Volume 3, Issue 4 – January – June – 2017

ECORFAN

Journal- Republic of Nicaragua

ISSN-On line: 2414-8830

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ECORFAN Journal-Republic of Nicaragua, Volume 3, Issue 4, January –June 2017, is a journal edited semestral by ECORFAN. First Avenue Southwest, San Sebastian area, León, Republic of Nicaragua. P. C. 21000. WEB: www.ecorfan.org/republicofnicaragua/, journal@ecorfan.org. Editor in Chief: RAMOS-ESCAMILLA, María. On line: 2414-8830. Responsible for the latest update of this number ECORFAN Computer Unit. ESCAMILLA-BOUCHÁN, Imelda, LUNA-SOTO, Vladimir, First Avenue Southwest, San Sebastian area, León, Republic of Nicaragua. C.P. 21000, last updated June 30, 2017.

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Presentation

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As a first article we present, *Response of jalapeño pepper (Capsicum anuum L.) Organic with drip irrigation and plastic mulch*, by DE LUNA-VEGA, Alicia, GARCÍA-SAHAGÚN, María Luisa, RODRIGUEZ-GUZMAN, Eduardo, PIMIENTA-BARRIOS, Enrique and GONZÁLEZ-LUNA, Salvador, with affiliation in the Universidad de Guadalajara, as a following article we present, *Extraction of essential oil of Epazote (chenopodium ambrosioides L.) for its use in the control of agricultural pests by the steam extraction method at laboratory level*, by RAMOS-AGUILAR, Maribel, MELESIO-ENRIQUEZ, Jaime, CALDERÓN-GONZÁLEZ, Giuliana and ARREGUÍN-SOTO, Javier, with affiliation in the Instituto Tecnológico Superior de Salvatierra, as a following article we present, *Recovery of irrigation water for greenhouses*, by DE ANDA-LÓPEZ , Rosa María & SÁNCHEZ-SALINAS, Agripín, with affiliation in 1Universidad Tecnológica del Sur of the State of México, as last article we present, *Agricultural and aquaculture extension program assessment in 2016 at Mexico City (CDMX)*, by MOCTEZUMA-LÓPEZ, Georgel, ROMERO-SÁNCHEZ, Martín Enrique, ESPINOSA-GARCÍA, José Antonio and CASTILLO-CARREÓN, Ana Laura.

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Response of jalapeño pepper *(Capsicum anuum L.)* Organic with drip irrigation and plastic mulch

DE LUNA-VEGA, Alicia*†, GARCÍA-SAHAGÚN, María Luisa, RODRIGUEZ-GUZMAN, Eduardo, PIMIENTA-BARRIOS, Enrique and GONZÁLEZ-LUNA, Salvador

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Received January 12, 2017; Accepted May 18, 2017

Abstract

The use of mulching with plastic allows to increase the production, accelerate maturation of the crops and improve its quality, in addition, reducing labor in different tasks such as weed control and irrigation. The objective was to determine the feasibility of the production of jalapeno pepper using compost under a production system with plastic mulching and drip irrigation. The work was realized at Rancho Borundas in Tototlán Jalisco. The treatments were: 1) without mulching, without compost and drip irrigation (control). 2) with mulching, with compost and drip irrigation. 3) with mulching and drip irrigation without compost. Three replicates of 10 m each were used in randomized blocks, applying NPK fertilization doses at 100% of what was recommended for the control. Statistical analysis included ANAVA and Tukey's means comparison test at 5%, using the SAS program. The results indicated that there is a highly significant difference at 1% probability between treatments for performance. When comparing Tukey's mean, treatment 2 yielded 29.7 Ton / Ha significantly exceeded the control, whose yield was 12.6 Ton / Ha, while treatment 3 had a yield of 19.8 Ton / Ha. The planting of jalapeño pepper with the application of plastic mulch, with compost and irrigation with dripping allowed to obtain the best yields of the Don Benito variety.

Compost, Organic Fertilizers, Production, Inorganic Fertilizers

Citation: DE LUNA-VEGA, Alicia, GARCÍA-SAHAGÚN, María Luisa, RODRIGUEZ-GUZMAN, Eduardo, PIMIENTA-BARRIOS, Enrique and GONZÁLEZ-LUNA, Salvador. Response of jalapeño pepper *(Capsicum anuum L.)* Organic with drip irrigation and plastic mulch. ECORFAN Journal-Republic of NIcaragua. 2017, 3-4: 1-10.

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1.- Introduction

The man in the search of better alternatives of conservation of the renewable resources has tried different techniques and materials, among them the acochado with plastic in soils; Through this technique has been achieved to increase production, accelerate the maturation of crops, improve quality, reduce the number of applications of agrochemicals and fertilizers, in addition to reducing labor in different tasks including weed control and application of Irrigation (Cruz, 2000), De Luna et al. (2015).

The plastic mulch makes the production of vegetables more competitive because it generates higher yields and opportunity in the market (precocity), and increases the quality of the fruits and the efficiency in the control of weeds and in the application of agrochemicals. It also reduces soil evaporation, fertilizer percolation losses and soil compaction (Lamont, 1993, Kasperbauer, 2000). Other beneficial effects of the plastic mulch are the radiation reflection that allows to generate more photoassimilates, and the application of techniques such as transplant and fertirrigation to improve the development and yield of the crops (Tarara, 2000, Andino and Motsendbocker, 2004).

In Jalapeño chile Kirnak et al. (2003) They found that plastic mulching increased the availability of nitrogen under water stress conditions, because plastic mulching reduced the negative effect of stress by allowing a near-normal yield without moisture restriction; thus, when combining black mulch with the application of -65 kPa of water stress, the fruit production increased by 47% and the efficiency of water use by 34% with respect to the same treatment but without quilting.

In recent years, new options have been sought to increase their income, without altering the soil conditions to achieve profitability and sustainability of their properties, through the application of organic fertilizers and with an efficient use of irrigation water and plastic mulch. in new crops such as vegetables. In Mexico a great variety of types of chiles is cultivated; among them, jalapeño pepper (Capsicum annum L.) is one of the most economically important due to its wide consumption, high profitability and great demand for labor (SIAP, 2010).

Organic production in Mexico began in the 1980s in horticultural crops, which have represented a source of food throughout the history of mankind; At the moment they are conferred high dietetic value and for their versatility of consumption both fresh and processed, they obtain great importance in their interaction with man. In relation to organic fertilizers Ferreira and Santamaría (1997), he proposes the use of technologies that return the lost biological component to the soil, such as composts.

López Gutiérrez (2003) points out that quilting techniques were known long before the arrival of plastic materials and practiced using organic matter (straws) or inorganic (sand), the introduction of plastic materials has revolutionized and driven to occupy currently an area close to five million hectares worldwide.

García Díaz et al. (2005), in the spring summer 2004 agricultural cycle they prepared and mulched 64 beds 1.5 m wide by 87 meters long with black / white plastic. 16 macrotunnels of 6 * 3.5 * 87 m wide, high and long, respectively, were installed. Hungarian type güero chile was planted, cultivate Hell. The plot was irrigated with a belt and in the nutrition synthetic chemical fertilizers were used. Report that the water efficiency was 17.0 kg m-3 ha-1.

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The quilting has achieved an advance of up to 15 days in the harvest with respect to the crop without quilting, an important aspect in the commercialization, since it allows to place the product in early dates in the market. Since the use of plastic mulch reduces the evaporation of soil moisture by almost 100%, it brings with it a reduction in the irrigation sheet and a greater and better distribution of nutrients in the soil; with the use of this technology the weed population is reduced and this leads to a saving in the control of them and at the same time decreases the potential population of hosts or reservoirs of pests and diseases.

For Kasperbauer and Hunt (1993), and Lamont (1992) there are three types of mulch most commercially used in the production of vegetables: black, transparent and white. The most popular is black, as it slows the growth of weeds and warms the soil in the spring. The transparent one is used mainly in cold regions, since it maintains a warmer soil environment, not very different from the effect of a greenhouse; although, it requires the use of selective herbicides to prevent the growth of undergrowth of the mulch. White provides a cooler soil temperature, and is used for crops in very hot climates.

Although black does not heat the soil as efficiently as the transparent one, it prevents the growth of weeds by blocking the entry of light and is the best option in cases where it is sought to harvest earlier (Dainello and Cutner, 1995). If an autumn crop is to be planted in excessively hot soil, reflective pads such as aluminum foil and white plastic or paper are more suitable. For Ramírez (1991), choosing the color and caliber is fundamental in the choice of plastic. Color significantly influences the temperature of the soil, the microclimate, the foliage of the crop, the development of weeds, the early harvests, the yield and quality of the fruits, the durability of the mulch, and the control of diseases.

Brown et al. (1992) indicate that it can also change the amount of light and the spectral balance achieved by the plants, with resulting effects on growth and production. In studies on the effect of the color of the mulch on the growth of the plants, it was found that they altered the color of the reflected light towards the lower surface of the foliage, which influenced the growth of the plant by modifying the relationship between the red phytochrome (Pr) and far red (Pfr). This is where the color of the plastic plays its main role, since by reflecting the desired wavelength, the producers could influence the growth of the stem and the root (Kasperbauer and Hunt, 1993).

Drip irrigation, this irrigation system consists mainly of carrying water and fertilizers, to the roots of plants through a system of plastic tapes and make them come out in the form of drops by means of specific devices called emitters. In this way it is possible to give water to the plants properly dosed in quantity and time. Daily watering is recommended or every third day; also depending on the type of soil and soluble fertilizers should be applied weekly through irrigation (Bravo and Garcia, 2000). The use of a belt for drip irrigation is to make the water resource and the nutrient application more efficient, it is an alternative that is being evaluated at the productive level of the region..

One of the main factors that limit crop production is the availability of water, as it is scarce, expensive and of low quality. Another limitation is the high production costs for manual and mechanical weeding to eliminate weeds, mainly in the early stages of crop development; an option to reduce costs and the amount of water used is the use of plastic mulch (Mirafuentes, 2000).

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On the other hand, nitrogenous fertilization is carried out basically with nitrate sources (Anonymous 2003), due to its greater solubility, however, these can cause damage to our organism, the problem being greater in children, because if nitrates are not harmful, they can be converted to nitrites, which in high concentrations are toxic.

One of the most important advantages of using compost is that at the doses that are used, they supply the plant with the microelements in a soluble form and in a micro-environment with a biologically favorable pH for root absorption (pH 6.5 to 7). Another advantage is represented by the fact that the beneficial microorganisms present in the compost compete for micro spaces and energy with the pathogenic microorganisms that exist in the root zone of the plant (De Luna, 2014).

1.1 Objective

With the present work, we intend to determine the feasibility of jalapeño pepper production using organic bocashi type compost under a production system with plastic mulch and drip irrigation, and propose a production methodology that allows water saving, and a higher return on investment in the short and long term.

2. Materials and methods

2.1 Location

The work was carried out at Rancho Borundas in Tototlán Jalisco.

The locality is to the east center of Jalisco, in the coordinates 20º05'00 "to the 20 ° 38'15" of north latitude and 102º39'00 "to the 102 ° 52'10" of west longitude; at an altitude of 1,800 meters above sea level. The climate that predominates is classified as semi-dry with autumn and winter semi-warm, with no well-defined winter thermal change.

The average annual temperature is 20.1 ° C and has an average annual rainfall of 820.8 millimeters, with a rainfall regime in the months of June to October. The prevailing winds are in a variable direction. The average number of days with frost per year is 12.7.

The municipality borders on the north with the municipality of Tepatitlán de Morelos; to the east with the municipalities of Tepatitlán de Morelos, Atotonilco el Alto and Ocotlán; to the south with the municipalities of Ocotlán and Zapotlán del Rey; to the west with the municipalities of Zapotlán del Rey, Zapotlanejo and Tepatitlán de Morelos. It belongs to the Lerma-Chapala-Santiago hydrological basin, Verde Atotonilco sub-basin. Its main streams are: Los Morales, El pícaro, La Peñuela, Plan Zula, Las Raíces, Tepetates and Blanco well; there is also the La Caja de Agua spring; the dams: Doodles, Coinan and San Isidro, in addition to boards used for irrigation and drinking troughs.

The territory is made up of lands that belong to the Quaternary period. The composition of the soils is of predominant types vertisolpélico and feozemháplico and luvisoléutrico. The municipality has a territorial surface of 29,285 ha, of which 9,842 are used for agricultural purposes, 15,043 in livestock activity, 2,100 are for forest use, 140 are urban land and 2,160 have another use. As far as the property is concerned, an extension of 18,566 hectares is private and another one of 10,719 is an ejido, there being no communal property.

2.2 Establishment of work

The work was established during the 2014-2015 agricultural cycle using a randomized block design with four replications. The useful plot was a groove of 1.20 m wide by 10 m long. The sowing date was the second week of June, the soil preparation consisted of a fallow and two harrow steps.

The compost was added with a spreader and with the harrow was incorporated to the soil, in both cases 1.50 Kg of jalapeño chile seeds of the variety "Don Benito" were used, which were planted directly in the ground. In the plot under organic management, ten tons of bocahi compost were used. Subsequently, a foliar fertilizer with trace elements was used, applying 4 liters per hectare making three applications during the development of the crop.

For the chemical handling treatment, the fertilization was done with the recommended formula for 120N-60P-0K chili (Castellanos et al., 2000), which was dosed in 10 equal fractions during the crop cycle, in the form of nutrient solution dissolved in the irrigation water. To prepare the nutrient solution, urea (46N) and ammonium sulfate (20.5 N) were used as sources of N, and phosphoric acid (60P) as source of P.

Fertilization was started 2 d after transplanting this amount of fertilizer is the which is commonly used in the region. Planting density was 155,000 plants per hectare. The compost was made using 50 kg of pig manure, 50 kg of grass waste obtained from pruning, dry leaves and the waste of fruits and vegetables generated in the home, 50 kg of corn silage, wasted in a feedlot, these ingredients were fermented for 21 days, the preparation was to build a "pile" from parallel layers of each of the materials, water was applied to moisten without causing runoff.

In the first three days the pile was mixed in the morning and in the afternoon and from the fourth day, it was turned only once. Finally, between 12 and 15 days the fermented fertilizer achieved its maturation, its temperature was equal to the environmental, acquiring a dark gray color, it was dry and of loose consistency after analysis.

Taking the parameters of humidity, organic matter, ash , organic carbon, total nitrogen, C / N ratio, total phosphorus, total potassium total sodium, total calcium, magnesium, pH, for chemical and physical variables, water absorption capacity, bulk density and infiltration, electrical conductivity and capillarity.

2.3 Variables

To determine the quality as organic fertilizer of the compost, the physical and chemical variables were considered.

2.3.1 Physical variables

In the physical variables, the following measurements were determined according to the Fisher et al. (2003): a) Apparent density (gr cm-3), b) Water absorption capacity (gr cm-3), c) Capillarity (gr cm-3), d) Infiltration (min.).

2.3.2 Chemical variables

Chemical variables, pH, nitrogen, phosphorus, potassium and organic matter. The physical, and chemical determinations, as well as the pH, electrical conductivity and absorbency were carried out in the Environmental and Organic fertilizers Laboratory located in the CUCBA, of the University of Guadalajara.

2.4 Physical evidence

Water absorption capacity. The determination of water absorption capacity was carried out in a pot with a capacity of 300 mL and placed on a basin. The pot was filled from the substrate to the mark (250 mL), dropping it several times to compress and filling it again until the mark, once the substrate was weighed (dry weight), water was added to the basin to a little less than the height of the pot, the pot was removed once the surface of the substrate was observed slightly covered with wáter.

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It was left to drain all the water from the pot and later it was weighed (wet weight). At the end to determine the capacity of water absorption the following equation was applied:

% Abs = ml water / Volume of the pot * 100 (1)

Where:
ml of water = (wet weight) - (dry weight)

Capillarity. To determine the capillarity, a 300 ml pot was used. and the pot was filled with compost to the mark (250 ml.), dropped several times and re-filled to the mark, its weight was recorded (dry weight), water was added to the basin (3 cm.) and the pot was placed inside, it was removed after 15 min .; it was left to drain for 10 min. and weighed (wet weight). To determine capillarity the following equation was used:

Abs. % Vol. = Ml. of water * 100 / Volume of the pot (2)

Where: ml of water = (wet weight) - (dry weight)

Apparent density. For the determination of the density (weight / volume), a test piece of 500 ml capacity was used, to which the weight was recorded. The substrate was deposited in the test tube to 400 ml and weighed. It was shaken to reduce the empty space and level the surface and read the compacted volume. The density was determined by the following formula:

Density = (full specimen weight-empty specimen weight) (1000) / vol. compacted

Infiltration. For the infiltration test, a 300 ml plastic pot was used. The substrate was placed in the pot until 250 ml. In a test tube 100 ml of water was measured, which was added to the pot making circular movements. The chronometer was activated at the time of the water fall and stopped until it completely filtered on the substrate. The results were recorded as the infiltration time of the 100 ml.

2.5 Chemical evidences

Absorbency. 20g of screened compost was used, which was deposited in a 500 ml flask; 100 ml of distilled water was added. The flask was stirred for 15 minutes (on the AROS 160 agitator). Once the stirring time had elapsed, the samples were filtered by depositing the suspension in funnels with filter paper, the filtrate was deposited in test tubes from which 7 ml were taken. The filtrate was centrifuged for 30 minutes at 3000 rpm (Ultra 8-V centrifuge). After the centrifugation time, the samples were transferred to the spectrophotometer and the reading was taken at 640 mm. Once the reading was taken, 1 ml was taken. of each of the samples and was emptied into a petri dish with filter paper to record the stain bleed. Sampling was done weekly.

Measurement of pH and electrical conductivity (CE). For the determination of pH and CE, an empty jar without a lid was weighed, 20 gr. of substrate and were deposited in the flask, 40 ml of distilled water was measured in a test tube, the container was emptied and the flask was closed, it was stirred for 10 minutes in the agitator (AROS 160). In the suspension the pH and the EC were determined with a Hanna equipment (H1-9810).

2.6 Foliar fertilizer

Preparation of mineral organic liquid foliar fertilizer

Materials and equipment

50 kg of fresh pig manure, 9 liters of whey, 9 liters of molasses, dark plastic drums with a capacity of 200 liters with lid, 1 kg of zinc sulfate, 1 kg of magnesium sulfate, 300 g of sulphate of manganese, 300 g of copper sulphate, 1 kg of calcium chloride, 1 kg of boric acid, 50 g of cobalt sulphate, 50 g of iron sulphate.

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Preparation

In a 200 liter container (plastic with lid), 50 kg of bovine manure, 100 liters of water, one liter of whey and one liter of molasses dissolved in warm water were placed. He stirred well and let ferment for 3 days. Subsequently, every 3 days, each of the minerals was dissolved in warm water and one liter of whey and one liter of molasses was added. This mixture was added to the previous fermented, stirring well.

After all the salts had been added, the contents of the plastic container were filled with water up to 180 liters, covered and allowed to ferment for 30 days. The analyzes performed were: electrical conductivity, organic matter, pH, nitrogen, phosphorus, potassium, calcium, magnesium, manganese, cobalt, iron, copper, zinc and boron.

2.7 Treatments

The treatments were: 1) Grooves without mulching without compost and drip irrigation (control). 2) Grooves with mulch, compost and drip irrigation. 3) Grooves with quilting without compost and drip irrigation. The seed used was commercial seed of Don Benito, the back of the furrow was padded with silver / black plastic of 100 microns of thickness drilled to establish plants every 35 cm, below the padding was placed the band with emitters every 20 cm. placing this to the center of the furrow. The application of the compost was made to the sowing, incorporating it with a harrowing step.

The data were analyzed by analysis of variance for the performance factor and Tukey's means test by means of SAS.

3 Results and discussion

The results for the evaluated parameters of the bocashi type compost are shown in the following table 1.

According to the obtained results, the compost meets the requirements according to the Chilean and North American norm to be used as an organic fertilizer in the production of jalapeño peppers. With padding and drip irrigation.

Treatment	Performance/ha	
Treatment 2	21.7	A
Treatment 3	19.8	B
Treatment 1	12.6	C

Table 1 Chemical composition of compost and organic liquid fertilizer

According to the results of the analysis of variance, we can see that there is highly significant difference at 1% probability between treatments for the performance factor in kg ha-1

Determinations	**Compost**	**Foliar fertilizer**	**Composta de reference**
EC. (1: 1Ds / cm)	1.46		
pH (1: 2 in water)	8.48	3.40	
M.O. (%)	27.88	-	
Nitrates (mg / kg)	57.82	30.50	
Phosphorus (mg / kg)	498.00	300.00	
Potassium (mg / kg)	10,380	1.206 ppm	
Calcium (mg / kg)	75.96.	1,276 ppm	
Magnesium (mg / kg)	1,925	724 ppm	
Sodium (mg / kg)	18.10	421 ppm	
Copper (mg / kg)	0.98	106 ppm	
Iron (mg / kg)	1.00	37 ppm	
Manganese (mg / kg)	32.00	28 ppm	
Zinc (mg / kg)	2.89	5,614 ppm	
Boron (mg / kg)	0.44	-	
CO_3	7.84	-	
SO_4	10,003	-	
Blocks (B) Treatments (T), Experimental error (EP) Sources of variation (FV), Degrees of freedom (GL), Sum of squares (SC), Average squares (CM), Calculated F (FC), F of tables (FT).			

Table 2 Analysis of variance for the performance variable of jalapeño pepper

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When Tukey's means comparison test was performed for the performance variable, it is observed that the treatment 2) grooves with mulching plus application of organic compost and irrigation by drip, far surpassed to the control furrows without padding and without organic composting and drip irrigation, likewise to the treatment 3 furrows with mulch but without organic compost and drip irrigation. Likewise it is observed that treatment 3 exceeds the control furrows without mulching, nor organic compost (Table 3).

FV	GL	SC	CM	FC	FT
B	3	3.826	1.275		
T	2	255.800	127.800	12.240	9.78
EE	6	93.158	15.520		
Total	11				

Table 3 Tukey test for zucchini yield.

These results agree with those obtained by Ruiz and Torres (1988), where they found that with the application of organic compost they obtained the highest yields. The organic management offers the possibility of competing in the commercialization of the product and, additionally, it increases the fertility of the soil (Seufert et al., 2012).

By minimizing the evaporation of the soil, water availability increased and, consequently, it was possible to significantly increase the fruit yield in green and the efficiency of water use in the Jalapeño pepper. Similar results were reported by Miranda et al. (2006) and Chakraborty and Sadhu (1994).

4 Conclusions

The sowing of jalapeño pepper with the application of plastic mulch, organic compost and drip irrigation allowed to obtain the best yields of the Don Benito variety, without the application of chemical fertilizers and insecticides, in addition to obtaining a better control of weeds.

Having a smaller population of hosts, pests and diseases. Likewise, significant water savings were obtained with the use of a drip irrigation strip. With the application of plastic mulch, an advance of the crop was observed up to 10 days, which is a great advantage and a greater profitability in the short and long term, more application of organic compost and drip irrigation on conventional agriculture.

In organic agriculture, stable production stands out due to gradual improvements in soil fertility (Azadi et al., 2011), such as the increase in the amount of organic matter, microbial activity and the availability of N and P (Seufert et al..., 2012). At the same time, the environmentally friendly system strengthens social, cultural and ecological elements that allow the system to produce sustainably (Schipanski et al., 2014).

5.- References

Araní C., M. (2005). Influencia de la densidad de plantas y de la aplicación de enmiendas orgánicas al suelo en el cultivo de Cedrón Paraguay (*Lippia citriodora* L.) en el segundo año. San Pedro de Ycuamandyyu: Paraguay.

Azadi, H.; Schoonbeck, S.; Mahmoudi, H.; Derudder, B.; De Meyer, P. y Witlox F. (2011). Organic agriculture and sustainable Food production system: Main potentials. Agric. Ecosys. Env. 144:92-94.

Bravo, L. A. G., J. A. García S. (2000) El acolchado del suelo, un equipo práctico para realizarlo. 500 Tecnologías Lave en Mano. INIFAP, SAGAR. Serie 2000 Tomo II. pp.73

Brown E. J., W. D. Goff, J. M. Dangler, W. Hogue, M. S. West (1992) Plastic mulch color inconsistently affects yield and earliness of tomato. Hortscience 27(10):1135.

ISSN-On line: 2414-8830

June 2017 Vol.3 No.4 1-10

Calzada, M. (2003) Tendencias del mercado orgánico mundial. Oportunidades para Latinoamérica, CD Mov. Arg. Prod. Orgánica (MAPO). Cámara de Comercio.

Centro de Comercio Internacional (UNCTAD/OMC) (2001) Los mercados mundiales de frutas y verduras orgánicas. Netherlands. FAO. pp. 4-10.

Cruz, V. A. (2000). Riego por goteo para el cultico de chile seco en Zacatecas. 500 Tecnologías Llave en Mano. INIFAP, SAGAR. Serie 2000 Tomo II. pp. 170-171.

Chakraborty R C, M K Sadhu (1994) Effect of mulch type and color on growth any yield of tomato (Lycopersicom esculentum). Indian J. Agric. Sci. 64:608-612. Decoteau

Dainello, J. F., S. J. D. Cotner (1991). Cultural practices. Vegetable Grower's Handbook. TAES. USA.

Delate, K, H. Friedrich, V. Lawson (2003) Organic pepper production systems using compost and cover crops. Biol. Agric. Hortic. 21(2):131-150.

Delate, K. and C. A. Cambardella. (2004) Agroecosystem Performance during Transition to Certified Organic Grain Production. Agron. J. 96: 1288 - 1298.

De Luna, V, A; Vázquez, A, E. 2009 Elaboración de Abonos Orgánicos. Centro Universitario de Ciencias Biológicas y Agropecuarias. Universidad de Guadalajara., pp 4-12

De Luna, V, A. (2014) Lo práctico de la agricultura orgánica Centro Universitario de Ciencias Biológicas y Agropecuarias. Universidad de Guadalajara., pp 42-51

De Luna V, A. María Luisa García S, M,L, Rodríguez G ,E. Cecilia Jiménez P,C. Orozco D, M,M. Xóchitl Rocío Ávila D, X, R. 2015 Respuesta de la calabacita zucchini (*cucurbita pepo* l) orgánica con riego por goteo y acolchado plástico. XII Encuentro Mujer en la Ciencia León Guanajuato.

García-Díaz, C. A., R. Chaidez B., S. M. del Campo V., A. Losada V., J. López G., V. Trueba, J. A. Castañeda, J. González G. (2005) El sistema de macrotúneles: Una opción para incrementar la producción y la eficiencia en el uso del agua en chile güero 447

García, S. J. A., Nava P. R. (2000). Como evaluar el rendimiento de chile habanero y aprovechar mejor el sistema de riego por cintilla. 500 Tecnología Lave en Mano. INIFAP, SAGAR. Serie 2000 Tomo II. pp. 107

Kasperbauer, J. M., P. G. Hunt. (1993). US DA researchers study effects of colored mulch on plant growth. Newsline. Product and applications information. LI-COR, INC. Vol. 3 No. 1. Lincoln, Nebraska. USA.

Kirnak K, C Kaya, D Higgs, I Tas (2003) Responses of drip Irrigated bell pepper to water stress and different nitrogen levels with or without mulch cover. J. Plant Nutr. 26: 263-277

Lamont Jr., W. J. (1992). Horticulture and drip irrigation. A modern vegetable production system includes plastic mulching and supply of water and fertilizer drop by drop. Agribusiness Worldwide 14(1):4-10.

Memorias de la Segunda Convención Mundial del Chile, Zacatecas, Zac. México. pp. 139-142.

Madrid, C. M. (2000). Uso de plástico en hortalizas. 500 Tecnologías Llave en Mano. INIFAP, SAGAR. Serie 2000 Tomo II. pp. 86.

ISSN-On line: 2414-8830

McAndrews, G. M., M. Liebman, C. A. Cambardella, T. L. Richard. (2006) Residual effects of composted and fresh solid swine (*Sus scrofa* L.) manure on soybean [*Glycine max* (L.) Merr.] growth and yield. Agron. J. 2006 98:873-882.

Mirafuentes, H. F. (2000). Control de virosis en chile jalapeño y habanero con acolchado. 500 Tecnologías Lave en Mano. INIFAP, SAGAR. Serie 2000 Tomo II. p. 73

Miranda F R, R S Gondim, C A Costa (2006) Evapotranspiration and crop coefficients for Tabasco pepper (Capsicum frutescens L.). Agric. Water Manage. 82:237-246.

Multivariate relationships influencing crop yields during the transition to organic management. Agric. Ecosys. Env. 189: 119-126

Orellana B, F. E. (1997) Efecto de dos abonos orgánicos y tres niveles de fertilización química en el cultivo de tomate (*Lycopersicon esculentum* Mill). Buenavista: Saltillo Coahuila (México).

Ramírez V. J. (1991). El acolchado con plástico y los cultivos hortícolas. Revista Agronomía en Sinaloa. No. 3. Culiacán, Sinaloa. pp. 2-7.

Rendón, V. D. (1997). Sinaloa. Una versión de futuro. Centro de Estudios Estratégicos. ITESM. Culiacán, México. pp. 171-183.

Rendón, V. D. (1995). Estudio estratégico del Estado de Sinaloa. Centro de Estudios Estratégicos. ITESM. Culiacán, México. pp. 4-18, 100-115.

Seufert, V.; Ramankutty, N. y Foley, J. A. (2012). Comparing the yields of organic and conventional agriculture. Nature 485: 229-231.

SIAP. (2010). Un panorama del cultivo del chile. SIAP. México. 20 pp
Schipanski, M. E.; Smith, R. G.; Pisani-Gareau, T. L.; Jabbour, R.; Lewis, D. B.; Barbercheck, M. E.; Mortensen, D. A. y Kaye, J. P. (2014).

Tejada, M., J. L. Gonzalez. (2007) Application of Different Organic Wastes on Soil Properties and Wheat Yield. Agron J. 99:1597-1606.

Vásquez H. A., V. López G., G. Rodríguez E., A. B. Vargas G., I. Meneses M. (2005) Aplicación del bioabono Bocashi en chile Jalapeño bajo dos condiciones ambientales de cultivo. In: Memorias de la Segunda Convención Mundial del Chile 2005, Zacatecas,

Article

ECORFAN Journal

June 2017 Vol.3 No.4 11-15

Extraction of essential oil of Epazote *(chenopodium ambrosioides L.)* for its use in the control of agricultural pests by the steam extraction method at laboratory level

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Received February 21, 2017; Accepted June 20, 2017

Abstract

Essential oils are compounds composed of various volatile organic substances that are produced and stored in different parts of the plant such as leaves, stem and roots. These oils are highly volatile, oily, less density than water, soluble in difernetes organic solvents such as alcohol, ether and carbon tetrachloride and others, are responsible for the aroma, color and taste of plants. Due to their volatility, these oils can be extracted by different methods such as: maceration, steam extraction, extraction with solvents, extraction by supercritical fluids among other methods. Because of their properties, essential oils have been used in a therapeutic way, but they are also used in perfumery, in food and there is now a great interest in its effectiveness in agriculture as a natural form for non-aggressive pest control for environment. According to the described, the present article presents the process to carry out the extraction of the essential oil of epazote, which is intended to be a further alternative for the control of pests in the agriculture

Extraction, Pests, Agriculture, Environment

Citation: RAMOS-AGUILAR, Maribel, MELESIO-ENRIQUEZ, Jaime, CALDERÓN-GONZÁLEZ, Giuliana and ARREGUÍN-SOTO, Javier. Extraction of essential oil of Epazote *(chenopodium ambrosioides L.)* for its use in the control of agricultural pests by the steam extraction method at laboratory level. ECORFAN Journal-Republic of Nicaragua 2017, 3-4: 11-15.

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June 2017 Vol.3 No.4 11-15

1. Introduction

Aromatic plants have been used for a long time for different purposes. In many places in our country the essential oils of these plants are used as a culinary ingredient, to cure diseases and ailments. The essential oils of these plants are found in seeds, leaves, stems, glands, sacs, or in various places on the plant. Most plants contain 0.01 to 10% essential oil content. The average amount found in most aromatic plants is around 1 to 2%. The quality and intensity of essential oils vary due to: variety of the plant, cultivation conditions, time of harvest, part harvested from the plant, handling of plant material, extraction methods, others. For this study it was decided to extract the essential oil from the epazote Chenopodium ambrosioides L.) Using the steam extraction method.

Justification

According to the vision of FAO, the management of agriculture is based on knowledge based on the best available scientific information, and adaptation at the community and national levels to ensure local relevance and its applicability.

An alternative to try to stop the affectation towards the agricultural sector, by the indiscriminate use of products of synthetic origin, is the natural control based on active ingredients extracted from plants for the manufacture of organic products friendly to the environment and that do not cause damage to human beings. This is how the use of the epazote plant (Chenopodium ambrosioides L.) is intended to extract the active substances that constitute it and offer an alternative to prepare an organic product.

This plant has long been used as a means to combat certain parasites in humans and is believed to have a beneficial effect on the control of pests in plants.

1.2 Problem

Currently there is a large amount of chemical products harmful to the environment so there is great concern throughout the world to reduce the effects of pesticide contamination and promote sustainable agricultural development through more friendly products from different aromatic plants.

1.3 Hypotesis

The extract of epazote represents a sustainable alternative for the control of agricultural pests.

1.4 Objectives

1.4.1 General objectives

Extract the essential oil of the epazote (chenopodium ambrosioides, L.) through the steam extraction method at the laboratory level as an alternative for the control of agricultural pests.

1.4.2 Specific objectives

- To know the effectiveness of the steam extraction method with water in comparison with the use of alcohol as well as the combination of alcohol and water.
- Know the physicochemical properties of the epazote extract obtained.

2. Theoretical framework

The epazote is an aromatic plant, perennial, more or less pubescent, with the stem usually prostrate, strong odor, of approximately 40 cm of height; the leaves are oblong-lanceolate and serrated, between 4 cm long and 1 cm wide, with small green flowers in dense terminal panicles, each with five sepals; the persistent chalice surrounds the fruit, and the seeds are black and not larger than 0.8 mm in length (Gómez, 2007 quoting Gadano et al., 2006, Jamali et al., 2006).

ISSN-On line: 2414-8830

Epazote essential oil is a colorless, or slightly yellow, liquid with a non-viscous consistency, with a pungent and pungent odor resembling camphor, with a slightly bitter taste that is extracted from the whole plant, especially from seeds and fruits. steam distillation. (Gómez 2007 citing Gadano et al., 2006).

Essential oils are volatile liquid fractions, usually distilled by steam stripping. Essential oils are generally complex mixtures of up to more than 100 components that can be: Low molecular weight aliphatic compounds (alkanes, alcohols, aldehydes, ketones, esters and acids), Monoterpenes, Sesquiterpenes and Phenylpropanes (Martinez, 2003).

For the most part, essential oils have a pleasant smell, although there are some with a relatively unpleasant smell, such as those of garlic and onion, which contain sulfur compounds (Martínez, 2003). According to Peredo, Palou & López (2009), there are the following methods of extracting essential oils:

Distillation by steam drag: Consists of separating by heating, in stills or other vessels, volatile substances called essences, relatively immiscible with water, of other more fixed, then cooling their vapor to reduce them back to liquid. Maceration in fat. It is an extraction method with hot fat based on immersing the flower petals in the fat, and then extracting the essences with alcohol. This method has been completely replaced by extraction with organic solvents.

Extraction with volatile solvents It is based on dissolving its volatile oils, due to differences in boiling point between the essential oil and the solvent. It has the advantage of working at low temperatures, so it does not cause thermodestruction or chemical alteration of the oil components. It also offers the possibility of separating organic solvents easily to penetrate the plant material and individual components and / or present in small quantities.

It is used on a laboratory scale because at an industrial scale it is expensive due to the commercial value of solvents. Doped essences are obtained with other substances (sometimes toxic). Extraction by Supercritical Fluids (EFS): it consists of using chemical substances under special conditions of temperature and pressure. The plant material is cut into small pieces, liquefied and packed in a stainless steel chamber through which a supercritical liquid is circulated. The essential oils are solubilized and the supercritical liquid that acts as an extractor solvent is eliminated by progressive decompression until reaching the pressure and room temperature. Finally you get a pure oil.

3. Research Methodology

The present investigation was carried out by means of the laboratory study by means of the steam extraction method, since it represents a simple and low cost method.

3.1 Type of Research

An experimental research was carried out, performing different runs to observe the extraction time, the volume obtained as well as pH, color and smell.

3.2 Theoretical methods

The method used to extract essential oil from epazote was extraction by steam drag which consisted of heating the solvent for its passage to the vapor phase and contacting the dry sample and obtaining the essential oil by the condensation of said steam, and Afterwards, separation by decantation was used to obtain the essential oil of epazote.

3.4 Development methodology

- Research on the properties of the epazote and the extraction methods of the essential oil of aromatic plants.

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- Collection of the epazote sample necessary for the extraction process of the essential oil.
- Pre-drying the epazote sample to begin the extraction process.
- Execution of the extraction according to the vapor-trapping method at the laboratory level.
- Obtaining data about the physicochemical properties of extracted oil

4. Results

Different volumes of essential oil were extracted using water, alcohol and the combination thereof as solvents. When using only alcohol, a small amount of 5ml extract was obtained. When using the combination of water and alcohol the amount of product extracted increased compared to the previous one up to 8 ml.

When using only water, a greater quantity of final product was obtained, being 12 ml, since the vaporization of the water lasted longer and this allowed to collect a greater quantity of final product that contained a part of water and another of essential oil. Table 1 With respect to physicochemical properties the extractions were of a light yellow color to an intense yellow, with a strong and pungent odor with different pH data as shown in Table 1.

Run	Time	Solvent	Volume obtained from extract	PH
1	1 hour and 30 min	Alcohol	5 ml	8.7
2	3 hours 10 min	Alcohol + water	8 ml	7.8
3	2 hours and 30 minutes	Water	12 ml	7.4
4	2 hours and 30 minutes	Water	11 ml	7.4
5	2 hours and 31 min	Water	12 ml	7.5

Table 1 Record of obtained data
Source. Own, 2017

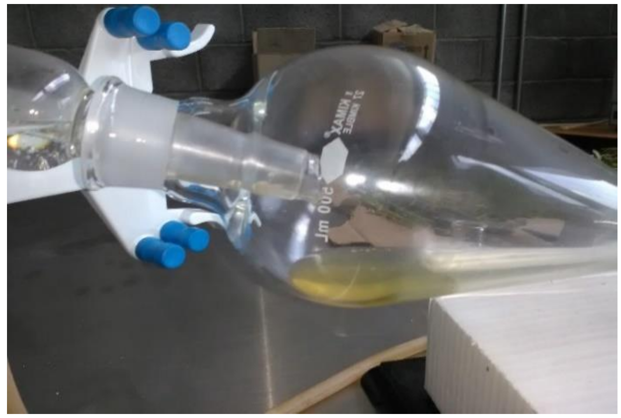

Figure 1 Extract obtained
Source: Own, 2017

5. Conclusios

So far, different volumes of product derived from extraction have been obtained, however it is necessary to continue working on the chosen technique to obtain a purer product that leads us to the evaluation in different agricultural pests.

It is also necessary to test the extraction by means of other techniques to verify its effectiveness, since the technique of steam drag is very slow and there are low yields.

6. References

Aceites esenciales: métodos de extracción. Temas Selectos en Ingeniería en Alimentos. pp. 24-32. Universidad de las Américas Puebla, San Andrés Cholula, Puebla, México.

Gómez, J. (2008). Epazote (Chenopodium ambrosioides). Revisión a sus características morfológicas, actividad farmacológica, y biogénesis de su principal principio activo, ascaridol.Boletín Latinoamericano y del Caribe de Plantas Medicinales y Aromáticas, vol. 7, núm. 1, 2008, pp. 3-9 Universidad de Santiago de Chile, Santiago, Chile.

Martínez, A. (2003). Aceites Esenciales. Universidad de Antioquía. Facultad de Química Farmacéutica. Pag 1. Medellín, Colombia. Recuperado de: http://www.med-informatica.com/OBSERVAMED/Descripciones/AceitesEsencialesUdeA_esencias2001b.pdf
Peredo, H., Palou, E., López, A. (2009).

Annexes

Figure 2 Drying the simple
Source: Own, 2017

Figure 3 Extraction process
Source: Own, 2017

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ISSN-On line: 2414-8830

Recovery of irrigation water for greenhouses

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Received February 25, 2017; Accepted June 16, 2017

Abstract

Plants need a favorable environment in which they are able not only to live but also to produce. One of the biggest concerns that any producer lives is the shortage of water, agricultural use of reclaimed water is an option that is being studied and adopting increasingly water-scarce regions, growing urban populations and increased demand for irrigation water.In the present work is to provide a tool to address this serious problem, have developed many projects for collecting rainwater, have generated solutions in the reuse of domestic wastewater, all they applied to irrigation of vegetables or greenhouses. They have developed hydroponic and aeroponic systems are designed efficient irrigation systems, but they all precious resource losses are generated. In this design you want to recover the irrigation water that is done, because usually you lose, there has been regarded as an important value in terms of volume.

Water Recovery, Mathematical Modeling, Numerical Methods

Citation: DE ANDA-LÓPEZ, Rosa María & SÁNCHEZ-SALINAS, Agripín. Recovery of irrigation water for greenhouses. ECORFAN Journal-Republic of Nicaragua. 2017, 3-4: 16-23.

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1. Introduction

Many regions of the world are experiencing increasing problems of water shortages. This is due to the relentless growth in demand for water in front of a static or declining water resources and periodic droughts due to climate factors (Winnpeny, Heinz, & Koo-Oshima, 2013).

In times of extreme scarcity, national authorities often choose to divert water from farmers to the cities, because the water has a higher economic value in its industrial and urban use in most agricultural purposes (Winnpeny, Heinz, & Koo-Oshima, 2013). This situation leads to design strategies to recover water from domestic activities, rain, waste, in many places have opened investigations where water is recovered by condensation in dwellings or greenhouse.

The countries most concerned about this situation is the European Community, which have generated a number of investigations in this regard (European Commission, 2015), these works have sparked a significant amount of development, whose main objective is to recover water, today more water is required to recover all the activities we develop.

This situation leads to the need to use auxiliary methods, which help ensure that the developed system will meet the requirements of design, one of those tools is the mathematical modeling.

On a scientific level, to describe reality and make predictions for the future models, which can be performed as scale representations (such as models) to mathematical models that explain natural phenomena develop. In agriculture, these can be used to define how much water and fertilizer to apply, as well as to predict the incidence or progression of a pest or disease (Hernandez, 2015).

Montgomery (1991) suggests that mathematical models are more concise and less ambiguous; This, together with the availability of rules that can be used mechanically, can describe more complex situations, with less effort, and less risk of confusion. Regression methods are often used to analyze data coming from experiments that were not designed or where you can not have control over variability.

This situation leads to suggest that the recovery of irrigation water plants, can be predicted using mathematical models, using a good model will allow to design the most appropriate control system, using the necessary variables. The more variables studied in a mathematical model can generate more accurate representation of reality, for scientific research shows that increasing the number of variables studied produce more accurate model (Hernandez, 2015).

Once data are now another problem arises, how to analyze the data in ways that are consistent, systematic and foremost, to answer the hypotheses. Today the world has increased the need for research in statistical models and advanced mathematical tools (Rodriguez, 2001). The use and proper interpretation of these techniques pemiten making optimal decisions, efficiency and achieving greater efforts in different areas and in spiced up the agricultural sector, whose application encourages the development of productive systems (Rodriguez & Bermúdez, 1995).

An example of this is the transfer of novel statistical analysis techniques that are applied in other branches of science, based on the physical and chemical properties of the materials to the field of agricultural engineering (Betancourt, Rodriguez, & Pineda, 2009) properties.

Applied Mathematics in agricultural sciences allow criteria and provide basic tools for interpreting man handle better and better farming, meet the demands of new technologies to produce in highly competitive global markets while protecting natural resources and make decisions in the medium and long term conditions Similar experimentation (Ortega, 2000).

Based on these approaches there is a need to understand the nature of the process, closely related to the research and know some of the tools most used chords Applied Mathematics the target of the investigation. Situation resulting experimentation to make this project, where once irrigation data collected will be submitted to a mathematical treatment that allows to know the mathematical function of the system behavior and determine the efficiency of the project.

2. Theoretical framework

2.1. Water recovery

Fresh water is approximately 0.6% of the total amount of water on the planet. The freshwater resource is unevenly distributed and water quality is deteriorating in many parts of the world, but also an improvement in some places. In the world water crisis is present. The cause of this crisis may be attributed to the lack of precipitation and limited resource, in addition to increased demand for the sectors: agricultural, urban and industrial, also most of the water available globally it is used to irrigate crops (He raised 1998).

Lost water is to capture the resource, water various activities currently recovers: domestic, which are known as wastewater, rain or condensation, more recent research, the scarcity of water in all its aspects has serious costs economic, social and even political.

Reuse of wastewater in agriculture is an element of development of water resources and innovative leadership that maintains an alternative for agriculture. The reuse of reclaimed water for irrigation enhances agricultural productivity; this provides water and nutrients, and improves crop yields. However, it requires protection of public health, appropriate treatment technology, reliability treatment, water use, acceptance and participation must also be economically and financially viable (Bahri, 1999).

2.2. Mathematical model

The scientific activity is inconceivable without the development of mathematical models to synthesize and increase existing knowledge about a system. Agricultural research and especially the science and art of horticulture are no exception. Mathematical models allow you to test scientific hypotheses vegetables and also have potential application in both education and practice of horticulture. The models used to evaluate possible strategies of managing a greenhouse without carrying out costly experiments (Lopez-Cruz Ramirez-Arias & Rojano-Aguilar, 2005).

The comprehensive nature of the solution of current scientific and economic tasks, as well as the high efficiency of the specialized methods used to influence work objectives demand a high preparation specialist, in particular the agricultural industry, to enable it issue opinions in agricultural processes, with high levels of reliability (Chavez, Sabin, Toledo, & Jimenez, 2013).

Over the past 15 years we have developed mathematical models for vegetables grown under greenhouse conditions. Gary et al. (1998a) reported that the number of species studied to this year amounted to 25 fruit species, 23 plant species grown in the open, 20 and 4 ornamental plants grown in the greenhouse.

2.3.Numerical methods

Applied mathematics consists of a set of useful tools for various purposes, ranging from the Statistics, process optimization, numerical mathematics and the use of finite elements (Alvarez & Urrutia, 2000).

An example of these applications is the non-linear regression, for describing physical and biological systems (Rebolledo, 1994). Ostle (1986) and Montgomery (1991) proposed that if the linear model is not appropriate, consider setting a nonlinear model. For Rodriguez (1989) and Graybill and Iyer (1994), models seem to be non-linear can become using any suitable linear transformation of the response variable, the predictor variables, parameters, or combination thereof. Some nonlinear models include logistic, exponential, Michaelis-Menten and monomolecular.

3. Basic principles and energy technologies

In this paper a prototype to simulate the behavior of the system, which is presented in Figure 1, Figures 2 and 3 the schematic wiring diagrams and sensor with Arduino UNO presented is generated.

This type of sensor operating characteristics and low cost in the market, this sensor has the same performance as a radar sends pulses at high frequency ultrasound in this case was selected. It can be expressed mathematically as: $d = 170(^{m}/_{s}) \times t$.

Figure 1 Model of the irrigation system, the Ultrasonic sensor shown

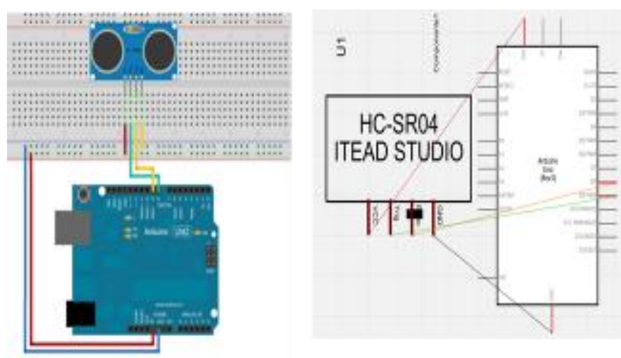


Figure 2 Protoboard connection and connection scheme

The Arduino board one is used as a simple, cheap and effective data acquisition card, coupled with its ease of programming, then the Arduino code developed for obtaining data shown:

```
/*
        Rosa María de Anda López
        Sensor ultrasónico HC-SR04 para control
        de tamaño de riego
        Ahorro de energía
        */
        #define echoPin 8
        #define triggerPin 9
        #define ledPin 13
        int delaymili = 500;
        int maximumRangeCm = 200;
```

ISSN-On line: 2414-8830

```
int minimumRangeCm = 0;
long duration, distanceCm;
void setup() {
        Serial.begin(9600);
        pinMode(triggerPin, OUTPUT);
        pinMode(echoPin, INPUT);
        pinMode(ledPin, OUTPUT);
}
void loop() {
        initTrigger();
        duration    =    pulseIn(echoPin,
HIGH);
        distanceCm                     =
microsecCm(duration);
        if         (distanceCm         >=
maximumRangeCm  ||  distanceCm   <=
minimumRangeCm) {
                Serial.println("Out      of
range");
                digitalWrite(ledPin,
HIGH);
        }
        else {
                digitalWrite(ledPin,
LOW);
                Serial.print("Distance   in
cm: ");

        Serial.println(distanceCm);
                delay(delaymili);
        }
}
long microsecCm(long microsecond) {
        return microsecond / 58;
}
void initTrigger() {
        digitalWrite(triggerPin, LOW);
        delayMicroseconds(2);
        digitalWrite(triggerPin, HIGH);
        delayMicroseconds(10);
        digitalWrite(triggerPin, LOW);
}
```

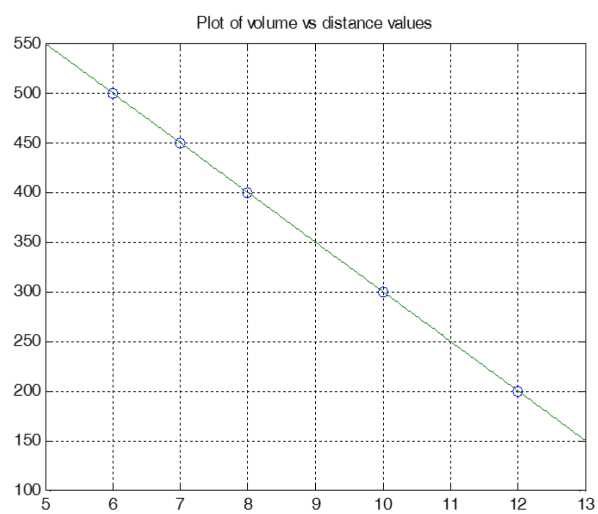
4. Economic Sustainability

The results obtained in making data were analyzed and processed by first obtaining the mathematical model of the process.

Firstly vectors determined values of the sensor and the volume meter are obtained the vectors: d = [6 7 8 10 12] v = [500 450 400 300 200], where the first value is the detected distance, in cm and the second volume is given in ml. With these values the corresponding graph in matlab, is built for observer behavior characteristic polynomial function, with the following results:

```
clc
clear all
close all
t=[6 7 8 10 12];
v=[500 450 400 300 200];
x=5:0.01:13;
y=interp1(t,v,x,'spline');
plot(t,v,'o',x,y)
grid on
title('Gráfica de valores distancia  vs  volumen')
```

Where the graph of Graph 1 shows that the behavior is linear.



Graph 1 Graphic System Behavior

Taking two points thrown sensor: $x1 = (6, 500)$ $x2 = (10, 300)$, the function is built:

$$y - 500 = (x - 6)\left(\frac{300-500}{10-6}\right) \quad (1)$$

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Simplifying the equation 1 is obtained:

$$y = -50x + 800 \quad (2)$$

What it represents us the function modeling system.

And with these data, an application in matlab, where a linear interpolation is performed to determine the volume at any position (distance) is generated.

```
clc
clear all
close all
syms x
x=input(' The distance value is:  ');
y=-50*x+800
```

Now have to perform measurement system efficiency, irrigation of 200 ml is performed with a time of 26 seconds, after 3 hours of runoff water volume recovered is measured, resulting in a recovery of 75 ml, it giving the system an efficiency of 37.5%, if it takes a real size of 10 000 plants in a greenhouse, and each plant was subjected to the same treatment, presumably could be obtained 750 000 ml of water recovered in total system, this represents a reservoir 750 liters, which would represent 200 ml irrigation 3750, with recovery logic 75 ml. these data are again reaffirms 37.5% efficiency.

Representing sustainability of the greenhouse, knowing that water is one of the most coveted resources in certain regions, where their scarcity, it becomes vital resource for production.

5. Diagnosis of energy consumption

Research has been conducted wherein the means for collecting water is provided through which rain water is used other residuals and other major projects have been started in designs where condensation is one of the means for withdrawal of water.

Mainly countries such as Chile, Colombia and Spain are countries that have been working hard on these issues, since water has become a very precious resource, Valparaiso University is working with an intelligent greenhouse, where the new technology that the greenhouse will allow you to reuse 70% of water and control evapotranspired climatic parameters (temperature and humidity) and irrigation remotely through software.

In Spain, specifically in the region of Almeria, systems that capture 75% of rainwater to be used to irrigate crops in greenhouses are generated, also are designing treatment plants that allow use wastewater as it should avoid heavy residues, metals, bacteria, viruses and those microorganisms that might contaminate the culture, these systems are having an efficiency of 70%, it requires only elements that raise the irrigation.

The proposed system has the advantage that recovery of water is created by gravity, directing it to the tank allocated, only the elements present on the crop, which makes the water can be reused without danger of contamination, and same switching on the pump automate, so that will turn 3 times per day, representing a saving in energy costs of 70%. Both situations combined greenhouse ensures sustainability. Annex 1 an analysis of energy savings and payback shown

6. Comprehensive program of energy saving

This project presents benefits allowing it to be sustainable, given that the water recovery system for irrigation, which will be entirely by gravity, which will greatly reduce the use of a pump is designed. In addition to thinking about being automated, reliability that is generated, the system will allow the necessary conditions to ensure the collection of recovered water is as constant as possible.

It is noteworthy that the system right now is 37.5% efficient, but it could provide more efficient considering the recovery by condensation, subject of another project that can complement and increase the current.

A project to help provide certainty in the recovery of water, using the minimum of energy consumption, is a project to be sustainable, development is not simple, because it requires a systematic series of steps that will ensure controlled behavior system, but once you are applying values and subjected to appropriate mathematical treatment, then the sustainability of the system is ensured.

7. Acknowledgment

I recognize and appreciate the valuable support given by the Technological University of South Mexico State (UTSEM), the UACh and CIATEQ, my homework, for allowing me to realize the project assigned.

8. References

Álvarez, V., & Urrutia, I. (2000). *Una experiencia en la utilización de la matemática como complemento en la enseñanza del Análisis Matemático.* III Taller Internacional: "La enseñanza de la Matemática y la Computación en la Educación Superior. La Habana, Cuba: Universidad de la Habana.

Alzaba, A. A. (1998). Necessity for modification of management parameters when using low quality water. *Agricultural water management*(36), 210-211.

Bahri. (1999). Agricultural reuse of wastewater and global water management water. *Sciencia Technology*, 339-346.

Betancourt, Y., Rodríguez, I., & Pineda, E. (2009). Las propiedades químicas del suelo para definir la zona de aplicación del laboreo localizado en los suelos arcillosos pesados. *Revista Ciencias Técnicas Agropecuarias*, 18(3), 46-48.

Chávez, D., Sabín, Y., Toledo, V., & Jiménez, Y. (2013). La Matemática: una herramienta aplicable a la Ingeniería Agrícola. *Revista Ciencias Técnicas Agropecuarias*, 22(3), 81-84.

European Commission. (2015*). Optimising water reuse*, final report part-I. Luxemburgo: Publications Office of the European Union.

Hernández, F. (2015). *agro-tecnologia-tropical*. Obtenido de http://www.agro-tecnologia-tropical.com/modelos_matem_ticos.html

López-Cruz, I. L., Ramírez-Arias, A., & Rojano-Aguilar, A. (2005). Modelos matemáticos de hortalizas en invernadero: trascendiendo la contemplación de la dinámica de cultivos. *Revista Chapingo serie horticultura*, 11(2), 257-267.

Ortega, D. R. (2000). *Perfeccionamiento de la enseñanza de la Matemática en la carrera de Agronomía*. Tesis (en opción al título de Master en Ciencias Pedagógicas. Santa Clara, Cuba: UCLV.

Rebolledo, R. H. (1994). *SAS en Microcomputadoras. Análisis de experimentos con fines de optimización de insumos agrícolas. México*: Universidad Autónoma Chapingo. Departamento de Suelos. Área de fertilidad.

Rodríguez, E. C. (2001). *La superación del profesor de Matemática en la Universidad de hoy, una experienciacubana*. COMAT'01.

Rodríguez, L. F., & Bermúdez, T. (1995). *Usos y aplicaciones de la simulación en la investigación agropecuaria.* Agronomía colombiana, XII(I), 198-204.

Winnpeny, J., Heinz, I., & Koo-Oshima, S. (2013). *Reutilización del agua en la agricultura: ¿Beneficios para todos? Roma*: FAO

Agricultural and aquaculture extension program assessment in 2016 at Mexico City (CDMX)

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Received February 21, 2017; Accepted June 27, 2017

Abstract

In this document, we present an evaluation of the agricultural and aquaculture extension component in Mexico City, as part of one of the planning, monitoring and evaluation activities of the SAGARPA Rural Extension Support Project. A structured survey was prepared to be answered by the leading producers of the 11 agro-productive chain value selected to implement technological innovations.

Technical assistance, Chain values, Assessment, Extension and Innovations

Citation: MOCTEZUMA-LÓPEZ, Georgel, ROMERO-SÁNCHEZ, Martín Enrique, ESPINOSA-GARCÍA, José Antonio and CASTILLO-CARREÓN, Ana Laura. Agricultural and aquaculture extension program assessment in 2016 at Mexico City (CDMX).ECORFAN Journal-Republic of Nicaragua 2017, 3-4: 24-33.

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Introduction

The word extension (extensionismo in Spanish) has its origin in the Latin word extensio, onis, which means the action and effect of extending or extended (DRAE, 2016). On the other hand, the Secretariat of Agriculture, Livestock, Rural Development, Fisheries and Food (SAGARPA), within its portal "SERMEXICANO" (2016) defines extension as "the service provided by education and research institution staff that facilitates access to knowledge, information and technologies to producers, rural economic groups and organizations and other actors in the agricultural, fisheries and aquaculture sector ".

The importance of the agricultural and aquaculture extension in Mexico City (CDMX) is mainly due to the huge market of almost nine million inhabitants (CONAPO 2015) that require a lot of food products from agricultural, livestock and aquaculture. During the period 2000 - 2015, the average annual growth rate for the CDMX population was 0.90%, which is the lowest in Mexico, and in contrast to the above.

The area sown in the CDMX for the same period have a decrease in their average annual growth rate of 2.75%, which in absolute terms will be of approximately 27.000 hectares to 17.500 hectares (INEGI 2015), which to a large extent is due to the pressure of the urban area. This ambivalent situation, that, on the one hand, in absolute terms, have an increase in population of nearly three million people in a period of 15 years and that on the other reduce the agricultural area that is intended for the supply of food crop, livestock and aquaculture, makes the CDMX is not self-sufficient, and with much, in themselves, makes it a net importer of food from all the states of Mexico. It is important to emphasise that the CDMX (before Federal District) is the core of the United Mexican States because within their limits are located the executive, legislative and judicial powers of the country.

The origin of the CDMX dates back to the Great Tenochtitlan founded in the year of 1325 (Wikipedia 2016). Tenochtitlan was a great agricultural producing area, and it made one of the largest contributions to rural development by means of the technology that became known as the production in the "chinampas". Chinampas were spaces of crops within the lake and were self-sufficient to supply food to the Aztec population. Other important sources of food were the various fish extracted from the lake and animal protein obtained mainly from the hunting of birds coming from the mountains of the Valley of Anahuac.

The CDMX is the smallest state in the country, 1,485 km^2, which represents only 0.08% of the total area of Mexico, with a political division composed of 16 municipalities as shown in Table 1.

Name	Area	Name	Area
Álvaro Obregón	96.17	Iztapalapa	117.00
Azcapotzalco	33.66	Magdalena Contreras	74.58
Benito Juárez	26.63	Miguel Hidalgo	46.99
Coyoacán	54.40	Milpa Alta	228.41
Cuajimalpa	74.58	Tláhuac	85.34
Cuauhtémoc	32.4	Tlalpan	312.00
Gustavo A. Madero	94.07	Venustiano Carranza	33.40
Iztacalco	22.30	Xochimilco	122.00

Table 1 Municipalities from CD**MX** and area in Km^2
Source: INEGI. 2014

The largest municipalities are in first place Tlalpan, following Milpa Alta and Xochimilco in third place, with the 21%, 15.4% and 8.2%, respectively of the territory. These municipalities account for 44.6% of the surface of the CDMX, and plus the Tlahuc municipality, they concentrate the agricultural and aquaculture activity which represents more than the half of the CDMX (50.3% of the total area). Because the extension and importance of these municipalities, all the activities from the extension program are focalized.

ISSN-On line:2414-8830

The aim of this work was to evaluate the program of agricultural, livestock and aquaculture extension addressed to small producers within the levels I and II of the CDMX. The extension program is implemented by extension workers and with the support of universities (Autonomous University of Chapingo) and research centres (INIFAP), to display and validate before the federal authorities of the SAGARPA and state of the Government of the CDMX.

Methodology

The methodological process used for the evaluation of component extension was to take into account the main actions proposed within the project to support the Rural Extension of the SAGARPA, in which the INIFAP had as main activity the technological support, which consisted of the following stages:

Selection of the extension staff. To incorporate the SAGARPA's technical staff, in coordination with the Ministry of Rural Development and Communities Equity (SEDEREC), the Government of the CDMX launched a public open call. By a scoring process, professional careers related to the primary sector were pre-selected; then, an interview previously made was added the result of their interviews to their scoring sheet. Finally, according to the scores, the best agricultural, livestock and aquaculture technicians were selected as well as the coordinator of the extension staff.

Selection of value chains. To quantify and measure the importance of the primary activity within the CDMX, we conducted a discussion of the Strategic Plan prepared by the SAGARPA and SEDEREC through the guidance of National Institute for Capacity Development (INCA Rural).

From this exercise, we selected and extracted the most relevant agro-productive and aquaculture chains from the CDMX, and they were considered within the support project of the Rural Extension of the SAGARPA.

Development of the innovation agendas and schedule of the extension staff at the individual level and by a chain. Using a pre-determined script and with the collaboration of the Autonomous University of Chapingo, series of participatory workshops with extension staff were conducted to define the actions that were considered to be on the agendas. The agendas served as a framework to technicians during the process of integration of individual schedules. The tasks related to the individual schedules were aligned to the innovation agenda of the chain.

Socialisation of the agendas of innovation. This activity was performed by developing workshops in partnership with the INIFAP, UACh and INCA Rural. For each of the agricultural, livestock and aquaculture value chains selected, the leading producers, cooperating producers and producers were the main actors of these workshops. During the workshops, an explanation on how and what was the process for developing the agendas. In a second phase, the participants provide feedback and opinions. The information shared during the workshops was added to the agendas of innovation to validation, and above all, to the appropriation of the participants.

Implementation of the innovations. This step was carried out in situ under the direct supervision of each of the extension staff responsible. Besides, periodic visits to producers plantations were made with the aim of observing the evolution of innovations implemented.

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Supervision on the field. Monitoring visits were made by the three institutions responsible for this activity: Center for Rural Innovation and Extension of the Autonomous University of Chapingo, the INCA Rural and INIFAP, as well as to the accompaniment of officials of the State Delegation of the CDMX SAGARPA and the Government of the SEDEREC CDMX.

Evaluation of the component. To assess the program a questionnaire was designed to be answered primarily by the producers dedicated to the agricultural activity, with two groups of questions; one relating to questions qualitative and quantitative, respectively. In total, 16 questions were applied, 10 were qualitative and five quantitative-type. The sample size was determined according to the strata within the universe of producers. Were applied stratified random sampling with fixed proportional sample size proportional (Grégoire and Valentine 2008) following the formula:

$$N = \sum_{h=1}^{L} N_h \quad (1)$$

Where:

N = Population
L = Stratum
Nh = units of each one of the L stratum

Then, from before:

$$nh = n\left(\frac{N_h}{N}\right) = nW_h \quad (2)$$

Where:
nh = number of samples from the stratum
n = number of samples
N = population
nW_h = number of weighted samples per stratum
From the above, the implementation of the data is shown in Table No. 2 (Appendix 1)

The proportional allocation by value chain agricultural and aquaculture was as follows: amaranth = 3.84; ornamental = 4.09; corn = 3.20, vegetables = 8.57, nopal = 9.79, cattle = 1.92, apiculture = 4.03 rabbits = 5.89, sheep = 5.76, pigs = 3.84 and aquaculture = 3.07.

The values of the variables were average = 46.74; Beta = 9.61, permissible error = 0.20 and the permissible error in percentage = 1.09

Development and Results

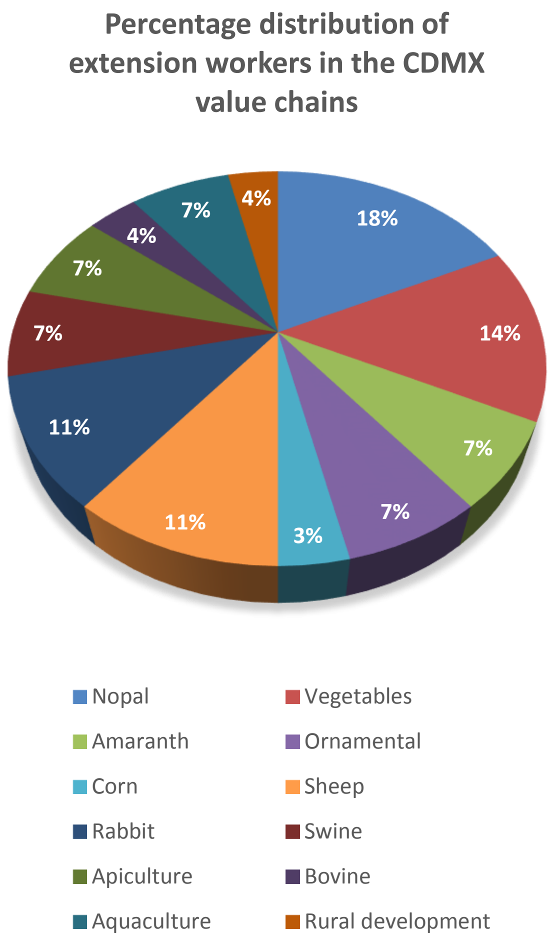
Selection of agricultural extension staff. With the aim of improving the efficiency in the response to the demands of the agricultural producers in the CDMX, and based on the federal and state budget, several technicians were hired for a period of 11 months which included April of 2016 to February of 2017, according to Table 3

Chain	No. Tech.	Chain	No. Tech.
Amaranth	2	Apiculture	2
Vegetables	4	Rabbit	3
Corn	1	Sheep	3
Nopal	5	Swine	2
Ornamental	2	Aquaculture	2
Bovine	1	Rural development	1
Coordination	1	Total	**29**

Table 3 Technicians hired by each value chain in the CD**MX**
Source: Personal development

The allocation of extension staff to value chains of the CDMX pursued a balance between the agricultural and livestock sub-sectors; the first with 14 technical and the second with 11; in addition, 2 technicians were allocated to aquaculture, and in the cross-sectional chain of rural development 1 more technician was allocated. The percentage distribution is shown in Graph 1.

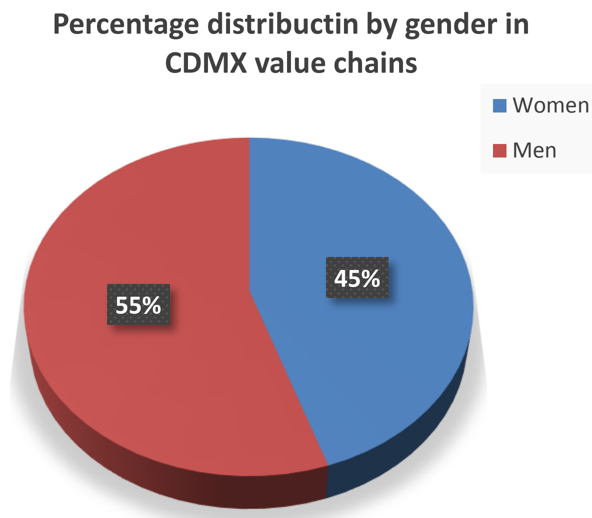
ISSN-On line:2414-8830



Graph 1 Number of extension staff and their percentage participation in attending chain values in the CDMX

The largest number of extension staff were allocated to the value chain of Nopal, followed by vegetables in order of importance of vegetables with 32% of the technicians. The chains of sheep and rabbit covered little bit more of 22% and the chains with lower coverage of extension staff were corn, cattle, and cross-sectional of rural development.

The performance of the women within the rural extension program in the CDMX is important for the contributions that they promote within the chains as you can see in graph 2.



Graph 2 Extension staff and their percentage participation by gender

The participation of gender is remarkable and almost equal within the CDMX rural extension program and even in four of the chains: corn, cattle, apiculture and swine, its coverage was 100%, which reaffirms its action within the improvement of value chains in the primary sector.

In relation to the number of producers that participated in the program, SAGARPA and SEDERC requested to extension staff the formation of a list of at least 30 producers who were classified within the levels II and I according to the rules of operation of the component extension. They would be considered for further attention. The number of producers attended is shown in Table 4.

Chain	Women	Men	Total
Amaranth	7	53	60
Vegetables	20	114	134
Corn	12	38	50
Nopal	89	64	153
Ornamental	14	50	64
Bovine	5	25	30
Apiculture	26	37	63
Rabbits	38	54	92
Sheep	21	69	90
Swine	15	45	60

ISSN-On line:2414-8830

Aquaculture	12	36	48
Rural development	7	23	30
Total	**266**	**608**	**874**

Table 4 Register of producers by value chain and gender issues that were dealt with in the rural extension component of the CDMX in the year 2016.

Personal development

Among the producers, those who attended the chains of nopal and vegetables were highlighted within agricultural value chains, and the rabbits and sheep were highlighted within the livestock chain. The nopal and vegetable chains concentrated one-third of the producers registered (32.84%) and livestock chains of rabbits and sheep amounted to a little more than one-fifth part of the total (20.82%). These four value chains account for more than half (53.66%) of the producers that were registered in the program to support the rural extension of the CDMX. The cross-sectional chain was appointed, as rural development was the one that had the lowest number of producers (30), which represented 3.43% of the list of producers; however, only one technician was assigned to take care of this action.

It is worth noting that participation of woman was outstanding in the value chain nopal, because of the representativeness was 58.17%, meanwhile, in rabbits, 41.3% of the actors interviewed were women. Evaluation of the extension component. Based on all the surveys that producers responded, 45 in total, 35 were cooperating producers and 10 were leaders. The 95.56 % of the people had knowledge of the extension and innovation network model (REI, in Spanish), as was explained by the extension staff. On the other hand, 88.89% of the producers took part in an event of dissemination, transfer of technology or training and 95.56% of them participated in the implementation of some of the agricultural or aquaculture innovations proposed by the extension program.

Regards to the practice of sharing experiences with other producers within the area, 95.56% responded favourably. The number of agricultural producers who were exposed to the extension program in the CDMX was 631 and all of them were from productive chains mentioned lines above. All producers (100%) shown interest in the continuity of the extension program from SAGARPA and SEDEREC and remain to obtain the support of the technical assistance on agricultural and aquaculture activities.

In the quantitative questions, we used a scale of 1 to 10, in which 10 meant very good; nine and eight meant good; seven and six regular and five or less are catalogue as bad. Table 5 shows the scale used in this study.

Question	**Max value**	**Min value**	**Mean**	**Mode**
How do you qualify the REI?	10	7	9.04	9
How do you qualify the implemented innovations?	10	7	9.17	10
How do you qualify benefits coming from the implemented innovations?	10	8	9.36	10
How do you qualify the extension staff participation within the model REI?	10	7	9.23	9
How do you qualify the information provided regards to the extension process?	10	8	9.32	9

Table 5 Producer's assessment to the survey questions of the extension component of the CDMX.

Personal development according to survey data

From Table 5 , the most common qualifications and with the highest values were for the innovations implemented and the benefits they left.

However, the lower evaluations (minimum) were also in innovations and the participation of the extension staff. The lowest value (minimum) assigned by the producers was 7, and it was on three questions: implementation of the innovations, participation of the extension staff and the Network model of extension and innovation. The main innovations implemented by the SAGARPA and the SEDEREC extension program, in the CDMX, under the supervision of the agricultural extension staff were the following: management of organic fertilizers, mineral, earthworm compost, improved seeds, inoculation, planting of conservation, mycorrhizae, filters to clean water, pest repellents, composting, biofertilization, new product development, business plan, design of corporate image, technical and economic journals, foliar fertilization, certification and cushioning.

In the livestock sector, the main innovations implemented were: animal transformation of raw materials into value-added products, leather tanning, earthworm compost, use of diaries and technical and economic records, preventive medicine, nutritional supplementation and diet, breeding periods, preparation of silos, good management practices, use of traps for propolis, weaning, rugs, wastewater treatment and improvement of water quality. Regards to the benefits detected by the agricultural producers are mentioned as follows: cost reduction and higher yields, higher income, obtaining knowledge, lower consumption of agrochemicals and chemical fertilizers, increased production in critical seasons, processing of products, markets, sales, less pollution of the environment, better management, linking with other companies, greater management capacity and cooperatives, better product quality, greater competitiveness, better animal health and welfare, improve the presentation of the products and a decrease in the “varroa” disease.

Conclusions

The extension program in the CDMX operated for the fourth time. This was the first year (2016) in which the INIFAP joined in the technology accompaniment. The number of chains that were selected to participate in the 2016 extension program was twelve, distributed in five agricultural: amaranth, Maize, Nopal, Vegetables and Ornamentals; five Livestock: Cattle, pigs, sheep, rabbits and bees; one in aquaculture and a cross-sectional study in rural development. All of them are representative of the agricultural sector and aquaculture of the CDMX.

The operation of the program focused on the four delegations located in the south-east of the CDMX: Milpa Alta, Tlahuac, Tlalpan and Xochimilco. The agro-productive chains that had the largest number of extension staff were Nopal and Vegetables, agricultural chains, and rabbits and sheep, in the livestock segment. Among these four chains, the 55.6% of the producers are located (31% in agricultural chains and 24.6% in the livestock, respectively).

The program allocated 29 technical staff distributed among chains and a coordinator of extension staff. The participation by gender was very relevant since 45% were women, and they provided relevant contributions in the implementation of the actions planned within the Rural Support project to the SAGARPA extension program. The number of agricultural producers incorporated in extension program was 874. From the total of participants, the gender was significant (30.4% were women), and it is inferred that the agro-productive activities in the CDMX begin to feminise.

The structured survey with open questions (qualitative) and numerical assessments (quantitative), which was implemented, had a permissible error measured as a percentage of 9%, which is considered as acceptable in our survey. The Network Model of extension and innovation implemented had a broad knowledge among the producers interviewed. The 95.6% responded affirmatively about the existence of the extension program and the model and its agro-productive chains attended.

The 88.9% of the producers who gave their responses stated that they participated in at least one event, disclosure, dissemination of technological tour, demonstration of technology transfer, training or lectures with which the informative actions of the extension staff had high acceptance. The 95.6% of producers participating in the survey said they worked on the implementation of at least one technological innovation under the guidance and supervision of extension staff and they share experiences with other producers in their localities. This reached 631 primary producers in the CDMX.

The main benefits detected by the producers that implemented innovations were higher yields, lower costs, better quality, the transformation of their raw materials to give an added value, less pollution, better animal health and welfare, greater management capacity and awareness to associate themselves (cooperatives). Within the numerical assessments, the program identified three areas of improvement, as the variables that had the lowest ratings: to improve the participation of the extension staff, to improve the implementation of innovations and to make adjustments to the model.

Finally, the 100% of the agricultural and aquaculture producers surveyed expressed their interest in continuing with the operation of the extension component of the SAGARPA and SEDEREC.

Aknowledge

To SAGARPA through its Project Support to Rural Extension. No. SIGI: 1118933872

References

Aguilar A. J., Altamirano C. J. R. y Rendón M. R. 2010. Del Extensionismo Agrícola a las Redes de Innovación Rural. Universidad Autónoma Chapingo. Estado de México, México. 281 pp.

Cadena I. P. Guerra M. M., González C. M., Berdugo R. J. G. y Ayala S. A. 2009. Estrategias de Transferencia de Tecnología, como Herramientas del Desarrollo Rural. INIFAP. Centro de Investigación Pacífico Sur. Campo Experimental Centro de Chiapas. Libro Técnico No. 2. Ocozocoautla de Espinosa, Chiapas, México. 112 pp.

Cadena I. P., Camas G. R., Rodríguez H. R. F., Berdugo R. J. G., Ayala S. A., Zambada M. A., Morales, G. M., Espinoza P. N. y López B. W. 2015. Contribuciones del INIFAP al Extensionismo en México y la Gestión de la Innovación. Revista Mexicana de Ciencias Agrícolas. Vol. 6. No. 4. Chapingo, Estado de México. México. 883 – 895 pp

Comisión Nacional de Población. 2015. Anuarios Estadísticos. CDMX. México.

Diario Oficial de la Federación. 13 diciembre 2013. Decreto por el que aprueba el Programa Sectorial de Desarrollo Agropecuario, pesquero y Alimentario 2013 – 2018.

Diario Oficial de la Federación. 30 diciembre 2015. Acuerdo por el que se dan a conocer las Reglas de Operación de los Programas de la Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación para el ejercicio fiscal 2016.

Diccionario de la Real Academia de la Lengua Española. 2014, 23ª Edición Espasa. Madrid, España.

Gregoire, Timothy G., and HarryT. Valentine. 2008. Sampling Strategies for Natural Resources and Environment. Boca Raton, Fl.: Chapman and Hall / CRC. https://www.crcpress.com/Sampling-Startegies-for-Natural-Resources-and-the-Environment/Gregoire-Valentine/p/book/9781584883708.

Instituto Nacional de Geografía y Estadística. Estados Unidos Mexicanos. (2015) Censo Agrícola, Ganadero y Forestal. Aguascalientes México.

Manrubio M. R., Altamirano C. J. Reyes., Aguilar A. J., Rendón M. R., García M. J. G. y Espejel G. A. 2007. Innovación: Motor de la Competitividad Agroalimentaria – Políticas y Estrategias para que en México Ocurra – CIESTAAM. Universidad Autónoma Chapingo. Texcoco, Estado de México. 310 pp.

McMahonM.A., Valdés A., Cahill C. y Jankowska C. 2011. Análisis del Extensionismo Agrícola en México. OCDE. 50 Mejores Políticas para una Vida Mejor. Paris, Francia. 73 pp.

Moctezuma, L. G, J. A. García E., V. Cuevas R., J. L. Jolalpa B y F. Romero S. 2008. Detección de Demandas de Investigación Tecnológicas, de Conocimiento y de Política en la Cadena Agroalimentaria Cebada en el Estado de Hidalgo, México. XLIV Reunión Nacional de Investigación Pecuaria y III Reunión Nacional de Innovación Agrícola y Forestal Yucatán 2008. Memoria. Guadalajara, Jal. México. 247 pp.

Moctezuma L. G., Velázquez F. L., González C. G. y Castillo C. A. L. 2016. Avances del Extensionismo Pecuario en la CDMX. Memoria de la Reunión Nacional de Investigación Pecuaria. INIFAP. Querétaro. Qro. 516 – 518 pp

Saldaña, A. R., J. A. Espinosa G., G. Moctezuma L., A. Ayala S., C. A. Tapia N., R.M. Ríos I., S. M. Valle L. y A. M. Gomes de C. 2006. Proyecto Quo Vadis: El Futuro de la Investigación Agropecuaria y Forestal y la Innovación Institucional de México. INIFAP. México, D. F. 276 pp

Secretaría de Agricultura, Ganadería Desarrollo Rural, Pesca y Alimentación. SER MEXICANO (2014). www.extensionismo.mx/web1/index.php/contenido/119-extensionismo-rural

Reyes Osorio Sergio. 2013. El Servicio de Extensión Rural en México. Propuesta de Política Pública. Biblioteca Básica de Agricultura, México. 156 pp

Sanderson S.E. La Transformación de la Agricultura Mexicana. Estructura Internacional y Política del Cambio Rural. 1990. Consejo Nacional para la Cultura y el Arte. Alianza Editorial Mexicana. México, D. F. 290 pp.

Turrent F. A. Políticas de Investigación y Transferencia Agrícola, Pecuaria y Forestal para el Campo Mexicano. 2007. En Desarrollo Agropecuario y Forestal. Agenda para el Desarrollo. Volumen 9. Editorial Miguel Ángel Porrúa. México, D. F. 135 – 146 PP.

Villareal René. 2015. Extensionismo Holístico y el Agrocluster. Modelo de Asociatividad e Integración de la Cadena Productiva. SAGARPA. México. 38 pp.

Wikipedia. Enciclopedia libre. 2016. es.wikipedia.org/wiki/México-Tenochtitlan.

ISSN-On line:2414-8830

Zamora M. M. C. 2016. Extensionismo Forestal. Revista Mexicana de Ciencias Forestales. Vol.7. No. 36. Julio-agosto. México. 4 - 5 pp.Appendix 1.

Appendix

Cadena	♀	♂	Nh	Wh	nh	Wh	Mean of the stratum	Wh Mean	Variance of the stratum	Stratified variance
Amaranthus	7.00	53.00	60.00	0.07	3.20	0.07	18.76	1.33	1058.00	313.09
Ornamental	14.00	50.00	64.00	0.08	3.41	0.08	18.76	1.42	648.00	179.78
Corn	12.00	38.00	50.00	0.06	2.67	0.06	18.76	1.11	338.00	120.03
Vegetables	20.00	114.00	134.00	0.16	7.14	0.16	18.76	2.98	4418.00	585.40
Nopal	89.00	64.00	153.00	0.18	8.16	0.18	18.76	3.40	312.50	36.27
Bovine	5.00	25.00	30.00	0.04	1.60	0.04	18.76	0.67	200.00	118.37
Apiculture	26.00	37.00	63.00	0.07	3.36	0.07	18.76	1.40	60.50	17.05
Rabbits	38.00	54.00	92.00	0.11	4.91	0.11	18.76	2.04	128.00	24.70
Sheeps	21.00	69.00	90.00	0.11	4.80	0.11	18.76	2.00	1152.00	277.27
Swine	15.00	45.00	60.00	0.07	3.20	0.07	18.76	1.33	450.00	133.17
Aquaculture	12.00	36.00	48.00	0.06	2.56	0.06	18.76	1.07	288.00	106.53

Nh = Units of each of the L strata
Wh = Sample number weighted by stratum
nh = Sample number of the stratum

Table 2 Data distribution of the participating producers by value chain in the agricultural and aquaculture extension components of the CDMX

ISSN-On line:2414-8830

Instructions for authors

A. Submission of papers to the areas of analysis and modeling problems of the:

- Biological and Health Sciences
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- Immunology
- Human Ecology
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-Written in English. It is mandatory to submit the title and abstract as well as keywords. Indicating the institution of affiliation of each author, email and full postal address and identify the researcher and the first author is responsible for communication to the editor

-Print text in Times New Roman #12 (shares-Bold) and italic (subtitles-Bold) # 12 (text) and #9 (in quotes foot notes), justified in Word format. With margins 2 cm by 2 cm left-right and 2 cm by 2 cm Top-Bottom. With 2-column format.

-Use Calibre Math typography (in equations), with subsequent numbering and alignment right: Example;

$$\left[\frac{P_a^M + P_i^M}{\left[\frac{PPP}{V}\right]^{1/2}}\right]^{3/4} + \left[\frac{MP_a^a + M_a^i}{A_c}\right] + \xi^2 \quad (1)$$

-Start with an introduction that explains the issue and end with a concluding section.

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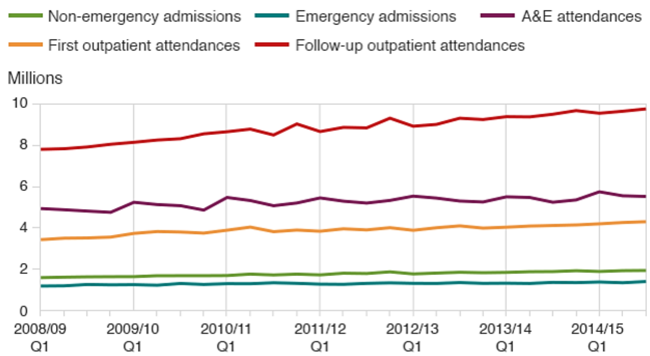

Graph 1 Hospital Activity

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