

OIL CROPS AND SUPPLY CHAIN IN ASIA LA FILIÈRE OLÉAGINEUSE EN ASIE

Rapeseed in China

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Abstract – In 2015, China was the world's second most important producer of rapeseed after Canada, with 7.59 million hectares under cultivation and a production of 14.1 million tons. It is also a major importer of rapeseed grain, as well as the premier consumer. Currently, its R&D remains mainly public. Its rapeseed seed market is slightly superior to 2.7 billion RMB (362 million €) and concerns partly hybrid varieties. Nevertheless, the improvement in living standards and the strong development of animal production in China has brought with it an increasing dependence on oil and protein crops, notably rapeseed but especially soybean and palm.

Keywords: Rapeseed / *Brassica* / *Brassica napus* / P.R. of China / production / yield / quality / end-uses / R&D / breeding / biotechnologies / oil / meal

Résumé – Colza en Chine. En 2015, la Chine était le second producteur mondial de colza après le Canada, avec une surface de 7,59 millions d'hectares et une production de 14,1 million tons. C'est également un importateur majeur de colza grain et le premier consommateur. Aujourd'hui, sa R&D reste essentiellement publique. Son marché de semences de colza dépasse 2,7 milliards de RMB (362 million €) et concerne pour partie des variétés hybrides. Néanmoins, l'amélioration du niveau de vie en Chine et l'essor spectaculaire de ses productions animales s'accompagnent d'une dépendance croissante du pays en oléo-protéagineux, notamment en soja et huile de palme et plus qu'en colza.

Mots clés : Colza / *Brassica* / *Brassica napus* / Chine / production / rendement / utilisations / R&D / selection / biotechnologies / huile / tourteaux

China's domestic oilseed production growth continues to be restricted by limited arable land and policies favoring cereal, vegetable and fruit production. In 2014/15, according to the Chinese Ministry of Agriculture, China's total planted area for all oilseed crops had declined to 23.4 million hectares. Among this surface, China is the second world producer of rapeseed after Canada (Fig. 1), with a cultivation area of 7.59 million hectares accounting for 21% of the world's total area and producing in 2015 14.1 million tons, which represents 21% of the world's total rapeseed production (Regnault, 2016). Simultaneously, China imported 3.9 million tons. However, some US experts consider that these governmental data are overestimates. By their reckoning, the 2015 Chinese rapeseed acreage was just 6.00 million hectares with imports covering the decline in domestic production, without the increases in rapeseed crushing volumes (Jamet, 2016).

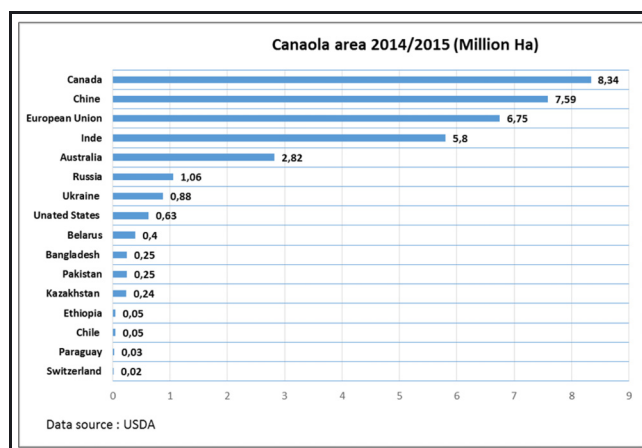


Fig. 1. Canola area 2014/2015 (Million ha).

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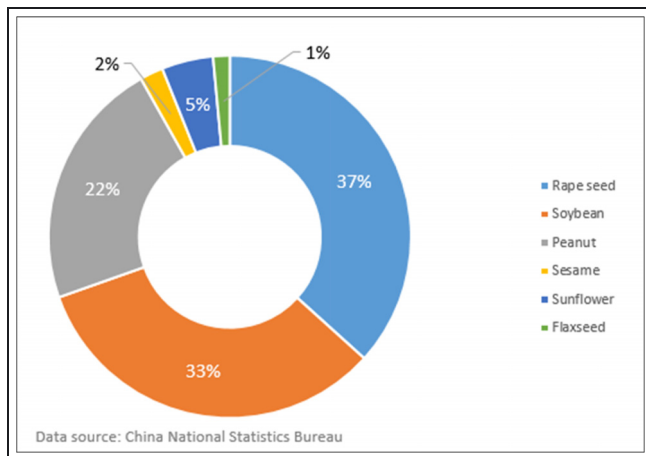


Fig. 2. Oilseed production in China.

However, rapeseed has become the principal oil crop in China, surpassing soybean in 2014 (Fig. 2). Simultaneously, China is a major rapeseed consumer and a significant importer (Clever *et al.*, 2015).

Crops introduction into China

Rape or *yóucài* (油菜) in Chinese is a very ancient crop in China, like other Brassica oil crops (Needham and Bray, 1984). The oldest archaeological remains of rape found in the country may date back to *ca.* 5000 BCE and corresponds to *Brassica juncea*. This plant was probably introduced during the Neolithic period from the Middle East or Southern Iran, or from India; if oilseed types of *B. juncea* were cultivated by ancient Chinese farmers, it was mostly considered as a leaf vegetable, or as a root-type vegetable (var. *napiformis*, which is also cultivated for forage), or as a vegetable and a pickle in Sichuan and Yunnan (var. *tumida*). A Chinese ideogram of rape was first recorded *ca.* 2500 years ago (Yan, 1990). The *Book of Songs*, written during the Spring and Autumn Period (770 to *ca.* 476 BCE), records the both cultivation of mustard-type rapes (*B. juncea*) and cabbage-type rapes (*B. campestris*, also called *B. rapa*), which were spring types and offered low oil yields (Yi *et al.*, 2015). It is believed that *B. campestris* was introduced in China through Western Asia or Mongolia and has been cultivated in China for more than 2600 years. Its fleshy roots are used as a vegetable. Varieties include *B. campestris* var. *oleifera* cultivated for seed oil and also as a vegetable for its tender stems, *B. campestris* var. *chinensis* (bok choy), cultivated throughout China since the 3rd century, and *B. campestris* var. *glabra* (bai cai) cultivated for over 2000 years (He *et al.*, 2015). Standard rapeseed (*B. napus*) was introduced into China from Japan only in the early 1930s (Liu, 1985) and European varieties were introduced in 1941 from United Kingdom (Fang and Chang, 2007). It was first experimented with on a production scale in Sichuan, in 1953. Since then, this new and 'exotic' oilseed crop has been quickly extended to cover a large area cultivation and has become a major oilseed crop within the Yangtze basin. This region is now one of the three largest *B. napus* growing regions in the world.

Current situation of the oilseed rape production and import in the P.R. of China

Officially, the 2015–16 planted area of rapeseed was estimated at 7.3 million hectares and the 2015–16 production is forecast at 14.3 million tons.

Among this cultivation area, winter planted rapeseed area in rice-rapeseed systems, located in the Changjiang mid- and low-basin, was estimated at 7.03 million hectares by the Ministry of Agriculture. The rest of the production comes from scattered spring cultivars sown in North China (Clever *et al.*, 2015).

The 10 most important provinces are listed in Figure 3 and Table 1 and account for approximately 86% of the total area under rapeseed cultivation in China (source: MoA; Sang and Lessard, 2015).

In 2014–15, the national average yield was 1.95 t/ha (ton/hectare), slightly increasing from the previous year and the top yield was 2.73 t/ha in the Jiangsu province (Fig. 4).

The Chinese government encourages rapeseed farming as it uses land otherwise idle in winter and lessens the competition for land with other grain crops. This policy includes a 'minimum price purchase program' and a direct subsidy. In 2014–15, the government fixed the rapeseed purchase floor at RMB 5100/ton, significantly higher than the price for imported rapeseed. The policy will be the same in 2015–16. In addition, in 2015–16, farmers will continue to receive a seed subsidy of RMB 150/Ha (Clever *et al.*, 2015).

A 2015 industry survey shows that rapeseed profits of farmers were RMB 1800/Ha (Clever *et al.*, 2015) (Tab. 2).

Rapeseed imports hit a record 5.04 million tons in 2013–14. This was largely driven by the recent expansion of crushing capacity particularly along the coastal provinces of Fujian, Guangdong and Guangxi. 2016–17 rapeseed imports in are forecast to recover to 4.5 million tons from the estimated 4.2 million tons in 2015/16. CNGOIC estimates that China's current rapeseed crushing capacity surpasses 40 million tons per year (some plants crush both rapeseed and soybean, but technically, a rapeseed crushing factory may be used for soybean too but not reversely because the extraction of rapeseed oil needs more energy than soybean oil), with a utilization rate of less than 40%. Guangdong, Guangxi and Fujian provinces own new crush plants; this added 6 million tons of crushing capacity to the country in 2014. These facilities utilize primarily imported rapeseed grains, with custom taxes limited to 9% and account for about one third of the Chinese production (Clever *et al.*, 2015). Due to this policy, the Chinese government currently has to manage substantial rapeseed oil stocks. Another point to underline is that China imports only rapeseed grain, not oil or cake (Jamet, 2016).

Oilseed rape R&D in China

China's modern rapeseed breeding began in the 1930's. Chinese rape breeders developed most cultivars initially through the pedigree selection method and interspecific hybridization between European/Japanese-Korean *B. napus* and the indigenous *B. rapa* stocks which include in addition to *B. rapa* subsp. *campestris* a wide range of important vegetables, such as *B. rapa* subsp. *pekinensis* (Chinese cabbage

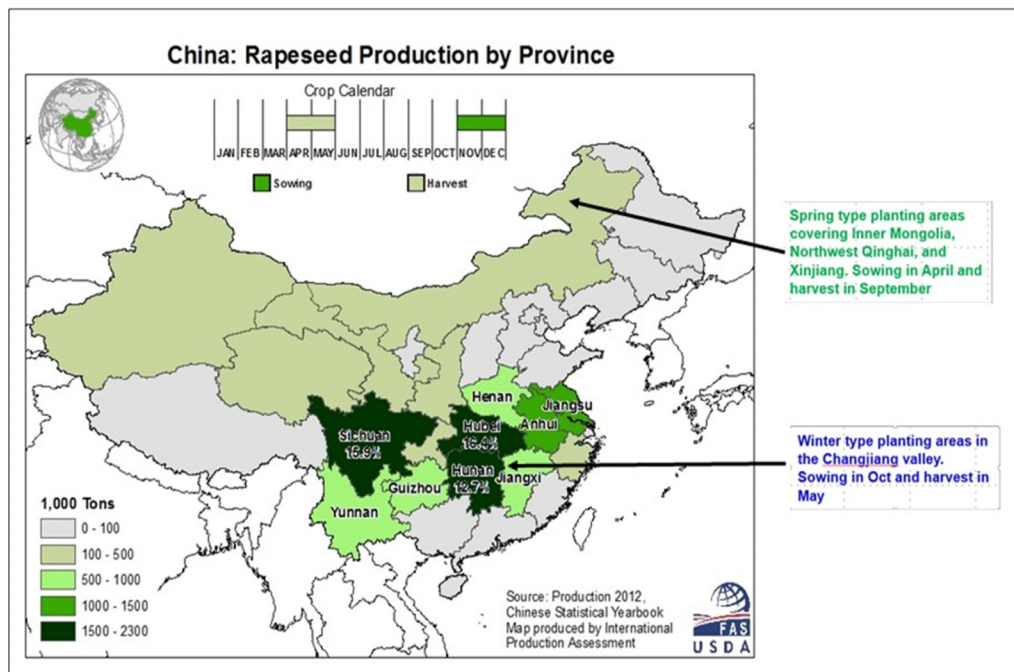


Fig. 3. Rapeseed production by province in China (10 first producers, in surface).

Table 1. Rapeseed production by province in China (10 first producers, in surface).

Million Ha	Province	2009	2010	2011	2012	2013	2014
1	Huna	1.02	1.09	1.17	1.20	1.30	1.30
2	Hube	1.17	1.16	1.14	1.17	1.23	1.25
3	Sichua	0.94	0.95	0.96	0.98	0.99	1.01
4	Anhu	0.72	0.69	0.64	0.61	0.57	0.55
5	Jiangx	0.54	0.55	0.54	0.55	0.55	0.55
6	Guizho	0.47	0.48	0.49	0.50	0.51	0.52
7	Jiangs	0.48	0.46	0.44	0.42	0.41	0.40
8	Hena	0.38	0.39	0.38	0.38	0.37	0.36
9	Inner Mongolia	0.22	0.22	0.22	0.27	0.29	0.31
10	Yunnan	0.25	0.27	0.27	0.28	0.29	0.29
Total 10 leading provinces		6.19	6.26	6.25	6.36	6.51	6.54

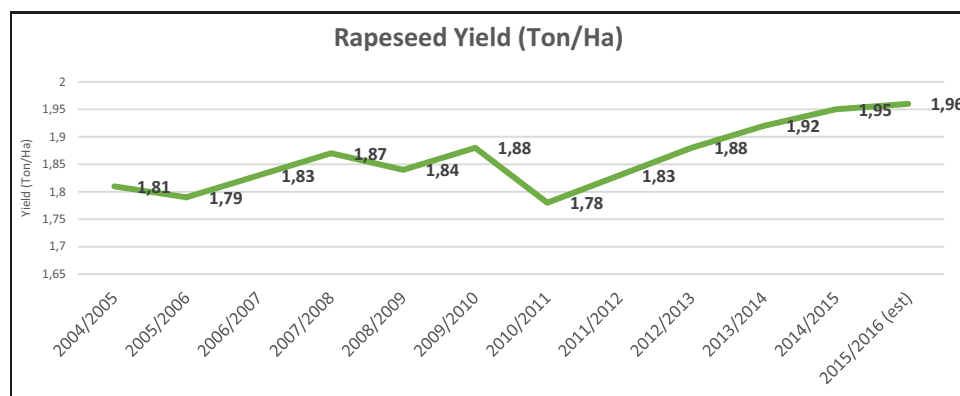
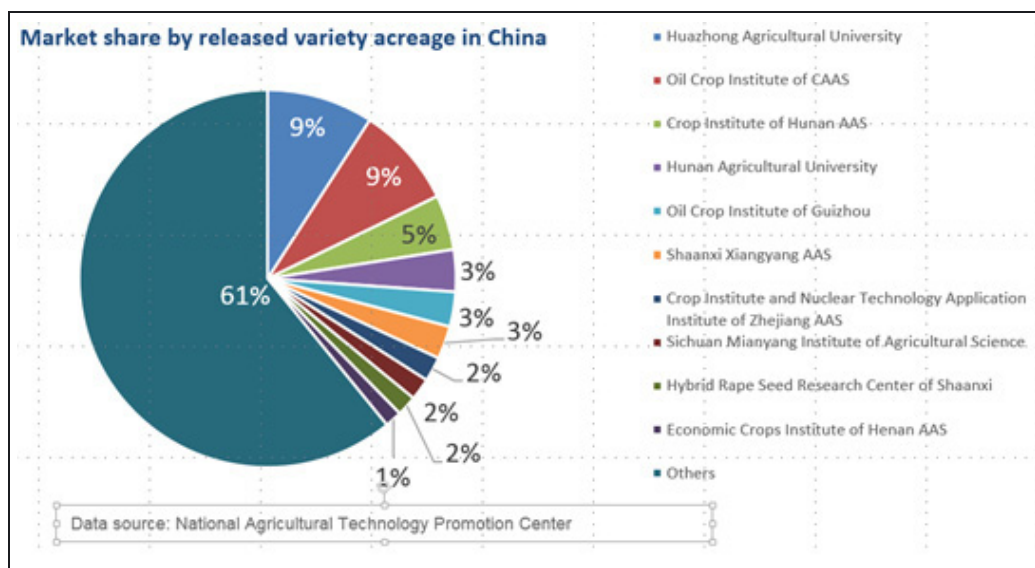


Fig. 4. Rapeseed yield in China (ton/ha) (Source: Foreign Agricultural Service, Official USDA Estimates).

Table 2. Oil rapeseed of China (1000 t; 1000 ha).

Years	2014–15	2015–16	2016–17
Market year begin	10/2014	10/1015	10/2016
Area planted	7588	7300	7000
Area harvested	7588	7300	7000
Beginning stocks	1036	1502	1002
Production	14 772	14 300	13 500
MY imports	4594	4200	4500
Total supply	20 402	20 002	19 002
Crush	18 300	18 400	17 500
Feed waste.	600	600	600
Total dom. cons.	18 900	19 000	18 100
Ending stocks	1502	1002	902
Total distribution	20 402	20 002	19 002
CY imports	4470	4200	4250

Source: Gain Report, 2016.

**Fig. 5.** Market share by released variety acreage in China.

or pet-cai), *B.rapa* var. *purpuraria* (hong caitai), *B.rapa* subsps. *chinensis* (you cai or bok-choy), *B.rapa* subsps. *chinensis* var. *rosularis* (wuta cai), *B.rapa* subsps. *japonica* (jinghui cai), *B.rapa* subsps. *parachinensis* (cai xin) and *B.rapa* subsps. *rapifera* (wuqing). At the end of the 1970's, a set of "00" canola were also introduced to China from Canada, Australia and Europe, which contributed to improving the quality of local varieties. In the 1990's and 2000's, molecular marker investigations revealed considerable genetic variation among Chinese and Western accessions. It was found that Chinese landraces lines contain frequently desirable traits, such as maintaining and restoring genes for Polima *cms* or Shaan *cms*, which makes production of hybrid seed easier in China without genetic manipulation (Bonjean, 2011).

Traditionally, semi-winter rapeseed is sown in the Changjiang basin in September-October and harvested in May. The length of the growing season covers 210–230 days. Modern spring sown canola types recently cultivated in North China have shorter cycles of 95–125 days. The main diseases are club root, Sclerotinia and blackleg (white rust for

B. juncea). Aphids and few other insects are the other major biotic stresses. Early maturity, wide adaptation, mechanized production adaptation and high oil/meal content are the other key-breeding goals.

In 2015–16, among the market and according to Sang and Lessard (2015):

- 80% is cultivated with hybrids (20% Polima *cms*, 20% Shaan *cms*, 40% *gms*);
- 20% remain covered by open-pollinated varieties.

From all cultivars registered during the 201–2010 period, double-low (low erucic and low glucosinolate contents) attained 85% of total planting acreage and among them double-low hybrids 70%.

More than 90% of the winter varieties and hybrids still come from public institutions, even if a few private programs have appeared (which commercialize simultaneously public cultivars too) (Hubei Jingchu Seed Technology, Jiangsu MLingtian, Wuhan Liannong Seed, Cgendu Fengle, Longping HighTech, Origin, etc.). At present, none of these structures have more than a 10% market share (Fig. 5).

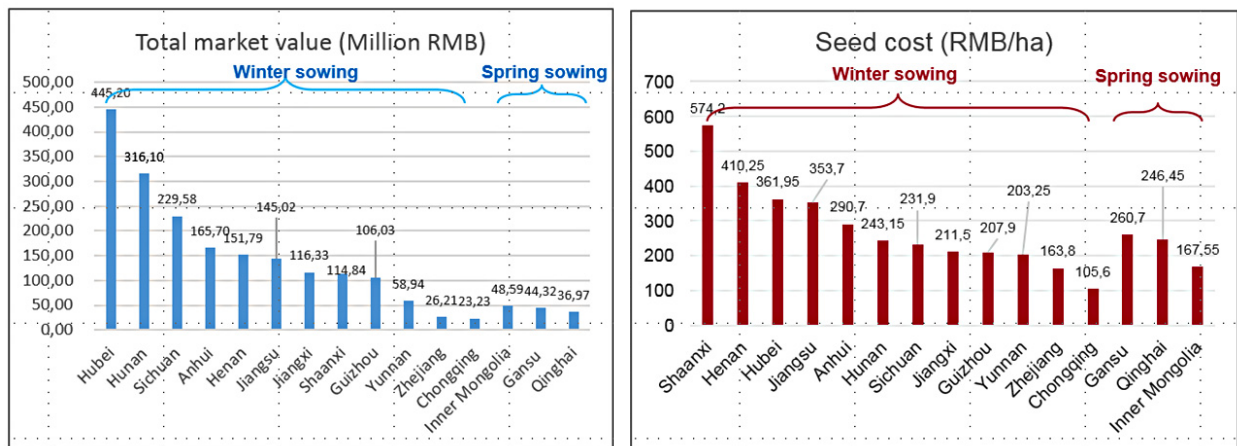
Table 3. Top ten varieties and hybrids in China.

Variet	Breeder	Released province	Acreage (M ha)
Qinyou 10	Shannxi Xianyang AAS	Anhui, Fujian, Gansu, Henan, Jiangsu	0.16
Fengyou 737	Crop Research Institute of Hunan province	Anhui, Hubei, Hunan, Jiangsu	0.13
Huanyouza 9	Huangzhong Agricultural University	Anhui, Hubei, Hunan	0.13
Youyan 10	Guizhou Provincial Oil Research Institute	Anhui, Guangxi, Guizhou, Hunan, Sichuan, Chongqing	0.11
Fengyou 730	Crop Research Institute of Hunan province	Hunan, Jiangxi	0.10
Zhongshuang 9	Oil Research Institute of CAAS	Hubei, Hunan, Jiangxi	0.09
Deyou 8	Lihouying, Wanghua	Anhui, Hebei, Hubei, Hunan, Jiangxi, Sichuan	0.09
Zheyong 50	Crop and Unclear Technology Application Institute	Zhejiang, Jiangsu	0.09
Huayouza 62	Huangzhong Agricultural University	Hubei, Hunan	0.08
Huayouza 13	Huangzhong Agricultural University	Hubei, Hunan, Sichuan	0.08

Table 4. China rapeseed market from 2007 to 2013.

Item	2007	2008	2009	2010	2011	2012	2013
Seed (RMB/ha)	157.05	170.55	201.30	221.10	236.25	262.35	276.30
The volume of sown seed (kg/ha)	5.10	5.25	5.10	5.10	5.10	5.10	4.95
Acreage of oil rape seed (M HA)	5.64	6.59	7.28	7.37	7.35	7.43	7.50
Total volume of sown seeds (M kg)	28.78	34.62	37.12	37.59	37.47	37.90	37.13
Total seed market value (Million RMB)	886.11	1124.55	1465.05	1629.43	1735.82	1949.75	2072.25

Source: 2015 Year book of national agricultural product cost and benefit statistics.

**Fig. 6.** Total market value (million RMB) and seed cost (RMB/ha).

As a consequence, in 2014, more than 282 varieties and hybrids were available in China, but among them the top 10 accounted for only 14% of the market (Tab. 3).

The situation is quite similar for the spring market, which accounts for 5% of the total mostly located in Qinhai and Inner Mongolia and included 26 varieties in 2014. There, the main breeder is the Spring Rape Institute of Qinhai AAS occupying 47% of this segment with 9 varieties. The most important are Qingza 5, Qingza 2, Qingza 14 and Qingza 4.

In terms of biotechnologies, two points merit underlining:

- BGI-Shenzen in association with Bayer, Keygene and the University of Queensland announced in 2009 it had sequenced the entire genome of *B. napus* and its constituent genomes present in *B. rapa* and *B. oleracea*.
- Until now, China has not officially commercialized any GM rapeseed but is active in this research. The recent acquisition of Syngenta by ChemChina should eventually

result in an evolution of the situation towards GM rapeseed cultivation. That said, this is not totally certain due to the fact that Chinese have traditionally consumed a lot of Brassica vegetables which would intercross with GM rapeseed pollen.

Chinese seed market of rapeseed

According to the 2015 yearbook of national agricultural production cost and benefit statistics, China's rapeseed market was estimated to be worth 370 million € (2.756 billion RMB) in 2014 (Tab. 4).

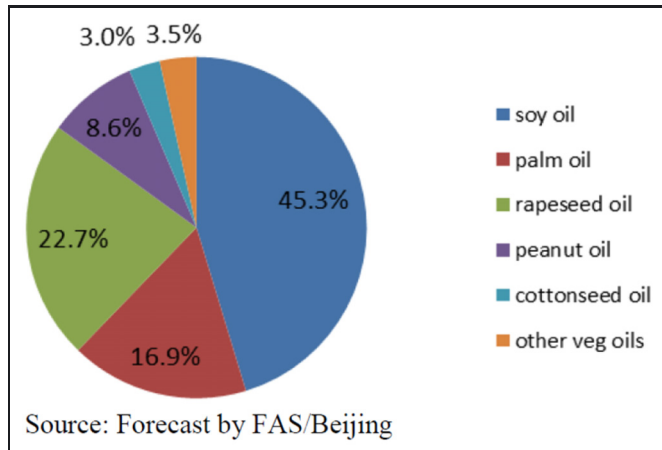
The main market segments are located in Hubei, Hunan and Sichuan provinces (Figs. 6a and 6b).

China seed exports in volume and value are summarized in Table 5.

Table 5. China seed exports (in volume and value).

	Volume (Mt)			Value (Thousand US\$)		
	2012/2013	2013/2014	2014/2015	2012/2013	2013/2014	2014/2015
Tota	28 376	28 847	27 299	247 941	263 931	263 022
Rape/Colza, ne	107	5	1	169	35	43
% total China seed export	0.37%	0.17%	0.04%	0.68%	0.13%	0.02%

Source: Yearbooks of national agricultural production cost and benefit statistics.

**Fig. 7.** Chinese vegetable oil consumption forecast for 2016/17.

Uses of oil crops and especially rapeseed products in China

During the last 20 years, China's urbanization and its continuing growth in GDP have led to changes in food habits (Bonjean *et al.*, 2014). In particular, Chinese families consume more vegetable oil than in the past, more animal proteins (meat and milk products, fish) and have diversified their diets in vegetables and fruits.

Initially, China started to increase its oil crop production, but now importations are becoming increasingly important: nearly 3/4 of the vegetable oils consumed come today from imports, vs. only 37% in 1996/97 (Jamet, 2016). In 2015/16, China continued dominating the world oilseeds market, being the world's largest soybean importer with more than 86 million tons for feeding its animal sector (Clever and Wu, 2016). This is a result of recent mergers and acquisitions. For example, in 2014, the State-Owned-enterprise China National Cereals, Oils and Foodstuff Corporation (COFCO) gained control successively of the Hong Kong-headquartered commodity company Noble Group, then the Dutch agri-trader Niderawich has important operations in Argentina and Brazil mainly focused on soybean and maize.

For 2016/17 (Fig. 7), the forecasted shares of Chinese vegetable oil consumption places rapeseed oil in 2nd position at 22.7% far behind soy oil with 45.3% though before palm oil at 16.9% (Clever and Wu, 2016).

Rapeseed oil is appreciated by Chinese consumers for its dietary fatty acid profile and its mild taste, but we can think its future consumption will mainly depend more on the comparative price ratio with those of soybean oil and palm oil, which will be imported into China in larger volumes.

In the 2000's, China started to invest in firstgeneration bio-fuel factories, but the Chinese government halted this initiative, the stock of available grain being too limited. In 2016, new industrial projects for 2nd generation biofuels have been initiated but it is too early to project their long-term trend (Jamet, 2016).

Regarding rapeseed meal, we must note that Chinese farmers do not currently use it for feeding animals but instead use it mostly as soil fertilizer.

Conclusion

A structural importer of oilseed and vegetable oils since 2004, China is and will stay at least within the next 10–20 years an important producer and consumer of rapeseed, probably also a regular importer, but this trend will remain of limited importance compared to its huge import needs of soybean and palm oils. During the same period, Chinese and foreign seed companies will presumably develop private rapeseed breeding programs, and especially 00 hybrids, to replace current public varieties.

Some recent events in the world of business, such as the takeover of Syngenta by ChemChina and the general orientations of the XIIth national plan will further open the rapeseed market to private actors, but State control will certainly remain strong in this sector.

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