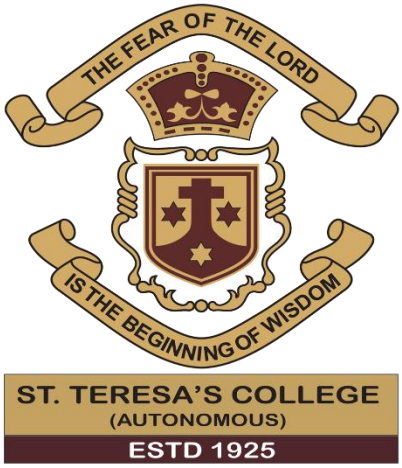
"A COMPARATIVE STUDY ON THE EFFECTS OF ORGANIC AND INORGANIC DETERGENT ON SPECIES OF EARTHWORM *Eisenia foetida*"



Project work by,

BIYA MARY MATHAI

AB21ZOO004

Under the guidance of

Ms. AKHILA ANILKUMAR, Assistant professor

Department of zoology, St Teresa's college (Autonomous), Ernakulam

Kochi-683011

Submitted to, St. Teresa's college (Autonomous), Affiliated to

Mahatma Gandhi University, Kottayam in partial fulfilment of requirement for the Degree of Bachelor in Science in Zoology

2023-24

CERTIFICATE

This is to certify that the project entitled "A COMPARATIVE STUDY ON THE EFFECTS OF ORGANIC AND INORGANIC DETERGENT ON SPECIES OF EARTHWORM *Eisenia foetida*" submitted by Ms. Biya Mary Mathai Reg no: AB21ZOO004 in partial fulfilment of the requirement of Bachelor of Science degree of Mahatma Gandhi, University, Kottayam in a bona fide work under my guidance and supervision and to my best knowledge, this is her original effort.

Ms.Akhila Anilkumar
Assistant Professor
Department of Zoology
St. Teresa's College (Autonomous)
Ernakulam.

Dr. Soja Louis
Head of Department
Department of zoology
St Teresa's College (Autonomous)
Ernakulam

EXAMINERS

1)

2)

DECLARATION

I, hereby declare that this project work entitled **"**A COMPARATIVE STUDY ON THE EFFECTS OF ORGANIC AND INORGANIC DETERGENT ON SPECIES OF EARTHWORM *Eisenia foetida***"** submitted to St. Teresa's College (Autonomous), Ernakulam affiliated to Mahatma Gandhi University, Kottayam in partial fulfilment of the requirement of Bachelor of Science degree in Zoology. This work has not been undertaken or submitted elsewhere in connection with any other academic course and the opinions furnished in this report are entirely my own.

BIYA MARY MATHAI SIGNATURE

REGISTER NO: AB21ZOO004

ACKNOWLEDGEMENT

I would like to express my gratitude and appreciation to all those who have contributed to this project. First and foremost, I would like to thank my project guide Ms. Akhila Anilkumar for the invaluable guidance, support, and encouragement. Thank you for guiding us along to build a good project work, by providing all the necessary information and the best available resources.

I thank all the teachers of the department of Zoology, St. Teresa's college, Ernakulam who were always willing to encourage and help us in all our efforts. I also thank the workers of plant nursery for their whole-hearted support and help.

My project work would not have been a success without the constant encouragement from my parents and my friends. Their support has kept me motivated and focused on completing this project successfully.

Above all I would like to thank God Almighty for showering his blessings upon me abundantly and for giving me the strength, knowledge, ability, and opportunity to undertake and complete this project work.

ABSTRACT

The chemicals present in laundry detergent are of great value as they clean dirt and stain form the cloth materials with ease. These chemicals include surfactants, enzymes, builders, bleachers, etc. But its effect when the waste water is released into the soil, remains a concern. A large portion of soil organism gets effected by these daily use substances. Mainly their effect on earthworms remains understudied. This study investigated the effects of inorganic and organic detergents on earthworms behaviour and survival.

Plastic containers were filled with soil and treated with various concentrations of detergents. Earthworms were introduced into the containers, and their behaviour was observed over time. The results yielded significant insights into the effects of detergents on earthworms. Even relatively small amounts of inorganic detergent (2gm) were found to be lethal to earthworms, highlighting the toxicity of certain detergent. In contrast, organic detergents exhibited minimal or no harmful effects on earthworms at similar concentrations.

However, higher concentrations of both inorganic and organic detergents (5gm, 10gm, 15gm, 20gm) proved to be lethal to earthworms, indicating the importance of dosage in determining detergent toxicity. These findings highlight the importance of considering the environmental impact of detergents and the need for sustainable practices to preserve soil ecosystems.

TABLE OF CONTENTS

INTRODUCTION

Earthworms play a crucial role in soil health and ecosystem functioning. Aristotle, the ancient Greek philosopher, first described earthworms as the "intestines of the soil," recognizing their importance in soil processes. However, it was Charles Darwin who truly highlighted their significance in his book 'The Formation of Vegetable Mold by The Action of Worms.' Earthworms are often referred to as the "farmer's friend" because they contribute to soil fertility and structure in several ways.

Earthworms break down organic matter like leaf litter, cattle manure and dead plant debris transforming them into simpler components and enriching soil with humus. Their burrowing activity makes soil porous and aerated. This ultimately promotes root growth in plants. The cast they excrete further enhance soil fertility. They play an important role in vermicomposting. the part played by earthworms in soil health is crucial making them a valuable source in agriculture and environment conservation.

Earthworm belongs to the order Haplotaxia and class oligochaeta of the phylum Annelida. Populations of earthworms increase along with the available organic matter. They can be used as good evaluators to indicate the amount of organic matter present in the soil and the level of soil contamination with toxic chemicals. (Edwards et.al.1995). the growth of earthworm is directionally proportional to the organic matter content. The species of earthworm taken for this particular experiment is *Eisenia foetida*.

Figure 1.0 : *Eisenia foetida*

Scientific classification

Kingdom : Animalia

Phylum : Annelida

Clade : Pleistoannelida

Class : Clitellata

Order : Opisthopora

Family : Lumbricidae

Genus : Eisenia

Species : *E. fetida*

These are epigeics species that primarily dwell on the top soil and feed upon leaf litter animal waste and organic debris. They do not construct burrows thus doesn't have significant value in modifying soil structure. But they play a crucial role in decomposing organic matter, contributing to nutrient cycling and soil fertility. *Eisenia foetida* is known as tiger worm, red wriggler worm or red worm. The term tiger worm originates form the distinctive striped pattern found in the bodies of *Eisenia foetida* that almost resembles the strips of a tiger and it has yellowish tail. they are native to Europe but introduced worldwide in every continent except Antarctica. it possesses a unique natural defense system in its coelomic fluid; cells called coelomocytes secrete a protein called lysenin, which is a pore-forming toxin, which is able to permeabilize and lyse invading cells. Their ability to adapt to composting environment and efficiently convert organic matter into compost making them a popular choice in vermicomposting for household composting system and commercial composting purposes.

Because of their natural habitat earthworms are exposed to a lot of chemicals that get accumulated in the soil. These include agricultural fertilizers like urea, pesticides, herbicides, industrial effluents and nuclear powerplant waste. Analysis of the wastewater discharged from the different manufacturing operations showed that major sources of pollution are wastes discharged from the saponification and sulfonation processes. (F.A. El-Gohary *et. Al.*)

Laundry detergents are chemical substances that are used to remove dirt and other contaminants from the surface of clothing. They have numerous applications like cleaning clothes, removing stain, brightening the cloth, odour elimination etc. They are typically made of components like surfactants which are the primary cleaners, builders that enhance the activity of the cleaning processes, enzymes that help in removing protein

-based stains like blood and sweat, bleaching agent that removes tough stains, fragrances to impart pleasant smell, optical brighteners and so on.

Laundry detergent is used in most households of Kerala. But studies have shown that their discharge into soil significantly affect the soil structure. the direct discharge of laundry grey water into the soil produces negative effects on the soil properties. The soil pH and RC demonstrate a slight increase after irrigation with the first wash PLD (powered detergent water) and LLD (liquid detergent water) (Mohamed, R.M., Al-Gheethi, A.A., Noramira, J. *et al 2018)*

This study is a comparison between two powdered laundry detergent products. Product 1, readily available in local markets, is a synthetic detergent. Its key components include cleansing agents (anionic and non-ionic surfactants, enzymes), water softeners (sodium carbonate and sodium aluminosilicate), fabric whitener, sodium perborate, anti-redeposition agent, perfume, washer protection agent (sodium silicate), and processing aids (sodium sulfate). While Product 2, available throughout India, is an organic detergent. It is praised for being phosphate-free, eco-friendly, acid-free, caustic-free, hypoallergenic, biodegradable, devoid of harmful chemicals, and non-toxic.

OBJECTIVES OF THE STUDY

- To assess the impact of organic and inorganic detergents on the behaviour and survival of *Eisenia foetida.*
- To compare the mortality rates of *Eisenia foetida* exposed to different concentrations of organic and inorganic detergents.
- To analyse any changes in the growth, reproduction, and movement patterns of *Eisenia foetida* in response to organic and inorganic detergent exposure.

REVIEW OF LITERATURE

Chemicals solid or liquid discarded into the soil surface would have a negative effect on the micro and macro fauna of the land. Earthworms that play an important role in the production of humus and maintaining the nutrient content in the soil are greatly affected by the chemicals. Largely the fertilizes and detergents that are left to the soil untreated contribute to the depletion of soil texture and death of earthworms. The studies reviewed below all highlights the disastrous impact they have on earthworms

Thomas *et.Al.,* (2019) studied the impact of detergent on *Megascolex konkanensis*, including weight, length, diameter, and motility. Observations following treatment with low detergent concentrations (0.1 gm, 0.5 gm, 1 gm) revealed normal earthworm growth, with increases noted in weight, length, and diameter, alongside normal motility. However, elevating the detergent concentration (5 gm, 3 gm, 1 gm) led to a notable decline in weight, length, and diameter. This work highlights the impact of detergents h in the life of earthworms urging the need for more refined production of detergents for the sustainability of the ecosystem.

In the work produced by Liu Boaping on Effects of Six Household Detergent Dilutions on the Behavior and Survival of *Eisenia and*rei and *Pheretima guillelmi* Earthworms. the findings revealed that all *E. andrei* specimens perished after 4 hours of immersion in the six detergent dilutions, while all *P. guillelmi* specimens survived. Upon extending the immersion period to 24 hours, *all P. guillelmi* specimens also perished. However, when the same detergent dilutions were added to Yellow-brown soil after the earthworms had burrowed into it, *all P. guillelmi and E. andrei* specimens survived after 4 hours in control solutions and two detergent dilutions: perfumed soap and lavatory cleanser. Nevertheless, all *P. guillelmi* specimens perished in the other four detergent dilutions. In contrast, survival rates of *E. andrei* were 30%, 24%, 19%, and 12% in treatments with washing powder, shampoo, dishwashing liquid, and bath lotion, respectively. The work emphasizes on the need for production of safer detergents to uphold ecosystem sustainability.

A comparative study on effect of chemical fertilizers and organic fertilizers on *Eisenia foetida* by Nidhi Rai *et.Al.,* (2014), Studied the impacts of soil fertilization with both inorganic and organic fertilizers on earthworm rearing (including populations, biomass, number of cocoons, juveniles, etc.) under varying doses over a 60-day period. Marked changes were noted in the activity of *Eisenia foetida* in response to both types of fertilizers applied. These findings suggest the harmful effects of inorganic fertilizers on the survival of the earthworm community in soil.

The impact of inorganic fertilizer (NPK) on the earthworm population was examined across various plantations in Mizoram, a northeastern state of India. Within the study sites, five species of earthworms from

three families were identified. Inorganic fertilizer treatments were given as per the recommendations from the state agriculture department. Earthworms were collected from five randomly selected sampling sites on a monthly basis using the hand sorting method in each replicate. The *Drawida* species was identified as the most adaptable species. Notably, the epigeic species, *P. excavatus*, exhibited significant population variations between NPK-treated areas and control sites in both study locations. The uppermost soil stratum (0-10 cm) appeared to be the most impacted by the fertilizer treatment. Additionally, juvenile and immature worms were found to be particularly influenced by the application of NPK.

In the study ,Effect of detergents from laundry greywater on soil properties: a preliminary study by R. M. Mohamed *et.Al.*,(2014) showed that soil pH increased from 3.85 to 4.42 and 4.09 after irrigation with PLD and LLD greywater, respectively. Additionally, the electrical conductivity (EC) of the irrigated soil rose from 50.32 to 152.5 and 147.6 μS/cm, respectively. Furthermore, the cation exchange capacity (CEC) increased to 79.93 and 41.39 meq/100 g, while the soil hydraulic conductivity (Ksat) decreased to 7.38 × 10−10 and 7.11 × 10−10 cm/s, respectively. These results underscored the adverse impacts of laundry greywater discharge on soil properties.

In the work, Determination of acute toxicity of potash to *Eisenia foetida* using a simple paper contact method, Abbiramy k *et.Al.*, (2012) made significant discoveries using simple paper contact method proposed by OECD (Organization for Economical and Cooperative Development) testing guideline no. 207. The earthworm was exposed to potash deposits uniformly placed on filter paper for 48 hours, and mortality was recorded. Concentrations were measured in μg/cm^2. According to the determined LC50 value, the potash was categorized as "highly toxic" to earthworms. This study's outcome underscores that direct contact with inorganic chemical fertilizer can also pose toxicity risks to earthworms.

long W, *et.Al.*, (2017). The effect of urea on epigeic earthworm species (*Eisenia foetida*). Cell Biol Dev 1: 46-50. The study was conducted to determine the effect of urea in earthworm *E. foetida* in clay soil. The significant findings of this work were that concentration of urea about 250mg/kg showed the highest rate of mortality. This concluded that the higher concentration of urea applied in the soil as fertilizer for crops have adverse effects on the soil organisms including macro-organisms like earthworms.

Single and Joint Effects of Acetochlor and Urea on Earthworm *Eisenia Foetida* Populations. Xiao, *et.Al.*,(2004) observes drastic changes in the mortality rate of earthworm with the change in concentration of acetochlor and urea. Acetochlor exhibited increased toxicity levels as concentrations rose from low to high. Earthworm mortality following a 6-day exposure ranged from 0 to 86.7%, and the weight change rate varied from 7.86 to –30.43% as acetochlor concentration increased from 164 to 730 mg/kg. Conversely, urea demonstrated positive effects on earthworms at concentrations below 500 mg/kg. However, concentrations exceeding 1000 mg/kg led to highly toxic effects, with earthworm mortality reaching 100% at concentrations surpassing 1500 mg/kg.

Anindita Bhattacharya *et.Al.*,(2014) The lethal effect of agrochemicals especially the pesticides on the soil ecosystem are well studied. Soil and earthworms were collected from an agricultural field with no history of agrochemical inputs. Various concentration of urea was prepared in water dilutions and added to the experimental sets. The study revealed no mortality among juvenile, immature, and adult *D. willsi* worms at doses of 100, 200, and 200 mg urea/kg dry soil, respectively. Thus, all age groups of earthworms were found to tolerate up to 100 mg urea per kg of dry soil. However, at a concentration of 800 mg urea/kg dry soil, mortality rates of 100%, 76%, and 52% were observed among juvenile, immature, and adult earthworms, respectively. Consequently, at this dosage, all age groups of earthworms are at risk of extinction.

A study done by Lian Duo, *et.Al.,* aimed to explore the impact of ethylenediaminetetraacetic acid (EDTA), a commonly used chelator, on earthworm growth, survival, and antioxidant enzyme activities. Earthworm toxicity assessments were conducted on day 14 and 35 after exposure to four concentrations of EDTA (0, 5, 10, 15 mmol kg−1) in turfgrass conditions. Results showed a notable reduction in earthworm growth and survival following EDTA exposure, with toxicity increasing with concentration and exposure duration. Additionally, antioxidant enzyme activities exhibited an initial increase at low concentrations but declined at higher concentrations, indicating the induction of oxidative stress by EDTA. These findings underscore the high toxicity and ecological risks posed by EDTA to earthworm population

In the work, the acute toxicity of chlorobenzenes for earthworms (*Eisenia andrei*) in different exposure systems it was identified that Except for the contact paper toxicity test, lethal body burdens (LBBs - which means the amount of chemicals that gets accumulated in the body of an organism that could lead to mortality) measured in these different exposure systems were similar for the same test chemical. LBBs for 1,2,3-trichlorobenzene varied between 0.44 and 2.1 μmol/g and for pentachlorobenzene between 1.29 and 2.34 μmol/g.

A study by Roy Hartenstein on effects of aromatic compounds, humic acid and lignins on the growth of earthworms *Eisenia foetida* proved that thirty-eight low molecular weight aromatic compounds, along with two humic acids and five lignins, were examined for their impact on the growth and survival of the earthworm *Eisenia foetida*, using activated sludge as a food source. It was observed that benzenoid molecules containing two methoxyl or methyl groups were typically more toxic compared to similar molecules substituted with one or two hydroxyl groups. Additionally, introducing a carboxyl group or groups to a molecule with relatively high toxicity tended to decrease its harmful effects or even result in a completely harmless substance. Substances like tannins and those capable of polymerizing to form tannin-like compounds were generally found to have no inhibitory effects on growth. Similarly, humic acids and lignins did not exhibit inhibitory effects on earthworm growth.

The findings of the work, Acute toxicological effects on the earthworm *Eisenia fetida* of 18 common pharmaceuticals in artificial soil, revealed that seven of the drugs examined induced acute adverse effects in

E. fetida, particularly NSAIDs and blood lipid-lowering agents. Among the tested compounds, ibuprofen exhibited the highest acute toxicity, followed by diclofenac and simvastatin. However, atorvastatin, bezafibrate, β-blockers, and antibiotics did not exhibit any detectable lethality in *E. fetida*. It was observed that the four NSAIDs underwent structural modifications after 14 days, suggesting that the detected toxicity might be attributed to both the original compounds and their degradation products. Conversely, the 3 blood lipid-lowering agents appeared to be more stable in soil.

Two test methods, namely the 2-day contact test and the 14-day artificial soil test, were employed to assess the effects of six major classes of organic chemicals on the earthworm *Eisenia fetida*. Among the organic chemicals examined, phenols and amines demonstrated the highest toxicity to the worms, followed by substituted aromatics, halogenated aliphatics, polycyclic aromatic hydrocarbons, and phthalates, in descending order of toxicity. These findings by E. F. Neuhauser, R. C. (1985) on The Toxicity of Selected Organic Chemicals to the Earthworm *Eisenia fetida*, suggest that earthworms can serve as effective biomonitoring tools to evaluate the impact of organic chemicals present in waste materials added to soils. Additionally, both the contact and artificial soil tests proved to be valuable in assessing biological impacts.

In the work The combined stress effects of salinity and copper on the earthworm *Eisenia fetida*, To evaluate the combined toxic impact of salinity and copper on earthworms, *Eisenia fetida* specimens were exposed to OECD artificial soil containing various sub-lethal concentrations of NaCl and Cu, both individually and as mixtures. Throughout the study, mortality, weight change, and internal copper concentrations in the worms were monitored, while the concentrations of Cu in the soil were also analysed. Notably, no worm mortality was observed in either the individual or combined toxicity tests. However, increased levels of NaCl and Cu, when present individually, significantly affected weight change and cocoon production in the worms. When combined, the contaminants generally exhibited additive effects on these worm parameters.

METHODOLOGY

Experimental model :-

The earthworms (*Eisenia foetida*) were gathered from a nearby plant nursery in Kakkanad. Since adult worms were not available, non-clitellate juveniles were also utilized for the experiment. Before the experiment commenced, the collected earthworms were kept under natural conditions.

Laundry detergents used :-

The detergents used for the experiment are widely available in the local markets in India. The inorganic and organic detergent was labelled as product 1 and product 2 respectively.

Preparation of soil beds :-

The experiment was conducted as per method of NidhiRai *et.al* (2014). Eight plastic containers were used for the preparation of soil beds. These were filled with soil mixed with dried and powdered cow dung. Cow dung powder was added in order to avoid starvation. All the containers were filled with 600 grams of soil, supplemented with an additional 20 grams of soil that had been used to house and preserve the earthworms before the start of the experiment. The containers were positioned in a tray filled with water to prevent ant and pest infestation.

Addition of detergent :-

Out of the eight containers, four were treated with inorganic detergent at concentrations of 0.5g, 1.0g, 1.5g, and 2.0g, marked as A, B, C, and D respectively. The other four containers were treated with organic detergent at concentrations of 0.5g, 1.0g, 1.5g, and 2.0g, marked as E, F, G, and H.

After three weeks, the detergent concentration was increased to 5.0gm, 10.0gm, 15.0g, and 20.0g.

Addition of earthworm :-

Four earthworms were added to each experimental set-up and the average was found to determine the approximate weight of the earthworms. Once the earthworms were added, the containers were covered with a damp cloth to maintain moisture levels and also it will prevent them from crawling out of the container.

Additionally, there was a common control container that lacked any detergent. To maintain moisture levels, water was supplied at regular intervals, and after a week and a half, the change in weight was observed and recorded. Mortality was also recorded within three weeks

OBSERVATION AND RESULT

OBSERVATION :-

At the beginning of the experiment, when the earthworms were introduced into the plastic containers containing detergents of specific concentrations, particularly in the inorganic ones, notably in containers C and D, the earthworms exhibited active movement. They appeared to be attempting to escape from the setup. This behaviour was observed for about an hour after which normal behaviour was observed.

RESULT :-

EFFECT OF INORGANIC DETERGENT ON THE WEIGHT OF *Eisenia foetida*

	container a (.5gm)	**container b (1.0gm)**	**container c (1.5gm)**	**container d (2.0gm)**	**control (0.0gm)**
average weight at the start of experiment	0.66gm	0.83gm	0.51gm	0.48gm	1.75gm
average weight after one and half weeks	0.52gm	0.69gm	0.36gm	0.30gm	2.12gm
average weight after three weeks	0.40gm	.37gm	0.18gm	0.0gm (100% Mortality)	2.36gm

Table (i): shows the difference in weight between the start, one and half week and after three weeks

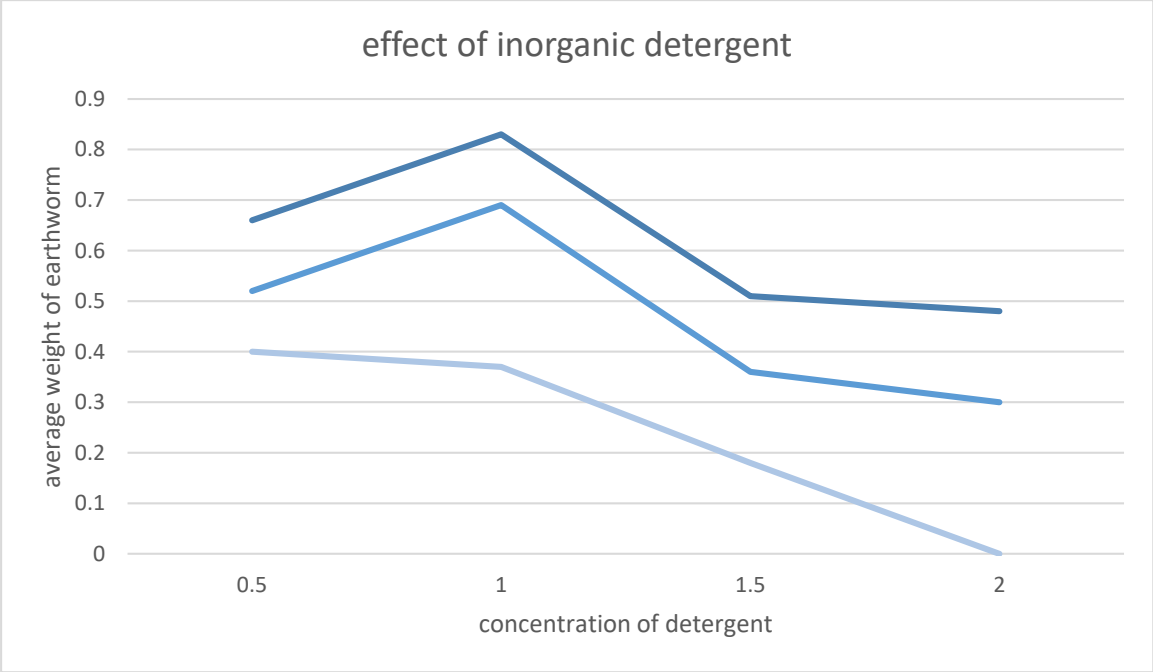


Figure 2.0 : line graph showing the variation in average weight with respect to time

EFFECT OF ORGANIC DETERGENT ON THE WEIGHT OF *Eisenia foetida*

	container e (.5gm)	container f (1.0gm)	container g (1.5gm)	container h (2.0gm)	control (0.0gm)
average weight at the start of experiment	0.77gm	0.75gm	0.64gm	0.79gm	1.75gm
average weight after one and half weeks	0.90gm	0.81gm	0.71gm	0.85gm	2.12gm
average weight after three weeks	0.98gm	0.90gm	0.79gm	0.90gm	2.36gm

Table (ii): shows the change in weight of the earthworm during the start, after one and a half week and after three weeks of the experiment

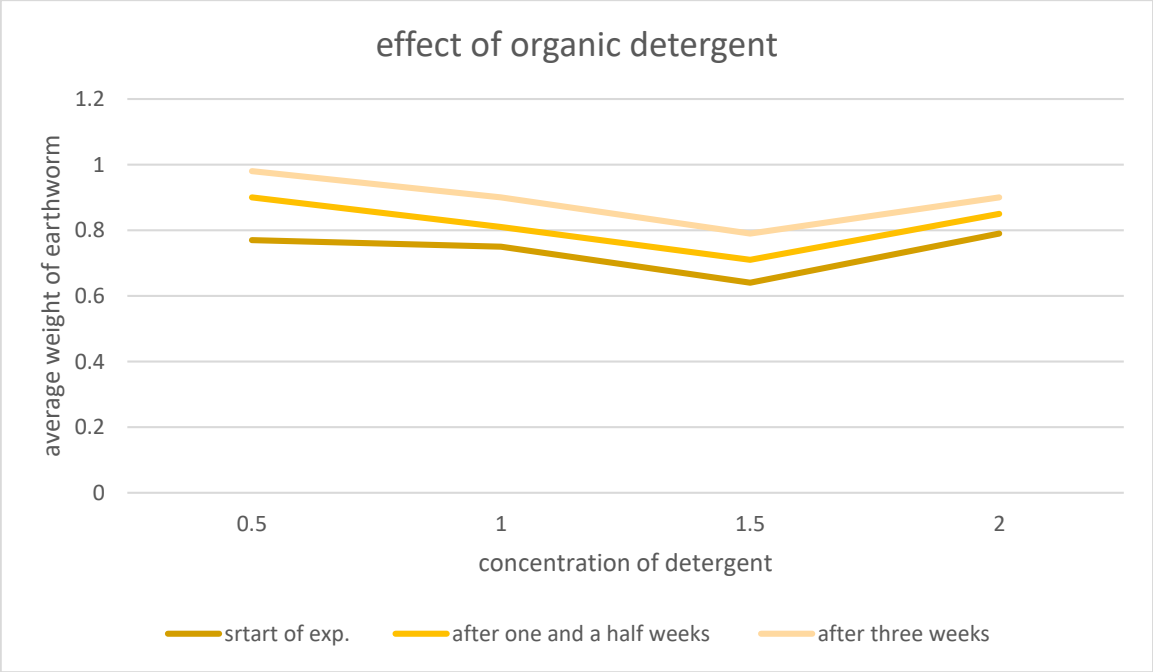


Figure 3.0: line graph that shows the variation of average weight with time

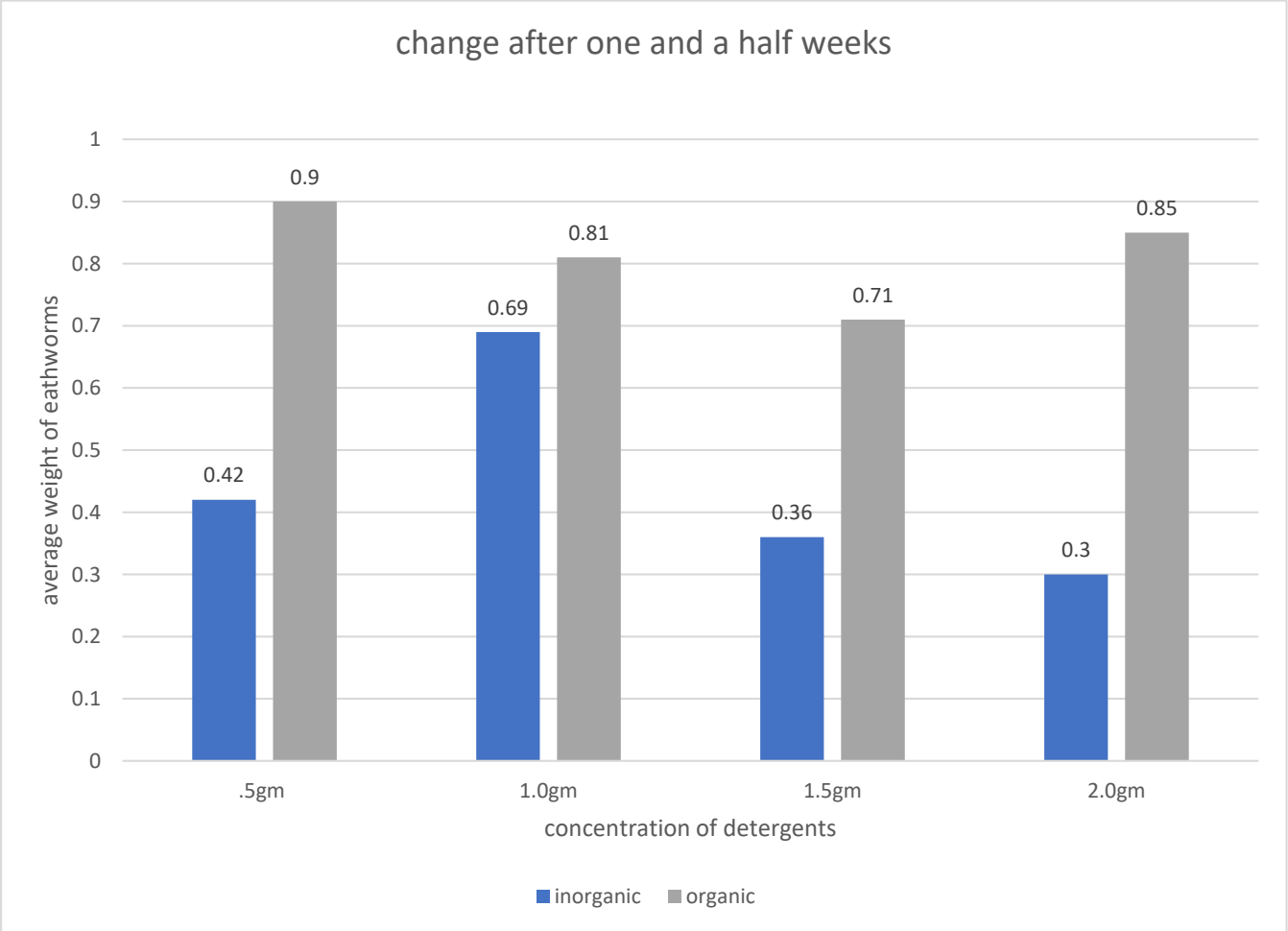


Figure 4.0 shows the difference in the weight of earthworms produced inorganic and organic detergent after one and a half week of experiment

After one and half week of the experiment drastic changes were seen in the containers that had inorganic detergent. The average weight of earthworms in the containers A, B, C, and D reduced while in the case of organic detergent the weight increased slightly. While the control had tremendous growth and even the formation of vermicast.

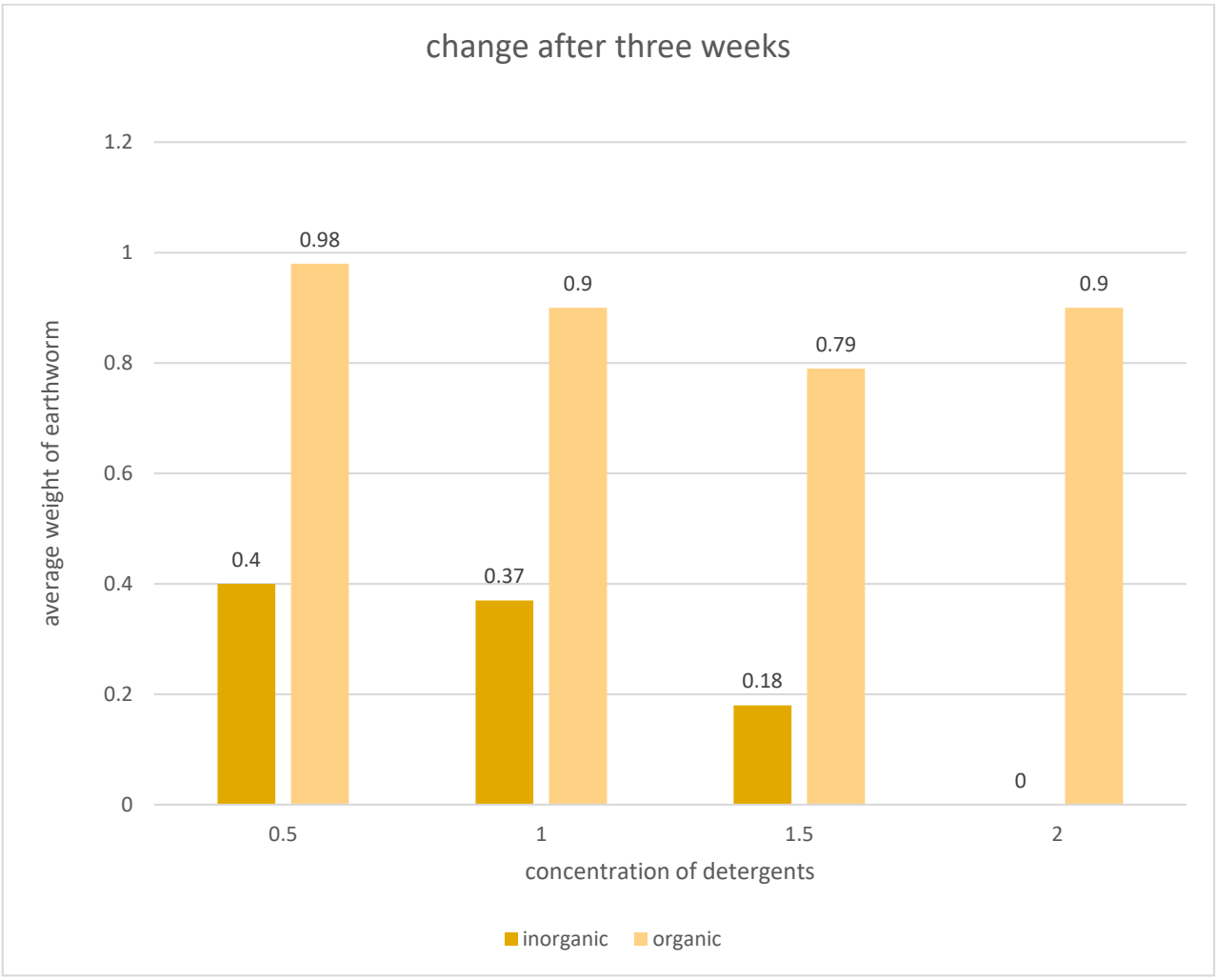


Figure 5.0 shows the difference in the weight of earthworms produced inorganic and organic detergent after three weeks of experiment

After three weeks of the start of the experiment the average weight of the earthworms in the inorganic setup reduced with 100 % mortality rate in container D. where as there was an increase in the weight organic setup. While the control setup has increase in the weight

Figure 6.0: shows the earthworms *E.foetida* used for the experiment

Figure 7.0: the earthworms after the introduction into the experimental setup

Figure 8.0: shows the setup of inorganic containers after intorduction of the eathworms along with control

Figure 9.0 shows the experimental setup all together

EFFECT OF INROGANIC AND ORGANIC DETERGENT AT HIGHER CONCENTRATION

The earthworms E. foetida was introduced to a higher concentration of 5 gm , 10gm, 15gm and 20gm on two different set of containers. In both cases 100% mortality was observed within two days after the setup. This was also followed by a fowl smell.

Figure 10.0: shows the picture of a dead earthworm when treated with higher concentration

DISCUSSION

The study by Thomas, Amala & Sachith, Sunish. (2019) on the impact of detergent on *Megascolex konkanensis*, including weight, length, diameter, and motility. The study observed the effect of different detergent on the growth and behaviour of earthworm. Their finding led to the conclusion that the effect of detergent on low concentration (.1gm,.5gm, and 1gm) induced the growth in earthworms while that of higher concentration greatly affected the growth rate. Whereas the finding of the current work explains that the even low concentration of detergent could reduce the growth rate of earthworm. This could prove that the type of detergent and species of earthworm use play an important role in the growth rate. But still highlight the fact that high concentrations have lethal effects. This indicates the sensitivity of earthworms to detergent exposure and highlights the potential risks associated with detergent pollution in soil ecosystems.

The study conducted by Liu Boaping sheds light on the significant impact of household detergents on soil ecosystems, particularly on earthworms. By examining the behaviour and survival of *Eisenia andrei and Pheretima guillelmi* earthworms exposed to various detergent dilutions. Interestingly 100% mortality is noted in *E.anderi* species with in four hours while all of *P.gullelmi* survived. This is further evidence to prove that the species and type of detergent used plays a vital role in the growth and behaviour of a species of earthworm. some of the detergents like perfumed soap and lavatory cleanser proved to be less harmless like the low concentration of organic detergent that enhanced the growth.

A comparative study on effect of chemical fertilizers and organic fertilizers on *Eisenia foetida* by Nidhi Rai et. Al (2014). This work suggests the harmful effects of inorganic fertilizers on the survival of the earthworm community in soil. Even though fertilizers and detergent are used in different cases the underlying fact that both are chemicals that contain harmful products could be easily linked together. The work further proves that organic fertilizers enhanced earthworm growth that directly corresponds with the enhanced growth seen in earthworms that were treated with organic detergent

CONCLUSION

Earthworms are a major part of soil fauna in a wide verity of soil and climate and helps in the boo-degradation of organic matter and production of humus and nutrient rich soil. They are widely used as bio-indicators for evaluating the toxicity of a terrestrial ecosystem. Thus its abundance indicate the health of soil.

A detergent is a surfactant that play a crucial role as a laundry cleaner, bleaching clothes, cleaning oil spills benefiting mankind in various ways. It is a chemical either in solid or liquid form. The laundry detergent is widely used in most households to clean and brighten clothes. The waste produced after washing laundry are usually discarded into the soil without much treatment. But these chemical greatly affect the soil texture and pose a threat to the soil fauna. Among the soil fauna earthworms are highly affected by them. These detergents effect the living cells by damaging the cell membrane attaching to proteins, and affecting cell physiological and biochemical processes (Azizullah et al. 2012)

From this comparative study it is clear that even small amounts of inorganic detergents(2gm) prove to be lethal to earthworms, whereas organic ones don't harm them. considerable changes can be observed within change in species and their tolerance level along with change in the detergent. Higher concentrations of both organic and inorganic detergents (5gm, 10gm, 15gm, 20gm) were observed to be lethal in the study.

In the experiment, detergent was directly to added soil, whereas laundry detergents usually mix with water when used. While this dilution may reduce their impact, long-term use of detergent can significantly alter soil structure, affecting both micro and macro fauna.

The project aims to assess how different types of detergents affect the behaviour and survival of *Eisenia foetida.* By comparing the effects of organic and inorganic detergents, the work provides details about which type of detergent may have a lesser impact on earthworm populations and soil health. The study explore the effects of different concentrations of detergents on earthworms and determine safe levels of detergent use.

The importance of the work relies on the fact that earthworms play a crucial role in the soil ecosystem by maintaining soil health and fertility. Identifying the impact and toxicity of detergents on earthworm can promote the use of less harmless organic detergents. It is necessary to take action to reduce soil pollution caused by changing to organic detergents or using natural remedies like soaps to prevent potential environmental harm.

REFERENCE

1. Abbiramy, K & Ross, P.. (2012). Determination of acute toxicity of potash to Eisenia foetida using a simple paper contact method. Annals of Biological Research. 3. 5714-5717. 10.15373/22778179/FEB2013/141.

2. Anindita Bhattacharya,Anindita Bhattacharyaand Sahu,S. K., 20143329458, English, Journal article, Bangladesh, 2222-3045 2220-6663, 4, (6), Dhaka, Journal of Biodiversity and Environmental Sciences (JBES), (64–72), Shamokal Publications, Lethal effect of urea on soil biota: a laboratory study on earthworm (*Drawida willsi*)., (2014)

3. Azizullah A., P.Richter and D.P.Hader, (2011). Toxicity assessment of a common laundry detergent using the freshwater flagellate Euglena gracilis. Chemosphere 84(10):1392–1400

4. Edwards, C.A and P.J.Bohlen(1992). The Effects of Toxic Chemicals on Earthworms. Reviews of Environmental Contamination and Toxicol. Earthworms 373 (125): 23–99.

5. E. F. Neuhauser, R. C. (1985). The Toxicity of Selected Organic Chemicals to the Earthworm *Eisenia fetida*. *journal of envrionmental quality* , 383-388.
6. F.A. El-Gohary, S.S. Nawar, H.I. Ali, (1986). Treatment of Wastewater from a Detergent and Soap Factory - Case Study,Editor(s): L. Pawlowski, G. Alaerts, W.J. Lacy,Studies in Environmental Science, Elsevier. vol 29 1986, Pages 113-124
7. H. Lalthanzara, and S.N. Ramanujam, ―Effect of fertilizer (NPK) on earthworm population in the agroforestry system of Mizoram, India, Science Vision, 10(4): 159 – 167, 2010.
8. LONG, WONECA & Ansari, Abdullah & Seecharran, Diana. (2017). The effect of urea on epigeic earthworm species (*Eisenia foetida*). Cell Biology and Development. 1. 46-50. 10.13057/cellbioldev/v010202.
9. . Lian Duo, Lijia Yin, Cancan Zhang, Shulan Zhao, Ecotoxicological responses of the earthworm *Eisenia fetida* to EDTA addition under turfgrass growing conditions, Chemosphere, Volume 220,2019, Pages 56-60
10. Liu Baoping "Effects of Six Household Detergent Dilutions on the Behavior and Survival of Eisenia andrei and Pheretima guillelmi Earthworms," Journal of Resources and Ecology 14(5), 1086-1091, (22 August 2023). https://doi.org/10.5814/j.issn.1674-764x.2023.05.019
11. Mª. Rosa Pino, Jonatan Val, Ana Mª. Mainar, Estefanía Zuriaga, Cecilia Español, Elisa Langa, Acute toxicological effects on the earthworm Eisenia fetida of 18 common pharmaceuticals in artificial soil, Science of The Total Environment, Volumes 518–519, 2015, Pages 225-237.

12. .Mohamed, R.M., Al-Gheethi, A.A., Noramira, J. *et al*. Effect of detergents from laundry greywater on soil properties: a preliminary study. *Appl Water Sci* **8**, 16 (2018).
13. . ngélique Belfroid, Willem Seinen, Kees van Gestel, Joop Hermens, The acute toxicity of chlorobenzenes for earthworms (*Eisenia andrei*) in different exposure systems, Chemosphere, Volume 26, Issue 12,1993, Pages 2265-2277
14. NidhiRai, PriyankaAshiya, Devendra Singh Rathore, "Comparative study of effect of chemical fertilizer and organic fertilizer on Eiseniafoetida", International Journal of Innovative Research in Science, Engineering and Technology, 2014.
15. Olugbenga J. Owojori, Adriaan J. Reinecke, Andrei B. RozanovThe combined stress effects of salinity and copper on the earthworm Eisenia fetida, Applied Soil Ecology,Volume 41, Issue 3, 2009, Pages 277-285
16. Roy Hartenstein, Effect of aromatic compounds, humic acids and lignins on growth of the earthworm eisenia foetida, Soil Biology and Biochemistry, Volume 14, Issue 6, 1982, Pages 595-599
17. Thomas, Amala & Sachith, Sunish. (2019). A Study on the Effect of Detergent on Megascolexkonkanensis. 102. 10.15680/IJIRSET.2019.0808015
18. Xiao, H., Zhou, Q.X. & Liang, J. Single and Joint Effects of Acetochlor and Urea on Earthworm *Esisenia Foelide* Populations in Phaiozem. *Environmental Geochemistry and Health* **26**, 277–283 (2004). https://doi.org/10.1023/B:EGAH.0000039591.36259.a1