Current status and strategies for Harvest Mechanization of peanut in Mexico

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ABSTRACT: *This work aims to analyze the peanut crop mechanization in Mexico, as this is a key factor for increasing the productivity of the crop, the sowing area is currently down, for this literature review is performed mechanical systems used in the production of this crop can be inferred from the review that the current problem is the harvest as there are no mechanical or machines designed in the country for the peanut crop systems, also there are restrictions on the adoption of models imported peanut harvester; a.-high initial acquisition cost differences b.- local farming systems c.-difficulty of proper maintenance and spare parts. Concluding that to promote the mechanization of production of peanuts in Mexico, urges institute the following future strategies; Make appropriate economic and agronomic conditions in the country with commercial impact for harvest designs since the other necessary operations can be machined as tillage, planting and cultural treatments have adequate and accessible tools for farmers and focus on, 1. - efforts to design an implement to dig and shake peanut of animal traction or traction for two wheels tractor 2.- efforts to develop a harvester for small properties of animal traction or traction for two wheels tractor 3.- efforts to design an appropriate harvester to medium sized properties*

Keywords *- Mexico, Agricultural mechanization, Peanut*

I. INTRODUCTION

Mexico has an area of 198 million hectares of which 15% is devoted to agriculture, climate and topography limits crop production to 20.6 million hectares, accounting for 10.5% of the total in the country. Likewise Mexico has a population growth of 1.2% World Bank 2013. The survival of a nation depends on how well its agriculture meets the needs of its population. With the increase in population is increasingly necessary food, but to meet the demand for agricultural mechanization is needed, rather than rural population decreases while the urban population increases. Since it is necessary to provide adequate tools to rural people to enable them to provide food and other agricultural inputs to the urban population .

The objective of agricultural mechanization is to produce more and better food more efficiently using water and energy occupying the same area of arable land. In our country the state should develop agricultural mechanization following the example of US agricultural policy which is aimed at adding value to agricultural produce, regulating the prices of some products between crops and subsidizing others to encourage production, and Japan that besides using a similar to that of EU policy seeks to maintain profitability and supports the use of technology in the agricultural sector. In both cases the implementation of mechanization was successful, because the state supports investment in agriculture when acting directly or indirectly in prices when investing in technology. Negrete, 2014.

For peanut crop production has declined due to low productivity and profitability of the crop. Since 1983 was when a production record of 170,433 ton. was obtained. with a yield of 2.04 t / Ha. Since today is 94848.58 production Ton / Ha .With a yield of 1.77 ton / ha.SIAP.2014.

The country has a shortage of about 100,000 tons per year to meet domestic demand, so you can identify regions with greatest potential to find business opportunities and leverage the domestic market demand. Esquivez 2011.

Santos 2013. Relates that peanut harvest is the critical moment. The peanut is grown in a short period of time during the reform of the sugar cane fields, providing a better use of agricultural areas in the region of Jabotical, SP.

Machine harvesting is around peanut essential for optimization of this oilseed crop on a commercial scale, Camara 2006 apud Zerbato 2013, also Wessler at.al. 2007 apud Zerbato 2013 claim that starting operations and mechanized harvesting due to increased operational capacity, provide greater possibilities for expanding areas of this crop.

Compagnon, 2013. The mechanical harvesting of peanuts is critical in the process of crop production.

The mechanization of agricultural production processes, mainly the crop is essential for the expansion of the area of peanut simple to transform subsistence farms in business activities necessary to socio-economic development and the growing demand for food. For the relevance exposed culture is vital and overriding continuous development of technologies, both in management practices, such as agro-machinery and components, thus achieving more efficient and closer to the entire chain of primary production peanuts. Boreto ,2011.

In this paper the role of mechanization is discussed in problem solving to increase efficiency and aims to contribute to increased production and productivity of peanut through appropriate mechanization of harvesting. The aim of this study is, therefore, present an overview of the state of mechanization of peanut in Mexico, based on national and international data.

2.- Literature Review

2. 1 History and Botanical peanuts.

The peanut (Arachis Hypogea L.) is native to warm regions of America plant; Brazil, Cuba and Mexico and was known since before the arrival of Columbus, having peanuts found in Peruvian tombs of Ancon area corresponding to the period of at least 1200 BC Moreover, in Mexico and was known by the natives since before the founding of Tenochtitlan. The peanut plant belongs to the leguminosae, autogamous, annual family, whose grain or kernel is oily. The plant consists of a primary root that is pivoting, which can reach up to 1.30 m depth, which in turn numerous secondary and tertiary roots form a dense network originate radical. The cultivated peanut belongs to the genus Arachis and anfidiploides series. The species L. Arachis Hypogeaea has two subspecies; Hypogaea and fastigata, each of these are two botanical varieties. Barrera, 2002.

2.2 Peanut Production in the world.

Globally China, India and Nigeria are the leading countries in terms of production and acreage but the prevailing situation in China, Argentina, Egypt and Vietnam which have a high production yield of peanut due to the fact that give importance to mechanization, because China has continued research in this area and currently manufactures two combines low power and a starter coupled to implement a rototiller turner.

The same is the case of Vietnam that is experimenting with a combine harvester and a stationary peanut. Quoc,2006.

2.3 Cultivation of peanut in Mexico

	sown area Has.	production tonnes	Yield Ton/ha.
Sinaloa	16,430.10	25,395.80	1.56
Chihuahua	7,532.31	23,256.20	3.09
Oaxaca	6,709.90	10,967.49	1.69
Puebla	6,317.90	6,980.70	1.10
San Luis Potosi	3,436.00	3,875.50	1.13
Total Mexico	57,354.31	94,848.58	1.77

Table 1 Area, production and yield in states with more production production in Mexico .SIAP.2014

Joaquín, 2005 relates that in Guerrero to erect varieties row spacing is between 48-60 cm and between plants of 25-40 cm. In Morelos to short guide varieties are furrows 50 cm apart and 90 cm for long guide varieties and for erect varieties to 75 cm and between plants a distance is 40 cm., in Puebla for creeping type varieties row spacing is 75 cm and 20-30 cm between plants. The varieties grown in Mexico are regionalized, the varieties erect growth habit Virginia type large seeds are the most commonly grown in Guerrero and Morelos. The creeping growth habit and Spanish Runner type of small seeds are grown in Morelos and Puebla .The creeping Virginia type varieties of large seeds that require more labor to harvest handling and cultured in minimum area and southern Morelos -this Puebla. Finally the fastigata subspecies creeping growth habit type Valencia

having 3 or smaller per fruit and seed cuticle purple, backyard grown in Puebla.

variety	habit growth	height plant cm	days flowering	yield straw ton/ha.	Fruit yield ton/ha.
RF-214	Semi rastrero	35	35	4.3	1.8
Huitzuco 93	rastrero	65	33	5.8	1.6
A-18	erecto	54	33	4.0	1.7
Ranferi Diaz	erecto	57	35	4.0	1.7
Rio balsas	erecto	58	33	5.5	1.7

Table 2 Main characteristics of some varieties grown in Mexico. Source Joaquín et.al.2005

Barrera 2002 ,relates that in Morelos short guide to varieties planted 50cm to erect growth varieties sown at 75 cm, for varieties of long furrows guide is 90cm. and harvest a moldboard plow is used to turn the plants and fruits are exposed peanut. In light soils the plants can be started manually and fruit plants emerge mechanically or manually.

Angulo S.J.R; Joaquín T.I.c .; In Sinaloa varieties erect growth for mechanical planting is recommended; row spacing is 75 cm., nine grains per meter are seeded at 6 cm deep. The peanut harvest when the foliage begins to turn yellow brown, and a maturity of 75-80% present process must be harvested at 4 steps:

1.-cut guidelines 2.- plants start fruiting plants 3.- swath threshing 4.-Threshing is to boot the fruits of plants.

In San Luis Potosi performing the work culture are; sowing, weeding, weeding, pesticide application, harvesting and post-harvest work, wages required 16 8 hours on average at a rate of 100-120 pesos per workday. Planting is done in rows 90 cm. and 25 between plants, to reap the producers tear kills manually and reach harvest between 1.3 ton / ha. Under rained conditions this practice is the most expensive so using a thresher would lower production costs and be more profitable crop, since this production costs 4965 pesos would be obtained without machinery increased to 7860 mexican pesos . Anonymous 2008.

Duran 2011. In the state of Veracruz recommended to plant at a distance of 60 cm. between rows and 40 cm. between plants to erect varieties being a density of 80.000 to 90.000 plants / ha. being used 75 kg of seed per ha., and 75-80 cm. between rows and 60 cm. between plants creeping varieties with a density of 50,000 plants / ha. Equivalent to using 47 kg of seed per hectare. The boot is between 120 and 125 days when the husk (cuticle) seed take a pink color.

Fosado 2011 relates that peanut acreage decreased by high production costs 11.000 to 14.000 pesos and low productivity 1.5 ton / ha .The domestic market is not supplied by domestic production. No assessment of varieties demanded by the market for the snack industry and oils demonstrating the technological components; use of new varieties, organic fertilization and crop mechanization peanut: Drill, starter, combine, sheller and toaster needed to increase production cutting times, increasing the% increments desired by Ha, improving production systems at low cost machinery and greater profitability. Having unwillingness to technological change, high attachment to traditional methods, low availability to innovation, few lines of research, lack of support for the development of new research, lack of adaptation of existing technologies.

Ojeda 2014 .From 2008 to 2011 apparent consumption of peanut in the country was more dynamic than the production: consumption grew at an annual average rate of 3.9% in this period, while production fell by 0.4 percent . This caused that in 2011 the average rural price quoted in 10,772 Mexican pesos per ton. Furthermore, it is noteworthy that the increase in apparent consumption was attended by imports, mainly from the United States. It is important to note that imports represent on average 115,000 tons annually. Thus, a window of opportunity for the case of peanut due to increased consumption, generated in part by the benefits it has for health to work as a high antioxidant healthy protein and its contribution to reduce the presence of observed chronic cardiovascular diseases and demand for the oil industry. Finally, for the current spring-summer 2014, near Guamuchil, Sinaloa., through a technological package consisting of improved seed, fertilizer and under rained conditions, the technical economic parameters peanut crop are: production cost 10,076 pesos per hectare; rural average price

8,000 Mexican pesos per ton, and a yield of 1.5 tons per hectare. Thus, a benefit / cost ratio of 1.2 is obtained.

De Rosas 2014.In Puebla peanut harvest has reduced its costs by up to 32% Production costs range from 11 to 15,000 Mexican pesos and selling Kg 6-7 Mexican pesos, with a yield of 1 to 1.5 ton / ha. In Puebla producers have an average of 3 hectares, 20 hectares Chihuahua. 20 average wages in a week is required only for manual starting in Ha. Another 20 for the off. Combine with rises in two-hour Ha. In 5700 Mexican pesos manual harvesting is spent, and mechanized slope of 3100-2400 Mexican pesos.

2.4 Peanut Harvest Systems.

The harvest time defined by the humidity and crop maturity, the start is 35-45% humidity and harvest and 18-24% humidity when maturity is greater than 70%.

To determine maturity Scrape Hull method is used , which consists of starting 5 representative plants in different parts of the area, get 200 developed fruit is used. Scrape the mesocarp if 70% of the fruits are ripe is time to harvest. Zerbato 2013.

There are 5 systems for the collection and are; Hand , semi-mechanized, conventional machining, direct and automated machining.

2.4.3.1. Hand harvesting

In this system all harvested by hand or with the use of tools. We proceed boot plants to hand except that the peel strength is small and the ground is consistent, in that case you should use the hoe. Once earrings swaying plants and allowed to dry for 2-3 days, then dried plants bang against a wood into a basket where they fall fruits detached. The time spent on manual harvesting and threshing between 300 and 400 hours / ha. Gracia 1983.

2.4.3.2 Semimechanized harvesting

In this system the boot of plants is to hand and windrowing to peanuts dry weather, dry one harvester and thresher to complete the harvest is used. Or start may be with a moldboard plow or rake and dry starter and threshed by hand.

2.4.3.3 Mechanized harvesting

In this type the entire operation is done with machines .Can be conventional two-stage or direct harvest with artificial drying.

1. Conventional Harvest

In two phases a) .- The digging b) .- The Harvest operation and threshing

a) .- The digging

This can be done with the following implements;

1.-with flat blade or with a moldboard plow step .Barrera 2002

2.-with diggers windrowers drying outdoors 3-4 days Gracia,1983, Gadanha Jr.1991 digger-shaker Ortiz-Cañavate 1995

3.-digger-shaker-inverter Srivastava 1993

Functions shakers; Bader 2012.

1.-start peanut plants 2.-earth shakes plant invests 3.- plants and placed in line for drying

Allbritton 2015. Three types of designs shakers exist ;

1.-shaker Bars .are bars mounted in chains to raise peanut plants and transport them to the inverter.2-shaker wheel .used one wheel shaped to shake and push peanut plants on the shaker. 3.-starter chains.-used conveyor chain to grab plants and load through the stationary section bars to sweep the land of peanut plants.

Conditions that influence the peanut digger: 1.-Growing (soil, weeds, health, maturity)2.-Harvester (design, regulatory relationship has.)

b) .- The harvest operation and threshed

Several authors describe the operation of these machines and named differently; -threshing pickers .Gracia1983, Harvester Ortiz-Cañavate 1995 Combines green peanut Srivastava1993.

The basic functions of a combined peanut include Bader 2012.:

1. Fetch plants for the row and the picking head will carry to threshing mechanism. 2-Thresh (remove peanut pods of plants) 3.- separate pods of plants and other material. 4.- separate the stalks 5.-transport pods to storage basket

Features a combined peanut Allbritton 2015;

1.-pick up plants within the combined 2-threshing pods of plants 3.- separate pods plant 4. -remover

stems pods 5-deliver clean and undamaged pods in the tank storage

b.- Direct Harvest

In the United States have conducted studies to direct harvesting peanut eliminating potential losses when plants are dried environment with potentially damp or rainy weather, and can reduce losses, but the drawback is the high cost of drying artificial, because the moisture content is 50%, compared with 30% in conventional crop. Wright & Steele1979.

c.-Precision Agriculture in peanut.

Schubert 2015 In the US research on peanut precision farming began in 1998 in the agricultural complex for advanced research and systems extension near Lamesa, TX. In 2000 the association of producers peanut West donated 320 acres that were used in precision agriculture peanut.

Fravel, 2013.Development and evaluated a system performance monitor impact plate for peanuts. He found that the system has errors attributable to excessive vibration harvester antiquated used in this study.

In Argentina and combines peanut currently marketed with performance monitor. Results obtained by Boreto 2011 indicate that it is more than feasible incorporating components for precision agriculture as the performance monitor in the peanut crop.

2.5 Park peanut harvester in the world.

When analyzing a park peanut mechanical harvesters have the following questions: it is efficient, modern, replenishment ratio stripper for harvesters.

2.5.1 Argentina

In a study conducted in 2000 by Bragachini mentions that existed in Argentina the nine companies manufacturing harvesters; and five Digging and removers companies , also a crop such as peanuts with 260,000 hectares has a machinery industry with 43 companies and more than 1,120 people are employed directly in the field, and put value to a product that is exported by 95%, which means that through a product made as peanuts confectionery can be exported labor.

Argentina has a park of 1200 both propelled and towed harvesters, of which 450 are new generation 250 and 500 adapted and improved without proper equipment and very old in design, about 8 companies that manufacture or manufactured peanut harvester, likewise has diggers shakers 1650.Bragachini 2000.

When analyzing the park for planting campaign 2007-2008 found that 233,000 hectares of peanut stripper-inverting 1458 and 460 harvesters. And is necessary to replace 243-inverting strippers are amortized for six years and 46 harvesters as these amortized over 10 years. Bragachini (2000).

Currently exist in Argentina several companies that manufacture peanut harvester which are; Self Propelled Combine Leonhartt, Vasalli Fea, Shinko Drag and pull type harvesters; BOSIG, Tecnolineingenieria, COTAGRO, Pecayna, Industrial GSF, Bombassei, Ocheti, Cobra and De Roque.

2.5.2 India

Akhtar 2012 In the Indian Potohar region harvesting and threshing was completely handmade mid eighties so during 1982-1984 prototype development peanut digger and was tested in the provinces of Punjab, Sindh, Khyber Pakhtunkhwa. At present the cost of this operation is 1680 rupees per acre. In 1985 a stationary diesel peanut thresher was tested during 1986-1990 and motor development, later I will turn into a PTO driven tractor machine. Currently six manufacturers manufacture and market the starter and the thresher. In 2012 over 2050 and 2000 stripper harvesters were in operation, also 90% of farmers used the stripper and threshers designed by PARC. The machines have benefited the country with over 2 billion rupees annually and continues to study these machines to reduce losses.

2.5.3. USA

In the US mechanical harvesting beginning from 1887 to record the first patent mechanical harvesting peanut was the patent US369071, there are currently three companies that manufacture; Amadas harvesters that manufactures harvesters propelled and pulltype, the latter since 2005 manufactured in Argentina under license ,Lilliston and KMC US which since 2013 manufactured in Brazil under the brand BMDUMONT.

2.5.4 China

In Chinese the start of patents mechanical harvesting peanut reported in 2001, from that year are registered 90 patents, which has crystallized in

manufacturing 4HJL-2 combine low power and cost.

2.5.5 Brazil

In Brazil the company CEMAG fabricate peanut harvesting since 1973 but then suspended this manufacturing..CEMAG 2014 , Casas .2006 apud Barrozo 2009, reports that peanut harvesting crops in Brazil is recent and started in the 1999 harvest - 2000. Although Gadanha 1991 describes a swath starter peanut manufactured by IMEP Industry Mechanical Pompeia and peanut harvester thresher manufactured by Machines and Implements Agricultural Colombo.

2.5.6. Other countries

Israel, South Africa, France and the United States have a peanut combine factory each country. (AG machine 2014), Israel have one digger-shaker factory .

2.6 Park Peanut harvesters in Mexico

The analysis of the situation of the park peanut harvester Mexico is not possible because the country lacks the culture of having a census and a body that is dedicated to information of agricultural machinery of any kind (tractors, combines, implements etc.) Negrete 2013.So questions about the park and stripper harvesters as they are; It is efficient, modern, replenishment of this, the ratio for strippers harvesters stay in the air until action was taken. If the same proportion as in Argentina to Mexico, a park stripper-inverting 359 and 113 harvesters would need to be maintained.

3. Materials and Methods.

The data presented were raised in research databases of websites of national and foreign government agencies, patents, academic papers, journals, conferences, manufacturers, importers and distributors, scientific journals, professional thesis, newspaper articles, books, etc.

4.-Results and discussion

In Mexico there are no data on agricultural machinery of any kind Negrete 2013 so it is imperative that decision makers should act on one of the first steps is to have a system of accurate and timely information of existing agricultural machines in the country to act accordingly. Negrete, 2011. 2014.

Regarding the mechanization of harvesting peanut in Mexico, Zerwatowsky and collaborators from 1991 to 2000 he conducted studies on the development of a combine peanut in Guanajuato, although no data are available on its local impact or nacional.DICIVA.UGTO.2014 and a three students projects for peanut threshing machines and one in ITSH. Anonymus 2013.,two in Chapingo University. In Table 2 the information obtained is summarized and shows that countries are leaders in technology harvest peanuts, as China is leading with 90 patents on harvesting peanuts and Argentina is a leader in the manufacture thereof with 12 factories engaged this area. As for inverting strippers United States leads with 49 patents and Argentina also tops the list with 16 factories inverting strippers.

Crountry	Harvester patents	Diggers-shakers	Harvesters Factories	Diggers-shakers factories
Argentina	1		12	16
India			1	6
China	90		1	1
USA	49	11	3	2
Brazil		1	2	5

Table 2 Factories and patents harvesters, threshers and Diggers-shakers peanut in selected countries. Source Based on data from various sources

Several authors agree that adequate mechanization can increase the productivity and profitability of peanut (De Rosas 2014.Anónymus 2008 .Camara 2006 apud Zerbato 2013 Wessler . 2007 apud Zerbato 2013 Compagnon 2013) as Mexico can stop importing peanut if the country increase the productivity of your growing area. Since today is production 94848.58 Ton / Ha .With a yield of 1.77

t / ha. In 57,354.31 Has. If the productivity of Chihuahua 3.09 which is the highest in the country became widespread, it could compete with China, Argentina and Egypt that have productivities 3.51,3.52 and 3.16 respectively. Which would give us a production of 177,224.81 tons to nearly cover the deficit and avoid importing, saving foreign exchange, prevent rural exodus and migration and create jobs in the mechanical industry metal, for Bragachini (2000) reports the case of Argentina with 260,000 you. Has planted peanut machinery industry with 43 companies and over 1,120 people are employed directly in the field. Since it would be necessary to produce about 359 stripper-inverting and 113 harvesters.

Also in Brazil peanuts used in the reform of the areas planted with sugarcane .Santos et.al.2013, which is used in rotation with this crop in Mexico 845,162.67 hectares of cane SIAP (2014) were seeded at if this system is used in the country peanut production that could be obtained would be considerable.

China is losing ground peanut exports because it exported 45% in 2004-2005 under 22% in 2013-2014, which was used by Argentina and India increased its exports from 17% to 32% of the first and from 9% to 19% the second, USDA 2014.

What should be imitated by Mexico investing in improved varieties and produce national design team, as not only imports cover but could export surplus.

The lack of planning of the production chains of the field shows that although there is a growing demand and supply dispersed public policies do not meet these requirements. Martínez 2011

No mechanical systems or machines designed in the country to harvest peanuts so there are restrictions for adopting imported peanut combine models;

a.- high initial cost of acquisition b.- differences with local farming systems c.- difficulty of proper maintenance and spare parts

4.- Conclusions

Considering the importance of this crop in the generation of income and employment, and contribute to the generation of foreign exchange, should promote development projects .In addition there is strong justification is necessary to encourage both horizontal and vertical coordination, the first would allow the access to technology at a lower cost, associated, the second tends to reduce opportunistic behavior and market uncertainties.

As should be; increase the volume of production and productivity, reduce costs, expand the planted area and to develop and perfect the system of harvest.

To increase the productivity of peanut crop should promote mechanical harvesting in Mexico, Producers machines require easy and economical operation that can harvest under a wide range of conditions. A peanut harvesting system depends on physiological, social, economic and technological factors. and urges establish future strategies such as;

1. Assess-adapted varieties high performance and its ability to be harvested mechanically

2.-Making appropriate economic and agronomic conditions in the country with commercial impact of the following machines and implements designs;

a.- animal-drawn peanut digger shaker inverter.

b.- animal traction harvester for small properties.

c.- harvester suitable for medium sized properties.

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