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The works must be unpublished and refer to topics of agriculture-forest, pathology-sustainable, forest, management, horticulture, engineering and integrated water useand other topics related to Biotechnology and Agricultural Sciences.

Presentation of Content

Volume nine, issue seventeen, as the first article we present, *Benefit-cost analysis of the optimum level of giberellic acid as an inductor of the germination of chiltepín chili (Capsicuum annuum var. aviculare) cultivated in backyard*, by RODRÍGUEZ-LÓPEZ. Karen Alexa, ORTEGA-MONTES, Fabiola Iveth, RUBIO-ARIAS, Héctor Osbaldo and MACÍAS-LÓPEZ, María Guadalupe, with adscripction in the Universidad Autónoma de Chihuahua, as a second article we present, *Determination of physical and chemical parameters in water for irrigation for agricultural use in Tepatepec, Hidalgo*, by CALLEJAS-HERNÁNDEZ, Judith, RODRÍGUEZ-ORTEGA, Alejandro, RODRÍGUEZ-MARTÍNEZ, Nellybeth and BUSTAMANTE-ESPINOSA, Laura Virginia, with adscripction in the Universidad Politécnica de Francisco I. Madero, as third article we present, *Damage caused by Peltophorus polymitus (Boheman 1845) in maguey leaves in the state of Hidalgo*, by RODRÍGUEZ-ORTEGA, Alejandro, RODRÍGUEZ-MARTÍNEZ, Nellybeth, CALLEJAS-HERNÁNDEZ, Judith and BUSTAMANTE-ESPINOSA, Laura Virginia, with adscripction in the Universidad Politécnica de Francisco I. Madero, as fourth article we present, *Technoscience in cloning Drosera spatulata from leaf explants, its dissemination through social marketing*, by ESPEJO-MARTÍNEZ, Abraham & ESPEJO-CRUZ, Abigail del Carmen, with adscripction in Universidad Autónoma “Benito Juárez” de Oaxaca.

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Article **ECORFAN Journal-Republic of Nicaragua**
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Benefit-cost analysis of the optimum level of giberellic acid as an inductor of the germination of chiltepín chili (*Capsicuum annuum* var. *aviculare*) cultivated in backyard

Análisis beneficio-costo del nivel óptimo de ácido Giberélico como inductor de la germinación de chile chiltepín (*Capsicuum annuum* var. *aviculare)* cultivado en traspatio

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Abstract

The gastronomic culture of Mexico is linked to various vegetables, to certain species and, in particular, chili. It is clear that chilies are plant species that have great importance in the identity of the people of Mexico. The objective of this research was to analyze the cost-benefit of sowing chiltepin-type chili in the backyard using the optimal level of applying gibberellic acid as a germination inducer. Prior to the cost-benefit analysis, seven treatments were evaluated to select the best one to induce chiltepín germination. The treatments were supported by the application of gibberellic acid in different percentages, plus a control (T1-no application). The results showed that the optimal level of germination was obtained with the application of substrate, perlite, vermiculite and 5% gibberellic acid. With this treatment, a greater number of plants and 95% rooting were obtained, compared to the control treatment (T1) as well as a greater yield of chili (171 g plant-1) compared to the control (128 g plant-1). A cost-benefit ratio of 1.33 was calculated for the best biological treatment, so it is concluded that it is possible to improve family income through the production of chiltepin-type chili under backyard conditions.

Evaluation, Production, Alternative cultivation

Resumen

La cultura gastronómica de México está ligada a diversos vegetales, ciertas especies y en lo particular al chile. Es claro que los chiles son especies vegetales que tienen gran trascendencia en la identidad del pueblo de México. El objetivo de esta investigación fue analizar el costo-beneficio al sembrar el chile tipo chiltepín en traspatio utilizando el nivel óptimo de aplicar ácido giberélico como inductor de la germinación. Previo al análisis costo-beneficio se evaluaron siete tratamientos para seleccionar el mejor para inducir la germinación del chiltepín. Los tratamientos se sustentaban con la aplicación de ácido giberélico en diferentes porcentajes, más un testigo (T1-sin aplicación). Los resultados mostraron que el nivel óptimo de germinación se obtuvo con la aplicación de sustrato, perlita, vermiculita y ácido giberélico al 5%. Con este tratamiento se obtuvo un mayor número de plantas y un 95% de enraizamiento, en comparación con el tratamiento testigo (T1) así como un mayor rendimiento de chile (171 g planta-1) en comparación al testigo (128 g planta-1). Se calculó una relación de b/c de 1.33 para el mejor tratamiento biológico por lo que se concluye que es posible mejorar el ingreso de las familias mediante la producción de chile tipo chiltepín bajo condiciones de traspatio.

Evaluación, Producción, Cultivo alternativo

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Introduction

Chilli peppers are a plant species of particular importance in Mexican culture and identity. The chiltepín chilli (*Capsicum annuum* L. var. *glabriusculum* (Dunal) Heiser & Pickers- gilles) also known as quipi, pikin or ají pajarito is native to tropical areas, being found from the south of the United States of America, in various regions of Mexico (Rueda, *et al*., 2010) and in Central America (Castro, 2020). The word chiltepín is believed to come from the Nahuatl word meaning "flea". In Mexico, the main producers, and consumers of chiltepín are the states of Sonora and Sinaloa. In Sonora it is known as the red gold, due to its high cost as an exotic chilli (Camarena, 2016). The wild chiltepín from the Sierra de Sonora occupies a significant place in the culture of Sonorans. However, studies on this species are scarce and one-dimensional (Bañuelos, *et al*., 2008). Chiltepín is mainly collected by women and children in the various ecoregions of the country, which is why this activity represents a source of extra income for rural municipalities and, therefore, is a factor of socio-economic development for the region.

Mexico has been classified as a high producer and consumer of chilli. For this reason, several types of species are consumed, depending on the region and the type of vegetation, but one of the most important is the Chiltepín type chilli. Mexico stands out for the importance of the origin and diversity of the most representative chilli species, which includes Capsicum annuum among the more than 100 varieties of chillies consumed worldwide (Gallardo, 2017). Chilli is a relevant element in the national culture for the preparation of dishes and traditional medicine and is undoubtedly a source of income for rural communities where it is naturally produced.

It is well documented that Mexico has been classified as a high consumer of spicy products. Thus, consumers identify several types of chilli, depending on the region, the environment, and the type of vegetation. In the case of chiltepín, it should be mentioned that this species is consumed in the communities surrounding the production areas and, it is believed, that its harvesting has not endangered the survival of this species; that is to say, its cultivation has taken place under sustainable conditions.

In addition, it should be mentioned that consumption has increased in recent years as a result of their display in US supermarkets, promoted as exotic chillies (Camarena, 2016). However, in some regions of Mexico (i.e., in the region of Chínipas in the state of Chihuahua), this species is intensively harvested in the wild, deteriorating its habitat and participating in the gradual extinction of this species (Oviedo, *et al*., 2017).

Chiltepín is produced seasonally and at a specific time; consequently, it is necessary to practice adequate management of the plant in order to have a product all year round. For this reason, it is necessary to generate clonal lines by selecting plants with the required characteristics, such as size, shape, fruit colour, quantity and quality of modern crops (González, 2016).

Once a line has been generated, cuttings can be taken from the plant, i.e. stems cut lengthwise to which hormones are added in substrate during the period when the plant is not differentiating, flowering or bearing fruit. Finally, the plant is properly managed until it is big enough to be transferred to soil or hydroponic cultivation. Ibid.

The objective of this study was to perform a benefit-cost (b/c) analysis of the investment made by producers in the municipality of Rosales, Chihuahua, Mexico in the production of chiltepín chilli under backyard conditions. The results will reduce the costs associated with the purchase of chili peppers for daily consumption by participating families and increase their financial indicators. We hypothesised that growth in the agricultural sector plays an important role in reducing poverty in communities, as some estimates have determined that such growth is three to four times more effective than growth in other non-agricultural sectors (Christensen, 2018).

Methodology to be developed

The study was carried out from February 2022 to June 2023 in the town of Ortiz, in the municipality of Rosales, Chihuahua, Mexico. This community is located at the coordinates Latitude 28,1833, Longitude-105.467 28° 10`60" North, 105° 28`1" West. Figure 1 and Figure 2 show the location of the study.

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The area has an extreme semi-arid climate, the average annual temperature is 18.6 ºC, the maximum temperature is 42 ºC and the minimum temperature is -13º C. The average annual rainfall is 294.7 mm, with an annual average of 82 days of rain and a relative humidity of 45%. There are an estimated 60 days of rain and 2 days of hail. The number of frost days is 110 and there are 3 d of early frosts (October) and 4 d of late frosts (April). The prevailing winds come from the southwest (INAFED, 2021).

In a first stage, an experiment was established under backyard conditions with the objective of identifying the optimum level of gibberellic acid application to obtain good chiltepín seed germination. The following eight treatments with additions of substrate, perlite, vermiculite and gibberellic acid were evaluated; the control treatment (T1), application of substrate, perlite, vermiculite and gibberellic acid at 3% (T2), application of substrate, perlite, vermiculite and gibberellic acid at 4% (T3), application of substrate, perlite, vermiculite and gibberellic acid at 5% (T4), application of substrate, perlite, vermiculite and gibberellic acid at 6% (T5), application of substrate, perlite, vermiculite and gibberellic acid at 7% (T6) and application of substrate, perlite, vermiculite and gibberellic acid at 8% (T7). The treatments were established in soil with a plant spacing of 2x2 m.

Statistical analysis of biological response

Differences between treatments were analysed by analysis of variance (ANOVA) considering an unstructured arrangement of treatments (Rubio and Jiménez, 2012). The statistical package SAS (Statistical Analysis System) was used for the analysis. When the F value was significant, a mean comparison test was used with Tukey's method. The statistical analyses considered a significance value of 95%, i.e. α=0.05 in all cases.

Cost-benefit analysis

Once the best evaluated treatment of gibberellic acid application was determined from the biological point of view, a cost-benefit analysis was carried out. The simplest formula was used for this analysis, i.e., the b/c ratio was calculated, where b represents the benefit and c the cost.

The benefit is determined as a percentage and its interpretation is: if the result is greater than 1, it is acceptable or profitable; if the result is equal to 1, there is no profit or loss; and if the result is less than 1, it is not profitable, so the treatment or project is rejected. Its formula:

$$\text{Benefit Cost} = \left(\frac{\text{Net income}}{Net\ cost}\right) \times 100$$

Results and discussion

The ANOVA results for the percentage of gibberellic acid applied to chiltepin chili seed showed differences between treatments in rooting, seedling development and yield ($P<0.05$). A detailed analysis of these results is not shown as it was not the objective of this study. Of the evaluated treatments, the one that presented a higher growth and a better rooting of the chiltepin chili seedling under backyard conditions was T4; that is to say, with the application of substrate, perlite, vermiculite and gibberellic acid in 5%. It was noted that this treatment had a positive effect favouring a better development of the plant. With this treatment, a greater number of plants were obtained (17 plants), which greatly surpassed the control (T1), where 8 plants were observed. With respect to yield, in T4 171 g of fresh red fruit per plant were harvested, while in the control treatment 128 g were harvested.

Agronomic results show evidence that this plant is highly adaptable to different environments and soil types (Cano *et al*., 2015; Rueda *et al*., 2010). In a recent work developed by Alcalá, e*t al*. (2019), where they evaluated 11 germination treatments in chiltepín, they found that the application of gibberellic acid to the seed with a scarification process improved the germination percentage, germination index and germination speed and reduced seed death. Koornneef and Bentsink (2002) reported that gibberellic acid offered an excellent way to improve plant germination. Similarly, Quintero *et al*. (2018) found that gibberellic acid treatments had a positive effect on germination compared to the control group.

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Our results are interesting because there is a marked interest in domesticating this plant and, in this way, making it possible for families to harvest their chilli needs, in this case chiltepín. However, little has been studied about the dormancy mechanism of this particular species, which has allowed it to overcome adverse climatic conditions or to resist light, water and nutrients with special competitiveness (Finkelstein *et al*., 2008). It is traditional for Mexican families to collect chiltepín fruits in the wild (Guerrero, 2015) and little has been done to domesticate this plant in backyard plots, although several studies have shown that chili seed production is a highly profitable market (Tigari and Swathi, 2019). Major problems in domestication include variation among genotypes, low and erratic germination rates, morphological and physiological information among other factors.

The benefit-cost analysis found a value of 1.33, i.e. it is possible to support the sowing of chiltepín type chilli under backyard conditions, as this crop is profitable and without any visible risk. It is desired that the producer adopts an innovation or alternative that will improve his standard of living and, consequently, increase his income. It is not common to find benefit-cost analyses on agricultural and livestock products; however, some researchers have conducted such analyses to motivate the planting and promotion of a certain type of crop. For example, researcher Avila (1997) conducted a study to determine the benefit-cost of several important crops in the northwest region of the state of Chihuahua and concluded that oats were the most suitable crop for producers because of their 63.41% profitability including land costs.

The advantage of producing one's own type of chilli under backyard conditions by a Mexican family is truly innovative, as it is well documented that the price of this product, which is consumed in practically every meal, increases significantly in local markets. For example, in India 90% of chillies sold are produced in other regions and only 10% is a local product, which increases the price of the products significantly (Srikala, *et al*., 2016).

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Article **ECORFAN Journal-Republic of Nicaragua**
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Determination of physical and chemical parameters in water for irrigation for agricultural use in Tepatepec, Hidalgo

Determinación de parámetros físicos y químicos en agua para riego de uso agrícola en Tepatepec Hidalgo

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Abstract

The Mezquital Valley is a region of the state of Hidalgo dedicated to agriculture with 456,855.69 hectares of which, 20% is irrigated and the rest is seasonal; Precipitation is low, so it is necessary to reuse wastewater from the Valley of Mexico, currently treated to eliminate pathogenic microorganisms, toxic metals, fats, oils, nutrients and organic matter. Given the fertilizer crisis, it is necessary to evaluate water quality in relation to nutrient content: nitrogen, phosphorus, potassium, magnesium, sulfur, calcium, pH and EC after treatment. Weekly sampling was carried out during April-August 2021. EC represents a medium to high risk since it can cause salinity problems in soils in the long term and affect crops with low or no tolerance although the presence of Ca^{2+} and Mg^{2+}, counteract the effect of the Na+ ion and reduce the risk of sodicity. The water has a high variation in its ionic composition, however, magnesium, nitrogen, phosphorus and potassium are at an adequate level as well as the pH, their contribution through irrigation water reduces the cost of fertilization to obtain high yields.

Wastewater, Quality, Nutrients, Fertilizers

Resumen

El Valle del Mezquital es una región del estado de Hidalgo dedicada a la agricultura con 456,855.69 ha de las cuales, 20% es de riego y el resto de temporal; la precipitación es baja, por lo que es necesario reutilizar las aguas residuales del Valle de México, actualmente tratadas para eliminar microorganismos patógenos, metales tóxicos, grasas, aceites, nutrientes y materia orgánica. Dada la crisis de fertilizantes es necesario evaluar la calidad de agua en relación al contenido de nutrientes: nitrógeno, fósforo, potasio, magnesio, azufre, calcio, pH y CE después del tratamiento. Se realizó un muestreo semanal durante abril-agosto de 2021. La CE representa un riesgo de medio a alto ya que puede provocar problemas de salinidad en suelos a largo plazo y afectar a los cultivos con baja o nula tolerancia aunque la presencia de Ca^{2+} y Mg^{2+}, contrarrestan el efecto del ión Na+ y disminuyen el riesgo de sodicidad. El agua presenta alta variación en su composición iónica, sin embargo, el magnesio, nitrógeno, fósforo y potasio se encuentran en nivel adecuado al igual que el pH, su aporte a través del agua de riego disminuye el costo de fertilización para obtener altos rendimientos.

Agua Residual, Calidad, Nutrientes, Fertilizantes

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Introduction

The Mezquital Valley, located in the state of Hidalgo, is an agricultural area, with more than 90,000 ha, where 59% of the state's total production is obtained (García-Salazar, 2019). It is a semi-arid region, where annual rainfall varies from 350 to 500 mm, resulting in a low amount of water available for plants. This area mainly produces crops such as maize (Zea mays) with 41,950 hectares, alfalfa (Medicago sativa) 41,526 hectares, beans (Phaseolus vulgaris) with 4,398, fodder oats (Avena sativa) 3,146 hectares, barley (Hordeum vulgare) and wheat (Triticum spp), all irrigated with residual water (RA) since 1912. It should be noted that according to the National Water Commission (Conagua, 2009), MV crops fall into the category of crops conditioned for irrigation with wastewater. Currently, the Mezquital Valley is known as the second region in the world with the highest use of wastewater in the agricultural sector, as well as the largest sewer in the country for the amount of water it receives, water that comes from the metropolitan area of the Valley of Mexico (ZMVM) and is sent to Hidalgo without any prior treatment.

Currently, part of this water reaches the main irrigation districts (DDR) of the state, 003 Tula, 100 Alfajayucan and 112 Ajacuba, its distribution is shown in Figure 1 and is considered the largest in the world (Islas, 2011) to be distributed in the region. The amount of RA amounts to 1,467,993.8 thousand cubic metres per year (García-Salazar, 2019), however, the installed capacity for urban water treatment is 8,655 L/s and only 4,353 L/s are processed. For industrial treatment, there is an installed capacity of 1,297 L/s, of which 851 L/s are treated, so large amounts of RA are generated, of which only 11.3 % are treated. In Hidalgo, an average volume of 31 to 56.6 m3/s of untreated RA is received (CONAGUA, 2009; Jiménez-Cisneros et al., 2004). In 2016 CONAGUA started the operation of the Wastewater Treatment Plant (WWTP) in Atotonilco de Tula, with a capacity of 35 thousand L/s, although on average only 23 thousand L/s are treated and an additional 12 thousand L/s in the rainy season (CONAGUA, 2016-2017, García-Salazar, 2019), considered one of the largest in Latin America and worldwide, with the objective of treating up to 60% of the water received through primary, secondary and tertiary treatment.

For many farmers, it represents a great economic benefit as the supply is permanent, unlike rainwater, which can be seasonal or erratic. While the use of this water on crops is attractive because of its accessibility and the low cost of fertiliser, due to the high content of nutrients and organic matter. As a result, farmers are able to obtain higher yields per unit area at a lower cost. Even after applying a treatment, the RA can supply 225 kg of nitrogen and 45 kg of phosphorus per hectare per year, which reduces or eliminates the need for supplementary fertilisation.

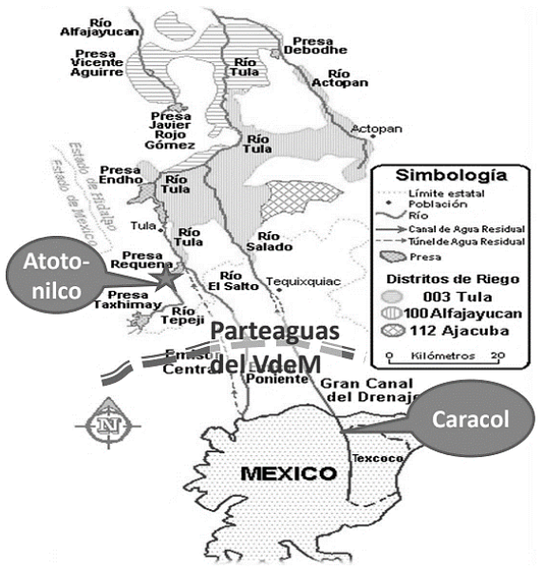

Figure 1 Map of irrigation districts 003, 100 and 112 located in the Mezquital Valley, within the south-central region. 100 and 112 located in the Mezquital Valley, within the south-central region
Source: (Siebe, 2020)

Although there are also multiple negative impacts (Siebe, 1994; Chen et al, 2005; García-Salazar, 2019) in the social, environmental and economic spheres, from health problems, soil contamination by the presence of bacteria, viruses and parasites that pose risks to the crops themselves, if the water comes from industrial effluents, it may present certain chemical contaminants such as heavy metals, as some of them are toxic to plants, soil and of course human health, many of them can be absorbed by crops affecting their productive potential (Hernández-Silva, 2014; Garcia-Salazar, 2019) irrigation can also generate unfavourable effects on the soil, such as salinisation or sodicity due to the excessive accumulation of salts, when the concentrations of some ions are high, which decreases crop yields and makes the soil susceptible to erosion and finally economic inequality among farmers due to wastewater hoarding.

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The operation of the PTAR Atotonilco has generated controversy among farmers, some of them; They consider that the treatment of the RA will imply an increase in the tariffs for the water they use, a reduction in the volume of water they receive and a decrease in the nutrients in the crops derived from the treatment, which will lead them to invest in fertilisers, and loss of harvests, It is therefore proposed to evaluate water quality in relation to the content of nutrients nitrogen (NO^{3-}, $N\text{-}NO^{3-}$), phosphorus (PO_4^{-3}, P_2O_5), potassium (K^+, K_2O), magnesium (Mg^{2+}), sulphur (SO_4^{-2}), calcium (Ca^{2+}), pH and EC after treatment for use in agricultural irrigation.

Methodology

Samples were collected from the main drainage canal that runs through the Polytechnic University of Francisco I. Madero within the DR003 -Tula. Simple sampling was carried out once a week from April to August. Sampling was carried out in accordance with NMX-AA-003-1980. All the analyses mentioned below were carried out in triplicate. For nitrate determination, the APHA-AWWA-WEF (2005) methodology was used, method 4500-NO_3- B; method 4500- SO_4^{2-} E., method 4500-P A, C and E., method 3500-Ca B; 3-83 and 3-84 method 3500-Mg B for pH, a potentiometric method was used (APHA, 1995. 4500-H+B) and finally for electrical conductivity a conductivity meter (APHA, 1995. 25108).

Results

The pH of the water is classified as slightly alkaline and shows a variation between 7.2 and 8 according to figure 2, coincides with that reported by other authors (Pérez-Díaz et al; 2020, Ontiveros-Capurata et al; 2013), which allows the water to be used for agricultural irrigation without effects on the soil.

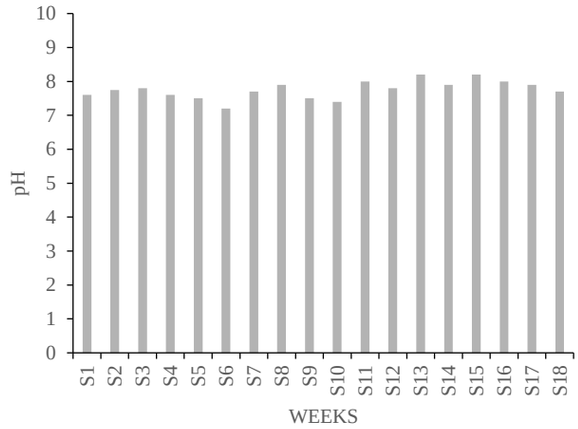

Figure 2 Average hydrogen potential in wastewater
Source: Own elaboration, 2021

The electrical conductivity (EC) is considered a medium to high risk (figure 3) for use as irrigation water, due to the risk of salinity in soils and affecting crops with low or no tolerance to salinity. The use of wastewater in crop irrigation can induce salinisation processes in soils in the long term, especially because of the ion values and EC (Flores Avalos, 2015).

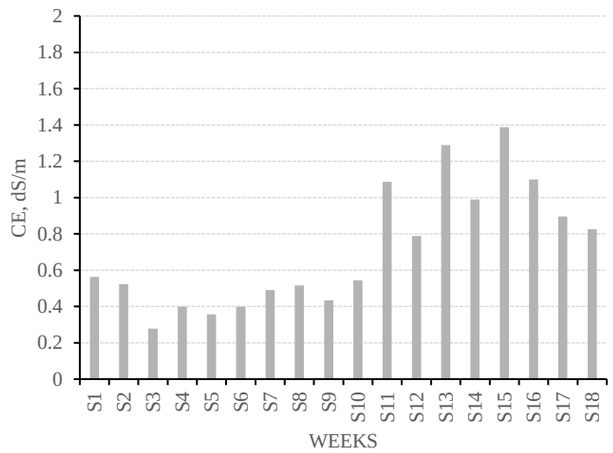

Figure 3 Average electrical conductivity in wastewater
Source: Own elaboration, 2021

It has been found that the wastewater analysed presents representative quantities of nutrients such as nitrates, phosphate, potassium, calcium and magnesium. For calcium and magnesium, the amounts in mg/L are double that of potassium as shown in figure 4, which is why the EC values are medium to high, while potassium is at the values reported by Perez-Diaz (2019).

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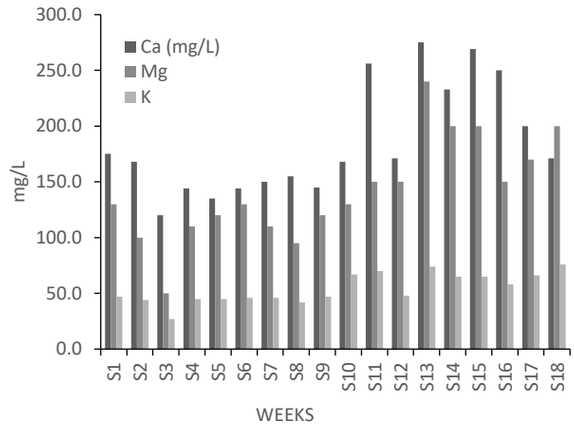

Figure 4 Calcium, magnesium and potassium values in wastewater
Source: Own elaboration, 2021

The presence of Ca^{2+} added to the soil through irrigation water can counteract the effect of the Na+ ion in the soil, which, although not determined in the study, reduces the risk of sodicity in soils and improves the structure. Wastewater (RA) has a high variation in its ionic composition.

Figures 5 and 6 show the results for phosphorus and nitrogen present in the wastewater. Nitrogen-nitrogen presents a risk due to the contamination that can be generated, as it is easily washed out and can be lost and cause contamination towards groundwater, something very similar happens with phosphorus, both ions also represent a risk for aquatic organisms when RA are not used for irrigation and are discharged into water bodies causing severe problems of eutrophication.

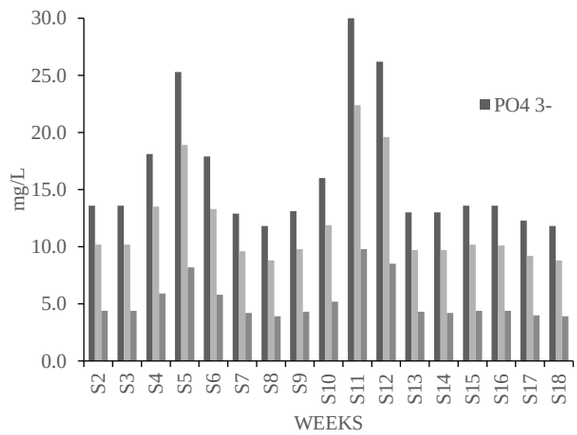

Figure 5 Phosphorus values in the form of phosphate in wastewater
Source: Own elaboration, 2021

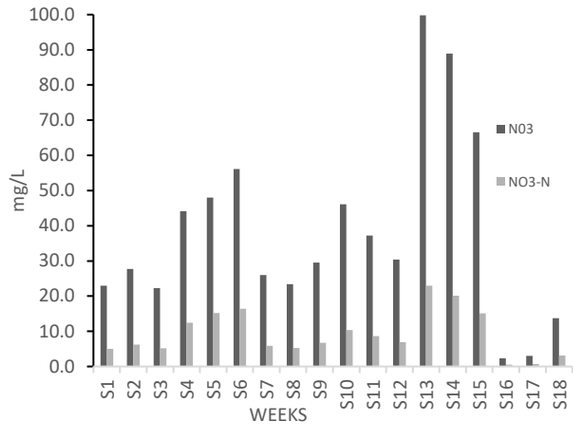

Figure 6 Nitrogen values in the form of nitrate and nitrate nitrogen in wastewater
Source: Own elaboration, 2021

Conclusions

The AR presents a high variation in its ionic composition. However, the pH is suitable for use as irrigation water.

The electrical conductivity is considered medium to high risk for use as irrigation water, as it can cause salinity in soils and affect crops with low or no tolerance to salinity.

The presence of Ca^{2+} and Mg^{2+} added through irrigation water can counteract the effect of the Na+ ion in the soil, which, although not determined in the study, reduces the risk of sodicity in soils.

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Article **ECORFAN Journal-Republic of Nicaragua**
December 2023, Vol.9 No.17 11-14

Damage caused by *Peltophorus polymitus* (Boheman 1845) in maguey leaves in the state of Hidalgo

Daños ocasionados por *Peltophorus polymitus* (Boheman 1845) en hojas de maguey en el estado de Hidalgo

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Abstract

Maguey has been used since ancient times as a source of food, drink, clothing, religious use, decoration, furniture, tools, medicine and in construction. In this research, the damage caused by the mouthparts of adult insects on the upper and lower sides of maguey leaves was analyzed. It is concluded that adult *P. polymitus* insects feed on the leaves of agave plants, causing the same damage to the upper and lower surfaces. This means that there is no feeding preference for any side of the leaf and so far, the damage caused by this beetle does not seem very important. However, these wounds caused during feeding can encourage the entry of fungi or bacteria and cause disease.

Maguey, Beetle, Agave, Coleoptera, Hidalgo

Resumen

El maguey se ha utilizado desde tiempos muy antiguos como fuente de alimento, bebida, vestido, uso religioso, ornato, muebles, herramientas, medicina y en la construcción. En esta investigación se analizó el daño ocasionado por el aparato bucal de insectos adultos en el haz y envés de hojas de maguey. Se concluye que los insectos adultos de *P. polymitus* se alimentan de las hojas de plantas de agave, ocasionando el mismo daño en el haz y en el envés. Esto significa que no existe preferencia alimenticia por alguna cara de la hoja y hasta el momento, los daños causados por este escarabajo no parecen muy importantes, sin embargo, estas heridas ocasionadas durante su alimentación pueden propiciar la entrada de hongos o bacterias y causar una enfermedad.

Maguey, Escarabajo, Agave, Coleoptera, Hidalgo

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Introduction

Mexico is a centre of diversity for Agave, with many native and commercial species with local species of regional and international impact (Figueroa *et al*., 2016).

The Agavaceae family occurs naturally in the Americas. Agaves are found from Alberta, Canada; North Dakota in the United States, Mexico, Central America and as far south as Venezuela, the Guianas, Colombia, Ecuador, Peru, Bolivia and Paraguay; it also grows in the Caribbean islands (Garcia, 1992).

Approximately 310 species are reported in the Americas, and 272 in Mexico, which is considered the centre of origin of the genus with 88% of the species. Its true production area is cooler than temperate and it grows between 2,200 and 2,700 m.

It is a plant that withstands prolonged periods of drought. It is a plant that resists the prolonged droughts and inclemencies of the semi-arid zones of the states of Hidalgo, Tlaxcala, Mexico and Puebla, where it often rains only once a year, but where frosts are very strong and frequent in the autumn and winter seasons. Maguey has been used since ancient times as a source of food, drink, clothing, religious use, ornament, furniture, tools, medicine and in construction (Narváez *et al*., 2016).

Coleoptera (beetles) are the most diverse order of insects, with approximately 400,000 described species worldwide, of which 3.29% are found in Mexico. Curculionidae with 18 subfamilies, 90 tribes and about 60,000 species distributed worldwide is the most diverse beetle family, the family also includes several species of economic importance because they affect stored products, forest ecosystems and agroecosystems due to their feeding habits that include roots, stems, leaves, bark, flowers, fruits and seeds (Reyes *et al*., 2020).

One of the insects that feeds on the maguey pulquero is Peltophorus polymitus, identified by a body length of 6 to 10 mm, black colour, with white scales all over the body (figure 1E-F), with prosternal canal; mandibles without teeth, endodontic; very large round eyes, dorsally contiguous; geniculate antenna with compact clava, inserted at the base of the face, funiculus of 7 antennomeres, where antennomeres 1-3 are longer than antennomeres 4-7; on the head side a slightly dorsoventrally compressed, medium-sized rostrum; pronotum subtrapezoidal; scutellum trapezoidal; elytra with strongly emarginate base; anterior coxae separated by a prosternal canal; tarsomere 3 strongly bilobed, with abundant silk on the entire ventral surface, without dermal lobes, with a pair of claws attached at the base; pygidium exposed behind the elytra (Romo *et al*., 2012). The aim of this research was to evaluate the damage caused by the mouthparts of adult pinto beetle insects on the upper and underside of maguey pulquero leaves.

Methodology

The locality of Epazoyucan is located in the state of Hidalgo at the coordinates (19° 59' 47.92" N, 99° 40' 40.5" W; 2,419 m.a.s.l.). During 2021 and 2022, maguey stalks damaged by the mouthparts of the pinto weevil were sampled (Figure 1 A-D). Adult insects of the insect P. polymitus were also collected in bottles with 70% alcohol for determination and preservation. The material was analysed in the Entomology laboratory of the Universidad Politécnica Francisco I. Madero, located in Tepatepec, Hidalgo. Using a completely randomised design and Tukey's comparison of means, the damage caused by the mouthparts of adult insects on the upper and lower side of the stems of the *Agave* (Sas 2001).

Results

In this research we found that the damage present on the leaves of maguey pulquero (figure 1 C and D) is caused by adult insects. They feed on the leaves of the agave plant and leave small circular holes on the surface of the stalk without going through it. González et al., 2015, mention that during feeding and oviposition they can also generate small holes in the floral scape or quiote.

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The adult is on average 8 to 10 mm long, black with white scales (figure 1 E-F) all over the body, with a posternal canal to receive the rostrum at rest; the eyes are round and large; the antenna geniculate, with compact clava, inserted at the base of the rostrum, the antennal funiculus is of seven antennomeres; anterior coxae separated by the posternal canal, tarsomere 3 strongly bilobed; the elytra are strongly sclerotized, striated and with pubescence; pygidium exposed (González *et al*., 2015).

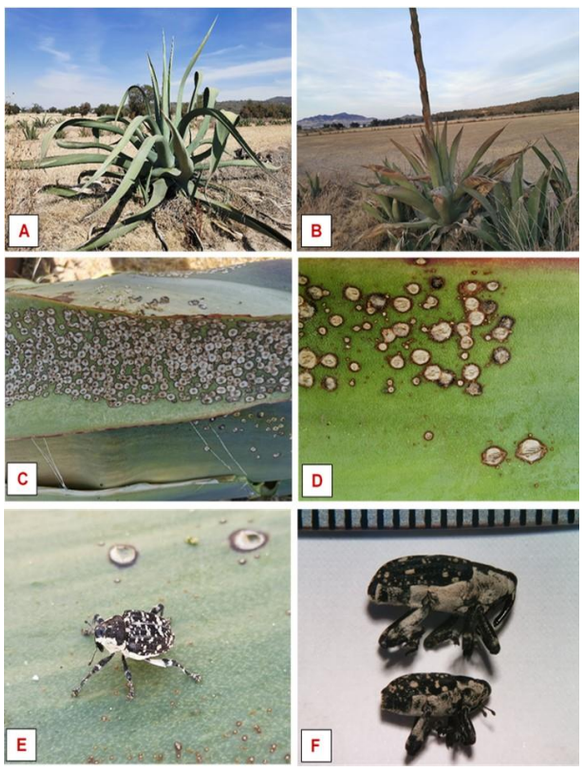

Figure 1 Damage caused by Peltophorus polymitus on maguey pulquero leaves in the state of Hidalgo. (A-B) maguey host of the pinto weevil, (C-D) symptoms caused by the mouthparts of the adult insect when feeding and (E-F) adult insects, the size of the sexual dimorphism was shown

Reyes *et al*., (2020), mention that P. polymitus is a species widely adapted to different vegetation types, altitudes and, therefore, tolerant to diverse environmental conditions since it was recorded in all ecoregions of the State of Durango.

Beam of the maguey leaf	Sampling 1	Sampling 2	Sampling 3	Average
Maguey leaf underside	5	8	7	6.6 a
	4	5	2	3.6 a
	10	12	7	9.6 a
	9	11	7	9.0 a
	3	4	5	4.0 a
	6	6	3	5.0 a
	8	7	10	8.3 a
	6	7	6	6.3 a
	4	4	2	3.3 a
	9	6	6	7.0 a
Values with the same letter are statistically equal at P>0.05.				

Table 1 Number of lesions caused by adult insects of P. polymitus on the upper and lower surface per four square centimetres on maguey leaves

Acknowledgement

We would like to thank the Agrotechnology Engineering Department of the Polytechnic University of Francisco I. Madero for the facilities provided for the execution of this research work.

Conclusions

From this research it is concluded that adult insects of P. polymitus feed on the leaves of agave plants, causing the same damage on the upper and lower sides. This means that there is no feeding preference for any side of the leaf and so far the damage caused by this beetle does not seem to be very important in maguey pulquero, however, these wounds caused during feeding can lead to the entry of fungi or bacteria and cause a disease that causes the death of the plant.

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Article **ECORFAN Journal-Republic of Nicaragua**
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Technoscience in cloning *Drosera spatulata* from leaf explants, its dissemination through social marketing

Tecnociencia en clonación de *Drosera spatulata* a partir de explantes de hoja, su divulgación mediante mercadotecnia social

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Abstract

In 1996, humanity learned of such a transcendent and new result in the world of biology through the dissemination of the cloning of a living being, the birth of Dolly the sheep in the United Kingdom, from that moment on science and technology came together more closely to investigate the possibilities of being able, through genetic manipulation, to duplicate living beings based on an already existing one. In the world of plants, something similar has happened and the present work gives an account of it by developing viable in vitro culture techniques for the cloning of species of ornamental plants where for this specific case *Drosera spatulata* was taken or in common terms carnivorous plant, taking into account the possibility of regenerating plant material and obtaining complete developed plants, free of pathogens and under controlled conditions whose results serve as a basis for future research through its dissemination through social marketing.

Plant cloning, *In vitro* cultivation, Social marketing

Resumen

En el año 1996 la humanidad se enteró de un resultado tan trascendente y nuevo dentro del mundo de la biología mediante la divulgación de la clonación de un ser vivo, el nacimiento de la oveja Dolly en el Reino Unido, a partir de ese momento la ciencia y la tecnología se unieron mas estrechamente para indagar las posibilidades de poder, a través de la manipulación genética, duplicar seres vivos con base en uno ya existente. En el mundo de las plantas ha ocurrido algo semejante y el presente trabajo da cuenta de ello al desarrollar técnicas de cultivo in vitro viables a la clonación de especies de plantas ornamentales en donde para este caso específico se tomó a la Drosera spatulata o en términos comúnes planta carnívora, teniendo en cuenta la posibilidad de regenerar material vegetal y obtener plantas desarrolladas completas, libres de patógenos y en condiciones controladas cuyo resultado sirva de base para futuras investigaciones mediante su divulgación a través de la mercadotecnia social.

Clonación vegetal, Cultivo *in vitro*, Mercadotecnia social

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Introduction

The concept of technoscience defines not only the process of articulation between contemporary science and technology as an innovative expression of research, but also refers to the material and intellectual production that assumes the communion between science and technology in the new research tasks and dynamics that not only explain reality but also intervene in it and the conceptions that are determined about reality given the uses in specific social contexts where cultural, symbolic, ideological, economic and aesthetic dimensions, among others, are configured (Osorio, 2022).

Since the first record in 1908 biotechnology [...] has had important advances such as cloning (Ugalde, et. al. 2020). The socio-technical context has led to an evolution in the possibilities of experimentation on living things, transcending the laboratory and establishing previously unknown interdisciplinary working methods (Sturbin, 2021). Since the birth of the world's first mammal cloned from adult cells (Dolly the sheep in 1996), the technique has been constantly improved (Bilañski, 2020).

Today, the basis of plant breeding is based on creating genetic variation, selection, evaluation, identification and cloning of new genotypes (Tiessen, 2012). According to Vázquez et al. (1997), clonal or vegetative propagation of plants is a production from vegetative parts where plant tissues that retain the potential for cell multiplication and differentiation are used to generate new stems and roots from cell clusters present in various organs. There are essentially three variants of this type of propagation:

- Micropropagation from plant tissues in in vitro culture.
- Propagation from bulbs, rhizomes, stolons, tubers or segments (cuttings) of plants with rooting potential.
- Propagation by grafting plant segments onto the stems of more resistant receptive plants.

Vegetative propagation ranges from simple procedures, known from time immemorial to farmers all over the world, to technologically advanced procedures, based on plant tissue culture technology, by which the mass propagation of genetically homogeneous, improved and pest-free plants can be achieved. Modern procedures allow the production of cultivars totally free of pathogens, including viruses, and even the manufacture of artificial seeds by means of somatic embryogenesis and encapsulation. In addition to propagation, in vitro tissue culture techniques also allow modern germplasm conservation procedures to be followed thanks to the prolonged maintenance of slow-growing cultures and cryopreservation of tissues.

Cloning of individuals

Reproduction through in vitro meristem culture, or cloning, is very efficient and consists of removing a root tip or shoot tip and placing it in a suitable culture medium under sterile conditions. Under the influence of phytohormones, the meristems develop into a mass of undifferentiated tissue, capable of giving rise to new seedlings. The seedlings thus obtained are separated from each other and grown in separate test tubes. The plants are perfect clones of the original plant, so this is the method most applicable to mass propagation of a particular variety or of sterile hybrids.

Genus Drosera

Represents the largest genus of carnivorous plants with approximately 195 species. It is named after the Greek drosos, meaning dew or dewdrops. Members of this genus are easily identified by the fact that they attract, capture and metabolise insects and some protozoa by means of glands. In spite of the above, their reality is not affected in the absence of insects, but their growth is not.

Characteristics

They are mostly herbaceous perennials, although some may be annuals. Their size depends on the available nutrients and can vary from one centimetre to one metre. It has been proven that these plants can live up to 50 years.

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Because this genus has evolved depending on the presence of insects, it currently lacks enzymes that promote nitrate reductase activity, i.e. it is poorly able to metabolise the nitrogen present in the soil.

Taxonomy

Reino: *Plantae*

Division: Magnoliophyta

Class: Rosopsida

Order: Caryophyllales

Family: Droseraceae

Genus: *Drosera*

Uses

As a medicinal plant: Many medicinally active compounds are found in sun dews, including flavonoids, quinones, and other compounds, among which plant acids (citric acid, formic acid, gallic acid), resin, tannin and vitamin C are prominent.

Today these plants are used for their constituents in between 200 and 300 registered medicines, usually in combination with other active ingredients. Drosera is currently used to combat ailments such as asthma, coughs, lung infections and stomach ulcers.

Medicines are mainly made using the roots, flowers and fruits of the plant. Since most of the species of this genus are protected in many parts of Europe and North America, extracts are prepared by cultivating fast-growing sun sprays or imported from Madagascar, Spain, France, Finland or the Baltic countries. Some species are used as a homeopathic remedy to treat spasmodic coughs and other respiratory conditions, as well as being a remedy for paranoid states.

As an ornamental plant: Due to their carnivorous nature and the beauty of their mucilaginous traps, sun dewclaws have become very popular ornamental plants. However, the environmental requirements of most species are relatively restricted and they can be difficult to grow, so many do not fulfil this role.

A few species have made inroads into the market and can be seen for sale, where they are frequently found *D. capensis*, *D. aliciae* y *D. spatulata*.

The requirements for cultivation vary greatly between species. In general, they need a very humid environment, in the form of constant moisture or a soil with soil that meets these characteristics. Many species also require pure water, as nutrients, salts or minerals in their substrate can limit their growth or even kill them. Plants are commonly grown in substrates accompanied by moss. *Sphagnum* (dead or alive) or sand, and can be irrigated with distilled water, reverse osmosis or rainwater.

Other uses: Some species are used in the textile industry as dyes in that region, while yellow and violet dyes are prepared in Scotland by using *D. rotunidfolia.* A sun dew liqueur is still made, the recipe for which has its roots in the 14th century, using fresh leaves of *D. capensis*, *D. spatulata* y *D. rotundifolia*.

Marketing is defined as those activities aimed at satisfying individual and organisational needs, beliefs and desires, which are classified in two dimensions: commercial marketing, which focuses solely on obtaining economic interests without promoting changes in the population, selling its services through ideas; and social marketing, whose main interest is to improve the needs of the market without economic purposes, in order to achieve changes in the behaviour and attitudes of the population (Priego, 2015), in such a way that an application can be found to the knowledge that is generated and reach society, having a better dimension of the existing unmet needs (Verre, Milesi & Petelski, 2020), taking into account the ease it represents when used as a tool to disseminate knowledge and research results making this information available to the society interested in them.

Methodology to be developed

For this experiment, eight adult individuals were taken as specimens of *Drosera spatulata in vitro*. Subsequently, inside a switched on laminar flow cabinet and with sterile tools, the material was extracted from the culture medium and placed on sterile paper, where the plant leaves were later cut.

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Then, in five flasks with culture medium previously prepared with one-third concentration of its elements, the explants were placed with the help of sterile forceps, making sure that the underside of the leaves touched the culture medium. Eight explants per flask were placed in the culture chamber at a controlled temperature of 24°C. The flask was closed with the lid and placed in the culture chamber.

To determine whether the cloning was successful or not, the material was kept under continuous observation, waiting for disorganised growth callus, which may or may not allow the development of apices, which will be counted to record the number of seedlings obtained.

Results

The results described below were reported up to 29 July, depending on the starting date of each experiment, the days that elapsed from day 1 are mentioned.

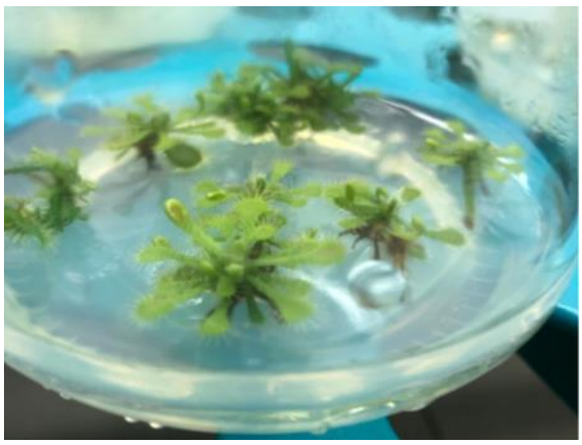

Figure 1 Results of cloning of Drosera spatulate
Source: Own elaboration

The experiment was started on 19 June and lasted 50 days

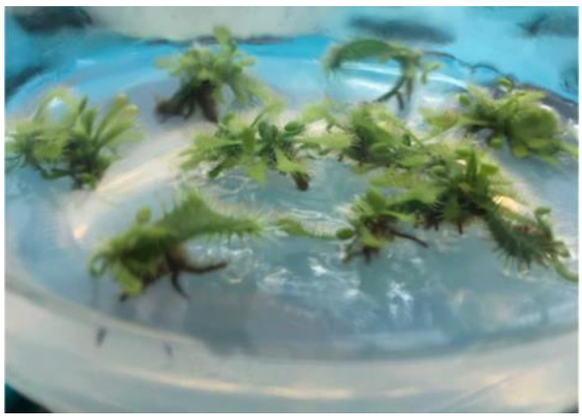

Figure 2 View of seedlings obtained from the cloning of Drosera spatulate
own elaboration.

As a result, 50 initial leaf explants were obtained, from which a total of 200 seedlings were obtained at a sufficient aerial and root development stage for cloning in their own container.

Figure 3 View of the root system of the plants obtained from the cloning of *Drosera* spatulate
Source: Own elaboration

Concluding remarks

Reproduction: Many species of this genus are self-fertile and the flowers self-pollinate before closing. Vegetative reproduction occurs naturally in some species that produce stolons or when the roots approach the soil surface. Stale leaves touching the substrate may also germinate seedlings.

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Pygmy sun dewroses reproduce asexually using special leaves called gems, which can be propagated by cutting their leaves, their roots or by planting their seeds.

They can produce seeds that require different specific conditions to germinate, which are mainly determined by the climate and the structure of the plant itself. It is very common for this genus to produce stolons when the roots come close to the ground, thus generating new seedlings. They also produce gems from their leaves, so propagation is easy.

Habitat

Plants within the genus grow during the wet season or constantly in habitats with acid-rich soils and high levels of sunlight. Common habitats include bogs, swamps, marshes and wet banks. Many species grow in association with mosses that absorb much of the nutrients from the substrate and acidify it, making them less accessible to the plant.

It is a highly variable genus in terms of habitat. Some have adapted to a wide variety of environments, including rainforests, deserts and even shady environments. The temperate species, which form a hibernaculum in winter, are an example of this kind of adaptation to their habitat; in general, these plants are more abundant in warm climates and have moderate cold hardiness.

Conclusions

The application of technoscience makes it possible to communicate and disseminate the scientific and technological aspects inherent to it in such a way that they are available to all sectors of society as a new form of knowledge.

Nowadays, there are tools, knowledge and strategies that allow us to carry out the necessary experiments for the reproduction of plants as alternative measures for their conservation and propagation in such a way that species in danger of extinction due to lack of care in their habitat or overexploitation can be rescued.

Social marketing through its strategies, techniques and studies contributes to disseminate ideas that benefit society by promoting a more responsible behaviour and at the same time generating positive impacts through its implementation in different fields of knowledge dissemination.

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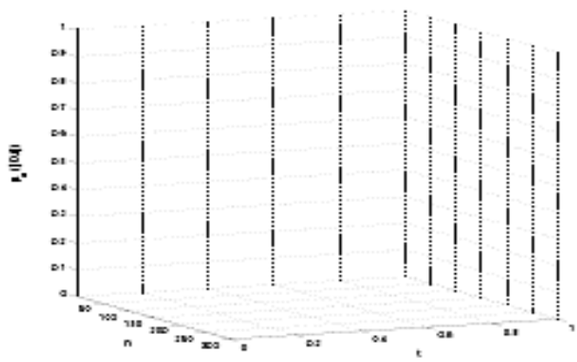

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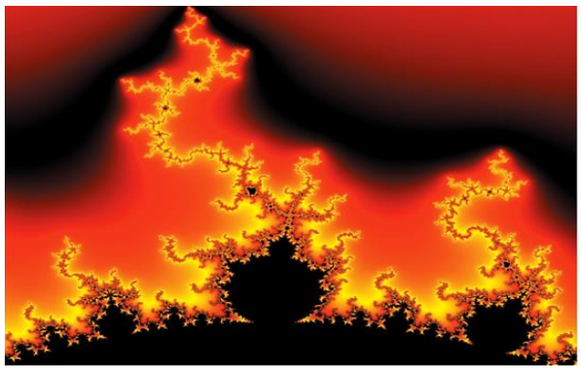

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