

Strengths and Limitations of Small and Medium-Sized Maize Seed Companies in Latin America

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Introduction

Towards the end of 2010, the International Maize and Wheat Improvement Center (CIMMYT) promoted the formation of a public-private partnership in Mexico that linked the main maize research and improvement centers (such as CIMMYT, INIFAP, Chapingo Autonomous University, among others), with the private seed production and marketing sector. Dubbed the Maize Seed Consortium, one of its main objectives was to evaluate, develop and/or deploy new high-yielding maize hybrids for distribution to maize grain producers, and at the same time contribute to the strengthening and diversification of the seed sector in Mexico. However, despite having had access to improved germplasm from research institutions such as CIMMYT, and having adopted new competitive hybrids, significant scope still remains to improve rainfed maize yields in Mexico.

This document seeks to describe the strengths and limitations of Latin American small- and medium-sized seed enterprises (“seed SMEs”), with a particular focus on Mexican companies that collaborated with CIMMYT between 2011 and 2021, by studying a representative sample consisting of 10 companies whose marketing data and product portfolio were analyzed in depth. The study serves as the basis for recommending actions that can further strengthen the Latin American seed sector, and interventions that are required to overcome its present weaknesses. As appropriate, these findings and recommendations can be extrapolated and applied to other Latin American SMEs such as those in Central America, Ecuador, Bolivia, Venezuela, and Colombia, for which information is also included.

Data and methods

The information for the analysis of the companies analyzed in this document came from the following sources:

Table 1: Data and information used for the analysis of seed companies

Data	Year	Project at CIMMYT	Information
Interviews with Mexican seed companies	2011 and 2012	MasAgro	Sales (maize seed bags) Seed products (portfolio)
Survey of commercialization of seeds to Mexican companies	2013-2021 ¹	Several	Sales (maize seed bags) Seed products (portfolio)
Interviews of capabilities and strategies of Mexican seed companies	2018	MasAgro	Capacities and strategies of a sample of companies from the Maize Seed Consortium.
INIFAP publications (articles in Mexican magazines and outreach brochures)	Several years	INIFAP	Pedigree CIMMYT germplasm content
CIMMYT database on commercial products with CIMMYT maize germplasm in Latin America.	2010-2021	Several	Pedigree CIMMYT germplasm content
List of seed companies participating in the Maize Seed Consortium	2011-2021	Several	Maize seed producers

¹ In case of not having data for a certain year for any company, data were estimated considering the commercial information reported from previous years and the general growth of the total number of companies that participated in the consortium in a given year).

The analysis of this document considered the following:

- Sources of origin of the germplasm (CIMMYT, whether a purely CIMMYT-derived hybrid or a combination hybrid with partial CIMMYT background; Public: hybrids developed by the public research sector; or Private: products developed using entirely a company's own germplasm)
- Number of CIMMYT hybrids (hybrids developed and released by CIMMYT) in its product portfolio.
- Number of products with CIMMYT germplasm (hybrids or varieties developed by CIMMYT partners using up to 100% CIMMYT lines)
- Sales of new CIMMYT hybrids compared to total company sales and other hybrids with germplasm from public institutions or private germplasm (the company's own)
- Markets reached
- Marketing capabilities

This document presents a general overview of the companies that participated in the Maize Seed Consortium of Mexico (public-private association for the generation, evaluation and commercialization of maize seeds) (Figure 1), as well as a perspective of the use and commercialization of products with CIMMYT germplasm by institutions in other Latin American countries, and a description of the specific situation of 10 Mexican companies whose commercialization data in terms of limitations and strengths were analyzed.

Figure 1: Companies participating in the Maize Seed Consortium 2011-2021



The Maize Seed Consortium was formalized in 2011 with the integration of just over 30 national companies (Mexican companies) that produce maize seed, but between 2011 and 2021, more than 80 companies and producer associations participated.

However, the sample for this document considered 10 Mexican companies selected on the following criteria: 1) their product portfolios currently or previously included CIMMYT hybrids and/or proprietary hybrids with CIMMYT germplasm background; 2) availability of marketing data for most of the years analyzed (2011-2021) and their detailed portfolios; 3) we know the target markets and marketing channels for at least a subsample of the products. The sample also took into consideration the need for representation of companies from the three agro-ecologies present in Mexico (tropical, subtropical, and even the much smaller highlands agro-ecology). The sample included maize seed companies from northern, southern, and central Mexico, in a range of sizes (see Table 2) ².

Table 2: Size classification of maize seed companies in Mexico

Category / size	Micro	Small	Medium	Large
Annual sales in tons	<200	≥200 - <1,000	≥1,000 – <5,000	≥5,000
Annual sales in bags	<10,000	≥ 10 – < 50,000	≥50 - <250,000	≥250,000
Number of companies sampled (n=10)	4	4	2	0

Results

Origin of genetic material

Mexican seed SMEs obtain germplasm from three main sources: the Consultative Group on International Agricultural Research (CGIAR), especially CIMMYT; the National Institute for Agricultural and Livestock Forestry Research (INIFAP); and the private sector (including the company's own proprietary germplasm and any germplasm licensed in from other private-sector genetics providers) (Figure 2). Other public institutions such as the *Colegio de Postgraduados* are also involved, but to a much lesser extent. Dependence on CIMMYT germplasm is more notable for micro-enterprises if we consider the 10 companies analyzed for this document: 76.6% of their germplasm comes directly from CIMMYT, with 23.4% coming from public institutions; of the latter, at least 17% also contain CIMMYT germplasm³. In this respect, the sample may not be entirely representative of the Mexican maize seed industry as a whole, as the study focused specifically on companies working with CIMMYT germplasm.

² To prevent disclosure of commercially-sensitive information, encourage candid responses, and maintain trust between CIMMYT and our valued deployment partners, we have refrained from identifying the specific companies who participated in this study.

³ The estimated content of CIMMYT germplasm in products developed by other public institutions is based on pedigree information obtained from surveys of the companies studied and INIFAP publications in articles and dissemination brochures, in which public materials with CIMMYT germplasm were identified. This document only considered products of public origin with CIMMYT content, those with certainty of the use of lines or populations developed by CIMMYT. Despite the fact that the estimates that are available (based on marketing surveys of the companies of the Maize Seed Consortium, brochures and articles) is that 50% of the content of public hybrids originates from CIMMYT, but unfortunately public institutions, in general, do not make the content of their final products official, so that information is not available for many of them.

Small companies depend equally on germplasm from CIMMYT and public institutions: 39.4% of their germplasm comes from CIMMYT and 41.6% from public institutions (of the latter, 15% also contain CIMMYT germplasm). Many of these companies already generate their own germplasm, representing 19% of their product portfolio. This is partly due to the fact that CIMMYT's germplasm, training and support provided by this institution since 2010 have allowed them, among other things, to develop or strengthen their own breeding programs.

Unlike small and micro-companies, medium-sized companies depend more on the germplasm they develop, which represents 67.4% of their product portfolio (50% of which are hybrids generated with parental lines having CIMMYT genetics). They practically do not use germplasm of origin from public institutions, which only represents 5.4% of their portfolio (and is known as well to contain CIMMYT germplasm). CIMMYT germplasm directly represents 27.2% of this group's portfolio (i.e., hybrids released by CIMMYT and combinations generated by companies with CIMMYT lines).

The above information shows that CIMMYT is the main source of germplasm for the sampled Mexican companies regardless of their size. It is notable that even as companies grow and seek to generate their own germplasm, CIMMYT germplasm continues to represent a considerable percentage of its product portfolio. Larger companies have the strength to generate their own germplasm, and smaller ones depend more on germplasm of institutions such as CIMMYT or public institutions such as INIFAP. This does not mean that they cannot compete, since germplasm of CIMMYT and public origin has proven to be competitive both in terms of yield and agronomic traits (Figure 3 and Figure 4).

Figure 2: Germplasm sources of the seed portfolio for the 10 companies analyzed, year 2021

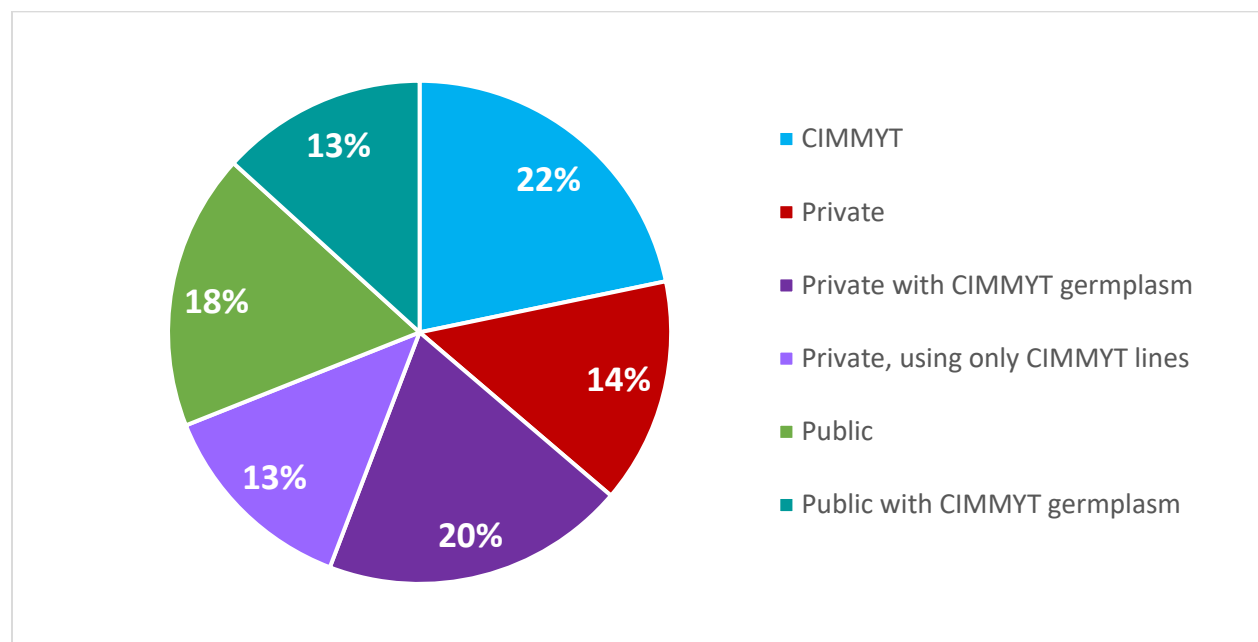


Figure 3: Example of competitiveness of CIMMYT-generated white hybrids (in orange) for the tropics of Mexico during 2011 to 2020 compared to CIMMYT testers (in green) and transnational company testers (in blue).

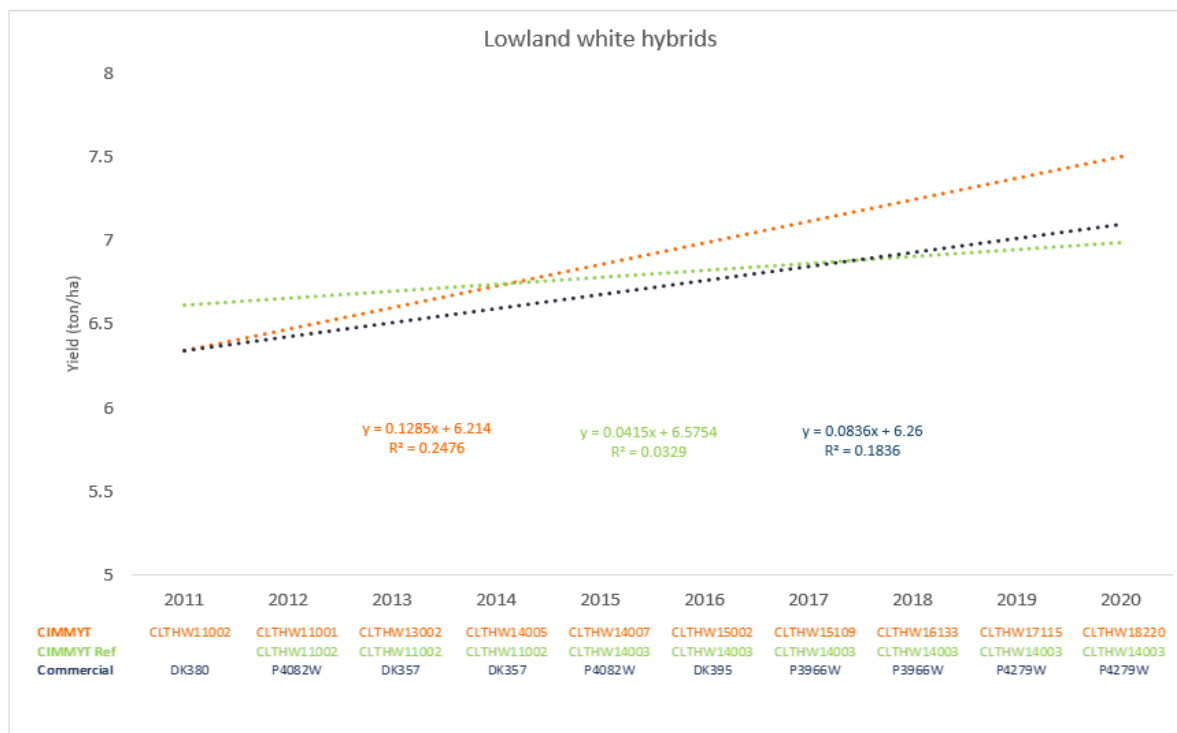
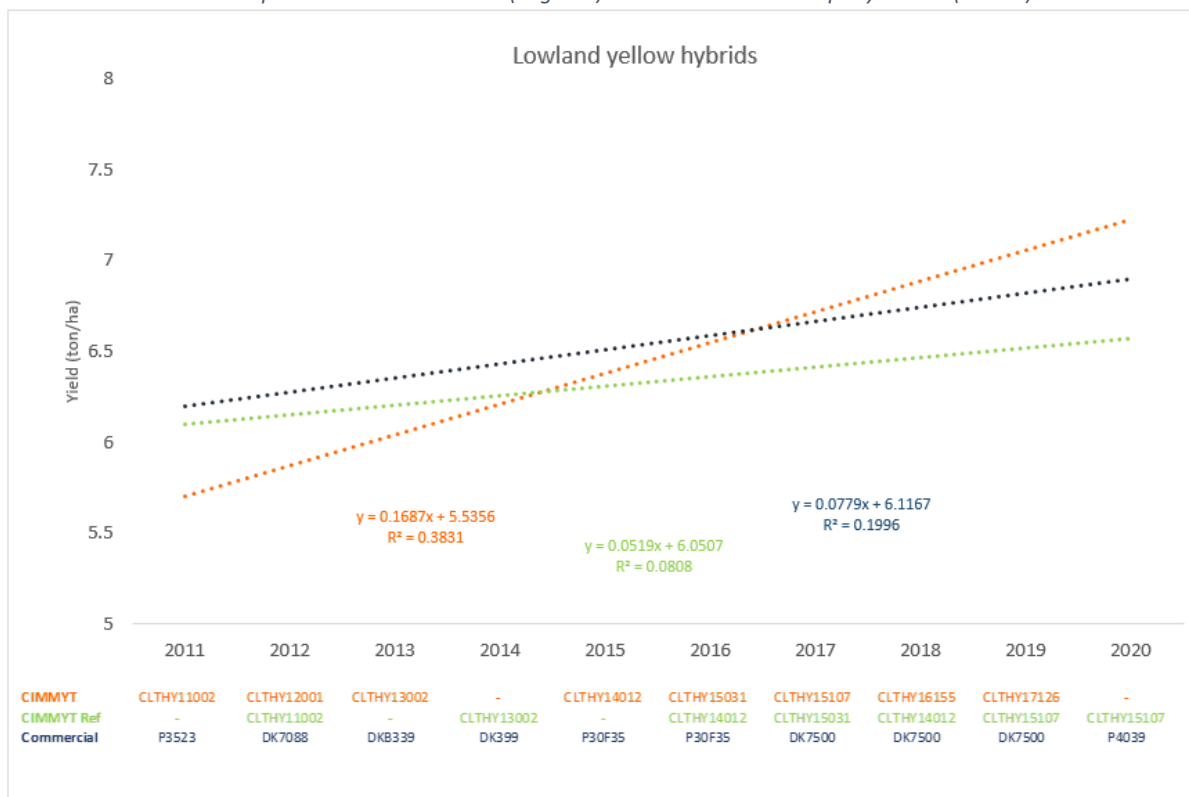


Figure 4: Example of competitiveness of CIMMYT-generated yellow hybrids (in orange) for the tropics of Mexico during 2011 to 2020 compared to CIMMYT testers (in green) and transnational company testers (in blue).



Sales and growth

The seed sales in Mexico of companies participating in the Maize Seed Consortium for the year 2021 were calculated using data from 31 companies that responded to the annual Seed Marketing Surveys and estimates for 32 other companies based on their average annual growth rates.

In 2021, 63 Mexican seed companies participated in the Maize Seed Consortium. Most of the participating companies (67%) are micro-enterprises with annual sales of less than 10,000 bags of seed, 25% are small companies, and 8% are medium-sized. No large companies participated in the Consortium.

Figure 5: Evolution of sales of the Maize Seed Consortium 2011-2021

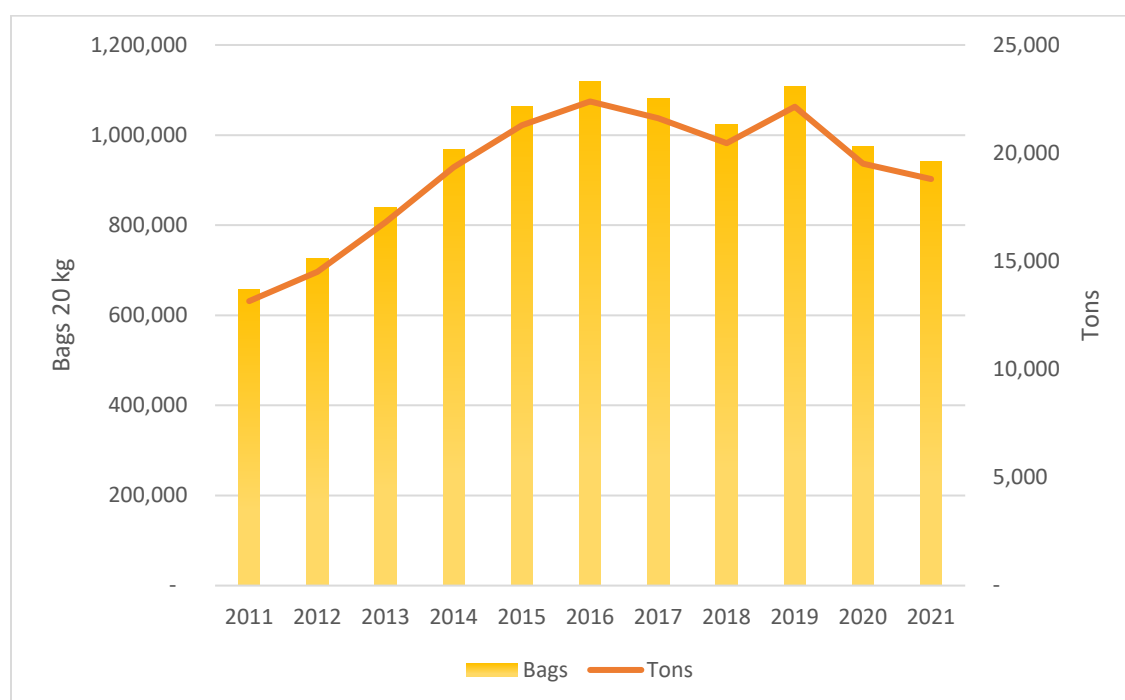


Figure 5 shows the trend of the Consortium's sales. In the first three years, 2011–2013, sales showed moderate growth, finally exceeding 800 thousand bags in 2013. Growth accelerated in the 2014–2016 period, crossing the one-million bag threshold in 2015. Starting in 2017, we observed a modest two-year decline (though never dipping below one million bags). In 2019 the Consortium achieved a new record high of sales before entering a decline in the years 2020 and 2021, mainly attributable to the global COVID-19 pandemic and declining sales to the federal government of Mexico. It is important for companies to diversify their clients and not depend on sales to the government, since they are volatile and can change dramatically from one year to another; sales to the government represent an opportunity, but a dependency should never be created.

Regarding the sales trends of the 10 sampled SMEs, it is notable that all but the smallest companies enjoyed significant growth: the four “small” companies growing by 60% between 2011 and 2021, and medium-sized companies by 65% for the same period (**Error! Reference source not found.**). The modest 5% decline in sales by the four sampled micro-enterprises between 2011 and 2021 is essentially attributable to just one company which saw a drop of just over 400 tons between 2020 and 2021, due to not being able to sell its products in government projects. Once again, the importance of not depending

on sales to the government, since their volatility is very high and they also limit cash flow, since the payment for seed can take years or even not be paid at all.

Figure 6: Sales trends of 10 Mexican SMEs (micro -small, small and medium-sized companies) sampled for the present study 2011-2021

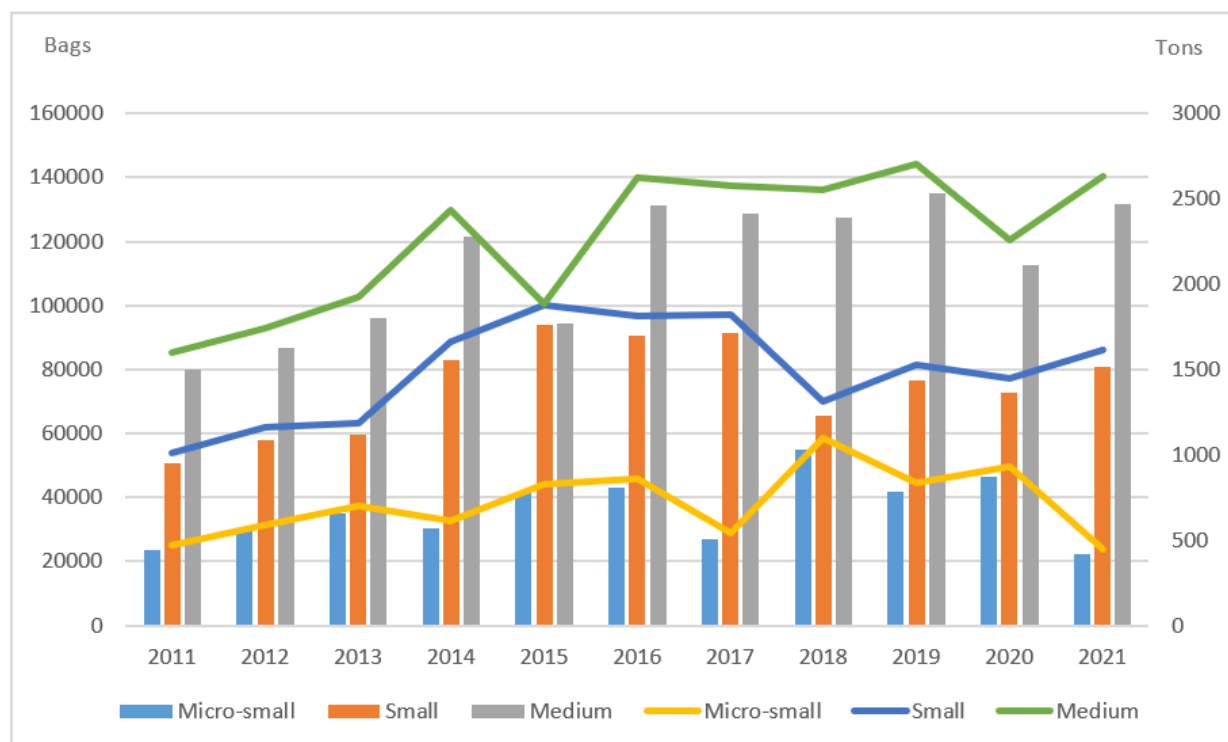


Table 3: Average number of bags sold by the companies that were part of the study

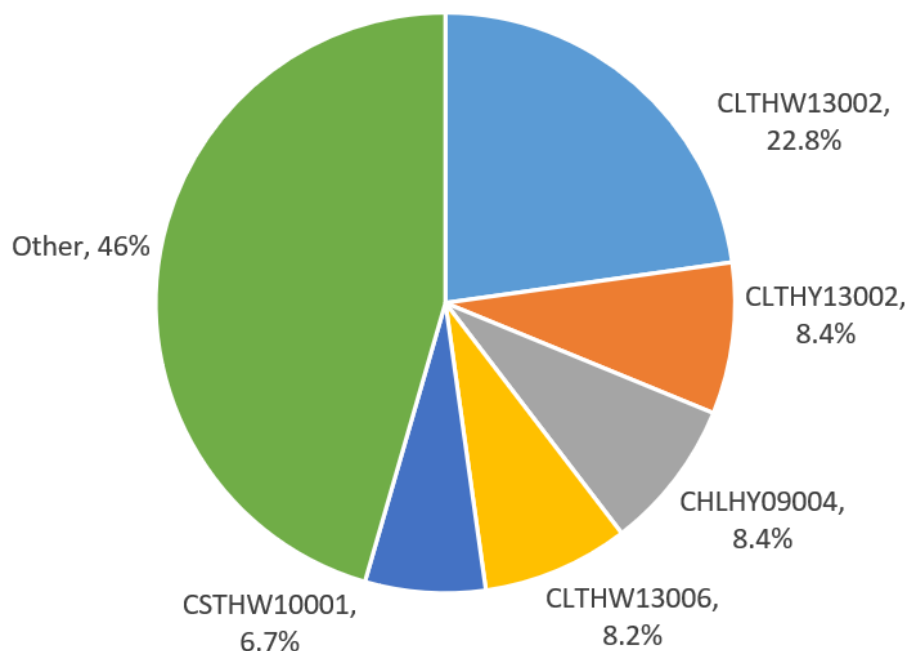
Classification of companies	No. of participating companies	Average total maize seed sales (bags) per company during 10-year period (2011 -2021)
Micro	4	35,942
Small	4	74,748
Medium	2	113,286

Sales of hybrids with CIMMYT germplasm

The sale in Mexico of new hybrids that were developed by CIMMYT's breeding programs has increased steadily since 2012 from just 420 bags to more than 70,000 in 2021. Similarly, an increasing number of hybrids and commercial seeds developed by the seed companies of the Consortium with the use of new CIMMYT lines has contributed to an increased number of varieties available to Mexican farmers. Unfortunately in 2020 and 2021, the COVID-19 pandemic, the elimination of government programs, and the decrease in the participation of companies in the Consortium, all led to a reduction in maize seed sales: the total number of reported bags of CIMMYT hybrids sold in Mexico (i.e., hybrids developed by CIMMYT maize breeding programs) was 196,613 in 2019 and less than 100,000 in 2021.

In 2021, the Maize Seed Consortium sold at least 28 CIMMYT products, including 26 hybrids and at least two open-pollinated varieties (OPVs). The five CIMMYT hybrids with the highest sales represented just over 50% of the total sales of these products in 2021 (sales reported as of August 31, 2022; as of this writing, the sales reports of some participating companies are still pending) (**Error! Reference source not found.**). Three of these best-selling hybrids are for the tropics, one for the subtropics, and one for the highlands; three are white-grain and two are yellow.

Figure 7: Relative performance of CIMMYT hybrids in 2021 in terms of sales by Maize Seed Consortium members



The development and release of competitive hybrids, as well as collaboration with CIMMYT and access to CIMMYT's improved germplasm, has in fact allowed companies to diversify their portfolios and develop their own germplasm improvement programs. The following tables (Table 4 through Table 8) illustrate examples of success stories of five Mexican companies with portfolio diversification, and which are five of the companies analyzed for this document.

Table 4: Company One - Number of products and percentage of sales by category of germplasm origin 2011-2021

Category	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Products in briefcase											
CIMMYT	-	-	-	6	10	10	7	7	7	5	2
Public	9	9	9	4	3	5	6	3	8	4	1
Private	-	-	-	-	-	-	-	-	-	-	1
Private + CIMMYT	-	-	1	1	-	1	1	4	2	2	10
Total	9	9	10	11	13	16	14	14	17	11	14
% of sales											
CIMMYT	-	-	-	46.9	84.6	50.5	38.3	23.8	36.1	29.7	15.4
Public	100	100	94.6	37.6	15.4	38.4	51.6	31.4	39.0	43.5	10.6
Private	-	-	-	-	-	-	-	-	-	-	5.2
Private + CIMMYT	-	-	5.4	15.5	-	11.0	10.0	44.8	25.0	26.8	68.8
Total	100	100	100	100	100	100	100	100	100	100	100

- ✓ In 2011, this company depended entirely on INIFAP germplasm.
- ✓ By 2020, CIMMYT hybrid sales accounted for nearly 30% of their total sales. The company also developed some proprietary hybrids using CIMMYT lines (own germplasm combined with CIMMYT germplasm), which by 2020 represented more than 25% of its sales.
- ✓ By 2021, sales of CIMMYT hybrids represented 15%, but 95% of their sales were products with CIMMYT germplasm, of which 69% were products with CIMMYT germplasm, but developed by the company itself – that is, using CIMMYT lines but the final combination of the hybrids was of their own origin.

Table 5: Company Two - Number of products and percentage of sales by category of germplasm origin 2011-2021

Category	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Products in portfolio											
CIMMYT	-	-	-	3	7	8	7	7	8	9	9
Public	13	7	10	11	11	10	10	9	9	9	7
Private	3	4	3	4	5	5	5	6	6	5	2
Private + CIMMYT	-	-	-	-	-	-	-	-	-	-	5
Total	16	11	13	18	23	23	22	22	23	23	23
% of sales											
CIMMYT	-	-	-	4.3	13.2	13.7	6.5	29.1	4.1	28.7	39.7
Public	89.3	82.2	65.2	63.6	55.0	56.9	49.0	38.0	43.9	42.8	36.9
Private	10.7	17.8	34.8	32.1	31.8	29.4	34.5	32.9	32.0	28.5	1.3
Private + CIMMYT	-	-	-	-	-	-	-	-	-	-	22
Total	100	100	100	100	100	100	100	100	100	100	100

- ✓ In 2011, this company depended almost 90% on INIFAP hybrids and varieties.
- ✓ By 2020, it had incorporated 9 CIMMYT hybrids that represented more than 25% of its sales.
- ✓ By 2021, the 9 CIMMYT hybrids in its product portfolio represented 39.7% of its sales. In all, 16 of its products contain CIMMYT germplasm, together representing 70% of its sales.

Table 6: Company Three - Number of products and percentage of sales by category of germplasm origin 2011-2021

Category	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Products in portfolio											
CIMMYT	-	-	1	3	3	3	two	5	4	4	3
Public	6	6	7	6	5	4	4	4	4	4	4
Private	-	1	2	-	-	-	-	-	-	-	-
Private + CIMMYT	-	-	-	-	-	-	-	-	-	-	1
Total	6	7	10	9	8	7	6	9	8	8	8
% of sales											
CIMMYT	-	-	9.6	15.9	32.0	30.4	33.4	34.7	43.2	40.4	40.7
Public	100	93.4	82.7	84.1	68.0	69.6	66.6	65.3	56.8	59.6	39.8
Private	-	6.6	7.7	-	-	-	-	-	-	-	-
Private + CIMMYT	-	-	-	-	-	-	-	-	-	-	19.5
Total	100	100	100	100	100	100	100	100	100	100	100

- ✓ In 2011, this company also depended 100% on hybrids and varieties from INIFAP. It occasionally sold hybrids privately owned by another private-sector entity.
- ✓ By 2020, 50% of the company's seed products were CIMMYT hybrids, which represented more than 35% of its sales.
- ✓ In 2021, 50% of its products were still hybrids with CIMMYT germplasm, and each of the public hybrids in its portfolio also contained between one and two CIMMYT lines.

Table 7: Company Four - Number of products and percentage of sales by category origin of germplasm 2011-2021

Category	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Products in portfolio											
CIMMYT	-	-	-	-	3	7	6	7	10	14	10
Public	10	18	18	13	16	14	12	13	14	9	12
Private	-	-	1	1	1	1	1	1	1	1	1
Private + CIMMYT	-	-	-	-	-	-	-	-	-	-	1
Total	10	18	19	14	20	23	19	21	25	24	24
% of sales											
CIMMYT	-	-	-	-	4.3	4.9	7.6	15.7	23.4	14.2	9.3
Public	100	100	98.7	89.5	89.8	91.3	84.8	78.6	71.3	79.1	82.9
Private	-	-	1.3	10.5	5.9	3.8	7.7	5.7	5.3	6.6	6.5
Private + CIMMYT	-	-	-	-	-	-	-	-	-	-	1.3
Total	100	100	100	100	100	100	100	100	100	100	100

- ✓ In 2011, this company depended 100% on hybrids and varieties from INIFAP.
- ✓ By 2020, the company had incorporated 14 CIMMYT hybrids into its portfolio, which constituted more than 14% of its sales.
- ✓ By 2021, the company continued to sell 10 CIMMYT hybrids, representing 9.4% of its sales. In addition, it incorporated for the first time a hybrid of its own development with the use of CIMMYT lines.

Table 8: Company Five - Number of products and percentage of sales by category of germplasm origin, 2011-2021

Category	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Products in portfolio											
CIMMYT	-	-	-	-	4	3	4	4	3	two	two
Public	6	6	6	6	-	-	-	-	-	-	-
Private	-	-	1	-	4	5	5	3	3	3	4
Private + CIMMYT	-	-	-	-	1	2	2	4	5	4	9
Total	6	6	7	6	9	10	11	11	11	9	15
% of sales											
CIMMYT	-	-	-	-	36.4	38.9	26.6	9.8	11.4	8.6	4.5
Public	100	100	88.9	100	-	-	-	-	-	-	-
Private	-	-	11.1	-	54.5	54.6	69.4	47.7	37.7	55.6	40.8
Private + CIMMYT	-	-	-	-	9.1	6.5	4.0	42.4	50.9	35.8	54.6
Total	100	100	100	100	100	100	100	100	100	100	100

- ✓ In 2011, this institution also depended 100% on hybrids and varieties from INIFAP.
- ✓ The company successfully incorporated CIMMYT hybrids, which represented around 30% of its sales between 2015-2017.
- ✓ Since 2015, it has opted for the development of its own materials, which by 2020 represented more than 50% of its sales.
- ✓ This company also developed more than 10 private hybrids from CIMMYT germplasm, which by 2020 represented more than 35% of its sales, and in 2021 its hybrids with CIMMYT germplasm had a 54.6% share of its sales.

In contrast to Mexican companies, the number of products with CIMMYT germplasm developed by Latin American institutions in other countries (in the context of this study, namely Central America, Ecuador, Bolivia, Venezuela and Colombia) and the number of released products developed by CIMMYT for Latin American markets are mostly OPVs. In part, this is due to the fact that from 2010 to 2020, the Mexican government financed the development of hybrids, but of course with a focus on adaptability to the Republic of Mexico. In addition, in Mexico there is a greater development of seed companies than in Central America or even countries like Colombia or Venezuela. In fact, the National Seed Inspection and Certification Service of Mexico (SNICS) has the registry of more than 80 institutions that produce maize seeds and in Central American countries, apart from transnational companies, there are no more than five or so known seed companies per country. However, there is the fact that the Mexican seed regulatory environment allows different companies can produce and sell the same hybrid, which is not the case for Central America, Colombia, Ecuador, Bolivia and Venezuela, which has facilitated the emergence of a diverse and highly competitive seed sector in Mexico.

In Mexico, more than 99% of the products released by CIMMYT for sale are hybrids, while in the rest of Latin America (in the context of this study, this includes Central America, Ecuador, Bolivia, Venezuela, and Colombia) OPVs represent almost 80% of released CIMMYT products. In fact, four of the five best-selling CIMMYT products in these countries are OPVs and only one is a hybrid. Of these, the CIMMYT OPV *Posta-sequía* stands out, representing almost 50% of the sales of all CIMMYT products sold by our Latin American collaborators. The other three OPVs in the top five are S07TLYNHGAB2, S06TLWQ SEQ-LN AB, and Catacama 9043.

Regarding the “combination products” (maize products developed by collaborators using CIMMYT materials), in Latin America outside of Mexico there is information on the development of just over 20 products for the period 2010 and 2021 (NB: the dataset for 2021 is incomplete; as of this writing in August 2022, not all the institutions with which CIMMYT collaborates have provided information on their impact). However, it can be said with confidence that compared to Mexico, there are fewer combination products on the market in other Latin American countries. We have reported only nine of the 20 products marketed with the use of CIMMYT germplasm (products developed by our collaborators) in Latin America outside of Mexico, while in Mexico there are more than 50 products.

The number of institutions involved in the development and commercialization of products using CIMMYT germplasm is also very different, since in Latin American countries outside of Mexico there are approximately five such institutions, while in Mexico there are more than ten companies that have breeding programs actively using CIMMYT lines to develop and release new hybrids.

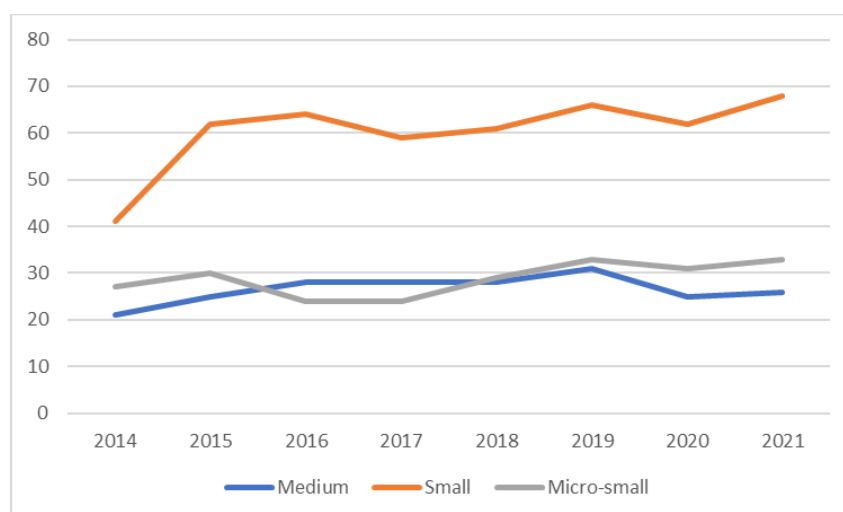
Additionally, it is to be noted that CIMMYT in Mexico has a much more active engagement with the private sector compared to many other Latin American countries, where the leadership has been maintained by public research institutions. That is to say, in Latin American countries outside of Mexico, commercialization of CIMMYT products is achieved through allocation of CIMMYT products to these public-sector institutions, who then register and sub-license them to commercial partners, whereas in Mexico, CIMMYT works directly with private-sector partners.

Changes in the product portfolio

The foregoing examples demonstrate that in recent years, in the case of Mexican seed companies, CIMMYT has strengthened its partnerships, contributing to accelerated varietal turnover in the Mexican market. Mexican seed SMEs’ product portfolios became more dynamic as they benefited from CIMMYT’s germplasm, and as they tried to compete and be efficient in placing their products on the market.

It is noteworthy that the 10 companies analyzed for this document increased the number of products in their portfolio since 2014 (Figure 9).

Figure 8: Number of products for the period 2014 to 2021 of the 10 companies that were part of the study



It is the four “small” companies that have the greatest number of products available and the largest growth in portfolio size, with an average of 10 products in 2014 to 17 by 2021, while medium-sized companies and micro-enterprises remained with the same number of products on average during the period 2014 to 2021. Medium-sized companies averaged 10 products each in 2014, only increasing to 13 products in 2021, while micro-small companies increased from an average of seven products each in 2014 to eight in 2021.

If we compare Mexican companies with CIMMYT collaborators in other Latin American countries, it can be said in general that the product portfolio in Mexico was renewed, while elsewhere in Latin America, the CIMMYT products on the market tend to be extremely old. For example, the only CIMMYT hybrid in the top five best-selling products was assigned in 1996, and the best-selling OPV was released in 2007.

We hope that this situation may improve in the coming years through the licensing of new CIMMYT hybrids to Latin American partners in recent years. We expect that by 2026 new CIMMYT products will become widely available across Latin American markets and begin to replace older, less advantageous products.

Table 9: Sales estimate for new hybrids assigned to Latin American collaborators

Allocated hybrid	Expected annual sales (tons)		
	1 st year after release	2 nd year after release	3 rd year after release
CLTHW14003 (Company 3, 4 and 6)	274	344	432
CLTHY15013 (Company 1)	60	80	100
CLTHY15031 (Company 4 and 5)	170	300	410
CLTHY16155 (Company 6)	200	200	200
CIM19LAPP1A-11 (Company 2 and 5)	110	180	280
CIM19LAPP1A-13 (Company 1 and 2)	48	70	140

Business markets

The companies of the Consortium, that is, the Mexican ones, in addition to increasing their sales volume, have also increased the number of states and municipalities of the Mexican Republic where they sell. The states with the highest sales in 2021 were Jalisco, Michoacán, Guerrero, Chiapas and Sinaloa.

In 2021, hybrids with CIMMYT germplasm were sold in at least 24 of the 32 states in the country and in more than 500 municipalities. Hybrids with CIMMYT germplasm have achieved a presence in the main maize-producing states of the Mexican Republic and with mature improved seed markets, such as Jalisco, Sinaloa and El Bajío; and they are also present in markets with low adoption of hybrids such as Guerrero and Oaxaca.

Figure 9: Sales and markets of maize seed products in 2014 of the Maize Seed Consortium

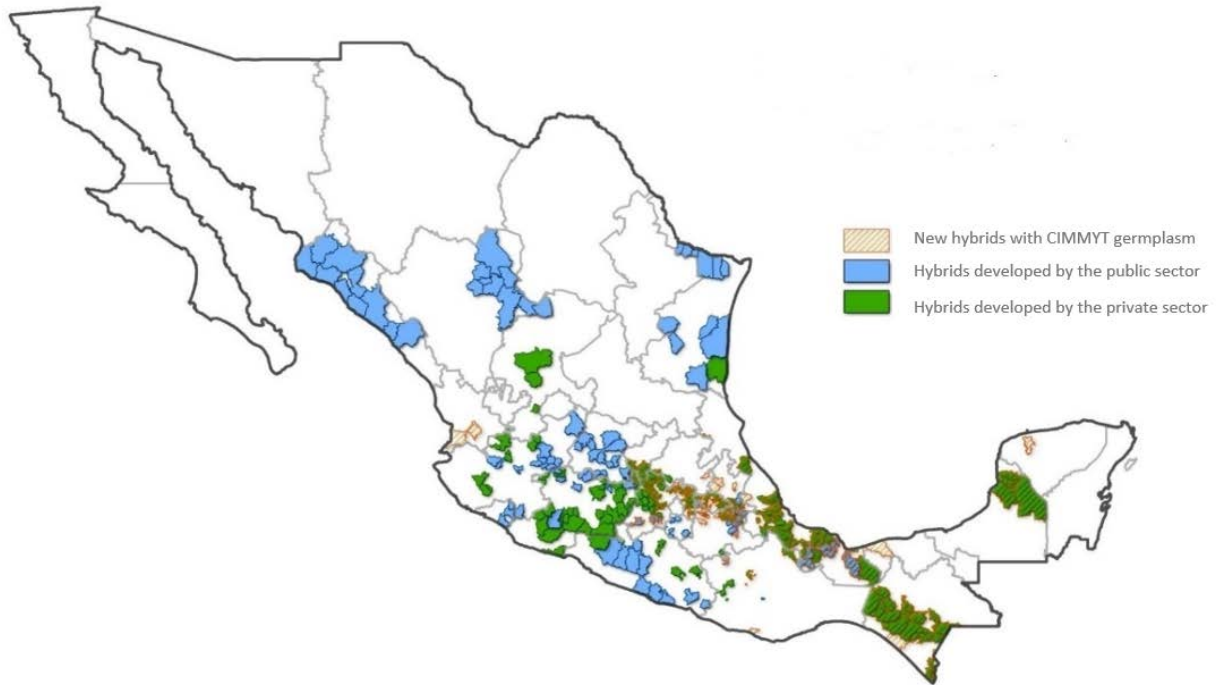
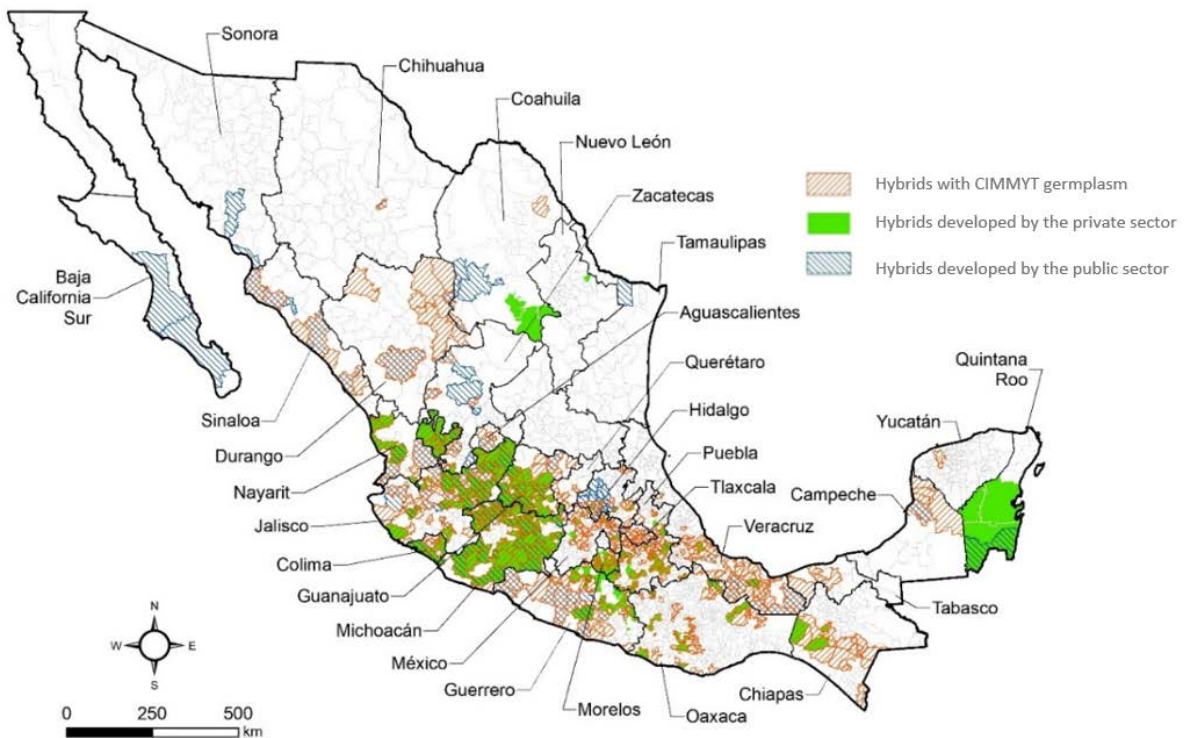


Figure 10: Sales and markets of maize seed products in the year 2020 of the Maize Seed Consortium



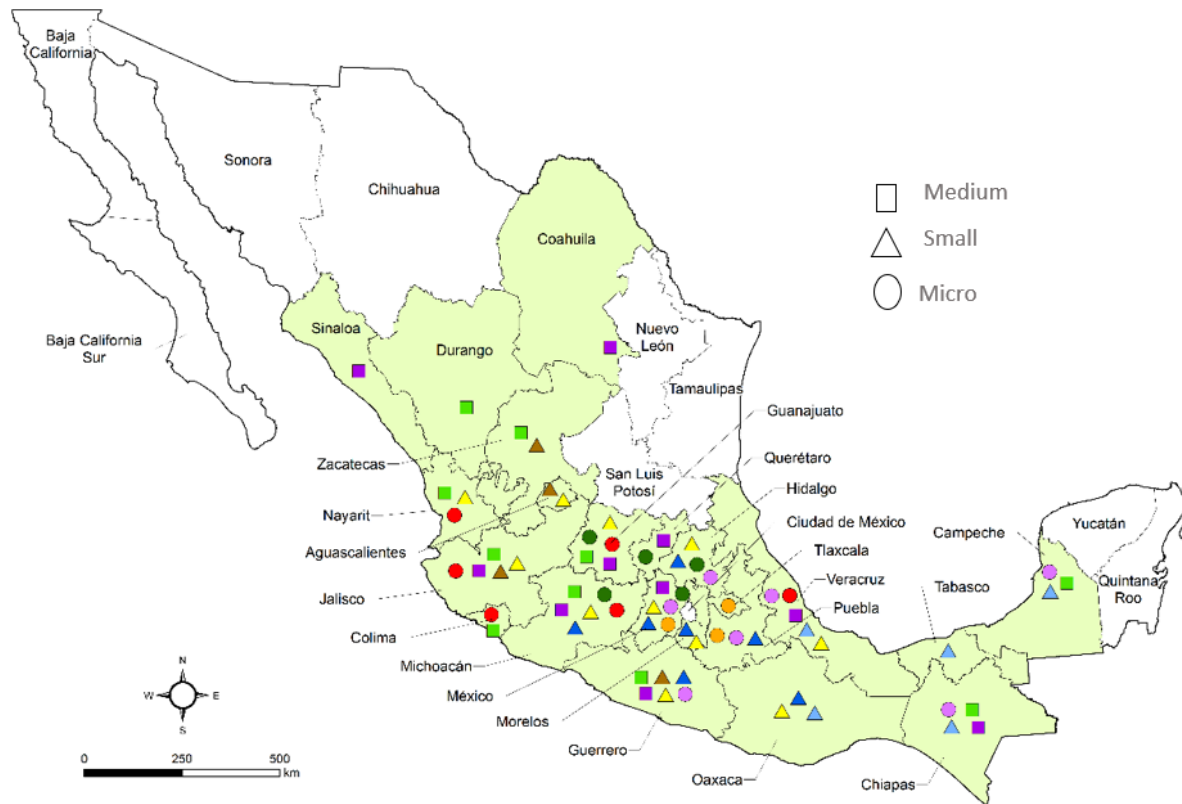
In specific reference to 100% CIMMYT hybrids (those developed by CIMMYT breeding programs), these are also present in at least 20 states of Mexico and in at least 400 municipalities.

We highlight that the presence of hybrids with new CIMMYT germplasm has been growing, as can be seen in Figure 9 and Figure 10. If we compare these two maps (one from 2014 and the other from 2020), we can see a growing number of municipalities with sales of materials with CIMMYT germplasm over the years, for example in the states of Oaxaca, Guerrero, Colima, Guanajuato, Michoacan, etc. It should be mentioned that CIMMYT programs target rainfed farms, hence the growth of sales with CIMMYT germplasm towards the center and south of the country, and not towards the north where the irrigated maize seed market predominates.

The Consortium seed companies had an estimated impact on a total of 940,414 hectares in 2021, assuming an average planting density of one bag per hectare (one bag sold equal to one hectare of impact), of which at least 213,472 hectares correspond to bags reported with CIMMYT germplasm; the remainder corresponds to private germplasm, or products whose pedigree was not reported.

Regarding the sample of ten companies analyzed, the medium-sized companies had a presence in at least ten states, the small ones varied from seven to eleven, and the micro-companies from three to seven. Of course, it is the medium-sized companies that reach more competitive markets such as Sinaloa, but they are also in other northern states such as Durango and Coahuila. The micro companies can have a presence in markets that are more complicated in logistical terms and the size of the land of the maize farmers, having a presence in areas that are less accessible to larger companies. Several states, such as Campeche, Chiapas, Guanajuato, Guerrero, Jalisco, State of Mexico, among others, host a variety of companies of varying sizes. Larger companies have the advantage of being able to reach markets that are more competitive in terms of product performance due to the participation of transnational companies, but the limitation of not reaching complex markets where smaller companies are able to carve out specialized niches.

Figure 11: States of the Mexican Republic with the presence of products from the 10 companies that were part of the study, year 2021 (each color represents a different company).



Marketing strategies

Regarding marketing channels, information was collected from six of the 10 companies in this study (three micro-small companies, one small, and two medium-sized). In this regard, agro-service stores are the most important marketing channel with a percentage that exceeds 55%, and in second place government sales, exceeding levels of 15%. Medium-sized companies are the least dependent on the government, and therefore, they do not have the limitation of receiving payment for their seed subject to the timelines and budget approvals of the government sector.

The biggest challenge for companies has been and continues to be the implementation of marketing strategies. Many of them, in fact, recognize that they do not have a defined strategy, and that the annual routine of seed production and sale overrides any strategic planning to reach or maintain new markets. In fact, they do not know what their main distribution channel is going to be from season to the next, making it impossible to implement campaigns or direct products to marketing channels or clients that could generate the greatest revenue.

The most common activities are establishing demonstration plots and hosting field days, where companies show off the benefits of their seed products to a significant number of farmers, and distribute promotional materials such as brochures, caps, pens, etc. However, there is no follow-up with these new farmers who show interest in their seed, nor concerted attempts to target farmers with the power to

convince other grain producers. In reality, the least frequent activities are the establishment of commercial plots with “witness” clients to show the results of their seeds with neighboring farmers, and in itself, it highlights the lack of seed promotion activities at the final point of sale with the farmers, agro-services or with the client grain producers of these agro-services

In fact, many companies are unaware of the behavior of their hybrids planted in the fields of their grain producing customers. After placing their seed in the agro-service store, the seed companies have no feedback mechanism to know what happens after the sale of their seed. As a result, seed companies struggle even to know where the seed went, much less if it worked.

In general, companies lack market information and the ability to generate this information, and therefore lack territory planning strategies, and medium- and long-term marketing strategies.

Discussion: Strengths and limitations

The analysis presented in this document indicates that Mexican seed companies have some strengths or limitations that are related to their size, and others that they all share, regardless of their size.

The dependency on germplasm from non-profit institutions (CIMMYT or other public research institutions) represents a limitation for smaller companies (micro -small and small companies). Larger companies have the advantage of resources to generate their own products through in-house breeding programs, making them less dependent. This can be extrapolated to companies across Latin America, since the smallest ones do not have breeding programs and therefore depend on public research institutions. However, the existence of improvement programs such as those of CIMMYT mean that micro or small businesses have access to competitive hybrids, as long as there is financing for the development of germplasm, was the case for Mexico from 2011 to 2020. Therefore, availability of germplasm ceased to represent barrier for Mexican companies to enter the market; as long as they continue to maintain said access this will be the case and ensure genetic diversity in the seed marketplace, and smaller companies will be able to hold their own against their larger competitors, since CIMMYT's germplasm has proven to be competitive both in terms of yield and agronomic traits. Nonetheless, dependence on public or CGIAR germplasm is a risk factor especially for smaller companies, considering the volatility of public and philanthropic sources of funding for these breeding programs⁴.

However, for many Mexican companies CIMMYT has become an enormously important source of germplasm, largely due to the boost provided by the MasAgro and Maize for Mexico projects, by providing resources to CIMMYT from 2010 to 2020 for the generation of tropical, subtropical and highland hybrids and parental lines, among other activities. This strengthened the companies by allowing them to diversify their portfolios and increase the number of products available to Mexican farmers. Although, as previously mentioned, the larger the size, the greater the number of self-developed products generated by the

⁴ It could be the case that, for example, CIMMYT prioritizes the generation of germplasm for other regions with higher levels of poverty and hunger than Latin America, and given the lack of resources, it must prioritize these regions, and temporarily suspend its breeding programs in Latin America, as happened with the breeding program for the subtropical area more than 20 years ago, and which could only be reactivated when the Mexican government provided resources for the generation of improved germplasm in 2010.

companies. This was not the case for our other Latin American collaborators outside of Mexico, who did not benefit from a robust, targeted breeding program for their own country; although they have access to CIMMYT products, those which remain today the most prevalent are from the 1990s or early 2000s and are no longer the most competitive. Resources are required to promote their replacement.

Another risk factor, particularly for the smallest companies, is when they rely on sales to the government. Yes, it is relatively easy to sell to governments, since marketing strategies and product positioning are not required, but it is also common for payments to be delayed or even incomplete, which of course may lead to problems of liquidity for the company. In addition, there is no guarantee that it will be sold every year, nor that any brand loyalty be generated with the grain producers. This dependency can affect both medium-sized and smaller companies, but it depends on the companies themselves to diversify their customer base. Sales to the government represent opportunities, but dependency should never be created. In fact, one of the companies analyzed in this document went from being a small business in 2020 to a microbusiness in 2021, for not having been able to maintain its sales to the Mexican government.

The market scope is another element that is influenced by the size of the company: medium-sized companies reach more competitive markets (such as Sinaloa in Mexico) as well as northern states such as Durango, and Coahuila; but the micro-enterprises, due to their locations, can have a presence in more complicated markets in terms of logistics and land size of grain producers, having a presence where the medium-sized ones do not reach as easily. Larger companies have the advantage of being able to reach the most competitive markets (especially those which are also targets of transnational companies and where only the highest-performing products survive), but the limitation of not reaching smaller, more complex markets. Therefore, government programs have a great opportunity in smaller companies, as they are able to access places that require more work, since they are more remote and populated by farmers with fewer resources and less land. Or, where appropriate, governments may consider offering incentives for medium-sized companies to go to these markets that may not currently be of interest to them.

Finally, marketing is a weakness for many seed companies, who often do not have a well-defined business strategy, may be unaware of their distribution channels, and may have no strategies for targeting or maintaining the most profitable customers. For example, there is no follow-up by seed companies to get feedback from the end users of their products, such that they even do not know the places where their seed was finally planted or how it performed. Companies choose to prioritize day-to-day activities, and do not place value nor invest in commercial strategies or brand or product positioning. It is not so easy to convince grain producers to adopt a new product, even if the one they currently plant has great agronomic or yield disadvantages compared to a new product; all the more reason why companies need to invest more in their marketing strategies.

Conclusion

In the case of Mexico, the country's problems are great, despite being among the ten world leaders in maize production, with a cultivated area of approximately 7.3 million hectares and an annual production of 22 million tons (SIAP, 2021). Even so, the country relies heavily on imports to meet its domestic grain consumption needs, mainly yellow corn for animal feed and industrial uses. Nonetheless, white-grain

maize continues to dominate the Mexican seed market. Though yields across the country can be significantly improved, it is not that Mexican companies do not have access to competitive products, as demonstrated throughout this document; indeed they do. The same cannot be said for collaborators in other Latin American countries, who have not benefitted from robust, country-focused projects aiming to replace obsolete products that continue to persist and even prevail in their national seed markets.

We have also highlighted that CIMMYT continues to be a pillar for the Mexican seed industry, given that most national companies do not have sufficient resources to develop their own research in germplasm generation, and even those that have achieved or maintained their improvement programs, make use of CIMMYT lines for the development of new hybrids.

It is true that investment in breeding programs such as those of CIMMYT, where hybrids or parental lines are efficiently released, have allowed the strengthening of Mexican seed companies, accelerating the development of new products and their commercialization in the market. In the last ten years, CIMMYT has developed and released dozens of final products (hybrids or OPVs), including at least 45 that have been marketed in Mexico between 2012 and 2021; therefore, CIMMYT's lines and final products continue to represent an opportunity for companies not only from Mexico but also from other Latin American countries to continue or modernize their seed supply, expand their sales and market share.

The participating companies of the Maize Seed Consortium in Mexico, including the 10 companies analyzed for this document, have responded satisfactorily by successfully introducing the new CIMMYT hybrids in their offer or CIMMYT lines within their portfolio, maintaining a more diverse and renovated seed portfolio. In the case of many other Latin American countries, unfortunately, the portfolio is not so diverse, and the renewal of products is urgent.

The growth of sales of CIMMYT hybrids in Mexico has been relatively constant since 2012 when they were first made available on the market (macroeconomic fluctuations notwithstanding). Likewise, the number of products (final hybrids) available to companies, the number of companies that market them and the commercial products available to the farmer have grown.

Therefore, the availability and supply of products is not the problem in Mexico, but there are challenges with regards to the marketing capacities of small- and medium-sized enterprises (SMEs) (lack of commercial planning, planning of territories, brand positioning and products with final producers, among others) which limitations the country's ability to achieve self-sufficiency. Furthermore, the tendency of some companies to rely on sales to the federal government generates high volatility in their sales and also in their liquidity.

This marketing weakness has been the great limitation of Mexican companies to influence those markets with lowest yields, dominated by smallholder farms and stress-prone environments. Therefore, in addition to maintaining a constant flow of competitive germplasm, there is a need for projects and programs that help seed SMEs improve their capacities in marketing and develop commercial strategies to reach complex and remote markets and improve the maize production in Mexico. Many other Latin American countries are a step behind: national companies need to inject new germplasm and, of course, also invest in generating demand for it.

Reference

SIAP. 2021. Statistical Yearbook of Agricultural Production. Retrieved September 1, 2022, from https://nube.siap.gob.mx/avance_agricola/