Recycling Plant Matter to Conserve Water:

Calculating the efficacy of green waste at increasing field capacity in sandy soils

Abstract

This experiment tested the efficacy of four different blends of green waste and Yuma-Mesa sandy soil at increasing field capacity in forty trials. Sandy soil field capacity was also calculated. Field capacity is the amount of water left in the soil after it has been thoroughly saturated and allowed to drain freely. Yuma-Mesa sandy soil and green waste were collected, sifted, and oven-dried. One hundred milliliters of soil and green waste/soil blends were prepared and placed in a coffee filter inside bottomed-out cups. The trials were saturated with distilled water and left to drain for 24 hours. The trials were weighed at the 24 and 48 hour marks. Field capacity was measured by dividing the weight of water in the soil by the weight of the soil. The hypothesis stated adding green waste to Yuma-Mesa sandy soil will increase field capacity because the green waste bonds with the soil and contains pores that store water. The hypothesis was supported. On average, after 24 and 48 hours, all of the blends had higher field capacities than sandy soil. The 5, 10, and 15% blends only had slightly higher field capacities than the control - less than two percent. However, the 20% blend increased field capacity by 4.64% after 24 hours and 3.92% after 48 hours. This is a statistically significant increase.

Narrative

My hypothesis stated adding green waste to Yuma-Mesa sandy soil will increase field capacity because the green waste bonds with the soil and contains pores that store water. Field capacity is the amount of water left in the soil after it has been thoroughly saturated and allowed to drain. Lake Mead is a reservoir built in the 1930s to hold excess Colorado River water. It is an essential source of water for agricultural production. In 2000, the reservoir was full. By 2021 it was at 27% capacity, which is dangerously low. An increase in snowfall in 2022 helped restore 20 feet of the lost water. This is a great step in the right direction; however, it will take at least four or five more years, similar to this one, to completely restore the lake. Increasing field capacity in soils conserves water by decreasing irrigation demand. It is critical that we find a multitude of ways to conserve water so that Lake Mead has time to recover. Green waste is recycled organic matter that can be used as a soil amendment to provide additional nutrients and increase the soil's ability to hold water. It consists of twigs, bark, grass clippings, etc. left after landscape maintenance. This experiment tested the efficacy of four different green waste/soil blends at increasing field capacity in Yuma-Mesa sandy soil after 24 and 48 hours. Ten trials were conducted for soil alone and each blend; data was collected from a total of fifty trials. In this experiment, the hypothesis was supported. The largest break in significance occurred in the 20% blend. After 24 hours, the 20% blend, on average, increased field capacity by 4.64%. After 48 hours, the 20% blend, on average, increased field capacity by 3.92%.

I learned many things from my research such as projected Lake Mead water levels, how soil holds water through its cation exchange capacity, the benefits of adding organic matter to soil, what green waste is, and the industry standard for green waste application. Lake Mead was at its lowest level in 2022, at 1,040 feet. It is projected to rise to 1,070 feet by February of 2024

because of historic snowfall and state and federal agreements to reduce water consumption from the Colorado River. If we continue to have high snowfall years, it will still take at least four years to fully recover.[1] Even though this indicates a positive trend, we are still in a drought and need to conserve water. The use of green waste as a soil amendment is one possible way to conserve water because it increases field capacity. Saturated soils require less irrigation.

An ion is an element with an electrical charge; if it is a positive charge, it is called a cation. Cation exchange capacity (CEC) is the total number of cations a soil can hold. CEC influences the soil's ability to hold onto essential nutrients, such as magnesium, potassium, and hydrogen. Soils with a high CEC also have a high field capacity. Organic matter has a high CEC, so adding it to soil helps the soil hold onto nutrients and water. Green waste is recycled organic plant matter that decomposes with time, and when not properly disposed of, ends up in landfills producing large amounts of methane gas. The industry standard is to add 3-5 tons of green waste per acre.

In this experiment, Yuma-Mesa sandy soil and green waste were collected, sifted, and oven-dried. One hundred milliliters of soil and green waste/soil blends were prepared and placed in a coffee filter inside bottomed-out cups. The blends were 5% green waste to soil, 10% green waste to soil, 15% green waste to soil, and 20% green waste to soil. Each type of soil and green waste/soil blend had 10 trials. There were a total of 50 trials. The trials were saturated with distilled water and left to drain in a sealed container for 24 hours. The trials were saturated again and left to drain in a sealed container for another 24 hours. Field capacity was measured by dividing the weight of water in the soil by the weight of the soil. It was expected that all of the

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[1] Nilsen, Ella and Renée Rigdon (2023, June 25). Here's how much Lake Mead could rise after an epic winter and new water cuts. Retrieved June 29, 2023, from the CNN website: https://www.cnn.com/2023/06/24/us/how-much-lake-mead-water-rise-climate/index.html

green waste/soil blends would have higher field capacities than sandy soil. This turned out to be true; on average, after 24 and 48 hours, all of the blends had higher field capacities than sandy soil. Statistically, there is not much difference in field capacity between the control and the 5%, 10%, and 15% blends. However, there is a statistically significant increase in the 20% blend. It increased field capacity by 4.64% after 24 hours and 3.92% after 48 hours.

The results of this experiment are promising, because they show that green waste, if applied in a high enough volume, has the potential to promote sustainable agriculture in times of drought by significantly increasing the field capacity of sandy soil. Green waste is also a great way to recycle organic plant matter by allowing it to decompose in soil rather than sit in a landfill and release methane gas into the atmosphere.

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