). This is symptomatic of the increasingly distinct trend of purchasing contractualisation (supply programme at a price often fixed for a six-month period).

Canada following in the footsteps of its massive neighbour

For the fourth consecutive year, Canada registered the highest growth rates in the world (between 17 and 24 %, with the exception of 2016-17, when Mexican volumes were lacking). The market, which has doubled in size in four years, has well and truly consolidated itself as the world number three with a consumption of close to 90 000 t (i.e. 2.5 kg/year, a higher level than the biggest consumer countries in Europe). This progress is down to the main market supplier, i.e. Mexico, being highly active in terms of promotion via APEAM. Yet another example showing that promotion pays off!



Japan: a pallid world number four

While Japan remains the world number four, it is far from exhibiting the same dynamic as the top three. It is even probably one of the only markets in the world to be stagnating among the high-revenue countries (at approximately 65 000-70 000 t since 2015-16). Why such a trend, when promotions are continuing to be conducted, especially by Mexico, the country's main supplier? On the one hand, it seems that the avocado is no longer seen as an exotic fruit and is no longer riding the wave of novelty, on this market with a great appetite for innovations. On the other hand, it seems above all that prices have struggled to increase. It is true that price tags have soared in recent seasons, since the fall in the yen has magnified the effects due to the tension of the world market. The graph opposite shows that the price per tonne of avocado to more than 300 000 yen in 2013-14 caused a distinct slowdown in the growth tempo, and that the leap up to 350 000 yen in 2016-17 resulted in a complete halt on the market.

China: still an up-and-coming market for the moment...

The market of the Middle Empire, aptly named since it is at the centre of operators' concerns, has continued to grow, though at a stately pace. According to our estimate based on exports from the supplier countries, volumes sold rose by approximately 10 000 t in 2017-18, to reach just over 40 000 t. This growth rate has been stable for four years, and for the moment is certainly not soaring. By way of comparison, the Canadian market – with much less media coverage – has risen in exactly comparable proportions for the same period. True, the prospects of the Chinese market with a population of 1.4 billion are in no way comparable to those of "little" Canada. Nonetheless, this further year of moderate growth clearly shows that we should not overestimate the growth capacity of this market in the short or medium term. Plenty of big players in the sector are investing heavily to develop it (Camposol and APEAM, with a strong presence in terms of promotion, Mission which has just opened a second ripening plant in the south of the country). Yet this new product is yet to become familiar - dietary habits do not extend to eating it cold. Perhaps most of all, the logistics remain a big constraint for the Latin American countries (25 to 30 days as a rule). As the Chinese proverb says, it takes time for the mulberry leaf to become a silk robe. The professionals should bear this saying in mind in their cultivation area expansion programme, especially the South Americans ■

Eric Imbert, CIRAD
eric.imbert@cirad.fr

Avocado – China + Hong Kong – Imports

in tonnes	2014-15	2015-16	2016-17	2017-18
Chile*	1 092	5 783	13 405	15 029
Mexico*	10 794	14 223	10 919	17 690
United States	243	1 052	644	927
Peru	1 154	520	2 802	6 437
Others	346	587	3 298	2 600
Total	**13 629**	**22 165**	**31 068**	**42 683**

* Estimated from exporter country Customs
Sources: Trademap, national Customs

Avocado
Consumption in the EU-28

Highly atypical growth

While the 2017-18 avocado campaign is not extraordinary in terms of consumption in the European Union, certain trend turnarounds are raising questions, and are worthy of analysis.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Modest growth in 2017-18, due to lack of volumes

During the 2017-18 season (period from June 2017 to May 2018, encompassing the 2017 summer campaign and the 2018 winter campaign), consumption growth was well below that registered in previous years. True, the 8 % figure achieved would be the envy of practically any other fruit industry. Yet the avocado market has become accustomed to so much better since 2013-14, with levels still between 14 and 24 % per year. While demand was in place, it is once again the supply which was lacking. Growth in the supply was rather limited during the 2017-18 winter season, because of the shortfall from the two main Mediterranean players, i.e. Spain and Israel. The same occurred during the 2017 summer season, with a particularly lean South African harvest and only a moderate rise by Peru (climate disruption due to La Niña).

Avocado — Consumption in Europe (June 2017 to May 2018)

	Estimated marketed volume in 2017-18 (t)*	Population in millions	Consumption per capita (g)	2017-18 compared to		GNP-PPS** (index)
				2016-17	2012-13	
EU-28 + Norway	**521 037**	**495.0**	**1 053**	**8%**	**110%**	**100**
EU-15 + Norway	**483 486**	**413.9**	**1 168**	**8%**	**104%**	**167**
France	123 790	67.2	1 842	3%	54%	104
United Kingdom	97 209	66.2	1 468	0%	162%	105
Germany	63 998	82.9	772	20%	150%	123
Scandinavia	53 021	26.7	1 986	-3%	25%	131
Sweden	19 733	10.1	1 954	-1%	1%	122
Denmark	13 274	5.8	2 289	-5%	7%	125
Norway (non-EU)	12 350	5.3	2 330	0%	67%	179
Finland	7 663	5.5	1 393	-9%	139%	109
Spain	50 252	46.7	1 076	18%	233%	92
Netherlands	39 233	17.2	2 281	43%	225%	128
Italy	17 374	60.4	288	22%	248%	96
Belgium	12 391	11.4	1 087	-18%	103%	117
Austria	7 497	8.8	852	8%	221%	128
Greece	6 900	10.8	642	-3%	230%	67
Ireland	6 530	4.8	1 361	16%	217%	184
Portugal	4 618	10.3	448	39%	56%	77
Luxembourg	674	0.6	1 123	-3%	230%	235
NMs Eastern Europe	**37 551**	**102.7**	**366**	**16%**	**240%**	**69**
Poland	13 704	38.0	361	14%	359%	70
Romania	6 450	19.5	331	17%	521%	63
Baltic States	6 329	6.1	1 038	8%	78%	70
Czech Rep.	3 310	10.6	312	11%	244%	89
Hungary	2 505	9.8	256	48%	284%	68
Slovakia	2 037	5.4	377	45%	254%	77
Bulgaria	1 768	7.1	251	17%	425%	49
Croatia	839	4.1	205	8%	78%	61
Slovenia	608	2.1	289	-24%	-35%	85
Switzerland (non-EU)	14 888	8.5	1 752	11%	96%	161

* Import-export+production / ** GNP: Gross National Product, PPS: Purchasing Power Standards / Professional sources, Eurostat, FAO

Still a fine growth margin in the EU-28

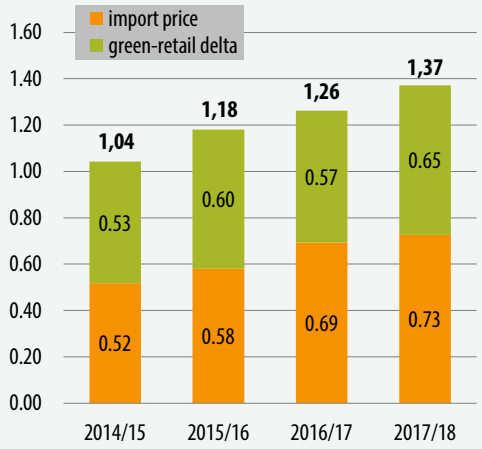
This modest growth will nonetheless have helped EU-28 average consumption to slightly exceed the one kilo per capita mark. Compared to the other big global markets, this remains a moderate level, even if we only look at the considerably higher consumption in Western Europe (1.2 kg/capita). Consumption per capita in the biggest non-producer consumer countries is twice as high (2.5 kg in Canada and 2.3 kg in Norway and Denmark). In the particular case of the producer countries, consumption has climbed to even higher levels: between 5.5 and 6 kg/capita in Chile and Israel, and 6.5 to 7 kg in Mexico. As for the USA, a market which can be used as a benchmark due to its low production (just 10 to 15 % of the total supply covered by the Californian harvest), consumption is now approaching the 3.5 kg/capita mark thanks to the massive promotion efforts of the entire industry via the HAB.

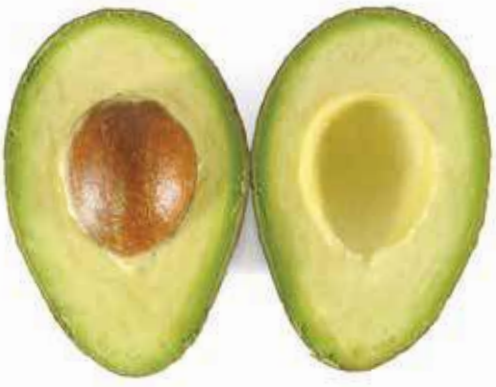
	Russia	Japan	EU-28	EU-15	Canada	USA	Israel	Mexico
kg per capita	0.1	0.5	1.05	1.2	2.5	3.5	5.5 / 6.0	6.5 / 7.0
	AVOCADO CONSUMPTION →							
Annual growth	6 %	4 %	17 %	15 %	12 %	7 %		

France curbed by a new surge in retail prices

Analysis of growth in Community consumption by market throws up a big surprise. For the first time, it was not the top two which hoisted up the EU-28 market. France remained by far the number one in terms of volumes (124 000 t, i.e. approximately 30 % of quantities taken in across the EC). However, it saw a rise of just 3 %, a low level well below that observed in previous campaigns. It was indisputably weighed down by the promotion and retail price policy of the supermarket sector. Prices tags continued to soar, reaching 1.35 to 1.40 euro/piece according to the season for the loose segment, i.e. a 35 to 40 % increase in four years! True, import prices soared too, though the distribution sector clearly opted to take advantage by increasing its margins (0.65 euro/piece in 2017-18, i.e. + 14 % on the previous season). While the marketing work by the WAO has helped boost sales at certain times of year, retail trade indicators show conversely that promotions remained more limited.

Avocado - France - Green price, retail price and retail margin
(in euros per size 18 fruit / sources: CIRAD, RNM)

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A surprisingly stagnant UK

The UK registered an even more mediocre performance with, for the first time since the start of the decade, consumption stagnant at approximately 100 000 t (i.e. 20 % of the EC supply). This stark zero is a shock since in recent campaigns this country was Europe's star pupil, with an average growth of between 20 and more than 30 %. Here too, soaring price tags seem to have played a major role, though it is probably not the sole reason. Certain professionals are lamenting a loss of attractiveness of the market due to Brexit, more particularly to the weakness of the pound: 1.10 against the euro for the majority of the season, as opposed to approximately 1.20 in 2016-17. Furthermore, the United Kingdom might also have suffered from German growth, as these two markets are in competition for the limited quantities of very high certification level merchandise.

Mehr Avokado bitte!

With record growth of 20 %, Germany was the indisputable winner of this 2017-18 season. It is now the number three European consumer country, with volumes approaching 65 000 t. Unlike the top two, retail prices seem to have maintained a fairly attractive level, thanks in particular to very strong promotions – the hallmark of this market (avocado often included in weekly promotions in chains such as Lidl or Aldi, a well-established commercial practice and expected by the public). Furthermore, it has had no difficulty rising since consumption per capita remains very modest. Despite several years of strong growth, it is still less than 800 g, as opposed to a West European average of approximately 1.2 kg.


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Scandinavian maturity confirmed

Analysis of the 2017-18 campaign does not reveal solely turnarounds in trend. Some of them have also been confirmed, such as the Scandinavian markets reaching maturity. Growth has gone from slack in recent years to zero in 2017-18. It is true that these countries are by far the European leaders in terms of consumption per capita, with levels ranging from 2.0 kg for Sweden to approximately 2.3 kg for Norway and Denmark (with Finland remaining apart, levelling out at 1.4 kg for the past several seasons). Hence, despite this recurrent flatness, Scandinavia remains one of the leading consumption centres on the Old Continent, with volumes of approximately 55 000 t (i.e. 10 % of total consumption).

A fine Spanish dynamic, at least presumably

Analysis of the 2017-18 figures also seems to show a fine dynamic for the Spanish market. This trend should be taken with great caution, since this country's consumption is hard to calculate – doubly so. The uncertainty is no longer solely based on the difficulty in estimating the local production level, but also the re-exports level. Spain is becoming an increasingly important hub, as is attested by the record level of extra-Community imports into this country during the 2017-18 winter season (just over 40 000 t, i.e. just over 15 % of extra-Community imports during this period). This trend, as uncertain as it may be, has nonetheless seemingly been confirmed by professionals.

Avocado – Spain – Imports

in tonnes	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Winter season	**5 241**	**4 449**	**7 018**	**9 282**	**9 902**	**29 916**	**27 311**	**40 778**
Mexico	505	386	2 268	677	2 705	16 644	9 789	14 089
Chile	3 303	2 821	4 368	5 202	2 815	6 085	6 633	7 874
Morocco	1 433	1 140	381	3 403	4 046	4 582	6 540	12 247
Colombia	-	-	-	-	121	2 460	4 114	6 441
Israel	-	102	-	-	216	146	235	127
Summer season	**22 793**	**22 389**	**23 706**	**30 005**	**36 880**	**35 479**	**46 802**	**49 888**
Peru	19 233	20 533	20 581	27 897	33 700	31 726	41 979	42 302
South Africa	1 602	296	838	740	1 009	1 559	2 133	1 666
Kenya	1 817	1 518	2 092	1 035	1 058	1 100	865	1 582
Brazil	140	42	195	333	1 113	1 094	1 825	4 338
Total	**28 034**	**26 838**	**30 724**	**39 287**	**46 782**	**65 395**	**74 113**	**90 666**

Source: Eurostat

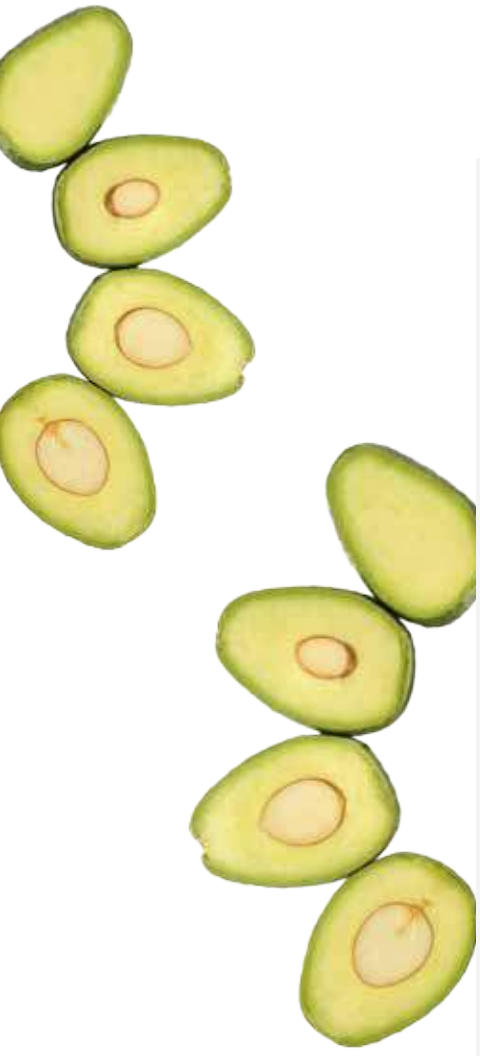
Take-off confirmed in Italy and "small markets" holding up nicely

The small markets too fared quite well. Italy seems to have confirmed its take-off, with growth of more than 20 % in 2017-18. There is an enormous margin for growth, with consumption per capita not even reaching 300 g per year. Nonetheless, expectations in terms of sizing from the distribution sector, which does not accept big fruits, could be a brake on growth in the medium term, in particular during the winter season when sizes 12 or 14 are fairly scarce. We should also hail the performances of Austria (+ 8 %), and above all of Ireland (+ 16 %).

Retail price inflation to be monitored on certain markets

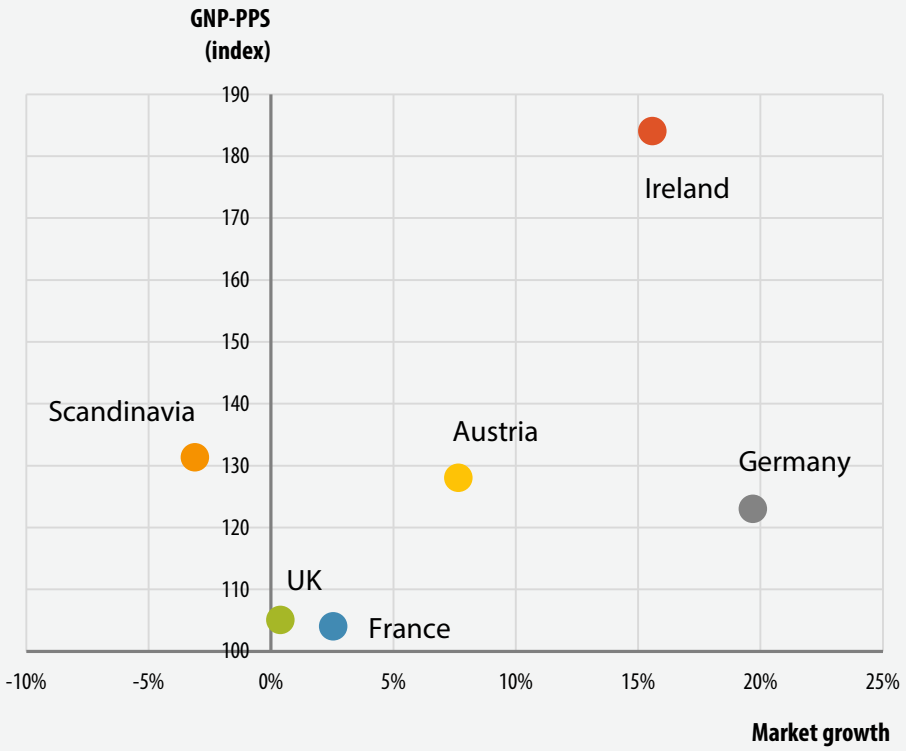
In conclusion to the analysis of this atypical campaign, an important point should be emphasised. Despite the efforts made by industry professionals to boost the market via the WAO, the level reached by retail prices seems to be starting to affect the growth capacity of certain markets. The phenomenon appears fairly clear on the two main markets of the EU-28, i.e. France and the United Kingdom, which take in more than 50 % of the supply between them. Furthermore, it seems that we can detect, with all the customary reserves associated with this type of exercise, a relationship between growth rate and purchasing power: the markets which have risen least are those where GDP per capita is lowest, while the dynamic has remained strong in the richer countries (with the exception of Scandinavia due to its practically mature market). It would be good for the distribution sectors in countries where retail price sensitivity among consumers has become strong to undertake not to undermine the dynamic of a still extraordinary market. In short, we would plead with the supermarkets not to kill the golden goose ■

Eric Imbert, CIRAD
eric.imbert@cirad.fr



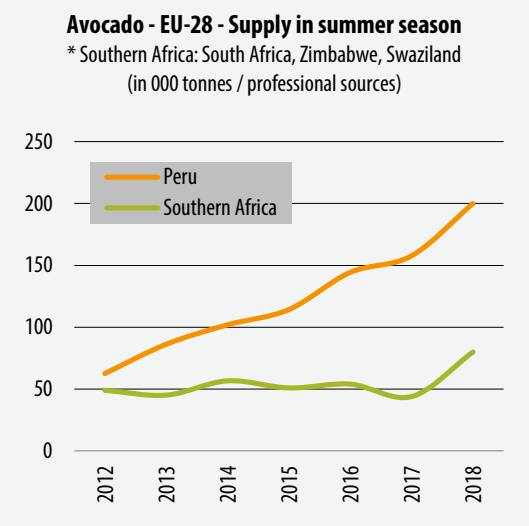
Avocado - Relation between market growth and GNP

(sources: CIRAD, Eurostat)



Avocado
Summer 2018 campaign in the EU
Scuttled

The 2018 summer campaign promised to be abundant, and in this respect it did not disappoint. The combined supply from the two main suppliers to the EC market, estimated since the Customs data are not yet available, should be close to 280 000 tonnes, which represents an outrageous and record rise of approximately 40 % on last season. Peru and South Africa both shipped considerably greater volumes than forecasted.



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Peru asserting itself as the world no. 2 exporter

For Peru, this 2018 season should be described as simply colossal in terms of volumes. Exports across all destinations and varieties should be within the range 310 000 to 320 000 t, marking a rise of approximately 70 000 t from 2017. Shipments to the EU-28 were massive, probably nearing 200 000 t (as opposed to 159 000 t in 2017). However, volumes bound for the USA were higher than ever, confirming Peru's more solid rooting on this market (probably more than 80 000 t, as opposed to just over 65 000 t in 2017). Similarly, Peruvian exports made fine breakthroughs on the Asian and Latin American diversification markets (probably more than 20 000 t to each of these destinations).

Besides the scale of the outgoing volumes, the other characteristic of this Peruvian campaign was the very high level of shipments to Europe in the latter part of the season (between 6.5 and 7 million boxes in September, i.e. more than double that of the previous season). Partly due to a cyclical factor (late maturity), this also reflects the development of production in the late-season zones.

Avocado – European Union – Supply in the summer season

in tonnes	2012	2013	2014	2015	2016	2017	2018	2018 compared to	
								2017	2014-2017 average
Total	**133 291**	**150 092**	**181 686**	**193 399**	**229 232**	**237 611**			
Total Southern Africa + Peru	**111 701**	**131 425**	**158 684**	**165 283**	**198 462**	**201 728**	**280 000**	**39 %**	**55 %**
Peru	62 618	86 260	101 971	114 321	144 367	157 744	200 000	27 %	54 %
Southern Africa*	49 083	45 165	56 713	50 962	54 095	43 984	80 000	82 %	56 %
Total other suppliers	**21 590**	**18 667**	**23 002**	**28 116**	**30 770**	**35 883**			
Kenya	17 078	13 313	15 604	20 728	23 444	25 425			
Brazil	3 959	3 928	5 265	3 535	3 908	7 189			
Tanzania	133	968	1 643	3 278	2 948	2 987			
Others	306	300	447	497	337	280			
Argentina	114	158	43	78	133	3			

* South Africa, Zimbabwe, Swaziland / Professional sources

Growth in the South African cultivation area showing through

South Africa too registered the biggest campaign in its history. Exports, practically all bound for the EU-28, should exceed 80 000 t (as opposed to just over 43 000 t in the well below-average 2017 campaign, and an average of 55 000 t in normal production years). This big and rapid rise illustrates the rapid expansion of the South African cultivation area in recent years (approximately + 750 ha/year), which hitherto went slightly under the radar for reasons of climate problems during the last season of positive alternate bearing (drought and hail during the 2016 season).

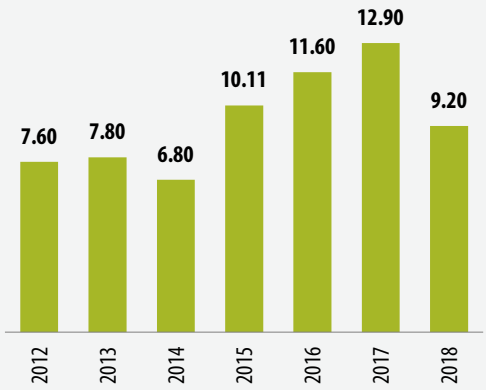
We do not have the figures to estimate the volumes from other suppliers to the EC market, which in 2017 represented a total of approximately 35 000 t. However, it seems that Kenya, which accounted for approximately two-thirds of volumes from small supplier countries in 2017, has also seen a rise of significant proportions (probably + 15 to + 20 %).

A 9-week summer crisis

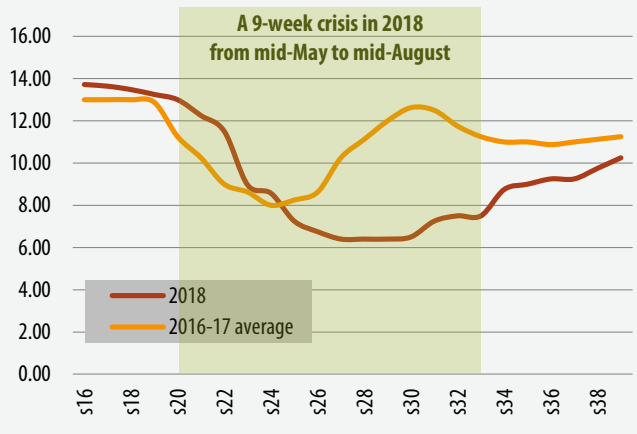
Of course, demand proved insufficient to absorb such a colossal rise in volumes, despite the major promotion efforts undertaken by the WAO. Hence the summer crisis, practically a matter of course until 2015 but which faded into the distance in 2016 and 2017, re-emerged on the EC market. It was once again in mid-May that the market weakened, hit by incoming shipments of more than 3.8 million boxes per week. Prices, in freefall from this date, sank below the 7.5-euros/box mark from mid-June to mid-August, i.e. for nine weeks. We would need to wait more than one month between the time when volumes started their decline (mid-July) and when rates took an upturn (mid-August). Despite that, the average Hass campaign price, calculated over the period running from mid-April to late September, would reach a level of approximately 9 euros/box, the few good weeks in April and May helping buffer the fall. A more in-depth analysis of these figures would be able to reveal the resistance thresholds of the EC market. Nonetheless, it clearly appears that given the volumes, the catastrophe was bound to happen ■

Eric Imbert, CIRAD
eric.imbert@cirad.fr

Hass avocado - EU-28
Price indicator in the summer season
(in euro/4-kg box / source: CIRAD)



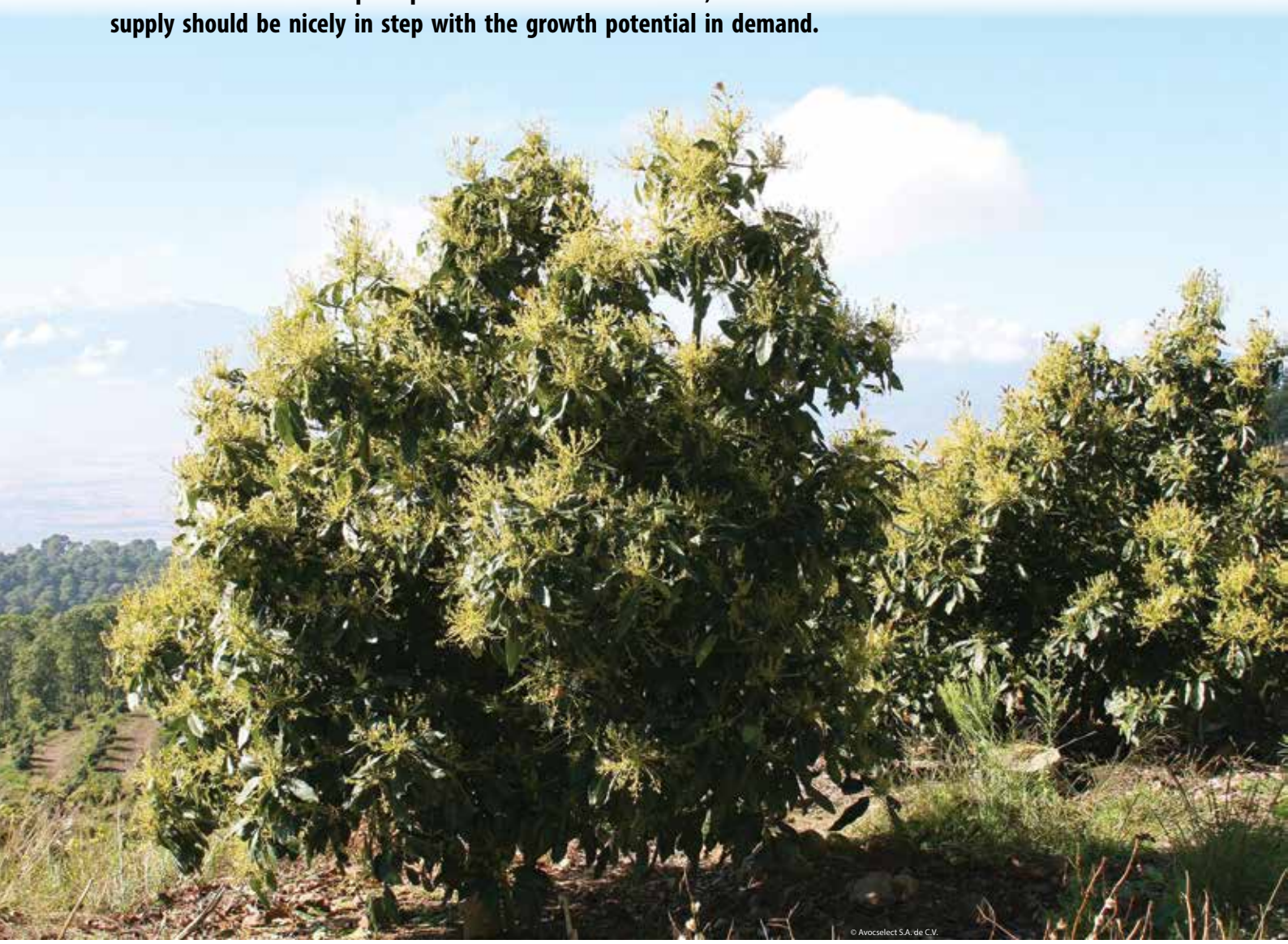
Hass avocado - EU-28 - Weekly prices in the summer season
(in euro/box / source: CIRAD)



Avocado
Winter 2018-19 forecasts for the EU

Just what was needed!

The 2018 summer campaign, now coming to a close, showed the limits of EC market demand. Should we fear the volumes expected during the winter 2018-19 campaign, when all the major market suppliers announced excellent export potential? The answer is no, since the supply should be nicely in step with the growth potential in demand.



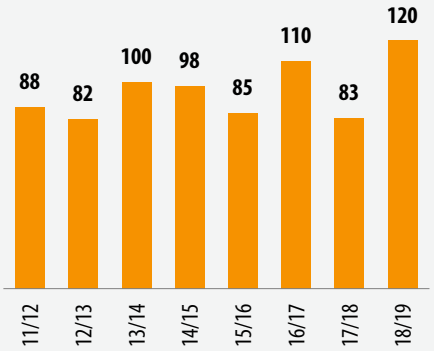
A record season in Israel, in particular for green varieties

A fine campaign is taking shape in the Mediterranean, with the leaders (Israel and Spain) both registering record production levels. The expected surge in Israeli production is on a par with the slump seen in 2017-18. At 120 000 t, the harvest will be the biggest ever recorded (+ 30 % on the average). The alternate bearing effect, this season on an upswing, and the excellent climate conditions, are not the only two factors explaining the very good production level. Growth in the cultivation area, with an average of 500 ha per year recently, is another relevant factor. In this high production context the local market, highly price-sensitive, should absorb approximately 50 000 t, which corresponds to consumption per capita of approximately 5.5 to 6.0 kg, a good level even for a producer country. Hence approximately 70 000 t should be left for export. Green varieties should continue to represent just over 50 % of volumes placed on the international market, despite the increase in Hass surface areas. The export potential will be very high for Ettinger, which remains by far the country's main green variety (nearly 40 % of green variety surface areas). Volumes shipped to the EU should be around 85 %, with Russia taking in the bulk of the leftovers.

ISRAEL

Planted area of nearly 9 200 ha (48 % green varieties and 52 % Hass)
World No. 4 exporter

Avocado - Israel - Production
(in 000 tonnes / professional sources)



Avocado — Israel — Exports

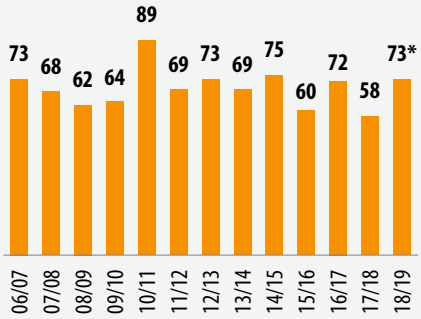
in tonnes	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
EU-28	40 355	35 117	42 844	46 086	34 995	56 600	41 567
Others	3 645	7 383	10 156	6 914	6 224	7 450	10 933
Total	**44 000**	**42 500**	**53 000**	**53 000**	**41 219**	**64 050**	**52 500**

Professional sources and Eurostat

SPAIN

Hass planted area of nearly 13 500 ha in the Peninsula
World No. 5 exporter

Avocado - Andalusia (Malaga, Granada, Cadiz, Huelva) - Production
(*estimate / in 000 tonnes / source: MARM)



Harvest on a par with the excellent 2016-17 figures in Spain

The Spanish harvest too will register a major rise. However, it will only regain the 60 000 t level from 2016-17 in the country's main production centre, Axarquía, with a much more moderate surface area expansion than in Israel. Unlike other regions in Spain or even Europe, summer temperatures were around normal (in particular, no heatwave). Furthermore, there was a decent rainfall level during the winter and spring. Hence the water reserves available from the Viñuela reservoir, the main irrigation source for Axarquía, are distinctly greater than at the opening of the previous campaign (reservoir at 39 % capacity, as opposed to 29 % in 2017). So the sizing is set to be rather above average. So Spanish exports, across all production zones, should return to a level of around 55 000 t (85 % Hass and 15 % green varieties).

Avocado — Spain — Exports

in tonnes	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Intra-EU-28	38 900	38 500	36700	50 600	37 600	54 600	48 600
Extra-EU-28	5 200	7 700	3100	4 000	2 900	5 800	3 718
Total	**44 100**	**46 200**	**39 800**	**54 600**	**40 500**	**60 400**	**52 318**

Professional sources and Eurostat

Heat wave and alternate bearing in Morocco

Unlike the top two, Morocco is set for a below-average season, albeit after a record 2017-18 harvest (more than 22 000 t exported, practically all to the EU-28). The downward alternate bearing effect was reinforced by a summer heatwave. Hence the volumes available for export should be less than 10 000 t, despite the ongoing rapid expansion in cultivation area (approximately 600 ha per year).

Avocado — Morocco — Exports

in tonnes	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
EU-28	2 803	840	4 766	7 293	7 141	9 237	22 000
Others	107	317	562	301	131	122	1 000
Total	**2 910**	**1 157**	**5 328**	**7 594**	**7 272**	**9 359**	**23 000**

Sources: Comtrade, Eurostat

MOROCCO
Hass planted area of nearly 6 000 ha
World No. 10 exporter

A new Mediterranean player: Portugal

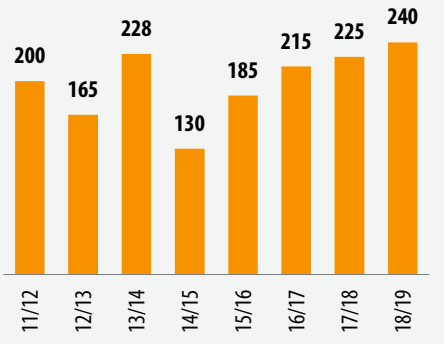
The 2018-19 campaign will be marked by the arrival of a new member in the Mediterranean exporter family: Portugal. Planting has been going strong in the south-west of the country (Algarve and the Bajo Alentejo coast), and some volumes should be making their debut on the international market this season. The Hass cultivation area covers approximately 1 000 ha in total, according to professional sources. It is based mainly on medium to large-sized orchards, developed in part by the growers/local investors. By way of example, Citago established one of Europe's biggest plantations (80 ha) near Lagos in Algarve. International avocado specialists have also invested in Portugal. The Spanish cooperative Trops has established a packing station in Tavira (Algarve) to market the produce of twenty or so local producers. The world number one in the sector, Westafalia, has started to set up a large-scale plantation near Setúbal further north, in partnership with a local player (80 ha of Hass and Gem planted in late 2017, out of approximately 500 ha available).

Near full potential for Chile

Just as in the Mediterranean, the big South American players will also be in top form. In Chile, the spectre of the dark years seems increasingly distant. For the third consecutive season, there should be a very good production level, even probably approaching its full potential with approximately 240 000 t expected. The frost in late May/early June had very little impact on the avocado industry, with the affected zones mainly planted with citruses. Excluding the large volumes earmarked for the local market, the export potential should be at a slightly higher level than in 2017-18. The main emphasis was on the diversification markets, so the EU-28 programme should be very slightly greater than its 2017-18 level of 93 000 t (slightly over 95 000 to 100 000 t expected). So while volumes are set to be similar to last season, maturity seems slightly later. This factor, combined with a deliberately deferred start to shipments to Europe, in view of the magnitude of Peruvian volumes still available in September, should lead to a bigger supply in the latter part of the season.

CHILE
Hass planted area of nearly 29 000 ha
World No. 3 exporter

Avocado - Chile - Production
(in 000 tonnes / professional sources)



Avocado — Chile — Exports

in tonnes	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
EU-28	32 929	42 571	64 247	43 481	79 421	91 385	93 496
USA	73 795	14 710	53 297	12 341	11 428	29 204	29 389
Central America	7 342	8 888	11 735	9 943	15 762	17 397	15 801
Japan+Asia	1 638	1 283	1 978	1 877	5 878	13 594	15 147
Total	**115 703**	**67 452**	**131 257**	**67 643**	**112 489**	**151 580**	**157 111**

Source: Chilean Customs

COLOMBIA
Hass planted area of nearly 17 500 ha
World No. 9 exporter

Colombian surge ongoing

As the 2017-18 campaign confirmed, the Colombian export industry is off to a flying start. Still marginal even in 2014-15, the Andean country's exports neared the 30 000-t mark in 2017-18. Unsurprisingly, they should again see very considerable growth in 2018-19, to reach 40 000 t. This rapid growth is due to huge expansion in surface areas, which have now reportedly reached 17 500 ha. Practically all of these volumes should continue to be aimed at the European Union. There are few operator currently prepared to export to the United States, as is attested by the modest volumes exported since this market opened up in late 2017 (fifty or so tonnes from November 2017 to May 2018). The sanitary protocol aimed at limiting risks of introducing quarantine pests remains very difficult to comply with.

Avocado — Colombia — Exports

in tonnes	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18*
EU-28	-	508	1 173	3 050	11 691	22 045	28 000
Others	7	30	38	1 450	100	292	500
Total	**7**	**538**	**1 211**	**4 500**	**11 791**	**22 337**	**28 500**

* Estimate / Source: DIAN

What about Jalisco?

Mexico is the origin that has seen the biggest rise on the EC market, with incoming shipments increasing ten-fold in four years to exceed the 60 000-t mark in 2017-18 (average rise of 15 000 t per year). It is of course the surge in production from Jalisco which is behind this boom (probably 45/50 000 t, i.e. 3/4 of volumes exported to the EU-28 according to professional sources). All the factors are there on the upstream side for this origin to continue developing its shipments to Europe in 2018-19. Production, in excess of 2 million tonnes nationally in 2017/18, should reach a record level, in both Jalisco (approximately 160 000 t expected, i.e. +15/20%) and Michoacán (+ 8 to 10 % according to the professionals). In addition, the political tension existing between Mexico and the USA, currently at a peak, gives little hope for US borders opening up to avocados from Jalisco this season, when moreover a change in government is expected in Mexico. Hence Jalisco should continue to focus on the Japanese, Canadian and European markets. Volumes could be between 70 000 and 80 000 t, depending on the scenarios (same rise as the overall rise in the EC supply, or ongoing average growth from this origin of 15 000 t per season).

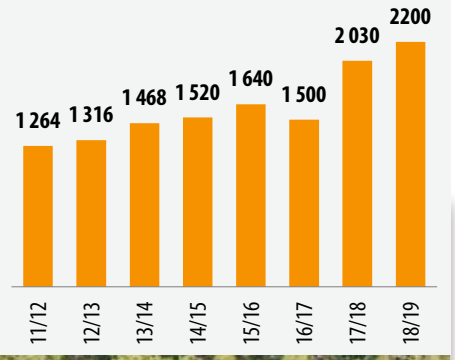
MEXICO

Hass planted area of nearly 218 000 ha

World No. 1 exporter

Avocado - Mexico - Production

(in 000 tonnes / source: USDA)

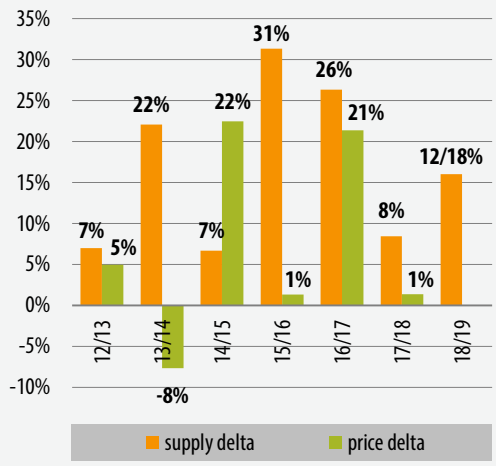


Avocado — Mexico — Exports

in tonnes	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
USA	359 262	522 488	516 085	693 344	862 457	759 318	861 393
Japan	42 354	55 883	51 626	53 175	64 864	62 459	60 455
Canada	27 431	35 044	33 632	44 958	62 148	71 607	83 346
EU	4 153	9 137	5 690	12 996	47 689	38 768	62 146
Others	29 537	34 893	26 386	42 597	44 092	33 820	66 306
Total	**462 737**	**657 445**	**633 418**	**847 070**	**1 081 250**	**965 972**	**1 133 646**

Source: Mexican Customs

Avocado - EU-28 - Evolution of supply and average price in the winter season
(sources: CIRAD, Eurostat)



Prices set to maintain a good level, though slightly lower than in 2017-18

If the hypotheses presented above are confirmed, the rise in the overall supply to the EC market should be within the range 12 to 18 %, depending on Mexican volumes. Analysis of past campaigns indicates a rough trend as to price evolution in 2018-19. Since 2014-15, rates have risen constantly despite the parallel increase in trade volumes, with supply peaks sometimes even accompanying record prices (volumes and prices increasing by 26 % and 21 % respectively in 2016-17). However, the 2017-18 campaign showed a distinct levelling out, with volumes up by "only" 8 % and practically stable prices (+ 1 %). This factor should be considered alongside the slowdown in growth in consumption in France and the United Kingdom because of the very high retail price level reached (see consumption article). A slight downturn in import rates should help revitalise the dynamic on these markets, which are from mature.

The distribution of volumes over time, another important point to incorporate into the equation to determine the price evolution, also points to this slight downturn. We might assume that the supply pressure will be higher during Q1 2019, due to the late start to the Chilean campaign and a rising Hass export potential, for both Israel and Spain. Prices should remain excellent during this period, but will probably not scale the heights seen in 2018. The influence of the green varieties market, which promises to be very abundantly supplied especially by Israel from October to December, on the Hass market should conversely be fairly minimal. On the one hand, the East European markets, with a keen appetite for avocados at attractive prices, will very definitely play a buffering role, especially since consumption growth has picked up in the last two seasons. On the other hand, the partitioning between the Hass market and the green varieties market should remain firm, with Ettinger, Pinkerton and co. not returning to the shelves of the supermarket chains which abandoned them ■

Eric Imbert, CIRAD
eric.imbert@cirad.fr

Avocado — Supply trend in 2018-19

in tonnes	Production 2018-19	Exports 2017-18	of which to EU-28	Trend 2018-19 / 2017-18
Chile	240 000	157 111	93 496	+ 5 %
Israel	120 000	52 500	41 567	+ 45 %
Spain	-	52 318	48 600	+ 15 %
Morocco	24 000	23 000	22 000	- 60 %
Colombia	-	28 500	28 000	+ 40 %
Total 5 suppliers	**-**	**313 429**	**233 663**	**+ 10 to 12 %**
Mexico	**2 200 000**	**1 133 646**	**62 146**	**+ 10 to 25 %**
			Total EU-28	**+ 12 to 18 % ???**

Professional sources

Hass avocado
Production prospects

Managing world production growth

The virtue of the summer crisis from which the EC market has just emerged was to highlight the rapid production rise of certain Southern Hemisphere producer countries. Yet what about the countries supplying the winter market?


© Jean-Pierre Coulet

The avocado - a lucrative, and therefore fast-moving industry

The avocado is seeing rapid development, at the risk of perhaps in the medium term falling victim to its own success. The return of a summer crisis in 2018 on the EC market is an alarm signal highlighting two vital points. The first so fundamental that it might seem banal, yet it has been forgotten after years of smooth growth: demand has limits. The second, while more clearly seen, really made itself clear in 2018: world production is progressing rapidly among suppliers to the counter-season market. This latter point, which concerns the summer season, should make us question the supply prospects during the winter season, hitherto low-profile, before a first accident possibly forces us to do so.

Avocado – Estimated average annual growth of the world production

	Surface areas (ha)	Annual growth (ha/year)	Average yield (t/ha)	Production growth (t/year)
Total	**337 050**	**20 725**	**11.1**	**229 065**
Winter season suppliers	**266 500**	**16 300**	**10.6**	**171 975**
Latin America	**224 800**	**14 000**	**10.7**	**149 800**
Michoacán	158 800			
Jalisco	21 000			
Chile	30 000			
Colombia	15 000			
Mediterranean	**29 800**	**1 750**	**10**	**17 500**
Spain	13 500			
Israel	9 200			
Morocco	6 000			
Portugal	1 100			
Others	**11 900**	**550**	**8.5**	**4 675**
New Zealand	3 800			
Australia	8 100			
Summer season suppliers	**70 550**	**4 425**	**12.9**	**57 090**
Latin America	**27 500**	**2 675**	**15**	**40 125**
Peru	26 000			
Brazil	1 500			
Africa	**22 450**	**1 900**	**9.6**	**18 240**
Southern Africa	17 500			
Kenya*	4 000			
Tanzania	950			
Others California	**20 600**	**-150**	**8.5**	**-1 275**

* Estimated surface areas based on exported volumes / Professional sources, official services

One million tonnes of additional exports from Mexico by 2030

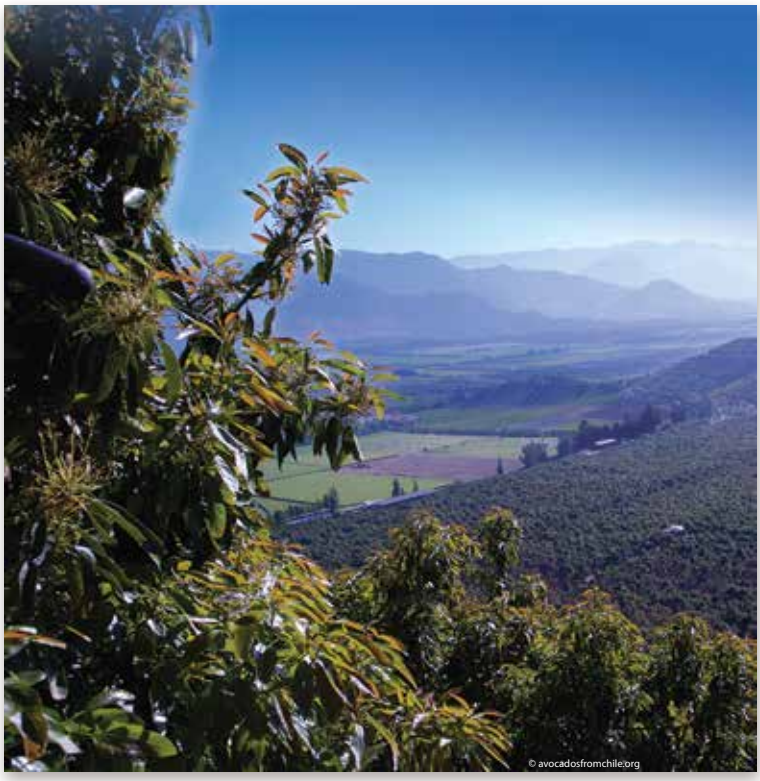
The volume increases expected during the 2018-19 winter season are set to usher in more. This is what is revealed by analysis of the Hass worldwide cultivation area. Of course, South America has the clearest growth. Surface areas are continuing to expand at an impressive rate in Michoacán. The cultivation area, covering just over 166 000 ha in 2018, has grown at an average tempo of approximately 10 000 ha per year for the past three years. It is above all the eastern fringes (Ario, Turicato, Tacámbaro) and western fringes (Los Reyes, Tingüindín) of the avocado region that are seeing the clearest progress, with the core areas seeing much more limited growth for lack of space (Tancítaro, Uruapan, Peribán). Jalisco is not to be outdone, with surface areas already reaching 22 500 ha in 2018 (world number four cultivation area behind Michoacán, Peru and Chile), and growing by nearly 2 000 ha per year on average for the past three years. It is above all the zones close to Ciudad Guzmán which are seeing the biggest progress (San Gabriel, Zapotlán, Gómez Farías). Hence according to a projection by the Ministry for Agriculture (fairly conservative since it assumes a slowdown in the planting rate in Michoacán over the coming years), production should grow by more than one million tonnes by 2030, to nearly 3.2 million tonnes. A hypothesis that seems wholly realistic given the average yields in these two zones (9 to 10 t/ha in Michoacán and 15 t/ha in Jalisco), and the average rate of surface area expansion in recent years. According to this same study, the bulk of these additional volumes should be aimed at the international market (export potential 2.1 million tonnes as opposed to 1.1 in 2017-18).

Colombia, following exactly in Mexico's footsteps

Colombia is following Mexico's footsteps. According to the latest available professional estimate, the cultivation area has already reached approximately 17 500 ha, and is expanding at a rate of approximately 2 000 ha per year. The dynamic is tending to gather pace with the opening up of the US borders and the increasingly significant arrival of foreign investors (such as the Peruvian giant Camposol, which has just purchased 350 ha of land, and declared its intent to set up 2 000 ha of plantations in Colombia). Growth in surface areas is particularly significant in the centre of the coffee zone (Departments of Caldas, Quindío and Risaralda). The country's assets, such as its ideal geographic location for serving both the US and European markets, and its wide production calendar, are attractive; although the lack of road infrastructures (link roads to the secondary network) and port infrastructures remains a weighty issue. Management of heterogeneity of maturity is another technical challenge to address, in this country where some zones can boast multiple flowering, another common point with Mexico.

Chile's awakening?

Chile seems to be emerging from a gloomy spell, when persistent drought brought about a collapse in the cultivation area of more than 5 000 ha (not to be mention plantations mothballed by severe pruning). The return to more generous rainfall and better profitability, thanks to the repositioning on the EC market and on the local market, seems to have caused renewed interest in the avocado. The trend is still limit. It is aimed mainly at the climatically most suitable zones with more abundant water (Santo Domingo centre on the coast of Region V).




© Eric Imbert

Growth in surface areas gathering pace in the Mediterranean

The excellent level of Moroccan exports in 2017-18, and the no less high Israeli level expected this season show that the Mediterranean cultivation area is also on the move. Surface areas are reportedly expanding at around 500 ha per year in Israel, with an acceleration in this tempo very likely according to some professionals (700 to 800 ha). Although interest in green varieties remains marked among some producers (especially Reed, with its high yield and value earned on the local market), the bulk of new planting involves Hass or Hass like. At least half of the expansion is taking place in the south of the country, in the western tip of the northernmost part of the Negev Desert (especially within a radius of 20 to 30 km around Ashkelon).

Similarly, there is a clear dynamic in Morocco, with surface areas expanding at around 600 ha per year, and with Hass now practically the only variety being planted under the development programmes. While plantations are continuing to be set up especially in the traditional Kénitra/Larache zone, some have also been developed in the Azemmour region north of Casablanca. The dynamic remains for the most part driven by small to medium-sized producers, with technical support from big players in the sector.

Spanish cultivation area not all that static

Is the progress in avocado exports from Spain due solely to the country's developing role as a hub? Is the big picture being concealed? In part, since a fine analysis of the avocado sector shows that the cultivation area is getting going (approximately + 650 ha/year). The majority of the expansion in surface areas should not be sought in the traditional production centre of Axarquía. For lack of sufficient land and above all water resources, expansion is reportedly only approximately 150 ha per year in this zone. This situation could change in the medium term, since the sector professionals have developed and are ready to finance a large-scale project that would double the cultivation area, using some of the water lost from the Rio Guadiaro. However, this project remains in political limbo, despite its economic and social advantages. Hence other cultivation zones are currently expanding, in some cases at a fast tempo. Growth is reported to be around 300 to 400 ha per year in the River Guadiaro valley (boundary between Cadiz and Málaga provinces). Similarly, there are large projects under development in the zone between Huelva and the Portuguese border (+ 200 to 300 ha per year). Finally, a large number of small-sized facilities are being set up in the Valencian Community, in particular in the provinces of Alicante and Valencia (+ 150 ha per year). These zones have generally more abundant water and land resources, especially thanks to conversion from less profitable crops such as citruses. In some cases, they are also under sometimes borderline conditions in terms of climate, which is windier and more frost-prone. Time will tell as to the real potential of these new cultivation zones.

Growth in world production from all sides

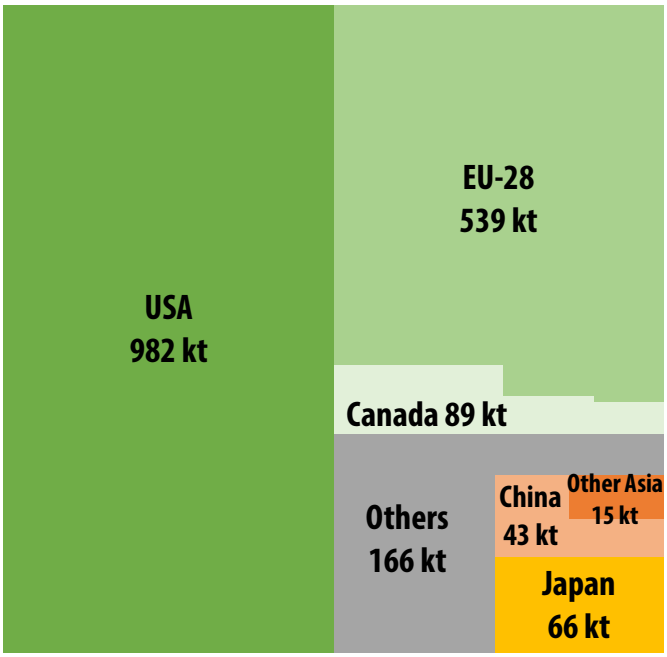
The analysis presented in this article has shown that during the winter season too, the supply to the world market should become very significantly stronger. On the one hand, new giants are emerging. Professionals from Colombia and Jalisco within a few years have been able to build industries on the strength of a cultivation area comprising nearly 20 000 ha or more, and set to feature very prominently among the world's top exporters. Furthermore, traditional market suppliers too have all seen renewed growth. Barring the exceptional case of Michoacán, which everyone could seem coming given the extraordinary proportions of its industry and its growth, all the market suppliers appear to have fairly clear dynamics (more than 500 ha per year, even among the Mediterranean suppliers). Finally, emerging industries are progressing not only in Portugal, but also in Ecuador or Guatemala. According to our projections, which cover producer countries supplying the counter-season market, the dynamic for which was presented in **FruiTrop** edition 256 (May 2018), the Hass world production growth rate should be around 220 000 to 230 000 t per year over the next five years.

A tight balance, which could quickly become precarious

As high as it may be, this rate remains exactly compatible with the hypothesis of worldwide growth in demand maintaining its current footing, i.e. 13 % per year (the four-year average). Nonetheless, it must be highlighted that the world market is currently relying on just two mainstays, namely North America (USA and Canada) and the European Union. They have taken in 95 % of the growth in world production over recent campaigns. Yet given the already high consumption levels reached in certain countries, threshold effects are bound to appear in the medium term. In Europe, the case of Scandinavia, which has been stagnant for several years, is symptomatic, whereas in the USA, growth is slowing down in California.

Calculation based on 2017-2018 volumes
* Last 4 years average
Source: CIRAD

The avocado, a world market of 1 900 000 t (2017-18)
(Customs sources)



Asia – big markets, but for the future

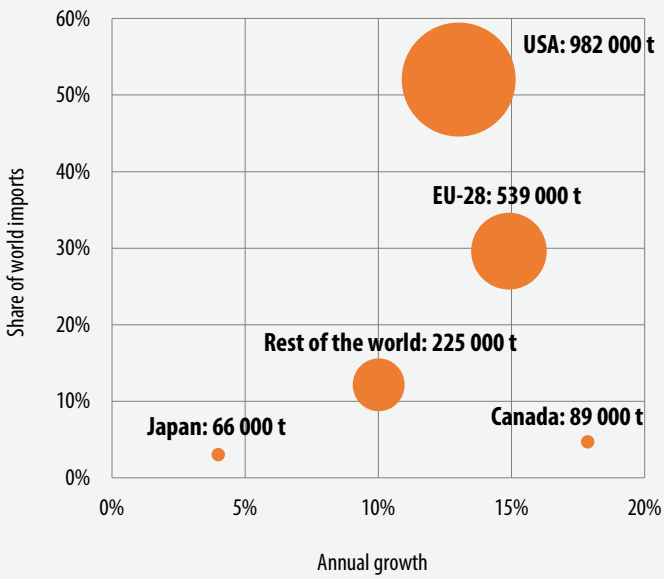
Well yes, the world is no longer limited to Europe and the United States. While growth reserves for the local markets in producer countries have already been largely tapped with success, Asia represents enormous potential which is barely starting to be unearthed. However, export figures show that this rich vein is only very gradually revealing itself, and that it is hard to exploit, both because of its distance from the world's main production centres and the difficulty in introducing what is often an alien product. Besides Japan which is no longer on the rise, the countries in this region absorbed approximately 60 000 t in 2017-18, i.e. barely more than 3 % of world trade. Furthermore, supplier countries with a small presence in Europe or the USA, such as New Zealand and Australia, also have ambitions on these markets, for which they have an obvious logistical asset. Nonetheless, this potential competition is rather for the future than tomorrow, given the still relatively limited size of these countries' cultivation areas (approximately 3 800 ha in New Zealand and 8 100 ha in Australia).

Promotion and prudence must remain the watchwords

Until the growth relays in Asia really get going, it would seem important to further step up the promotion actions, in order to make the most of the growth margins still available in the USA or EU. There are big margins, whether on under-consuming markets such as Germany, or others which are already big consumers but still far from maturity, such as France or the United Kingdom. The WAO's resources for stimulating the European market are still far too limited, as is attested by a budget approximately 20 times smaller than the HAB's (USA), for a population 1.5 times bigger. A parafiscal tax of a few eurocents per box earmarked for promotions seems more than ever like a good investment against any turnarounds in the market. It also appears clear that the "demand" dimension must now be much better incorporated into investment projects in new plantations. The current expansion rate of the cultivation area, of approximately 20 000 ha per year according to our estimates, seems to be a sound upper limit for the time being ■

Eric Imbert, CIRAD
eric.imbert@cirad.fr

Avocado - Size and growth of major world markets
(2017-18 imports and growth last 4 years average / source: CIRAD)

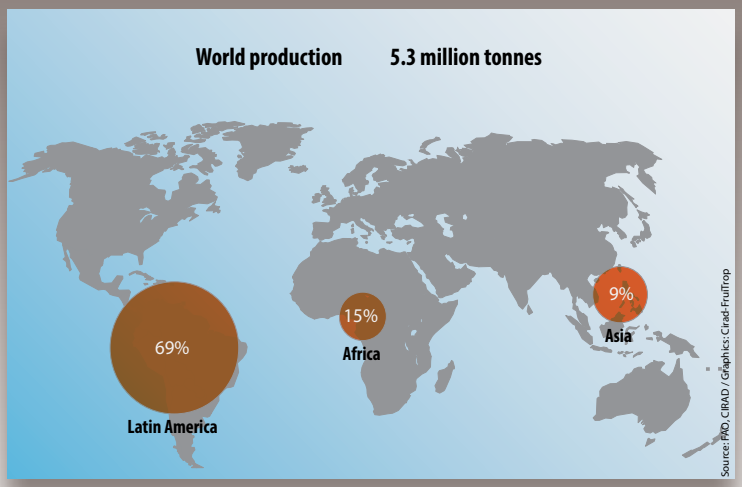


2019 WAO promotion campaign

The WAO will be both stronger and more visible in 2018-19. Stronger in that Spain and Colombia have joined the list of member countries, which now numbers nine (Mexico, Peru, the USA, South Africa, Tanzania, Zimbabwe and Mozambique, in addition to the above-mentioned newcomers). The organisation represents 70 % of volumes marketed in the European Union. More visible in that with a reinforced budget, especially through these new members (2.8 million euros), the number of markets covered by WAO actions will also increase. Two southern EU countries with low consumption have been targeted: Italy and Spain itself, where actions started this summer at Eroski. Furthermore, the WAO will become truly global in 2019, initiating the first generic promotion campaigns in China.

The promotion tools will also see changes, with all promotion media now translated into Spanish as well as English, French and German. New communication modes will also be launched. For the first time, a fresh fruit will partner the famous Michelin guide. The WAO will be involved at the party unveiling the chefs chosen by the Guide for its 2019 UK & Ireland edition in early October, offering avocado-based appetisers and beer.

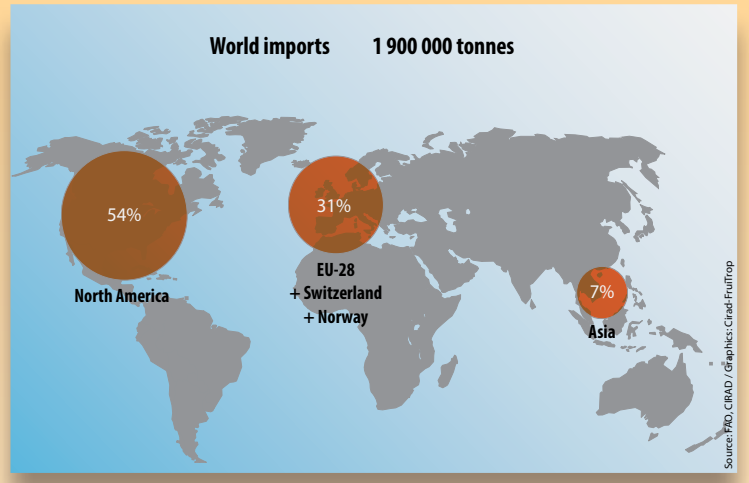
AVOCADO - Production (2016-17)



Avocado — Top 9 producer countries	
tonnes	**2016-17 or FAO 2016**
Mexico	1 500 000
Dominican Rep.*	601 000
Peru*	455 000
Colombia*	309 000
Indonesia	305 000
Chile	215 000
Brazil*	195 000
Kenya*	176 000
Rwanda*	162 000

Professional sources (2016-17), *FAO(2014)

AVOCADO - Imports (2017-18)



Avocado — Top 7 importer countries	
tonnes	**2017-18**
United States	982 227
Netherlands	279 792
France	113 271
Spain	93 839
Canada	89 052
United Kingdom	88 532
Japan	65 703

Source: national Customs

USA - Imports - Main supplier countries						
tonnes	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Total	**561 892**	**603 160**	**780 412**	**917 667**	**846 414**	**982 227**
Mexico	515 143	512 276	686 404	853 617	764 680	862 596
Peru	15 860	21 617	64 448	46 284	31 573	64 420
Chile	14 721	53 305	10 600	10 362	29 354	29 454
Dom. Rep.	16 150	15 958	15 548	7 393	20 805	25 757

Source: USDA

Canada - Imports - Main supplier countries						
tonnes	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Total	**47 185**	**46 139**	**57 089**	**69 953**	**76 118**	**89 052**
Mexico*	36 299	33 451	44 958	62 150	71 607	83 346
Peru	2 282	2 905	5 542	2 627	1 130	3 567
USA*	7 372	8 910	5 649	4 494	2 785	1 076
Dom. Rep.	351	456	534	483	379	629
Chile	659	261	65	3	3	20
Others	222	156	341	196	214	414

Sources: COMTRADE and *national Customs

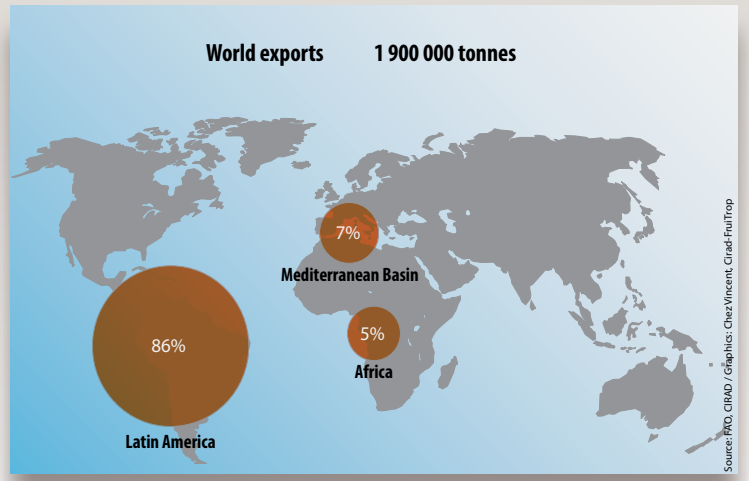
South America - Main markets							
tonnes	2011	2012	2013	2014	2015	2016	2017
Total	**15 048**	**17 670**	**18 403**	**21 125**	**21 760**	**24 152**	**22 757**
Argentina	5 493	9 179	9 621	13 208	10 807	12 784	19 033
Chile	1 880	698	3 882	2 659	9 285	11 151	3 584
Colombia	7 190	6 023	3 904	3 128	1 130	217	133
Ecuador	485	1 770	996	2 130	538	-	7

Source: COMTRADE

Central America and Mexico - Main markets							
tonnes	2011	2012	2013	2014	2015	2016	2017
Total	**27 486**	**42 132**	**42 266**	**38 184**	**38 777**	**37 975**	**32 511**
Salvador	9 262	13 754	12 666	12 213	12 269	12 570	12 005
Honduras	6 426	10 412	11 405	10 263	11 379	9 972	10 613
Costa Rica	9 958	13 731	13 061	12 424	11 187	9 334	7 783
Guatemala	900	3 312	2 923	3 211	3 942	6 081	2 110
Mexico	940	923	2 211	73	-	18	-

Source: COMTRADE

AVOCADO - Exports (2017-18)



Avocado — Top 6 exporter countries	
tonnes	**2017-18**
Mexico	1 134 000
Peru	246 000
Chile	157 000
Israel	54 000
Spain	52 000
Kenya	47 000

Professional sources, national Customs

European Union - Imports - Main supplier countries						
tonnes	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Total, incl.	**262 115**	**307 358**	**349 426**	**413 717**	**507 582**	**539 464**
Total N. Hemis.	**128 824**	**157 266**	**167 741**	**220 318**	**278 351**	**301 853**
Chile	41 074	62 968	42 797	78 244	90 138	92 467
Mexico	9 085	6 293	12 918	45 593	36 884	60 993
Spain	38 500	36 700	50 600	37 700	55 200	48 600
Israel	35 175	42 844	46 086	34 995	56 600	41 567
Colombia	486	1 142	3 740	11 189	24 024	28 000
Morocco	840	4 766	7 798	7 115	9 552	21 746
Dom. Rep.	2 503	1 810	3 034	4 445	5 527	7 345
Greece	474	740	765	987	424	560
United States	687	3	3	50	2	575
Total S. Hemis.	**133 291**	**150 092**	**181 686**	**193 399**	**229 231**	**237 611**
Peru	62 618	86 260	101 971	114 321	144 367	157 744
Southern Africa*	49 083	45 165	56 713	50 962	54 095	43 984
Kenya	17 078	13 313	15 604	20 728	23 444	25 425
Brazil	3 959	3 928	5 265	3 535	3 908	7 189
Tanzania	133	968	1 643	3 278	2 948	2 987
Others	306	300	447	497	337	280
Argentina	114	158	43	78	133	3

* South Africa, Zimbabwe, Swaziland / Source: Eurostat

Other West European countries - Main markets							
tonnes	2011	2012	2013	2014	2015	2016	2017
Total	**13 644**	**14 779**	**17 148**	**20 600**	**23 746**	**27 120**	**28 215**
Switzerland	6 789	7 340	7 915	9 516	11 376	13 823	14 694
Norway	6 555	7 090	8 787	10 496	11 673	12 411	12 422
Iceland	300	349	446	588	697	886	1 099

Source: COMTRADE

Russia - Imports - Main supplier countries						
tonnes	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Total	**11 817**	**13 948**	**14 404**	**9 677**	**14 961**	**17 783**
Total N. Hemis.	**7 883**	**9 431**	**8 209**	**5 914**	**9 738**	**10 466**
Israel	7 512	9 004	8 123	5 814	9 614	10 234
Spain	305	280	1	-	-	-
Chile	66	147	86	99	123	232
Total S. Hemis.	**3 934**	**4 545**	**5 208**	**3 763**	**5 223**	**7 317**
Kenya	330	405	232	497	1 735	4 260
Peru	1 259	1 462	982	1 069	1 586	2 100
South Africa	2 345	2 678	3 994	2 197	1 902	957

Source: COMTRADE

Other East European countries - Main markets							
tonnes	2011	2012	2013	2014	2015	2016	2017
Total	**1 529**	**1 948**	**2 636**	**2 749**	**2 850**	**2 324**	**3 321**
Ukraine	1 249	1 623	2 068	1 852	1 231	1 685	2 218
Belarus	229	255	482	744	1 441	388	770
Serbia	51	70	86	153	178	251	333

Source: COMTRADE

Japan - Imports - Main supplier countries						
tonnes	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Total	**62 687**	**56 836**	**57 372**	**67 241**	**67 394**	**65 703**
Mexico	56 373	50 278	52 758	63 986	63 549	59 192
Peru				25	969	3 347
United States	5 140	4 971	2 124	80	1 174	2 585
New Zealand	639	695	1 704	2 467	1 527	461
Chile	535	892	786	683	175	118

Source: national Customs

China - Imports - Main supplier countries						
tonnes	2012	2013	2014-15	2015-16	2016-17	2017-18
Total	**2 870**	**4 223**	**13 629**	**22 165**	**31 068**	**42 683**
Chile			1 092	5 783	13 405	15 029
Mexico			10 794	14 223	10 919	17 690
United States			243	1 052	644	927
Peru			1 154	520	2 802	6 437
Others			346	587	3 298	2 600

Source: national Customs

Other Asian countries - Main markets							
tonnes	2011	2012	2013	2014	2015	2016	2017
Total	**2 862**	**3 320**	**4 062**	**5 302**	**6 113**	**10 103**	**15 247**
South Korea	402	534	722	1 097	1 515	2 915	5 979
Singapore	1 497	1 691	2 015	2 815	2 991	4 210	5 737
Malaysia	523	565	773	956	1 075	2 377	2 932
Thailand	440	530	552	434	532	601	599

Source: COMTRADE

Oceania - Main markets							
tonnes	2011	2012	2013	2014	2015	2016	2017
Total	**14 695**	**9 629**	**10 967**	**19 889**	**15 214**	**19 757**	**16 407**
Australia	14 695	9 627	10 941	19 889	15 214	19 757	16 407
New Zealand	-	2	26	-	-	-	-

Source: COMTRADE

Persian Gulf - Main markets							
tonnes	2011	2012	2013	2014	2015	2016	2017
Total	**9 228**	**16 985**	**22 604**	**26 818**	**36 400**	**39 476**	**39 167**
Saudi Arabia	2 056	7 736	10 156	10 312	16 697	17 527	20 451
U.A.E.	5 347	7 352	10 077	13 250	15 841	17 000	15 304
Kuwait	1 001	857	1 247	1 601	1 791	2 084	2 341
Bahrain	116	266	382	726	791	955	545
Qatar	360	486	598	904	1 280	1 910	526
Yemen	348	288	144	25	-	-	

Source: COMTRADE

Africa - Main markets							
tonnes	2011	2012	2013	2014	2015	2016	2017
Total	**10 277**	**11 790**	**15 675**	**11 517**	**11 671**	**8 134**	**7 687**
Morocco	6 683	8 817	9 130	7 627	6 749	3 975	4 417
South Africa	2 156	1 660	2 308	1 962	2 246	2 416	2 733
Namibia	674	518	734	802	647	774	537
Burkina Faso	679	683	589	1 046	1 436	767	-
Egypt	85	112	2 914	80	593	202	-

Source: COMTRADE

Avocado

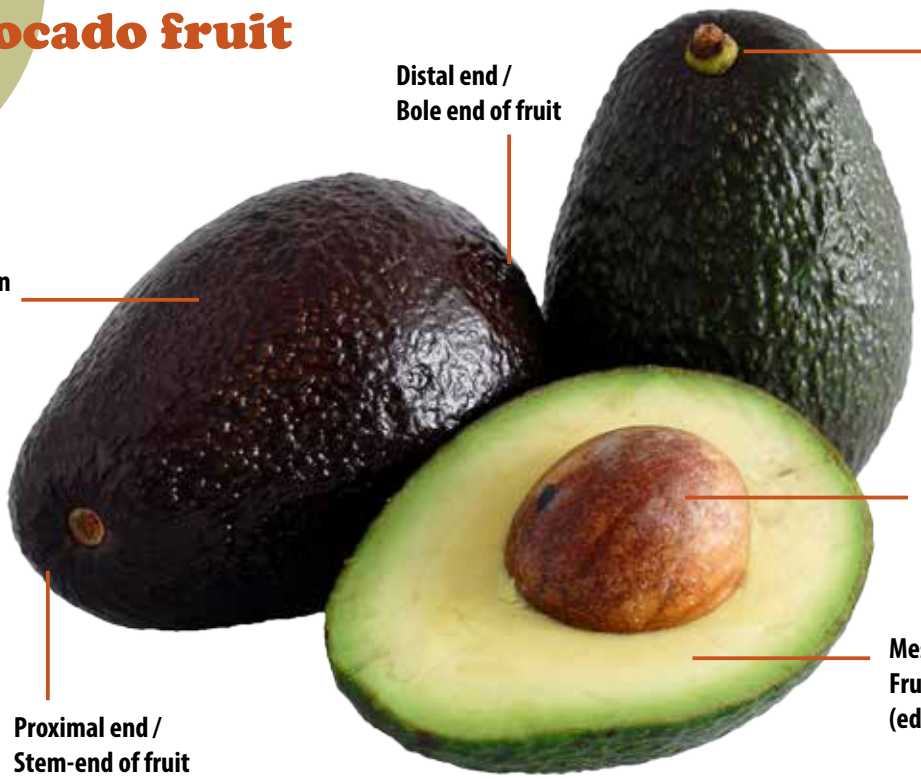
Common Avocado Quality Defects

by **Richard Nelson,** richard.nelson@sfr.fr

The purpose of this article is to describe and to provide background on some of the mostly commonly observed "defects" affecting avocados sold in Europe. This list is not exhaustive and excludes most cosmetic defects (including pest-related injuries), since fruits with such defects are usually visible and discarded at source.

Due to insufficient European production of avocados (mainly from Spain), the vast majority of the avocados sold in Europe are imported, and thus have to be transported long distances from their production areas. The time from orchard to European consumer outlet can be as short as a week to ten days (e.g. from Israel or Morocco) to a month or more (e.g. from Mexico, Kenya, Chile, South Africa, Peru). Refrigeration and other technologies such as controlled atmospheres are used to delay in-transit ripening. These are complex processes, and fruit quality can be negatively affected if the correct procedures have not been followed or if anything untoward happens. However, the root cause of many of the most common quality defects is often in the orchard, resulting in the fruits not being in optimal condition to be able to withstand long distance transport. Various quality defects have very similar appearances and are often incorrectly identified by European receivers. It is hoped that this article will assist the European Trade in correctly identifying some of the more common avocado quality defects.

Anatomy of an avocado fruit



Black or brown marks on fruit skin

A variety of phenomena can cause such marks on avocado skins, hence there being considerable confusion as to the correct identification of such defects. A common fault is to refer to all black marks as anthracnose infection, which is rarely the case, especially for unripe fruits.

1. Lenticel damage

Lenticels are the slightly raised pores on the surface of the skin of an avocado, which allow the fruit to "breathe". Damage results in the blackening of the lenticels themselves, as well as in some instances, also the blackening of a small area of the skin immediately surrounding the individual lenticels caused by water loss through the damaged lenticels. These areas may also become more sensitive to low temperatures, resulting in the appearance of chilling injury symptoms (see point 2 below). The primary cause of damage to lenticels is rough handling during the picking or packing process. The susceptibility of the lenticels to damage is also sometimes increased by cold and wet weather during or immediately preceding harvest. Cold air flowing across the surface of the fruit (e.g. from a cold store's refrigeration unit at the packing station) can also induce lenticel damage. It is incorrect and inaccurate to describe an avocado displaying such symptoms as "having too much lenticel". All avocados possess lenticels, so one needs to specify that the lenticels have been damaged. The symptoms of lenticel damage can develop days to weeks after the fruits have been packed and deemed to be of satisfactory export quality. Lenticel damage may thus be considerably more pronounced upon reception in Europe. Avocado cultivars with thick / rough skins (e.g. Hass, Maluma) have more prominent lenticels, which are thus more prone to damage. However, for ripe fruits of such cultivars, the symptom is often barely visible due to the masking effect of the darkened skin. Lenticel damage is purely a cosmetic defect which does not affect eating quality. There is no concrete evidence that lenticel damaged fruits are more liable to develop secondary pathological infections.

Lenticel damage

2. Black Cold Injury

This is the term used by the South African avocado industry to refer to what is generally a post-harvest external chilling injury, characterised by shiny dark brown to black lesions / marks on the skin of the avocado, most commonly at or towards the bole-end of the fruit. The lesions are slightly sunken and have clearly defined edges. The symptom starts developing within a few days of packing, and is almost always visible immediately upon arrival in Europe. Black Cold Injury can occur on both hard and soft fruits, although receiving agents usually observe the symptom on fruits which have been delivered in a hard condition. The purple to black colour of the skin of ripe Hass (and other dark-skinned avocados) usually masks the symptom. The primary cause of Black Cold Injury is from avocados having been transported at inappropriately low temperatures, but there is also a risk that hard avocados can develop Black Cold Injury when stored under excessively cold conditions after European delivery. It is also important to note that it is not unusual to find that within the same consignment only fruits from certain growers have been affected

Black Cold Injury

Black Sun Burn

Rubbing

by Black Cold Injury. The most common cause for certain fruits being more prone to Black Cold Injury is fruit physiological immaturity at time of harvest. As avocados become more physiologically mature prior to harvest, their oil content increases and moisture content decreases, and in the process they become less susceptible to lower post-harvest temperatures. Larger avocados (e.g. Code Sizes 8,10,12,14) are more prone to post-harvest chilling injuries than is the case for smaller fruits. This partially explains why some avocado cultivars which tend to bear a higher percentage of larger fruits (e.g. Pinkerton, Edranol, Lamb Hass) are also more prone to Black Cold Injury. Tree condition as well as orchard nutritional imbalances can influence the susceptibility of avocados to Black Cold Injury, hence the differences between the fruit from different growers or orchards. In the overall majority of cases (especially for Fuerte and Hass avocados), the presence of a Black Cold Injury lesion on the exocarp of an avocado does not have an adverse effect on the internal / eating quality of the fruit, with the fruit pulp not being affected. However, it has been noted that some cultivars such as Pinkerton often develop secondary infections such as Anthracnose within regions of the fruit skin affected by Black Cold Injury lesions. Black Cold Injury lesions are post-harvest symptoms and are not caused by low orchard temperatures.

3. Black Sun Burn

In contrast to Black Cold Injury, black lesions caused by sunburn are not sunken – they may in fact be slightly raised. Black sunburn lesions are usually shinier in appearance than is the case for Black Cold Injury. A region of yellowed skin ("yellow sunburn") sometimes surrounds black sunburn lesions. Black sunburn injury does not affect the eating quality of avocados.

4. Rubbing

Black discoloration as a result of sensitisation of the skin caused by rubbing during the picking or (more usually) the packing process. Symptoms can be virtually identical to Black Cold Injury. Black marks caused by rubbing are commonly found on the widest portion of the fruit, and where present it is common that more than one fruit per carton exhibits this cosmetic defect. Rubbing lesions have no effect upon internal quality.

5. Sooty Mould

Sooty Mould is often confused with external chilling injury symptoms. It is a naturally occurring fungus present in avocado orchards. These fungal infections can develop on

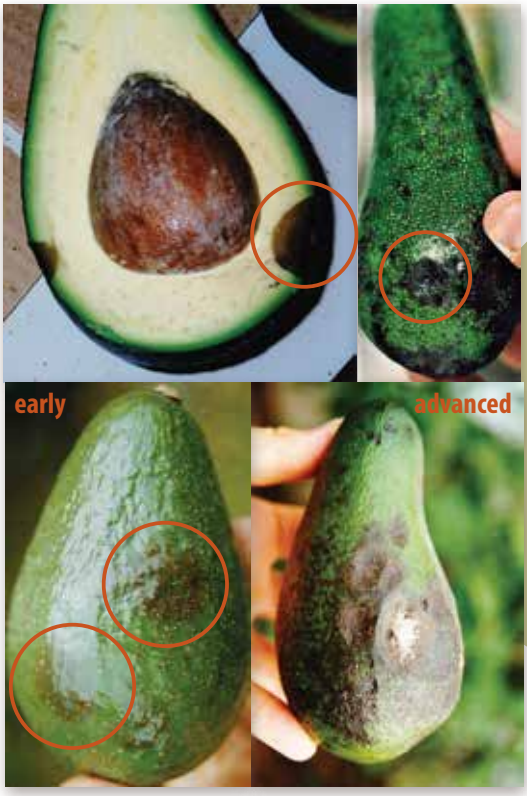
the fruit skin, most commonly at the pedicel end of a fruit, with streaks of the fungus running longitudinally down the fruit towards the bole. Sooty mould is light grey in colour and is generally removed during the washing process prior to packing. Such infections make fruits unsightly, but do not affect the internal eating quality of the avocado.

Sooty Mould

6. Anthracnose and Stem-end Rot

Anthracnose is the generic term to describe infections caused by fungi of the genus Colletotrichum. However, in avocado fruits, Dothiorella and other fungi can also be involved in secondary infections with similar appearance. Anthracnose commonly develops on over-ripe fruits and can also develop in transit. Early stages of Anthracnose infections are characterised by circular brown to black external lesions which may become sunken and exhibit a white fungal development in the centre of the lesion during the advanced stages of infection. Internally, infections penetrating the exocarp are characterised by a half-moon-shaped discoloration of the flesh.

Anthracnose



Stem-end Rot affects the pedicel end of the fruit and is often caused by the same fungi that cause anthracnose infections elsewhere on the fruit. Stem-end Rot is characterised externally by a blackening of the skin surrounding the stem ("pedicel") end of the fruit. The fungi enter the fruit via the cut end of the pedicel itself or other sites of injury caused to that part of the fruit during harvest (e.g. by clippers used to cut the fruit from the tree). Physiologically less mature fruits are far more likely to be affected by Stem-end Rot, one of the reasons being that less mature fruits take longer to ripen, which also allows the pathogen more time to develop. Stem-end Rot often also affects the vascular tissue, resulting in symptoms of vascular browning or blackening. When high percentages of this defect are noted, it is most likely that the fruits were under-mature when harvested. A high incidence of Stem-end Rot is also an indication of inadequate disease control in the orchard.

Stem-end Rot

7. Carbon-dioxide poisoning / "Suffocation"

This occurs as a result of malfunction of a controlled atmosphere system, resulting in a build-up of carbon dioxide, causing suffocation of the fruit. External symptoms are similar to Black Cold Injury, but the lesions are considerably more sunken and generally

Carbon-dioxide poisoning / "Suffocation"

confined to the pedicel end of the fruit. Another difference compared with Black Cold lesions, is that suffocation lesions tend to be a dark "chocolate-brown" colour and shiny in appearance, whereas Black Cold lesions tend to be dull and dark-brown to black in colour. The severity of the internal disorders caused by carbon dioxide poisoning varies according to the extent and duration of the malfunction. Carbon dioxide poisoned avocados will usually not ripen properly or at all, and may be difficult to cut open. Flesh can be dried-out and grey to black. If symptoms of carbon dioxide poisoning are found in a container, it is extremely likely that all fruits in the container will be affected and will not ripen properly, even if some fruits do not display the characteristic external symptoms. Such fruit will not be of acceptable eating quality and ought to be destroyed. In more extreme cases, the symptoms are immediately apparent upon removal of the fruit from the container and an unpleasant odour may be noticeable when the container doors are opened. However, it is important to note that such symptoms can also develop 24 hours or more after the fruits have been removed from the modified atmosphere of the container. There is therefore always a risk that fruits which were judged to be sound upon reception, develop suffocation symptoms later on. It is thus important that consignments of avocados that are to be forwarded to a client by a receiving agent, should be subjected to an additional quality control, even if these fruits had already been identified as being of acceptable quality during standard reception procedures.

Skin discoloration following prolonged refrigeration

It is sometimes noted – specifically for certain green-skinned avocados (e.g. Fuerte, Edranol), where the exocarp characteristically remains green upon ripening – that the exocarp acquires a brownish, unsightly tinge upon ripening. Such symptoms are far less common for dark-skinned cultivars and are often difficult to distinguish from the progressive skin colour change as the fruits ripens. Several years ago, the South African avocado industry identified, defined and named two such quality defects, which at the time were classified as chilling injuries – hence the (still used) terms Brown Cold Injury and Dusky Cold Injury for these symptoms.

Brown Cold Injury

Brown Cold Injury is a brown discoloration of the avocado exocarp, the blemishes having defined but not sunken edges. The lenticels remain green and healthy

About the Author:

Richard Nelson *is an independent fruit quality assessor and consultant based in France. For more than two decades he was employed by the South African tropical fruit industry as their technical representative in Europe, monitoring fruit quality and identifying the causes of fruit quality problems. He has an extensive knowledge of the pre-harvest and post-harvest factors impacting upon avocado quality, and provides trouble-shooting services and guidance to the international avocado industry.*

within the blemished area. Brown Cold is rarely seen on hard, unripe fruits. Far more commonly, the symptom develops when the fruits ripen under refrigeration, such as when transport times have been unusually long as a result of lengthy shipping delays, or following prolonged cold storage after arrival in Europe. The fruit flesh is normally unaffected when Brown Cold Injury symptoms are present, but such fruits are unattractive and unmarketable. It is unclear why certain avocados are more susceptible to Brown Cold Injury, but inappropriate refrigeration conditions are quite likely to be a contributing factor, in particular unacceptably low relative humidity levels in European cold-stores.

Brown Cold Injury

Dusky Cold Injury

It is the author's belief that this quality defect is a more severe form of Brown Cold Injury, with internal quality commonly being affected. The symptom is a diffuse greyish-brown discoloration of the exocarp, which is usually confined to the distal (bole) end of the fruit upon ripening. The disorder is most common when avocados have been stored under refrigeration for an excessively long period of time and when they have ripened under refrigeration. Flesh discoloration is common for fruits displaying Dusky Cold Injury. The symptom is not distinguishable externally on ripened dark-skinned cultivars such as Hass.

Dusky Cold Injury

Internal Flesh Discoloration

Grey Pulp

The most common such defect, and the only one that will be discussed in this article, is what is referred to by the South African avocado industry as Grey Pulp, also commonly referred to as Internal Browning and (less accurately) as Internal Chilling injury. This is characterised by grey or brownish discoloration of the fruit flesh and is more pronounced and thus more commonly observed in ripe fruits. A number of factors can contribute to the development of Grey Pulp in avocados, the most important of these being incorrect temperature management, prolonged cold-storage and, fruit physiological maturity. By far the most common cause of Grey Pulp is physiological over-maturity at time of harvest.

Fruits which were physiologically very-mature (not RIPE, since avocado fruits do not ripen on the tree) at the time of harvest, have a higher likelihood of developing Grey Pulp once the fruits ripen. Inappropriately low transit temperatures can play a role in the development of Grey Pulp, but it should be stressed that since lower transport temperatures are often used for end of season (i.e. physiologically very mature) fruits which would otherwise ripen more rapidly, in such cases the root cause is still physiological maturity. Fruits from some growers are known to be more susceptible to the disorder, probably related to nutritional factors. It is important to note that the temperature at which avocados are stored after arrival in Europe, as well as the length of time of that storage will greatly influence the incidence and degree of severity of Grey Pulp development ■

Grey Pulp

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 is adapted to low temperatures originated in the Mexican highlands. It differs from the two other races in several botanical characteristics:

- the leaves are generally small and release a characteristic aniseed 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 fairly small in hot regions. Keeps well 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 non-fibrous 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 frost resistance (to 4°C), but is particularly temperature-sensitive during the flowering period. Productivity is generally good in temperate zones but it displays strong alternate bearing. The fruits are easy to peel and have excellent organoleptic qualities (buttery pulp).

Ettinger

Mexican x Guatemalan hybrid

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

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

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 mild. 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 fibreless.

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 '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 enzyme activity, electrical conductivity, aromatic compounds or precursors or by tasting tests when the fruits have ripened.

Photos © Eric Imbert

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 maintaining 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 for no 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 beginning of the ripening process and this must be taken into account. Maintaining the cold chain is of crucial importance.

Controlled atmosphere

Controlled atmospheres are 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 of 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 regard to 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 below 3.5°C. There are procedures (temperature and duration) for the different cultivars and regions of South Africa.

Photos © Eric Imbert

Packing

Fruits with the desired maturity index are sorted, washed and graded before packing. Each market has its own packing requirements.

Avocado — USA — 11.34-kg box 43 x 32.6 x 17.50 cm	
Weight (g)	Size
422	28
377	32
340	36
298	40
241	48
196	60
156	70
122	84
102	96

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 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

Photos © Eric Imbert

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.

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.

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 pre-harvest treatments. Any 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 seed. 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 seed. Any injury in the epidermis favours infection by the pathogen.

Avocado — Post-harvest diseases caused by pathogenic fungi

Pathogens	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

The harvest stage in the case of climacteric fruits

This stage is particularly important since the state of maturity of the fruit is "set" upon harvesting (see FruiTrop No.198, page 29, maturation article). The impact of the harvest stage is split into two aspects (see diagram):

- in qualitative terms, the earlier a fruit is harvested, the less taste properties it will exhibit, with a fairly low sugar content (enrichment in sugars is linked to the length of time on the plant) and a poor ability to develop flavours;
- in commercial terms, a fruit harvested at a stage too close to the fruit's true maturity will have a lower conservability. But if the fruit is harvested too early, its ability to ripen may be insufficient, and it will not be able to go through the correct maturation development.

Importers are dependent on the compromise which may be found to reconcile taste quality and market distribution. Defining an optimum harvest stage is a real challenge, since there are not necessarily any clear visual descriptors indicating with acceptable precision the stage of maturity before maturation of climacteric fruits (known as the preclimacteric stage).

In parallel, with the markets constantly changing, the development of triggering (avocado, mango) becomes singularly complicated: how to be sure that the fruits have reached their ability to ripen? How to adapt the triggering process to the fruit's stage of maturity, in the knowledge that the batches are heterogeneous?

There are possible alternatives for improving batch homogeneity, but this calls for a high degree of interaction between the production and distribution industries. Eventually, we will need to take into account the changes to cropping techniques on fruit physiology (conservation, metabolism of maturation). We will also need to assess the possibility of sorting fruits using non-destructive measures, to obtain homogeneous batches in order to adapt and ensure the performance of the triggering techniques.