

the development of scientific competences, reason why an indicator of their quality are the scientific contributions published in high-impact magazines with useful knowledge (Ortega *et al.*, 2017). In Mexico, these contributions have a high weight in order to belong to the National Quality Postgraduate Program (Programa Nacional de Posgrados de Calidad, PNPC), of the National Committee of Science and Technology (Consejo Nacional de Ciencia y Tecnología, Conacyt); for the agricultural and rural sectors, the postgraduate courses are aimed at providing guidelines that allow the government to set the public agricultural policy to cooperate in the solution for its problems (Reyes & Reyes, 2018). In this context, the objective of this work was to analyze the contemporary scientific contributions of the Postgraduate Course in Tropical Agroecosystems (PTA) both at Master's degree and PhD.

Origin and Evolution of the Postgraduate Course in Tropical Agroecosystems

In 1993, the Veracruz Campus began the Master's Degree in Tropical Agroecosystem Sciences, based on a diagnosis, forecast and prospective for tropical agriculture in Mexico; the PhD in Sciences was incorporated in 1994. Before the program, there were research lines, some of which were addressed individually by the researchers. In 2001, research lines that were aligned with social and scientific trends on the handling of natural resources and production of foodstuffs were implemented, and this resulted in a robust program development. The educational scopes of students should be both national and international; the PTA has fostered the agroecological focus for the analysis of agroecosystems (AES) and an integrated agricultural perspective. In 2014, their knowledge generation and/or application lines (Lineas de Generación y Aplicación del Conocimiento, LGAC) were addressed at three levels: a) agroecosystems and their relationships with the territory, b) processes and interactions in the handling of AES and c) self-regulated ecological processes. Today there are three lines: 1) Assessment and Re-Design of Agroecosystems (ARAES), 2) Tropical Agroalimentary and Agroindustrial Chains (TAAC), and 3) Natural Resources, Agroecosystems and Climate Change (NRACC). The postgraduate course seeks to develop capacities under the competence focus in order to apply and transfer knowledge in productive units, under an integrated focus of agricultural and natural resources use, with interdisciplinary participation (CP, 2017).

Agroecology: Disciplinary Framework of Agroecosystems

Since the beginning, PTA professors considered the agroecosystem to be their unit of study and as a scientific discipline of agroecology (Martínez *et al.*, 2011; Ruíz, 2006). Agroecology is an approach for understanding the ecological principles of traditional agricultural systems and to define, classify and study these systems from an ecological and socioeconomic perspective (Altieri, 1989; Méndez *et al.*, 2013). Agroecology stopped seeing the field or plot scale (1930-1960) and began the perception of an agroecosystem (1970-2000) (Wezel *et al.*, 2009; Wezel & Jauneau, 2011); the PTA was consolidated in this last period. The study of agroecosystems initially considered the components and functions of natural ecosystems, including local knowledge and production strategies based on ecological principles (ecological handling of plagues, association of crops and agroforestry systems (Altieri *et al.*, 1999; Argüello, 2015; Gliessman, 2011). Currently the agroecosystem is studied as a unit of analysis from the systems approach; it considers both ecology, social and political aspects in the context of decision-makers (farmers) (Gallardo *et al.*, 2018); together with this growth in intention (qualitative) and extension (qualitative) of agroecology and its unit of study, the PTA has co-evolved as a response to the complexity of social demands.

MATERIALS AND METHODS

A query was made on the SCOPUS and Web of Science databases in February 2020, with the name of each PTA researcher; the last 5 years were considered (2014-2019). SCOPUS gave 138 scientific papers and Web of Science gave 101; upon suppressing repeated papers there were 92 papers left. In both databases information on 23 researchers was found from a total of 28 PTA professors. The final database had the name of the author, the publication, the magazine, volume, issue and publishing year. A Word file with the title, year, abstract, keywords and conclusions was created for each document. A text analysis of these documents (Gallardo *et al.*, 2018; Gallardo *et al.*, 2019) was made by analysis category of challenges for Mexican agriculture set in advance according to FAO's classification (2018): 1) effective alternatives to adapt and mitigate climate risks, 2) sustainable practices in the handling of natural resources, 3) knowledge and practice of indigenous communities and 4) articulation of public social protection and economic development policies that leverage an integrated human development. The NVivo

12 Pro for Windows was used for the analysis of contents (Kaefer *et al.*, 2015). An emergent category named "increase in agricultural productivity" was identified.

RESULTS AND DISCUSSION

The queried publications (N = 92) show an intensification in the last two years: 2014 (5.4%), 2015 (12%), 2016 (16.3%), 2017 (16.3%), 2018 (28.3%) and 2019 (21.7%). The text analysis found scientific contributions in the following categories: effective alternatives for adapting and mitigating climate risks (8.5%), sustainable practices in the handling of natural resources (14.9%), articulation of public social protection and economic policies that intensify an integrated human development of rural population (10.6%) and increase in agricultural productivity (66%), a more prolific category. No contributions of "knowledge and practices of indigenous communities" were found. The orientation of publications is related to the increase in production and is supported by their text contents (Figure 1).

Effective alternatives for adapting and mitigating climate risks

This category showed both renewable energies and the adaptation of flora and fauna and social and cultural responses to attain the adaptation and mitigation of climate risks until reaching the design of strategies by farmers (Ávila *et al.*, 2018; Casanova *et al.*, 2016, 2018; Casanova *et al.*, 2019; Castellanos *et al.*, 2017; Pérez *et al.*, 2016; Torres *et al.*, 2016; Vilaboa *et al.*, 2019).

Sustainable practices in the handling of natural resources

These contributions are oriented toward the preservation of flora and fauna (handling and consumption), soil improvement practices, organic fertilizers for the sustainable production of crops, handling of natural resources and adequate use and handling of pesticides (Avenidaño *et al.*, 2018; Candelaria *et al.*, 2014; Cisneros *et al.*, 2015; Cruz *et al.*, 2019; Chontal *et al.*, 2019; De Farias *et al.*, 2015; García *et al.*, 2015; Jacinto *et al.*, 2017; Linares *et al.*, 2018; Linares *et al.*, 2017; Llarena *et al.*, 2019; Nikolskii *et al.*, 2019; Ramirez *et al.*, 2016; Vandepitte *et al.*, 2019).

Articulation of Public Social Protection and Economic Development Policies that Intensify an Integrated Human Development of the Rural Population

Forms of implementation of public policies, the main role of actors and performed strategies, agroecology as

emergent production forms, which has evolved together with science, farmer practices and social movements appear in this category (Arroniz *et al.*, 2015; Casanova *et al.*, 2015; Cruz *et al.*, 2019; Figueroa *et al.*, 2019; Gallardo *et al.*, 2018; Gallardo *et al.*, 2019; Guerrero *et al.*, 2016; Ireta *et al.*, 2018; Platas *et al.*, 2017; Quintero *et al.*, 2017).

Increase in Agricultural Productivity

The contributions propose an increase in animal, forestry and crop productivity. The livestock part does research on ovines, bovines, birds, bees and rabbits, byproducts thereof and factors that limit production (Arce *et al.*, 2017; Dominguez *et al.*, 2015; Fraire *et al.*, 2018a; Fraire *et al.*, 2018b; González *et al.*, 2016; Herman *et al.*, 2019; Hernández *et al.*, 2017; Hernández *et al.*, 2018; Hernández *et al.*, 2016; Huerta *et al.*, 2018; Juárez *et al.*, 2016; Ramírez *et al.*, 2018a; Ramírez *et al.*, 2018b; Ramírez *et al.*, 2017a; Ramírez *et al.*, 2017b; Ramírez *et al.*, 2017c; Rivera *et al.*, 2016; Rodríguez *et al.*, 2017; Romero *et al.*, 2018; Rosales *et al.*, 2018; Sosa *et al.*, 2014; Yáñez *et al.*, 2018). Within the factors that limit or improve the production, sociocultural, technological and productive aspects that suggest fostering the use of technology to improve productive indexes are identified (Juárez *et al.*, 2015; López *et al.*, 2017; Maldonado *et al.*; Purroy *et al.*, 2015). In the forestry part, the availability of nutrients in the production of commercial forest species is addressed (Montero *et al.*, 2019; Rodríguez *et al.*, 2014; Santiago *et al.*, 2016). The contributions on the production of crops are more prolific and include basic crops, fruits, grass



Figure 1. Conceptual superlatives in scientific contributions of the Tropical Agroecosystem Program.



and forage, citrus fruits and energy crops (Aguas *et al.*, 2014; Alamilla *et al.*, 2016; Andrés *et al.*, 2017; Calzada *et al.*, 2014; Espinosa *et al.*, 2018; García *et al.*, 2016; García *et al.*, 2019; Grifaldo *et al.*, 2019; Guillén *et al.*, 2018; Gutiérrez *et al.*, 2018; Hernández *et al.*, 2015; Hernández *et al.*, 2016; Hernández *et al.*, 2018; Hernández *et al.*, 2019; Ibarra *et al.*, 2018a; Ibarra *et al.*, 2018b; Jaimez *et al.*, 2015; José *et al.*, 2017; Mendoza *et al.*, 2019; Mendoza *et al.*, 2015; Pérez *et al.*, 2016; Rueda *et al.*, 2016; Rueda *et al.*, 2018; Sánchez *et al.*, 2018; Valdes and Pérez, 2019; Villanueva *et al.*, 2019).

The current PTA challenges suggest that the subject matter of the study and generation of knowledge integrate experiences of stakeholders in a transdisciplinary research process (CP, 2017). Nevertheless, the results show scientific contributions oriented to increasing productivity, in congruency with the development of scientific research in the last 60 years that fosters a highly productive and profitable agriculture, although with environmental and social consequences (Sarandón, 2019). Similar studies are centered under the perspective of social relevance without considering scientific contributions like this work does, although with similar results, reflections and conclusions. Garrocho & Lazcano (2012) explored the social relevance of scientific research projects of Universidad Autónoma del Estado de México; these evidence the need of a more integrated academic structure centered on social relevance criteria that guarantee a sustained progress of knowledge areas, but which mainly contribute to reaffirming the commitment of scientific communities with their social environment. In the state of Chihuahua, Hernández *et al.* (2017) suggested orienting the training of researchers in a curriculum design that is congruent with the context in order to respond to real needs. As for postgraduate degrees in Universidad Autónoma de Nuevo León, Duéñez *et al.* (2018) considered that the relevance in education should be reviewed constantly and this allows changes in policies toward a contemporary education, such as reinforcing research competences for the design and implementation of innovative projects. This analysis on the scientific contributions of PTA and its contribution before the challenges of Mexican agriculture are the background for re-thinking our research, as the current administration points to a development model that prioritizes emergent social and economic issues to attain human wellbeing and development (Muñoz, 2019).

CONCLUSIONS

Publications generated from 2014 to 2019 by postgraduate course Tropical Agroecosystems researchers show that the research is oriented mainly to an increase in agricultural productivity, with low social relevance, according to the main challenges identified by FAO. This shows contributions with respect to sustainable practices and the articulation of public policies; initial contributions to the adaptation and mitigation of climate risks, although there were no contributions from the knowledge and practice of indigenous communities. This also suggests laying down a new role for the research of the program to address complex contemporary challenges and disciplinary interfaces with a transdisciplinary trend.

REFERENCES

- Aguas-Atlahua, A., García-Pérez, E., Ruiz-Rosado, O. & Trinidad-Santos, A. (2014). Calidad de fruto de Litchi (*Litchi chinensis* Sonn.) producido en el estado de Veracruz, México. *Rev. Fitotecnia Mex.* 37(4):373-380.
- Alamilla-Magaña, J., Carrillo-Ávila, E., Obrador-Olán, J.J., Landeros-Sánchez, C., Vera-Lopez, J. & Juárez-López, J. (2016). Soil moisture tension effect on sugar cane growth and yield. *Agric. Water Managem.* 177:264-273.
- Altieri, M. (1989). Agroecology: A new research and development paradigm for world agriculture. *Agric. Ecosyst. Environ.* 27(1):37-46.
- Andrés-Meza, P., Vázquez-Carrillo, M.G., Sierra-Macias, M., Mejía-Contreras, J.A., Molina-Galán, J.D., Espinosa-Calderón, A., Zetina-Córdoba, P. (2017). Genotype-environment interaction on productivity and protein quality of synthetic tropical maize (*Zea mays* L.) varieties. *Interciencia*, 42(9):578-585.
- Arce R., C., Aranda I., E.M., Osorio A., M.M., González G., R., Díaz R., P. & Hinojosa C., J.A. (2017). Evaluación de parámetros productivos y reproductivos en un hato de doble propósito en Tabasco, México. *Rev. Mex. C. Pec.* 8(1):83-91.
- Argüello, A. (2015). Agroecology: scientific and technological challenges for agriculture in the 21st century in Latin America. *Agron. Col.* 33:391-398.
- Arroniz, J.V., Dávila, J.P.M., Rosado, D.E.P., Rivera, P.D., Córdoba, P.Z. & Campbell, W.B. (2015). Experiencias en la estrategia para el desarrollo territorial del distrito de desarrollo rural 008, Veracruz, México. *Interciencia*, 40(4):241-248.
- Avendaño-Yáñez, M.I.L., López-Ortiz, S., Perroni, Y. & Pérez-Elizalde, S. (2018). Leguminous trees from tropical dry forest generate fertility islands in pastures. *Arid Land Res. Manag.* 32(1):57-70. doi: 10.1080/15324982.2017.1377782
- Avila-Bello, C., Hernandez-Romero, H., Mendoza B., M.A. & Vázquez L., D. (2018). Complex Systems, Agroecological Matrices, and Management of Forest Resources: An Example of an Application in Los Tuxtlas, Veracruz, Mexico. *Sustainability*, 10:3496. doi: 10.3390/su10103496
- Calzada-Marín, J.M., Enríquez-Quiroz, J.F., Hernández-Garay, A., Ortega-Jiménez, E. & Mendoza-Pedroza, S.I. (2014). Análisis

- de crecimiento del pasto maralfalfa (*Pennisetum* sp.) en clima cálido subhúmedo. *Rev. Mex. C. Pec.* 5(2):247-260.
- Candelaria-Martínez, B., Ruiz-Rosado, O., Pérez-Hernández, P., Gallardo-López, F., Vargas-Villamil, L., Martínez-Becerra, Á. & Flota-Bañuelos, C. (2014). Agroecosystems Sustainability of the Micro-watershed Paso de Ovejas 1, Veracruz, Mexico. *Cuadernos Des. Rural*, 11 (73):87-104.
- Cardoso E., E.O. & Cerecedo M., M.T. (2011). Propuesta de indicadores para evaluar la calidad de un programa de posgrado en Educación. *Rev. Electr. Inv. Educ.* 13(2):68-82.
- Casanova-Pérez, L., Martínez-Dávila, J.P., López-Ortiz, S., Landeros-Sánchez, C., Romero, G.L. & Peña-Olvera, B. (2015). Enfoques del pensamiento complejo en el agroecosistema. *Interciencia*, 40(3):210-216.
- Casanova-Pérez, L., Martínez-Dávila, J.P., López-Ortiz, S., Landeros-Sánchez, C. & López-Romero, G. (2016). Sociocultural dimension in agriculture adaptation to climate change. *Agroecol. Sustain. Food Syst.* 40(8):848-862.
- Casanova-Pérez, L., Martínez-Dávila, J.P., López-Ortiz, S., Landeros-Sánchez, C. & López-Romero, G. (2018). Climate change communication between farmers and adaptation strategies in agroecosystems of the Mexican sub-humid tropics. *Trop. Subtrop. Agroecosyst.* 21(2):189-198.
- Casanova-Pérez, L., Martínez-Dávila, J.P., López-Ortiz, S. & Rosales-Martínez, V. (2019). Mercantilización del maíz en un contexto político y de cambio climático en el trópico subhúmedo mexicano. *Cuad. Des. Rural*, 16(83).
- Castellanos, B., Gallardo-López, F., Padilla, G., Pérez-Vázquez, A. & Landeros-Sánchez, C. (2017). Spatio-Temporal mobility of apiculture affected by the climate change in the beekeeping of the gulf of Mexico. *Appl. Ecol. Environ. Res.* 15:163-175.
- CEPAL (Comisión Económica para América Latina y el Caribe). (2018). Agenda 2030 y los Objetivos de Desarrollo Sostenible: una oportunidad para América Latina y el Caribe (p. 59). Santiago de Chile. https://repositorio.cepal.org/bitstream/handle/11362/40155/24/S1801141_es.pdf
- Cisneros-Saguilán, P., Gallardo-López, F., López-Ortiz, S., Ruiz Rosado, O., Herrera-Haro, J.G. & Hernández-Castro, E. (2015). Current epistemological perceptions of sustainability and its application in the study and practice of cattle production: a review. *Agroecol. Sust. Food Syst.* 39(8):885-906.
- CP. (Colegio de Postgraduados) (2018). Doctorado y Maestría en Ciencias en Agroecosistemas Tropicales. CP, Campus Veracruz <http://www.colpos.mx/wb/index.php/campus-veracruz/agroecosistemas-tropicales#.V2wKCP1974b>
- Chontal, M.A.H., Collado, C.J.L., Orozco, N.R., Velasco, J.V., Gabriel, A.L. & Romero, G.L. (2019). Nutrient content of fermented fertilizers and its efficacy in combination with hydrogel in *Zea mays* L. *Int. J. Recycl. Org. Waste Agric.* 8(3):309-315.
- Cruz, A.R.O., Ortega-Jimenez, E., Díaz-Rivera, P., Aranda-Ibáñez, E., Ramos-Juárez, J. & Mendoza, G. (2019). *Pleurotus ostreatus* effects on agricultural waste degradation. *Agrociencia*, 53:25-33.
- Cruz-Bautista, P., Casanova-Pérez, L., Martínez-Dávila, J.P., Flores-Martínez, C. & Villegas-Rodríguez, I. (2019). Family as a social system and homegardens agroecosystem: conceptual theoretical model from the Luhmannian theory. *Trop. Subtrop. Agroecosyst.* 22(3):713-722.
- De Farias, P.M., Arellano, L., Hernández, M.I.M. & Ortiz, S.L. (2015). Response of the copro-necrophagous beetle (Coleoptera: Scarabaeinae) assemblage to a range of soil characteristics and livestock management in a tropical landscape. *J. Insect Conserv.* 19(5):947-960.
- Dominguez, P., Pro-Martínez, A., Narciso-Gaytan, C., Hernández-Cazares, A., Sosa-Montes, E., Pérez-Hernández, P., Ruiz-Feria, C. (2015). Concurrent supplementation of arginine and antioxidant vitamins E and C reduces oxidative stress in broiler chickens after a challenge with *Eimeria* spp. *Can. J. Animal Sci.* 95(2):143-153.
- Duñéz, V.P.G., Elizondo, J.A.C., Escamilla, N.E.R. & Duñéz, P.Y.G. (2018). Análisis de pertinencia de un programa de posgrado. *Espirales Rev. Multidisc. Inv.* 2(23). <http://www.revistaespirales.com/index.php/es/article/view/389/339>.
- Egas, J.J. & De Salvo, C.P. (2018). Agricultural Support Policies in Latin America and the Caribbean: 2018 Review. *Agricultural Policy Reports*. <https://publications.iadb.org/publications/english/document/Agricultural-Support-Policies-in-Latin-America-and-the-Caribbean-2018-Review.pdf>
- Espinosa-Espinosa, J.L., Palacios-Vélez, E., Tijerina-Chávez, L., Ortiz-Solorio, C.A., Exebio-García, A. & Landeros-Sánchez, C. (2018). Factores que afectan la producción agrícola bajo riego: cómo medirlos y estudiar su efecto. *Tecnol. C. Agua*, 9(2):175-191.
- FAO (Organización de las Naciones Unidas para la Alimentación y la Agricultura). (2018). México rural del Siglo XXI Ciudad de México. FAO. <http://www.fao.org/3/i9548es/i9548ES.pdf>.
- Figueroa-Rodríguez, K.A., Álvarez-Ávila, M.C., Hernández Castillo, F., Schwentesius Rindermann, R. & Figueroa-Sandoval, B. (2019). Farmers' market actors, dynamics, and attributes: A bibliometric study. *Sustainability*, 11(3):745.
- Fraire-Cordero, S., Rodríguez, P.P., Pérez-Hernández, P., Cortez-Romero, C. & Gallegos-Sánchez, J. (2018a). Reproductive response of pelibuey sheep to the application of recombinant bovine somatotropin and a metabolic restorative preparation. *Pesq. Agropec. Bras.* 53(12):1392-1398.
- Fraire-Cordero, S., Salazar-Ortiz, J., Cortez-Romero, C., Pérez-Hernández, P., Herrera-Corredor, C. & Gallegos-Sánchez, J. (2018b). External stimuli help restore post-partum ovarian activity in Pelibuey sheep. *S. African J. Animal Sci.* 48(2):337-343.
- Gallardo-López, F., Hernández-Chontal, M.A., Cisneros-Saguilán, P. & Linares-Gabriel, A. (2018). Development of the Concept of Agroecology in Europe: A Review. *Sustainability*, 10(4):1210.
- Gallardo-López, F., Hernández-Chontal, M.A., Linares-Gabriel, A. & Cisneros-Saguilán, P. (2019). Scientific contributions of agroecology in Latin America and the Caribbean: a review. *Rev. FCA UNCUYO*. 51(1):215-229.
- García-Álvarez, A., van Leeuwen, C.H.A., Luque, C.J., Hussner, A., Vélez-Martín, A., Pérez-Vázquez, A., Castellanos, E.M. (2015). Internal transport of alien and native plants by geese and ducks: an experimental study. *Freshwater Biol.* 60(7):1316-1329.
- García-Méndez, V.H., Ortega-Arenas, L.D., Villanueva-Jiménez, J.A. & Sánchez-Arroyo, H. (2016). Susceptibilidad de *Diaphorina citri* Kuwayama (Hemiptera: Liviidae) a insecticidas en Veracruz, México. *Agrociencia*, 50(3):355-365.
- García-Saldaña, A., Landeros-Sánchez, C., Castañeda-Chávez, M.R., Martínez-Dávila, J.P., Pérez-Vázquez, A. & Carrillo-Ávila, E.



- (2019). Fertirrigation with low-pressure multi-gate irrigation systems in sugarcane agroecosystems: a review. *Pedosphere*, 29(1):1-11.
- Garrocho, C. & Lazcano, G.S. (2012). La pertinencia social y la investigación científica en la universidad pública mexicana. *Ciencia Ergo-Sum*, 19(1):24-34.
- Gliessman, S. (2011). Transforming food systems to sustainability with agroecology. *J. Sustain. Agric.* 35(8):823-825.
- Gómez O., L. & Tacuba S., A. (2017). La política de desarrollo rural en México. ¿Existe correspondencia entre lo formal y lo real? *Economía UNAM*, 14(42):93-117.
- González-Gómez, R., Otero-Colina, G., Villanueva-Jiménez, J.A., Santillán-Galicia, M.T., Peña-Valdivia, C.B. & Santizo-Rincón, J.A. (2016). Effects of neem (*Azadirachta indica*) on honey bee workers and queens, while applied to control *Varroa destructor*. *J. Apic. Res.* 55(5):413-421.
- Grifaldo-Alcántara, P., Alatorre-Rosas, R., Villanueva-Jiménez, J., Hernández-Rosas, F., Stock, S. & Ramírez-Valverde, G. (2019). Evaluación de dos cepas de nemátodos entomopatógenos (Steinernematidae) para el control de salivazo (Hemiptera: Cercopidae) en caña de azúcar. *Nematropica*, 49(1):83-90.
- Guerrero-Carrera, L.M., Soto-Estrada, A., Landeros-Sánchez, C., Vargas-Mendoza, M. & Carrillo-Ávila, A.E. (2016). Atmospheric agro-industrial sugarcane emissions: It's effect on health and properties of the habitants. *Toxicol. Letters*, 259:579.
- Guillén-Sánchez, D., Gonzaga-Muñoz, M., Villanueva-Jiménez, J., López-Martínez, V. & Alía-Tejacal, I. (2018). Atracción de *Aphis nerii* a combinación de colores bajo condiciones de laboratorio. *Southwest. Entomol.* 43(2):439-445.
- Gutiérrez-Gómez, C., Carrillo-Avila, E., Landeros-Sánchez, C., Coh-Méndez, D., Monsalvo-Espinosa, A., Arreola-Enríquez, J. & Pimentel-López, J. (2018). Soil moisture tension as an alternative for improving sustainable use of irrigation water for habanero chilies (*Capsicum chinense* Jacq.). *Agric. Water Manag.* 204:28-37.
- Herman-Lara, E., Bolivar-Moreno, D., Toledo-López, V.M., Cuevas-Glory, L.F., Lope-Navarrete, M.C., Barron-Zambrano, J.A., Ramírez-Rivera, E.J. (2019). Minerals multi-element analysis and its relationship with geographical origin of artisanal Mexican goat cheeses. *Food Sci. Technol.* 39(supl. 2):517-525.
- Hernández, C.C., Luna, J.M. & García, Y.I.L. (2017). La formación de investigadores en los posgrados. Una reflexión curricular. *Rev. Bol. Redipe*, 6(9):53-72.
- Hernandez-Castro, E., Nava, A.D., Aguilera, J.A.M., Villanueva-Jimenez, J., Vargas-Alvarez, D. & Palemón-Alberto, F. (2015). Incidence of the papaya ringspot virus (PRSV-p) and management in the state of Guerrero, Mexico (pp. 119-127). *In: S. Todorov, D. & Ivanova, I.V. (eds.). Tropical Fruits.* Nova Science Publishers, Inc.
- Hernández-Domínguez, C., Guzmán-Franco, A., Carrillo-Benítez, M., Alatorre-Rosas, R., Rodríguez-Leyva, E. & Villanueva-Jiménez, J. (2016). Specific diversity of *Metarhizium* isolates infecting *Aeneolamia* spp. (Hemiptera: Cercopidae) in sugarcane plantations. *Neotrop. Entomol.* 45(1):80-87.
- Hernández-Hernández, E., López-Ortiz, S., Villarruel-Fuentes, M., Pérez-Hernández, P., Velasco-Velasco, J. & Salinas-Ruiz, J. (2017). Feeding rabbits (*Oryctolagus cuniculus*) with tree fruits from tropical deciduous forest. *World Rabbit Sci.* 25(2):135-145.
- Hernández-Landa, L., Lopez-Collado, J., González-Hernández, H., Vargas-Mendoza, M., Osorio-Acosta, F. & Nava-Tablada, M.E. (2018). Fluctuation and synchronization of adults catches of *Diaphorina citri* Kuwayama (Hemiptera: Liviidae) in urban backyards and commercial citrus plantations. *J. Asia-Pacific Entomol.* 21:745-753.
- Hernández-Marín, J.A., Pro-Martínez, A., Cortez-Romero, C., Pérez-Hernández, P., Herrera-Corredor, C.A. & Gallegos-Sánchez, J. (2016). Inducción de la ovulación con efecto macho y un reconstituyente energético en ovejas pelibuey prepúberes. *Agrociencia*, 50:811-823.
- Hernández-Marín, J., Cortez-Romero, C., Herrera-Corredor, C., Pérez-Hernández, P., Pro-Martínez, A. & Gallegos-Sánchez, J. (2018). "Male effect" and "temporary weaning" in synchronization of post-partum ovarian activity in Pelibuey ewes. *S. African J. Animal Sci.* 48(4):734-750.
- Hernández-Salinas, G., Soto-Estrada, A., García-Pérez, E., Pérez-Vázquez, A., Rocandio-Rodríguez, M. & Córdova-Téllez, L. (2019). Variación morfológica in situ de *Carica papaya* L. nativa de México. *Rev. Fitotecnia Mex.* 42(1):47-55.
- Huerta, M., Ortega, M., Haro, J., Kawas-Garza, J., Díaz-Cruz, A., Nava, C., Hernandez, D., Ortega-Jimenez, E. & Alarcon-Rojo, A. (2018). Relationship between glycerol administration to livestock 24 h before sacrifice and indicators of physiological and oxidative stress. *J. Animal Behav. Biometeorol.* 6:116-123.
- Ibarra-Cortés, K., Guzmán-Franco, A., González-Hernández, H., Ortega-Arenas, L., Villanueva-Jiménez, J. & Robles-Bermúdez, A. (2018a). Susceptibility of *Diaphorina citri* (Hemiptera: Liviidae) and its parasitoid *Tamarixia radiata* (Hymenoptera: Eulophidae) to entomopathogenic fungi under laboratory conditions. *Neotrop. Entomol.* 47(1):131-138.
- Ibarra-Cortés, K.H., González-Hernández, H., Guzmán-Franco, A.W., Ortega-Arenas, L.D., Villanueva-Jiménez, J.A. & Robles-Bermúdez, A. (2018b). Interactions between entomopathogenic fungi and *Tamarixia radiata* (Hymenoptera: Eulophidae) in *Diaphorina citri* (Hemiptera: Liviidae) populations under laboratory conditions. *J. Pest Sci.* 91(1):373-384.
- Ibarrola-Rivas, M.J. & Galicia, L. (2017). Repensando la seguridad alimentaria en México: La necesidad de discutir políticas transversales sustentables enlazando la producción de alimento con el consumo. *Inv. Geogr.* 94(94):1-16.
- Ireta-Paredes, A.R., Pérez-Hernández, P., Bautista-Ortega, J. & Rosas-Herrera, E.L. (2018). Análisis de la red de valor calabaza chihua (*Cucurbita argyrosperma* Huber) en Campeche, México. *Agrociencia*, 52(1):151-167.
- Jacinto-Padilla, J., Lopez-Collado, J., Lopez-Collado, C.J. & García-García, C.G. (2017). Species distribution modeling for wildlife management: ornamental butterflies in México. *J. Asia-Pacific Entomol.* 20(2):627-636.
- Jaimez-Ruiz, I. A., Otero-Colina, G., Valdovinos-Ponce, G., Villanueva-Jimenez, J.A. & Vera-Graziano, J. (2015). Population growth and characterization of plant injuries of *Steneotarsonemus spiniki* Smiley (Acari: Tarsonemidae) on rice. *Neotrop. Entomol.* 44(3):294-300.
- Jose-Pablo, R., Villanueva-Jiménez, J.A., Vargas-Mendoza, M.C. & Huerta-De-La-Peña, A. (2017). Life cycle and larval predation by *Ceraeochrysa valida* (Banks) on nymphs of *Diaphorina citri* Kuwayama. *Southwest. Entomol.* 42(1):61-72.

- Juárez-Barrientos, J.M., Herman-Lara, E., Soto-Estrada, A., Ávalos-de la Cruz, D.A., Vilaboa-Arroniz, J. & Díaz-Rivera, P. (2015). Tipificación de sistemas de doble propósito para producción de leche en el distrito de desarrollo rural 008, Veracruz, México. *Rev. Cient.* 25(4):317-323.
- Juárez-Barrientos, J.M., Díaz-Rivera, P., Rodríguez-Miranda, J., Martínez-Sánchez, C.E., Hernández-Santos, B., Ramírez-Rivera, E., Torruco-Uco, J.G. & Herman-Lara, E. (2016). Caracterización de la leche y clasificación de calidad mediante análisis cluster en sistemas de doble propósito. *Rev. Mex. C. Pec.* 7(4):525-537.
- Kaefer, F., Roper, J. & Sinha, P. (2015). A software-assisted qualitative content analysis of news articles: example and reflections. *Forum: Qual. Soc. Res.* 16(2). doi: 10.17169/fqs-16.2.2123
- Linares-Gabriel, A., López-Collado, C.J., Tinoco-Alfaro, C.A., Velasco-Velasco, J. & López-Romero, G. (2017). Application of biol, inorganic fertilizer and superabsorbent polymers in the growth of heliconia (*Heliconia psittacorum* cv. Tropica). *Rev. Chapingo S. Horti.* 23(1):35-48.
- Linares-Gabriel, A., López-Collado, C.J., Hernández-Chontal, M.A., Velasco-Velasco, J. & López-Romero, G. (2018). Application of soil amendments and their effect in the growth of heliconia. *Ornam. Horti.* 24:248-254.
- Llarena-Hernández, R.C., Alonso-López, A., Hernández-Rosas, F., López, C.J., González, J.M., Savoie, J.-M. & Mata, G. (2019). Aerobic fermentation prior to pasteurization produces a selective substrate for cultivation of the mushroom *Pleurotus pulmonarius*. *Biotechnol. Agron. Soc. Environ.* 23(3):165-173.
- Lopez-Collado, J., Cruz-Rosales, M., Vilaboa-Arroniz, J., Martínez-Morales, I. & Gonzalez-Hernandez, H. (2017). Contribution of dung beetles to cattle productivity in the tropics: A stochastic-dynamic modeling approach. *Agric. Syst.* 155:78-87.
- Maldonado-Jáquez, J., Salinas-González, H., Torres-Hernández, G., Becerril-Pérez, C. & Díaz-Rivera, P. (2018). Factors influencing milk production of local goats in the Comarca Lagunera, México. *Livestock Res. Rural Develop.* 30:1-6.
- Martínez, D., Gallardo, L., Bustillo, G. & Pérez, V. (2011). El agroecosistema, unidad de estudio y transformación de la diversidad agrícola. pp. 453-462. *In: Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO), La Biodiversidad en Veracruz: Estudio de Estado, Vol. 1.* Veracruz, México.
- Méndez F., E. (2005). La pertinencia como requisito para la calidad en educación superior. La planeación institucional y el compromiso como condición esencial para el desarrollo del posgrado. *Rev. Iberoam. Educ.* 36(3):1-20.
- Méndez, V.E., Bacon, C.M. & Cohen, R. (2013). Agroecology as a transdisciplinary, participatory, and action-oriented approach. *Agroecol. Sust. Food Syst.* 37(1):3-18.
- Mendoza-García, E.E., Ortega-Arenas, L.D., Serrato Cruz, M.A., Diaz Cedillo, F., Villanueva-Jiménez, J.A., López-Arroyo, J.I. & Pérez-Pacheco, R. (2015). Biological effect of *Tagetes coronopifolia* (Asteraceae) oil against *Diaphorina citri* (Hemiptera: Liviidae). *Rev. Col. Entomol.* 41(2):157-162.
- Mendoza-García, E.E., Ortega-Arenas, L.D., Serrato-Cruz, M.Á., Villanueva-Jiménez, J.A., López-Arroyo, J.I. & Pérez-Pacheco, R. (2019). Chemical composition, toxicity, and repellence of plant essential oils against *Diaphorina citri* (Hemiptera: Liviidae). *Chilean J. Agric. Res.* 79(4):636-647.
- Montero-Solís, F.M., López-López, M.Á., Jiménez-Casas, M., Cetina-Alcalá, V.M., Platas-Rosado, D.E. & López-Collado, C.J. (2019). *Gliricidia sepium* and fertilization affect growth, nutrient status, and incidence of *Hypsipyla grandella* in a *Cedrela odorata* plantation. *Agrofor. Syst.* 93(3):813-823.
- Muñoz, R.T. (2019). La Cuarta Transformación y los modelos del desarrollo anhelado: ¿Hacia dónde nos llevan? *Est. Culturas Contemp.* 5:135-156.
- Nikolskii, Y.N., Aidarov, I.P., Landeros-Sanchez, C. & Pchyolkin, V.V. (2019). Impact of long-term freshwater irrigation on soil fertility. *Irrig. Drain.* 68(5):993-1001.
- Ortega, C., Passailaigue, R., Febles, A. & Estrada, V. (2017). El desarrollo de competencias científicas desde los programas de posgrado. *REDVET. Rev. Electr. Vet.* 18(11):1-16.
- Ortega-Vargas, E., Burgueño-Ferreira, J.A., Ávila-Reséndiz, C., Campbell, W.B., Jarillo-Rodríguez, J. & López-Ortiz, S. (2019). Morphological and physiological responses of *Guazuma ulmifolia* Lam. to different pruning dates. *Agrofor. Syst.* 93:461-470.
- Pérez-Vazquez, A., Herrera, J., Valdés, R.O., Córdoba, T.L. & Sánchez, S.O. (2016). Can *Jatropha* have a second chance? Insights based on previous experiences in México pp. 215-231. *In: Segura, C.M.R. & Betancur, A.D* (eds.). *The promising future of *Jatropha curcas*: properties and potential* Appl. NY: Nova Publishers.
- Pérez-Zarate, A., Osorio-Acosta, F., Villanueva-Jimenez, J., Ortega, L. & Chiquito-Contreras, R. (2016). Factores que inciden en el control químico de *Diaphorina citri* Kuwayama en Áreas Regionales de Control. *Southwest. Entomol.* 41:1037-1050.
- Platas-Rosado, D.E., Vilaboa-Arroniz, J., González-Reynoso, L., Severino-Lendecky, V.H., López-Romero, G. & Vilaboa-Arroniz, I. (2017). Un análisis teórico para el estudio de los agroecosistemas Trop. Subtrop. *Agroecosyst.* 20(3):395-399.
- Purroy V., R., Gallardo-López, F., Pablo, D.-R., Ortega-Jimenez, E., Ortiz, S. & Torres-Hernández, G. (2015). Contribution of productive activities of agroecosystem to overcome poverty of rural families in central Veracruz state, Mexico. *Rev. Fac. Agron. (LUZ)* 32:495-514.
- Quintero, M.A.S., Aguilar, S.P., Vázquez, A.P., Maurice, M.J.E. & Comins, J.S. (2017). El turismo rural en México: Una aproximación conceptual al debate suscitado sobre las políticas públicas desarrolladas, la irrupción de agentes externos y las nuevas metodologías de acción endógena y participativa. *Est. Geogr.* 78(282):373-382.
- Ramírez-Rivera, E.J., Juárez, B.J.M., Rodríguez, M.J., Díaz, R.P., Ramón, C.L.G., Herrera, C.J.A., Hernández, S.M.I. & Herman, L.E. (2017a). Typification of a fresh goat cheese of Mexico by path models. *Turkish J. Vet. Animal Sci.* 41:213-220.
- Ramírez-Rivera, E.J., Lopez-Collado, J., Diaz-Rivera, P., Ortega-Jiménez, E., Torres-Hernández, G., Jacinto-Padilla, J. & Herman-Lara, E. (2017b). A multi-criteria approach to identify favorable areas for goat production systems in Veracruz, México. *Trop. Animal Health Prod.* 49(4):725-731.
- Ramírez-Rivera, E.J., Ramón-Canul, L.G., Díaz-Rivera, P., Juárez-Barrientos, J.M., Herman-Lara, E., Prinyawiwatkul, W. & Herrera-Corredor, J.A. (2017c). Sensory profiles of artisan goat cheeses as influenced by the cultural context and the type of panel. *Int. J. Food Sci. Technol.* 52(8):1789-1800.

- Ramírez-Rivera, E., Ramón-Canul, L. G., Torres-Hernández, G., Herrera-Corredor, J.A., Juárez-Barrientos, J.M., Rodríguez-Miranda, J.... Díaz-Rivera, P. (2018a). Tipificación de quesos madurados de cabra producidos en la zona montañosa central del estado de Veracruz, México. *Agrociencia*, 52(1):15-34.
- Ramírez-Rivera, E.J., Díaz-Rivera, P., Ramón-Canul, L.G., Juárez-Barrientos, J.M., Rodríguez-Miranda, J., Herman-Lara, E... Herrera, J.A.C. (2018b). Comparison of performance and quantitative descriptive analysis sensory profiling and its relationship to consumer liking between the artisanal cheese producers panel and the descriptive trained panel. *J. Dairy Sci.* 101:5851-5864.
- Ramírez-Mora, E., Arturo, P.-V., Landeros-Sánchez, C., Villanueva-Jimenez, J., Martínez-Dávila, J. & Lagunes-Espinoza, L. (2016). Quality of pesticide use in sugarcane agroecosystem in Veracruz, Mexico. *Toxicol. Letters*, 259:5213.
- Reyes R., L. & Reyes, M.O.I. (2018). Análisis de la educación agropecuaria de posgrado en México. pp. 360-365. In: *Dinámicas Urbanas y Perspectivas Regionales de los Estudios Culturales y de Género*. México: UNAM-AMECIDER.
- Rivera, T.D., Valdovinos, M.A., Morales, R.A., Vázquez, A.G., Ponce, A.R. & Pérez, C.B. (2016). Frecuencias genotípicas y alélicas de la b-caseína en el bovino Criollo Lechero Tropical de México. *Arch. Zootec.* 65(251):409-411.
- Rodríguez-Dehaibes, S.R., Pardo-Sedas, V.T., Luna-Olivares, G. & Villanueva-Jimenez, J.A. (2017). Two commercial formulations of natural compounds for *Varroa destructor* (Acari: Varroidae) control on Africanized bees under tropical climatic conditions. *J. Apic. Res.* 56(1):58-62.
- Rodríguez-Morelos, V.H., Soto-Estrada, A., Pérez-Moreno, J., Franco-Ramírez, A. & Díaz-Rivera, P. (2014). Arbuscular mycorrhizal fungi associated with the rhizosphere of seedlings and mature trees of *Swietenia macrophylla* (Magnoliophyta: Meliaceae) in Los Tuxtlas, Ver., Mex. *Rev. Chil. Hist. Nat.* 87(1):9.
- Romero-Escobedo, E., Torres-Hernández, G., Becerri-Pérez, C.M., Alarcón-Zúñiga, B., Apodaca-Sarabia, C.A. & Díaz-Rivera, P. (2018). A comparison of Criollo and Suffolk ewes for resistance to *Haemonchus contortus* during the periparturient period. *J. Appl. Animal Res.* 46(1):17-23.
- Rosales-Martínez, F., Rosendo-Ponce, A., Canseco-Sedano, R., Cortez-Romero, C., Torres-Hernández, G. & Becerri-Pérez, C.M. (2018). Superovulation of tropical milking criollo females *Rev. Cient.* 2:146-152.
- Rueda, J.A., Ortega-Jiménez, E., Hernández-Garay, A., Enríquez-Quiroz, J.F., Guerrero-Rodríguez, J.D. & Quero-Carrillo, A.R. (2016). Growth, yield, fiber content and lodging resistance in eight varieties of *Cenchrus purpureus* (Schumach.) Morrone intended as energy crop. *Biomass & Bioenergy* 88:59-65.
- Rueda, J.A., Ortega-Jiménez, E., Enríquez-Quiroz, J.F., Palacios-Torres, R.E. & Ramírez-Ordoñez, S. (2018). Tiller population dynamics in eight cultivars of elephant grass during undisturbed growth. *Afr. J. Range For. Sci.* 35(2):109-119.
- Ruiz-Rosado, O. (2006). Agroecología: una disciplina que tiende a la transdisciplina. *Interciencia*, 31(2):140-145.
- Sánchez-Gómez, A., Rosendo-Ponce, A., Vargas-Romero, J., Rosales Martínez, F., Platas-Rosado, D. & Becerri-Pérez, C. (2018). Germinative energy in Guaje (*Leucaena leucocephala* cv. Cunningham) with different methods of seed scarification. *Agrociencia*, 52:863-874.
- Santiago-Hernández, F., López-Ortiz, S., Ávila-Reséndiz, C., Jarillo-Rodríguez, J., Pérez-Hernández, P. & Guerrero-Rodríguez, J.D. (2016). Physiological and production responses of four grasses from the genera *Urochloa* and *Megathyrsus* to shade from *Melia azedarach* L. *Agrofor. Syst.* 90(2):339-349.
- Sarandón, S.J. (2019). Potencialidades, desafíos y limitaciones de la investigación agroecológica como un nuevo paradigma en las ciencias agrarias. *Rev. FCA UNCUYO*, 51(1):383-394.
- Sosa-Pérez, G., Pérez-Hernández, P., Vaquera-Huerta, H., Salazar-Ortiz, J., Sánchez-del-Real, C., Cadena-Villegas, S. & Gallegos-Sánchez, J. (2014). Somatotropina bovina recombinante en sincronización de estros y prolificidad de ovejas Pelibuey. *Arch. Zoot.* 63(241):219-222.
- Toledo, M.V. & Barrera-Bassols, N. (2017). Political agroecology in Mexico: a path toward sustainability. *Sustainability*, 9(2):268.
- Torres-Rojo, J.M., Moreno-Sánchez, R. & Mendoza-Briseño, M.A. (2016). Sustainable forest management in Mexico. *Curr. For. Rep.* 2(2):93-105.
- Valdés-Rodríguez, O.A., Giadrossich, F., Pérez-Vázquez, A. & Moreno-Seceña, J.C. (2018). Above- and below-ground biomass and allometry of *Moringa oleifera* and *Ricinus communis* grown in a compacted clayey soil. *Flora*, 241:35-45.
- Valdes-Rodríguez, O.A. & Perez-Vazquez, A. (2019). Seedling characteristics of three oily species before and after root pruning and transplant. *Plants (Basel)*, 8(8):258.
- Vandepitte, K., Valdés-Rodríguez, O.A., Sánchez-Sánchez, O., De Kort, H., Martínez-Herrera, J., García-Pérez, E.... Honnay, O. (2019). High SNP diversity in the non-toxic indigenous *Jatropha curcas* germplasm widens the potential of this upcoming major biofuel crop species. *Ann. Bot.* 124(4):645-652.
- Vilaboa-Arroniz, J., Lopez-Collado, J., Platas-Rosado, D.E., & Vilaboa-Arroniz, I. (2019). The myth of biofuels in Mexico. *Trop. Subtrop. Agroecosyst.* 22(2):431-441.
- Villanueva-Jiménez, J.A., Osorio-Acosta, F., Hernández-Castro, E., Téliz-Ortiz, D., Avila Resendiz, C., Abato-Zárate, M.,... González-Munguía, M.V. (2019). Integrated management of papaya pests in Veracruz: Papaya ringspot virus, papaya mealybug and mites. *Acta Hort.* 1250:10.
- Wezel, A., Bellon, S., Doré, T., Francis, C., Vallod, D. & David, C. (2009). Agroecology as a science, a movement and a practice. A review. *Agron. Sust. Dev.* 29(4):503-515.
- Wezel, A. & Jauneau, J.C. (2011). Agroecology-interpretations, approaches and their links to nature conservation, rural development and ecotourism. pp. 1-25. In: *Integrating agriculture, conservation and ecotourism: examples from the field*. Switz: Springer.
- Yáñez, B.A.L., Rodríguez, J.M.P., Murillo, P.D., Espin, T. & Hernández, P.P. (2018). Efecto de la sustitución de maíz por corno de malanga (*Colocasia esculenta*) en la degradación *in vitro* de dietas y en el desarrollo de corderos pelibuey. *Agrociencia*, 52(1):97-105.