

Cultivation conditions of the Californian Red Worm in Ciudad Juárez, Chihuahua

Condiciones de cultivo de la Lombriz Roja Californiana en Ciudad Juárez, Chihuahua

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Abstract

The objectives of this research are to promote new knowledge related to sustainability in the interested university student community and in other students of different schools. Improve the green areas of the University and test the result of the Organic Compost in the plants of some teachers of the institution. Comply in part with the social commitment to transmit knowledge and care for the environment. In this investigation, it will be proved visually that the Red Worm only develops well under average temperatures of 30 °C (Edward & Bater, 1992). In the results obtained it was possible to observe that although in Ciudad Juarez, the summers are very hot, the winters are short and cold. During the course of the year the temperature varies from 1 °C to 36 °C in summer and up to 6 °C below zero on cold fronts. The earthworm reproduction did not stop if it did not double the initial amount placed in the worm compost.

Sustainability, Develops, Investigation, Reproduction, Compost

Resumen

Los objetivos de esta investigación son propiciar en la comunidad estudiantil universitaria interesada y en otros estudiantes de diversas escuelas nuevos conocimientos relacionados con la sustentabilidad. Mejorar las áreas verdes de la Universidad y probar el resultado del Abono Orgánico en las plantas de algunos maestros de la institución. Cumplir en parte con el compromiso social de transmitir conocimientos y el cuidado del medio ambiente. Sin embargo, en esta investigación se probará de manera visual que la Lombriz Roja solo se desarrolla bien bajo temperaturas promedio de 30°C (Edward & Bater, 1992). En los resultados obtenidos se pudo observar que pese a que, en Ciudad Juárez, los veranos son muy calientes, los inviernos son cortos y fríos. Durante el transcurso del año la temperatura varía de 1°C a 36°C en verano y hasta 6°C bajo cero por frentes fríos. La reproducción de lombrices no cesó si no duplicó su cantidad inicial colocada en los lombricomposteros.

Sustentabilidad, Desarrollo, Investigación, Reproducción, Composta

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Introduction

The indiscriminate use of pesticides in agriculture involves a series of contamination risks for farmers, soil, water, flora and fauna resources, and food intended for consumption by the population. There is substantial evidence of negative effects on human health and harmful impacts on the environment (MDRyT, 2017 and Mamani, 2020 and Martínez, 2022).

The beneficial effect of Californian redworms is not a recent discovery but has been known since ancient times. The Greeks also knew of their beneficial activity for agriculture and soil improvement; the Greek philosopher Aristotle called them "the intestine of the earth". Reines (1998) points out that soil without earthworms becomes cold, hard, unfermentable and therefore sterile. Later, the eminent biologist Charles Darwin spent more than 10 years studying the structure, feeding and life of earthworms and was the first to demonstrate the function of earthworms in nature in his book, "The transformation of vegetable detritus by the action of earthworms, in 1881" (Rodríguez,1998). (Rodríguez, 1998)

Thomas Barret (1948) was attributed the paternity of the breeding of earthworms in captivity. Finally, in the middle of the 20th century, worms started to be used for the production of organic fertilisers on a large scale. The present research takes place in Ciudad Juárez, Chihuahua because it has physical characteristics of an arid zone (extreme temperatures in winter and summer, as well as strong winds and scarce rainfall during the year). Due to all of the above and other social situations, it represents a great challenge for its development and the well-being of its inhabitants. The area of Anapra, where the Paso del Norte Technological University is located, is located in a desert zone, with sandy soils that, due to their characteristics, contain less than one percent organic matter. The vegetation is mainly composed of cactus and scrubland; with respect to rainfall, it is considered to be less than 250 mm per year, most of it falling in the summer months.

The objectives of this research are to provide the interested university student community and other students from different schools with new knowledge related to sustainability. To improve the green areas of the University and samples offered to teachers with the use of organic compost. Fulfilling part of the social commitment to transmit knowledge and care for the environment (Navarro L, 2018). Above all, to seek food sovereignty and security as a transcendental economic-social category (Altieri, 1999).

The need to conduct this research is due to the importance and the various opportunities offered by the university through the learning offered by the various careers offered, both in the area of technology and administration, all of them developed in the commitment to environmental care. (Corral, 2018), (Navarro L, 2018).

Vermicomposting is a process of bio-oxidation, degradation and stabilisation of the average organic matter by the combined action of earthworms and microorganisms, through which a stabilised, homogeneous and fine-grained final product called vermicompost, vermicompost or worm humus is obtained. (Villegas, 2017)

The annelid species most commonly used in the decomposition of organic waste is *Eisenia fetida*, particularly known as the Californian red worm. According to Chamorro and Romero (1996), the adult red worm measures between 6 and 8 cm in length and has a diameter of 3 to 5 mm. The exploitation of earthworms is carried out in two ways: for ecological or productive purposes (Somarriba, 2004).



Figure 1 Californian Red Worm

Source: Own elaboration

The extract or leached earthworm humus is the result of the digestion of all those materials such as crop residues, organic waste and all kinds of manure, which serve as food for the earthworm. The excreta resulting from the digestion process, when subjected to a washing and filtering process, gives a product that possesses properties (Rosales, 1998).

Description of the method

In order to carry out this project of starting a business in Ciudad Juárez, the following methodology was developed.

Key activities

First stage

The initial activities consisted in the elaboration of a 2x3.5 meters waterproofed wooden roof for the protection of two vermicomposters. For this purpose, a 200-litre drum was acquired, which was split in half and in each of the parts the "bed" was prepared with soil, manure and water for eight days to introduce the breeding stock donated by CONALEP II, an average of 20 to 30 kilos of substrate containing approximately 3 kg of earthworm.



Figure 2 Worm bedding
Source: Tovar, A., (2018)

The care of the earthworm culture consists of keeping the "beds" covered with black plastic in winter, and in summer uncovered but in the shade and protected with netting to avoid flies, birds or other organisms that could damage them; provide them with food (manure or vegetable waste with humidity between 50 and 80%, for this a layer of this material is spread between 3 to 4 cm along the worm culture, twice a week) and clean water until obtaining a humidity of 80% in the culture, with these cares it is expected that around three months the worms can be deposited in the definitive space. (Infante, 2016 and Somarriba, 2004).

For the commercialisation of the leachate, a campaign will be carried out at the University with students, teachers and administrative staff, to collect water containers with a capacity of one litre, as well as four-litre gallons, which can be milk or juice, the latter will be requested washed. After the containers have been collected, they will be checked to see if they need to be washed, and the original labels will be removed so that the project's own labels can be applied, and then they will be stored and filled with leachate according to demand.



Figure 3 Leachate produced from vermicomposting
Source: Tovar, A., (2018)

Analysis based on the method

The First Stage (developed in February and March)

Costs.

Waterproofed wooden roofing 2x3.5m = 2100.00

Labour = 800.00

Plastic drum with a capacity of 200 Lts. = 250.00

Gasoline (transport CONALEP II and purchase of = 200.00

200.00 material)

Total----- = 3350.00

With the above investment two worm composting bins were installed, which were obtained by cutting in half a 200 litre plastic drum with a hole at one end for the exit of the leachate, each one with a capacity of 0.1m³ each. with a capacity of 0.1m³

They were also placed on blocks, considering the appropriate inclination.

Product	Production/year	Costs/production	Net profit/year
Leachate	552 litres/year Retail sale \$35.00/litre TOTAL= \$46,080.00	Fixed costs/year \$28,282.00 Variable costs/year \$14,360.00 TOTAL= 42,642.00	\$3,438.00
Humus	140 kg/year Retail \$15.00/Kg. Total \$2100.00	Fixed costs/year \$ 1,718.00 Variable expenses/year \$619.54 TOTAL \$2,337.54	-\$237.54
TOTALS	\$48,180.00	\$44,974.54	\$3,205.46

Table 1 Cost and production table
Source: Own elaboration

The calculation in this section was based on the capacity of two installed and producing vermicomposters with a volume of 0.1 m³ each.

As a first stage, layers of soil and manure and enough water were added little by little over a period of three weeks to keep the mixture moist.

After this process, the earthworms donated by CONALEP II were installed. To determine the number of worms, the born worms were separated from the introduced worms every 30 days until the 90th day, after 120 days all the worms, including the newly born ones, were quantified. With this production area, the results of the cost and production table were determined (see table 1).

Soil study in the community of Puerto Anapra in Juarez

The soil in the community of Puerto Anapra is composed mainly of sand, which means that water seeps through easily, which means that there is no process of decomposition of organic matter, which is necessary to maintain humidity in the soil, making it difficult for any plant species other than cacti and bushes to survive. A soil suitable for planting non-desert plants should have at least five percent organic matter. The use of vermicompost would provide part of this organic matter required by plants and trees for their development, in such a way that the use of this natural fertiliser generates a sustainable and ecological alternative for domestic gardening, public parks, urban gardens, greenhouses, fruit trees and crops in general.

Socio-economic study of Cd. Juárez

The Municipality of Juárez belongs to the Bravos Judicial District; it borders the municipalities of Ahumada to the south, Ascensión to the west and Guadalupe to the east, in the State of Chihuahua. To the north with the County of El Paso, Texas and the County of Doña Ana in New Mexico, the last two in the United States of America. It is one of the most populated municipalities in Mexico, as is its capital. According to projections, the population of the Municipality of Juárez in mid-2016 according to the Population and Housing Census has 1'407,959 inhabitants, of which 1'301,452 live in Ciudad Juárez (97.70% of the total). Of the 788,514 workers contributing to Social Security in Chihuahua, a total of 17,773 earn one minimum wage, another 310,251 earn twice the minimum wage, 186,488 earn three times the minimum wage, 83,361 earn four times the minimum wage and 46,191 earn up to five times the daily wage. The market study was carried out by applying a survey to a group of men and women of different ages, mainly from 18 to 40 years old and over 40 years old at UTPN campus ANAPRA (Navarro G, 2018) and also electronically through the survey monkey tool.

Results

A quantitative study was conducted by calculating the sample size using the probability method. The sample size was 200 people matching the scenario that would be used for a non-probability method. For which the following calculations will be made.

Sample size calculation:

$$\text{Calculation for 1185 students} \\ N = ((1.96)^2 (.50) (1-.50) (1185)) / ((1185) (.05)^2 + (1.96)^2 (.50) (1-.50)) = 290$$

Calculation for 199 students

$$n = ((1.96)^2 (.50) (1-.50) (416)) / ((416) (.05)^2 + (1.96)^2 (.50) (1-.50)) = 199$$

Survey applied to quantify the consumption of naturist products

VERMICOMPOST SURVEY

- 1 Personal data
- Gender: Male or Female
- Age:
- 2 Do you have a taste for gardening and/or urban agriculture?

YES
NO

- 3 Do you use any type of chemical fertilizer?
- YES
NO

- 4 Have you had any problems at the time of application?
- YES
NO

- 5 Have you heard about leaching and worm composting?
- YES
NO

- 6 Would you like to use a 100% natural fertiliser that is environmentally friendly and easy to apply?
- YES
NO

- 7 When you think of the product, do you think it is something you need or don't need?
- Definitely need it
Probably need it
I don't care
I probably don't need it
Definitely don't need it

- 8 If the product were available today, how likely would you be to buy the product?
- Extremely likely
Very likely
Somewhat likely
Not so likely
Not at all likely

- 9 How likely are you to replace your current product with the one offered?
- Extremely likely
Very likely
Somewhat likely
Not very likely

Analysis of the survey results

Middle-class women, apart from being interested in flowers, also grow vegetables and/or fruit trees in their backyards, so that the activity in many cases also involves their husbands and children, so that their concern also includes caring for the harvesting of their crops.

It is important to note that the houses in this segment are in housing developments, so their backyards are restricted, but they optimise them for gardening. In this group, they are primarily interested in caring for the environment, since most of these households have highly educated people in the family, so that they are willing to invest part of their economic resources in favour of environmental conservation for this activity.

In this segment, the participation of men is not excluded; a large number of them, from young to old, are interested in the cultivation of vegetables and fruit trees in small gardens located in backyards.

Customers

The sale of organic products is generally offered to the middle- and upper-class segment.

By broadening the vision, the aim is to include low-income people as well. According to INEGI 2015 there is a ratio of 98.7 men to 98 women, 98 men for every 100 women, with a total population of 1,391,180 in Chihuahua, which represents 39.1% of the state population. 49.7% are men and 50.3% are women, who culturally are the ones most related to gardening. These segments do not exclude the participation of male farmers in the Juarez Valley.

Conclusions

Worm farming and marketing can become an excellent business with a small investment. However, few people know how to carry out such a project.

Temperature is one of the important factors, but it does not govern worm production.

We also ruled out that worm culture conditions with temperatures of 30°C are not only met but that they can reproduce in cold or warmer conditions and also with rain and wind gusts.

It was observed that the pH variation was in the neutral to slightly alkaline range during the first few days, but by the end of the study there was a rise in pH as well as humidity. The advantages of the vermicomposting production as an ecological alternative to have organic fertilizer and a way to diminish the environmental contamination by the solid residues that are generated day by day which generate problems in our society.

The results of applying the leachate to plants and trees can also be seen in the results, which show an increase in growth and strengthening of the trees.



Figure 4 Lemon plant with leachate applied (Before)
Source: TOVAR, (2018)



Figure 5 Lemon plant that leachate was applied in a period of 5 months (After)
Source: Own elaboration

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