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Presentation

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As a first article we present, *Innovation focused on the agroindustrial sector (literary review)*, by MÉNDEZ-HERNÁNDEZ, José Luis, GALAVIZ-RODRÍGUEZ, José Victor, RODRÍGUEZ-DOMÍNGUEZ, María Ángeles and SANCHEZ-VILLANUEVA, Gerardo, with secondment in the Instituto Tecnológico Superior de San Martín Texmelucan, as following article we present, *Effect of inorganic and organic fertilization performance hybrid corn (Zea mays): 1052 and genotypes that form it*, by CARRIZALES-MEJÍA, Norberto, ARELLANO-RODRÍGUEZ, Luís Javier, TORRES-MORÁN, José Pablo, SÁNCHEZ-MARTÍNEZ, José, as a following article we present, *Structural Analysis of Greenhouse for Vegetable Growing*, by MARTÍNEZ-LÓPEZ, Sergio Romeo & ORTIZ-TENA, Francisco, with affiliation in the Universidad Tecnológica de San Miguel de Allende, as the last article we present, *Physicochemical characterization of lignin isolated from agricultural vegetable residues for the study of its properties as fuel and estimation of its energy potential*, by TORRES-RAMOS Ricardo, MONTERO-ALPIREZ Gisela, VALDEZ-SALAS Benjamín, CORONADO-ORTEGA Marcos A, with affiliation at the Universidad Autónoma de Baja California.

Content

Article

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Innovation focused on the agroindustrial sector (literary review)

MÉNDEZ-HERNÁNDEZ, José Luis*†, GALAVIZ-RODRÍGUEZ, José Victor, RODRÍGUEZ-DOMÍNGUEZ, María Ángeles and SANCHEZ-VILLANUEVA, Gerardo

Instituto Tecnológico Superior de San Martín Texmelucan, Camino a la Barranca de Pesos, s/n, San Lucas Atoyatenco, 74120 San Martín Texmelucan de Labastida, Puebla

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Abstract

The following article focuses on a review of the scientific literature based on the subject of agroindustrial innovation with the objective of knowing the current state of such relevant concept for all countries, it was proceeded to realize this review on scientific platforms such as Thomson Reuters, which contemplates the scientific literature from 2013 to 2017, it was also considered the degree of impact of the journal where such articles are housed, within the main findings, it was found that exists different elements that intervene in the creation of innovative agroindustrial companies within which they stand out; the intellectual capital, culture, business cooperation, institutional frameworks, innovative behavior, business and market orientation, university - industry relations, vocational training centers, entrepreneurial orientation, geographical concentration and technological capacity. It was detected a knowledge management model focused on the agroindustrial sector; however, it does not take into account the elements mentioned before in the structure of the model.

Agroindustry, Innovation, Competitiveness

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* Correspondence to Author (email: jlmendez@aol.com.mx)

† Researcher contributing first author.

1. Introduction

There is innumerable literature on the relevance of the term competitiveness as a key factor for companies to remain in the preference of customers and therefore remain in force in the current and increasingly fluctuating markets, in short, the preferences of customers continuously change and companies are forced to be flexible in every way, whether in the manufacturing process, innovation process, organization, business model, etc., those efforts aimed at achieving competitiveness, Michel Porter one of the most iconic characters In terms of strategy and competitiveness, he mentions that the competitiveness of companies in a given country lies in their inherent capacity to innovate and improve in the products and services offered (Porter, 1996).

Porter includes a relevant factor, ability to innovate. Innovation is highly recognized as one of the main drivers of business success and economic development in the knowledge-based economy today. Researchers have found that innovation contributes significantly to economic growth, since it is the basis for increasing productivity, both through incremental improvements and change of progress (Pavitt, 1969). Innovation is also widely recognized as playing a central role in creating value and maintaining competitive advantages (Jamrog, 2006).

The concept of innovation was initially defined by the economist Schumpeter as "a process of creative destruction, where the search for innovation pushes constantly breaking the old rules to establish new ones, which implies the introduction of new products, new processes, the opening of new markets or the introduction of new forms of organization "(Zhen et al., Pag. 3. 2014).

The previous argument leads to consider the content of the Oslo Manual, innovation is divided into four major areas, product innovation , which consists in the introduction of a product or service with improvements in its technical characteristics and that are appreciated and perceived by consumers, process innovation focused on the improvement of production or distribution processes, marketing innovation that relates to new marketing methods and finally innovation in organization consisting of the introduction n a new method of organizing the workplace and even the external relations of companies (Oslo Manual, 2005).

Companies require skills to acquire and apply innovative knowledge to create new products and services, marketing practices and the opening of new markets, technology and organization of production, forms of organization and business management. Also, to create new ways of relating in business networks and value chains and with providers of business development and financing services, universities and other potential for innovative knowledge (Cummings, 2013).

The current context in which technological innovation is found is one of constant change. The generation, access and adaptation of knowledge, coupled with the emergence and accelerated diffusion of new technologies, require permanent adaptations, which undoubtedly constitutes a challenge for society as a whole. Economic and social growth, the maintenance of employment and competitiveness, inevitably go through innovation and technological transfer. (Zarazúa, Solleiro et al, 2009).

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1.1 Justification

Once the importance of innovation and the different areas of innovation have been highlighted, it is important to point out that the present research proposal will take as a subject of study the agroindustrial sector, this sector so important for most of the countries refers to a social construct and historical, that is to say, a set of processes and social relations of production, transformation, distribution and consumption of fresh and processed foods, in different spatial scales. The above arguments highlight the global relevance of the agro-industrial sector and, therefore, the need for this sector to be highly competitive (Ocón, 2015).

1.2 Problem

The main problem detected derived from this literary review is that until now scientific research has focused on the study of elements or variables that directly affect the formation of innovative agroindustrial companies, these elements were studied in isolation, however these Elements must be considered together.

1.3 Hypotesis

The main hypothesis that arises is that currently the agroindustrial sector is in an outstanding development phase in developed countries while in developing countries this concept is precarious, which causes that most of the companies do not manage the good administrative and operational practices that affect the formation of highly competitive organizations at the global level.

1.4 Objectives

1.4.1 General objective

The objective of the present proposal consists in the detailed literary review on the subject of agro-industrial innovation with the objective of knowing the current state of such a relevant concept for the different countries.

2. Theoretical framework

Competitiveness means, in general terms, the ability to enter a market and position itself in it. It is necessary to have some kind of advantage over potential competitors in terms of price, quality, quantity, opportunity, presentation, packaging, delivery conditions and financing (Corpoica, 2000).

To gain competitive advantage between organizations, agroindustrial companies collaborate with other supply chain partners through participation in knowledge exchange routines, that is, not only the incorporation of new companies in the sector, but also in a sustainable way to guarantee the service of added value, this context establishes the key guidelines to achieve a cycle of technological innovation within the agro-industry.

Beyond the strategic intention and the organizational structure, in general, an agroindustrial company must establish a set of processes that promote innovations and increase the success of the company. Develop the ideology of a company to seek the creation of innovation with every aspect that the organization, requires to maximize the benefits and minimize the risks associated with new innovations (Dyer and Singh, 1998).

The incorporation of different types of innovation depends on the capacity of the companies, this capacity is expressed by certain inherent characteristics of the producers, production unit or company and its relationship with the operating environment, to the extent that these characteristics support innovation (Nossal and Lim, 2011). Similarly, it must be recognized that the effect or impact of each innovation on the performance of the company is different.

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The most important and complex issue that an agro-industrial company can face is the simultaneous incorporation of the 4 types of innovation. This can be seen as a consequence of the fact that the process of innovation in agroindustrial companies tends to be sequential (Nossal and Lim, 2011).

The use of technology in the agro-industrial sector has historically served as a mediating tool between man and nature. Its basic function in theory is to contribute substantially to transform nature for the benefit of the people who live in the countryside, in the West the use of technology has been handled in discourse as the axis converting from the traditional to the modern. (Herrera, 2006), the traditional is supplanted by technological innovation, this brings with it a series of economic and sociocultural situations that many authors have worked in terms of their impacts and implications of social order, thus, technology is understood as " set of specific knowledge and processes to transform reality and solve a problem "(Lara, page 2, 1998). Seen this way, technology is positioned as a key element in the development of the agricultural sector and clearly necessary to increase the degrees of competitiveness facing other national or international productive forces.

Taking into account the previous argument, which typifies innovation in terms of degree of technology assumes that innovations are not equal from the point of view of the characteristics of the technologies incorporated, the impact and technology required (Ariza et. Al. , 2013).

3. Research Methodology

For the present research proposal, a review of the scientific literature was carried out, taking as a guiding principle the topic of innovation in the agroindustrial sector worldwide.

The review was carried out in the Thomson Reuters platform, it was considered in the first instance the level of impact of the journals containing the articles consulted, the most current literature consulted on the subject of study was from 2013 to 2017, it was also considered the classic literature on competitiveness and innovation as are the writings of Schumpeter and Porter.

3.1 Type of Research

It is a descriptive investigation, its intention being to refer the state, the characteristics and phenomena that occur naturally, without explaining the relationships that are identified among the different factors that determine it, that although it tries to analyze the relationships between categories (technological strategy and management processes), to determine the behavior of the product, has no explanatory or correlation claims, that is, it is not about finding causal relationships between these two elements.

3.2 Development methodology

Authors	Aporte
Castilla, Sánchez and Gallardo (2017)	The research points out the characteristics of this type of agro-industry and shows the importance of adopting a responsible orientation in the promotion of reputation to create sustainable competitive advantages.
	Cognitive-organizational proximity is a positive determinant of business cooperation with other organizations, while social and institutional proximity are negative determinants. It also establishes that business cooperation is a positive determinant of business innovation. In addition, it is observed that the levels of business cooperation are lower in micro-enterprises, a result that differs from developed countries.
Geldes, Heredia, Felzensztein and Mora (2017)	The institutional framework that legitimizes technological innovations are conditions of success for agroindustrial models, emergence of new "innovative" social actors.

Gras and Hernández (2016)	The research proposes and develops the concept of technological complexity (TC) as a useful and simple tool to group key attributes that add value to a product (multinomial logistic regression model with mixed effects)
Cotes A., Muñoz and Cotes J.M. (2016)	Innovative companies obtain better results both in economic and productive terms. In addition, the innovative behavior of the agri-food sector has been less affected by the economic crisis than the rest of the economic sectors.
Zouaghi and Sanchez (2016)	The main significant factors of the competitiveness of the agroindustrial sector are identified; geographical concentration, specialization of companies, scope of viable and relevant businesses, privileged position, complementarity through the use of by-products, cooperation among cluster companies, uniformity of technological level, culture adapted to the cluster, evolution before new technologies, results strategy oriented to the cluster.
Sarturi, Augusto, Vargas, Boaventura and dos Santos (2016)	The authors propose a model to measure the technological capacity of the agroindustrial companies since the Technological Capacity plays an important role in the efficiency of the productive process of the company and in the degree of innovation. It is associated with the skills and knowledge necessary for a company to absorb, use, adapt, develop and transfer technologies
De Mori, Batalha and Alfranca (2016)	Dimensions: A) Resources; research intensity, human resources, infrastructure
Mirzaei, Micheels and Boecker (2016)	B) Technological update; preprocessing, processing, controls, environmental aspects.
Mujeyi, Mutambara, Siziba and sadomba (2015)	C) Processes and routines; Product engineering, process engineering, monitoring and project management, planning and control.
Bitzer and Bijman (2014)	D) Learning mechanisms; internal, external acquisitions, socialization and coding
Storer, hyland, Ferrer, Santa and Grififiths (2014)	E) Coordination and accessibility; interaction with the environment, relations with suppliers, accessible sources of information, intensity of participation.

Table 1

The review of the scientific literature on issues of agro-industrial innovation leads to the detection of certain problems of which the following stand out: there is an imbalance in the development of different types of innovation, innovation in process is the one that develops least in agroindustrial companies, which is very important because experts in business competitiveness issues such as Porter mention that the competitive advantage lies in the processes and internal resources of an organization, coupled with this situation the agro-industrial companies have focused on the development of product innovation.

In addition to the above, different elements were detected that seek the generation of innovative agroindustrial companies, among which the following can be mentioned:

- Intellectual capital
- Cultural aspects
- Business cooperation
- Geographical concentration
- Institutional framework
- Innovative behavior
- Technological capacity
- Business and market orientation
- Technological surveillance
- Industry-university relationship
- Intellectual capital
- Entrepreneurial guidance
- Professional training centers

Knowledge management model

(Pérez and García, 2013), propose a model for the administration of knowledge within the agroindustrial sector, specifically in Colombia in fruit and vegetable cultivation activities, the model is based on the formation of a network that promotes acquisition, production, dissemination and knowledge transfer, is firmly established in the center of such network is knowledge.

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As such, it is understood that the solution to the problems of agro-industry is not based solely on infrastructure, which although considered necessary and especially biased by the fact that large investments are always required, is not the only factor involved in the development of the agroindustrial sector, an additional component is the implementation of this knowledge network that would work to manage shared knowledge through the interdisciplinary work of various actors that strive to obtain benefits for this sector of the agricultural economy.

The model proposed by the authors is Etzkowitz's traditional triple helix model, used as a metaphor to express a dynamic alternative to the model of innovation prevailing in the policies of the eighties of the twentieth century, while visualizing the inherent complexity of the processes of innovation (Etzkowitz, 2003).

The proposed model consists of three fundamental nodes to characterize the knowledge network in the fruit production chain of the department of Córdoba, as a strategy for generating innovation in this sector; These nodes are connected as follows: primary producer node; node of associations and the technological node, these nodes act as the points of transfer or interconnection through which knowledge flows, can be described as storage centers of information that are interconnected in a systemic way the nodes can be described as follows way:

Primary producers, most of the activity is concentrated in this node, which generates the primary product as a result of the internal application of the acquired knowledge, thus demonstrating the degree of effectiveness of the proposed strategy. In addition, the evaluation of various events that have occurred becomes a source of valuable information that can be applied in future experiences.

Association node, this node is associated as a repository or central knowledge node where related experiences are found, for example through the problems and their corresponding solutions. The way in which knowledge flows and spreads through all the components of the network can be established through this node or nucleus, in order to facilitate its effective implementation in the different nodes or components that require its use.

Technological node, this node serves as a channel that facilitates and promotes the intercommunication activity between the different actors, converting the technological component into a tool that facilitates the implementation and development of multiple possibilities. This shows how any idea, whether a positive or negative experience, can be accessed or disseminated.

The model also includes what the authors call facilitating agents, the objective is that these elements stimulate the performance of the personnel of the companies and accelerate the operative processes, taking into account the direct impact on the organization, these elements are classified as external facilitators. related to market conditions, cultural factors and sectoral elements, and provide elements for the regulation or management of agro-industrial activities. These components constitute the environment of this sector, and as such its dynamics have a direct influence on it. The external facilitating agents described in this proposed model are: markets, knowledge, strategy and self-management.

The internal facilitators or facilitators of the internal management of the supply chain: These agents are an inherent part of the production system and the supply chain during the harvesting and post-harvesting stages, and are involved with the node or core principal.

The internal facilitators are: disease prevention program, system of access to new markets, expansion in new environments. In this proposed model, each of the nodes is associated with a facilitating agent, but there is no restriction to associate them with others based on the strategy you want to set in motion. The internal facilitators of the primary nodes are: quality of the tools implemented, quality of knowledge, productivity, teaching, workshops and conferences. Internal Facilitators of the association node: performance of associations, modernization and continuous improvement. Internal facilitators of the technological node: Implementation of technology, Technical innovation.

The model also has several indicators established throughout the network that allows each event in a specific area to be monitored and registered and, in turn, the necessary corrections or adjustments of a specific performance can be made as required, based on in specific arguments and specific reasons, thus facilitating the management and control of the entire network in all its parts (Pérez and garcia, 2013).

5. Conclusions

The most current contributions of the topic of agro-industrial innovation argue that there are different elements that seek the generation of innovation and with it the management of robust companies in the competitive context, within which the following can be mentioned; intellectual capital, cultural aspects, business cooperation, geographical concentration, institutional frameworks, innovative behavior, technological capacity, business and market orientation, technology watch, industry - university relationship, intellectual capital, entrepreneurial orientation and vocational training centers.

Scientific research so far is limited to analyzing each of the aforementioned elements in isolation and individually, opening up a new research proposal that would consist of determining whether the aforementioned elements can relate to each other to work together and integral in a possible innovation management model specific to the agro-industrial sector with the aim of potentiating innovation in such an important economic sector.

The knowledge management model proposed by Pérez and García in 2013 makes considerable contributions to the subject of agro-industrial innovation, but does not include within this model the most current elements that manage the formation of innovative organizations, therefore, the relevance of A new research proposal is of relevant importance.

6. References

Andrés Felipe Ruiz Moreno, Andrés Leonardo, Caicedo Otavo Javier Arturo Orjuela Castro (2015) External Integration on Agri-Food Supply Chain: A review to the state of the art. Ingeniería Vol. 20 No. 2 Universidad Distrital FJC.

Bryman, A. (2008) Métodos de investigación social (Oxford, University Press).

Castilla Polo, Francisca; Isabel Sanchez-Hernandez, M.; Gallardo-Vazquez, Dolores. Assessing the Influence of Social Responsibility on Reputation: An Empirical Case-Study in Agricultural Cooperatives in Spain. Journal of Agricultural & Environmental ethics Volume: 30 Issue: 1 Pages: 99-120 Published: Febrero 2017.

Carayannis, Elias G.; Grigoroudis, Evangelos; Goletsis, Yorgos A multilevel and multistage efficiency evaluation of innovation systems: A multiobjective DEA approach. Expert Systems with Applications Vol. 62 pages 63-80.

Carla Susana Marques, Chris Gerry, Susana Covelo (2011) Innovation and the performance of Portuguese businesses: a 'Sure' approach Int. J. Management and Enterprise Development, Vol. 10, Nos Christian Horn, Alexander Brem, (2013). "Strategic directions on innovation management – a conceptual framework", Management Research Review, Vol. 36 Iss: 10, pp.939 – 954.

César Ariza, Laura Rugeles, Diana Saavedra and Bladimir Guaitero (2013). Measuring Innovation in Agricultural Firms: A Methodological Approach. Electronic Journal of Knowledge Management. 11(3) . 2/3.

Ciarli, Tommaso; Valente, Marco (2016). The complex interactions between economic growth and market concentration in a model of structural change. Structural Change and economic dynamics Vol.: 38 SI Pages 38-54.

Cotes-Torres, Alejandro; Antonio Munoz-Gallego, Pablo; Miguel Cotes-Torres, Jose. Technological complexity: a tool for understanding the behaviour of consumers of high value-added foodstuffs. Journal of Business Economics and Management Volume: 17 Issue: 3 Pages: 444-457 Published: JUN 2016.

Cook, Michael L.; Savoie, Rebecca; Almog, Ronen. Agribusiness as the Anchor: The Role of KijaniAgro International Food and Agribusiness Management review Volume: 17 Issue: B Special Issue: SI Pages: 153-158 Published: 2014.

Cummings, A. (2013). Construyendo capacidades de innovación en iniciativas asociativas de pequeñas agroindustrias rurales en El Salvador. Revista Iberoamericana de Ciencia, Tecnología y Sociedad - CTS, Septiembre-, 295-319.

CORPOICA (Corporación Colombiana de Investigación Agropecuaria) (2000). Lecturas sobre economía campesina y desarrollo tecnológico. Colombia.

De la Fe, T. G. (2009). El modelo de Triple Hélice de relaciones universidad, industria y gobierno: un análisis crítico. Arbor, 185(738), 739-755.

De Oslo, M. (2005). Guía para la recogida e interpretación de datos sobre innovación. Luxembourg: OECD.

De Mori, Claudia; Batalha, Mario Otavio; Alfranca, Oscar. A model for measuring technology capability in the agrifood industry companies. British Food Journal Volume: 118 Issue: 6 Pages: 1422-1461 Published: 2016.

Gras, Carla; Hernández, Valeria. Custom farming and its integration into the agrobusiness model: production and services in the Pampa región. Mundo Agrario Volume: 17 Issue: 36 Article Number: e028 Published: DEC 2016.

Echeverria, Rodrigo; Gopinath, Munisamy. Export Behaviour in the Chilean Agribusiness and Food Processing Industry. Chilean Journal of Agricultural Research Volume: 68 Issue: 4 Pages: 368-379 Published: Dec. 2008.

Geum, Youngjung; Noh, Eunji; Park, Yongtae (2016). generating new service ideas: the use of hybrid innovation tools to reflect functional heterogeneity of services. R & Management Vol. 46 issue 4, pages 736-748.

Geldes, Cristian; Heredia, Jorge; Felzensztein, Christian; et al. Proximity as determinant of business cooperation for technological and non-technological innovations: a study of an agribusiness cluster. Journal of Business & Industrial Marketing Volume: 32 Issue: 1 Pages: 168-179 Published: 2017.

Guzman, Isidoro; De-Nieves-Nieto, Carmen; Briones-Penalver, Antonio-Juan. Evaluación de la eficiencia en el sector de los agronegocios en España: un estudio empírico para la Región de Murcia Cuadernos de Desarrollo Rural Volume: 10 Issue: 71 Pages: 81-100 Published: Jan-Jun 2013.

Joshua D. Detre, Aaron J. Johnsonb and Allan W. Gray (2011). Innovativeness and Innovation: Implications for the Renewable Materials Supply Chain. International Food and Agribusiness Management Review. 14(2).

Herrera Tapia, Francisco. (2006). Innovaciones tecnológicas en la agricultura empresarial mexicana: Una aproximación teórica. Gaceta Laboral , 12(1), 93-119. Recuperado en 21 de junio de 2016, de http://goo.gl/id40jo.

Hernandez Sampieri, R. (2009) Metodología de la Investigación (México, Mc Graw Hill).

Krishnapriya V. and Rupashree Baral (2014). Supply Chain Integration – A Competency Based Perspective. International Journal of Managing Value and Supply Chains. 5(3).

Leguizamon, Amalia. Disappearing nature? Agribusiness, biotechnology and distance in Argentine soybean production. Journal of Peasant Studies Volume: 43 Issue: 2 Special Issue: SI Pages: 313-330 Published: Marzo 3 2016.

Liina Joller (2012). Eco-innovation in business models– theoretical considerations. University of Tartu, Faculty of Economics, Narva Rd. Vol. 4 (11).

Lytneva N.A.1; Goncharov P.V.1; Kyshtymova E.A.2 (2015) The strategy of innovation and investment activity of the integrated agro-industrial enterprises. International Journal of Innovative Technologies in Economy.

Mingaleva, Z., & Aitkazina, M. A. (2013). Multi-Agent Model for Financing Innovative Projects in Agriculture. World Applied Sciences Journal, 24(2), 222-226.

Montoya-Ramírez, M. F. (2016). Medios de control para un sistema de gestión de la innovación en las empresas manufactureras: caso agroindustria. Ingeniería Industrial, (33), 205-225.

Mirzaei, Omid; Micheels, Eric T.; Boecker, Andreas. Product and Marketing Innovation in Farm-Based Businesses: The Role of Entrepreneurial Orientation and Market Orientation International Food and Agribusiness Management Review Volume: 19 Issue: 2 Pages: 99-129 Published: 2016.

Molla, Alemayehu; Peszynski, Konrad; Pittayachawan, Siddhi. The Use of E-Business in Agribusiness: Investigating the Influence of E-Readiness and OTE Factors Journal of Global Information Technology Management Volume: 13 Issue: 1 Pages: 56 78 Published: 2010.

Mutema, Maxwell; Chiromo, Pamela. Inclusive Agribusiness Models for Africa: The Case of an Innovative Initiative by TechnoServe in Zimbabwe. International Food and Agribusiness Management Review Volume: 17 Issue: B Special Issue: SI Pages: 167-174 Published: 2014.

McRoberts, Keenan C.; Nicholson, Charles F.; Blake, Robert W.; et al. Group Model Building to Assess Rural Dairy Cooperative Feasibility in South-Central México. International Food and Agribusiness Management Review Volume: 16 Issue: 3 Pages: 55-98 Published: 2013.

Nannan Wang, Shengnan Yao, Chin, Chia Wu and Dongdong Jiang (2015). Critical Factors for Sustainable Project Management in Public Projects. International Association for Management of Technology. (1).

Odongo, Walter; Dora, Manoj; Molnar, Adrienn; et al. Performance perceptions among food supply chain members: A triadic assessment of the influence of supply chain relationship quality on supply chain performance. British Food Journal Volume: 118 Issue: 7 Pages: 1783-1799 Published: 2016.

Ortega Cerdà, Miquel, and Marta G. Rivera Ferre. "Indicadores internacionales de Soberanía Alimentaria. Nuevas herramientas para una nueva agricultura." Revibec: revista de la Red Iberoamericana de Economía Ecológica 14 (2010): 0053-77.

Ortega, o. v. d., & valencia, j. b. (2014). desempeño competitivo del sector agroindustrial en el estado de michoacán agro industry competitive performance in michoacan's state. investigación.

Ocón, h. b. f. (2015). cadenas, redes y actores de la agroindustria en el contexto de la globalización. el aporte de los enfoques contemporáneos del desarrollo regional. espiral. estudios sobre estado y sociedad, 13(37).

Pérez Pérez, Mario F, Medina García, Victor H (2013) Knowledge Management Model for Fruit-Horticultural Agroindustry Case: Córdoba - Colombia International Journal of Future Computer and Communication.

Porter, M.E. (1980) Competitive Strategy. Techniques for Analyzing Industries and Competitors, The Free Press, New York.

Porter, M.E., & Perez, MADLC. (1996). Ventaja competitiva. Compaqma Editorial Continental.

Roucan-Kane, Maud; Gramig, Benjamin M.; Widmar, Nicole J. Olynk; et al. U.S. Agribusiness Companies and Product Innovation: Insights from a Choice Experiment Conducted with Agribusiness Executives. International Food and Agribusiness Management Review Volume: 16 Issue: 4 Pages: 123-139 Published: 2013.

Sarturi, Greici; Augusto, Carlos; Vargas, Franca; et al. Competitiveness of clusters: A comparative analysis between wine industries in Chile and Brazil. International Journal of Emerging Markets Volume: 11 Issue: 2 Special Issue: SI Pages: 190-213 Published: 2016.

Samuel Mwangi Njuguna (2015) Strategic Options for Creating Competitive Advantage for Youth Enterprises in Kenya. A Survey of Youth Enterprises in Murang'a County. International Journal of Education and Research. 3(10).

Shengbin Hao, Bo Yu (2011). The Impact of Technology Selection on Innovation Success and Organizational Performance. Scientific Research. (3). Srholec, Martin . Multilevel Approach to Geography of Innovation (2010). Regional studies, Vol. 44, issue 9, pages 1207-1220.

Storer, Maree; Hyland, Paul; Ferrer, Mario; et al. Strategic supply chain management factors influencing agribusiness innovation utilization. International Journal of Logistics Management Volume: 25 Issue: 3 Pages: 487-521 Published: 2014.

Trends in Food Science & Technology Volume: 50 Pages: 230-242 Published: Apr. 2016.

Tomoo Machiba (2012). The Future of Eco-Innovation: The Role of Business Models in Green Transformation. OECD/European Commission/Nordic Innovation Joint Workshop. Vol. 19 (20).

Ulrike de Brentani, Elko J. Kleinschmidt, and So¨ ren Salomo (2010). Success in Global New Product Development: Impact of Strategy and the Behavioral Environment of the Firm. Product Development & Management Association. (27).

Valencia, g., & Vasco, a. f. (2012). implementación de la metodología de gestión tecnológica por proyectos" mgt" en empresas del sector agroindustrial. biotecnología en el sector agropecuario y agroindustrial, 10(1).

Velez , Andrés., & ruiz , santiago. (2012). adn de la innovación de factores claves de innovación en 21 empresas del sector agroindustrial. biotecnología en el sector agropecuario y agroindustrial, 10(2), 197-206.

Zarazúa, J. A., Solleiro, J. L., Altamirano, C. R., Castañón, I. R., y Rendón M. R., (2009).Esquemas de innovación tecnológica y su transferencia en las agroempresas frutícolas del estado de Michoacán. Estudios sociales (Hermosillo, Son.), 17(34), 37-71.

Zouaghi, Ferdaous; Sanchez, Mercedes. Capturing value from alliance portfolio diversity: The mediating role of R&D human capital in high and low tech industries.

Zhanna Mingaleva and 2Madina Amangeldinovna Aitkazina (2013) Multi-Agent Model for Financing Innovative Projects in Agriculture. World Applied Sciences Journal 24 (2): 222-226.

ZhangXiaoren, DingLingandChenXiangdong (2014). Interaction of Open Innovation and Business Ecosystem. International Journal of u- and e- Service, Science and Technology. 7(1).

Zhen Liu, Ron G.M. Kemp, Maarten A. Jongsmac, Caicheng Huangd, J.J.M. (Hans) Dons and S.W.F Omtaf (2014). Key Success Factors of Innovation Projects of Vegetable Breeding Companies in China. International Food and Agribusiness Management Review. 17(4).

Effect of inorganic and organic fertilization in the performance of hybrid corn (Zea mays): 1052 and genotypes that form it

CARRIZALES-MEJÍA, Norberto*†, ARELLANO-RODRÍGUEZ, Luís Javier, TORRES-MORÁN, José Pablo and SÁNCHEZ-MARTÍNEZ, José

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Abstract

The objective of this study was to determine the fertilization formula (FF): inorganic or organic that increases the yield during grain or seed production of four genotypes (G) that integrate trilineal hybrid: 1052. Six fertilization formula (organic and inorganic) were evaluated: Worm humus, WH, (solid and liquid); NPK, Entec more micronutrients, Nitro Plus-9 and the following combinations: (½ inorganic + ½ organic) and (½ inorganic + ½ Nitro Plus-9), on five G of maize. The treatments were distributed in a factorial arrangement: 6 × 5 in a design: "Split Plots" with three replicates. The variable analyzed was the yield of grain (t ha^{-1}). The FF were the same in their effect on the G, however, the organic was numerically better to the chemical or inorganic. Eto 7) - 52 / A20 exceeded the average yield of G ($p < 0.05$). Likewise, the average weights of CS and CT were higher than those of the three lines that formed them ($p < 0.05$). The best performance was obtained by treatments integreted by: (Eto 7) -52 / A20 with the six types of fertilization evaluated.

Fertilization, Organic, Inorganic, Genotypes, Humus, Yields

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* Correspondence to Author (email: norberto.carrizales@academicos.udg.mx)
† Researcher contributing first author.

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1. Introduction

Tapia and collaborators (2013) reviewed information from the SIAP and indicated: of the basic grains in Mexico, corn is characterized as the most planted crop (7.8 million ha) with an average yield of 2.9 t ha-1. Likewise, they highlighted the value of corn production, calculated at: 72 billion pesos. Its constant production, both for grain and seed, requires an intensive supply of chemical fertilizer to make it perform under favorable conditions, however, this technology is expensive and causes pollution problems to the ecological environment.

Castellanos (1980) and Romero et al., (2000) cited by Tapia et al., (2013) mentioned: organic fertilizers have been used since ancient times and their influence on soil fertility has been demonstrated; the value of organic matter (OM) in the soil offers great advantages that can hardly be achieved with chemical or inorganic fertilizers, since its chemical composition, the contribution of nutrients to crops and their effect on the soil vary according to their origin, age , handling and moisture content.

In 2009 Clementelli and Zevallos reviewed information from FAO and indicated: fertilizers, when used together with other inputs such as: high yield varieties (genotypes) and irrigation water, cause a positive interaction by which it increases, even more, its contribution to the performance increase; they considered humus as M.O. degraded to its last state of decomposition (microorganisms) and chemically stabilized as colloid regulator of the dynamics of plant nutrition in the soil. The application of inorganic or organic chemical fertilizers to the soil completes the nutritional needs of maize (a common and necessary practice for the crop).

However, if a smaller quantity is applied, the yield potential of the genotype (G) is wasted and, if applies a greater amount of fertilizer, production costs increase; in addition it could provoke phytotoxic reactions reducing crop production (SAGARPA, 2015 a)

Soil degradation is a threat to more than 40% of the planet's surface: climate change has accelerated the rate of soil degradation and threatens food security as a result; More than 12 million ha of crops could be lost each year. However, M.O. in soils, it intervenes in four important ecosystem services: 1) resistance to soil erosion, 2) water retention, 3) plant fertility and 4) Biodiversity. (SAGARPA, 2015 b)

Tapia and collaborators in 2013 considered organic fertilization as an alternative to reduce the consumption of inorganic fertilizer and mentioned that organic nutrition is considered as a viable option to supply nutrients to crops of interest, for corn producers, in order to to decrease the dependence of chemical fertilizers and production costs.

This study was proposed in order to evaluate the response of corn to FF: chemical, traditional or inorganic and organic, in terms of its effect on grain yield and seed production for planting, of five Genotypes: (three lines , a simple cross and a triple cross) formators of corn hybrids CS: (Eto 7) - 52 / A20 and CT: 1052 to produce and grow in Western Mexico.

1.1 Objectives

1.1.1 General objectives

Know the adequate FF (organic and inorganic) to increase the yield of maize (t ha-1) during seed production of the G (lines, CS and CT) of the hybrid: 1052.

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1.1.2 Objetivos específicos

a. Determine the adequate FF (organic and inorganic) to increase the yield of the hybrid: 1052 and its parents.
b. Generate information on the benefits of the use of organic FF that propitiate the significant increase of grain and seed yield of the hybrid: 1052 in Western Mexico.

1.2 Hypotesis

a. With the use of organic FF, for seed production, the corn G of the hybrid: 1052 increase or maintain its yield (t ha-1) compared to the use of traditional FF (chemical or inorganic)
b. The use of organic FF and / or the combination of: inorganic FF plus organic FF, in the seed production of the G, could give a grain yield (t ha-1) higher than that obtained with the use of Inorganic or chemical FF.

2. Materials and methods

2.1Materials

The study was carried out in the Experimental Field of the University of Guadalajara (UdeG) located in: Zapopan, Jalisco, in the University Center of Biological and Agricultural Sciences (CUCBA) during the cycles: Spring-Summer (2013 and 2014)

Five G of corn were used: three lines, one CS and one CT, See Table 1. As a source of elements for FF (NPK and micronutrients) organic fertilizer was used: Worm Humus (HL) solid and liquid in doses of four t ha-1 and 60 L ha-1, respectively. Also used traditional or inorganic chemical fertilizer (Urea, DAP, micronutrients) plus the product: Entec and a liquid fertilizer, soil improver, identified as: Nitro Plus-9; is last in a dose of 35 L ha-1 (Table 2)

No.	Genotype.
1	* A-20
2	* (Eto 7) -52
3	* AVN
4	** (Eto 7) - 52 / A20
5	**1052
** = Línea.*	*** = CS y CT*

Table 1 Corn genotypes evaluated with FF (organic and inorganic). Cycles: P.V. 2013 and 2014. Zapopan, Jal. Mexico. (UdeG-CUCBA)

Number.	Formula.
1	(220 - 80 – 00)
2	(110 - 40 - 00) + ½ Nitro Plus-9
3	(110-40-0)+ ½ Fert. Organic.
4	Nitro Plus-9 *
5	Organic fertilizer. **
6	Entec (inorganic)
** 35 liters per hectare (L ha-1) ** four (t ha-1) plus 60 L ha-1 ½ = half dose.*	

Table 2 Fertilization formulas (organic and inorganic,) for corn G, evaluated during the cycles: P.V. 2013 and 2014. Zapopan, Jal. Mexico. (UdeG-CUCBA)

2.2 Methods

2.2.1 Experimental design

Two factorial experiments (6 x 5) were carried out under a design: "Split plots" with three repetitions (Little and Jackson, 1976). The repetition consisted of 30 plots of four rows of 0.80 m wide by five m long, each one (4 m2); the experimental plot (PE) was 16 m2 and the useful plot (PU) were the two central furrows (8 m2). The large plots (PG) were six FF (organic and inorganic). See Table 2. The small plots (PCh) corresponded to five G of corn. (Picture 1)

2.2.2 Treatments

30 treatments were designed. To be evaluated in each replica of the experiment; The treatments were integrated with the following factors: Fertilization formula (FF) and Genotypes (G). See Table 3.

Entrance.	Treatment.
1	A20 + (220-80-00)
2	Eto7)-52 + (220-80-00)
3	AVN + (220-80-00)
4	Eto7)-52 / A20 + (220-80-00)
5	1052 + (220-80-00)
6	A20 + (110-40-0) + ½ NitroPlus-9
:	: : :
10	1052 + (110-40-0) + ½ NitroPlus-9
11	A20 + (110-40-00) + ½ Humus.
:	: : :
15	1052 + (110-40-0) + ½ Humus.
16	A20 + Nitro Plus-9
:	: :
20	1052 + Nitro Plus-9
:	: :
22	Eto7)-52 + Humus.
:	: :
29	Eto7)-52 / A20 + Entec.
30	1052 + Entec.
Note: *HL in doses of four t ha-1 (solid) plus 60 L ha-1 (liquid)* *Nitro Plus-9 in a dose of 35 L ha-1* *½ = half dose of the product used.*	

Table 3 List of 30 treatments evaluated (P.V. 2013 and 2014). Zapopan, Jal. Mex. (UdeG-CUCBA)

2.2.3 Planting method

The land preparation, in both experiments, was done with a "fallow" and two crossed steps of "harrow" to ensure a good "planting bed". The sowing was done when the bed was "coming earth": two seeds were deposited per point, a separation between points of 0.15 m, and ensure a population density of 82 000 plants ha-1 after making a thinning, 20 days after sowing

The cultural practices such as: weed control and pests were made according to the technological package for the cultivation of seasonal maize that is carried out in the area (SAGARPA, 2015 a)

2.2.4 Variables studied

1. Days to male flowering (♂): ten% initial to ten% final.
2. Days to feminine flowering (♀): ten% initial to ten% final.
3. Plant height (m)
4. Cob height (m)
5. Stem stalk (%)
6. Plant root (%)
7. Number of ears per plant.
8. Cob rot (%)
9. Grain yield (t ha-1) at 15% humidity.

2.2.5 Statistic analysis

We present the analysis of the variable: performance (t ha-1) made with the SPSS® statistical package, version (20. 0. 0). The honest significance test (DHS) of: Tukey ($\alpha = 0.05$) was used to indicate the significant statistical groups.

4. Results

Variation analysis of the experiments indicated: a significant statistical difference ($p < 0.05$) between the fertilization formulas (FF) of the experiment: P.V. 2013, however, the experiment (P.V. 2014) did not present a significant difference for this factor (PG). Both experiments showed a significant difference between the evaluated genotypes (G), however, the interaction variation factor: PG * PCh or FF for G was not significant ($p < 0.05$) in the two experiments.

4.1 Fertilization formulas

Regarding FF, the 2013 experiment showed statistical difference, highly significant ($p < 0.05$) while, the 2014 experiment did not present a statistical difference for this factor. It should be noted that when applying the Tukey test (DHS), in the first experiment, no significant groups were detected between FF and, on the other hand, the organic FF: Solid Worm Humus (four t ha-1) plus Worm Humus liquid (60 L ha-1) was numerically more efficient in the two experiments and obtained an average production of 5.43 t ha-1 in the first experiment and 6.17 t ha-1 in the second.

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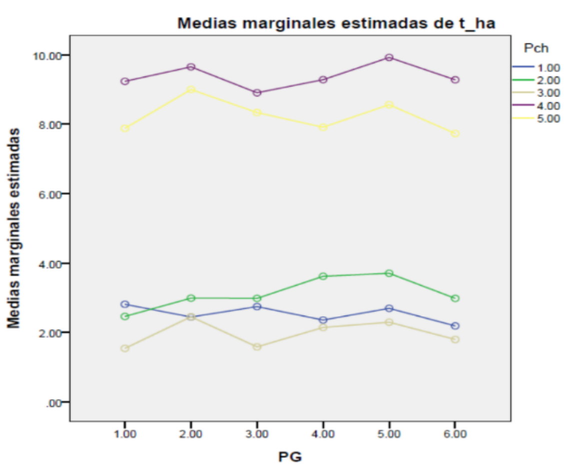
Likewise, the traditional FF (220-80-00) obtained a performance similar to that of the previous FF, during the cycle (P.V. 2014). The two inorganic (traditional) FFs: 220-80-00 and Entec with (15-22-12) plus micronutrients obtained the lowest numerical performance in the 2013 experiment (4.79 t ha-1). The lowest yield (P.V. 2014) corresponded to the inorganic FF: 110-40-00 plus 15 L ha-1 of Nitro Plus-9 with an average weight of 5.53 t ha-1.

4.2 Genotypes

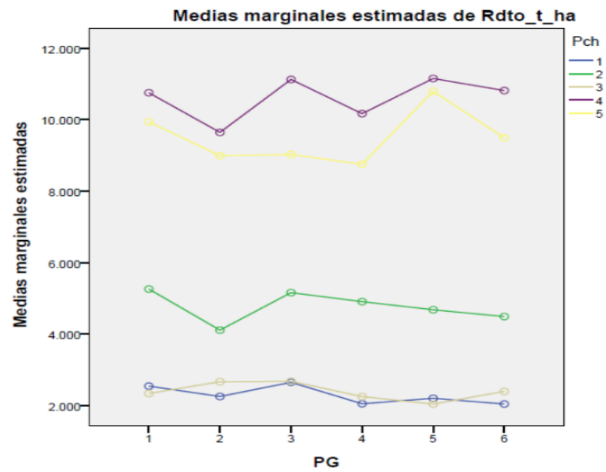
Both experiments presented significant statistical difference (p <0.01) among the G. The CS: (Eto 7) - 52 / A20 obtained the best yield of grain or seed (9.38 and 10.61 t ha-, respectively) and was superior to the hybrid : 1052 with 8.24 t ha-1 (PV 2013) and 9.50 t ha-1 (PV 2014). See figures: 1, 2 and Table 4.

In both experiments, both hybrids exceeded the performance of the three lines (p <0.05) whose performance varied from 1.97 t / ha-1 with: AVN in 2013, up to 4.77 t ha-1 with: (Eto 7) - 52 in PV2014 (See Table 4)



Lines: 1 = A- 20, 2 = (Eto 7) -52 and 3 = (AVN)
Hybrids: 4 = (Eto 7) - 52 / A20 and 5 = 1052

Graph 1 Response in yield (t ha-1) of five Corn Genotypes (PCh), before the effect of six Fertilization Formulas (PG). Cycle: P.V. 2013. Zapopan, Jal. Mexico. (UdeG-CUCBA)



Lines: 1 = A- 20, 2 = (Eto 7) -52 and 3 = (AVN)
Hybrids: 4 = (Eto 7) - 52 / A20 and 5 = 1052

Graph 2 Response in yield (t ha-1) of five genotypes of Corn (PCh), before the effect of six Fertilization Formulas (PG). Cycle: P.V. 2014. Zapopan, Jal. Mexico. (UdeG-CUCBA)

No. orden.	Genotype	P.V. 2013	P.V. 2014	Media
1	Eto 7)-52 / A20	9.38 **a**	10.61 **a**	9.99
2	1052	8.24 b	9.50 b	8.87
3	(Eto 7) - 52	3.12 c	4.77 c	3.95
4	A - 20	2.54 cd	2.29 d	2.42
5	AVN	1.97 d	2.40 d	2.19
Nota: cantidades con la misma letra son estadísticamente iguales entre sí al 5 % de probabilidad, según DHS de Tukey.				

Table 4 Average yield (t ha-1) of five maize genotypes evaluated with six FF. (P. V. 2013 and 2014). Zapopan, Jal. Mex. (UdeG-CUCBA)

4.3 Treatments

When not finding significant differences between the interactions: formulas of fertilization by genotypes (FF * G), Table 5 presents the average yields of the treatments evaluated in both experiments.

The greatest numerical weight corresponded to the treatments integrated by the simple cross: (Eto 7) -52 / A20, fertilized with all the FF tested; its weight varied from 9.65 t ha-1, from treatment nine: (Eto 7) -52 / A20 with 110-40-00 plus 15 L ha-1 of Nitro Puls-9, up to 10.54 t ha-1 of treatment 24: (Eto 7) -52 / A20 with four t ha-1 plus 30 L / ha-1 of HL (See Table 5). The hybrid: 1052 with the FF: 110-40-00 plus 15 L / ha-1 of Nitro Plus-9 produced nine t ha-1 and the lowest numerical performance was obtained with the treatments integrated by the G: AVN and the different FF, whose yield fluctuated from: 1.94 to 2.56 t ha-1 (Table 5)

			2013	2014	Med.
No. Ord.	No. Ent.	Treatment.	Rend.	Rend.	Rend.
1	24	Eto7)-52/A20 + Organic.	9,92	11,15	**10,54**
2	9	Eto7)-52/A20 + 110-40-00 + ½ NPlus-9	9,65	9,64	**9,65**
3	29	Eto7)-52/A20 +Entec.	9,28	10,81	**10,05**
4	19	Eto7)-52/A20 + Nitro Plus-9	9,28	10,17	**9,72**
5	4	Eto7)-52/A20 + (220-80-00)	9,23	10,75	**9,99**
6	10	1052 + 110-40-00 + ½ Nitro Plus-9	9,00	8,99	**9,00**
7	14	Eto7)-52/A20 + 110-40-00 + ½ Organic.	8,90	11,12	**10,01**
8	25	1052 + Organic.	8,56	10,79	**9,68**
9	15	1052 + 110-40-00 + ½ Organic.	8,33	9,02	8,68
:	:	:	:	:	:
11	5	1052 + 220-80-00	7,88	9,94	8,91
12	30	1052 + Entec.	7.73	9.49	8.61
13	22	Eto7)-52 + Organic.	3,70	4,68	4,19
:	:	:	:	:	:
17	12	Eto7)-52 + 110-40-00 + ½ Organic.	2,98	5,16	4,07
18	1	A 20 + 220-80-00	2,81	2,54	2,68
:	:	:	:	:	:
26	26	A 20 + Entec.	2,19	2,04	2,12
27	18	AVN + NitroPlus-9	2,14	2,25	2,20
:	:	:	:	:	:
30	3	AVN + 220-80-00	1,54	2,34	1,94
Note: amounts of treatments (bold) are the best numerical yields.					

Table 5 Yield (t ha-1) of 30 treatments, five G for six FF: inorganic and organic. (P. V. 2013 and 2014). Zapopan, Jal. Mex. (UdeG-CUCBA)

5. Conclusions

1. The FF evaluated were equal in their effect on the G tested; organic FF: Humus de Lombriz was more profitable in both evaluation cycles and could be quite economical, compared to traditional FF, evaluated in the study.

2. The G, in general, respond in a similar way to the FF used, as long as the natural capacity of the G's performance is taken into account; whether they are: CS or Trilinear hybrids such as: 1052.

3. Within the evaluated G, the CS: (Eto 7) -52 / A20 had the highest weight of grain or seed compared to the rest of G, including hybrid 1052. Likewise, the average yield of (Eto 7) -52 / A20 and CT: 1052 was much higher than that obtained by the other G that integrate them.

4. The line: AVN was the G least efficient of the three that were tested.

5. The best treatments (FF * G) were those integrated by CS: (Eto 7) -52 / A20 fertilized with the types of fertilization evaluated. Likewise, the least productive treatments were integrated by the G: AVN, fertilized with the types of fertilization evaluated. See Table 5.

6. References

Clementelli A. y Zevallos R. *Fertilización nitrogenada mineral y orgánica en el cultivo de Stevia* (*Stevia rebaudiana Bertoni*). Univ. Cienc. Soc. [Online]. 2009, vol.1, no.1 [citado 25 Febrero 2013], p.47-50. Disponible en <http://www.revistasbolivianas.org.bo/scielo.php?script=sci_arttext&pid=S8888-88882009000100007&lng=es&nrm=iso>. ISSN 8888-8888.

Little M. T. y Jackson H. F. 1976. *Métodos estadísticos para la investigación en la Agricultura*. Editorial Trillas. Primera edición en español. Págs. 87 – 94. México.

Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación. 2015a. *Agenda Técnica Agrícola de Jalisco.* Pág. 97-106. ISBN Volumen: 978-607-7668-42-8. ISBN obra completa: 978-607-7668-11-4. Segunda edición, 2015. Impreso en México. México, D.F.

Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación (SAGARPA). 2015b. Coordinación General de Asuntos Internacionales. *Iniciativa "4 por1000". Suelos ricos en carbono para la seguridad alimentaria y el clima*. Ministerio de Agricultura, Alimentación y Silvicultura de Francia.

Tapia V. L. M.; Larios G. A.; Hernández P. A.; Díaz G.T.; Muñoz V. J. A. 2013. *Fertilización orgánica y química del cultivo de Maíz (Zea mays) de temporal en Michoacán*. Agrofaz: Volumen: 13. Número: 2.

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Structural Analysis of Greenhouse for Vegetable Growing

MARTÍNEZ-LÓPEZ, Sergio Romeo*† & ORTIZ-TENA, Francisco

Universidad Tecnológica de San Miguel de Allende. Camino a San Julián No.8 Col. Casco de Landeta., 37700 San Miguel de Allende, Gto.

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Abstract

The study of the Analysis of greenhouse vegetable production is identified by the need to know the different physical and chemical variables that are performed inside a greenhouse, at present there are different variables to consider to have an effective production in greenhouse, handling of good (GAP) to obtain good results in obtaining quality crops, this is considering the different physical and chemical variables that would be found in a production system once the implementation is carried out, one of the variables more known are the temperature management inside the greenhouse as it is a very important physical factor for the good development of the plant is for them that a well designed and installed structure is required, others such as physical elements such as wind and loads integrations that go according to the structure of the greenhouse, in this case plastics used to protect the crop are of great importance. It is intended to make the reader aware of the possibility of implementing the simulation as an object of Analysis in the Structure, since the benefits of this implementation leads to a high safety factor for the greenhouse designer and, as can be known, a higher efficiency at time to build and another positive factor, will require less structural maintenance.

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* Correspondence to Author (email: srmartinez@utsma.edu.mx)
† Researcher contributing first author.

1. Introduction

The analysis of a greenhouse for the production of vegetable crops addresses concepts that serve to know the key points in which the production or management of crops in greenhouses will be more susceptible. It is convenient to bear in mind that one of the advantages of greenhouse production in Mexico is its ability to produce during the winter season, since in general, in this period there is only vegetable production in some areas of the Mexican Republic and the State of Florida in the United States.

It is important to mention that the structure plays a fundamental role in the good quality of production of vegetables under greenhouse and at the same time be competitive in terms of the prices that are being handled in the US and Mexico market- the mild climate of autumn and winter in Mexico, it enables the production of greenhouse vegetables at more competitive costs, using simple structures, low technology and mesh-shade, without incurring the use of heating, equipment and special structures that entail higher levels of investment.

It is important to mention that the market prices of greenhouse crops in Mexico are still low - regardless of the production of the vegetables under controlled or semi-controlled environments - these in turn are strongly influnked by the volume of production generated in the field open sky, and these in turn by the most important factors, in this case the climatic.

If we take into account the structure with which the greenhouse is manufactured, we have to assess the stiffness and resistance factors of the materials in a greenhouse, since we must consider the dynamics of the winds, since when making a good installation of the materials used You can make a precision of the useful life of the greenhouse in question durability.

The application of a software to carry out the Analysis of the finished element can give us the certainty that the construction and installation of the greenhouse has the necessary study elements and a greater certainty that would indicate us that the structure is adequate to have enough support for the forces that will be applied due to the climatic and physical factors that will be taken into consideration for the structure. The software tells us visually how the structure will behave, and will give us guidelines to ensure that the production within it is more stable and therefore entails less execution of predictive and corrective maintenance.

1.1 Justification

As it is a material of metal fabrication, it is always important that the necessary tests of resistance, durability and to ensure the proper functioning of the same are carried out in the construction, that is why to take the design to the construction status, in this way it is easier to achieve the above, having results based on the physical behavior of the structure at the moment when it begins to carry out the production of the crop.

1.2 Problem

Generally when establishing greenhouses of metal structure do not take into account the physical and climatological factors that are in the field, if we take into account these factors to obtain values before taking them to the construction we can have more certainty and reliability in the installation of the greenhouse and thus achieve a longer duration of it, this is where we carry out the structural analysis.

1.3 Hypotesis

1.4 Objectives

1.4.1 General Objective

Determine the feasibility of implementation of greenhouses for vegetable cultivation taking into account aspects of climatology and orography of the state of Guanajuato...

1.4.2 Specific objectives

– To delimit the pertinent climatological conditions for the cultivation of vegetables.
– Compare the climatological conditions of the state of Guanajuato with those obtained in a greenhouse structure.
– Establish the orography suitable for the culture of hotalizas.
– Contrast the weather conditions of the state of Guanajuato with those obtained in a greenhouse structure.
– Determine the degree of technification that the greenhouses that are implemented in the state of Guanajuato should have

2. Theoretical framework

The state of Guanajuato includes three main types of climates, the dry and semi-dry climate that covers 43% of the surface of the state, which can be found in the northern zone; a warm and subhumid climate covers 33% of the state in the southwest and east; and a temperate subhumid climate comprising 24% of the state which is in the center and southern part.

Figure 1

– The orange color represents the Dry and semi-dry, green subhumid climate and temperate lilac.
– Average temperatures range between 5.2ºC in the winter months and 30ºC in the spring months. Presenting an annual average of 18ºC.
– The rainy season in the state occurs mainly in the summer months.
– The orography of the state is affected by the Sierra Madre Oriental (northeast), Mesa Centro (north) and the Neovolcanico axis (south)
– In the north central part we find saws with plateaus and saws with a height of 2140 meters above sea level.
– In the Sierra Madre Oriental we find maximum heights at 3000 meters above sea level.
– In the Neovolcanic Axis we find different volcanoes separated by plains lomeríos and valleys.

Conditions of vegetables

The greenhouses are used to ensure the production and quality of the crops, since in the open field it is very difficult to maintain the crops in a perfect way throughout the year.

The concept of greenhouse crops represents the step from extensive production of vegetables to intensive production. For this, the plants have to meet optimum conditions for the development of the crop.

The controls of temperature, relative humidity, air currents and atmospheric composition are essential, as are, in addition, the control of water and fertilizers, the maintenance of the oxygen level near the roots and the health of the crop to ensure a optimal quality and productivity.

Coupled with this in vegetables such as tomatoes, it requires that the greenhouse has or is made of a resistant material, in other words with an optimum resistance to the weight since in vegetable crops such as tomato, the tutorate of this is carried out and that subject to a resistance of materials to the greenhouse and must be the most optimal so that it does not suffer structural damage.

3. Research Methodology

The implementation of a greenhouse with a level of technology is based on all the comparisons of the possible variables, the temperature differences found in any season of the year with those obtained with a greenhouse, as well as the advantages or disadvantages that we can find due to the orography of the state. For the development of the project you need to organize a study base consisting of the following variables:

a. Determination of the optimum conditions for the cultivation of vegetables.
b. Obtaining the climatological variables presented by the state of Guanajuato.
c. Analysis of the differences found between the climatic variables of the state and the optimum ones of the crop.
d. Obtaining the orographic variables presented by the state of Guanajuato.
e. Analysis of the differences found between the orographic variables of the state and the optimal ones for the crop.
f. Results
g. Improvements
h. Final report.

3.1 Type of Research

The comparisons that are projected in the article have the purpose of expressing a methodology that can be carried out for the climatological and orographic analysis of crop cultivation, the way in which it was investigated was carried out in the following way:

The documentation used for this project was based on:

- Climatological and orographic variables of the state of Guanajuato.
- Maximum conditions for the cultivation of vegetables.
- Analysis of the variables with the conditions.

3.2 Theoretical Methods

The theoretical elements used in research and optimal conditions for the cultivation of vegetables leads to sustenance, knowledge of how technically a greenhouse should be in the state of Guanajuato. Knowing the climatological variables will lead us to determine how much investment has to be made in equipment necessary to condition the greenhouse.

4. Results

The structure that is shown below is part of the designed greenhouse, applying 45 N or 4.6 Kg in the structure.

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That is, it is enough for the production of hotalizas that do not require subjection, in this way we can deduce that the structure designed with the following structural characteristics as those of the figure are 6 cm wide PTR profile with a value of 2648.7 N (270kg) simulating the charges derived from the pendants that hold the guides of the plants, with a minimum value of 1.1, that is, it is 10% above the total supported. The recommendation is made that it is necessary to reinforce the structure by installing beams with 45 ° angles, which are necessary within the design and the final assembly.

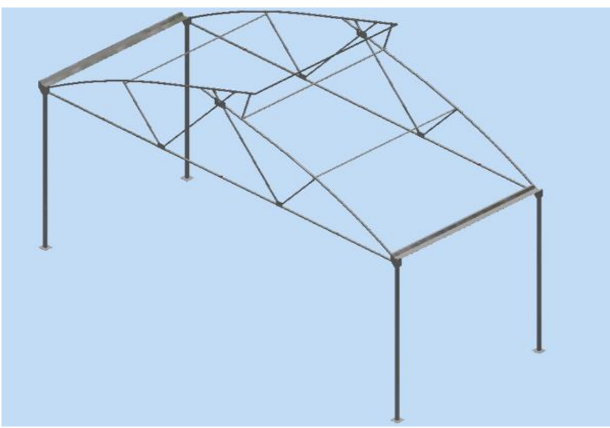

Figure 2

5. Conclusions

Once known the structure and the optimal characteristics for the installation of a greenhouse of these qualities it is determined that it is not exactly the best in its bouquet since the design is suitable for certain vegetables but once used in vegetables such as tomato, cucumber among others, it will have some difficulties especially in its resistance factor

It is also appropriate to mention that it is a greenhouse design which has favorable conditions for the production of horticultural crops as it meets parameters of quality, form, capacity among others.

6. References

Estructuras utilizadas en la agricultura protegida, Dr. Porfirio Juárez López, Dr. Rubén Bugarín Montoya, Dr. Rogelio Castro Brindis, M.C. Ana Luisa Sánchez-Monteón, Dra. Elia Cruz-Crespo, Dra. Cecilia Rocío Juárez Rosete, Dr. Gelacio Alejo Santiago, Dr. Rosendo Balois Morales. Unidad Académica de Agricultura, Universidad Autónoma de Nayarit, Departamento de Fitotecnia, Universidad Autónoma Chapingo.

Norma Mexicana para el Diseño y construcción de Invernaderos NMX-E-255-CNCP-2008. Diario Oficial de la Federación.

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Physicochemical characterization of lignin isolated from agricultural vegetable residues for the study of its properties as fuel and estimation of its energy potential

TORRES-RAMOS, Ricardo[1]*†, MONTERO-ALPIREZ, Gisela[1], VALDEZ-SALAS, Benjamín[2], and CORONADO-ORTEGA, Marcos A.[1]

[1]Universidad Autónoma de Baja California, Institute of Engineering, Cuerpo Académico Sistemas Energéticos. Blvd. Benito Juárez and Calle de la Normal, CP 21280 Mexicali, Mexico
[2]Universidad Autónoma de Baja California, Institute of Engineering, Cuerpo Académico Corrosión y Materiales. Blvd. Benito Juárez and Calle de la Normal, CP 21280 Mexicali, Mexico.

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Abstract

Lignin is one of the main constituents of plant biomass and is generated as a by-product in the production of bioethanol. However, it has important energy properties that convert it as a potential fuel, and its use can improve the competitiveness of biomass as a source of renewable energy. In Baja California-Mexico, there is a preponderance agricultural activity that generated in 2016 around 102,960 t of wheat straw and 48,315 t of cotton stalk. Therefore, the objective of this research was to determine the percentage of lignin in wheat straw and cotton stalk, to valorize the amount of lignin available in Baja California and estimate the energy potential of this region. The analyses included isolation and determination of the lignin percentage; morphological analysis; proximate analysis; higher heating value determination; elemental analysis by electrons dispersed of X-rays; analysis of the majority of elements by X-rays fluorescence; analysis by Fourier transform infrared spectroscopy. It was found that wheat straw contains 20.81% lignin, with a higher heating value of 22.91 MJ/kg, while cotton stalk 22.33% and 24.99 MJ/kg. By 2016, Baja California had 114,571 t of lignin from both wastes, giving it an energy potential equivalent to 2,644 TJ or 80,120 tons of anthracite coal.

Agricultural Wastes, Energy Properties, Higher Heating Value, Physicochemical Characterization, Lignin

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* Correspondence to Author (email: rtorres84@uabc.edu.mx)
† Researcher contributing first author.

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Introduction

Plant residues from agriculture are a type of lignocellulosic biomass consisting essentially of cellulose, hemicellulose, and lignin. There is now a growing interest in the deposition of these wastes as renewable energy sources. The production of bioethanol from this type of waste is one of the main objectives in many investigations around the world. (Mohapatra et al., 2017; Chng et al., 2016). However, the process for the production of bioethanol presents a major drawback that increases its production. The plant material must be delignified before hydrolyzing and fermenting the cellulose. (Baskar et al., 2016).

The elimination of lignin is an indispensable step in the production of bioethanol because its presence in the material affects the process of transformation of the biomass into fermentable sugars in two ways. Firstly, lignin can irreversibly absorb hydrolytic enzymes by blocking their action on cellulose. And secondly, lignin has a hydrophobic character that prevents or reduces swelling of the cellulose, decreasing the surface accessible to the enzymes. (Palonen et al., 2004; Chang & Holtzapple, 2000). Therefore, the fermentation of plant biomass for the production of bioethanol inevitably generates large amounts of lignin as a by-product.

Lignin is a complex, branched and an amorphous polymer composed of three monomeric units, syringyl propane (3,5-dimethoxy-4-hydroxyphenylpropane), guaacyl-propane (4-hydroxy-3-methoxyphenylpropane) and 4-hydroxyphenylpropane. (Bittencourt et al., 2010; Monteil et al., 2013; Singh et al., 2015). This polymer has important energetic properties that can be harnessed for the production of thermal and/or electric energy (Cotana et al., 2014).

Their use can contribute to lower bioethanol production costs and improve the competitiveness of residual agricultural biomass as a source of renewable energy, especially in regions with intense agricultural activity (Buranov & Mazza, 2008).

The state of Baja California, Mexico has devoted extensive areas to wheat and cotton crops, making this region one of the most active sites of Mexican agriculture. This characteristic represents a significant potential for the development of renewable energies, such as the production of lignocellulosic bioethanol and, consequently, the generation of large amounts of lignin as a by-product. In 2016, 102,960 ha of wheat and 10,931 ha of cotton were grown (SIAP, 2016). Generating approximately 741,312 t of wheat straw and 48,315 t of cotton stalk, considering a residue generation index of 7.2 t/ha and 4.42 t/ha for wheat and cotton crops, respectively (Gemtos & Tsiricoglou, 1999; SENER, 2016).

Therefore, the objective of this work was the study of the energetic properties and physicochemical characteristics of lignin isolated from vegetable residues of wheat and cotton crops in the State of Baja California. It also quantifies the amount of available lignin and its energy potential as a biofuel of the region.

Methodology

This research was developed in four steps: (a) preparation of the sample; (b) determination of the lignin percentage; (c) physicochemical characterization and energy properties determination and (d) estimation of the energy potential lignin. In all cases, these samples were analyzed in triplicate.

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Preparation of the sample

200 g of *Triticum aestivum L genus* wheat straw and 200 g of *Gossypium hirsutum L* genus cotton stalk were collected from a cropland of the Mexicali Valley that is located in the State of Baja California. The samples were finely milled using a GRINDOMIX GM 300 Retsch mill series and homogenized in a sieve Nº 35.

Determination of the lignin percentage

Before determining the percentage of lignin, samples of wheat straw and cotton stalk were dried according to ASTM E871 to determine their humidity content. Two extractions were then performed, one in hot water and other in ketone, according to the standards established in TAPPI T207 and PATTI T264, respectively. The percentage of lignin was determined as the amount of sulfuric acid insoluble material according to the methodology established in ASTM D1106.

Physicochemical characterization and energy properties determination

Five analyses were carried out to the physicochemical characterization and energy properties determination of the wheat straw, and cotton stalk, each of them described below.

a. Higher heating value

The higher heating value (HHV) was determined using an IKA C2000 series isoperibolic bomb calorimeter. This equipment was set at 25ºC through the isoperibolic method according to the ASTM 711 standard.

b. Proximate analysis

The proximate analysis was carried out to quantify the solid, gaseous, and non-fuel fraction from the agricultural wastes.

This analysis includes determinations such as the volatile material, fixed carbon, and ash according to the ASTM E872, ASTM E870, and ASTM E830 standards.

c. Analysis by scanning electron microscope

The morphology of the lignin powders and the distribution of elements were characterized by a scanning electron microscope (SEM) using a JEOL JSM-6010LA series microscopy. This instrument consists of an energy dispersive X-ray analyzer and a retro-dispersed electrons detector to capture images. It was operated under conditions of low vacuum and a voltage from 15 kV to 20 kV.

d. X-ray fluorescence spectrometry

The isolated lignin powders of wheat straw and cotton stalk were analyzed by the X-ray fluorescence spectrometer of dispersed energy, using a SHIMADZU EDX-7000 equipment. The X-ray generator consists of a tube that uses the Rhodium (Rh) element as a target, and it was set at 50 kV and 283 μA.

The operation characteristics allowed determining the majority of elements found in the samples in a range that covers from sodium to uranium. The X-ray fluorescence lines emitted by the samples were identified using a silicon drift detector (SDD).

e. Analysis by Fourier transform infrared spectroscopy

The wheat straw and cotton stalk isolated lignin was characterized by the infrared spectrometry, using a Perkin Elmer Spectrum One FT-IR Spectrometer, which consists of a detector of attenuated total reflection (ATR). The spectra were collected in the range from 400 to 4000 cm^{-1} with a spectral resolution of 4 cm^{-1}, and 16 scans were performed for each sample.

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Estimation of the energy potential lignin

The amount of available lignin were calculated according to the Eq. (1), where the calculated lignin percentage is multiplied for each residue per the amount of agricultural waste (no humidity and total extractions) generated in 2016. The residue production index of wheat straw considered was 7.2 t/ha and 4.42 t/ha for cotton stalks (Gemtos & Tsiricoglou, 1999; SENER, 2016).

$$A = [B \times (1 - \%H - \%E)] \times \% L \quad (1)$$

Where:
A: Amount of recovered lignin
B: Tons of residues generated in 2014
% H: Humidity percentage
% E: Total extractions
% L: Percentage of lignin in wheat straw

The potential energy was estimated considering the amount of available lignin from the wheat straw and the cotton stalk in 2016. It was calculated according to the yield of available lignin that corresponds to each residue regarding its higher heating value; that was measured in MJ/kg.

Results

Morphological analysis

The lignin was isolated from the vegetable materials as the insoluble residue in sulfuric acid, and it was filtered and dried at 40°C. As a result, a brown powder of soft texture was obtained. The color of the wheat straw lignin was darker than the cotton stalk lignin. The morphology of the isolated lignins was analyzed by SEM, and the captured images are illustrated in Figure 1. These images indicate some important differences of the isolated materials, even though both residues were treated similarly in the lignin separation process.

The wheat straw lignin is like a micrometric powder that agglomerates in layers with micro-metric sizes smaller than 25 µm. The cotton stalk lignin presents densely packed microparticles. These microparticles have a defined structure and a high porosity.

The porous structure observed in the isolated lignins provides a major superficial area available for gasification reactions. The high porosity favors the mass transference inside of the material, which facilitates the carbonating agents penetration, e.g., CO_2 and H_2O. It causes an increase in the reaction speed during gasification, desirable characteristics in thermochemical processes (Butterman & Castaldi, 2012; Rincón et al., 2011).

Typical cellulose and hemicellulose micro fibers were not observed in the SEM images depicted in Figure 1. Therefore, it could be assumed that the treatment of agricultural wastes with 72% w/w sulfuric acid dissolved those components.

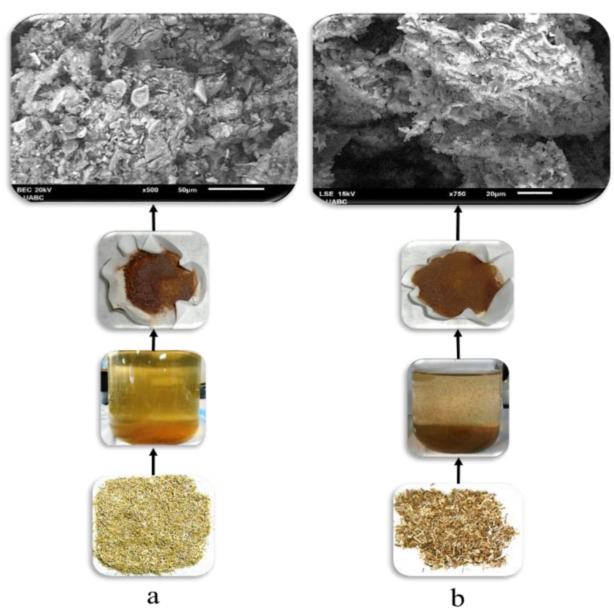

Figure 1 Lignin extraction process and SEM images of (a) wheat straw and (b) cotton stalk.

Lignin percentage, proximate analysis, and higher heating value

The cotton stalk contained 6.28% of humidity and 11.57% of the extractable material. This waste had 22.33% of lignin as part of their structural compounds. The higher heating value of the lignin was 24.99 MJ/kg. The experiment results are exhibited in Table 1.

The wheat straw contained 8.83% of humidity and 25.91% of the extractable material. This waste had 20.81% of lignin as part of their structural compounds. The higher heating value of this lignin was 22.91 MJ/kg. The experimental results are displayed in Table 1.

The values obtained of volatile material, ashes, fixed carbon, and the HHV in both lignins are in the range of values according to the literature (Horst et al., 2014; Blunk et al., 2000). Regarding the proximate analysis results, the high amounts of volatility found in the lignins revealed important thermal properties. These lignins provide a high reactivity and burn at low temperatures. Therefore, they do not require staying a long time in the furnace. These properties increase the efficiency of the combustion process (Nogués et al., 2010).

Analysis	**Cotton stalk**		**Wheat straw**	
	Average	SD	Average	SD
Humidity	6.28	0.01	8.83	0.14
Extract	11.57	0.33	25.91	0.36
Lignin	22.33	0.31	20.81	0.22
Analysis	Isolated lignin		Isolated lignin	
	Average	SD	Average	SD
VM	70.25	0.33	69.15	0.59
FC	29.51	0.37	27.54	0.80
Ash	0.78	0.09	2.29	0.20
HHV*	24.99	0.15	22.91	0.06
* Expressed in MJ/kg				

Table 1 Lignin in cotton stalk and wheat straw and its physicochemical characteristics in dry base.

The quantification of the ashes content is important in a fuel material because the ashes decrease the heating value and the combustion efficiency. The isolated lignin of both materials has a low content of ashes. It means that diminishes the occurrence of problems related to the powder emissions, maintenance difficulties, crud formation, corrosion, and deposits in the heat exchangers. The low contents of ashes also make its grinding process and transportation easier (Suramaythangkoor & Gheewala, 2010).

The fixed carbon refers to the amount of material that burns slightly without igniting a flame. Its value is related to the time required to complete the oxidation of the material. It is important to determine the feeding speed to the furnace. The fact that the cotton stalk lignin contains a higher percentage of fixed carbon than the wheat straw lignin implies that the HHV of the cotton stalk lignin is higher than the HHV of the wheat straw lignin (Nogués et al., 2010).

The results of the approximate analysis and the high-energy contents of the isolated lignins are similar to the characteristics of the sub-bituminous coals according to the Standard Classification of Coals by Rank (ASTM D338). Therefore, it is possible to convert the energy of the residual lignin generated in Baja California by using more efficient conversion systems such as gasification or co-firing with these coals (Suramaythangkoor & Gheewala, 2010). The lignin can be pelletized and densified to make its transportation easier and cheaper, which makes its final arrangement possible into far places from the agricultural lands.

Elemental analysis

After performing the elemental analysis by EDX, it was found that the cotton stalk lignin contains 74.83% of carbon and 24.83% of oxygen.

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The EDX analysis of the wheat straw lignin revealed 63.56% of carbon and 32.94% of oxygen. These results are disclosed in Table 2, and they support the results of HHV where the cotton stalk lignin has a higher amount of energy per unit of mass, compared to the wheat straw lignin.

The atomic O/C ratio is usually used as a parameter to evaluate the efficiency of fuels in the different processes of energy conversion (Ohm et al., 2015). The O/C ratio of the cotton stalk lignin was 0.33, and the O/C ratio of the wheat straw lignin was 0.52. An increase of 0.20 in the O/C ratio meant a decrease in the HHV of 2.08 MJ/kg. This ratio indicates that the cotton stalk lignin will provide a higher reactivity in the pyrolysis processes, direct combustion, or gasification (Wang et al., 2010). The higher O/C ratio is also related to the decrease of liquid fuel produced by the liquefaction processes (Hayamizu & Ohshima, 1985; Saxby, 1980). Nevertheless, several studies indicate that the increase in this ratio increases the total efficiency of gaseous products through the hydropyrolysis processes in carbonaceous materials (Strugnell & Patrick, 1995).

Analysis	**Elements**	**Lignin Source**	
		Cotton stalk	**Wheat straw**
Elemental analysis	Carbon	74.83	63.56
	Oxygen	24.82	32.94
	Sulfur	ND*	0.09
	Silicon	0.34	3.41
	O/C	0.33	0.52
Analysis of the majority elements	Silicon	41.035	76.341
	Sulfur	34.851	10.856
	Bromine	6.925	2.400
	Calcium	6.771	3.678
	potassium	5.980	3.562
	Iron	2.592	1.964
	Copper	1.847	0.219
	Zinc	-	-
	titanium	-	0.477

Table 2 Percentage of elements in the lignin and relative concentration of majority elements (w/w).

Fuels are usually composed of elements that are responsible for the emission of pollutants and elements related to corrosion problems in the combustion systems, for instance: nitrogen, chlorine, and sulphur. These elements were not found in the isolated lignin, but it was found sulphur in the wheat straw lignin.

However, the low sulphur concentrations in the wheat straw make its combustion or co-firing easier with other fuels without high environmental risks.

Analysis of the majority elements

This analysis allowed classifying the elements of the inorganic fraction in the isolated lignin, as it is indicated in Table 2. During the combustion of the lignin, it is expected the formation of oxides of silicium, sulphur, calcium, and potassium.

Although the wheat straw lignin had a higher relative amount of sulphur, it also had the higher amount of calcium, which means that a great part of sulphur oxides generated from the combustion, will remain in the calcium oxides. This decreases the emission of polluting and corrosive products to the environment. It is also expected that the ashes of the cotton stalk lignin burn at higher temperatures than the wheat straw lignin because it has the higher content of silicon oxides and the lower content of potassium oxides (Melissari, 2012).

On the other hand, heavy metals were not found in the isolated lignin, except for the zinc in the cotton stalk lignin. The determination of the elements present in the inorganic fraction of biomass is important because such elements have a catalytic effect on the pyrolysis and gasification reactions.

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Furthermore, they may react with the carbonating agent and impact on the reactivity of the carbonaceous residue and the thermal decomposition of the vegetable material. The calcium, sodium, potassium, and magnesium are components present in the ashes and have a catalytic effect over the gasification (Butterman & Castaldi, 2012; Hattingh et al., 2011).

FT-IR analysis

FT-IR spectra of isolated lignin powders in wheat straw and cotton stalk are illustrated in Figure 2, and the principal absorption bands are indicated in Table 3. The absorption spectrum values of the wheat straw lignin were lower than the spectrum values of the cotton stalk lignin. It may be caused by changes or damages in the chemical structure of lignin during the isolation process.

Nevertheless, both spectra reveal the characteristic functional groups in this biopolymer. Coming from the vibration of OH stretching groups in the aromatic and aliphatic compounds, a strong absorption at 3323/3350 cm^{-1} was observed. Two absorption bands at 2921/2917 and 2852/2832 cm^{-1} were assigned to the asymmetric and symmetric vibrations, respectively, of the saturated CH_2.

Other bands at 1710/1706 cm^{-1} are part of the non-conjugated carbonyl groups, whereas the others at 1645/1650 cm^{-1} are part of the conjugated carbonyl. Moreover, the rings or aromatic skeleton absorption at 1603/1599 and 1513/1500 cm^{-1} were noticed (Li, Wu, 2012; Kang et al., 2012; Balagurumurthy et al., 2014). The absorption bands associated to the monomers that form the lignin of vegetable materials may be noticed in the spectrograms.

In the spectrum of the cotton stalk lignin, there are bands at 1376, 1263, and 1218 cm^{-1} that correspond to the G units, the typical bands of S units appear at 1376 and 1110 cm^{-1}, and the characteristic bands of H units are present at 824 and 933 cm^{-1}.

Bands of G (1313, 1114 cm^{-1}) and S (1266, 1214 cm^{-1}) units are also noticed in the wheat straw lignin. However, just one band at 925 cm^{-1} is noticed, which could be caused by the H monomer. This result indicates a lower concentration of H units in wheat straw lignin that corresponds to the results given by other authors (Monteil et al., 2013; Watkins et al., 2015; Bauer et al., 2012).

The determination of the chemical lignin composition is strongly affected by the methods and extraction solvents used. For that reason, the lignin spectra of the same vegetable material may have differences concerning the absorption band and the intensities. The spectra obtained in this study differ with the spectra of isolated lignin using dioxane (Sun et al., 2005) or sodium hydroxide (Ahvazi et al., 2011). Nonetheless, they maintain greater similarities to the spectra of isolated lignin with sulfite (Sahoo et al., 2011) or using a sulphuric acid treatment supported by microwaves (Monteil et al., 2013).

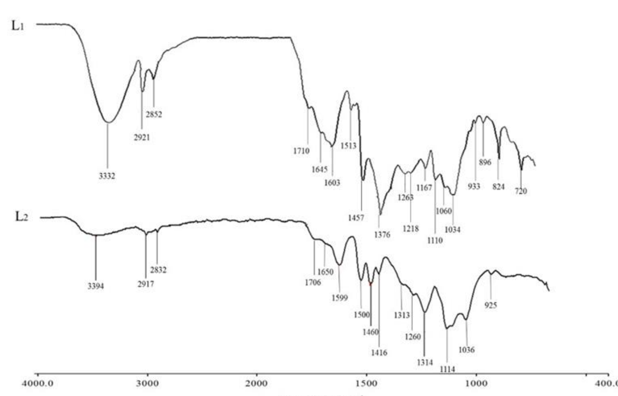

Figure 2 FT-IR spectrum of cotton stalk lignin (L1) and wheat straw lignin (L2).

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Wavelength (cm^{-1})		Vibration type	
Cotton stalk lignin	**Wheat straw lignin**	**Functional groups**	**Origin**
3332	3394	O-H stretching	Phenolic and alcoholic groups
2921, 2852	2917, 2832	C-H symmetric and asymmetric stretching	$–CH_3, –CH_2 –CH$
1710	1706	C=O stretching	Non-conjugated carbonyl groups
1645	1650	C=O stretching	Conjugated carbonyl groups
1603, 1513	1599,1500	C=C stretching	Aromatic ring or skeleton
1457	1460	C-H bending	Asymmetric deformation in $–CH_3$ and $–CH_2$
1376	-	C-H bending	Syringyl or guaiacyl units
-	1313	C-H bending	Syringyl units
1263	1260	=C-O-R stretching	$–OCH_3$ y $–OH$ guaiacyl units
1218	1214	C-C, C-O and C=O stretching	Condensed and esterified guaiacyl units
1110	1114	C-H in-plane bending	Typical syringyl units
1034	1030	C-H and C-O bending	Aromatic ring, $-OCH_3$, primary alcohol
933	925	=CH- out-of-plane bending	Alkenes

Table 3 FT-IR absorption bands of the isolated lignins

Available lignin

In 2016, the lignin that might has been recovered from cotton stalks in Baja California was 8,940 t that is equivalent to 223 TJ taking into account the HHV experimentally determined. For the same year, it was estimated that about 105,631 t of lignin from wheat straw could be obtained that are equivalent to 2,421 TJ based on the experimental HHV.

The cotton stalk and wheat straw lignins totalized 114,571 t, this quantity represents an approximate total energy potential of 2,644 TJ. And this potential is equivalent to the energy that would be obtained from 80,120 t of anthracite coal.

Conclusions

The separation of the lignin from the rest of the fibers present in the cotton stalk and wheat straw`s cell wall was achieved. The lignins recovered from both agricultural wastes were physicochemically characterized, and the energy properties were determined. The quantified lignin in the cotton stalk was 22.33% and 20.83% for the wheat straw. The results highlighted that the lignins have a high heating value and a high carbon content. The wheat straw lignin has sulphur and calcium. The sulphur oxides generated from a combustion process will remain in the calcium oxides. This decreases the emission of polluting and corrosive products to the environment.

The lignin is a renewable resource that could be exploited for the energy supply through more efficient conversion systems such as the gasification or the co-combustion. Furthermore, its high energy density, compared with the source biomass, has a positive impact on the transport costs.

The amount of lignin available from wheat straw and the cotton stalk was 114,571 t, equivalent to 2,644 TJ or 80,120 t of anthracite coal. The lignin represents a renewable energy resource for the State of Baja California. However, the separation of this polymer implies processes or operations that involve additional costs. Those processes allow the obtainment of various products, which add value to the agricultural wastes and promote the economic development of the rural sector.

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December 2017 Vol.3 No.5 24-34

References

Ahvazi, B., Wojciechowicz, O., Ton, T.M., & Hawari, J. (2011). Preparation of lignopolyols from wheat straw soda lignin. *Journal of agricultural and food chemistry*, 59(19), 10505–10516.

Balagurumurthy, B., Singh, R., Oza, T.S., Kumar, K.S., Saran, S., Bahuguna, G.M., & Bhaskar, T. (2014). Effect of pressure and temperature on the hydropyrolysis of cotton residue. *Journal of Material Cycles and Waste Management* 16(3), 442–448.

Baskar, G., Kumar, R. N., Melvin, X. H., Aiswarya, R., & Soumya, S. (2016). Sesbania aculeate biomass hydrolysis using magnetic nanobiocomposite of cellulase for bioethanol production. *Renewable Energy*, 98, 23–28.

Bauer, S., Sorek, H., Mitchell, V.D., Ibáñez, A.B., & Wemmer, D.E. (2012). Characterization of Miscanthus giganteus lignin isolated by ethanol organosolv process under reflux condition. *Journal of agricultural and food chemistry*, 60(33), 8203–8212.

Bittencourt P.S, Fernandes D.M., Silva M.F, Lima M.K., Hechenleitner A.W., & Pineda E.G. (2010). Lignin modified by formic acid on the PA6 films: evaluation on the morphology and degradation by UV radiation. *Waste and Biomass Valorization*, 1(3), 323–328.

Blunk, S.L., Jenkins, B.M, & Kadam, K.L. (2000). Combustion properties of lignin residue from lignocellulose fermentation. *National Renewable Energy Laboratory*.

Buranov, A.U. & Mazza, G. (2008). Lignin in straw of herbaceous crops. *Industrial crops and products*, 28(3), 237–259.

Butterman, H.C., & Castaldi, M.J. (2012). Experimental investigation of lignin decomposition and char structure during CO_2 and H_2O/N_2 Gasification. *Waste and Biomass Valorization*, 3(1), 49–60.

Chang, V.S. & Holtzapple M.T. (2000). Fundamental factors affecting biomass enzymatic reactivity. *Applied Biochemistry and Biotechnology*, 84, 5–37

Chng, L. M., Chan, D. J., & Lee, K. T. (2016). Sustainable production of bioethanol using lipid-extracted biomass from Scenedesmus dimorphus. *Journal of Cleaner Production*, 130, 68–73.

Cotana, F., Cavalaglio, G., Nicolini, A., Gelosia, M, Coccia, V., Petrozzi, & A., Brinchi, L. (2014) Lignin as co-product of second generation bioethanol production from ligno-cellulosic biomass. *Energy Procedia*, 45, 52–60.

Dong, X., Dong, M., Lu, Y., Turley, A., Jin, T., & Wu, C. (2011). Antimicrobial and antioxidant activities of lignin from residue of corn stover to ethanol production Industrial. *Crops and Products*, 34(3), 1629–1634.

Gemtos, T.A., & Tsiricoglou, T. (1999). Harvesting of cotton residue for energy production. *Biomass and Bioenergy*, 16(1), 51–59.

Hattingh, B.B., Everson, R.C., Neomagus, H.W., & Bunt, J.R. (2011). Assessing the catalytic effect of coal ash constituents on the CO_2 gasification rate of high ash. *South African coal Fuel Processing Technology*, 92(10), 2048–2054.

Hayamizu, K., & Ohshima, S. (1985). Characteristic diagrams of coal-derived liquids: the correlation between aromaticity and atomic HC ratios. *Fuel*, 64(1), 130–133.

ISSN-On line: 2414-8830

Horst, D.J, Ramírez, J.J., De Andrade, P.P, & Kovaleski, J.L. (2014). An experimental comparison of lignin yield from the Klason and Willstatter extraction methods. *Energy for Sustainable Development*, 23, 78–84.

http://www.uni-assel.de/upress/online/frei/978-3-89958-950-4.volltext.frei.pdf Accesed 05 May 2016

Kang, S., Xiao, L., Meng, L., Zhang, X., & Sun, R. (2012). Isolation and structural characterization of lignin from cotton stalk treated in an ammonia hydrothermal system. *International journal of molecular sciences*, 13(11), 15209–15226.

Li, X.H., & Wu, S.B., (2014). Chemical structure and pyrolysis characteristics of the soda-alkali lignin fractions. *BioResources*, 9(4), 6277–6289.

Melissari, B. (2012). Comportamiento de cenizas y su impacto en sistemas de combustión de biomasa. *Memoria de Trabajos de Difusión Científica y Técnica*, (10), 69–82.

Mohapatra, S., Mishra, C., Behera, S.S., & Thatoi, H. (2017). Application of pretreatment, fermentation and molecular techniques for enhancing bioethanol production from grass biomass–A review. *Renewable and Sustainable Energy Reviews*, 78, 1007–1032.

Monteil, F., Phuong, M., Ye M, Halasz, A., & Hawari, J. (2013). Isolation and characterization of herbaceous lignins for applications in biomaterials. *Industrial Crops and Products*, 41, 356–364.

Nogués, F., García, D., and Rezeau, A. (2010). Energía de la biomasa. *Textos Docentes*, 1, 125–143.

Ohm, T.I., Chae, J.S., Kim, J.K., & Oh, S.C. (2015). Study on the characteristics of biomass for co-combustion in coal power plant. *Journal of Material Cycles and Waste Management*, 17(2), 249–257.

Palonen, H., Tjerneld, F., Zacchi, G., & Tenkanen, M. (2004). Adsorption of Trichoderma reesei CBH I and EG II and their catalytic domains on steam pretreated softwood and isolated lignin. Journal of Biotechnology, 107(1), 65-72.

Rincón, S., Gómez, A., & Klose, W. (2011). Gasificación de biomasa residual de procesamiento agroindustrial. Kassel University Press.

Sahoo, S., Seydibeyoğlu, M.Ö., Mohanty, A.K., & Misra, M. (2011). Characterization of industrial lignins for their utilization in future value added applications. *Biomass and bioenergy*, 35(10), 4230–4237.

Saxby, J.D., (1980). Atomic HC ratios and the generation of oil from coals and kerogens. *Fuel*, 59(5), 305–307.

SENER Secretaría de Energía (2006). Potenciales y viabilidad del uso del bioetanol y biodiesel para el transporte en Mexico.

SIAP (2016). Cierre de la producción agrícola por estado Servicio de Información Alimentaria y Pesquera.

Singh, R., Prakash, A., Balagurumurthy, B., Singh, R., Saran, S., & Bhaskar, T. (2015). Hydrothermal liquefaction of agricultural and forest biomass residue: comparative study. *Journal of Material Cycles and Waste Management*, 17(3), 442–452.

Strugnell, B., & Patrick, J.W. (1995). Hydropyrolysis yields in relation to coal properties. *Fuel*, 74(4), 481–486.

Sun, X.F., Sun, R., Fowler, P., & Baird, M.S. (2005). Extraction and characterization of original lignin and hemicelluloses from wheat straw. *Journal of agricultural and food chemistry,* 53(4), 860–870.

Suramaythangkoor. T., & Gheewala. S.H., (2010). Potential alternatives of heat and power technology application using rice straw in Thailand. *Applied Energy*, 87(1), 128–133.

Tenkanen, M. (2004). Adsorption of Trichoderma reesei CBH I and EG II and their catalytic domains on steam pretreated softwood and isolated lignin. *Journal of Biotechnology*, 107(1), 65–72.

Wang, J., Du, J., Chang, L., & Xie, K. (2010). Study on the structure and pyrolysis characteristics of Chinese western coals. *Fuel Processing Technology*, 91(4), 430–433.

Watkins, D., Nuruddin, M., Hosur, M., Tcherbi, A., & Jeelani, S. (2015). Extraction and characterization of lignin from different biomass resources. *Journal of Materials Research and Technology*, 4(1), 26–32.

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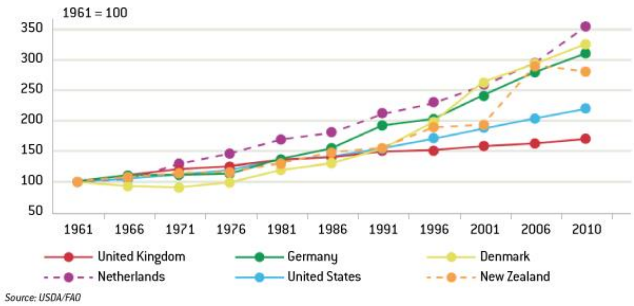

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