Animal Manures and the Growth Patterns of Plants

Sarah Ravert & Alexa Knellinger, Dr. Robin Shedlauskas

Abstract

Animal manure can be a valuable asset to assist in plant growth in both agricultural and commercial settings. Manure contains nutrients and organic matter that can be recycled into soil at act as an affordable fertilizer. Phosphate (P), potassium (K), and nitrogen (N) are the primary elements found in a stable fertilizer. Depending on the type of manure, certain components will either encourage or inhibit growth. This research investigates manure compositions of various species and compares the growth of the same tomato plant. The results are compared to determine which manure type produces the most optimal conditions for plants to thrive.

Introduction

There was a collection of manure from the animal species chosen for the project. The manure types were distributed into the appropriate pots, while additionally filling a pot with regular fertilizer only. From there, the tomato seeds were planted for germination and growth. .

After transferring the seedlings to the appropriate pots, check-ins occurred every other day to record if there were any changes in growth and to ensure all plants were hydrated. A log was kept to note any changes to demonstrate how successful each manure is at producing plant growth. As the plants are growing, analysis will also be conducted to investigate the breakdown of each manure and what levels of nutrients are found in each.

Methods

Sunrise F1 tomato sauce seeds were planted into seedling starter trays filled with neutral fertilizer and monitored for germination. For the following few weeks, equine, bovine (dairy and beef), porcine, ovine, rabbit, guinea pig, and poultry manure samples were collected and mixed in a 50:50 ratio with neutral soil. Two pots for each species were prepared as to decrease the odds of plant death/growth being due to chance. There is one pot for the control. Depending on germination yield, some pots received two seedlings per pot, some only received one. This selection was chosen randomly. During week 2 of plant growth in the pots, a neutral fertilizer (Osmocote) was sprinkled on top of the soil in each pot. This was to encourage plant growth during the adjustment period. Fresh manure samples were collected and sent to a lab to analyze their compositions. All plants were germinated and grown in the temperature controlled greenhouse space.

Results

The chicken manure plants did the poorest, resulting in one plant completely dying off and the other having a weak growth pattern. Chicken manure had the highest levels in all three components of nitrogen (N), phosphorus (P), and potassium (K), supporting the evidence found with the growth of the plants.

Beef cattle, dairy cattle, and equine had the most consistent growth results of all the plants. These were the strongest and largest of all the plants. When looking at the manure analysis, beef and dairy cattle had the lowest levels, also supporting the evidence from the plant growth.

The swine sample also did poorly when looking at its growth throughout the weeks. This was also a manure that had higher levels of all the components, especially P. While the plant did not died, it did struggle to grow and keep up with the other plants in the experiment.

While the guinea pig, rabbit, and sheep manure plants did grow better than the control, these plants did not exceed their opponents. This can be attributed to their varying levels of the nutrients. Guinea pig, for example, had a high ammonia N level, a high overall total N level, a high level of K, and an even higher level of P. While none were at detrimental levels, these results had consequences on the growth pattern. Rabbit had similar issues as the guinea pig, and sheep had low levels in all three, but not as low as the cattle manures were. Although it had stable growth, it did prove that having only a small increase in nutrient levels can positively affect plant growth.

Discussion

Literature found supports the hypothesis that excess ammonia is toxic for plant growth and well being of plants. It stunts the root growth of plants causing them to die or grow at a slow rate.

P fertilizer has been used in previous research to improve crop yield. It is necessary to have to harvest the sun's energy to assist in plant growth. Although, having too much phosphorus can damage the plant, and lead to iron and zinc deficiencies. This can be seen through the yellowing of leaves in plants.

K helps with the movement of water, nutrients, and carbohydrates in plant tissue. There is still a silver lining with K because if there is too much, it can hurt the plants overall health. It may not kill the plant immediately, but it keeps it from getting other nutrients it needs to thrive.

The plants with the manures that did well grow at a great rate and got larger than our control did over time. Regular potting soil may not contain every nutrients needed to help a plant thrive. Some components that could be correct for this project included measuring how much water and sunlight each plant got, measuring a 50/50 mix of manure and soil, carrying out the project until fruit is produced, and trying to control plant growth in the same direction (all vertical instead of horizontal)

Conclusion

Proper soil composition is crucial for the growth of plants. There must be a balanced mix of components; too much or too little of one compound could led to plant death. With this in mind, soil and fertilizer developers should consider these results when formulating new products for farmers/gardeners. Likewise, farmers can consider this data when looking to save money during crop season. It is important to remember the samples used were of fresh manure, not composted. Recycling manure not only has financial benefits, but also environmental effects by limiting waste. Equine, beef cattle, and dairy cattle manure produced the most consistent growth results, while chicken manure led to plant death.

References

Santoso, B, et al. "Effect of Zeolite and Cow Manure Application on Soil Nitrogen Content in Ramie (Boehmeria Nivea) Plant Growth." *IOP Conference Series: Earth and Environmental Science*, vol. 974, no. 1, 2022, https://doi.org/10.1088/1755-1315/974/1/012073.

Sawyer John Creswell Michael Tidman, John, et al. "Phosphorus Basics." *Phosphorus Basics Integrated Crop Management*, Iowa State University, 7 Aug. 2000, https://crops.extension.iastate.edu/encyclopedia/phosphorus-basics.

Kaiser, Daniel E. "Potassium for Crop Production." *UMN Extension*, https://extension.umn.edu/phosphorus-and-potassium/potassium-crop-production.

Liu, Ying, et al. "Ammonium Inhibits Primary Root Growth by Reducing the Length of Meristem and Elongation Zone and Decreasing Elemental Expansion Rate in the Root Apex in Arabidopsis Thaliana." *PLoS ONE*, vol. 8, no. 4, 2013, https://doi.org/10.1371/journal.pone.0061031.

Provin , T L, and J L Pitt. "Phosphorus - Too Much and Plants May Suffer." *Texas Cooperative Extension* , Texas A&M University, https://counties.agrilife.org/valverde/files/2014/11/Phosphorus-Too-Much-Plants-May-Suffer.pdf.