**SRI VENKATESWARA INTERNSHIP PROGRAM FOR RESEARCH IN ACADEMICS (SRI-VIPRA)**

SRI-VIPRA

# Project Report of 2023:

## SVP-2331

"Effect of drain chemicals on garden soil and plants"



**IQAC**
**Sri Venkateswara College**
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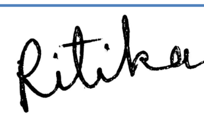
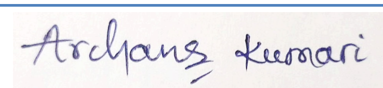
**Benito Juarez Road, Dhaula Kuan, New Delhi**
**New Delhi -110021**

# SRIVIPRA PROJECT 2023

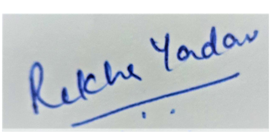
**Title:** Effect of drain chemicals on garden soil and plants.

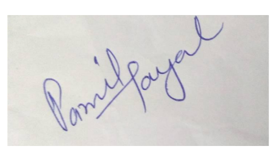
| | |
|---|---|
| Name of Mentor: Dr. Rekha Yadav<br>Name of Department: Chemistry<br>Designation: Assistant Professor |  |
| Name of Mentor: Dr. Pamil Tayal<br>Name of Department: Botany<br>Designation: Assistant Professor |  |

***List of students under the SRIVIPRA Project***

| S.No. | Photo | Name of the student | Roll number | Course | Signature |
|---|---|---|---|---|---|
| 1 |  | Ritika Madankar | 1121165 | B.Sc. (P) Life Science Third year |  |
| 2 |  | Archana Kumari | 1121144 | B.Sc.(P) Life Science Third Year |  |

**Signature of Mentor**



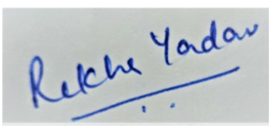


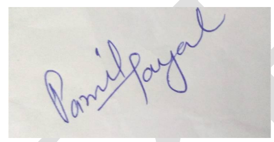
**Dr. Rekha Yadav** **Dr. Pamil Tayal**

## Certificate of Originality

This is to certify that the aforementioned students from Sri Venkateswara College have participated in the summer project SVP-2331 titled "Effect of drain chemicals on garden soil and plants". The participants have carried out the research project work under our guidance and supervision from 15th June 2023 to 15th September 2023. The work carried out is original and carried out in an online/offline/hybrid mode.

**Signature of Mentor**





**Dr. Rekha Yadav**

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## Acknowledgments

The students and mentors are highly grateful to Prof. C. Sheela Reddy and the SRIVIPRA team for introducing such an innovative activity.

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## Introduction

A critical and limited resource, soil is crucial to the survival of life on Earth. Its importance cannot be understated because it forms the basis for forestry, agriculture, and the very ecosystems that keep us alive. Numerous species, such as earthworms, bacteria, and fungi, which are essential for nutrient cycling and decomposition, can be found in soil. It also serves as a carbon sink, storing significant volumes of carbon dioxide, and a reservoir for water, helping to control the flow of surface and groundwater. Despite its enormous value, soil is under constant attack, and subsurface drainage is one of the major causes of soil degradation. While drainage systems are essential for addressing difficulties with waterlogging and inadequate drainage in some regions, they can unintentionally have several negative effects on the health and quality of the soil.

The loss of important nutrients is one of the subsurface drainage's most alarming effects on soil degradation. Drainage systems effectively remove extra water from the soil profile, which helps to avoid waterlogging. However, this procedure may also cause vital nutrients like nitrogen, phosphate, and potassium to be lost outside the reach of plant roots. As a result, the soil loses nutrients, becomes less fertile, and is eventually less able to sustain the growth of healthy plants. Additionally, the delicate equilibrium of soil microbial communities can be upset by subsurface drainage. Oxygen levels in waterlogged soils are frequently low, which makes the environment unfriendly for many soil microbes. Installing drainage systems raises soil oxygen levels, which at first glance might be advantageous. This fast change, however, has the potential to upset existing microbial communities, causing imbalances and perhaps reducing the diversity of soil microorganisms. These bacteria are essential for the breakdown of organic matter, the cycling of nutrients, and the general health of the soil. As a result, upsetting their homeostasis could harm the soil ecology over time. Furthermore, pH values in the soil can be impacted by subsoil drainage. Because there is less oxygen available in waterlogged soils, acidic chemicals are more likely to accumulate. The pH of the soil may increase and become more alkaline as extra water is drained through drainage. The availability and uptake of nutrients by plants may be impacted by this change in soil pH. Additionally, it may affect an element's solubility, which might cause the release of hazardous compounds into the environment.

The possibility of soil compaction is another issue with subsurface drainage. Sometimes, especially in regions where machinery or equipment is utilized for installation, drainage system installation and maintenance can result in soil compaction. Because soil compaction diminishes pore spaces and restricts water infiltration, drainage issues may get worse over time. Compacted soil is less favorable for root development and can obstruct the flow of water and air through the soil profile, further lowering the quality of the soil.

The current research focussed on the effect of subsoil drainage on different soil samples collected from the college campus at various sites. The effect was studied for soil properties such as soil pH, nutrient concentration, soil structure, microbial community, and crop production was examined. In general, pH ranging from 6.9 to 7.2 is ideal for better crop production. It was observed that the soil samples with a good amount of water in it has neutral to acidic pH, good nutrient ion concentration and thereby support the crop production. On the other hand, the samples from chemically drained soil, and disturbed site showed either highly acidic or alkaline pH, less nutrition concentration, and thus is unable to support the growth of plants optimally. According to the observations, it was concluded that subsoil drainage with water can greatly improve soil quality, which will increase agricultural production and promote sustainable land use.

## 2. Methodology

### 2.1 Collection of soil samples from the college campus

Six different sites i.e. Botanical garden, chemistry lab lawns, canteen area, construction site (near library), parking area, and open green space (Rock Garden) were selected. At each sampling point, using a spatula, soil samples were collected at a specified depth of 8-10 cm without disturbing the layers in between.
Each sample was collected and placed in a clean and labeled bag.

### Effect of Subsoil Drainage on Soil Properties

### 2.2 Soil Structure

The fresh weight of the collected soil sample was weighed and recorded using a weighing machine. For this, a spatula full of soil was weighed. The soil was kept was drying in an oven at 65 $^{0}$C, overnight.

Later, the dry weight of the soil was recorded and the difference between fresh and dry weight helped in determining the moisture content of the soil.

Percent Moisture content (% MC) = Fresh weight – Dry weight / Dry weight x 100

**2.3 Nutrient Content**

Concentrations of macronutrients (P and Mg) as well as micronutrients (Fe, Cu, Zn, and Mn) were determined in shoot and root according to AIlen (1989).

*Digestion of Samples* - A mixed acid procedure was used for the digestion of samples in Kjeldahl digestion unit. The steps involved in the digestion were: Oven—dried, ground sample (0.2g) Was weighed into a 50 ml Kjeldahl flask. 0.5 ml 60% perchloric acid, 2.5 ml nitric acid, and 0.25 ml sulphuric acid were added to the Kjeldahl flask. The sample was swirled gently and slowly digested at moderate heat, increasing the heat later. The same was further digested for 10-15 minutes after the appearance of white fumes. The mixture was set aside to cool. The cool digest was colorless. The above mixture was diluted to about 10 ml and boiled for a few minutes, filtered with Whatman filter paper no. 44 into a test tube and volume was made to 25 ml. The residual acid was 1% (v/v). The above solution was used for the determination of P, Mg, Cu, and Fe. Blank digestions were also carried out in the same manner.

**2.4 Microbial Activity**

A common method for estimating the microbial populations in soil samples is the study of soil microorganisms using the serial dilution method. With this technique, a soil sample is diluted several times with a sterile diluent to achieve a variety of dilutions. Each diluted sample is then plated onto the proper agar substrate and cultured in microbial growth-friendly conditions. Following incubation, the number of microbial colonies that grow on the agar plates is determined. Calculations based on the dilution factor can be used to establish the initial concentration of soil microorganisms. This method sheds light on the diversity and abundance of soil microorganisms, which are crucial to ecosystem functioning, nutrient cycling, and soil health. Additionally, it offers useful information for research in agriculture, the environment, and ecology, assisting scientists and researchers in understanding the dynamic microbial communities found in soil ecosystems.

**2.5 Soil pH**

The soil was collected from the college campus, five grams of collected soil from each site was weighed and 25 ml of distilled water was added to each sample in a conical flask. The samples were stirred for 30 minutes, after that the suspension was filtered through a Whatman filter paper and the filtrate was collected in a test tube. The pH of each filtrate was measured using a pH meter.

## 3. Results

The enhancement of soil structure is one of the main consequences of subsurface drainage on soil parameters. Due to their excessive moisture content, poorly drained soils can have compacted and anaerobic conditions that can inhibit root growth and water infiltration. By removing extra water, subsoil drainage systems help to alleviate these problems and improve soil aeration and aggregation. It is simpler for crops to obtain nutrients and water when the soil structure is improved because it encourages root growth and improves soil tilth.

| **Soil Sample** | **Fresh weight of Soil (g)** | **Dry Weight of Soil (g)** | **Moisture content (%)** |
|---|---|---|---|
| Botanical garden | 5.4 | 3.2 | 68.75 |
| Chemistry lab lawns | 5.2 | 3.0 | 73.33 |
| Canteen area | 5.0 | 3.1 | 67.7 |
| Construction site (near library) | 5.6 | 3.9 | 43.5 |
| Parking area | 5.3 | 4.4 | 20.4 |
| Open green space (Rock Garden) | 5.8 | 3.4 | 70.5 |

Soil pH is an important soil property affected by subsoil drainage. Waterlogged soils tend to have lower pH levels due to the reduced oxygen availability, which can lead to soil acidity. Subsoil drainage helps in raising soil pH by facilitating better aeration and reducing the accumulation of acidic compounds. This can be particularly beneficial in areas where acidic soils are a limiting factor for crop production, as improved pH levels enhance nutrient availability and root health. The pH was found to be increasing in the following order:

Chemistry lab lawns < Construction site (near library) < Canteen area < Botanical garden < Open green space (Rock Garden) < Parking area.

## 4. Conclusion

Subsoil drainage is a valuable tool for improving soil properties and enhancing agricultural productivity. It positively impacts soil structure, nutrient content, microbial activity, soil pH, and ultimately crop yield. However, it is crucial to consider the potential environmental implications and implement responsible drainage practices to minimize adverse effects on water quality and ecosystems. Overall, subsoil drainage systems have the potential to play a pivotal role in sustainable land use and agricultural development, particularly in regions with drainage challenges. Further research and technological advancements in drainage systems will continue to refine and optimize their effectiveness in managing soil properties and supporting food production.

## 5. Future Prospects

1. To study the nutrient content of the samples.
2. To study the microbial activity of the samples.