

# EVALUATING PHENOLICS OF MEDICINAL PLANTS IN GREEN ROOF AGRIVOLTAIC SYSTEMS

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## PROJECT INTRODUCTION



### OBJECTIVES:

- Explore the growth, yield, and phenolic content of 5 species of medicinal herbs.
- Study the reciprocal interactions between vegetation grown at ground level (at grade) compared to a rooftop agrivoltaic system.
- Screen selected species for health relative to the environment by observing growth rate, relative chlorophyll content, dry weights, chamomile flower count, and total phenolic content per species.

### Rooftop Agrivoltaics (RTA):

-When solar panels are vertically integrated into rooftop agriculture systems, it is known as rooftop agrivoltaics (Boussetot et al. 2020).



### Phenolics:

-Phenolic compounds are a large class of molecules produced by plants that show a wide range of distinct biological activities. Phenolic compounds play important roles in many physiological processes and activities such as antioxidant, antimicrobial, anticarcinogenic, anti-inflammatory, plant stress resistance, and plant quality. (Zhang et al. 2022).

**We hypothesize that medicinal plants grown in rooftop agrivoltaic systems will result in comparable or potentially enhanced phenolic content for the 5 species observed compared to the plants grown at grade.**

## INTERNSHIP GOALS

- Gain hands-on experience in both lab and field in rooftop agriculture and rooftop agrivoltaic systems as well as research pertaining to green roof agriculture and RTA.
- Collect data, assist with data analysis.
- Interact with professionals and gain experience in the areas of green roof systems, extension, horticulture.
- Develop my own research questions relating to rooftop agricultural systems and rooftop agrivoltaics.
- Build scientific communication skills.

## HOW DOES THIS APPLY TO YOUR EDUCATION

My future academic and career goals lie in applying my horticultural science education to urban agriculture systems, and sustainability in agriculture. Growing food and beneficial medicinal plants on rooftops under solar panels has been a real-life, hands-on application of my present and future goals. Gaining an understanding of how research is performed, analyzed, and interpreted has been and will continue to be extremely beneficial as I move through my senior year at CSU and beyond.

## WHAT YOU DID



### TREATMENTS, METHODS, & DATA COLLECTION:

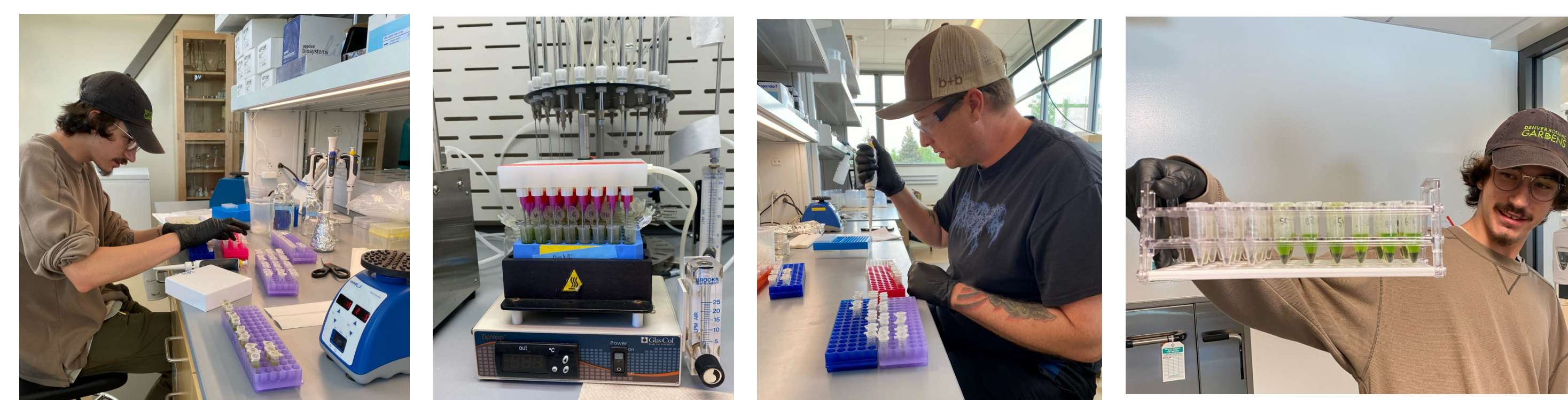
Experiments for 2023 were conducted on the 5<sup>th</sup> floor roof of the Hydro building at CSU Spur, as well as an at grade plot at the Hydro building, and at grade full sun plot and solar array plot at the CSU foothills campus.

- Crops were started from seed and transplanted in early June 2023, into each respective treatment plot in a randomized order.
- Data was recorded at regular intervals on growth rate, flower count, stomatal conductance, and relative chlorophyll content.
- Experiments for 2022 were conducted on the 4th floor rooftop, Terra building, located at the Colorado State University Spur campus summer 2022, and a field plot site (at grade).
- Phenolics analysis for 2022 experiments was performed in May 2023, (shown below).
- Phenolics analysis for 2023 crops (pictured above) will be performed in Fall of 2023. (See next steps)



### PHENOLICS ANALYSIS:

-Phenolics analysis was performed in Spring of 2023 using the F-C method on plant material grown in summer of 2022. This analysis will yield data that tells us the phenolic content of each species tested per treatment. A phenolics analysis will be performed post harvest on 2023 crops during fall of 2023, and the data will be compared to the phenolic data from 2022.



Phenolic assay performed by B. Adams, K. Braun, S. Boyko, Dr. S. Toulabi – CSU Agricultural Chemistry Lab 2023

## WHAT YOU LEARNED

Figure 1.

Dry weights were collected twice during the summer 2022. (Figure 1.) The average dry weight will be compared to the treatments (pictured left) over the course of our summer research in 2023. The dried plant material will be used to perform the phenolic analysis.

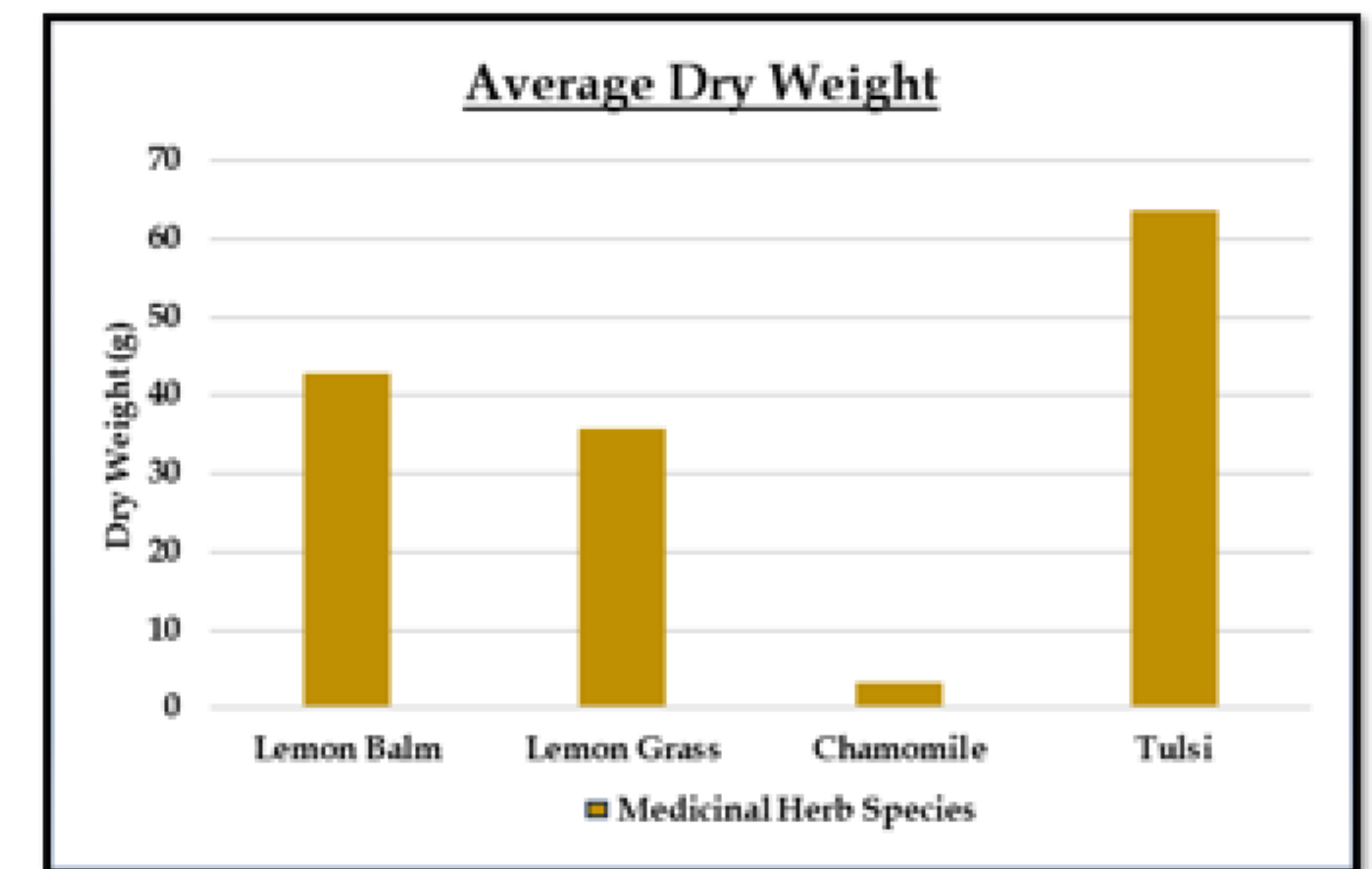


Figure 1. Medicinal Plants Average Dry Weight 2022.

Figure 2.

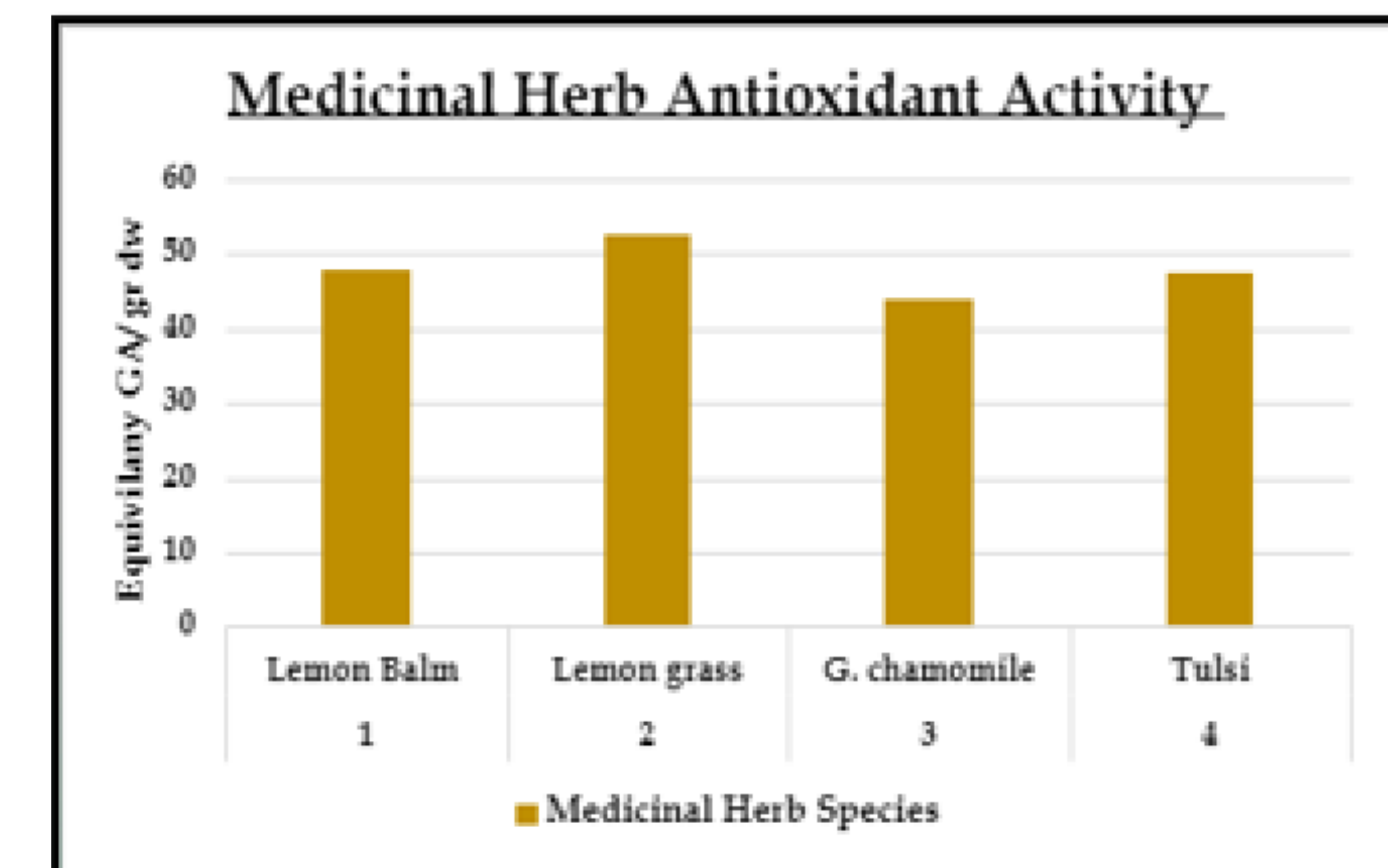


Figure 2. Medicinal Plants Antioxidant Activity 2022.

(Figure 2.) The total phenolics assay shown describe the antioxidant (phenolic) activity of medicinal plants investigated in 2022. Studying and comparing total phenolics may inform rooftop producers of the potential quality and value of medicinal plants grown in rooftop agriculture systems.

## NEXT STEPS

- Analysis of phenolic content of crops grown under all treatments, summer 2023.
- We expect that medicinal plants grown under RTA systems (summer 2023), will provide comparable phenolic activity to the phenolic activity data from summer 2022. We also expect to see comparable phenolic activity in the crops grown at grade, as well as from the full sun rooftop treatment in summer 2023.
- Comparable results of phenolic activity between different treatments provides justification for further research on the influence of rooftop agrivoltaic systems on phenolic activity in medicinal plants. Comparable phenolic activity would show that medicinal plants produce phenols just as well in an RTA system as they do without being in an RTA system.