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# Factors Influencing the Acquisition of Corn Seed in the State of Veracruz, Mexico

## Factores que influyen en la adquisición de semillas de maíz en el estado de Veracruz, México

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## ABSTRACT

Corn production is a fundamental agricultural activity in Mexico. However, producers face significant challenges in accessing improved seeds that can optimize yields. Identifying the factors influencing the acquisition of these seeds is crucial for developing effective support strategies for local farmers. This study aimed to analyze the factors affecting the acquisition of improved corn seeds in three communities within the municipality of Paso de Ovejas, Veracruz, Mexico. A survey method and semi-structured interviews were conducted with 103 producers. Agricultural technicians and neighboring farmers were identified as the primary sources of information on seed use. Economic and social factors were found to have the greatest influence on access to information. Hybrid seeds from transnational companies, such as Monsanto and Pioneer, dominated the market, accounting for 83% of seed purchases. These seeds were more expensive than those from national companies, with an average cost of $5,728 per producer. Economic factors were determined to be the most significant influence on the purchase of improved seeds, outweighing social, political, and human factors.

**Keywords**: agricultural economy; aid programmes; collective farming; social group.

 

## RESUMEN

La producción de maíz es una actividad agrícola fundamental en México; sin embargo, los productores enfrentan desafíos significativos para acceder a semillas mejoradas que optimicen sus rendimientos. Identificar los factores que influyen en la adquisición de estas semillas es clave para desarrollar estrategias de apoyo efectivas para los agricultores locales. El objetivo de este estudio fue conocer los factores que influyen en la adquisición de las semillas mejoradas de maíz en tres comunidades del municipio de Paso de Ovejas, Veracruz, México. Se empleó un método de encuesta y una técnica de entrevista semiestructurada, que dieron como resultado la recopilación de 103 entrevistas. Se encontró que los principales medios de divulgación respecto al uso de semilla de maíz son el técnico agrícola y el productor vecino. Los factores económicos y sociales son los que tienen más influencia en el acceso a medios de información. Predomina el uso de híbridos de transnacionales en un 83% (Monsanto y Pioneer) los cuales son más caros que los híbridos de las empresas nacionales. El costo promedio en la adquisición de semillas fue de $5,728 por productor. El factor que tiene mayor influencia en la adquisición de semillas mejoradas es el económico por encima del social, político y humano.


**Palabras clave**: economía agrícola; explotación agrícola colectiva; grupo social; programas de apoyo.

## INTRODUCTION

Mexico ranked seventh worldwide in corn production (2.5%) in 2015 (USDA, 2016), and the state of Veracruz was sixth nationally in terms of production. Corn is a primary source of energy in the Mexican diet, with per capita consumption reaching 123 kg in 2009 and 167.8 kg of white corn in 2011 (SAGARPA, 2010; FAO, 2013).

The widespread adoption of technologies is perceived and embraced by corn producers to improve productivity and competitiveness. However, this adoption is heterogeneous, as reflected in corn production. Genetic improvement and seed innovation are established as key strategies for achieving higher yields, improved quality, and increased income for producers (Turrent, 2010; Donnet *et al*., 2012).

From 2008 to 2010, 160.2 thousand tons of seeds were used, with 42% being improved seeds and 58% being native seeds. To address the national deficit of improved seeds, research centers and governmental institutions have promoted the establishment of national seed-producing microenterprises (García & Ramírez, 2014).

According to a study conducted in the central zone of Veracruz, 84% of producers, who have an average age of 62 years and have not completed basic education, use improved seeds, while only 16% use native seeds. Transnational companies, such as Monsanto (34%) and Pioneer (13%), dominate the market share, while public research institutions, including the Colegio de Postgraduados (9%) and INIFAP (28%), provide a significant portion of improved seeds.

According to another study conducted in the municipality of Paso de Ovejas, Veracruz, corn production is the most important economic activity, covering 5,700 hectares. The primary challenge faced by producers is the high cost of seeds (SIAP, 2015). Over half (53%) of the population in this municipality lives in poverty, with corn as the main cash

 

crop and cattle raising as a secondary source of income in the primary communities of Bandera de Juárez, Paso Panal, and Acazónica. Therefore, primary sector activities (corn and cattle) represent the primary income source for producers, who are seeking to diversify their activities to meet their year-round needs (Candelaria *et al*., 2011; Zarazúa *et al*., 2012).

The average age of rainfed corn producers in Paso de Ovejas, Veracruz, is 55 years old, and most are living in poverty. This limits their purchasing power and ability to acquire essential inputs like raw materials. Additionally, a lack of organization hinders their ability to negotiate wholesale prices. To access improved seed technologies, some producers resort to personal loans, while others sell livestock or rely on government support programs such as PROAGRO, PROGAN, and PROSPERA.

The primary challenges faced by these producers include the accessibility of semi-enhanced seeds due to their cost and the limitations of the land, which often exhibits low fertility, erosion, and an eight-month dry season. This research hypothesizes that economic factors have the greatest influence on the acquisition and acceptance of improved seeds, outweighing social, political, and human factors. The objective of this study was to identify the economic, social, human, and political factors that impact the acquisition of improved corn seed in relation to access to information media in the Acazónica, Paso Panal, and Bandera de Juárez ejidos in the municipality of Paso de Ovejas, Veracruz.

## MATERIALS AND METHODS

This study was conducted in three ejidos within the municipality of Paso de Ovejas, Veracruz, located at coordinates 19°17’12”N to 19°18’26”N and 96°26’30”W to 96°27’16”W, at an average altitude of 40 meters above sea level, covering an area of 387.83 km$^2$, or 0.54% of the state’s total area. The primary economic activities in the region are agriculture and livestock.

A sample of 103 rainfed corn producers was selected from the three ejidos, based on a list provided by the Ejidal Commissariat and using the snowball sampling technique (Martín & Salamanca, 2007). Respondents were classified according to land ownership (ejido owners, small landowners, or both). A semi-structured questionnaire was administered to collect data on seed acquisition, which was operationalized in terms of access to information sources, genetic origin of seeds (hybrids and open-pollinated varieties), and seed-producing companies.

Seed acquisition was considered a function of the following factors and their respective analysis variables:

**Economic factors:** income per cycle, loan per hectare, land availability, government subsidies (PROAGRO), and credit from traders (including fertilizer, herbicides, insecticides, and seeds).

 

**Social factors:** formal and informal organizations and land tenure.
**Human factors:** age and education.

The data collected from 2018 were organized in a spreadsheet and analyzed using Statistica (Stat Soft Inc., 1984-2006, Tulsa, OK, USA). Parametric (ANOVA) and non-parametric (KW-H) statistical analyses were conducted, along with normality tests, analysis of variance graphs (Box-Whiskers), and calculations of the mean dependent variable in relation to the independent variable (Breakdown and one-way ANOVA). Both frequency and contingency tables were generated. All statistical analyses were performed at a 95% confidence level.

## RESULTS AND DISCUSSION

**Human factor.** Most producers are older (average age of 62 years, ranging from 50 to 84) with an average education level of only the third year of elementary school. These factors did not significantly influence access to information sources, corn-producing companies, or seed genetic origin (Table 1). This contrasts with Salas *et al*. (2013), who suggest that technology adoption is influenced by education and age. However, according to the technology adoption curve by Everett (1962), these, these producers may already be in a late stage of technology adoption.

Table 1. Mean age and education level of producers with respect to the information source, genetic origin of seeds, and corn-producing companies.

| Independent variables | | Age (years) | Education (years) |
|---|---|---|---|
| Information Sourcer | Neighboring farmer | 59 | 3 |
| | Agricultural technician | 54 | 4 |
| | Local middleman | 22 | 12 |
| | TV | 62 | 4 |
| | Brochure | 49 | 7 |
| | Demonstration plot | 49 | 5 |
| | City Council | 55 | 3 |
| | Traders | 53 | 5 |
| | Plot visits | 50 | 2 |
| | | *P*=0.47 | *P*=0.07 |
| Genetic origin of seeds | Hybrids | 55 | 4 |
| | Open-pollinated | 57 | 2.5 |
| | | *P*=0.70 | *P*=0.18 |
| Corn-producing companies | Monsanto | 54 | 4 |
| | Pioneer | 55 | 4 |
| | Semilla Rica | 56 | 5 |
| | CP | 56 | 2 |
| | INIFAP | 48 | 3 |
| | Natives | 65 | 2 |
| | | *P*=0.76 | *P*=0.76 |

**Social factor.** Regarding land ownership, producers with ejido land tenure feel more settled and secure. The study identified three types of land ownership: leasing, small landowner, and ejido. The majority of producers (58%) were ejido owners, while small landowners accounted for 47% in Bandera de Juárez. This is consistent with the findings of Serrano (1996), Zarazúa *et al*. (2011) who reported that the Mexican countryside is predominantly composed of ejidatarios and communal producers. Statistical differences were found between land ownership types (KW-H[3,12]=9.0117, *P*=0.0291; F[3,8]=15.35, *P*=0.0011).

Ejidatarios primarily rely on agricultural technicians for information, aligning with findings by Candelaria *et al*. (2011). Small landowners, on the other hand, often seek information from neighboring farmers and tend to purchase hybrid seeds from transnational companies (Table 2). This indicates that technology diffusion occurs through interpersonal channels, such as agricultural technicians and neighboring farmers.

According to Cadavid Higuita *et al.* (2012), the adoption of innovations, such as new seed varieties, can be influenced by the number of individuals who have already adopted the innovation. This suggests heterogeneity among producers in terms of innovation adoption, where individual behavior and social interactions play a significant role in driving change (Kiesling *et al*., 2012).

**Table 2.** Influence of information source, genetic origin, and producer companies on producer's land ownership type.

| | | Ownership Type (%) | | | |
|---|---|---|---|---|---|
| | | Tenants | Sm. Own. | *Ejidatario* | Both |
| **Information source** | Neighboring farmer | 4 | **17** | 12 | 1 |
| | Agricultural technician | 1 | 9 | **26** | 4 |
| | Local middleman | 0 | 0 | 1 | 0 |
| | TV | 0 | 0 | 2 | 0 |
| | Brochure | 0 | 0 | 2 | 1 |
| | Demonstration plot | 0 | 1 | 5 | 0 |
| | City Council | 1 | 1 | 6 | 0 |
| | Traders | 0 | 1 | 5 | 2 |
| Genetic Origin | Open-pollinated | 2 | 1 | 6 | 0 |
| | Hybrid | 4 | 27 | **52** | 8 |
| Corn Production Companies | INIFAP | 1 | 1 | 2 | 0 |
| | CP | 1 | 0 | 2 | 0 |
| | Semilla Rica | 1 | 0 | 4 | 2 |
| | Pioneer | 3 | 12 | 18 | 3 |
| | Monsanto | 0 | 16 | **30** | 3 |
| | Nativas | 0 | 1 | 2 | 0 |

Regarding formal organization, no producer organizations were identified in the corn production or agricultural sector. However, 14% of producers were affiliated with the Local Cattle Association of the municipality of Paso de Ovejas, while 86% were not part of any organization. This suggests that age and education level may limit producers' business vision and awareness of the benefits of organizing.

While formal organizations were absent, 44% of producers engaged in informal organization through family labor exchange, known as "días vueltos" or "mano vuelta." This involves exchanging labor among group members to collectively complete tasks like harvesting, cob peeling, and shelling, which are labor-intensive activities. This strategy is particularly common among low-income producers to access labor and economic resources. This type of informal organization is specific to this municipality, as other studies have not reported similar practices in other regions or for crops like coffee (Candelaria *et al*., 2011).

Additionally, 30% of producers organize with family or trusted friends to purchase seeds, fertilizers, and agrochemicals, while 70% purchase these products individually from traders or informal markets. This informal organization may serve as a strategy to reduce production costs, potentially due to distrust in existing producer organizations or limited awareness due to age and education factors. Producers often prefer to organize with community members they know and trust. Furthermore, fluctuating oil prices and political factors can impact the price of production inputs (seeds, fertilizers, and agrochemicals), limiting the effectiveness of government subsidies and support programs (Rubio, 2008).

The limited organization of producers in the three ejidos is complemented by the support of technicians, primarily from seed, fertilizer, and agrochemical companies (Candelaria *et al.,* 2011). Organized producers, both formally and informally, often rely on agricultural technicians as their primary source of information, leading to the widespread adoption of hybrid seeds from transnational companies (Table 3). According to Aguirre *et al*. (2011), agricultural technicians play a crucial role in disseminating technology, as producers have limited access to knowledge, adoption, and implementation strategies. This highlights the complex nature of technology adoption, which cannot be solely explained by social processes and diffusion mechanisms (Everett, 1962).

 

**Table 3.** Formal and informal organization of producers with respect to the influence of information sources, genetic origin, and corn production companies.

| Independent variables | | Formal organization (%) | | Informal supportive organization (%) | | | |
|---|---|---|---|---|---|---|---|
| | | | | "días vueltos" | | Does they buy to a Wholesaler? | |
| | | No | yes | no | yes | no | yes |
| Info. Source | Neighboring farmer | **31** | 2 | 17 | 16 | 22 | 11 |
| | Agr. Tech. | **31** | **9** | **23** | 17 | 25 | 15 |
| | Local middleman | 1 | 0 | 1 | 0 | 1 | 0 |
| | TV | 2 | 0 | 1 | 1 | 2 | 0 |
| | Brochure | 3 | 0 | 2 | 1 | 2 | 1 |
| | Demonstration plot | 5 | 1 | 2 | 4 | 5 | 0 |
| | City Council | 6 | 2 | 4 | 4 | 7 | 1 |
| | Trader | 7 | 1 | 3 | 5 | 6 | 2 |
| Genetic Origin | Hybrid | **77** | **15** | 50 | 42 | 65 | 26 |
| | Open-pollinated | 9 | 0 | 4 | 5 | 5 | 4 |
| Corn Production Companies | Native | 1 | 2 | 1 | 2 | 2 | 1 |
| | INIFAP | 3 | 0 | 3 | 0 | 2 | 1 |
| | CP | 0 | 3 | 0 | 3 | 1 | 2 |
| | Semilla Rica | 4 | 3 | 4 | 3 | 4 | 3 |
| | Pioneer | 20 | 16 | 20 | 16 | 28 | 8 |
| | Monsanto | **25** | **23** | **25** | 23 | 33 | 16 |

**Economic factor**. The analysis focused on information sources mentioned at least twice by producers. Statistical differences were identified between information sources and five economic factor variables (Table 4). No significant differences were found for seed genetic origin or corn producer categories, except for loans. Producers who relied more heavily on loans tended to purchase seeds from transnational companies.

The study revealed that transnational companies supply corn seeds to traders and City Councils, who then distribute them to producers through established agreements. Governmental programs and support initiatives, such as Proagro, were identified as the primary source of funds for producers to pay back loans. This financial assistance is critical for producers' income. However, due to the program's requirements, seed purchases are restricted to companies or brands that have agreements with the City Council. This limits producers' choice and grants transnational companies significant control over the national seed market. As highlighted by García & Ramírez (2014), establishing a foundation for national seed producers could be a potential strategy to reduce this market dominance. Additionally, Candelaria *et al*. (2011) emphasize the strong dependence of Paso de Ovejas producers on government assistance, considering it an essential component of their income.

 

Agricultural technicians play a crucial role in seed distribution. Once an agreement is established between the City Council and traders (supplied by transnational companies), technicians conduct presentations and demonstrations to educate producers. Producers who receive information from agricultural technicians or neighboring farmers tend to allocate a higher percentage of land to corn cultivation (Table 4). This aligns with the findings of Zanetti (2000) and Zarazúa *et al*. (2012), who suggest that producers with larger landholdings and greater economic resources may have better access to information on specific technologies.

**Table 4.** Influence of information source, origin, and traders for five variables for the economic factor.

| Independent Variables | | Income from other crops | Income from ProAgro | Government Program Income | Loan | Percentage of corn area (%) |
|---|---|---|---|---|---|---|
| Information Source | Neighboring farmer | 0.10 | 2.14 | 4.07 | 0.75 | 60.72[a] |
| | Agr. Tech. | 5.31[a] | 3.65 | 5.45 | 5.95 | 47.28[a] |
| | TV | 0.18 | 4.90 | 5.23 | 0.00 | 33.33 |
| | Brochure | 0.00 | 7.50[a] | 10.33[a] | 0.00 | 60.31[a] |
| | Demonstration plot | 3.24 | 2.94 | 3.90 | 0.00 | 57.09[a] |
| | City Council | 3.45 | 5.51[a] | 8.65[a] | 7.51 | 17.19 |
| | Trader | 0.25 | 6.40[a] | 9.58[a] | 24.85[a] | 44.13 |
| | | P= 0.002** | P= 0.01* | P= 0.03* | P=0.02* | P=0.03* |
| Genetic origin | Fee pollination | 2.8861 | 3.4388 | 3.8955 | 0.0000 | 39.7187 |
| | Hybrids | 2.6119 | 3.6703 | 5.8180 | 3.8949 | 50.9654 |
| | | P=0.93 | p=0.86 | p=0.29 | p= 0.58 | p=0.33 |
| Corn Producers | Natives | 7.2000 | 3.4333 | 3.4333 | 0.0000 | 3.8172 |
| | INIFAP | 0.0000 | 1.6166 | 1.6166 | 0.0000 | 47.0851 |
| | CP | 1.4583 | 5.2666 | 5.2666 | 0.0000 | 50.0000 |
| | Semilla Rica | 4.3214 | 2.5000 | 2.5000 | 0.9442 | 56.5819 |
| | Pioneer | 1.6986 | 3.6541 | 3.6541 | 0.8121 | 47.1255 |
| | Monsanto | 3.0484 | 3.8462 | 3.8462 | 6.5893[a] | 57.0206 |
| | | p= 0.902 | p=0.83 | p=0.77 | p=0.02* | p=0.17 |

a= values with the same letter are the same statistics Tukey p≤ 0.05. ** y * = significant at a probability of p≤ 0.01 and p≤ 0.05, respectively, according to the F test.

Only 23% of interviewees purchase seeds directly from seed traders, aligning with the findings of Candelaria *et al.* (2011). The remaining 77% obtain seeds through government assistance programs. This 23% figure is higher than the 4% reported by Ramírez *et al*. (2007) in the state of Puebla, likely due to differences in purchasing power and access to government support programs.

 

Producers who receive loans from traders and government subsidies through programs like Proagro tend to acquire corn seeds from transnational companies (Figure 1). This finding is consistent with Galindo *et al*. (2000) and Serrano (1996), who reported that 12% of producers used loans to finance their crops.

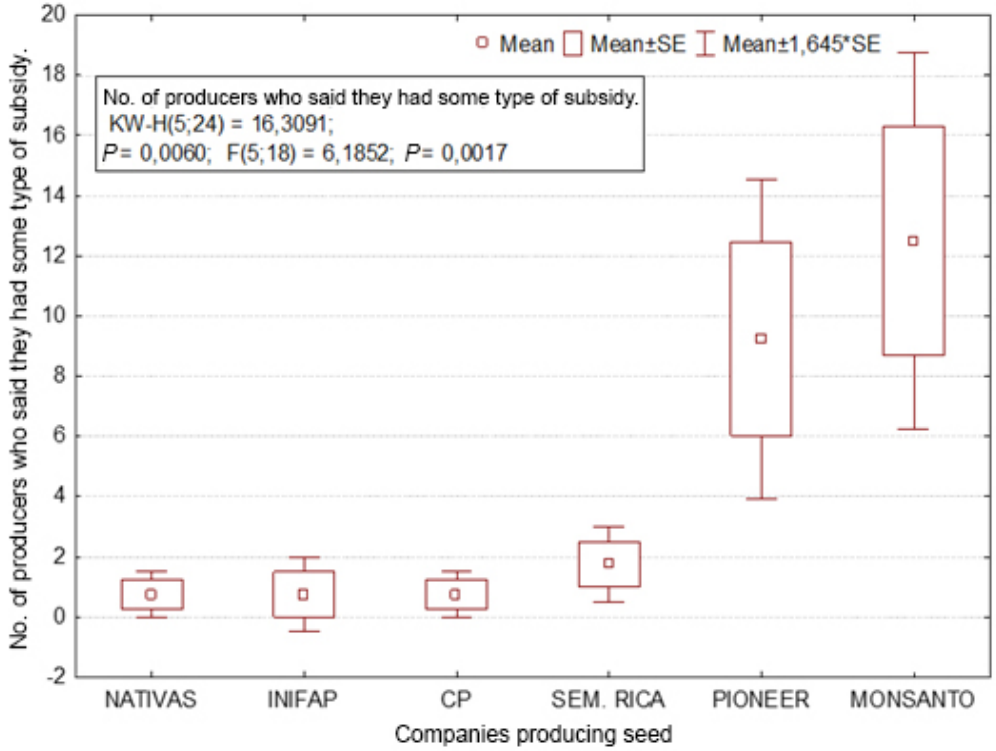


**Figure 1.** Seed corn companies preferred by producers.

Producers who purchase seeds from transnational companies pay higher prices than producers who purchase them from research centers (Figure 2). This is consistent with reports from Luna *et al.* (2012), who found that transnational companies are the top seed distributors in Veracruz (Mainly: Monsanto, Pioneer and Syngenta).

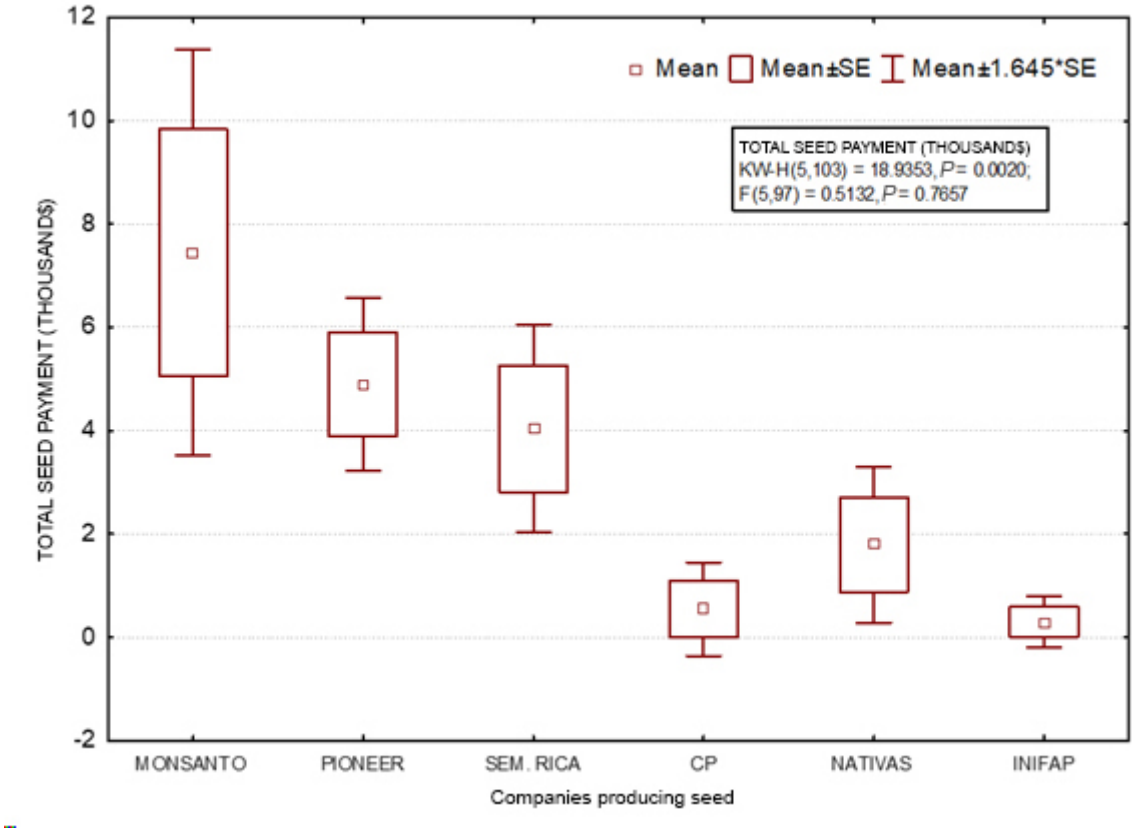


**Figure 2.** Analysis of variance graph of seed companies for the total payment of bags purchased by producers.

In terms of genetic origin, the seeds sown by producers were primarily hybrid seeds (H) and open-pollinated varieties (OP). This aligns with Espinosa *et al*. (2004), who noted that since 1940, Mexico has primarily relied on hybrid and open-pollinated varieties to meet national demand. While hybrid seeds are more expensive than open-pollinated varieties, producers generally prefer hybrids (Figure 3). This preference is consistent with Torres *et al*. (2015), who found that medium and large producers tend to sow more expensive hybrid seeds. However, it's important to note that hybrid seeds reach their maximum genetic potential under irrigated conditions and fertile soils, as reported by Sierra *et al*. (2016).

The increased adoption of hybrid seeds can be attributed to the influence of multinational corporations, which have gained significant market dominance, displacing public sector programs focused on developing improved corn seeds adapted to local conditions (Turrent *et al*., 2012) (Figure 3).

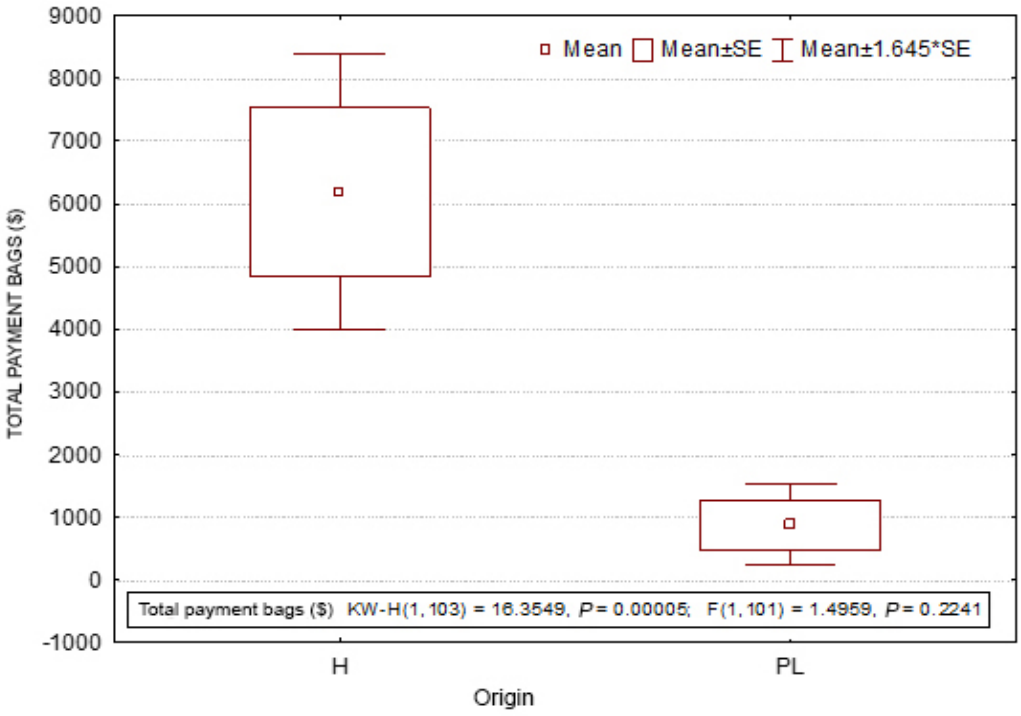


**Figure 3.** The genetic origin of the corn seed purchased by producers for the total payment of bags.

## CONCLUSIONS

The factors influencing the purchase of corn seeds in the studied ejidos of the municipality of Paso de Ovejas, Veracruz, include purchasing power and access to technical information provided primarily by agricultural technicians. Due to these factors, the majority of seeds used originate from transnational companies, leading to a loss of local genetic materials and increased dependence on external inputs and technologies.

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**Conflict of interest:** The authors declare that there is no conflict of interest regarding this manuscript.

## BIBLIOGRAPHIC REFERENCES


Aguirre, C.; Escobar, A.; Zúniga, T.; Rodríguez, R. (2011). Enfoques de extensión y adopción de tecnologías de conservación de suelos. Estudios de casos con ongs de esteli, boaco y matagalpa. *La Calera*. 6(7): 55-59.

Candelaria, B.; Ruiz, O.; Gallardo, F.; Pérez, P. (2011). Aplicación de modelos de simulación en el estudio y planificación de la agricultura, una revisión. *Tropical and Subtropical Agroescosystems.* 14(3): 999-1010.

Cadavid Higuita, L.; Awad, G.; Franco Cardona, C. J. (2012). Análisis bibliométrico del campo modelado de difusión de innovaciones. *Estudios Gerenciales.* 28(EE): 213-236. https://doi.org/10.18046/j.estger.2012.1486

Donnet, L.; López, D.; Arista, J.; Carrión, F.; Hernández, V.; González, A. (2012). *El potencial de mercado de semillas mejoradas de maíz en* México*.* Mexico: CIMMYT. 30p.

Espinosa, A.; Tadeo, M.; Sierra, M.; Gómez, N.; Coutiño, B.; Palafox, A. (2004). Mejoramiento genético y conservación de biodiversidad del maíz en México. http://www.somedicyt.org.mx/congreso_2004/ponencias/biodiversidad/Espinosa_Calderon_ext.pdf

Everett, R. (1962). *Diffusion of innovations*. New York: Free Press. 67 p.

FAO (Organización de las naciones unidas para la agricultura y la alimentación). (2013). Panorama de la seguridad alimentaria y nutricional en México 2012. http://www.colpos.mx/wb_pdf/Panorama_Seguridad_Alimentaria.pdf

Galindo, G.; Tabares, W.C.; Gómez, G. (2000). Caracterización de los productores agrícolas de seis distritos de desarrollo rural de Zacatecas. *Terra.* 18: 83-92.

García, A.; Ramírez, J.R. (2014). El mercado de la semilla mejorada de maíz (*Zea mays l.)* en México. Un análisis del saldo comercial por entidad federativa. *Fitotecnia de México*. 37: 69-77.

Kiesling, E.; Günther, M.; Stummer, C.; Wakolbinger, L. (2012). Agent-based simulation of innovation diffusion: a review. *Central European Journal of Operations Research*. 20(2): 183-230. https://doi.org/10.1007/s10100-011-0210-y

Luna, M.; Mena, A.; Hinojosa, J.; Ayala, F.; Castillo, A.; Mejía, C. (2012). Perspectivas de desarrollo de la industria semillera de maíz en México. *Revista Fitotecnia Mexicana.* 35(1): 1-7.

Martín, C.; Salamanca, B. (2007). El muestreo en la investigación cualitativa. *Nure Investigación*. (27): 4.

Ramírez, B.; Ramírez, V.G.; Juárez, P.; Cesín, V.A. (2007). Tecnología e implementos agrícolas: estudio longitudinal en una región campesina de Puebla, México. *Revista de Geografía Agrícola.* 38: 55-70.

Rubio, B. (2008). De la crisis hegemónica y financiera a la crisis alimentaria impacto sobre el campo mexicano. *Argumentos UAMX*. 21(57): 35-52.

Salas, G.; Leos, R.; Sagarnaga, V.; Zavala, P. (2013). Adopción de tecnologías por productores beneficiarios del programa de estímulos a la productividad ganadera (PROGAN) en México*. Revista Mexicana Ciencias y Pecuarias*. 4(2): 243-254.

Serrano, V. (1996). Caracterización de los productores de maíz de la planicie de la costa de Oaxaca. *Revista mexicana de*


 

*la ciencias agrícolas.* 22(2): 199–217. https://doi.org/10.29312/remexca.v11i7.2344

Sierra, M.; Rodríguez, M.F.; Palafox, C.A.; Espinosa, C.A.; Meza, P.A.; Gómez, M.N.; Valdivia, B.R. (2016). Productividad de semilla y adopción del híbrido de maíz h-520, en el trópico de México. *Agricultura, Sociedad y Desarrollo.* 13(1): 19-32.

Secretaría de Agricultura Desarrollo Rural Pesca y Alimentación (SAGARPA). (2010). Estudio de Gran visión y factibilidad económica y financiera para el desarrollo de infraestructura de almacenamiento y distribución de granos y oleaginosas para el mediano y largo plazo a nivel nacional. https://acortar.link/4t3ZCW

Servicio de Información Agroalimentaria y Pesquera (SIAP). (2015). Estadísticas de producción de semilla del año agrícola 2014. https://nube.siap.gob.mx/cierreagricola/

Torres, N.E.; Geoconda, P.P.; Mercedes, M.M.; Sánchez, L.A.; Muñoz, R.G.; Manosalvas, V.C.; Vargas, B.C. (2015). Financing of Corn Crops in Mocache Canton, Ecuador. *Revista Amazónica Ciencia y Tecnología.* 4(3): 270-300.

Turrent, F.; Wise, T. A.; Garvey E. (2012). Factibilidad de alcanzar el potencial productivo de maíz de México. *Mexican Rural Development Research Reports*. 24: 36.

Turrent, F. (2010). El potencial productivo del maíz. *Ciencias*. 92(092): 126-129. https://www.revistas.unam.mx/index.php/cns/article/view/14840

United States Department of Agriculture (USDA). (2016). Mexico Grain and Feed Update. https://acortar.link/V58sRU

Zarazúa, J.A.; Almaguer, V.G.; Rendón, M.R. (2012). Capital social. Caso red de innovación de maíz en Zamora, Michoacán, México. *Cuadernos de Desarrollo Rural*. 9(68): 105-124. https://doi.org/10.11144/Javeriana.cdr9-68.cscr

Zarazúa, J.A.; Almaguer, V.G.; Ocampo, L. (2011). El programa de apoyos directos al campo (PROCAMPO) y su impacto sobre la gestión del conocimiento productivo y comercial de la agricultura del estado de México. *Agricultura Sociedad y Desarrollo*. 8(1): 89-105.

Zanetti, L. (2000). Investigación exploratorio-descriptiva sobre medios de difusión y comunicación en la ciudad de Córdoba. *Revista Latina de Comunicación Social.* 3(35). https://www.redalyc.org/articulo.oa?id=81933512

 