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ECORFAN Journal Republic of Nicaragua

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Instructions for Scientific, Technological and Innovation Publication

Knowledge Area

The works must be unpublished and refer to topics of agriculture-forest, pathology-sustainable, forest, management, horticulture, engineering and integrated water useand other topics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

In Volume number ten, as the first article we present, *Pollutants present in the wastewater of the city of Pachuca and their relation to economic activities,* by CRUZ, Ernesto Alonso, LÓPEZ, Abelardo, JUÁREZ, Cesar Eduardo and LUCAS, Isacc Misael, whith adscripction in the Universidad de Guanajuato, as a second article we present*, Identification and assembly of entomophagous nematodes in the cold temperate forest of the high mountain range of Zacualtipán de Ángeles Hidalgo*, by VILLEGAS-VELAZCO, Moises, ORDOÑEZ-LOZANO, Itzcoatl and SAN JUAN-LARA, Jorge, whith adscripction in the Universidad Tecnologica de la Sierra Hidalguense, as third article we present, *Biogas production under different cattle manure concentrations and temperature ranges*, by LUNA, Jesús, LÓPEZ, Jose Dimas, JAQUEZ, Juan Carlos and MARTÍNEZ, Karla Janeth, as fourth article we present, *Preliminary inventory of macrofungi in the central zone of the biosphere reserve in the Sierra Gorda of Guanajuato*, by ALEJO-ITURVIDE, Francisco, MÁRQUEZ-LUCIO, María, GONZÁLEZ-LÓPEZ, Claudia and DE LA RIVA-DE LA RIVA, Gustavo.

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Pollutants present in the wastewater of the city of Pachuca and their relation to economic activities

Los contaminantes presentes en las aguas residuales de la ciudad de Pachuca y su relación con las actividades económicas

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Abstract

To Propose a statistical model who allows us to determine in any area either in the countryside or urban the relation that could be existed between the economic activities that are carried out in Pachuca city and the different pollutants that these activities discharge into the waste water system, with the principle goal to propose a technical solutions, the one who allows to have a correct treatment of waste water as well as better public policies, who helps handling these contaminants in order to try to inhibit the contribution of highly harmful pollutants in the waste water system.

Pollutants, Wastewater, Public policies, Statistical model

Resumen

Proponer un modelo estadístico que nos permita determinar en cualquier espacio, ya sea este rural o urbano la relación existente entre las actividades económicas que se realizan y los contaminantes que esas actividades descargan en las aguas residuales, con el propósito de proponer soluciones técnicas que permitan el correcto tratamiento de las aguas de desecho, así como políticas públicas que inhiban la aportación de contaminantes altamente dañinos en ellas.

Contaminantes, Aguas residuales, Políticas públicas, Modelo estadístico

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Introduction

Taking the decision to treat wastewater generated in urban or rural areas is undoubtedly a great contribution to protect ecosystems, natural resources and human subsistence; but this decision cannot be taken lightly, a series of aspects must be considered, including the pollutants that are present in the water to be treated, the daily volume to be treated, the level of purity to be obtained, how the water will be used and what technology is available; as can be seen, this decision goes beyond just wanting to do it.

Generally, the characterisation of wastewater is done without considering the contributors of the same, this analysis will allow us to identify the specific pollutants that each economic activity contributes to the drainage system or to the bodies of water, therefore, if there is environmental damage due to the presence of the same, we will know who the cause is and take the necessary steps to compensate for it.

The volume of wastewater generated in a population, as well as the types of pollutants present in them and their concentration levels, are closely linked to the economic and domestic activities that are carried out in these physical spaces; it is therefore important to analyse the relationship that exists between the economic units and the types of pollutants present in the wastewater, in order to be able to take preventive measures that allow us to protect water resources and ecosystems, thus collaborating with the environmental sustainability of the planet.

Development methodology

Sample collection: Regardless of the type of sample to be taken, there are three factors that intervene to have a reliable sample, which are the type of container for storage and transport, the collection procedure and the conditions of transport of the sample.

Analysis of samples, identification of contaminants and evaluation of the levels of contamination of the wastewater of the city of Pachuca and its surrounding area.

Sampling was carried out during 6 continuous months, from July to December 2013, at the end of this period the results obtained by type of pollutant were averaged in each of the monitored collectors, in order to determine the existence of a relationship between the predominant economic activity of the region and the level of contamination of its wastewater, as well as the type of pollutants present in them.

At the time of sampling, the only physical parameter that could be determined was temperature, due to the lack of equipment to determine conductivity, while the remaining parameters were determined by the Centro de Investigaciones Químicas de la Universidad Autónoma del Estado de Hidalgo (CIQ).

With respect to the concentration of pollutants present in the wastewater of the city of Pachuca and its conurbation with Mineral de la Reforma, the central hypothesis of this work is that they exceed the parameters established by the Mexican Official Standards.

To test this assumption, we will use a statistical tool called hypothesis testing, which is based on the affirmation or assumption of a parameter, which allows us to explain the behaviour of an economic, political, physical, biological, etc. process, and on the theory of probability, to determine whether the hypothesis put forward is a reasonable statement. This process is made up of five steps, which are set out below. a) Putting forward the null hypothesis and the alternative hypothesis.

The null hypothesis for the purposes of this work will sustain that the average value of each of the parameters that determine the degree of contamination of the wastewater to be evaluated are within the limits established by the NOM 001 and NOM 002 Standards. While the alternative or researcher's hypothesis will sustain that the average value of pollutants presents in the wastewater of the city of Pachuca and its suburban area, exceed the limits allowed by the aforementioned norms.

$\mu \leq$ limits established by the NOMS.

$\mu o >$ limits established by the NOMS.

Select a significance level.

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The significance level is the probability of rejecting the null hypothesis when it is true; for this analysis we will take a value of 5 %.

Calculate the test statistic

Depending on the number of available data to be evaluated, a type of statistic is chosen, which will serve as a support to accept or reject the null hypothesis. Due to the number of samples taken for this research, a Student's t-test will be used, because the number of samples is less than 30.

Formulate the decision rule

The decision rule to accept or reject the null hypothesis will depend on a critical value which delimits the areas of acceptance or rejection of the null hypothesis.

Making a decision

Finally, the decision to accept or reject the null hypothesis must be made based on the test statistic.

For the statistical analysis we will make use of the SPSS programme, which is an immensely powerful tool that will give us reliable results in a very short time.

Relationship between economic activities and pollutants present in wastewater

The volume of wastewater generated in a population, as well as the types of pollutants present in them and their concentration levels, are closely linked to the economic and domestic activities that are carried out in these physical spaces; therefore, it is important to analyse the relationship that exists between economic units and the types of pollutants present in wastewater, in order to be able to take preventive measures that allow us to protect water resources and ecosystems, thus collaborating with the environmental sustainability of the planet.

Not all economic activities pollute, for this reason, to evaluate the level of pollution in the city's sewage system and its relationship with economic activities, we considered those activities that when producing a good or performing a service.

Use, generate or dispose of any substance, particle or gas that seriously alters the physical, chemical, and biological characteristics of water.

To carry out a correlation exercise, at least two variables are needed, where one of them is the dependent variable and the other or others are the independent variables. For the purposes of this research, we will consider as dependent variables the monthly values of the pollution parameters sampled by collector (y) and as independent variables we will take each of the economic units of the same type that discharge their wastewater into these collectors (x).

$$y = B_0 + B_1 X_1 \quad (1)$$

The correlation will determine the cause-effect relationship between two variables, i.e., the alteration that the independent variable will cause in the dependent variable, this correlation will be measured through Pearson's r coefficient. This can take any value between -1 and 1, and the results can be interpreted as shown in the following figure.

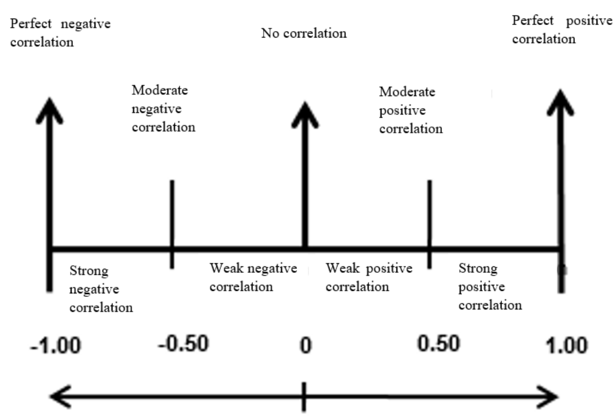

Figure 1 Criteria for assessing the correlation of variables in linear regression

Results and discussions

Sampling: To determine the types of pollutants present in the city's wastewater, as well as their characteristics, it was necessary to carry out a sampling of this water, for which each of the city's collectors, the type of sample, the type of container in which the sample was to be kept and the conditions of its transport, as well as a specific time, were taken into account as sampling locations.

All in strict adherence to the provisions of the operating manual for wastewater treatment plants of the Centro Mexicano de Capacitación y Saneamiento, A.C. (Mexican Centre for Training and Sanitation, A.C.). Dependent on CONAGUA.

Characterisation and concentration of pollutants

Tables 1 and 2 show the pollutants that could be detected in the wastewater analysed and whose parameters were significant. It should be clarified that those pollutants whose concentration is ephemeral and is within the limits allowed by the standards NOM- 001-ECOL 1996 and NOM-002-ECOL1996 were discarded.

Manifold	DBO	DQO	SST	G and A
July 11	347.20	929.60	358.10	76.40
Loreto	97.00	188.30	94.00	21.40
May 5	540.10	958.80	451.20	118.00
Ven-Can	422.20	882.10	321.90	93.70
Tulipanes	356.80	863.40	302.50	88.70
Columbia	308.10	747.50	249.00	89.80
Reforma	396.30	842.20	377.60	135.20
Providencia	453.00	831.00	320.50	163.00
Maximum limits allowed	150	200	60	15

Table 1 Average of chemical and physical pollutants in natural and man-made reservoirs (concentration in mg/L)

Cities are the largest consumers of electricity, water, and natural resources, as well as the largest generators of solid waste and wastewater. The environmental impact of the pollutants generated in them goes beyond their territorial boundaries, as they travel through the air and bodies of water, altering the ecosystems with which they come into contact, which is why what appears to be a local problem becomes a regional and global problem.

Manifold	S. Sed	NT	PT
July 11	5.10	59.60	10.50
Loreto	1.10	2.40	0.70
May 5	4.40	70.10	11.80
Ven-Can	4.50	70.10	11.80
Tulipanes	3.40	72.00	10.00
Columbia	2.10	56.20	8.40
Reforma	5.70	81.90	11.00
Providencia	3.50	69.20	10.30
Maximum limits allowed	1	15	5

Table 2 Half-yearly average of chemical and physical pollutants in natural and man-made reservoirs (concentration in mg/L)

Relationship between economic activities and pollutants

The economic dynamics of the cities directly affect the environmental sustainability of the localities or municipalities that are in their surroundings. For example, the city of Pachuca, to satisfy its needs for drinking water supply to its inhabitants and its economic activities, extracts the vital liquid from the aquifers that are located along the Mexico-Pachuca highway, to later dispose of the water generated in the city through the river of the avenues.

As can be seen, there is an unconscious use of water resources as they are exploited without compensating for the damage caused to ecosystems or these resources or their sources.

Pollutant	Economic activity	Correlation index
BDO	Industry	0.512
	Hotels	0.542
	Printers	0.484
DBO	Hotels	0.483
SST	Industry	0.619
SSed	Industry	0.526
NT	Dry cleaners	0.505
	Hospitals	0.630
	Bakery	0.496
G and A	Industry	0.475

Table 3 Correlation between economic units and pollutants

Out of the 12 selected economic activities, three of them can be considered the biggest polluters, namely industry, hotels, and hospitals.

Industry has an important influence on the presence of BOD, COD, TSS, SSed and G&A; while hotels contribute significant amounts of BOD, COD and TSS; finally, hospitals contribute to the presence of G&A, TN and PT.

The number of industries established in the study area is small but nevertheless their contribution of pollutants is important, this activity is located within the basins of contribution of the collectors 5 de Mayo and Reforma, which presented high levels of BOD, COD, TSS, G&A and GSSed.

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Conclusions

Central cities such as Pachuca produce a large amount of waste, since their economic activities are destined to satisfy the consumption needs not only of their inhabitants, but also of the municipalities within their area of influence.

Undoubtedly, the environmental sustainability of wastewater in cities must be evaluated taking into account the sewerage and sanitation infrastructure they have, as well as their strict adherence to regulations and the sanctioning of pollutants generated in urban centres are closely linked to the type of inputs, processes and products of the economic activities they generate, processes and products of the economic activities carried out within their territory (industry, commerce, agriculture and services), as well as domestic activities (food preparation, household cleaning, personal hygiene), the number of inhabitants and existing economic units, in addition to the mobility of people who come to work in these centres or in search of goods or services offered there.

Public policies on environmental issues cannot be issued if there is no prior technical study that determines the affected areas, the types of pollutants, their levels of contamination, the sources of generation, as well as the possible solutions and their impact on the environment or on human beings. (To support the actions to be taken)

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Identification and assembly of entomophagous nematodes in the cold temperate forest of the high mountain range of Zacualtipán de Ángeles Hidalgo

Identitificación y montaje de nematodos entomófagos bosque templado frío de la sierra alta de Zacualtipán de Ángeles Hidalgo

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Abstract

The study on the identification of nematode entomophages was carried out in the forest of Zacualtipán of Angeles, Hidalgo, property of the Technological University of the Sierra Hidalguense. The problematics presented in the zone is the application of chemical pesticides that damage to the environment, since they kill many charitable organisms and even, they concern the health of the human being. To solve this problem, it was done a research on the morphological identification by means of microscope of nematode entomóphages that are present in the enclosed floor to the good healthy pine roots. This was achieved using the techniques of having sifted, flotation and permanent fixation, it was also made a count and a calculation of the percentage of this type of microorganisms. Being a great variety of nematode entomophages that can serve in a future as biological control of plagues that damage to the timber production. The impact looked is that there could be generated biological nice pesticides to the environment from the studies done in this work.

Entomophages nematodes, sifted, flotation, permanent fixation, Zacualtipán

Resumen

El estudio sobre la identificación de nematodos entomófagos se llevó acabo en el bosque de Zacualtipán de Ángeles Hidalgo, propiedad de la Universidad Tecnológica de la Sierra Hidalguense. La problemática que se presenta en la zona es la aplicación de plaguicidas químicos que dañan al medio ambiente, pues matan muchos organismos benéficos e incluso afectan a la salud del ser humano. Para solucionar este problema se realizó una investigación sobre la identificación morfológica mediante microscopio de nematodos entomófagos que se encuentran presentes en el suelo adjunto a las raíces de pino en buen estado de salud. Esto se logró utilizando las técnicas de tamizado, flotación y fijación permanente además se hizo un conteo y un cálculo del porcentaje de este tipo de microorganismos. Encontrándose una gran variedad de nematodos entomófagos que pueden servir en un futuro como control biológico de plagas que dañan a la producción maderera. El impacto que se busca es que se puedan generar plaguicidas biológicos amables al medio ambiente a partir de los estudios realizados en este trabajo.

Nematodos entomófagos, tamizado, flotación, fijación permanente, Zacualtipán

Citation: VILLEGAS-VELAZCO, Moises, ORDOÑEZ-LOZANO, Itzcoatl and SAN JUAN-LARA, Jorge. Identification and assembly of entomophagous nematodes in the cold temperate forest of the high mountain range of Zacualtipán de Ángeles Hidalgo. ECORFAN Journal-Republic of Nicaragua. 2020. 6-20:6-10.

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Introduction

Nematodes are organisms of the animal kingdom that are basically found everywhere. Entomophagous nematodes are organisms that feed on other insects, mites, or other arthropods, which have multiplied massively and are released in the fields against pests of these same groups. They are called natural enemies of pests, and naturally fulfil the function of reducing the populations of phytophagous pests, reducing their possibilities of developing and producing economic damage.

In the Zacualtipán region it has not been possible to carry out an adequate study to indicate if these organisms are present in the forest, as well as to obtain information on the benefits of entomophagous nematodes to the trees. The forest is an especially important source of economic resources, due to the forest exploitation, as well as a valuable ecosystem that possesses soil, water, fauna, and air in good quality. However, the forest area is reduced year after year, due to various causes, such as immoderate logging, forest fires and the attack of pests and diseases.

The species used for forestry in the municipality of Zacualtipán are threatened by pests, so the aim is to study the forest species of Pinus patula found in the cold temperate forest of the central sierra of Zacualtipán, Hgo. The aim of the study is to locate the genera of phytoparasitic nematodes that are present in the roots of *Pinus patula* so that the necessary preventive measures can be taken to prevent diseases from developing in other tree species and causing both economic and environmental losses to the ecosystem.

The project aims to analyse the soil attached to the roots of *Pinus patula* in the forest of the central highlands of Zacualtipán, to search for entomophagous nematodes present to identify and describe their population. This information will be of great help in the prevention and control of pests in the crops surrounding the ecosystem.

By carrying out these activities, we are helping to understand and maintain the forests in good condition, free of diseases and pests, obtaining great economic benefits due to the systems of sustainable forestry, since the forests are in good condition, obtaining a good timber harvesting and good quality, the ecosystem will also benefit, since the ecological balance between the various species will be better understood and thus will seek their conservation.

The aim of the soil study is to analyse the genera of nematodes associated with pine trees to combat pests that damage them.

Theoretical background

Description of nematodes. Nematodes are one of the most diverse species on the planet, with more than 20,000 species classified. They live in all parts of the world. They survive in freshwater, saltwater, and all types of soil. They are present in various types of climates, from tropical forests to polar ice caps, from underwater pits to desert sands, from ocean beaches to mountain peaks. The word nematode comes from the Greek words "nematos" meaning "thread", and "eidos" meaning "thread".

Meaning "form" which is very explicit, all these species share the basic characteristics of being structurally quite simple. They are divided into two main groups: chewers: they eat and devour their prey. Suckers: they absorb and suck the juices of their prey. [3]

Nematodes are thread-like organisms of the animal kingdom, colourless, unsegmented, lacking appendages; they can be free-living, parasitic, or predatory and are generally microscopic. They have digestive organs and glands, reproductive and excretory structures, muscular system, nervous system, cuticle.

The word nematode derives from the Greek word "nema", which means "thread-like", as they have an elongated, cylindrical body. As a result of their evolution, nematodes have adapted to explore a wide variety of food sources. Thus, parasitic nematodes can colonise and feed on plant and animal tissues, while free-living forms feed on micro-organisms (bacteria and fungi), protozoa, algae, other nematodes, and micro-invertebrates.

They move by zig-zag muscle contractions and extensions, swimming on the ground with a film of water. They are found everywhere and in all types of habitats and with different feeding habits: animal parasites, human parasites, plant parasites, predators, entomophagous, mycophagous, bacteriophagous and free-living [1].

Entomophagous nematodes

Entomophagous nematodes: They belong to the Family: Mermithidae. Entomophagous nematodes are useful for insect control. The Families Heterorhabditidae, Mermithidae and Steinernematidae.

They are Main genera and species used as potential biological control agents [2].

Organisms that feed on other insects, mites, or other arthropods, which have multiplied massively and are released in the fields against pests of these same groups, are called natural enemies of pests, they naturally fulfil the function of reducing phytophagous populations, reducing their chances of developing and producing economic damage.

Entomophagous nematodes are more complex than entomopathogenic micro-organisms, developing through four larval moults before reaching maturity; adults are bisexual.

Entomophagous nematodes attack different groups of insects. They require a certain moisture environment for active infection; they usually act on insects that have part of their life cycle in the soil, where moisture is higher [5].

Three types of entomophagous nematodes can be distinguished and are described below:

1. More primitive nematodes. These are pathogenic but eat bacteria of the Rhabditoides group. The nematode penetrates the insect and secretes into it a bacterium with which it is associated. The nematode feeds on the bacteria it secretes, which develop inside the insect. Nematodes of the genera *Neoaplectana* and *Heterorhabditis* are prominent.

2. Evolved nematodes. These are plant pathogenic nematodes that have evolved into insect pathogenic forms. They use the stylet to penetrate the insect. The main groups are the Aphelenchida and Tylenchida.

3. Predatory nematodes. They belong to the Dorylaimida group. Commercially, *Neoaplectana carpocapse*, which affects Lepidoptera and Coleoptera, and *Heterorhabdilis* spp. in Lepidoptera, are the most important.

The life cycle and reproductive habits of parasitoids are often extraordinarily complex. In some species only one individual grows inside its host. In other cases, hundreds of young larvae develop inside the insect pest.

A parasitoid needs a host to complete its life cycle. The adult matures and the host dies. [4].

Characterisation

The nematodes most used in biological control (Heterorhabditidae and Steinernematidae) have an infective juvenile stage that protects and carries a bacterium of the genus *Xenorhabus* that is released into the haemocoel. The infective juveniles enter the insect via the spiracles, anus or mouth and pass into the haemocoel, via the gut wall, where they inoculate the bacterium which kills the host after 1 to 2 days. Depending on the host, certain species of *Heterorhabditis* can penetrate directly through the cuticle (see Fig. 1, 2). (See Fig. 1, 2) [1].

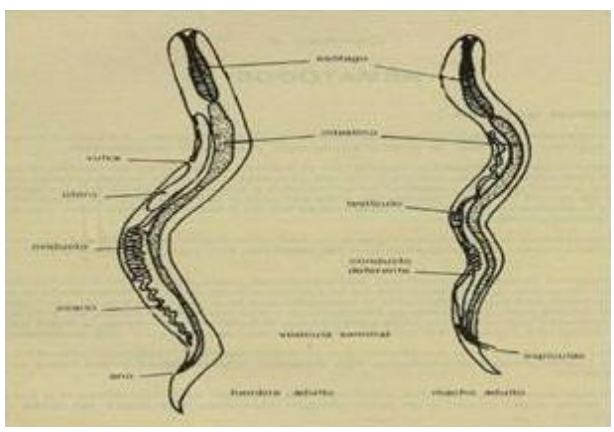

Figure 1 General morphology of nematodes

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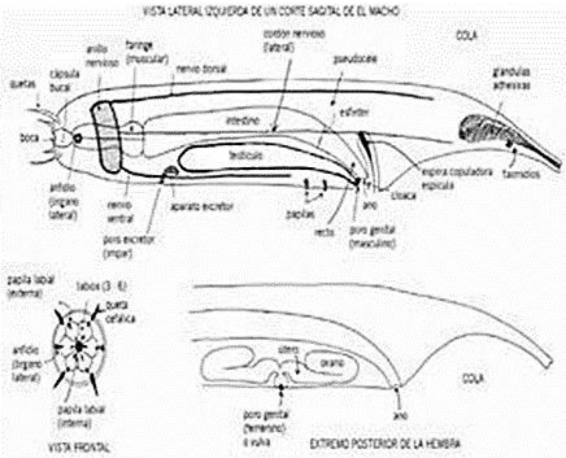


Figure 2 Nematode morphology

Methodology

A systematic search for nematodes was carried out in the soil attached to the roots of various trees in the forest of the Universidad Tecnológica de la Sierra Hidalguense, where nematodes were extracted from the soil by sieving, centrifugation, and flotation in sugar solution. The nematodes were then isolated, killed, fixed, dehydrated and permanently mounted for identification. Identification was made by microscopic morphology.

Soil samples were collected in May 2014. In each plot, 10 samples were taken at a depth of 5 cm from the soil surface, each sample weighed 1 kg, then in the laboratory the samples were sieved to remove clods and organic matter. Each sample was subdivided 7 times, each sub-sample weighed 50 g and was poured into 100 ml plastic cups. After sieving, 5 to 15 mL of sterilised water was added to moisten the soil without reaching saturation point. Finally, they were left to stand for 2 hours at room temperature.

Isolation of microorganisms

The bait insect technique (Zimmermann 1986) was used for the trapping of entomopathogenic microorganisms in soil. Five Tenebrio molitor larvae per beaker were incubated. Samples were examined every day for one month. When the larvae showed symptoms of infection, they were incubated in petri dishes with moist paper to allow their displacement and survival of the nematodes.

Results

Using the bait insect technique for trapping entomopathogenic microorganisms, *Steinernema* nematodes were found. (See Fig. 3 and 4).

Figure 3 *Steinernema* nematodes

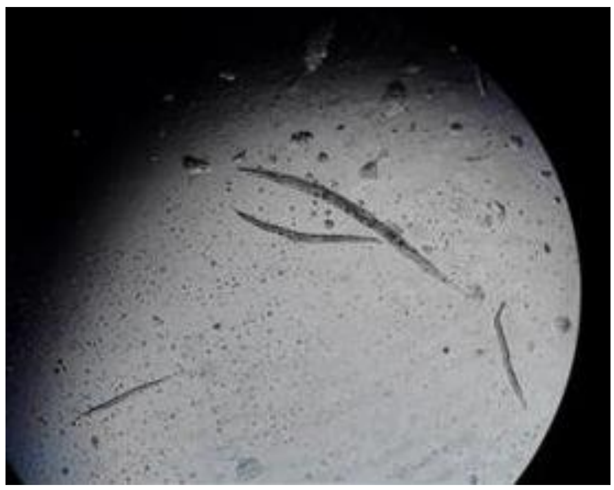


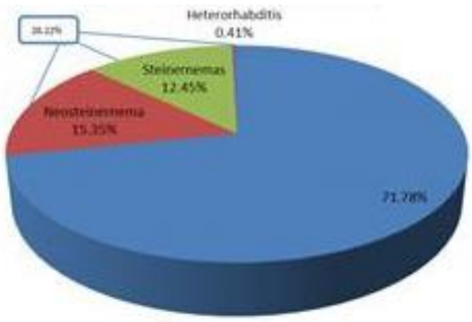
Figura 4 *Steinernema* nematodes

Out of 17 samples taken from one hectare of forest at the Universidad Tecnológica de la Sierra Hidalguense, 241 nematodes were found, of which 71.78% could not be analysed because the necessary equipment was not available, therefore they were classified as Non Entomophagous, of the remaining 15.35% are *Neosteinernema*, 12.45% are *Steinernema* and finally 0.41% are *Heterorhabditis* as shown in the following table:

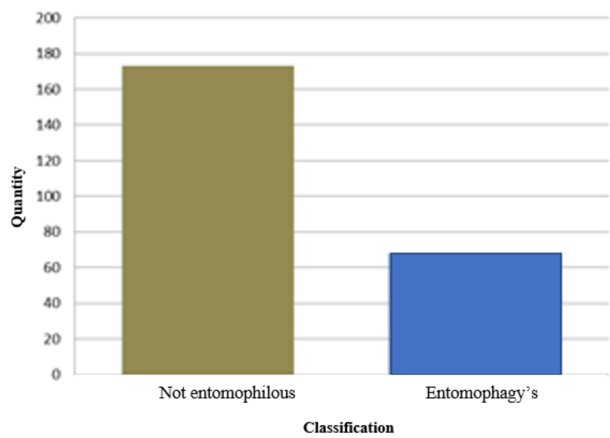
Nematode type		Quantity	%	Total (%)
Not entomophagous		173	71.78	71.78
Entomophages	*Neosteinernema*	37	15.35	28.22
	Steinernema	30	12.45	
	Heterorhabditis	1	0.41	
Total		241	100.00	100.00

Table 1

The results obtained can be better appreciated in the following pie chart, which shows the percentage of each type of nematode obtained (see Graphics 1 and 2).



Graphic 1 Classification of nematodes



Graphic 2 Quantification of nematodes

Interpretation

In total 241 nematodes were found, 68 entomophagous nematodes were identified and it could be observed that the presence of predatory nematodes is relatively considerable compared to the other types of nematodes, but it is still particularly important as it controls the other populations. It is important to emphasise that using nematicides will also kill nematode populations that balance the insect population, which is something that should be considered by professionals seeking to control nematode pests.

Conclusions

In the studies carried out around the Universidad Tecnológica de la Sierra Hidalguense, 241 nematodes were identified, of which 68 are entomophagous nematodes, and it was observed that the presence of predatory nematodes is relatively considerable to create ecological pesticides that do not harm the environment or mankind, favouring the development of trees and thus improving the quality of wood obtained from these forests.

All this analysis helps agricultural and forestry producers to have a valid tool for the treatment of infested plants of economic interest. Further research is needed.

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Biogas production under different cattle manure concentrations and temperature ranges

Producción de biogás bajo diferente concentración de estiércol bovino y rangos de temperatura

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Abstract

Experimental anaerobic biodigestion test results are presented to obtain biogas from varying bovine manure loads and temperature. In this experiment a batch type biodigester was employed, it was constructed using polyurethane hermetic sealed bottles, high temperature silicon was used for sealing assurance. Four levels of bovine fecal organic matter (FOM) were used as degradation material (0, 62.5, 125, 250 g) under 2 different temperature grades (27 and 35 °C). Generated biogas production was measured under temperature grade conditions, methane production was also estimated (CH_4). Better effectiveness in biogas production was obtained in the FOM concentration and temperature highest levels samples.

Biogas, Methane, Temperature

Resumen

Se exponen los resultados de un ensayo experimenta de biodigestión anaeróbica para obtener biogás variando las condiciones de carga y temperatura. Para ello se utilizó el biodigestor tipo batch construido a partir de bottellas de poliuretano sellados herméticamente con silicon de resistente a altas temperatura. Como materia prima se utiliza materia orgánica fecal (MOF) bovino en diferentes concentraciones (0, 62.5, 125, 250g) y se colocan los digestores en diferentes temperaturas (27°C, 35°C) donde se miden la producción de biogás generado en las condiciones establecidas de temperatura estimándose la producción de metano (CH_4). Los valores obtenidos indican que la mayor concentración de MOF bovina a una mayor temperatura tiene una mayor efectividad en la producción de biogás.

Biogás, Metano, Temperatura

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Introduction

Energy is the main ingredient of the world economy, and even if we work hard on energy efficiency and invest in new technologies to reduce energy costs, oil and natural gas will remain the main source of energy for many years to come. The exponential development of industrial activities suggests that global demand for oil and gas will continue to grow in the short term. However, demand will be affected by the decline of gas fields, thus increasing the cost of fuel sources (Soler, 2009; Forsberg, 2008 and Demirbas & Balat, 2006).

However, the uses of manure can be beneficial in today's livestock economy, since bovine faecal organic matter (FOM) or manure has the capacity to produce methane (CH_4) for energy use, at the same time it treats water, using FOM as a source of energy, apart from obtaining a manure free of pathogenic organisms (Weiland, 2010).

The Comarca Lagunera is one of the main livestock basins, producing around 925,000 tons annually, where a large part of this is used to fertilise agricultural land (Figueroa et al., 2009). These remnants go on to generate methane (CH_4), the second most important long-lived greenhouse gas, 60% of which is caused by anthropogenic activities (livestock, fossil fuel exploration, etc.) (WMO, 2013).

The importance of using bovine MOF produced by cattle as stable waste is to take advantage of the CH_4 generated from the fermentation of bovine MOF and to avoid CH_4 pollution by transforming it into lower greenhouse gases and energy that can be used in the stable and thus reduce the energy costs of the process.

The objective of this work was to determine the best temperature-concentration interaction of bovine faecal organic matter layers to generate the highest number of gases without the use of a gas chromatograph.

Methodology

Location of the experimental site

The present investigation was carried out in the laboratory of the Universidad Politécnica de Gómez Palacio, located at carretera El Vergel-La Torreña km 0.820, C.P 25120 locality El Vergel, Gómez Palacio, Durango. México (25°38'20.0 "N 103°31'51.1 "W) and in the laboratory of the laboratory of the Universidad Autónoma Chapingo. Unidad Regional Universitaria de Zonas Aridas, Bermejillo, Durango. Mexico (25°53'44.4 "N 103°36'05.1 "W). During the period from September to December 2014.

Characteristics of the manure

The manure was donated by the stable Antonio Rodriguez Ramirez in Ejido Esmeralda, municipality of Gomez Palacio, Durango (25.7459133, -103.4281867). The manure had the following properties (Table 1).

Analysis	Unit	Result
pH		8.93
Conductivity	dS m^{-1}	1.724

Table 1 Manure characteristics

Experimental design

A two-factorial design (2x4) with 3 repletions was used with the following study factors: A) Temperature (27°C, 35°C) B) concentration of bovine MOF (0 g, 62.5 g, 125 g, 250 g).

Incubator design

An incubator was designed using everyday materials such as high-density polyethylene bags which were cut into 1.5x2m pieces.

A solid cement table, which served as the side of the incubator, was then placed on the wall where a solid cement table is located. The Taylor model 5327 liquid thermometer with direct reading was placed on the wall where the different treatments were placed (27°C and 35°C respectively), due to an extension of one of the thermometers.

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Two 100w spotlights were also placed on one side of the bottles at a height of 30 cm from the 1.5 L polyethylene terephthalate bottles, and two 100w lamps were placed on the other side of the bottles at a height of 30 cm from the 1.5 L polyethylene terephthalate bottles.

1.5 L polyethylene terephthalate bottles, and the sensor of one of the thermometers was placed in the middle of the bottles, thus obtaining an average response of the temperature of the bottles.

Design of the biodigesters

The biodigesters were installed on 24 October in the process laboratory facilities located between building A and building B; the biodigesters were made of polyethylene terephthalate bottles with a volume of 1.5 litres, where they were filled with manure in concentrations of 0 g, 62.3 g, 125 g and 250 g and mixed with 1 litre of water; this step was repeated in the 24 bottles with screw caps.

The caps of the polyethylene terephthalate bottles were pierced with a Truper CAU-140 pistol soldering iron and perforations of 1 cm were made. The caps were then sealed with Nasca RTV silicone and carefully placed on the corresponding bottles.

Data analysis

Data analysis was performed using the statistical package SPSS IBM Statistics version 20®. Each treatment was measured in three replicates under a two-factor design for analysis of variance (ANOVA) (F1: Temperature & F2: MOF concentration).

Variables to be evaluated

Independent variable: Temperature 27°C and 35°C and bovine MOF concentration at 0 g, 250 g, 500 g and 750 g.

Dependent variable: Biogas volume. Concentration of bovine MOF: The concentration of bovine MOF is understood as the mixture of different masses of manure as raw material source in 1 L H_2O.

Conduct of the experiment

The different concentrations (62.5 g, 125 g, 250 g) were weighed on a digital balance (Pioneer model Ohaus®) and then the different concentrations were placed in each polyethylene terephthalate bottle containing one litre of water and capped with RTV silicone and sealed.

After 24 hours, the available air inside the polyethylene terephthalate bottles is extracted and the 12 polyethylene terephthalate bottles are placed in the incubator at a temperature of 35°C. The rest of the 24 polyethylene terephthalate bottles are placed at room temperature. For 30 days the biogas is extracted with 20mL, 10 mL and 1mL syringes.

Results and discussion

Effect of concentration and temperature on biogas production

The results obtained from the statistical support SSPS IBM, shows the main effects of the factors (concentration and temperature) where a significant difference was found ($p<0.05$) indicating that both concentration and temperature influence biogas production in the bioreactors and their respective interactions (Table 2).

F.V.	Sum of squares	*g.l.*	Mean squares	F value	P V
Conc.	39255009.62	3	1308 13085003.20	2084.14	.00
Temp.	7069774.232	1	7069774.232	1126.05	.00
C*T	5206485.672	3	1735495.224	276.42	.00
Error	4470184.855	712	6278.350		
Total	109403679.03	720	719		
Total	56001454.38				

Table 2 Analysis of Variance of main effects and interactions of biogas production. Using α: 0.05, S= 79.23, R^2= 92.0% and R^2 (adjusted)=91.94%

The main effects of the experiment were found to have a positive interaction with the higher the concentration and the higher the temperature, the higher the biogas production in each of the bioreactors or treatments used (Graphic 1).

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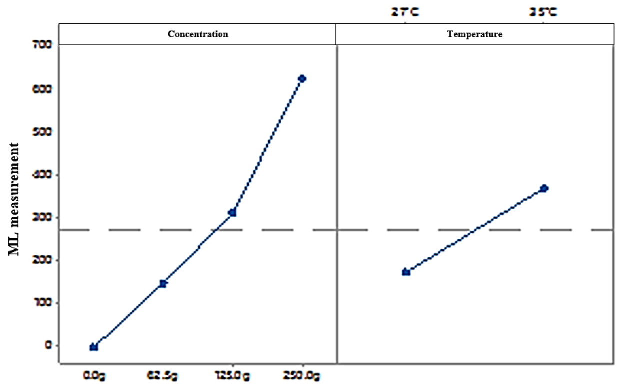

Graphic 1 Interaction of main effects on biogas production

Comparison of means of main effects and interactions in biogas production

Based on the results of the two-factor ANOVA, the means were compared by Dunnett's method and the means of biogas production of the concentration factor were compared to verify that biogas production is influenced by concentration; where it was shown that the concentration factor influences biogas production, together with the higher concentration of bovine MOF indicating higher biogas production (Table 3).

Concentration	Half	Group
0 (Control)	0	A
62.5	147.9483	
125	313.0044	
250	628.4122	

Table 3 Comparison of biogas production means comparing concentrations with a control. Means not labelled with the letter A are significantly different from the control Dunnett α: 0.05

Estimating a CH_4 production of 63% of the total volume of the averages can produce around 93.2074, 197.1927, 335.8996 mL per day respectively at the concentrations of 62.5, 125, 250 g.

While the means obtained using the tukey method with shows that temperature influences the biogas production where the highest concentration was at temperatures of 35°C. This proves what Nallthambi (1997) mentioned in his research on anaerobic digestion of biomass for methane production (Table 4).

Temperature	Half	Group
35 °C	371.433	A
25°C	173.250	B

Table 4 Comparison of temperature means for biogas production. Means that do not share letters are significantly different, α=0.05

Both methods indicate that the concentration of 250 g at a temperature of 35 °C yields the highest concentrations of biogas. However, when comparing the means of the interactions between the two factors (concentration and temperature), it is observed that the best treatment was the one with the highest concentration and the highest temperature, which shows a significant difference ($p<0.05$) with respect to the other interactions.

However, the interactions of 125g at 35°C and 250g at 26°C are statistically equal; the same happens with the interactions 62.5g at 35°C and 125g at 27°C, having differences respectively with the interaction of 62.5g at 27°C, where it is the treatment with the lowest yield in comparison with the others (Table 5).

Concentration * Temperature	Half	Group
250 g 35°C	855.020	A
125 g 35°C	432.822	A
250 g 27°C	401.804	B
62.5 g 35°C	197.889	C
125 g 27°C	193.187	C
62.5 g 27°C	98.008	D
0 g 35°C	0	E
0 g 27°C	0	E

Table 5 Comparison of means of concentration and temperature interactions on biogas production. Means not sharing a letter are significantly different, Tukey α: 0.05

Biogas production was affected by temperature conditions; it was theorised that the levels of chemical and biological reaction increase with increasing temperature and hence biogas increase; as in the experiment conducted by Sosa et al. (1999) who used bovine manure as feedstock, a considerable increase in biogas production was observed. The same conclusion was reached by Zeeman (1991) using cattle manure, where he indicated that high temperatures increase rapidly after 30 days at a temperature of 25-30 °C respectively.

However, in the research by Rorick et al. (1980) using feed water as feedstock in reactors at 40-60 °C he obtained a methane production of 166 mL/g volatile solids of feed to the reactor at a temperature of 60°C and 162 mL/g volatile solids of feed to the bioreactor at a temperature of 40°C where he observed this concentration in a retention time of 6 days.

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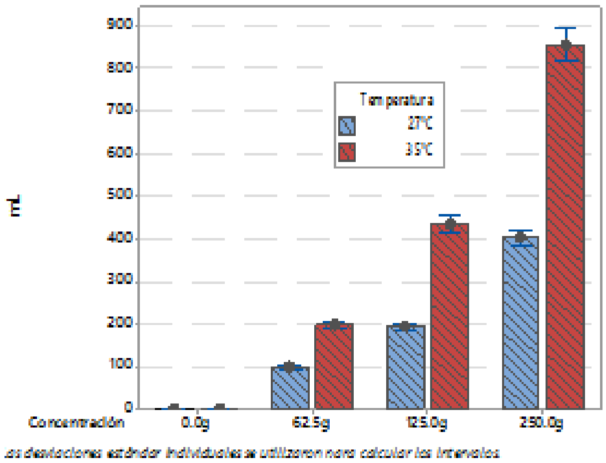
While at a concentration of 250g at 35°C and estimating a methane production of 63% of the volume in 6 days, a volume of 107.7325/g of used bovine manure was obtained, which indicates that the differences between both experiments is similar and is influenced by the temperature and concentration (Graphic 2).



Graphic 2 Effect of MOF concentration and temperature on biogas production

However, some factors that may influence methane production are metals, pH, hydraulic retention time, which were not taken into account, but according to El-Mashad et al. (2004) in their investigation of the effect of temperature on beef cattle manure and Cottle et al. (2011) in their investigation of methane-producing ruminant enterobacteria mention that these factors are important for methane production in biogas as they influence the metabolic effects of the bacteria themselves found in ruminants.

Conclusion

Because the Comarca Lagunera is the second largest dairy basin in the country, producing 925,000 tons of manure per year, without exploiting the energy level of the manure, and with the increasing energy demand and rising prices, an alternative is being sought to reduce the costs of livestock farmers. An alternative to exploit the energy level of the manure is the production of biogas from the manure produced in La Comarca Lagunera and thus reduce the energy consumption of the farms.

In addition, the ambient temperature of La Comarca Lagunera can facilitate the production of biogas and methane. Due to the temperatures of 28 to 40 °C generated there.

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Preliminary inventory of macrofungi in the central zone of the biosphere reserve in the Sierra Gorda of Guanajuato

Inventario preliminar de macrohongos en la zona centro de la Reserva de la Biósfera en la Sierra Gorda de Guanajuato

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Abstract

Mexico produces around 25% of total guava (*Psidium guajava* L.) in the world. The importance of the guava crops has a focus traditional and industrial; however, this point does not free the guava about the intensive use of chemical products during its production. The promoting growth plant rhizobacteria (PGPR) representig a sustainable biotechnology option to minimize that problem. In this paper is described the physiological characterization since a qualitative focus of bacteria isolated from soil of guava orchards located in Salvatierra, Gto. The tests were performed shown the metabolic profile through the BIOLOG system; also, the antibiotics resistance tesa was developed, the evaluation of phosphates solubilization, nitrogen fixation, indol production and the germination in guava seeds. The results shown that the strains have routes of action potentialof PGPR and, these are candidates to will do quantitative studies about the same aspects.

Metabolic profile, Biolog, Rizhobacteria

Resumen

México produce alrededor del 25% del total de guayaba (*Psidium guajava* L.) a nivel mundial. La importancia radica desde el punto de vista artesanal hasta el industrial; sin embargo, esto no exenta a la guayaba de ser un fruto perjudicado por el uso intensivo de productos químicos durante su producción. Las bacterias promotoras de crecimiento (PGPR) representan una alternativa biotecnológica sustentable para atenuar dicho problema. En el presente trabajo se caracterizaron fisiológicamente desde un enfoque cualitativo y con pruebas in vitro bacterias aisladas a partir de suelos de huertos de guayaba ubicados en Salvatierra, Gto. Se realizaron pruebas relacionadas con el perfil metabólico por medio del sistema BIOLOG, así como pruebas de resistencia a antibióticos, solubilización de fosfatos y germinación en semillas de guayaba. Los resultados mostraron que los aislados presentaron potenciales vías de acción de las PGPR y que son candidatas para realizar estudios cuantitativos sobre los mismos aspectos evaluados.

Perfil metabólico, Biolog, Rizobacterias

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Introduction

Macrofungi or carpophores play an important role in human life as they participate in various ecological and economic cycles. They play several important roles as they are used in industry, agriculture, medicine, the food sector as well as in bio-remediation alternatives, etc. Unfortunately, only a small fraction of them have been described and subjected to scientific scrutiny, and there are also very few documented inventories of them in the country. It is estimated that Mexico has about 10% of the world's myco-biota, with approximately 200,000 species (Gúzman, 1998), of which 6,000 species (3.5%) are known: 4,000 macromycetes and 2,000 micromycetes (Mueller et al., 2007). Particularly in the state of Guanajuato, studies on the diversity of macromycete fungi are scarce, so to know an approximate number of fungal species it is necessary to carry out an arduous search and subsequent analysis in order to have an idea of the number of species. To effectively manage natural protected areas, it is necessary to carry out specific inventories that identify the taxa and their distribution, as well as contribute to the knowledge of the natural history of the species recorded (Janzen, 1997). Considering that the State of Guanajuato has a high biodiversity of macromycetes and that knowledge and reporting on fungi is minimal, there is a need for studies to estimate the diversity of fungi in the different forest systems. This study is focused on a preliminary inventory of macrofungi in the central zone of the Biosphere Reserve in the Sierra Gorda de Guanajuato.

Methodology to be developed

Study sites. Systematic sampling was carried out during the rainy season in the limits of the municipalities of Xichú and Victoria with Charco Azul as the starting point, in the centre of the Biosphere Reserve in the Sierra Gorda de Guanajuato.

Collection of biological material. For the collection and recording of wild macromycetes, we have carried out surveys during the months that correspond to the season of maximum rainfall, mainly during the summer, in the period July-September 2012 and 2013.

Herborisation and identification of carpophores. The herborisation of the collected carpophores was carried out by taking the measurements and macroscopic characteristics corresponding to the taxonomic group (colour, characteristics of the petiole and stipe, etc.) according to Cifuentes et al. Once the main macroscopic characteristics were recorded, the fungi were dried on the same day of collection at 50-55 °C for 24 h (Vázquez-Marrufo, 2003). In addition, each specimen was photographically recorded, and record cards were filled in with morphological characteristics, chemical reactions and the use of keys and guides for identification (Arora et al., 1986; Taylor, 2002). The collected samples have been stored in cardboard containers with desiccant material for their preservation, deposited in the mycological collection of the Instituto Tecnológico Superior de Irapuato for further molecular studies.

Results

Study site. The municipality is entirely within the Sierra Gorda de Guanajuato Biosphere Reserve and has a surface area of 912.20 square kilometres (3.0% of the state's surface area).

It is bordered to the north by the state of San Luis Potosí, to the east by Atarjea, to the south by the state of Querétaro and Santa Catarina, and to the west by Victoria. Bordering the Municipality of Victoria is the community of Casitas, where the area known as Charco Azul is located, which is 15 km away along the road to San Luis de la Paz.

Registration of specimens. A total of 212 specimens were recorded, of which 165 were identified to species level (77.8%) and 47 individuals were identified only to genus level (22.17%). A total of 48 species were identified and 17 were unassigned. The species corresponded to 24 genera, 15 families and 6 orders.

Table 1 shows the number of specimens per genus recorded. As can be seen, the most represented genera are *Amanita* and *Lycoperdon* with 34 and 24 specimens respectively, *Marasmius*, *Suillus*, *Boletus*, *Russula* and *Lactarius* with abundance values between 12 and 18 specimens.

List of species. Although there is no list of macrofungi for the study area, it is important to point out that due to the climatic, vegetation and soil conditions, the number of species must be much higher than those reported here, so that in the following years the list will surely incorporate new records for the area.

Some species were more common, such as *L. perlatum*, *L. pyriforme*, *A. pantherina*, *A. rubescens* and *F. velutipes*, accounting for 20% of the total, while other species such as *T. atrosquamosum*, *C. splendens*, *G. dryphilus*, *X. badius*, *X. chrysenteron*, *D. confragosa* and *S. esculentus* were exceedingly rare, together accounting for only 3%.

Representative specimens. Some of the most representative species are presented in Figures 1 - 5 below, together with their edibility, toxicity, and lifestyle.

Genders	No. of specimens
Lepiota	4
Lycoperdon	24
Amanita	34
Cortinarius	5
Cuptophyllus	2
Hygrophorus	2
Hygrocybe	6
Hebeloma	3
Calocybe	2
Marasmius	12
Gymnopus	1
Mycena	9
Strobilurus	1
Flammulina	10
Lepista	5
Tricholoma	4
Suillus	12
Boletus	15
Scleroderma	7
Xerocomus	2
Ramaria	14
Daedaleopsis	1
Russula	18
Lactarius	17
Aleuria	4
Total	212

Table 1 Genders and their abundances in number of recorded specimens

Genders	No. of specimens
Lepiota brunneoincarta	4
Lycoperdon perlatum	10
Lycoperdon pyriforme	7
Lycoperdon spp1	2
Lycoperdon spp2	3
Lycoperdon spp3	2
Amanita ovoidea	5
Amanita pantherina	7
Amanita rubescens	9
Amanita citrina	4
Amanita caesaria	4
Amanita virosa	2
Amanita muscaria	3
Cortinarius splendens	1
Cortinarius alboviolaceus	4
Cuptophyllus pratensis	2
Hygrophorus pudorinus	3
Hygrocybe coccinea	3
Hebeloma radicosum	3
Calocybe carnea	2
Marasmius oreades	3
Marasmius spp1	2
Marasmius spp2	3
Marasmius spp3	4
Gymnopus drypjilus	1
Mycena inclinata	2
Mycena spp1	4
Mycena spp2	3
Strobilurus esculentus	1
Flammulina velutipes	10
Lepista sordida	3
Lepista inversa	2
Tricholoma aestuans	3
Tricholoma arrosquamosum	1
Suillus luteus	2
Suillus americanus	1
Suillus bovinus	2
Suillus granulatus	4
Suillus spp1	3
Boletus radicalis	2
Boletus edulis	5
Boletus spp1	2
Boletus spp2	1
Boletus spp3	3
Boletus spp4	2
Scleroderma citrinum	4
Scleroderma spp1	3
Xerocomus badius	1
Xerocomus chrysenteron	1
Ramaria flaccida	3
Ramaria spp	6
Ramaria stricta	5
Daedaleopsis confragosa	1
Russula lepida	4
Russula vesca	4
Russula sanguinea	4
Russula fageticola	2
Russula spp1	2
Russula spp2	2
Lactarius indigo	6
Lactarius tabidus	1
Lactarius torminosus	4
Lactarius vellereus	1
Lactarius delicius	5
Aleuria aurantia	4

Table 2 List of species and number of specimens recorded for each species

Figure 1 *Lactarius indigo*. Edible, ectomycorrhizal

Figure 2 *Ramaria flava*. Poorly Edible, ectomycorrhizal

Figure 3 *Lactarius deliciosus*. Excellent edible, ectomycorrhizal

Figure 4 *Amanita muscaria*. Hallucinogenic toxic, ectomycorrhizal

Figure 5 *Amanita caesarea*. Excellent edible, ectomycorrhizal

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Conclusions

Macrofungi are organisms that are little studied due to their ephemeral nature. They are only generated when soil moisture and temperature conditions are adequate, especially soil moisture, so they are highly dependent on rainfall and its distribution throughout the year. In one year, they can be very abundant and the following two or three years relatively scarce, with not only the diversity but also the species represented varying.

This study presents a list of 48 species and 17 specimens that have not been morphologically identified so far, so that further studies are needed to refine their identification. With the preparation of detailed descriptions of the species so far recorded in the area, it is possible to compile a guide to mushrooms, so that it can serve as a reference and support for studies in the field of mycology. The classification into edible, toxic and deadly mushrooms, as well as their lifestyle, whether they are ectomycorrhizal symbionts, saprophytes, or parasites, will also help to make better use of these fascinating fruiting bodies.

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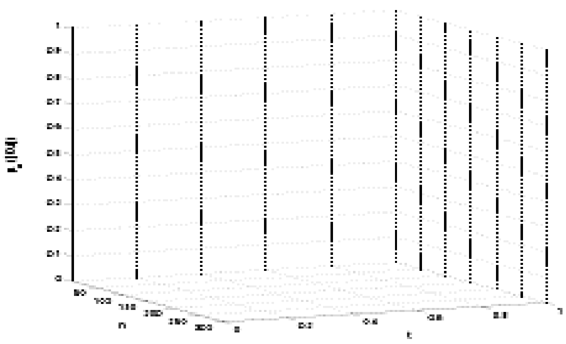

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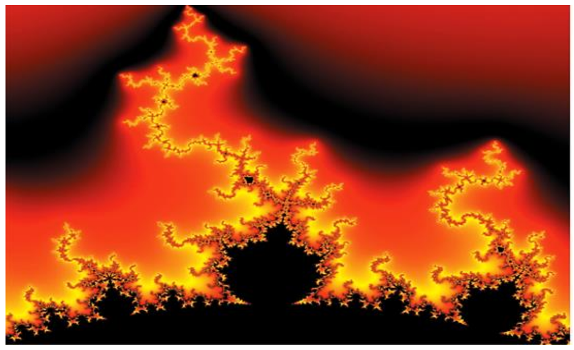

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