A study and comparison of soil quality after discharge of wastewater from hydroponic vegetable cultivation.
Suso Subdistrict, Phalean District, Trang Province, Thailand.

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Abstract

This research aims to: 1. Study soil quality after releasing hydroponic effluent, and 2. Compare soil quality between areas with and without effluent discharge. The study focused on changes in soil pH and other properties for potential application in fertilization. Data collected included pH, soil fertility (N-P-K), soil moisture, soil structure, soil color, soil consistency, and soil texture. The results showed that areas with hydroponic effluent had higher average primary nutrients, soil moisture, and soil temperature than areas without discharge. Both areas had a granular soil structure. Soil in the treated area was dark black, while the untreated area was light brown. The texture in the effluent area was sandy loam, whereas the untreated area was sandy clay.

Keywords: Hydroponic effluent, Soil quality, Soil fertility (N-P-K)

Research Question

Does waste water from growing hydroponic vegetables affect changes in the amount of macronutrients (N-P-K) and pH (pH) in the soil?

Introduction

A Study on the Impact of Hydroponic Wastewater on Soil Quality in Trang Province

- Objective: To compare soil quality and nutrient levels (pH, N-P-K) between areas receiving wastewater discharge and areas not receiving discharge from hydroponic farms.
- Results: The study found that the soil in the area receiving wastewater became more fertile, with the following details:

1. Nutrients and Soil Conditions: The levels of N-P-K (fertilizers), soil moisture, and soil temperature were higher than in the area that did not receive wastewater.
2. Physical Characteristics:

- Soil receiving wastewater: Dark black color, Sandy Loam texture (better drainage).
- Soil not receiving wastewater: Light brown color, Sandy Clay texture.
- Note: Both areas exhibited the same Granular soil structure.

Research Methods

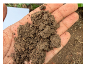
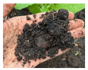
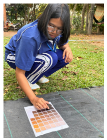
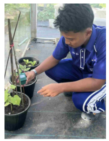
1. Site Preparation and Experimental Design

Study Area: Soil sampling points located in Suso Sub-district, Palian District, Trang Province. The study area is divided into two primary sites:
Site 1 (Experimental Group): Soil area regularly irrigated with wastewater from a hydroponic system.
Site 2 (Control Group): Nearby soil area that does not receive any hydroponic wastewater.

2. Experimental Procedures and Data Collection
Part 1: Physical Soil Analysis
Soil Temperature: Measured using a Glass Thermometer at depths of 5 cm and 10 cm. Measurements are taken at the same time daily to control external variables.
Soil Moisture: Measured using a Soil Moisture Meter to determine the water content within the soil pores.
Soil Color: Soil samples are compared against the Munsell Soil Color Chart to identify value, chroma, and hue.
Soil Texture and Structure: Evaluated using the "Feel Method" to classify soil types (e.g., sandy loam, clay loam) and observing soil aggregation according to GLOBE protocols.
Part 2: Chemical Soil Analysis
Soil pH: Soil samples are mixed with distilled water following GLOBE standards. The solution is filtered, and the pH level is recorded using pH Strips.
Primary Nutrients (N-P-K): A Soil NPK Tester is used to analyze the accumulation of Nitrogen (N), Phosphorus (P), and Potassium (K) resulting from the wastewater discharge.

3. Data Recording and Analysis

3.1 All collected data—including pH levels, moisture, temperature, and soil color—are recorded in a structured result table.
3.2 Data from both sites (Wastewater-affected vs. Non-affected) are compared using tables and charts. 3.3 Differences in physical and chemical properties are analyzed to conclude the impact of hydroponic wastewater on soil quality.

Carrying Out Investigations

A study and comparison of soil quality after discharge of wastewater from hydroponic vegetable cultivation.Suso Subdistrict, Phalean District, Trang Province, ThailandLatitude 7.2693791 N and Longitude 99.6759748 E.

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1. Research Methodology
Site Preparation:
A comparative study was conducted in Suso Subdistrict, Trang Province, dividing the study site into two specific areas:
1. Treatment Area: Soil receiving wastewater discharge from the hydroponic system.
2. Control Area: Soil not receiving wastewater discharge.
Data Collection (Following GLOBE Protocols):
- Physical Properties: Measurement of soil temperature (at depths of 5 cm and 10 cm), soil moisture, soil color comparison (), and classification of soil texture and structure using the Feel Method.
- Chemical Properties: Measurement of pH levels and soil macronutrients (N-P-K).

2. Data Analysis & Conclusion
Data Analysis:
Collected data was recorded in tables to compare the physical and chemical averages between the "Wastewater Treatment Soil" and the "Non-treatment Soil."
Conclusion:
Hydroponic wastewater discharge resulted in improved soil quality and higher fertility compared to the non-treatment area, as detailed below:
- Nutrients: Significantly higher N-P-K levels were observed in the treatment area.
- Physical Properties: The treated soil exhibited higher moisture content and a dark black color (indicating high organic matter). The soil texture was identified as Sandy Loam, which provides better aeration and drainage compared to the Sandy Clay found in the control group.

Results

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Table showingPhysical soil quality analysis

Figure #1

Parameters	Hydroponic Wastewater Area	Non-Wastewater Area
Temperature (°C)	25.67 °C	27.50 °C
pH Value	7.00	6.33
Moisture (VWC)	10.00	7.33
Soil Fertility (N-P-K)	N: 3.6, P: 5.3, K: 11.0 (mg/kg)	N: 1.66, P: 1.33, K: 3.33 (mg/kg)

the study in Suso Sub-district shows that the soil receiving hydroponic wastewater has an average NPK fertility of 6.63 ± 10%, which is significantly higher than the non-treated area at 2.11 ± 10%. The overall pH level is maintained at a moderate/neutral average of 6.67 ± 0.5%

Discussion

Discussion of Results
The study comparing soil quality after the discharge of hydroponic wastewater in Suso Sub-district, Palian District, Trang Province, yielded the following results:

1. Physical Properties
Soil Temperature: It was found that the soil temperature in the wastewater discharge area at a depth of 5 cm averaged 26.33°C, and at 10 cm averaged 25°C. In the non-discharge area, the average temperature was 28.66°C at 5 cm and 26.33°C at 10 cm. These results indicate that the wastewater discharge area maintained a lower temperature than the non-discharge area, likely due to the cooling effect of the water.

Soil Moisture: The discharge area had an average moisture content of 10% (VWC), while the non-discharge area averaged 7.33% (VWC). Therefore, the soil receiving hydroponic wastewater had a higher moisture level by an average of 2.67% (VWC).

Soil Color: Based on the Munsell Soil Color Chart, the soil in the discharge area was identified by code 3/1 (Jet Black), whereas the non-discharge area was identified by code 6/4 (Light Brown). The darker color suggests a higher accumulation of nutrients and moisture.

Soil Texture and Structure: The soil in the discharge area was classified as medium-textured. It felt slightly gritty, loamy, and soft to the touch. In contrast, the non-discharge area consisted of sandy clay, which felt heavier due to similar proportions of silt and clay. Both areas, however, shared a similar granular (crumb-like) soil structure.

2. Chemical Properties

Soil pH: The analysis showed that the average pH level in the wastewater discharge area was higher than that of the non-discharge area, suggesting that the hydroponic effluent influenced the soil's acidity/alkalinity.

Soil Fertility: Regarding nutrient content, the soil in the hydroponic wastewater discharge area contained a higher concentration of primary macronutrients (N-P-K) compared to the soil in the non-discharge area.

Conclusions

The comparative study of soil quality in Suso Sub-district, Palian District, Trang Province, reveals significant differences between the two study areas.
The soil in the wastewater discharge area exhibited a moderate pH level, while its moisture content and nutrient levels (N-P-K) were significantly higher on average than those of the non-discharge area. In terms of physical characteristics, both areas shared a granular soil structure and were classified as medium-textured soil. However, they differed in consistency and appearance: the discharge area featured loose, loamy soil with a jet black color (Munsell code 3/1), whereas the non-discharge area consisted of sandy clay with a light brown color (Munsell code 6/4).

In conclusion, the soil receiving hydroponic wastewater possesses higher fertility compared to the non-discharge area. These findings suggest that such soil can be effectively repurposed for vegetable cultivation without the need for additional chemical fertilizers, providing a sustainable approach to agricultural soil management.

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