Summer (I) Research Proposal

Faculty Mentor: Dr. Rebecca Nelson

Topic: Leveraging Organic Underutilized Resources and Urine-Based Fertigation for Sustainable Urban and Peri-Urban Crop Production

Introduction

The global shift towards urbanization— an increase in the spread of a nation's population living in urban areas —has led to more than half of the world's population residing in urban and peri-urban environments (Satterthwaite et al., 2010, Hume et al., 2021). According to the Food and Agriculture Organization of the United Nations, urban and peri-urban environments are spaces within cities and surrounding regions. Urban and peri-urban agriculture has a crucial role in food and nutrition security in most low and middle-income countries and it's quite unfortunate that access to land in such contexts is becoming increasingly difficult (Satterthwaite et al., 2010). This trend of urbanization has been encountered with a concerning issue – soil contamination. Even though urban gardens are a potential source of affordable, locally grown, fresh produce, they may also increase exposure to heavy metals and toxic chemicals such as lead and other heavy metals present in the urban environment (Mitchell et al., 2014). Therefore, there is a need for innovative solutions to enable sustainable crop production, especially in such environments. Gardening in raised beds is encouraged among urban gardeners to help reduce exposure to soil contaminants (Mitchell et al., 2014). For example, in the Kibera slums of Nairobi, Kenya, sack gardening - a practice where growers plant vegetables into the sides and on top of growing media contained in sacks - has become more acclaimed (Gallaher et al., 2015)

For this summer, I aim to help investigate whether the utilization of urine, a valuable source of nutrients, in combination with crop residues, as a carbon source, can positively impact above-ground biomass across substrates, and whether the findings could be leveraged within the Circular Bionutrient Economy (CBE) framework; to transform organic waste into valuable agricultural inputs (Midega, 2022).

Proposed Methods

We will be conducting the experiments in a high tunnel using kale as a bioassay at Dilmun Hill Student Farm, at Cornell University, Ithaca, New York. Using a total of seventy-two, 30-gallon sacks, experimental units will be laid out in a completely randomized design with at least four replicates per treatment to compare urine versus Miracle-Gro® fertilizer on 4 different substrates: Maize Stover, Maize Stover ± Biochar, Wheat Straw Bales, and Field Soil.

Non-soil (organic underutilized resources) experimental units will undergo initial conditioning with full-strength urine and concentrated Miracle-Gro® for one month, then two four-week-old dinosour kale plants (cultivar Black Mamba) will be transplanted into each unit.

Units will be fertigated once every week: urine at a rate of ⅛ dilution with water and Miracle-Gro® mixed at the standard rate (24-8-16).

Throughout the growing season, plant health (on a qualitative 0-3 scale) and leaf length will be measured at multiple time points. Wet and dry biomass will also measured at the end of the season.

Anticipated Results

Research by Midega (2022) found that the utilization of urine in combination with crop residues can positively impact plant performance. Therefore, we hope that urine-fertilized units will exhibit comparable performance to Miracle-Gro® in terms of promoting plant growth and development.

Conclusion

The research will help underscore the effectiveness of urine-fertilized raised bed media in supporting crop growth and highlight the significance of appropriate substrate combinations. This study will also contribute to the growing body of knowledge on sustainable urban agriculture, offering insights into innovative strategies that can enhance food security and mitigate the adverse effects of soil contamination in densely populated regions.

References

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