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# Jagresh Rana

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> Ushering in the Next Wave of Agriculture Innovations with Emerging Tech Trends and Integrated Solutions for the Farm

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## **Oligarch Structure of Chinese Rice Seed Industry**



By Haiying Liu Nanfang Rural Newspaper

Statistics reveal that there are some 3,293 seed enterprises in China, which include 691 rice seed enterprises. According to an expert estimation, the market value of the rice seed industry is roughly 18.4 billion yuan, including the hybrid rice value of 11 billion yuan, with the total business sales reaching 6 billion yuan.

In 2016, the rice seed sales of Long Ping High-Tech were 1.372 billion yuan, while that of Da Bei Nong Group and Win-All Hi-Tech Seed were 530 million yuan and 420 million yuan, respectively. The total of the top three reached 2.322 billion yuan, accounting for 38.7% of the total hybrid rice seed sales. This is the first time such a high concentration ratio has been seen, indicating the Chinese rice seed industry has assumed an oligarch structure, where tycoons dominate the industry.

#### **1.Chinese Rice Industry Overview**

#### 1) Planting area of some 450 million Mu with the total output being roughly 200 million tons

China's rice planting area is some 450 million Mu, ranking second in the world, while the unit and total yield rank first in the world. In 2016, China's hybrid rice planting area was some 226 million Mu and the conventional rice planting area was 223 million Mu, both being somewhat same. According to the 2017 Grain Production Public Notification issued by the National Bureau of Statistics of China, China's paddy planting area in 2017 reached 453 million Mu, which was some 204,000 Mu more than that of 2016, while the paddy output reached 208.56 million tons, which was some 315,000 tons more than the record high of 2015, thus setting a new record. The paddy output has stayed above 200 million tons for seven consecutive years.

## 2) Indica varieties of southern region are the main planted rice varieties

The distribution of rice plantations in China shows that the southern planting region is the main rice production region of China, including the double rice cropping rice area of central China and south China, as well as the single/ double cropping rice area of the plateau of southwest China. The southern region of China accounts for some 93% of China's total rice planting area, producing mostly indica rice varieties, except for the small amount of japonica rice planted on Yunnan-Guizhou Plateau.

In recent years, japonica rice has been developing rapidly in China, which is mainly distributed in four prime regions: northeast paddy rice region, downstream Yangzi and Huai River Basin japonica rice region, Yunnan-centered southwest japonica rice region and northwest paddy rice region. Among the above, the planting area of Heilongjiang Province and Jiangsu Province has reached 54.62 million Mu and 29 million Mu, respectively, which is still growing, accounting for some 60% of China's total japonica rice planting area.



## 3) China's hybrid rice variety being upgraded to 4th generation

Chinese rice breeding has experienced three generations of development: dwarf breeding, three-line hybrid rice breeding and two-line hybrid rice breeding, of which the two-line hybrid rice breeding and the super hybrid rice breeding have developed simultaneously. Accordingly, the rice variety promotion has experienced three upgrades. The landmark varieties are:

Shanyou 63, Liangyoupeijiu, Feng Liang You No.1 and Y Liangyou No. 1.

From provenance perspective, the breeding revolution of three generations were led by Aizizhan, "Wild Abortive" male sterile line, IR8 Rice and Nongken 58. The dwarf rice revolution started from Aizizhan rice and Aijiaonante rice, while the threeline hybrid rice breeding was driven and promoted by the discovery of the "Wild Abortive" male sterile line and the strong restorer line IR24 (IR8 derivatives). The two-line hybrid rice breeding revolution originated from Nongken 58.

The fourth generation of Chinese hybrid rice breed is regarded as having started from 2015 when the "Huazhan" series variety was promoted and applied, which is referred to as the Huazhan Era. Its representational varieties include Tianyou Huazhan, C Liangyou Huazhan, Long Liangyou Huazhan and Jing Liangyou Huazhan.

#### 4) Rice purchasing price in China gradually marketized

Since China's marketization of corn purchasing, rice purchasing was also marketized in 2017 after the implementation of the protective price policy for 14 years. In 2017, the lowered purchasing price of early indica rice, midlate rice and japonica rice was deemed as the beginning of marketization of rice purchasing. In 2018, the rice purchasing price went down further and dropped significantly.



#### 5) Green and fine-quality rice varieties becoming tendency of future development

The supply-chain reform of Chinese agriculture has provided the paddy rice industry with great opportunity for development, which facilitates paddy rice to move towards diversified, green, quality-oriented and featured development for the benefit of cultivation of fine-quality rice. The restructuring of rice varieties, promotion of green and fine-quality rice varieties are bringing about unprecedented opportunities.

Over recent years, a breakthrough in indica rice hybrid breeding has been achieved, which ends the notion that "hybrid rice is not tasty." In the coming years, simpler and mechanized cultivation of rice of better quality will become an irreversible process in rice production.

It is noteworthy that japonica rice in northeast China is superior to southern indica and will be more competitive. It would be wise to pay due attention to any possible changes in the southern indica rice market. Experts have given a bold forecast that the rice production structure in China in the future will be a one-third situation, where japonica rice, indica rice and hybrid rice will each take one third of the share.



Remark: Some 165 out of the 178 nationally registered rice varieties in 2017 were hybrids, of which 98 were grade 3 or above, accounting for over 55%.

#### 2.Formation of oligarch structure of rice seed industry

#### 1) Rice seed industry has the highest concentration ratio in the seed industry

The number of Chinese seed enterprises has dropped from more than 8,700 to some 3,200, with continued mergers and acquisitions. However, the concentration ratio of top 10 Chinese seed enterprises is below 20%, which appears decentralized and less competitive, as compared to the international seed industry.

Nevertheless, in 2016, the concentration ratio of the Chinese rice industry's top 3 — Long Ping High-Tech, Da Bei Nong Group and Win-All Hi-Tech Seed — reached 38.7%, thus gradually forming an oligarch structure of the rice seed industry in China.

#### Top 20 Hybrid Rice Enterprises of 2016 Publicized by the National Agro-Tech Extension and Service Center (NATESC)

	Company		Company
1	Long Ping High-Tech	11	Sichuan Huafeng Seed
2	Beijing Jinse Nonghua Seed	12	Hunan Hoping Seeds
3	Win-All Hi-Tech Seed	13	Zhejiang Wuwangnong Seeds
4	China National Seed Group	14	Hunan Tao Hua Yuan Agricultural Technologies
5	Hubei Jingchu Seed	15	Jiangsu Grand Agriseeds
6	Hainan Shennong Dafeng Seed	16	Guangxi Zhaohe Seed
7	Zhongnongfa Seed	17	Sichuan Golden Harvest Seed
8	Jiangxi Modern Seed	18	Sichuan Guohao Seed
9	Ningbo Seed	19	Hunan Huoli Seed Technical
10	Hefei Fengle Seed	20	Hunan Keyulong Seed

#### 2) Variety registration highly concentrated

Concerning variety registration, it is noted that the stronger is stronger, as shown by the variety registration structure. Among the varieties registered in 2017, the registrations of the three seed industry leaders — Long Ping High-Tech, Win-All Hi-Tech Seed and Jinse Nonghua Seed of Da Bei Nong Group — accounted for 58.1% of the total registrations, which also increased significantly over the 33.9% in 2016.

As regards to the regional distribution, in 2017, the number of variety registrations of Long Ping High-Tech for all main rice production regions increased significantly, particularly in the upstream Yangtze region and south China of great potential, where its registered varieties accounted for 91.7% of the total in south China. These varieties not only have apparent trait advantages of yield, quality and rice blast resistance but also have proved to be remarkably developed in respect of bacterial blight resistance and heat resistance.

By virtue of its "Huazhan" variety series, the Jinse Nonghua Seed of Da Bei Nong Group has shown its strong competitiveness in the Yangtze valley rice production region, supported by its continued independent breeding achievement. The company has made a breakthrough in achieving five nationally registered varieties, accounting for 12.8% of the total nationally registered varieties. Win-All Hi-Tech Seed, which is deeply rooted in the semi-late and late rice market of the mid/downstream Yangtze valley region, is now developing upstream Yangtze market and has made a breakthrough from zero in the national variety registration for the upstream Yangtze region. The company owns two nationally registered varieties, accounting for 5.1% of the total nationally registered varieties.

## 3) Continued merger and acquisition activities

Among the three industry leaders — Long Ping High-Tech, Da Bei Nong Group and Win-All Hi-Tech See — Long Ping High-Tech has conducted a large number of acquisitions. In the last two years, Long Ping High-Tech has successively acquired 51% stake in Guangxi Hengmao Agricultural Technology Ltd, 32.49% stake in Hubei Huimin Agricultural Technology Ltd and 80% stake in Hunan Golden Rice Seeds Ltd, with its market share growing continuously. In 2015, Long Ping Seed International was founded, followed by the establishment of an international R&D center in Hainan Province in 2017. So far, research bases have been set up in the Philippines, Pakistan, Bangladesh, India, Viet Nam, Indonesia and Angola. The Southeast Asian market volume of Long Ping High-Tech has reached 15 billion yuan, while its overseas deployment is expected to have a bright future prospect.

As for Da Bei Nong Group and Win-All Hi-Tech Seed, Da Bei Nong Group has entered into a strategic partnership with Heilongjiang Academy of Agricultural Sciences to hold a controlling share in Heilongjiang Long Ke Seed, aiming to shape the largest seed enterprise in Heilongjiang Province. In the meantime, Da Bei Nong Group made an equity investment in Win-All Hi-Tech Seed, thus becoming the second largest shareholder of Win-All Hi-Tech Seed. Experts said that Da Bei Nong Group intends to take over Win-All Hi-Tech Seed to make up for its inadequate overseas rice deployment and further grow the rice business of the company.



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## Field Crop Seeds in Ukraine: Analysis of Varietal Preferences of Agrarians



Ukraine could rightly be considered as agricultural country. According to estimations of international experts Ukraine is among TOP-3 European agricultural countries with the share of agriculture in GDP at 17–18% in 2017. Upon that production of grain and oilseed crops was instrumental in reaching this level. Thus, according to FAO, Ukraine ranked 8th in global grain production and 7th in oilseed output in 2016. Herewith, the high-quality crop depends not only on modern technologies and climate but also on lean approach to formation of variety structure.

By Svitlana Synkovska marketing director of APK-Inform

According to the study "Market of crop protection products and seeds in Ukraine" made by APK-Inform in 2016-2017, the qualified producers solely planted about 14 mln ha with grain and oilseed crops and they used 1.5-1.7 mln tonnes of seeds. Winter wheat seeds made up 2/3 of total seeds volume.

We examine the Ukrainian seeds market in view of TOP-5 crops ( see picture on the right ).

#### Winter wheat

Wheat is one of the main crops cultivated in Ukraine. According to official data, commercial wheat area solely reached 4.9 mln ha in 2017 with winter wheat accounted for more than 90% of total area.

According to the study, variety preferences mainly depend on farm planted area. Thus, during planting campaign of 2016/17 season the farms with area less than 5 thsd ha mainly preferred 5 winter wheat varieties – Shestopalovka, Podolyanka, Bogdana, Smuglyanka and Antonivka. The area under these varieties reached about 26% out of total at farms with mentioned area. Upon that the area under Shestopalovka and Antonivka varieties increased significantly while that of Podolyanka and Smuglyanka declined somehow.





#### **MARKET INSIGHT**

At the same time, the preferences of middlesize farms (5 to 10 thsd ha) were stable. Over the last years they used Bogdana, Shestopalovka, Smuglyanka, Kuyalnik and Podolyanka varieties. However, despite the area size, variety preferences were rather intent at these farms and TOP-5 varieties accounted for 25% of total seeds used.

The preferences of the farms with area higher than 10 thsd ha differed significantly. The study revealed that they mainly used Antonivka, Smuglyanka, Bogdana, Skagen and Podolyanka varieties. Moreover, taking to account that broadly farmers preferred to use their own seeds, the variety range was stable year on year, except Podolyanka. The sowing of this variety has been declining in all types of farms.

Moreover, farmers consider not only variety qualitative characteristics but also a climate zone while planning the variety structure. For example, Shestopalovka, Antonivka, Kuyalnik, Mission Odessa, Odesskaya 267 and Blagodarka varieties are widely cultivated in southern regions, while Bogdana, Podolyanka and Favoritka varieties are mainly used in eastern part of the country.

#### Soybeans

Soybeans have the biggest area among spring grain and oilseed crops after sunflower and corn. Upon that it accounted for 9% of total seeds volume (2nd place in the rating). According to official data, commercial soybean area solely reached 1.8 mln ha in 2017 and the total area reached 2 mln ha.

Farmers are rather interested in soybeans production. Thus, they are willing to get high yield and they plan the variety structure with greater deliberation year by year.

According to APK-Inform, Ukrainian farmers cultivated about 230 soybeans varieties during two last seasons. At the same time, variety preferences differed significantly depending on farm size. Madison variety was an exception that was the most used one at all farms. The highest difference in varieties between two seasons was observed at the largest farms.

Madison, Annushka, Terek, Lybid and Anastasiya varieties accounted for 40% out of total seeds used in farms with area less than 5 thsd ha. Unlike bigger farms, variety structure in this segment was mainly stable as farmers basically used their own seeds.

< 5000 ha		5000-99	5000-9999 ha			>=10000 ha		
	2016	2017		2016	2017		2016	2017
Shestopalovka	5,9%	6,7%	Bogdana	8,7%	7,4%	Antonivka	6,3%	7,2%
Podolyanka	6,2%	5,8%	Shestopalovka	8,5%	6,3%	Smuglyanka	8,3%	5,9%
Bogdana	5,4%	5,4%	Smuglyanka	8,5%	3,8%	Bogdana	6,5%	4,8%
Smuglyanka	5,6%	4,9%	Kuyalnik	2,1%	3,7%	Skagen	4,9%	4,7%
Antonivka	1,9%	3,5%	Podolyanka	6,5%	3,4%	Podolyanka	7,2%	4,3%



< 5000 ha			5000-9	9999 ha	I	>=10	0000 ha		
		2016	2017		2016	2017		2016	2017
	Madison	14,4%	14,4%	Madison	10,2%	17,8%	Madison	16,3%	13,5%
	Annushka	8,5%	12,0%	Valuta	1,7%	5,3%	Sultana	9,9%	10,4%
	Terek	4,7%	6,0%	Terek	6,4%	5,3%	Lybid	7,6%	8,0%
	Lybid	5,7%	5,9%	Horol	5,6%	4,6%	Cheremosh	12,3%	8,0%
	Anastasiya	1,4%	3,1%	Almaz	5,5%	4,5%	Kuban	9,0%	5,7%

At the same time, middle-size farms preferred Madison, Valuta, Terek, Horol and Almaz varieties in 2017. For Valuta it was a real breakthrough as it took the 25th place in the list in 2016 with the share at 1.7% and it ranked the 2nd in 2017 after leading Madison.

The list of soybean varieties cultivated at large farms stayed the same in 2017. However, varieties shares changed. Cheremosh gave ground significantly as it ranked the 2nd in 2016 with the share at 12.3% and moved to the 4th place (8% share) in 2017.

#### **MARKET INSIGHT**



< 5000 ha		5000-9999 ha			>=10000 ha			
	2016	2017		2016	2017		2016	2017
Dostoinyi	20,7%	26,1%	Luran	21,6%	26,0%	Highlight	39,2%	17,5%
Luran	20,8%	23,9%	Dostoinyi	33,7%	13,8%	Naomi	7,2%	17,4%
Highest wave	12,1%	14,0%	Highest wave	5,3%	12,8%	Luran	13,3%	16,7%
Snow queen	8,0%	7,5%	Gerlah	3,8%	8,4%	Gerlach	5,3%	14,9%
Highlight	4,0%	4,2%	Academicheskiy	5,8%	5,6%	Dostoinyi	7,3%	9,3%



< 5000 ha		5000-9999 ha			>=10000 ha			
	2016	2017		2016	2017		2016	2017
Stalker	14,3%	12,9%	Helios	18,6%	15,5%	Antigone	24,1%	20,4%
Adapt	13,0%	9,6%	Adapt	7,6%	13,8%	Sebastian	29,8%	16,0%
Helios	10,3%	8,5%	Stalker	8,3%	9,6%	Vakula	18,2%	9,9%
Dostoinyi	6,9%	7,4%	Dostoinyi	3,3%	9,4%	Helios	10,0%	8,3%
Aeneas	10,6%	6,5%	Commander	6,7%	8,5%	Stalker	1,0%	7,2%

#### **Barley**

According to official data, Ukraine planted barley throughout 1.3 mln ha in 2017, winter barley accounted for almost 50% out of total area. Winter barley area declined by 17% in 2017 due to unfavorable weather during planting campaign.

Currently there are more than 60 varieties of winter barley on Ukrainian market. At the same time, registered varieties accounted for 60% in variety structure formed by farmers. Analysis revealed that except qualitative characteristics farm size influenced seeds preferences.

Small-size farms mainly preferred five winter barley varieties including Dostoinyi, Luran, Highest wave, Snow queen and Highlight. At the same time, middlesize farms preferences differed somehow and they mainly cultivated Luran, Dostoinyi, Highest wave, Gerlach and Academicheskiy varieties. Notably, the 25% of respondents at each segment chose Luran variety.

The most significantly variety structure differed at large farms with area higher than 10 thsd ha. Thus, the study revealed that TOP-5 varieties accounted for 75% out of total seeds volume in 2017. These farms preferred Highlight, Naomi, Luran, Gerlach and Dostoinyi varieties. Moreover, it was the large farms who often revised the variety structure. For example, Wintmalt ranked the 2nd during planting campaign of 2015/16 MY and it moved to the 6th place next year.

Variety structure of spring barley is more diverse comparing to winter barley. The study revealed that Ukrainian farmers cultivated 92 varieties of spring barley during 2016-2017. TOP-10 varieties accounted for 70% out of total seeds volume.

The variety structure of spring barley was the most diverse at large farms (more than 10 thsd ha) the same as in case of winter barley.

At small-size farms TOP-5 varieties accounted for 45% out of total seeds volume in 2017, down from 55% in 2016. At the same time, the list of cultivated varieties stayed stable and farmers preferred Stalker, Adapt, Helios, Dostoinyi and Aeneas over the last two seasons.

The three leading varieties were the same at middle-size farms. According to APK-Inform, Helios, Adapt and Stalker varieties accounted for 40% out of total seeds volume in 2017.

TOP-5 varieties covered about 2/3 of total seeds used at large farms. Farmers' preferences were less intent in 2017. Thus, the same varieties were in TOP-5 in 2016 with the common share exceeded 80%. Moreover, the variety structure of large farms differed significantly from that of small and middle-size farms. They preferred Antigone, Sebastian and Vakula that were barely used in smaller farms.

#### Corn



< 5000 ha		5000-99	99 ha		>=10	000 ha	1	
	2016	2017		2016	2017		2016	2017
Monica 350 MV	2,4%	4,3%	Monica 350 MV	5,2%	5,2%	Nerisa	5,6%	5,3%
DKC 4590	4,2%	3,7%	Nerisa	4,2%	5,0%	DKC 3511	5,5%	5,1%
DK 315	3,2%	2,9%	Delitop	4,1%	3,3%	Delitop	1,4%	4,7%
DKC 3511	1,0%	2,6%	DKC 3511	2,7%	3,2%	DKC 4590	7,2%	3,6%
DKC 4964	1,7%	2,3%	DKC 4590	5,5%	2,6%	NK Falcon	0,8%	3,4%

#### **MARKET INSIGHT**

Corn takes the 5th place in the rating of seeds used. It is one of the main grain crops in Ukraine. At the same time, it is very important to consider the variety structure particularly amid climatic changes observed over the last couple of years. Farmers have to revise the variety structure more often preferring disease resistant hybrids.

The table above shows that the large farms had more intent variety preferences. Thus, at small farms TOP-5 varieties accounted for just 16% out of total seeds volume, while this index reached 22% at large farms. Actually, all farm types cultivated DKC 4590 and DKC 3511 varieties.

Small-size farms preferred Monica 350 MV, DKC 4590, DK 315, DKC 3511, DKC 4964 varieties. Middle-size farms cultivated Monica 350 MV, Nerisa, Delitop, DKC 3511 and DKC 4590. However, DKC 4590 gave ground significantly at this segment as it was the leading variety in 2016.

The variety structure changed somehow at large farms. Farmers preferred to cultivate DKC 4590, DKC 4408, Nerisa, DKC 3511 and DK 315 in 2016. The TOP-5 list changed in 2017 and they turned to Nerisa, DKC 3511, Delitop, DKC 4590 and NK Falcon.

Summarizing all the above we should point out that the right choice of seeds is the key to high-quality product regardless of crop. Timely revision of variety structure let farmers to keep the average yield high.



## A Glance at the Brazilian Seed Market



**By Paulo Campante** Executive Superintendent, Brazilian Seed Association (ABRASEM)

According to the first survey for the 2017/2018 crop, conducted by the National Supply Company - CONAB, an estimated grain production for the crop should be around 228 million tons with a planted area of 62.02 million hectares. Soybean and maize remain as the main crops produced in the country. Both products correspond to almost 89% of what is produced. Soybeans can reach a production up to 108 million tons, while corn production can reach up to 93.5 million tons, between the first and second harvests. Is also noted a significant increase in the production of cotton, beans, sunflower and castor beans

In just over 20 years, the Brazilian grain crops has grown up from 76 to more than 200 million tons, while the increment of the area was approximately 40%. Studies show that if the productivity levels were kept as few years ago would be necessary to incorporate an additional 70 million hectares, to harvest the current crop. Such improvements, which impress by the grandeur, were sustained by the development of a strong seed production system, that have heavily invested over the years, in order that the producers had in their hands more productive cultivars. better adapted to the new environmental conditions and resistant to pests and diseases.

The result through years of investment in research, the seed stands out today as the main vehicle of technology and innovation in the agricultural sector, being directly responsible for significant productivity rates experienced in almost all the Brazilian territory. Nowadays, in Brazil, it is common to find productivity averages above 12,000 kg / ha, for the corn crop, and more than 3,500 kg / ha in the soybean crop.

The country has got an established seed industry for over three decades and it has one of the largest domestic markets in the world behind only the United States and China, besides having on one of the biggest productive parks in the world. The country's own continental characteristic favors the production of high quality seeds, in different edafoclimatic conditions, besides allowing 3 to 4 cycles per year in some species, which may represent a good competitive advantage for seed production and in the conduct of generation advancement projects in the case of genetical enhancement programs.

Today the Brazilian domestic market is approximately the amount of US \$ 4 billion, with emphasis on large crops accounting for 83% of the market, forages with 11% and vegetables 6%. The Brazilian seed production went from from 1.6 million tons in the 2001/02 crop to almost 4 million tons of seeds in the 2015/16 crop, being that the production of soybeans, corn, wheat,



Figure 1. Brazilian Seed Market in Brazil

#### **MARKET INSIGHT**



Figure 2. Participation of field crops into the Brazilian seed market.

rice, cotton, beans and sorghum remains the main seed markets in the country.

In 2016, the vegetables seed sector reached a value of US \$ 245 million, with special emphasis on the production of tomato, onion, carrot, watermelon, lettuce, melon, pepper, cucumber, sweet corn and cauliflower seeds, being the Brazil's southeastern region responsible for about 45% of this market. However, other regions still have great potential for growth, via mainly, expansion of cultivation and replacement of open pollinated cultivars by Hybrid F1.

Another highlight to be observed is the tropical forage sector, which registered a growth of 122%, going from 27 thousand tons of seeds in 2010 to 144 thousand tons in 2016, reaching revenues of approximately US \$ 600 million driven mainly by the meat market growth and by federal government incentive programs, through the Agricultural and Livestock Plan.



Figure 3. Participation of vegetables species into the Brazilian seed market.

From the second half of the 90's, the seed industry in Brazil has gone through major changes, with the establishment of new legislation in the seeds 'areas, intellectual property and biosafety, with the consequent availability of biotechnology in the market. The Brazil's entry into the WTO has triggered a series of changes and adjustments in national legislation, especially in intellectual property, involving several links in the chain such as public and private research, the seed industry, trade and also the government agencies responsible for implementing policies for the sector. Regarding to intellectual property was established broader mechanisms of rights ownership with the creation of the Patents Act (1996) and the Protection of Cultivars (1997).

The new plant variety protection law significantly changed the technology generation model in the seed production area then in force in the country. Under the new model, the private initiative was called to participate in the generation of new technologies in seeds, initiating a process of structural change in the seed market, with a heavy presence of private enterprise that now operates the strong contribution of new technologies, high investments and aggressive strategies for the market conquest.

Brazil has chosen to format its law according to the UPOV Convention 1978, introducing, however, in the law, some modifications that incorporate concepts of the 1991 version. The duration of the cultivar's protection is effective from the date of granting of the Provisional Protection Certificate, for a period of 15 years, excepting vines, fruit trees, forest trees and ornamental trees, for which the duration shall be 18 years. Once the term of validity of the right of protection is done, the cultivar will fall into the public domain and may be freely used by any person, without the authorization of the protection holder.

According to the legislation, new cultivars and those derived essentially from any genus or species are entitled to protection, if they meet the requirements of distinguishing, homogeneity and stability (DUS). In other words, the cultivar must be distinct, different from another cultivar; homogeneous, have uniformity in their characteristics; be stable and maintain homogeneity during successive plantations. Besides that, it may not have been offered for sale in Brazil for more than 12 months in relation to the date of the protection request, and have not been offered for sale in other countries, with the knowledge of the breeder, for over six years.



Figure 4. Evolution of the number of protected cultivars protected by SNPC/MAPA.

Among the exceptions to the breeder's rights, the law provides for the right of the farmer to reserve and plant seeds in his establishment, using for own consumption the product obtained from the planting of a protected cultivar. It also contemplates the right of the breeder, who may use the material as a source of genetic variation; except the repeated use of the cultivar for hybrid formation or the creation of essentially derived varieties.

The system adopted by Brazil foresee that the National Service of Protection of Cultivars, agency of the Ministry of Agriculture, Livestock and Supply which will be executed by the interested party in obtaining the protection of the cultivar. Thereby, it is through demand submitted by the productive sector that the National Service of Protection of Cultivars initiates a new directive of DUS or promotes the revision of the existing ones.

Today the National Service for Plant Variety Protection has included more than 110 species in the plant variety protection regime and has granted more than 3,386 Crop Protection Certificates. By the year of 2004 the majority of plant variety protection requests were related to major crops such as soybeans, coffee, rice, wheat and cotton. From 2004, requests for the protection of ornamental, forage, oil and fruit species increased significantly an in 2016, these species already accounted for 38% of the requests for protection of cultivars. Only the group of ornamental species represented about 21% of the protection order.

Unlike the National Service of Protection of Cultivars, the National Register of Cultivars (RNC) is the register of cultivars qualified for the production, marketing and use of seeds and seedlings throughout the national territory and is linked to the Seed and Seed Coordination

(CSM/MAPA), to the Department of Agricultural Inputs Supervision (DFIA/ MAPA) connected to the Agricultural Protection Department of the Ministry of Agriculture, Livestock and Supply (SDA/MAPA). Its importance is due to the condition of being an instrument of market organization that aims to protect the farmer from the indiscriminate sale of seeds and seedlings of cultivars not tested or validated against the conditions of Brazilian agriculture. The RNC aims to discipline the use of cultivars that have a remarkable application in national agriculture, that meet the technical conditions of being distinct, homogeneous and stable and that have a value of cultivation and use - VCU, identified.

The National Register of Cultivars of the Ministry of Agriculture, Livestock and Supply has got today more than 36 thousand cultivars registered and only 9% of which are protected by intellectual property. Regarding the cultivars registered, 42% of the registrations with the National Register of Cultivars (RNC) are of ornamental species, 24% are cultivars of vegetable crops, 22% of large crops, 8% of cultivars of forest species and 4% of cultivars of fruit species.

These numbers presented are quite impressive, especially when we consider that the seed market in Brazil can still be considered a developing market when compared to more consolidated markets such as the US market or EU markets for seeds and seedlings. For anyone involved in agribusiness, it is easy to see that the seed area is directly responsible for the success or failure of food production, as well as being an essential factor to leverage national agriculture. More than this, it is in the performance of this sector that the very sustainability of agribusiness lies.



Figure 5. Participation of the species into National Register of Cultivars (RNC/ MAPA).

Used to cyclical and all sort of difficulties, the seed industry continues to strengthen and will certainly have the necessary conditions to further leverage the Brazilian presence in the global market. There are aspects, however, that the current industry leaders should be aware of, so that a current trend of weakening the system does not worsen. In order to keep the national system of seeds and seedlings in constant evolution, it is really important to break with the immediacy and fragmented view that prevails in some segments of agribusiness, that the agricultural cycle begins in the planting when, in fact, it starts well before, with the work of the researchers in the development of new cultivars and technologies. Respect for intellectual property should continue to be the basis of the seed business in Brazil.

It is necessary to raise awareness among all small and medium-sized farmers that only by efficient use of technology will wealth continue to be shared maximizing efficiency and productivity, essential conditions for the Brazilian agribusiness to continue to present surprising numbers

The first vocation of Brazil is agricultural, and the national system of seeds and seedlings is strategic for the country.

AgroPages.com



#### Sales of Top 20 Global Seed Companies in 2017\*

	Company (Country)	2017 Sales (US\$ m)	2016 Sales (US\$ m)	Change %
1	Monsanto (US)	10,913	9,988	9.26%
2	Corteva Agriscience (DowDuPont) (US)	8,143 <sup>1</sup>	8,188 <sup>2</sup>	-0.55%
3	Syngenta (ChemChina) (China)	2,826	2,657	6.36%
4	Limagrain (France)	1,900	1,746	8.82%
5	Bayer (Germany)	1,805	1,427	26.49%
6	KWS (Germany)	1,596	1,506	5.98%
7	Sakata Seed (Japan)	558	529	5.48%
8	DLF (Denmark)	542	533	1.69%
9	Long Ping High-Tech (China)	492	331	48.64%
10	Rijk Zwaan (Nederland)	480	431	11.37%
11	Takii Seed (Japan)	459	480	-4.38%
12	Barenbrug (Nederland)	291	258	12.8%
13	Enza Zaden (Nederland)	NA <sup>3</sup>	281 4	NA
14	Bejo Zaden (Nederland)	NA <sup>3</sup>	270 4	NA
15	Florimond Desprez (France)	NA <sup>3</sup>	255	NA
16	RAGT Semences (France)	238	239	-0.42%
17	Advanta Seeds (UPL) (India)	231	248	-6.85%
18	Beidahuang Kenfeng Seed (China)	220	244	-9.8%
19	Euralis Semences (France)	NA <sup>3</sup>	192	NA
20	InVivo (France)	189	178	6.18%

\* The 2017 annual reports of prime industry players were the main source of data for the figures in this analysis. The monetary values were converted to dollars at the exchange rate listed on the last day of the fiscal year. Data from Monsanto, Bayer, DuPont Pioneer, Dow AgroSciences, RAGT Semences, Euralis Semences and InVivo provided the seed sales value of the year; data from Limagrain: without IFRS11 impact, excluding Garden products; and data from all other companies were used to indicate sales value per company within the fiscal year. (Source of exchange rate from PoundSterling Live). 1 According to the financial report of DowDuPont, seed sales accounted for 56.78 percent of its agricultural sales; the agricultural sales of DowDuPont of

2017 was \$14,342 million. 2 Consolidated sales of Dupont Pioneer and Dow AgroSciences of 2016

3 No annual sales of Enza Zaden, Bejo Zaden, Florimond Desprez and Euralis Semences of 2017 are available; ranking is referenced to sales of 2016.

4 Source of data: Access to Seed Index Note: The above ranking is for reference only

In our past seed business publications, we released the Top 10 Global Seed Companies, which was warmly welcomed by readers. In today's publication, the ranking has been extended to top 20 to include more extensive information on the global seed industry.

Since the merger of Dow Agro Sciences and DuPont Pioneer in 2015, the restructuring activities in the global seed industry have developed more depth. Merger and divestment have become a mainstream of the seed business. With the closing of the DowDuPont merger, the finalization of ChemChina's acquisition of Syngenta in 2017 and Bayer's acquisition of Monsanto on 7 June this year, the consolidation of the global seed market has come to an end. However, foreseeable subsequent consolidation will still go on for some time. In 2018, we will watch who will get the vegetable seed business unit divested from Bayer. It could be BASF or KWS. What are the new acquisition targets for Syngenta? What changes will the newcomer BASF and the rising Long Ping High-Tech bring to the set-up of the world seed industry? Visit our website www.agropages.com and subscribe to the AgroPages Seed E-Weekly newsletter.

By sorting out the annual report of multinationals for 2016 and 2017, AgroPages made a list of the top 20 global seed companies. They are:

Two US companies – Monsanto and Corteva Agriscience (DowDuPont); 12 European companies, including two German companies – Bayer and KWS; five French Companies — Limagrain, Florimond Desprez, RAGT Semences, Euralis Semences and InVivo; one Danish company — DLF; four Dutch companies — Rijk Zwaan, Barenbrug, Enza Zaden and Bejo Zaden); three Chinese companies — Syngenta (ChemChina), Long Ping High-Tech and Beidahuang Kenfeng Seed; two Japanese companies — Sakata Seed and Takii Seed; and one Indian company — Advanta Seeds (UPL).

#### **Top 1-10**



It is seen that no companies were able to shake the dominant position of Monsanto in the seed industry. In 2017, backed by its GMO advantages, Monsanto's field crop sales reached \$10.098 billion, 9.9% up year on year. In the meantime, its leading status in vegetable seed was maintained with the achievement of sales of up to \$815 million, 2% up year on year. After Bayer's acquisition of Monsanto, Bayer divested itself of almost all its seed business and sold most of its field crop seed business to BASF. It may well be that the vegetable seed business will be still sold to BASF. Baver's acquisition of Monsanto will not add a significant volume of business, as the seed business will be basically the previous seed business of Monsanto. However, it is believed that Bayer's research capacity and market presence in Europe will further enhance its leading position in the market.



After the DowDuPont merger, its new agricultural brand shows up in the name of Corteva Agriscience. Although part of the assets of AgroSciences were sold to Long Ping High-Tech, in 2017, DowDuPont, after the merger, owing to its good performance, could achieve a seed sale amount close to the total seed sales of DuPont and AgroSciences of 2016. In 2018, Corteva announced its new, focused multi-channel, multi-brand seed strategy for the U.S. It is foreseeable that the two companies, after completion of the consolidation of brand and distribution channel, will further narrow their gap between Monsanto, as being benefited by the synergistic effect.



As regards to Syngenta, the seed business still remains the same, before the acquisition by ChemChina, because ChemChina does not have a seed business. Moreover, Syngenta could divest itself of no small amount of seed business assets owing to the impact of business restructuring and the acquisition. The company says that its future focus will be on the acquisition of high-quality seed assets. Currently, the company has acquired Nidera Seed from COFCO to enhance its market influence in Latin America. The company has also acquired the American vegetable company Abbott & Cobb to enhance its sweet corn (vegetable corn) seed business strength, which is the core business of the company. It is worth paying attention to Syngenta's act in the years ahead, as to how it will utilize the seed market advantage of China. The writer of this article believes that Syngenta's use of China's seed market potential will play a key role in narrowing the gap between Syngenta and the top two.



In 2017, Long Ping High-Tech and CITIC Agriculture Fund acquired the Brazilian corn seed business of AgroSciences at a cost of \$1.1 billion. With the strong capital back-up of CITIC, the company has speeded up its globalization process. Meanwhile, the company has become the largest seed company in

China via the consolidation of businesses in China. The company ranks ninth among the world's seed industry in terms of business turnover, which is the first time that a Chinese seed company is being listed in the Global Top 10. Recently, Long Ping High-Tech said it would start building new seed plants in Brazil next year to increase the production capacity beyond its current four installations. The plan is to boost its share in a market worth 15 billion real (\$4.02 billion) from the current 15% to 30% in five years.

#### **Top 11-20**

A large number of European companies show up in the newly listed top 11 to 20, which included three Dutch and four French companies. This is a reflection of the historic strength of the European seed industry, as typically being represented by the Netherlands and France. The Netherlands' leading position in vegetable seeds is well-known in the world, with three of the four companies listed in the top 20 being vegetable companies. The other one, Barenbrug, is the world's largest turf grass seed breeding and sales company, which is beyond the field crop seed industry. The seed industry of the Netherlands sets a good example for many countries, being a good reference for other countries in the development of the seed industry.

The steady development of the French seed industry is attributed to its good climate and rich crop varieties, enabling France to take up a dominant position in the EU and even in the world. According to statistics, the French seed sales for the 2014–2015 financial year reached 3.254 billion euros, ranking first among the seed production countries in the EU. After the war, the French seed industry experienced a change from a government-guided business pattern to a commercialized business pattern, thus further being carried over to the global seed business pattern, run by multinationals since the end of the 20th century. The commercialized pattern of seed breeding has greatly enhanced the competitiveness of the French seed industry. The stress laid on science and technology, efforts made for research and development, as well as the sound legislation and the intellectual property system, respectively, provide the commercialized seed breeding industry of France technical and institutional support.

AgroPages is preparing to invite experts from the Netherlands and France to share with us their commercial success in the seed industry, as well as their experience with the change in the development pattern. Stay tuned.





## **Top 20 Chinese Seed Companies in 2017**

#### Co-authored by AgroPages and NOVOSEED

	Company	2017 Sales (US\$ m)	2016 Sales (US\$ m)	Change %
1	Long Ping High-Tech	399.63	294.08	35.89%
2	Beidahuang Kenfeng Seed	192.95	220.06	-12.32%
3	Jiangsu Dauha Seed	191.41	171.09	11.88%
4	Denghai Seed	122.46	229.42	-46.62%
5	Win-All Hi-Tech Seed	101.95	77.62	31.34%
6	Guangdong Xianmei Seed	94.24	85.83	9.79%
7	Zhongnongfa Seed	93.01	107.15	-13.20%
8	Beijing Jinse Nonghua Seed	91.00	95.77	-4.98%
9	Beijing Lantron Seed	63.85	55.59	14.87%
10	Henan Qiule Seeds	49.20	50.12	-1.83%
11	Jiangsu Mingtian Seed	46.89	46.23	1.43%
12	Hefei Fengle Seed	41.95	44.50	-5.73%
13	WanXiang Doneed	39.79	45.94	-13.38%
14	Gansu Dunhuang Seed	39.02	60.77	-35.79%
15	Jiangsu Red Flag Seed	38.87	32.84	18.37%
16	Jiangsu Zhongjiang Seed	36.25	39.89	-9.14%
17	Hainan Shennong Dafeng Seed	34.09	49.69	-31.40%
18	Sichuan Xike Seed	23.75	20.45	16.15%
19	Fujian Kehui Seed	20.36	18.00	13.10%
20	Xinjiang Jinfengyuan Seeds	19.74	15.84	24.62%

#### Sales of Top 20 Chinese Seed Companies in 2017 \*

\* Sources of data from the annual report of 2016 and 2017 of listed seed companies, converted to \$ at the exchange rate of the last business day of the fiscal year. Business income refers to the seed sales of listed seed companies in 2017 (foreign exchange rate from PoundSterling Live)

2017 was a very important and a special year to the Chinese seed industry due to the dramatic industry development and business changes, and could be also a tough year to most enterprises.

The year 2017 was an important and a special year for the Chinese seed industry owing to the dramatic industry development and business changes, and could be also a tough year for most enterprises.

The market volume of the Chinese seed industry has sustained growth for many years. The market volume is acknowledged by all statistical analyses as having exceeded 100 billion yuan, ranking second in the world, only next to the USA. In 2017, according to an official report, the number of seed enterprises fell to 4,300. Long Ping High-Tech stepped into the world's seed market and surged to rank among the world's top 10 seed companies. Through finequality breeding research programs, more than 100 fine varieties were sorted out from among four major crops. The use of Chinese breeds greatly increased in the year, while the policy and legal environment had also improved.

At the same time, it must be clearly seen that the Chinese seed industry is confronted with serious difficulties, such as higher level of stock, blowout of large varieties, intensified market competition, occurrences of extreme weather, pest and disease damages, as well as shortened life cycle of product varieties. No more than 15% of enterprises in the seed industry could maintain a stable business performance, although a growth against the trend was achieved by companies such as Long Ping High-Tech, Win-All Hi-Tech Seed, Beijing Lantron Seed and Hongxiang Seed. However, most companies were stuck in a difficult situation.

The upgrade of hybrid rice and industry updates brought

exponential growth to Long Ping High-Tech and Win-All Hi-Tech Seed, enabling the two companies to go far ahead of others. A lookback at hybrid corn indicates that 2017 might be the darkest moment just before dawn. In 2017, more than 3,000 varieties were either registered or approved for use in extended regions, which were, however, highly homogenized. Denghai Seed was encumbered by the continuous hot weather, while enterprises in the northeast ran into difficulties for ineffable reasons.

The methods of grain collection and the storage system have been reformed. In the past, the government would purchase whatever the farmers planted. Nowadays, farmers plant what is needed by the market, which decides the action taken by the seed breeding enterprises, who ought to start to listen to the voices of consumers. High-quality hybrid rice and high-quality wheat are much sought after in the market, and many corn seed breeders have started exploring fine varieties.

It is a relief and delight to see several performance results in 2017. One good result is the satisfactory performance of Long Ping High-Tech, Win-All Hi-Tech Seed, Beijing Lantron Seed and Hubei Kangnong Seed, attributable to their continued input on research, while the performance of Denghai Seed, Beijing Huanong Weiye Seed, Gansu Wugu Seed and Hoping Seeds has appeared to rebound. The other good performance has been from the backend service that has now received unprecedented close attention from the market. Following the first trial operation by MLLINKS and MAP (Sinochem MAP), Kingenta Jinfeng Cooperative and Long Ping Modern Agricultural Technology Service have also started adopting the new approach. On the other side, NONGFENQI and GAGO are receiving favor from capital investments.



#### "World Seed" magazine Chinese Edition, Issue II, 2018 is coming up this November

With the cooperation of two local seed media "NOVOSEED" and "Nanfang Rural Newspaper", we deliver Chinese magazines to local seed readers, including growers, distributers, breeders and decision-makers, etc.

Take the opportunity to promote your brand in Chinese seed market.

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Agriculture is at the center of global trends. Through using all the innovations at our disposal to create integrated solutions, we can make tremendous progress in helping farmers achieve their goals of growing enough healthy food, while conserving the earth's precious resources.

- Jagresh Rana President of Asia-Africa at Monsanto Company

#### **Monsanto:**

Ushering in the Next Wave of Agriculture Innovations with Emerging Tech Trends and Integrated Solutions for the Farm

By 2050, the global population is expected to grow from the current 7.3 billion to 9.7 billion. This means that global grain production needs to increase by 50% to meet the nutritional demands of the growing population. Further, such rapid growth is expected to pose a severe challenge to global agriculture.

As the largest agricultural company in the world, Monsanto has moved forward in its journey from chemical company and biotechnology innovator, to seed maker and, recently, to digital agriculture solution provider, extending the boundaries of agricultural innovations, and has taken up the important task of sustainable agricultural development.

Recently, AgroPages.com conducted an interview with Mr. Jagresh Rana, President of Asia-Africa at Monsanto Company. Rana has been focused on farming, while working in the food and agriculture sector for over 20 years. He joined Monsanto India as a Business Development Manager in 1997, and has since held several leadership roles. Prior to the current position, he was the Geography Strategy Lead at Monsanto's headquarters in St. Louis, Missouri, responsible for heading Corporate Strategy initiatives for the global commercial organization.

#### Offering continuous innovations for farmers through Monsanto's Integrated Solutions

Monsanto began as a company engaged in chemicalmolecules and pharmaceuticals; later, it established itself as an industry leader in biotechnology. For the past two decades, Monsanto has been developing cutting-edge technologies in traditional breeding and biotechnology, along with helping farmers improve yields and meet consumer demands.

Rana pointed out that Monsanto is dedicated to improving yield potentials per acre through technological innovations, helping farmers improve their production efficiencies and generally produce more with less input.

"One of our R&D focuses is on developing biotech solutions for seeds - crops such as corn, cotton, canola and soybean crops, which are resistant to diseases, pests, herbicide applications, and stress (such as drought ), to help farmers to produce more from every acre," said Rana.

For the past two decades, many Asian and African farmers have benefited from Monsanto biotech products. For example, Monsanto introduced its biotech cotton technology (Bt Cotton) to China in the late 1990s, to India in about 2000, and also to South Africa and Australia. Monsanto's Bt cotton technology has had a tremendous impact on the cotton industry in these countries, especially in China and India, the two largest cotton producers in the world, which has helped local farmers increase their yields and reduce the use of pesticides.

Facing ever-emerging challenges in agriculture, such as weed resistance, Monsanto has stepped up its pace in developing next generations of products and solutions. The Roundup Ready Xtend<sup>®</sup> Crop System is designed to provide farmers with the more consistent and flexible control of weeds, especially tough-to-manage and glyphosate resistant weeds, and to help maximize crop yields.

The system includes Roundup Ready 2 Xtend<sup>®</sup> soybeans, the industry's first biotech product with tolerance for both dicamba and glyphosate herbicides, and Bollgard II<sup>®</sup> XtendFlex<sup>®</sup>, providing tolerance to three herbicides, dicamba, glyphosate and glufosinate. Monsanto, together with its partners, supplied Roundup Ready 2 Xtend<sup>®</sup> soybeans to the U.S. and Canada soybean market, following a season in which more than 20 million acres were planted during the 2017 growing season. The company estimates that the North American planting area will grow to 40 million acres in 2018.

At present, Monsanto is developing its fourth to fifth generations of insect resistance and herbicide tolerance traits for key row crops, including corn, soybean and cotton. Herbicide tolerance traits are expected to further enable notill and conservation-tillage farming, preserving the top layer of soil and limiting its runoff into streams, rivers and lakes, which also help in saving fuel used in farm equipment operations, while reducing carbon emissions. The newer generations of insect protection traits will help manage potential insect resistance issues and broaden the spectrum of pest species, in addition to the benefits of chemical pesticide reductions.

Monsanto innovatively introduced its Roundup Ready Plus<sup>®</sup> Crop Management Solutions in 2011 to provide growers with expert weed management recommendations and better management practices. As Rana said, sharing and cooperation is one of Monsanto's core business philosophies. Monsanto cooperates with other companies in the industry, helps farmers use multiple modes of action to better manage resistance and tough-to-control weeds. The company also adopts a broad licensing approach to help industry partners use its technology in their seeds.

With the in-depth development of molecular biology and merging of different disciplines, new technologies, such as gene editing and RNA interference technology, have entered the field of crop breeding.

The evolution of gene editing technology makes it possible for people to use precise technologies to improve each indigenous gene in crop genomes. Monsanto believes gene editing technologies can offer a method for scientists to develop precise edits or deletions to specific plant genes to enhance beneficial traits or remove undesired plant characteristics. Monsanto has announced a number of agreements and collaborations with several companies and institutes on gene editing in agriculture. With gene editing, scientists can make changes to a plant's already-existing DNA without adding foreign DNA. To that end, gene editing technologies have a great potential, through enabling plant



breeders to deliver better hybrids and varieties more efficiently, as well as offering plant scientists additional resources to deliver new plant improvements.

In 2017, the US EPA approved a genetically modified corn trait, known as SmartStax Pro<sup>®</sup>, with the use of Monsanto's RNA interference (RNAi) technology, to control western corn root worm damage. Corn root worm is a pest that has been dubbed the "billion-dollar-bug" because of the extensive below-ground damage it causes to corn plants. Monsanto uses RNAi to enter the target cells of the root worm and selectively "mute" or decrease the target protein, to provide more effective pesticide control. Monsanto is leveraging the naturally occurring RNAi process to provide improved control of corn root worm.

Rana introduced this RNAi-based solution for agriculture, providing new tools that have novel Modes of Action to



Advanced scripting involves using a farmer's historical field data, combined with data from proprietary field-testing results, to provide seed prescription options that farmers can easily customize and execute, using their equipment of choice. (Source: The Climate Corporation)



Farmland Health Imaging provides information, while analyzing the performance of crops, as soon as possible, and prioritizing scouting and taking actions to ensure crop yields, due to the help of frequent and constant high-quality satellite imaging. (Source: The Climate Corporation) help farmers dealing with significant agricultural pests, which ensures farmers produce food in a more efficient and sustainable way.

In the field of microbials, Monsanto formed the BioAg Alliance with the Danish Novozymes A/S in 2013, and has already introduced innovative products to the market. In 2017, the Alliance introduced its new product, Acceleron<sup>®</sup> B-300 SAT, the world's first microbial seed coating agent (SCA) for the ex-factory treatment of corn seeds. The product's active ingredients comes from a kind of fungus in the soil, which can help increase the yield of corn, and was used by U.S. farmers on more than 4 million corn acres in the first year of its commercial launch.

Additionally, the Alliance announced its reaching a significant milestone in the Corn BioYield 2 project, and its pipeline update in January 2018. Corn BioYield 2 harnesses the signal



Zone-Based Nitrogen Management monitors nitrogen by customizable zones in each field to help farmers better understand their unique field variables and take action to prevent yield losses. (Source: The Climate Corporation)



Yield Analysis is performed by quickly and easily comparing digital field maps side-by-side, allowing farmers to analyze seed performance by soil type, field, or management zones, and better understand their field variabilities. (Source: The Climate Corporation)

molecule LCO (lipo-chitooligosaccharide) that promotes beneficial plant-microbe interactions, such as symbiotic relationships between soil fungi and plants. Beneficial soil fungi colonizes roots to increase the crop's ability to take in nutrients and water. This product has advanced to Phase 4 in the BioAg Alliance R&D pipeline, and is expected to reach the market, where it will be branded as Acceleron<sup>®</sup>B-360 ST.

#### Making agriculture more efficient and sustainable by digital agriculture

"Innovation" is the cornerstone of Monsanto. Recognized as one of the "World's Most Innovative Companies" by Forbes Magazine, Monsanto is taking advantage of the most advanced technologies in the world to break through industry boundaries and drive agriculture into another era.

All those who pay close attention to developments in agriculture can feel the shift of Monsanto's strategic layout in recent years. Now, the company is looking at precision agriculture based on data science, and has become a pioneer in this field.

"The digitization in Ag is, and will be, profound in influencing agricultural development. It allows farmers to optimize seeding, irrigation, and applications of fertilizer and pesticides, and to predict their harvests based on parameters, such as soil composition, weather and inputs. As the most cutting-edge agricultural technology company, Monsanto takes great pride in standing at the forefront of the industry, amid this revolution. Looking back on the 100-year-plus history of the company, we have maintained such advantages in plant protection chemistry, seeds and biotechnology, and more. We are once again on the cusp of the next wave of the agricultural revolution," noted Rana.

Crop yields are susceptible to many factors, such as genetics, surrounding environments, agronomic practices, and other factors. Monsanto aims to help farmers sustainably increase their productivity through optimization of all these factors, using data science tools.

To promptly join the field of digital science, in 2012 and 2013 Monsanto acquired Precision Planting and The Climate Corporation, at a cost of 250 million USD and 930 million USD, respectively. Today, The Climate Corporation has established a solid footprint in North America, South America and Europe.

Rana shared two examples of Monsanto's digital agriculture, which seeks to meet large commercial farmers, as well as smallholder farmers, such as Climate FieldView<sup>™</sup> and FarmRise<sup>™</sup>, respectively.

The Climate FieldView<sup>™</sup> digital agricultural platform, fueled by deep science and data analytics, aims to meet the needs of



those large commercial farmers in the US, Canada, Brazil and some European regions.

Bringing together seamless field data collections, advanced agronomic modeling and local weather monitoring, into simple mobile and web software solutions, the Climate FieldView<sup>™</sup> platform offers farmers a deeper understanding of their fields, so they can make more informed operating decisions to optimize yields, maximize efficiencies and reduce risks.

The Climate FieldView<sup>™</sup> digital agricultural platform offers two versions. In the free version, farmers can acquire basic information about fields, which can guide their agricultural operations. While in the paid version, farmers can obtain more in-depth and advanced information, such as how to better resist and combat plant diseases and insect pests, how to precisely use nitrogen fertilizers, and assessing overall field plant health conditions through satellite imagery, and more.

Rana noted that in the 2017 growing season, the Climate FieldView<sup>™</sup> platform was adopted throughout an area of over 120 million acres in the US, Brazil and Canada, with registered users exceeding 100,000.

The company has announced that in 2018, Climate FieldView<sup>™</sup> will expand to the European market (Germany, France and Ukraine). In the coming years, the company will further expand into more markets, such as Australia, Argentina and South Africa.

The FarmRise<sup>™</sup> platform is primarily for use by smallholder farmers in Asian and African countries, to help them unlock their agricultural potentials. Based upon the unique demands of smallholders, FarmRise<sup>™</sup> tailors diversified services to farmers, including weather forecast alerts, online consulting and professional advice on agronomy, market price information, and more.

The FarmRise<sup>™</sup> platform for small farmer households has been operating in India, and some four million Indian farmers are connected to the platform. Meanwhile, Monsanto is also trying to extend the FarmRise<sup>™</sup> platform to more Asian and African countries.

Rana cited an example in Malawi, a country in East Africa. By using FarmRise<sup>™</sup>, local farmers can purchase Monsanto DEKALB branded corn seeds via mobile phones and receive crop insurance at the same time. In the event of there being no rain within 3 weeks after planting, Monsanto provides replacement seeds free of charge to farmers. Farmers can also learn about market prices of certain crops in a timely manner, allowing them to make better market decisions. It just comes with having data at farmer's fingertips.

When Rana was asked about whether education levels of farmers will become an obstacle for the promotion of emerging technologies, he indicated that based upon Monsanto's experience, farmers around the world, regardless of their education levels, have the same desires to have access to real technologies and will learn to use these technologies.

Rana thinks that, currently, the biggest challenge for the promotion of digital platforms may come from a lack of mobile and IT infrastructures.

"As far as Asia Pacific is concerned, China has done a tremendous job. China is far ahead of not only the rest of Asia, but the rest of the world, with Internet transmission speeds in rural areas even exceeding that in the US. But in the rest of Asian and African countries, this is still a need for improvements. But it is improving, as farmers will have access to more smart phones, they will be able to receive much information and perform many of their field operations on their phones. In the future, the development of digital agriculture in this region has very great prospects," said Rana.

#### Emerging Technologies Stimulating the Future of Modern Agriculture

The entire agricultural industry is undergoing a large-scale consolidation, and scientific development is having far-reaching influences on agriculture. In Rana's view, with the constant development of new technologies, such as digital agriculture, artificial intelligence (AI), gene editing, RNA interference and microbials, all of which continue to evolve and provide tremendous benefits, the next transformation of agriculture has quietly arrived.

Increasing numbers of companies are investing in emerging agriculture-related industries. Rana said that such competition means there will be more advanced technologies in the future market, and farmers will be able to access more effective tools.

Rana added, "We have seen that every year, venture capital investment in agriculture technology has been growing at a very rapid pace. Every year has become a record year, when it comes to venture investment in agriculture technology. These investments involve a myriad of domains, even including many new technologies never heard of before, such as artificial intelligence (AI), robotics, the use of new biological tools, such as gene editing to develop better crops, and new technology to develop or screen microbials, which can be used for either crop nutrition or disease control."

"A new agricultural revolution has begun, which is led by data science. One focus of our R&D is on digital agriculture and AI. Monsanto's daily expenses on R&D reached \$4.4 million USD and annual expenses of over 1.6 billion USD in 2017, which including the investment in data science and AI. Monsanto will be standing at the forefront of the revolution and playing a very important role," Rana added.

This January, The Climate Corporation announced 17 advancements that are accelerating through its R&D pipeline. One of the key R&D highlights is how the company is using artificial intelligence to diagnose diseases in corn, soybeans and wheat.

When talking about Monsanto's combination with Bayer, Rana indicated that the goal of the consolidation is to accelerate the speed of innovative products entering the market. "We are very excited about the merger deal," he said, "Looking at the mergers and acquisitions in the field of agriculture over the past 20 years, you will find that these M&As further intensified competitions and provided more innovative products. I believe that things will also be like this in the future."

Once the merger is completed, it will mean that Bayer's traditional plant protection products will combine perfectly with Monsanto's achievements in seeds, traits and data science. After the merger, the synergistic effects of the two parties, will accelerate the speed of new products entering the market and will deliver solutions to farmers more quickly. This will benefit farmers around the globe.

Agriculture is at the center of global trends. It involves such matters as climate change, hunger, human nutrition, obesity, and more. "Monsanto's vision is to help global farmers grow crops sustainably and effectively. During the past tens of years, the tools we have brought about have been helping farmers reduce their input of resources, as much as possible, and to improve agricultural productivity. In the years ahead, emerging technologies will expand the definition of modern agriculture. Through using all the innovations at our disposal to create integrated solutions, we can make tremendous progress in helping farmers achieve their goals of growing enough healthy food, while conserving the earth's precious resources," noted Rana.

(Editing by Mickey Shan, editor of AgroPages)



Access to Seeds Index

The Access to Seeds Index shines a light on seed companies that are taking the lead in supporting smallholder farmer productivity



### Regional Index for Eastern Africa

- 1 East-West Seed (THA-Private)
- 2 Victoria Seeds (UGA-Private)
- 3 East African Seed (KEN - Private)
- 4 Kenya Seed Company (KEN-State owned)
- 5 NASECO (UGA-Private)

DuPont Pioneer



www.accesstoseeds.org



## After US Market, Cibus' SU Canola Set to Expand in Canada

- Interview with David Sippell, Vice President at Cibus



"SU Canola provides a brand new herbicide control option for canola farmers; so this is something completely new in the market."

Cibus is a leading precision gene editing company with a unique, patented Rapid Trait Development System (RTDS<sup>™</sup>) technology for naturally modifying cell functions. It is the first company to commercialize a non-transgenic precision gene editing product and the first to plant it on the ground. The product SU Canola was first launched in United States in 2015.

David Sippell, vice president, seed and general manager, Canada, recently shared his view on the three-year performance of Cibus and its SU Canola in



the global seed industry in an interview with AgroPages.

1.Cibus launched its first gene editing product SU Canola in 2015 in the United States. Now, you are expanding the business opportunity in the Canadian canola market. Could you please tell us about the development of SU Canola during these three years?

SU Canola was the first product to come out of the seed lab. It was developed a few years ago, and then placed in our canola breeding program.

Three years ago, the first variety was launched in the United Sates, and since then, the market in the US has grown quite nicely. This year, the sales are looking promising, so the product is catching on, and we are quite excited about it.

We also started testing products in Canada. I'm not sure if you are aware, but Canada has a variety registration system. So in order to sell varieties, whether it is canola or other varieties, they need to be put through a variety registration. Our first variety went through that system and was approved last year. Now, this year, around September to November, we started selling the product, and this will be our first year of selling canola in the Canadian market. Our Canadian office is based in Winnipeg. Right now, we are in the process of feeling orders for seeds and launching it in our very first year.

## 2. Compared to GM Canola and traditional canola varieties, what's the advantage of SU Canola?

SU Canola provides a brand new herbicide control option for canola farmers; so this is something completely new in the market. In the US, it works really well. For example, in the glyphosate tolerance soybean rotation system, this works extremely well. Also, SU Canola is a non-GMO product.

Further, there are premium contracts where growers are paid at a level higher than conventional canola when they deliver the product. So that's a little bit of extra dollars, especially, when you look at a company such as Cargill, based out of West Fargo, which is being contracted for this product. They are dedicated, they are really working with us very closely to maximize the acres, to increase the acres as quickly as possible, and to courage growers to deliver the products back to West Fargo; so that's a great opportunity.

Of course when you look at the yields, you compare them to other varieties. There is more to the story than the yields. So what I'm trying to explain to you with all this information is that we look at the returns on investment for the growers. The returns on investments are positive compared to other varieties.

#### 3. Besides the herbicide resistant canola, has Cibus developed any other kind of canola varieties?

Well, we do have a canola breeding program, so that's focused on our SU trait absolutely. But, it is also focused on making sure that we have the right product for the market. So within the context, SU Canola has a good yield. But as I mentioned, some of those products perform well under stressful environments, and others perform well under environments that are not stressed, when you have a high-yielding environment; so, it depends on the varieties that we are producing.

We are focused on the crop weed and diseaseresistant aspects of the products. Of course, the agronomics must be suitable for farmers, otherwise, they could not grow our products. As we are looking at our breeding program, what we are seeing is more and more SU tolerant varieties and SU hybrids in the market. We are really excited about the products unfolding.

Within the context of the new traits, our trait machine is kicked in the canola, and we are developing many new traits that are coming soon, but we have not announced another new canola trait this time.

4. In the recent years, some companies are developing next generation canola traits, which could generate low saturate, high oleic canola oil. For example, Cargill and Precision BioScience teamed up to develop this kind of oil last year. What about Cibus?

We are looking at a number of different traits. I will look at them as end-use categories, and I will look at them as input categories. So Cibus is targeting both end-use traits, which will be things such as the special oil, and will be targeting input traits, such as SU tolerance. We are targeting both ends of the spectrum. So, we are not only looking at different types of special products, special technologies, but also at the input traits; it's both sides of the equation.

I think it's fair to say that we are looking at developing healthier products for consumers, which is really an important part of our strategy. I feel it is a great opportunity for farmers, a great opportunity for our partners, and a great opportunity broadly in the market place, as we try to grow the market for canola. We are trying to participate as best we can.

## 5. What do you think of the gene editing regulatory policies right now, especially in Latin America and Europe?

It's really an interesting time for the regulatory developing system for our technology. We are optimistic actually. The regulatory policies are moving in the right direction. Of course, we need to see how these things unfold, but there are a couple of examples. There has been a recent opinion from the Advocates General of the European Court of Justice; I don't know if you saw that report or not, but that report has come out. We are still waiting for the final court ruling, but the Advocates General's ruling was positive for our technology.

Several countries in Latin America have systems quite favorable to our technology. We are seeing these things, in addition to the US announcement, as being positive. Of course, there are still many decisions that need to be made. But a lot of initial discussions and works are going on. We believe it is recognizing the nature of the product



#### 6. What will be the next overseas market for Cibus after US and Canada?

Right now, it's a bit hard to say where our next commercial market is going to be outside of North America. We have, of course, technology coming in for canola, and so there could be opportunities in other large markets, such as Europe, depending on the ruling from the court and the government.

More importantly, we also have technologies coming in for other crops. Some of the crops may have an opportunity in some different countries, outside of North

America as well.

Right now, our focus is on North America, and on canola, but we are working on both flax and rice. For these two products, as well as canola, we are anticipating commercial products.

#### 7. The year 2017 was important for gene editing in agriculture. More and more companies have joined and become new players. How does Cibus maintain its position in the global industry?

In our view, the agricultural game is really about continuing innovation, efficiency and going fast. Right now, Cibus has the expertise and the IP (intellectual property) in place. So, we believe we will continue to be in this game.

Clearly, over the past few years, the competition has got stronger, and there is a lot more interest. But for us, it's about maintaining the innovation level, making sure we stay ahead of the game in the innovation, being super efficient in how we do things, getting those traits to develop quickly and getting to market as quickly as possible. These things, we believe, are going to really help us in this business.

#### 8. What's the future vision of Cibus?

We wish to continue our canola seed business, and that is, I guess you call it "the short term mission." The company is really focused on the trait development for canola and will continue to work to build our business, and of course, part of that is SU Canola.

We want to apply the technology to many other crops as well; of course, that is the longer term mission, whether it is flax or rice, or any other new crops which are further down in the pipeline. We believe we have the expertise in place to be a leading plant technology company globally.

Our mission is to continue to focus on plants, continue to focus on new technologies, adding to our RTDS<sup>™</sup> tool box, and help meet the increasing demand for healthy food, ensure a good clear environment, where our crops which may be tolerant to, for example, moisture will be very different in the environment, and to do all that in a sustainable way.

So we have long future investments in developing technology over the next years. I think that's our main mission. We see our technology can really make a big difference in the world. We wish to become a key player, working in various varieties for crops.



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## Syngenta's

## Ambitious Plans for Growth in Seeds

Interview with Alexander
 Tokarz, Head Global
 Marketing Seeds at Syngenta



#### 1.Could you please introduce Syngenta's performance in the global seed market?

The global seed market is worth some \$40 billion a year, and has doubled over the last decade. Over half its value comes from corn and soybean, and 57 percent of sales are made in just three markets: North America, Brazil and China.

Syngenta is one of the world's three largest developers and producers of seed. We have leadership positions in several crops and geographies. We are the number one or two seed company in global sunflower, wheat, barley and several vegetables crops such as specialty tomatoes, watermelons, brassica, and sweetcorn. Following the acquisition of Nidera Seeds in February this year, Syngenta is the number two seed player in Latin America in terms of both market value and hectares planted with Syngenta seed. And last but not least, we are among the leading multinational seed companies in China and South Asia.

To meet the complexity of our customers' needs, we deliver constant innovation and performance improvement. In 2017, we invested more than \$0.5 billion in breeding and R&D to accelerate our rate of innovation to bring better products to markets faster.

We have ambitious plans to grow Syngenta's share of the global seed market, both organically as well as through acquisitions and strategic partnerships in our core crops and geographies.

## 2.Since the end of last year, Syngenta has acquired several companies including seed and digital farming companies, what's the strategic target in these asset acquisitions?

Syngenta has ambitious plans for growth in seeds. And it is a unique time because there is so much M&A activity going on thanks to industry consolidation and the market is

Syngenta is one of the three biggest seed companies in the world. Last July, the company was officially acquired by ChemChina. Since then, Chineseowned Syngenta is "aggressively seeking acquisition and partnership opportunities" in the global seed market, The company want to "improve on their current market share position at a distant No. 3, to a closer No. 3 with an eye on No. 2."

Recently, AgroPages invited Alexander Tokarz, Head Global Marketing Seeds at Syngenta, to share his ideas of the company's presence in global seed market, strategic target in asset acquisitions, GMO corn trait litigation in US and also the opportunity of Syngenta in Chinese seed market.

reshaping. There are a lot of assets becoming available either by choice or forced by regulators.

Nidera in Latin America is a great acquisition for us – it's a priority market for Syngenta, very important for our core crops of soybean and corn. We are taking the opportunity to create a new seeds business in Latin America that combines the best of both Syngenta and Nidera, allowing us to do more for growers in that market. We are expanding the choice and germplasm variety we can offer growers through licensing agreements. And there will be more to come.

Digital technologies are rapidly transforming agriculture. We are developing a growing portfolio of digital solutions and capabilities to support our customers, improve their experience with us, optimize their results, and increase the effectiveness of our stewardship and loyalty programs. Recently we made two acquisitions in this space as we build our capabilities: Farmshots in the US, an innovator of high-resolution satellite imagery; and Strider in Brazil, a digital farm management company. As part of the Syngenta Ventures fund we also hold minority positions in a number of digital start-ups.

#### 3. Early April, Syngenta India sold part of seed business to Crystal Crop Protection. As you said Syngenta is aggressively seeking acquisitions and collaboration in seed business, so why sell seed asset in India?

We divested the India pearl-millet, sorghum and fodder businesses to Crystal Crop Protection Ltd in April. These are small businesses in very local crops, and they didn't bring us the scale and opportunity we need to meet our goals. So this was a strategic divestment for Syngenta, enabling us to focus resources on our growth opportunities, and on our stronger crops and markets.

Alongside the Nidera acquisition, we have also made acquisitions which strengthen our position in crops where we already have a leadership position, for example the acquisition of Abbott & Cobb in the US, which strengthens our leading sweet corn business.

## 4.This March, Syngenta agreed to pay \$1.5B to end GMO corn trait litigation in US, which is believed to be the largest agricultural litigation settlement in U.S. history. How do you think of this case?

Agrisure Viptera and Agrisure Duracade demonstrate significant, scientifically validated benefits for growers in combatting a wide spectrum of pests. Syngenta launched these products to help ensure that American farmers could access the latest seed technology approved in the U.S. There is no dispute these products were fully approved by all U.S. regulatory authorities at the time of their launch.

The proposed settlement would allow both sides to avoid

the uncertainty of ongoing litigation and does not constitute an admission by either side concerning the merits of the parties' allegations and defenses. With this litigation largely resolved, Syngenta will continue its focus on agricultural innovation, and continues to believe that American farmers should have access to the latest U.S.-approved technologies to help them increase their productivity and crop yield.

5. Speaking of GMOs, 2020 will be the dead-line year for GMO commercialization in China as the government included the phrase "promotion of commercialization of GM crops" in China's 13th Five-Year Plan in 2015. What's the influence of ChemChina's takeover of Syngenta for the GMO commercialization in China?

The 13th five year plan has a comprehensive range of objectives to enable China to achieve basic self-sufficiency in cereal grains and absolute food security. This will be achieved by making agricultural structural adjustments and raising production capacity for agricultural products while also improving quality and safety. This will result in a better structured, more effective supply of agricultural products.

Agricultural biotechnology is one of the most promising technologies that can contribute to the overall objective of the 13th FYP. Ag biotechnology has been widely adopted in major agricultural countries, especially in the US and South America and has proven to deliver substantial agronomic, environmental, economic and social benefits to farmers and society.

Syngenta, as part of the ChemChina group, is fully committed to playing a vital role to support Chinese agricultural modernization through partnerships with key stakeholders. Syngenta respects the Chinese government's position on commercialization of biotech crops, and is willing to support the access of biotechnology for Chinese growers according to the Government's timeline.

Under the ownership of ChemChina we have a long-term view to support Chinese agriculture and achieve our ambition to become the most collaborative and trusted team in agriculture, providing leading seeds and crop protection innovations to enhance the prosperity of farmers.

#### 6. In April, Syngenta China published 2018 Vegetable Seed Planning and in March ChemChina also cooperated with China's Longping High-Tech setting up a corn seed JV, what's the challenge and opportunity for Syngenta in Chinese seed market after the acquisition by ChemChina?

China is the biggest growth opportunity in the world for the food value chain and the ag industry. The market is already the second largest seed market globally but still highly fragmented, and with the initiatives outlined in China's Five-Year Plan, consolidation and professionalization of this market will be inevitable. Now under the



ownership of ChemChina, we are in the best position to lead this consolidation in China.

Technological innovation is at the heart of China's agricultural modernization agenda, and we are investing resources in areas important to the Chinese market. One example is biotechnology where we are strengthening our capabilities at Syngenta's Beijing Innovation Center. The center is at the forefront of biotechnology in the country, and is leading our global genome editing program. The center is also driving important collaborations with the Chinese institutes. We now have about 2000 employees in China and we continue to bring top talent from across the company to China.

#### 7. In the past two or three years, any new seed technologies/ trait launched in Syngenta? Could you please introduce some representatives?

The most important development in 2017 was China's import approval for AGRISURE DURACADE®, our trait for effective control of corn rootworm. This enables us to offer growers more choice with new hybrids that combine top quality genetics with the most advanced rootworm control technology. This destructive pest currently costs US growers more than \$1 billion annually in yield losses and control costs. Last year, we also strengthened our soybean trait portfolio with in-licensing deals, giving us the most trait options in the US and Latin America markets, enabling us to respond to customer needs and preferences.

Across all our crops we have launched numerous new varieties, often with new and value- adding native traits and characteristics helping growers to better manage their crops.

#### 8. Outlook of Syngenta in Global seed industry.

We are very confident about the outlook for Syngenta Seeds. We are expanding our capabilities to be able to do even more for growers around the world, and we have a very clear strategy for growth. We will continue to focus on our strongest crops - corn, soybean, sunflower, cereals and vegetables – and the markets where there is the greatest opportunity for growth. China is one of the most important markets for us, as is the Americas and Eastern Europe. We will continue to seek growth through acquisitions and strategic partnerships, and by working with partners in academia, start-ups and institutes we are poised to translate the newest scientific achievements into winning products for growers.

## 2017 Overview of Global GMO Development



By Jason Zhang Editor of AgroPages jason@agropages.com

In 2016, global GMO planting areas rebounded quickly after the declination in 2015. According to ISAAA, GMO planting areas of 2016 reached 185.1 million hectares, 3 percent up year on year, being roughly 5.40 million hectares. Besides the increase in planting areas, more and more GM crop varieties have been approved and also commercialized. According to an estimation of Cropnosis, the GM crop market value of 2016 accounted for 35 percent of the total seed market. In 2017, with the rebounce of grain prices (2017 FAO price index being 3.2 percent up versus 2016) and the positive change of GMO policies in all countries, worldwide GMO planting areas are expected to continue to increase. In 2017, there are 102 GMO approvals all over the world, which cover 65 varieties, six of which are new crop varieties (Table 1) being respectively potato (one variety), sugarcane (one variety), corn (one variety), soybean (one variety) and

rapeseed (two varieties). Among them, the sugarcane CTC 20 BT approved in Brazil is the first GM sugarcane approved worldwide.

#### China's Ice-Breaking GMO Development

In 2017, global GM crops developed quite well in general, especially in China, where ChemChina completed its acquisition of Syngenta and the 100-day plan was agreed upon between China and the US, which brings positive effect to China's GMO development. In 2017, the Chinese Ministry of Agriculture approved 18 GMO varieties, 4 of which cover new varieties and 14 are renewals. These approved GMO varieties include soybean, corn, rapeseed, cotton and sugar beet, being approved for "use for processing". The year of 2018 is likely to be a critical year for commercialization of GM crops. Back in 2015, China's 13th Five-Year Plan included the phrase "promotion of commercialization of GM crops", thus the year of 2020 will be the dead-line year for GMO commercialization. As each step of breeding and mass planting needs certain period of time, the common understanding reached among the industry is that if GMO commercialization is still not initiated in 2018 there would be a certain degree of difficulty in reaching the set target by 2020. As a follow-up to the GMO commercialization target set forth in the 13th Five-Year Plan, in April 2016 the

Chinese Ministry of Agriculture announced a program to promote a pest-resistant corn variety. According to Dai Jingrui, the professor of China Agricultural University and an academician of Chinese Academy of Engineering, in China there have been so far 20 plus GM corn varieties applying for GMO cert and their products have reached the state of readiness for commercialization, just waiting for permit.

The fundamental reason for the hesitation of commercialization lies on the lack of a consensus at central government level, which however should not last too long. Chinese government has spent more than Yuan20 billion on GMO researches. Since 2008, lots of enterprises have also given hundreds of millions of inputs. If no commercialization is carried out, enterprises would not be able to sustain any further development, even if government may still continue to allocate funds for GMO researches for the sake of national food security. A GM corn research leader of a Chinese enterprise says that each year the company spends around Yuan100 million on research having lasted for seven years. The research leader expresses that if no commercialization is carried out in large scale the company cannot sustain any further development, saying that the company is currently thinking about the possibility of commercialization of their product in a foreign country like Argentina, then applying for GMO cert and "import" the product to China.

#### The Issue of Resistance

Over recent years the issue of resistance has become a hot subject pertaining into GMO commercialization. According to an article published in Nature Biotechnology, the pest resistance to GMO Bt Cry increased from the 3 cases in 2005 up to the 16 cases in 2016. It is vitally important that enterprises should think about how to maintain the pestresistance property of GM crops and the weed's sensitivity to pesticide so as to limit farmer's use of pesticide. Here we would invite the two experts from Syngenta and Bayer to share with us their ideas.

Michiel Van Lookeren Campagne, Syngenta Head Seeds Research: "Resistance is a natural biological response to repeated use of the same control technology. It is not linked to any specific technology, and farmers have been in a continuous battle with disease resistance and pest shifts for centuries, applying a multitude of technologies. At Syngenta, through our integrated offers, we are able to provide holistic solutions to help growers manage insect and weed resistance.

In order to tackle this issue, effective resistance management strategies should include:

Best Management Practices

Insect-resistance management
practices

Crop rotation to non-host crops such
as soybean

• Planting refuges

• Rotating or combining multiple modes of action against target pests

Stacked traits

The most effective way to manage resistant weeds is to apply multiple effective modes of action. Our products have increased food security for many years but there are always new challenges, such as changing climate conditions and resistance. We try to anticipate these and are constantly



Michiel Van Lookeren Campagne Syngenta Head Seeds Research

seeking innovative solutions, like our recently launched Agrisure Duracade® corn, which offers multiple modes of action against corn rootworm (CRW) and above-ground insects to control 16 yieldlimiting pests. Agrisure Duracade 5122 E-Z Refuge is available with multiple modes of action against CRW and corn borer, plus a single mode of action against ear-feeding insects. "

Frank Terhorst, Global Head of Seeds for Bayer: "We recognize weed resistance as a serious threat to a healthy, strong and sustainable agricultural sector. Bayer's Integrated Weed Management program tackles the problem of weed resistance and helps to preserve and enhance productivity through customized agronomic solutions.

Our weed control research takes a comprehensive and future-oriented approach, and our aim is to provide farmers all over the world with new diagnostic tests, herbicides with new modes of action, and a wider choice of high-performing herbicide tolerance traits. The scientists and specialists employed at our Weed Resistance Competence Center in Frankfurt/Main, Germany, test and develop new solutions and share our knowledge with the international agricultural community.

Our global initiative against weed resistance, 'Diversity is the Future,' promotes the fundamental shift in thinking



Frank Terhorst Global Head of Seeds for Bayer

and acting required by everyone in farming. To successfully combat weed resistance, we need diversity in nonchemical weed management through, for example, crop rotations and cultivation methods, as well as diversity in the herbicidal modes of action. In many countries, local programs are already supporting farmers in their struggle against resistant weeds. In Europe, for example, mainly cereal crops are affected by resistant weeds such as blackgrass, silky bent grass, wild oats and ray grass."

#### **Gene Editing**

Over recent years, the gene editing technique represented by CRISPR has developed intensively, particularly, the year of 2017 is an important year of gene editing for application to agricultural sector. The new breeding technique reduces significantly the time frame of breeding, due to its high-efficient and accurate genomic reediting. In the meantime, as the product formed by gene editing is free of exogenous gene, thus the industry players and many government authorities believe that such a product should not be governed by GMO supervision and regulation. The special features of gene editing allow for reduced cost of breeding and it has become possible for small and medium-sized enterprises to participate in trait development. No small number of

people hold the view that this technique has a higher chance of substitution of GMO in a couple of years ahead. Concerning the new breeding technology, the two experts from Syngenta and Bayer would give us their opinions.

"We see genome editing and other Plant Breeding Innovations (PBIs) as complementary to GMO technology. PBI's are additional tools in a plant breeder's toolbox used to develop better varieties of plants. Those plants are bred to meet the evolving needs of growers around the world," Michiel said.

"GMO technology allows us to use genes from different species to add functionality to a crop. E.g. we can use a gene from a bacterium to produce a protein in crops that can confer resistance to insect damage. Genome editing technology - as the term implies - is a tool used to edit genes already present in the crop, so is much more constrained in its scope. It improves on conventional breeding by making intentional, specific and beneficial changes in the plant genome providing the same genetic diversity that would be available via traditional breeding, but in a faster and more directed way," He added.

"Both technologies can be used to efficiently develop plant varieties that improve plant health, nutritional quality and yield, and we expect both technologies will continue to be utilized in suitable markets and crops around the world," Michiel concluded.

"For Bayer and agriculture, the potential of genome editing to deliver better plants more precisely is enormous. This method has the potential to cut the development time of new plant varieties to less than half of what it is today (today being ten years on average), so that innovative products get to the grower and the consumer more quickly. At Bayer, our research is focused on improving plants in a precise, efficient and responsible way. We think it is absolutely vital that we engage in an open dialogue with stakeholders to address persisting concerns and communicate the benefits of both gene editing and GM technology," Frank also shares his ideas.

#### Table 1 Biotech/GM crop approvals in 2017

Company/Products*(Event name)	GM Trait	Country/Region	Approved use		
	Syngenta				
Maize1 (3272 x Bt11 x MIR604 x TC1507 x 5307 x GA21)	Glufosinate & Glyphosate HT, Coleopteran & Lepidopteran IR, Multiple IR, Modified alpha amylase, MM	Columbia	Food use		
Agrisure® Viptera™ 2100 maize (Bt11 x MIR162)	Glufosinate HT, Lepidopteran IR, MM	Mexico, Columbia	Food use		
Maize1 (Bt11 x MIR162 x MIR604 x MON89034 x 5307 x GA21)	Glufosinate & Glyphosate HT, Coleopteran & Lepidopteran IR, Multiple IR	Canada	F, F&C		
Agrisure® 3122 maize (BT11 x 59122 x MIR604 x TC1507 x GA21)	Glufosinate & Glyphosate HT, Coleopteran & Lepidopteran IR, MM	EU	F&F		
Agrisure® Duracade™ maize (5307)	Multiple IR, MM	China	F&F		
		Malaysia, South Korea	F&F		
Maize' (MZHGUJG)	Giutosinate & Glyphosate H I	Taiwan	Food use		
Agrisure™ CB/LL maize [Bt11(X4334CBR, X4734CBR)]	Glufosinate HT, Lepidopteran IR	Singapore	Food use		
Agrisure™ Viptera maize (MIR162)	Lepidopteran IR, MM	Singapore	Food use		
Agrisure™ RW maize (MIR604)	Coleopteran IR, MM	Singapore	Food use		
Maize <sup>1</sup> (Bt11 x TC1507 x GA21)	Glufosinate & Glyphosate HT, Lepidopteran IR	Mexico	Food use		
	J.R. Simplot Co.				
Innate® Cultivate potato (E12)	RAP, RBS	New Zealand, Australia	Food use		
	DAD DDO Frank Disease Desistance	Canada	F, F&C		
	RAP, RBS, Fungal Disease Resistance	New Zealand, Australia	Food use		
		Canada	F, F&C		
Innate® Acclimate potato (X17)	RAP, RBS, Fungal Disease Resistance	New Zealand, Australia	Food use		
	DAD DDO Frank Disease Desiste	Canada	F, F&C		
innatew ששernate potato (ישטוח ששernate)	HAP, HES, FUNGAI DISEASE HESISTANCE	New Zealand, Australia	Food use		
Innate® Generate potato (F10)	RAP, RBS	New Zealand, Australia	Food use		

Company/Products*(Event name)	GM Trait	Country/Region	Approved use
Innate® Accelerate potato (J3)	RAP, RBS	New Zealand, Australia	Food use
Potato <sup>1</sup> (E56) <sup>3</sup>	RAP, RBS	New Zealand, Australia	Food use
	Genective S.A.		
Maize <sup>1</sup> (VCO-Ø1981-5)	Glyphosate HT	South Korea	Feed use
	Centro de Tecnologia Canavieira (CTC)		
Sugarcane <sup>1</sup> (CTB141175/01-A) <sup>3</sup>	Lepidopteran IR	Brazil	F, F&C
	Verdeca		
Verdeca HB4 Soybean (IND-ØØ41Ø-5)	Drought stress tolerance	USA	Food use
	Monsanto		
Genuity® Roundup Ready™ 2 Xtend™ soybean (MON87708)	Glyphosate & Dicamba HT	Turkey	Feed use
Soybean <sup>1</sup> (MON87769)	Glyphosate HT, Modified oil/fatty acid	Singapore	Food use
Cotton <sup>1</sup> (COT102 x MON15985 x MON88913 x MON88701)	Glufosinate & Glyphosate & Dicamba HT, Lepidopteran IR, AR, Visual marker	Taiwan	Food use
	Objection to a Objection of Discourses UT	Taiwan	Food use
	Giurosinate & Giypnosate & Dicamba H I	South Korea	Feed use
Maize <sup>1</sup> (MON87419)	Glufosinate & Dicamba HT	Japan, South Korea, Taiwan	Food use
Soybean <sup>1</sup> (MON87705 x MON87708 x	Glyphosate & Dicamba HT. Modified oil/fatty acid	Taiwan, Mexico	Food use
MON89788)		South Korea	Feed use
Maize <sup>1</sup> (Bt11 x MIR162 x MON89Ø34 x GA21)	Glufosinate & Glyphosate HT, Lepidopteran IB, MM	Taiwan, Mexico	Food use
		South Korea	Feed use
Soybean1 (MON87751 x MON87701 x	Glyphosate & Dicamba HT, Lepidopteran IB	Taiwan	Food use
MON87708 x MON89788)		South Korea	F&F
Maize <sup>1</sup> (MON87427 x MON89034 x TC1507 x	Glufosinate & Glyphosate HT, Coleopteran & Lepidopteran IB	Taiwan	Food use
MON87411 x 59122)		South Korea	F&F
Maize <sup>1</sup> (MON87403)	Increased Ear Biomass	Taiwan, South Korea	Food use
Maize <sup>1</sup> (MON87427 x MON89Ø34 x MIR162 x NK603)	Glyphosate HT, Lepidopteran IR, MM	Columbia	Food use
Soybean <sup>1</sup> (MON87751)	Lepidopteran IR	Columbia	Food use
Maize <sup>1</sup> (MON87427 x MON89034 x TC1507 x MON87411 x 59122 x DAS40278)	Glufosinate & Glyphosate & 2,4-D HT, Coleopteran & Lepidopteran IR	Canada	F, F&C
Vistive Gold™ soybean (MON87705)	Glyphosate HT, Modified oil/fatty acid	Turkey	Feed use
Maize <sup>1</sup> (MON88701 x MON88913 x MON15985)	Glufosinate & Glyphosate & Dicamba HT, Lepidopteran IR, AR, Visual marker	Taiwan	Food use
InVigor™ x TruFlex™ Roundup Ready™ Canola	Glufosinate & Glyphosate HT, Male sterility, Fertility	Taiwan	Food use
(MON88302 x MS8 x RF3)	restoration	EU	F&F
Maize <sup>1</sup> (MON87427 x MON89034 x MIR162 x	Glyphosate HT, Coleonteran & Lenidopteran IP	South Korea	F&F
MON87411) <sup>3</sup>		Mexico	Food use
Roundup Ready™ Maize, Agrisure™GT (GA21)	Glyphosate HT	Singapore	Food use
TruFlex™ Roundup Ready™ Canola (MON88302)	Glyphosate HT	Singapore	Food use
Soybean <sup>1</sup> (MON87769)	Glyphosate HT, Modified oil/fatty acid	Singapore	Food use
Soybean <sup>1</sup> (MON87708 x MON89788 x A5547- 127) <sup>3</sup>	Glufosinate & Glyphosate & 2,4-D HT	Mexico, South Korea	Food use

Company/Products*(Event name)	GM Trait	Country/Region	Approved use
	Bayer CropScience	1	<u>.</u>
GlyTol™ cotton (GHB614)	Glyphosate HT	Malaysia	F&F
Cotton <sup>1</sup> (T304-40)	Glufosinate HT, Lepidopteran IR	Malaysia	F&F
Fibermax <sup>™</sup> Liberty Link <sup>™</sup> cotton (LLCotton25)	Glufosinate HT	Malaysia	F&F
Cotton1 (GHB119)	Glufosinate HT, Lepidopteran IR	Malaysia, EU	F&F
Glytol <sup>™</sup> x Twinlink <sup>™</sup> x VIPCOT <sup>™</sup> Cotton (GHB614 x T304-40 x GHB119 x COT102)	Glufosinate & Glyphosate HT, Lepidopteran IR, AR	Brazil	F, F&C
Canola <sup>1</sup> (MON88302 x RF3)	Glufosinate & Glyphosate HT, Fertility restoration	Taiwan	Food use
	Olyfacinate HT Mala starility. Eartility restaration	USA	F, F&C
	Giulosinate FT, Male steninty, Fertinty restoration	New Zealand, Australia	Food use
Soybean <sup>1</sup> (FG72 x A5547-127)	Glufosinate & Glyphosate & Isoxaflutole HT	EU	F&F
	Dow AgroScience	1	1
Maize <sup>1</sup> (MON89034 x TC1507 x NK603 x MIR162)	Glufosinate & Glyphosate HT, Lepidopteran IR, MM	Canada Mexico, South Korea	F, F&C
 Enlist™ Maize (DAS40278)	2 4-D HT	FU Malaysia	F&F
Cotton <sup>1</sup> (3006-210-23 x 281-24-236 x MON88913 x COT102 x 81910)	Glufosinate & Glyphosate & 2,4-D HT, Lepidopteran IR, AR	South Korea	Food use
Soybean <sup>1</sup> (DAS81419 x DAS44406)	Glufosinate & Glyphosate & 2,4-D HT, Lepidopteran IR	South Korea	Food use
Enlist™ Soybean (DAS68416-4)	Glufosinate & 2,4-D HT	EU, Malaysia	F&F
Soybean <sup>1</sup> (DAS44406-6)	Glufosinate & Glyphosate & 2,4-D HT	EU, Malaysia	F&F
Southcorn <sup>1</sup> (DASS1410)	Glufacinata HT Lanidantaran IP	Malaysia	F&F
		Japan	F, F&C <sup>2</sup>
	BASF		
Cultivance soybean (CV127)	Sulfonylurea HT	Turkey	Feed use
	Monsanto/BASF	I	1
Genuity® DroughtGard™ maize (MON87460)	Drought stress tolerance, AR	Turkey	Feed use
	Monsanto/ Forage Genetics International	1	
HarvXtra™ alfalfa (KK179)	AR, Altered lignin production	Singapore	Food use
	Monsanto/Dow AgroSciences	I	
Widestrike™ Roundup Ready Flex™ Cotton (3006-210-23 x 281-24-236 x MON88913)	Glufosinate & Glyphosate HT, Lepidopteran IR	EU	F&F
	Monsanto/Scotts Seeds	1	
Roundup Ready™ Creeping Bentgrass (ASR368)	Glyphosate HT	USA	Food use, Cultivation
	Bayer CropScience/Syngenta		
Herbicide-tolerant Sovbean line (SYHTØH2)	Glufosinate & Mesotrione HT	Columbia	Food use
		Argentina	F, F&C
	DuPont (DuPont Pioneer)		
Canola <sup>1</sup> (73496 x RF3) <sup>3</sup>	Glufosinate & Glyphosate HT, Fertility restoration	South Korea	F&F
Soybean <sup>1</sup> (DP305423 x GTS 40-3-2)	Glyphosate & Sulfonylurea HT, Modified oil/fatty acid	Columbia	Food use
		EU	F&F
Treus™, Plenish™ soybean (DP305423)	Sulfonylurea HT, Modified oil/fatty acid	Malaysia	F&F
Note: * if the products have no trade name, only show the o	prop type;		

1 trade name is not available; 2 for Type 1 only: 3 new GM product varieties approved in 2017 F&F = Food and Feed use; F, F&C = Food, Feed and Cultivation; HT = herbicide resistance; IR = insect resistance; MM = Mannose metabolism; AR = Antibiotic resistance; RAP = Reduced Acrylamide Potential; RBS = Reduced Black Spot.

## **New Generation Forages**



**G Prabhakar Babu** Global Lead Forages for Asia, Africa & Europe at Advanta Seeds



Ganesh Agarwalla Product Manager Forages, India at Advanta Seeds

#### **Importance of forages**

Forages are an important part of animal diets for profitable dairy farming and animal rearing. Feeding is approximately 60% of total dairy farm expenses. Across the globe a large number of crops are used for forage feeding purposes. Normally these are traditional forages which are low yielding, have low nutritional value and hence have negative impact in farm productivity. Traditional forage crops are not tolerant to drought and climate changes. Additionally, there is a huge fodder deficit in various countries. According to the global research data the green fodder deficit is reaching from 40% to 60% and dry fodder to 20%. Along with roughages the estimation for concentrate feed deficit is around 25% to 50%. The deficits are more in under-developing and developing countries, whilst self-sufficient in developed countries. Hence there is a need for high quality and high yield forages across geographies to meet the growing demand for animal feed.

#### **Global forage market**

New generation forage crops are the great new opportunity in the seed industry. Most of the cover crops are now becoming forage crops with a high value driven component in dairy farming. Forages are again becoming a great business opportunity with the estimated market value to be between USD \$17 billion to USD \$20 billion by 2022, with CAGR of 8%. Winter based forages are the dominant crops with more than 70% of the gross revenue in the global forage seed market. Legumes like Alfalfa and Clovers are the front runners. The Asia and Oceanic regions are dominant by Forage Sorghums and Clovers. Key drivers for the forage business are an increase in demand in high yield and high nutritive forages since the demand for milk and dairy products is increasing along with the population. Additionally, an increase in the crossbred animal across the developing countries requires higher quality forages creating more demand. The dairy industry is a growing sector therefore there is the opportunity for forage crops.



## Innovative new generation forages

Global climate changes creating huge impact on forage production, grazing lands and pastures. Raising temperatures, erratic rainfall, heavy traffic on grazing lands and poor maintenance of pastures leads to low fodder availability to the animals. Forages experts like Advanta Seeds started new breeding programs to research and develop new hybrids to improve forage production. Advanta Seeds breeding programs are focused on high yield, nutrition, highly palatable fodder quality. Working in partnership with dairy farmers Advanta Seeds' research demonstrated that feeding animals with high quality fodders enhances animals health, milk productivity, lactation period and timely pregnancy.

Advanta Seeds new generation forages are highly nutritive and are replacing traditional forages, like clover, oats and grasses segment, that contain low value for animals. Advanta Seeds highly nutritive forages include Sweet Sorghum (Sugargraze), Hybrid Pearl Millet (Nutrifeed), high yield Brown Mid Rib SSG (BMR Rocket), high dry matter annual Rye Grass (Makhan Grass) and a perennial Alfalfa (Delight). The new generation fodder crops are characterised by high protein, high palatability with more digestibility and high yield. Each of the products has its own unique features focused on improving milk yield and productivity.

The benefit of the highly nutritive forages is reducing dairy farms dependency on feeding animals with a concentrated mix of grains and dry meals. Consequently, it reduces the cost of milk production and increases profit of dairy farms.

The highly nutritive forages are focused on animals' nutritional values but in some geographies the yield of the crop is more important.

Advanta Seeds launched global proprietary technology IMI Tolerant sorghum under igrowth<sup>®</sup> brand. The igrowth<sup>®</sup> was developed through mutagenesis methods and provides tolerance to herbicides of the Imidazoline family. This technology allows farmers to apply herbicides at the recommended dose and not damage the crop. The igrowth<sup>®</sup> hybrids genetics prevent death or irreversible damage to the crop while herbicides are applied. Having secured crop and better yield gives farmers peace of mind and secures the feed for the animals.

Another important innovation in forages that Advanta Seeds is focused on are hybrids with high drought tolerance. There are very few crops that have high drought tolerance and are suitable for animal feed. In many geographies which experience increased surface temperatures, the traditionally used corn for animal fails under drought conditions. Thus, it is important to increase production of crops that are suitable for animal feed and have high drought tolerance.

One of the success factors of Advanta Seeds strong portfolio with drought tolerant forages is availability of drought tolerant female genetics whereas other companies rely on tolerance coming from a male line. This is an important factor for production and control, and demonstrates the depth of the genetic diversity in the germplasm. It allows to use multiple sources of tolerance to stack the different genes together and provide the sorghum grower with a high and durable level of tolerance.

To meet the market needs currently Advanta Seeds is working on various molecular and high-throughput phenotyping technologies that will allow to select the very best of lines in the breeding populations. This will allow to maximize dual purpose, gain yield and bio-mass yield for high quality silage making. The changing environment and emerging technologies also inspired Advanta Seeds to start R&D programs for nitrogen use efficiency, cold tolerance and salt tolerance hybrids.

#### Forage based "Balanced Diet"

Currently many dairy farmers endure high feeding and maintain costs which impacting their profitability. Advanta Seeds collaborates with local farmers to design feeding plans that meets the nutritional animal needs and reduces feeding cost. The feeding plan is known as a "Balanced Diet" which includes highly nutritive forages and Cereal fibre, Grain and Legumes. The Balanced Diet helps animals to get required energy and protein for the body to optimise the diet conversion while reducing the feeding costs and increasing the farms profitability.

## Opportunities in emerging and expanding markets

New generation forages are the new great opportunity especially in markets where the forage demand is high. The biggest challenge for the forage market is the market fragmentation, diversity of crops and farmers' preferences.

## Importance of education in forage production and conservation

To increase the animal feed production in a sustainable way Advanta Seeds introduced a program to train and educate farmers on forage production and conservation. This initiative includes field visits, farmer seminars and training on agronomy and latest technology in production and conservation of forages. The Advanta Seeds program includes preservation of excessive silage, sorghum and corn silage production, hay preservation and enriched-dry fodder pellets for crop residues and legumes.

#### Investing in new generation forages

Advanta Seeds is deploying resources in various countries to develop forages suitable for local needs and testing available commercial hybrids for fast track solutions. Developing new forage crops aims to improve the animal feed production and reduce farmers cost from large dairy farms to small households where the new generation forages can make a huge difference.

## Advanta Seeds global leadership and expertise in Forages



60



Years experience in plant genetics research and development For ages suitable for various usage: grazing, hay or silage production Global forages production: USA, Australia, India, Argentina

Diversified Portfolio with unique and proprietary germplasm Forage Products available across the world

## **NEW GENERATION FORAGE CROPS**

**f y** in

**UPL** 

## Access to Seeds Index Evaluates Seed Companies Best Positioned to Support the Productivity of Smallholder Farmers

By Access to Seeds Index

193 Member States of the United Nations have adopted the Sustainable Development Goals (SDGs) in September 2015 which are the priorities for the world up to 2030. There are 17 SDGs in total with each goal having their own specific targets. Improving the productivity of smallholder farmers is one of the main targets on the United Nations' Sustainable Development Goals agenda (SDGs). "Smallholder farmers need to not only produce more food, but at the same time adapt their agricultural practices to changing weather conditions caused by climate change. By improving access to quality seeds, seed companies can

make a vital contribution in supporting smallholder farmers with overcoming this challenge," says Ido Verhagen, Executive director of the Access to Seeds Index.

The Access to Seeds Index, an initiative funded by the Bill & Melinda Gates Foundation and the government of the Netherlands, aims to encourage seed companies to step up their efforts to support smallholder farmer productivity. "By benchmarking seed companies, the index gives credit to companies that show leadership and encourages others to follow their example," says Mr. Verhagen. "It also provides valuable information for governments, research institutes and donors interested in building partnerships with seed companies." The Index is not the first index to examine the ways in which an industry can help to solve a global challenge. It is, however, the first to assess regional companies alongside their global peers.

The Index has identified four regions with (1) a food security challenge, (2) smallholder farmer presence and (3) agricultural potential: Latin America, Western and Central Africa, Eastern and Southern Africa, and South and Southeast Asia and provides for the first time a comprehensive picture of what the industry is doing in those regions.



The Index seeks to explore the possible contribution of seed companies to the six dimensions (availability, affordability, suitability, capability, profitability and autonomy) of access to seeds identified by farmers and other stakeholders. It assesses the companies' strategies, whether they handle their genetic resources and intellectual property in ways that does not limit access to seeds. Also it looks at activities in breeding, production, marketing and adoption and how they are tailored to smallholder farmers. The performance of companies is compared with each other rather than against an absolute, ideal state. As such, companies set and raise the bar.

In 2016, the first index was published which assessed the activities of global seed companies in the four regions and those of regional seed companies in Eastern Africa. It became evident that regional companies go a step further in addressing the needs of smallholder farmers than their global peers. Regional companies are active in domains generally neglected by global companies, notably breeding for local crops and marketing varieties from public research institutes. Also, these companies demonstrated practices that go beyond their global peers in adoption strategies and inclusion of smallholder farmers in the seed value chain. The publication resulted in coverage in over 170 media outlets, new initiatives by policymakers and discussions around the globe at events hosted by organizations including the Food and Agriculture Organization of the United Nations (FAO), World Bank and African Union.

The 2019 Index is scheduled for publication between November 2018 and April 2019. This index will more than double the number of companies assessed – from 25 to more than 60 – as regional seed companies in South and Southeast Asia and Western and Central Africa and Eastern and Southern Africa are now also part of the scope. In addition to evaluating 13 global seed companies for their business in all four regions, the Access to Seeds Index for South and Southeast Asia will evaluate 24 seed companies while the Access to Seeds Index for Eastern and Southern Africa and the Access to Seeds Index for Western & Central Africa will evaluate the efforts of 22 leading seed companies each in respective regions. The selection of the companies was based on company business models, track record and regional presence.

To conclude, the index provides a unique insight into the seed industry's current efforts. Company scorecards enumerate the efforts at the individual company level while the rankings provide insight into leadership at both the global and regional level, including the differences and similarities in the roles global and regional companies play in reaching smallholder farmers. "Since its publication, the 2016 Index has been widely discussed with farmer organizations, seed companies and policymakers in all four index regions. Although it seems obvious that achieving food security requires ongoing cooperation and coordination between these parties, it has become clear that these are often lacking. We hope that the evidence base provided by the index will help to fill this gap" says Mr. Verhagen.

Global Access to Seeds Index

		Company	Country
-			
	1	Advanta	ARE
	2	Bayer	DEU
	3	Вејо	NLD
	4	DowDuPont	USA
	5	East-West Seed	THA
	6	Enza Zaden	NLD
	7	Groupe Limagrain	FRA
	8	KWS	DEU
	9	Monsanto	USA
	10	Rijk Zwaan	NLD
	11	Sakata	JPN
	12	Syngenta (ChemChina)	CHE
	13	Takii	JPN

Regional Index for	
Eastern & Southern	Africa

	 _	-	 		-		-	
-								

_			,
	1	Capstone Seeds	ZAF
	2	Darusalam Seed Co	SOM
	3	Demeter Seed	MWI
	4	DowDuPont	USA
	5	East African Seed	KEN
	6	East-West Seed	THA
	7	Ethiopian Seed Enterprise	ETH
	8	Equator Seed Co	UGA
	9	FICA Seeds	UGA
	10	Hygrotech	ZAF
	11	Kenya Seed Company	KEN
	12	Kenya Highland Seed	KEN
	13	Klein Karoo Seed Marketing	ZAF
	14	Monsanto	USA
	15	NASECO	UGA
	16	Pop Vriend Seeds	NLD
	17	Seed Co	ZWE
	18	Starke Ayres	ZAF
	19	Syngenta (ChemChina)	CHE
	20	Technisem	FRA
	21	Victoria Seeds	UGA
	22	Zamseed	ZAM

#### Regional Index for Western & Central Africa

	Company	Country
1	AGRIPLUS	MLI
2	AINOMA	NER
3	BILOHF	CIV
4	Da-Allgreen Seeds	NGA
5	DowDuPont	USA
6	East-West Seeds	THA
7	Faso Kaba	MLI
8	GAWAL	CHN
9	Heritage Seeds	GHA
10	Maslaha Seeds	NGA
11	Monsanto	USA
12	NAFASO	BFA
13	Pop Vriend Seeds	NLD
14	Premier Seed	NGA
15	Seed Co	ZWE
16	SEDAB	SEN
17	SEMAGRI	CMR
18	Soprosa	MLI
19	Syngenta (ChemChina)	CHE
20	Technisem	FRA
21	Tropicasem	SEN
22	Value Seed	NGA

#### Regional Index for

	Company	Country
1	Acsen HyVeg	IND
2	Advanta	ARE
3	Bayer	DEU
4	Bioseed	IND
5	BRAC	BGD
6	Charoen Pokphand	THA
7	DowDuPont	USA
8	East-West Seed	THA
9	Groupe Limagrain	FRA
10	Kalash Seeds	IND
11	Known-You Seed	TWN
12	Lal Teer Seed	BGD
13	Mahyco	IND
14	Monsanto	USA
15	Namdhari Seeds	IND
16	National Seeds Corporation	IND
17	Nongwoo Bio	KOR
18	Nuziveedu Seeds	IND
19	Punjab Seed Corporation	PAK
20	Rallis/Metahelix	IND
21	Sakata	JPN
22	Syngenta (ChemChina)	CHE
23	Takii	JPN
24	Vinaseed	VNM



Lengthy flight preparation, damaged image capture and vast volumes of unmanageable data – the early days of commercial drone technology now seem like another world. Today, quick planning, cloud storage, actionable data insights and progressive legislation renders drone usage in agriculture an undeniably advantageous asset.

## 5 Reasons Why Today's UAV Technology is the Future of Your Agribusiness

A new revolutionary beta test from the US Federal Aviation Administration (FAA) has launched in the US, which allows drone pilots to ask for airspace permission via a smartphone app. The automated authorisation comes back in seconds.

This is just one example of how the now-proven value of drone technology – and its transformative potential for businesses – is driving governmental organisations to adapt laws that will accommodate, and actively encourage, commercial drone activity.

The correct combination of a long-range drone and cloudbased software solution for precise data analytics reduces costs and time, increases yield, and facilitates company growth into the future.

"A workflow that used to spread across weeks and months is now a fast, easy-to-manage process that can completely turn a business around," says Lénaïc Grignard, Delair's Agriculture and Forestry Product Manager.

"If you tried in the past and weren't satisfied, now is the time to test the technology again, because today's drone and cloud software solutions change everything."

#### 1. Drones are easy to operate and rules are changing

UAV operation and confusion around flight certification criteria is another barrier that prevents businesses from progressing

towards drone-based smart farming operations.

For both, Delair's team of UAV specialists, now strategically located in 70 countries around the world, train and support clients locally through the entire process.

While there are national laws to follow within each country, they are mostly quick to comply with. As Delair was granted the first Beyond Line of Sight (BLOS) certificate by the French Civil Aviation Authority (DGAC) for the DT18 system in 2012, the UAV itself meets all basic certification requirements.

All that remains is to register your operations in your own country and train or hire a suitable UAV operator (with Delair's expert help).

## 2. High-quality industrial drones mean minimal flight preparation

Once owners are familiar with the UAV and the software is set up, planning the flight parameters (such as altitude and field overlap) can take as little as five minutes.

"Drone assembly is completed with a few clicks and there is a short checklist to comply with," explains Grignard.

"Today everything is automatic," she continues, "including camera adjustment, flight operation, safety procedures and the transfer of data."



"Big data is a buzzword for our times, but how to store, manage and analyse data is one of the biggest challenges businesses are facing." - Lénaïc Grignard, Agriculture and Forestry Product Manager at Delair

## 3. Flight monitoring is made easy with state-of-the-art technology

Early drone technology required users to store the hundreds of images gathered during a flight, then return from the field to a computer where an arduous uploading procedure would ensue.

Sometimes after landing, operators would discover that no images were captured during a flight due a technical error, meaning the flight would have to be scheduled again.

As a result, many early adopters decided that this new technology cost time and money rather than saving it.

But today's user-friendly UAVs and cloud software solutions, such as Intel Insight Platform, keep you in control at all times.

"Images are captured as you observe in real-time and all safety nets are automated too," says Grignard. "For example, if the UAV doesn't have feedback from the pilot, it will return to the take-off point."

## 4.UAVs and cloud computing create quick image capture and insights

Big data is a buzzword for our times, but how to store, manage and analyse data is one of the biggest challenges businesses are facing. Mastering this, however, is the key to optimising your agriculture business.

Up until now, storing and processing the raw image data from drones has been one of the biggest barriers.

"Cloud-based storage and analytics means capacity to keep data easily with high-level algorithms in place to analyse it all," says Grignard. "Receiving actionable data quickly is key to running successful agriculture operations. Good quality cloud-based systems will do all the work for you, allowing you to present the insights in a clear and easily-actionable way."

## 5. Data volume is no longer a burden, it's the key to optimising your yield

Actionable insights mean that you can manage every inch of soil and plant with an optimised strategy.

Detailed mapping for planning, yield predictions, crop conditions and irrigation approaches, all these and more are possible once a smooth cloud-based system for data analytics is running alongside your drone operations.

"On top of the fact that the data is ready to add value to your business, it is also ready to go from drone to tractor," says Grignard. "From field to drone to tractor is now seamless and the drone and cloud technology combine to remove all difficulties by making these two different systems work together."

When combined correctly, cutting-edge UAV technology and cloud-based software solutions can deliver the future you need for your agribusiness.



#### **EVENT**

# **Seed is Life**

### **World Seed Congress Peaks with Position Papers**

By International Seed Federation (ISF)

As the sun set over Brisbane on Wednesday 6 June, the International Seed Federation (ISF) World Seed Congress reached its peak with the adoption of an unprecedented number of position papers by the General Assembly. At the General Assembly meeting representatives from 45 countries approved the adoption of eight position papers. The positions will provide ISF members with a clear line to take on each topic, strengthening consistency of messaging and approach across the seed sector so that we speak and act 'as one'.

## Illegal seed practices – threat to farmer livelihoods, food security and sustainable agriculture

Illegal seed practices encompass counterfeit or fake seeds, fraudulent labelling, intellectual property or trademark infringements, regulatory offenses, and trade secret thefts. In certain countries, it is estimated that around 50% of crop seed sold to farmers is illegal. In response to this growing concern, ISF has made a significant commitment to combat illegal seed practices and will coordinate engagement with plant breeders, seed producers, processors, traders and distributors to strengthen advocacy with all relevant stakeholders, including government ministries, agencies, judicial systems and international organizations, to improve legal systems and enforcement conditions, capacity and capabilities.

#### Supporting seed choice for farmers

ISF and its members – representing thousands of small, medium, large, local, regional and international entities – are committed to the ISF Vision: "A world where the best quality seed is accessible to all, supporting sustainable agriculture and food security". The accessibility of quality seed is vital to support the life and livelihood of each farmer. The seed industry strives to provide farmer-customers with diverse, well-adapted high-quality seed choices, as well as services and support to optimize productivity



and yield for their local conditions. Furthermore ISF believes that farmers should have the opportunity to make informed choices about which seeds they plant to best suit their personal circumstances, whether protected by intellectual property rights or not. Enhancing a farmer's ability to make an informed choice requires the availability of suitable seed options and knowledge of any limitation that may restrict the use of varieties chosen. Seed is the most important input in crop production, farmers must have the widest range of options available to them.

## Consistent criteria for the scope of regulatory oversight

In many countries, the possible regulation of plant breeding innovations is under public consultation. The ISF position paper clearly articulates the benefits of plant breeding innovation for society, and makes the case for a regulatory framework that enables their use based on consistent criteria. If consistent regulatory frameworks are deployed across countries, these same plant breeding innovations can help facilitate more and better seed choice for farmers. ISF is coordinating efforts to strengthen conversations across the value chain in order to avoid sending mixed messages from players in the same circle, and to create a unified voice.

## The international movement of treated seed

The free, international movement of treated seed is important to ensure that the best quality seed is accessible to farmers. Seed treated with Seed Treatment Products (STP) is a key tool for decreasing the environmental impact of agriculture and enabling the full expression of the seeds' potential.

Confusion surrounding regulations on the movement, application and release of STP in the environment during sowing is affecting seed producers' ability to provide farmers with a reliable supply of treated seed.

It is the view of ISF that any regulations, controls or conditions of use surrounding seed treatment must make the distinction between each of the below to facilitate the free movement of treated seed.

•The movement of the STP

•The application of the STP to seed in seed processing facilities

•The movement of treated seeds

•The release of the STP in the environment during the sowing of treated seed

#### **Digital Sequence Information**

Currently, access and benefit sharing of genetic resources is regulated at the international level by various treaties: the Convention on Biological Diversity, the Nagoya Protocol, the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). These treaties are implemented at the national level by various laws. However, some countries want to regulate the access and benefit sharing of intangible Digital Sequence Information that is contained in genetic resources. In support of effective sharing of genetic resources to create tomorrow's varieties, ISF's position states that Digital Sequence Information should not be regulated at either the international or national level.

Going forward, these position papers will help the seed sector to engage strongly with the whole agriculture value chain and beyond with international organisations, policy makers and regulators. Watch this space. In the meantime, you can find all the position papers on the ISF website: http://www.worldseed.org/ resources/papers/



#### EVENT

## APSA THE ASIA & PACIFIC SEED ASSOCIATION

## Manila to Host World's Largest Regional Seed Congress

By the Asia and Pacific Seed Association (APSA)

Make note of the following dates in your calendar: 12 – 16 November, 2018. That's when the 25th Asian Seed Congress (ASC) is underway at the Manila Marriott Hotel in the Philippines. Organized jointly by the Asia and Pacific Seed Association (APSA) and the host country's National Organizing Committee (NOC) – which this year is the Philippine Seed Industry Association (PSIA) – the ASC is the largest, most significant seed industry event in the world.

Held exclusively for members and associates of APSA, the annual event attracts key seed industry executives, regulators, breeders and scientists, who travel from throughout the Asia Pacific region and the world to attend. The event affords opportunity to make connections face-to-face, get down to business, network with key decision makers and get updated on all the latest developments in seed.

Delegates check in at the venue on Sunday, 11 November, collecting badges and delegate bags, which contain the delegate book (delegate contact list, venue maps, latest program, etc), APSA Calendar, Asian Seed Magazine, and other important event documentation and souvenirs. The five-day event kicks off informally on Monday, 12 November, with the Pre-Congress Workshop, an all-day seminar, round table and panel discussion centering on a seed-specific theme. This year's theme is Plant Breeding Innovation (PBI): delegates get a golden opportunity to sharpen their wits while delving into the latest seed industry breeding technologies available (or soon-to-be available). Regulation and marketing trends will be high on the agenda. Discussion will span everything from CRISPR/Cas9 to organic and reduced-chemical agriculture.

Registration for the Pre-Congress





Workshop is free for ASC delegates and includes lunch, but attendance is capped at 150 persons. As an alternative, on Monday, some may opt to join APSA's annual golf tournament, to be held just south of Manila at Mount Malarayat Golf & Country Club, in Lipa, Batangas.

Tuesday morning, 13 November, the Asian Seed Congress formally begins with the inaugural ceremony, presided over by APSA's president, vice president and executive committee, with chairs and officers from the national organizing committee and local government. Opening addresses are followed by an APSA Seed Award presentation, in which outstanding professionals in the Philippines will be formally acknowledged for contributions to the seed industry. Cultural performances feature throughout the morning session, which concludes with a Philippine seed industry country report from PSIA.

Following that, the trading booths, tables and meeting rooms open.

Seven technical sessions will be held concurrently, 13-15 November, hosted by APSA's four Standing Committees (or SCs) – Seed Technology; Intellectual Property Rights and Biodiversity; and Trade & Marketing; and four Special Interest Groups (or SIGs) – Vegetables & Ornamentals; Hybrid Rice; Field Crops; and Cover Crops.

Another important gathering to take place, on the morning of Wednesday, 14 November, will be APSA's annual National Seed Association (NSA) meeting, which brings together NSA reps – from throughout the region and world – to update one another on activities and trends in their respective countries.

On the afternoon of Thursday, 15 November, trading and training conclude, and APSA's General Assembly Meeting will commence. At the GAM, APSA members meet and vote on various matters of governance for the world's largest regional seed association.

The Asian Seed Congress formally concludes Thursday evening with the Grand Gala, featuring a set dinner, cultural shows, award presentations, event slideshow, live entertainment and a flag ceremony, in which the NOC symbolically passes on the Asian Seed Congress flag to reps from next year's host country.

Post Congress Tours have been organized by the PSIA, the International Rice Research Institute (IRRI) and EastWest Seed for Friday, 16 November. Registration for these is separate from the ASC; places are limited and confirmed on a first-come, first-served basis.

The Asian Seed Congress venue this year accommodates up to 2,000 delegates – double the capacity of last year's edition in Bangkok (when there was a full house). Early bird registration this year opened 2 May. Though several months remain before the doors officially open, full capacity already looms. So, to ensure that APSA can meet member needs, on-site and nonmember registration are not offered.

For more details, the latest programs and to register, visit https://apsaseed.org/ asian-seed-congress/

#### Α

#### Agronomix Software



Founded in 1990, we develop, market, and support software solutions for plant breeders and agronomists globally. Continuously enhancing our software to strengthen and maximize ROI in plant breeding programs, we are committed to your success. Contact us to learn how Agronomix can help you to develop superior hybrids and varieties.

Website: www.agronomix.com E-mail: info@agronomix.com

#### B

#### Bühler Inc.



Bühler provides optical sorting solutions for seed processors who demand the highest standards of seed quality, with a focus on maximising yields; cleaning and germination. Bühler's optical sorters sorts a variety of seeds; corn seeds, soya seeds, carrots, onions and grass seeds, producing excellent results and removing even the most challenging of defects and foreign material.

Website: www.buhlergroup.com E-mail: sortexenquiries@buhlergroup. com Services: Equipment supplier

#### C

## CCL Label (Packaging and Labeling)



CCL has over 30 years of expertise providing label and tag solutions in the agriculture industry. CCL is known as problem solvers with the ability and knowledge to create solutions with functional labels and tags for all types of seed packaging.

Website: www.ccllabel.com/seeds E-mail: labelinfo@cclind.com Service type: Packaging and Labeling

#### **Centor Oceania**



Centor Group has a dedicated Research & Development team at Centor Oceania, Australia who are research driven and committed to developing seed coating polymers for the local and global markets that offer more dust reduction, improved flowability of treated seed and greater colour depth with our brands of Seedworx and Ezi-Cote polymers. To complement our polymer range of the Centor Group also offer rotary seed coaters, analytical equipment and drying equipment.

Website: www.centoroceania.com E-mail: info@centoroceania.com Services: Seed coating polymers and seed treatment machinery and analytical equipment.

#### D

#### Delair



Delair is the world's leading commercial drone company, working with Intel across 70 countries to bring unique, innovative solutions to agro industries and farming. Its digital & virtual aerial phenotyping solution, plant focused, to extract, store, share and analyse traits have already been adopted by leading breeding companies.

#### Website: www.delair.aero E-mail: caroline.joseph@delair.aero Service type: drone hardware and software solutions to extract plant traits

#### H

#### HALDRUP GmbH

## HALDRUP

Since 1972, the HALDRUP brand has been well known for its optimum and individual solutions for seed breeding and field research worldwide.For more than 40 years now, HALDRUP has been providing optimal and individualized solutions for seed breeders and field trials worldwide. HALDRUP develops and manufactures robust machines to the highest quality standard for the increasing demands of breeding for field trials. Our aim is to provide you with an innovative and future-oriented solution for your requirements. We present you a selection of HALDRUP machines from the fields of combine harvesters, seed drills, harvesting equipment and laboratory equipment. Our highly qualified team is always at your disposal to develop and construct machines tailor-made according to your requirements and wishes and to achieve the best possible results for your field test.

Website: www.haldrup.net Email: info@haldrup.net Service type: develop and manufacture special machinery for field research worldwide

#### Μ

#### Michelman

## MICHELMAN

Michelman is a global manufacturer of inert solutions for the Seed Coating industry that are designed to improve the performance and processing of seeds in treatment and mechanical planting operations. Our additives and coatings make seeds easier to handle while improving flow, plantability, appearance, dust-off prevention, abrasion resistance and drying time.

Website: www.michelman.com Email: info@michelman.com Service type: Materials for seed coating manufacturers

#### P

#### **PETKUS Group**



PETKUS has a long tradition and longterm commitment to the seed business with a mission to provide the most innovative machines, best technology solutions and full turnkey projects. All products are manufactured by one source in-house at PETKUS: cleaners, indented cylinders, gravity tables, optical sorters, de-awners, treaters, dryers, conveyors and silos.

Website: www.petkus.com Email: info@petkus.com Service type: seed processing technologies & grain logistics

#### **Pyrotec PackMedia**



Pyrotec PackMedia develops and manufactures innovative on-pack informational and promotional booklet labels that take packaging to the next level and allow customers to multiply the area used for communication on their packaging several times over. This enables a vast potential for cost savings, packaging reduction, increased productivity and sales.

Website: www.packmedia.co.za Email: packmedia@pyrotec.co.za Service type: on-pack informational and promotional communication tools



S

#### Seed Processing Holland B.V.



Seed Processing Holland is THE worldwide specialist in developing and manufacturing equipment and machines for the seed processing industry.

We have innovative solutions for all processes, from seed extraction to packaging. We offer over 150 standard machines divided in 12 product groups and we develop customer specific solutions and turnkey projects. We are the one-stop-shop for seed processing solutions and known for our high-quality, innovation and craftsmanship. Over the past 50 years we have installed products worldwide.

Website: www.seedprocessing.com Email: info@seedprocessing.com Service type: seed processing equipment

#### Seedwiz



Seedwiz is a platform which enables the farmers the optimization of plant variety selection. The GIS OPTimizer is based upon a standardized information of the vast seeds supply combined with AI algorithms. The products properties are uploaded to the platform by the seed companies using an online interface. Following the recommendations, Seedwiz enables a direct seed trading between the parties.

Website: www.seedwiz.com Email: limor@seedwiz.com Service type: Planning/ Optimization/ Big data/ Market Linkage/ Seed Marketplace.

#### Staphyt



Staphyt provides services in agrosciences to agro-chemical, biological suppliers and plant breeding companies for the development, registration and promotion of their products. Our areas of expertise are experimentation, regulatory consultancy, coordination of registration dossiers, seeds studies.

Staphyt Seed department is the leader in variety field testing in Europe. Thanks to an effective geographic network, an up-to-date equipment and skilled field agronomists, we help seed breeders and producers in both screening and evaluation of their varieties. We set testing plots on any crops, arable or specialized ones, in any soil and climate conditions according to client's requirements.

Website: www.staphyt.com Email: contact@staphyt.com

#### Syngenta Seedcare



syngenta.

Successful crop protection starts with seeds, the essence of life. Today's seeds offer a broad spectrum of varieties and traits that give undisputed advantages to the growers. Seed breeders and growers invest significant amounts of money into these technologies. Ensuring this investment is best protected while exposed in soil to diseases, insect pests, nematodes or abiotic stresses (e.g. drought), seed treatments are critical to protect the genetic potential of high value seeds.

To address these challenges, Syngenta Seedcare offers an industry leading product portfolio based on its worldclass research, product development and support capabilities. We call it a three-pillar offer P.A.S. (Products – Application – Services) which delivers value to our customers BEYOND SEED PROTECTION™.

Website: www.syngentaseedcare.com Email: chbs.seedcare@syngenta.com

#### Valoya

V



Valoya is a provider of wide spectrum LED grow lights. Valoya's patented wide spectra are designed to optimise growth for a variety of plants in various applications and thus offer the best possible light for plants in an energy efficient way.

Website: www.valoya.com Email: sales@valoya.com Service type: Wide spectrum LED Grow Lights

#### **Vibe Imaging Analytics**



Vibe Imaging Analytics is an agriculture technology company that modernizes how the seed and grain industry conducts quality inspection, using best in class digital imaging, machine learning, and cloud-based data analytical tools to generate valuable information that companies can act upon to improve product quality and safety, reduce costs and enhance operational efficiency. Vibe's key offering comprises two elements: 1), simple to use sensors that measure, count and classify the size, shape and color of seeds and grains in an absolute, accurate and reproducible manner within seconds; 2), a big data driven approach powered by cloud-based analytical modules that help companies make sense of all the data collected, digitizing sampling records, streamlining grading and trading, and providing actionable insights for companies to improve bottom line.

Website: www.vibeia.com Email: elaine.yu@vibeia.com Service type: digital seed and grain inspections, big data analytics



SGS Seed & Crop Services provides a global network of R&D facilities with more than 600 experts in 28 countries for clients' research and product development programmes in Europe, North America, Latin America, Africa and Asia-Pacific.

Our experienced team provides project, program, GLP study management services to support the development of new pesticides, fertilizer, biostimulants and seeds as well as seed treatment solutions globally. With many years of experience in the field of R&D, analytical chemistry, regulatory affairs / registration services and project management, SGS processes laboratory and field studies within the scope of regulatory testing, such as efficacy, crop tolerance, residue, environmental, operator, consumer safety, along with bio safety and nutritional compositional testing of new seeds. The testing is based on international guidelines, including EPPO, OECD, EPA and SETAC and in compliance with GLP (Good Laboratory Practice) or GEP (Good Efficacy Testing).

SGS is the world's leading inspection, verification, testing and certification company. SGS is recognised as the global benchmark for quality and integrity. With more than 95'000 employees, SGS operates a network of over 2'400 offices and laboratories around the world.

CONTACT US SGS Seed & Crop Services E: seed.crop@sgs.com W: www.sgs.com/SeedAndCrop

#### SGS IS THE WORLD'S LEADING INSPECTION, VERIFICATION, TESTING AND CERTIFICATION COMPANY



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"Their experience; willingness to understand our organisation, and the long term commitment with customers provided us with the right partner."

Claudio Torres Global CEO, Advanta Seeds (2015)

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