The Study of the types of microplastics in soil in rice fields (in-season rice field) flooded during the flood season

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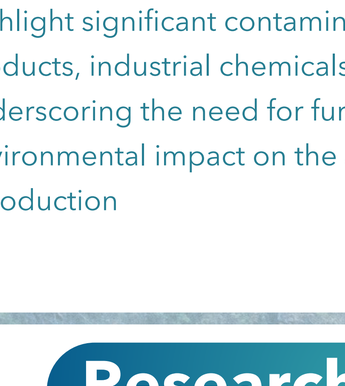
Abstract

This study investigates the presence of various chemicals and microplastics in soil samples from five different locations, analyzing potential sources and types of contamination in the agricultural ecosystem. The temperatures and pH values at each sampling location were as follows: Hole 1 had a temperature of 27.2°C and a pH of 6.5; Hole 2 recorded a temperature of 28.4°C with a pH of 6.3; Hole 3 showed a temperature of 27.5°C and a pH of 6.1; Hole 4 had a temperature of 28.7°C and a pH of 6.0; and Hole 5 displayed a temperature of 28.2°C with a pH of 6.4. The analysis revealed the repeated presence of Polydimethylsiloxane (PDMS), a silicone compound, suggesting possible contamination by silicone across multiple samples. Kaolin, a clay mineral, and Chromium(VI) Oxide, a chromium compound, were identified at several sites. Notably, at Hole 3, microplastics such as Rayon Fiber, Niobium(V) Oxide, Tantalum(V) Oxide, and Cellulose were detected, indicating the potential presence of synthetic fibers and organic compounds. At Hole 4, several chemical compounds, including Gitan 770, EFKA 3236, and Guar, along with inorganic compounds like Bentonite and Ferric Hydroxide, were found. Additionally, compounds associated with high-temperature processes, such as Tetraallylsilane and Silicone Oil, High Temperature, were detected. The findings highlight significant contamination from silicone-based products, industrial chemicals, and microplastics, underscoring the need for further investigation into the environmental impact on the agricultural ecosystem.
Introduction

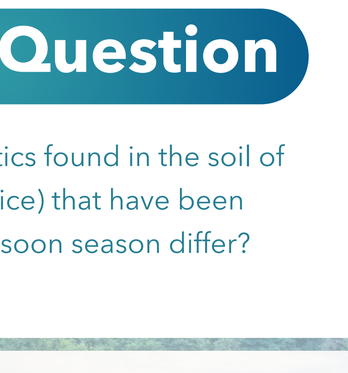
Research Question

Do the types of microplastics found in the soil of rice fields (wet-season rice) that have been flooded during the monsoon season differ?

Introduction



Thai farmers grow rice during the rainy season. Excessive rainfall causes flooding in rice fields.



Due to the farmers use of chemical fertilizers, when flooding occurs, microplastic particles in the fertilizers spread and accumulate in the soil.

The types of microplastics in the soil vary across different areas. However, microplastics are not beneficial to the environment.

Research Methods

Experiment step 1 Collect soil samples
1. Define the soil depth range as 10 cm.
2. Collect soil samples in containers free from contamination.
3.Measuring soil temperature
Comparing the Standard Thermometer
Pour room temperature water (about 250 ml) into a beaker (water level should be more than 4 cm to fully submerge the thermometer during calibration).
Submerge both the standard thermometer and soil thermometer into the water.
Wait 2 minutes.
Read the temperature from both thermometers. If the difference is less than 2°C, the soil thermometer is calibrated.
If the difference is more than 2°C, wait another 2 minutes.
If the difference remains more than 2°C, adjust the calibration screw on the thermometer to align the readings of both thermometers.

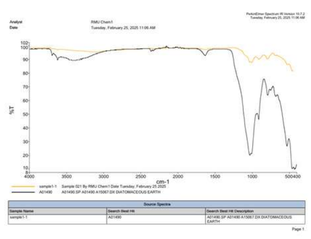
Experiment step 2 Measuring Soil Acidity and Alkalinity
Using a pH Meter or pH Paper
1. Weigh 20 grams of dried and sieved soil sample and place it in a beaker.
2. Add 20 or 100 milliliters of distilled water to maintain a 1:1 soil-to-water ratio.
3. Stir the mixture using a glass rod for 30 seconds, then let it sit for 3 minutes. Repeat this process five times.
4. After stirring five times, allow the soil to settle until clear water appears at the top.
5. Dip pH paper or a calibrated pH probe into the clear water layer, avoiding soil particles at the bottom. Wait for the reading to stabilize, then record the pH value.

Experiment step 3 Prepare samples
1. Dry the soil by air-drying or drying it in a hot air oven at 60°C for 20 hours to remove moisture.
2. Sieve the dry soil using a sieve to separate large particles and focus on small particles.
3. Remove organic substances using hydrogen peroxide (H_2O_2) to oxidize and eliminate organic matter.

Experiment step 4 Separate microplastics
1. Mix the soil with a saturated sodium chloride (NaCl) solution (density > 1.6 g/cm^3)
2. Mix and allow heavier particles to settle while the lighter microplastics float to the surface.
3. Separate the floating particles and filter through a fine mesh or filter (e.g., 0.45 µm).
4. Place the residue on a filter paper and dry in an oven at 60°C for 2 hours.

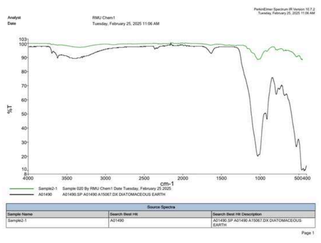
Experiment step 5 Analyze microplastics
1. Analyze using FTIR (Fourier Transform Infrared Spectroscopy) to identify polymer types by detecting the infrared spectrum.

Results

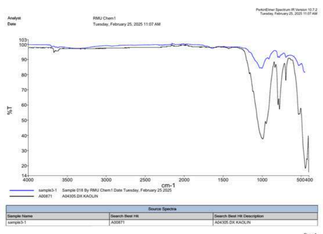


1st hole ; 16.43640° N, 103.53306° E

has a temperature of 27.2 degrees celsius and a pH value of 6.5 Polydimethylsiloxane (PDMS), a silicone possible contamination by silicone. Kaolin, a type of clay mineral while Chromium(VI) Oxide appeared as a chromium compound has a temperature of 28.4 degrees celsius and a pH value of 6.3 Polydimethylsiloxane (PDMS), a silicone possible contamination by silicone. Kaolin, a type of clay mineral while Chromium(VI) Oxide appeared as a chromium compound

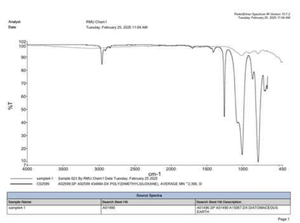


2nd hole ; 16.43629° N, 103.53281° E

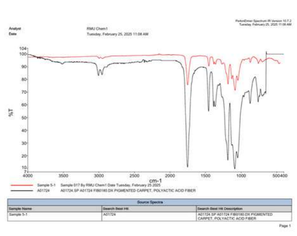


3rd hole ; 16.43612° N, 103.53260° E

has a temperature of 27.5 degrees celsius and a pH value of 6.1 Rayon Fiber appeared repeatedly, indicating the potential presence of rayon fibers in the sample. Niobium(V) Oxide was identified as a niobium compound, and Tantalum(V) Oxide was found as a tantalum compound. Additionally, Cellulose was detected has a temperature of 28.7 degrees celsius and a pH value of 6.0 770 recorded the highest "Search Score" (0.592357), followed by EFKA 3236 and Guar , which are chemical compounds. Florisil , a commercialproduct name, and Methylthiophosphonic Dichloride were also identified. Bentonite Sample B and Ferric Hydroxide were detected as inorganic compounds, along with BYK 322 and Kaolin. Further, Tetraallylsilane , 5-Chloro-2-(Trichloromethyl)benzimidazole , 1,7-Dichloro-Octamethyltrisiloxane, and Silicone Oil, High Temperature



4th hole ; 16.43649° N, 103.53302° E



5th hole ; 16.43670° N, 103.53306° E

has a temperature of 28.2 degrees celsius and a pH value of 6.4 Polydimethylsiloxane (PDMS), a silicone possible contamination by silicone. Kaolin, a type of clay mineral while Chromium(VI) Oxide appeared as a chromium compound

Discussion

1. Frequently Detected Substances (Points 1, 2, and 5):
- Diatomaceous Earth – Used in absorption and filtration industries.
- Poly(dimethylsiloxane) – Silicone possibly from industrial contamination.
- Kaolin – Clay mineral in cosmetics, ceramics, and medicine.
- Chromium(VI) Oxide – Highly toxic compound in metal coating and paint manufacturing.

2. Microplastics Detected (Point 3):
- Rayon Fiber – Possible contaminant.
- Niobium(V) Oxide – Used in aerospace and electronics.
- Tantalum(V) Oxide – Found in electronic devices and heat-resistant tools.
- Cellulose – Organic material used in bioplastics.

3. Various Chemicals Found (Point 4):
- Gitan 770 & EFKA 3236 – Used in manufacturing and rubber processing.
- Guar Extract – Common in food and cosmetics.
- Florisil – Used in chromatography.
- Methylthiophosphonic Dichloride – Used in chemical and pesticide production.

4. Other Compounds Identified (Point 5):
- Bentonite – Used in oil drilling.
- Ferric Hydroxide – Used in wastewater treatment.
- Tetraallylsilane – Silicone compound in the chemical industry.
- Other chemicals, including 5-Chloro-2-(Trichloromethyl)Benzimidazole and High-Temperature Silicone Oil, used in industrial and high-heat applications. The temperature ranges from 27.2-28.7 degrees Celsius and the pH value ranges from 6.0-6.5.

Conclusions

The analysis indicates industrial contamination, including microplastics, silicones, and agricultural chemicals, with microplastics (Rayon Fiber, Niobium Oxide, Tantalum Oxide) suggesting possible plastic contamination.The temperature ranges from 27.2-28.7 degrees Celsius and the pH value ranges from 6.0-6.5.

Bibliography

Department of Land Development. Soil management information. soil improvement research and development group, research and development division develop land management Ministry of Agriculture and Cooperatives.
Thai Encyclopedia Project Foundation for Youth. Soil and fertilizer.
Search online https://zhort.link/FP1