Investigating the Changes in the Soil Nutrients near Rocketdyne

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Problem / Question

In 1959, A Santa Susana Field Laboratory (SSFL), Rocketdyne, experienced a partial meltdown that released 28 Curies of radioactive noble gasses (ucla.edu). The impacts of Rocketdyne have been absent in the news for years, but there are still effects on the environment surrounding the site. The pollution from the site needs to be investigated in order to understand how it is affecting the soil and the environment.

Hypothesis

If soil is tested within different ranges of the Rocketdyne site, then lower levels of pH, phosphorus, nitrogen, and potassium can be identified because of the release of chemicals from the site. As a result, these contaminants can negatively affect plant life.

Introduction

In 1959, A Santa Susana Field Laboratory, Rocketdyne, experienced a partial meltdown that released 28 Curies of radioactive noble gasses (ucla.edu). The impacts of Rocketdyne have been absent in the news for years, but there are still prevalent effects on the public health of those living near the site, as well as the environment. A research article published by Environmental Health Perspectives monitored 2,297 people who worked at Rocketdyne for internal radiation exposure. 441 of the workers died and 134 of them died of cancer due to radiation exposure. The effects of the Nuclear Meltdown at the Santa Susana Field Laboratory have caused the release of toxic materials that are negatively affecting the environment.
We plan on measuring pH, phosphorus, nitrogen, and potassium from 4 different public parks located near Rocketdyne and one park located within Simi Valley that is far from the site which will serve as a control site.

The Santa Susana Field Laboratory

The Santa Susana Field Laboratory (SSFL) is a 2,849-acre property located 30 miles northwest of downtown Los Angeles in southeastern Ventura County. Its purpose was formerly a Rocketdyne rocket engine test and nuclear launch facility (Dts.ca.gov). Virtually every major U.S. space program, from the first manned Mercury flights to the Apollo moon landings and Space Shuttle fleet, owes part of its success to the field lab in California's Santa Susana Mountains. It was also the site of energy research and development for the U.S. government, including leading-edge nuclear, solar, and sodium reactor technology. These past operations left residual chemical and radiological contamination in soil and groundwater.

pH

pH is a basic measure of acidity with a range going from 0-14. 0 is the most acidic, 7 is neutral, and 14 is the most basic. Typically, pH measurements show significant differences between radiated materials and non-radiated materials. Correspondingly, radioactive materials contain the highest, and thus most basic, pH levels (Department of Soils and Water…, 1978). pH is vital to plant life because it influences the key nutrients available to plants and their ability to uptake and absorb necessary nutrients (cropnutrition.com)

Nitrogen (N)

Nitrogen is a colorless, odorless, tasteless gas that is the most plentiful element in Earth's atmosphere and is a constituent of all living matter. The absorption of ionizing radiation by living cells can directly disrupt atomic structures, producing chemical and biological changes, which is heavily apparent in nitrogen levels (Azzam et al., 2014). This means that excessive amounts of radiation can oxidize (change as a result of the influx of oxygen), which accordingly depletes the level of nitrogen. Nitrogen levels play a large role in the cellular functions of the plants' energy is available for their growth (cropnutrition.com).

Potassium (K)

Potassium is a silvery-white metal that is soft enough to be cut with a knife with little force. Radiation causes an almost two-fold increase in potassium and significantly increases extracellular potassium (Winter et al., 2014). Potassium is a critical nutrient that plants absorb from the soil, and from fertilizer. It increases disease resistance, helps stalks to grow upright and sturdy, improves drought tolerance, and helps plants get through the winter. (cropnutrition.com).

Phosphorus (P)

Phosphorus is a highly reactive element that is a major component of the cell membrane structure and a key energy source, ATP. Many proteins and sugars in the body are phosphorylated. Radiation can cause a major increase in phosphorus levels and lead to the possible formation of radioactive phosphorus, which can pose a major threat to plant life (NIH). This poses a threat because a balanced phosphorus level is vital to all plant life for harvesting the sun's energy and converting it into growth and reproduction (cropnutrition.com).

Materials

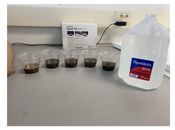
Materials	Quantity
12 Inch Soil Probe	1
Luster Leaf 1601 Rapitest Soil test kit	1
Cell Phone	1
Gloves	3
Journal/Pen	1
Mini Plastic Bags	20
Eye Dropper	1
Plastic Test Tubes/Containers	6
Distilled Water	1 gallon

Procedure

Step 1

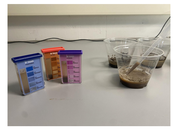
Use soil probe to collect soil samples from 5 parks and control

Step 2



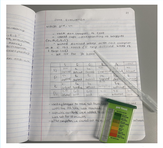
Bring Soil to Core and mix soil into cups with distilled water in a 5:1 ratio and let sit for 30 minutes

Step 3



Use Luster Leaf 1601 Rapitest test and its color chart to record each nutrient level

Step 4



Compare levels of each nutrient to control to determine and analyze effects of Rocketdyne

Discussion

Runkle Canyon Park

The soil of Runkle Canyon Park measured a neutral pH (7.0), a depleted nitrogen level, a surplus of potassium, and depleted phosphorus, which don't show any effects of radiation other than the surplus of Potassium However, this could be purely correlative or due to other factors because it is not consistent with other nutrient levels and their relationship to radiation.

Arroyostow Park

The soil of Arroyostow Park measured a neutral pH level (7.0), a depleted nitrogen level, a surplus of potassium, and a depleted phosphorus level. which don't show any effects of radiation other than the surplus of Potassium However, this could be purely correlative or due to other factors because it is not consistent with other nutrient levels and their relationship to radiation.

Sage Ranch Park

The soil taken from Sage Ranch Park measured a neutral pH level (7.0), a depleted nitrogen level, a sufficient level of potassium, and a depleted level of phosphorus, which don't show any effects of radiation other than the sufficient Potassium Although the soil did have a sufficient level of potassium and radioactivity exposure causes an increase in potassium levels, this is not consistent with the other nutrient levels and their relationship with radioactivity.

Castle Peak Park

The soil from Castle Peak Park measured an acid pH level (6.0), a depleted nitrogen level, a surplus of potassium, and a depleted level of phosphorus. which don't show any effects of radiation other than the surplus of PotassiumAlthough radiation exposure causes a surplus of potassium and the soil from Castle Peak Park had a surplus level of potassium, this is not consistent with the other nutrient levels and their correlation to radioactivity exposure so the surplus of potassium could have been caused by other factors.

El Escorpion Park

The soil from El Escorpion Park measured an acid pH level (6.0), a deficient level of nitrogen, a surplus level of potassium, and a deficient level of phosphorus, which don't show any effects of radiation other than the surplus of Potassium. However, this could be purely correlative or due to other factors because it is not consistent with other nutrient levels and their relationship to radiation. Radiation can leave a surplus of phosphorous levels, but El Escorpion Park showed depleted levels, signifying no effects of radiation.

Control

Soil was taken from the Thousand Oaks Community Center park, but it is apparent that the soil located near Rocketdyne had similar properties. All soil samples were consistent in having depleted or deficient phosphorus and nitrogen, having sufficient or surplus of potassium, and having a pH between 6.0 and 7.0. TThe control sample had a surplus of potassium, which while it can be an effect of radiation, is not consistent with the other nutrient levels and their correlation to radioactivity exposure. Finally, deficient levels of phosphorus at the Thousand Oaks High School control site show no effects of radiation.

Results

Soil Location	pH Level	Nitrogen Level	Potassium Level	Phosphorus level
Runkle Canyon Park	7.0 neutral	N0 Depleted	K4 Surplus	P0 Depleted
Arroyostow Park	7.0 neutral	N0 Depleted	K3 sufficient	P0 Depleted
Sage Ranch Park	7.0 neutral	N0 depleted	K1 Deficient	P0 depleted
Castle Peak Park	6.0 acid	N0 depleted	K3 sufficient	P0 depleted
El Escorpion Park	6.0 acid	N1 Deficient	K4 surplus	P0 depleted
Thousand Oaks Sample:	6.0 acid	N1 deficient	K4 surplus	P1 deficient

The independent variable is the distance of the soil samples from the original meltdown site. Based on the location of the park in correlation to the Rocketdyne site, the nutrients of the soil would be affected. Throughout all of the tests, the potassium and pH were most apparent almost immediately whereas nitrogen and phosphorus took longer to show a hint of color.

Limitations

We didn't get to conduct multiple tests for each element due to the lack of testing available within our budget. Moreover, this means we could have faulty tests since we only did one per sample. Additionally, our research did not measure levels of radiation directly, merely correlative factors that don't necessarily reveal radioactivity. This study needed to have the nutrients along with the radioactivity levels in order to precisely identify whether the radioactivity had an effect on the soil of surrounding areas. The lack of differences may also be due to the fact that only the top soil was tested because we didn't have access to get soil from a greater depth. Furthermore, Simi Valley Parks and Recreation district handles all of the parks in the same manner meaning that they all display similar characteristics because the topsoil consists of the same fertilizer and soil.

Conclusion

Based on what was tested in this experiment, the effects of the radioactivity exposure from the Rocketdyne laboratory site have little to no effect on the soil and dirt in Simi Valley, California. For example, our results show that the soil samples collected from public parks located around the Rocketdyne site have a neutral (7.0) or acid (6.0) pH levels and materials that have been affected by radioactivity tend to have high pH levels that are more basic (14.0) according to previous studies. Additionally, if the radioactivity affected the soil, we would have seen surpluses across all of the nutrients that we tested, but the only surplus that we saw was potassium. This surplus was also seen in the soil of our control which eliminates the potential effect that radioactivity would have left. Instead, there were deficiencies and depletion which can be attributed to other factors that are unrelated to Rocketdyne. These results contradicted our original hypothesis that the nutrients would display noticeable differences as the soil samples got closer to the Rocketdyne site. When comparing our samples to our control, the soil samples shared many of the same characteristics which leads to our conclusion that the radioactivity from Rocketdyne no longer affects the nutrients within the soil of nearby areas.

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