Can Vertical Farm Production Improve Plant Quality and Reduce Water Loss in African Marigold and Sage Crops?

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Introduction

As the frequency of droughts increases worldwide, it is crucial we limit our water consumption to protect our planet's health. Vertical farms are known to save water and provide a more controlled environment than traditional field cultivation.

- **Objective:** Given our desert location, this experiment aims to measure how well plants grow in indoor vertical farms compared to field environments.
- **Hypothesis:** It is hypothesized that plants grown in the vertical farm will have higher survival rates, consume less water, grow taller, and develop more leaves than plants grown in the field condition.
- **Expected outcomes**: This comparative analysis will help us better understand the advantages and disadvantages of growing crops in both environments. By evaluating our results, we can make informed and conscious decisions regarding sustainable cultivation practices in areas where water is scarce.

Materials and Methods

Plant Materials

- African Marigold (*Tagetes erecta*) 'Antigua Orange'
- Sage (*Salvia officinalis*)

Growth Conditions

	Young plant	Finishing plant	
Location	Vertical Farm	Vertical farm	Field
Container	128-cell plug	4-inch pots	
Nutrient solution	100 ppm nitrogen	150 ppm nitrogen	
Lighting	LED lighting	LED lighting	Sunlight
Daily light integral ($mol \cdot m^{-2} \cdot d^{-1}$)	13.2	13.2	18.1

Results

Fig. 1. Side (left) & top (right) view comparison of African marigold plants grown in the field (F) & vertical farm (VF) conditions. Pictures taken 50 days after sowing on 9/12/2023.

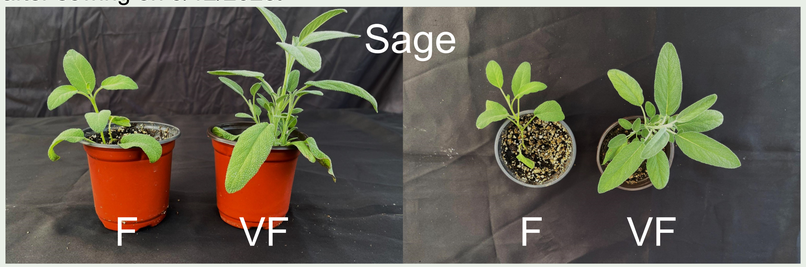

Fig. 2. Side (left) & top (right) view comparison of sage plants grown in the field (F) & vertical farm (VF) conditions. Pictures taken 50 days after sowing on 9/12/2023.

Table 1. Survival rate and average leaf number of African marigold and sage after 50 days growing in the vertical farm and field conditions.

	African Marigold		Sage	
	Vertical farm	Field	Vertical farm	Field
Survival rate	100%	95%	100%	40%
Leaf Number	20.0±3.3	14.4±4.1	25.8±8.4	9.0±4.3

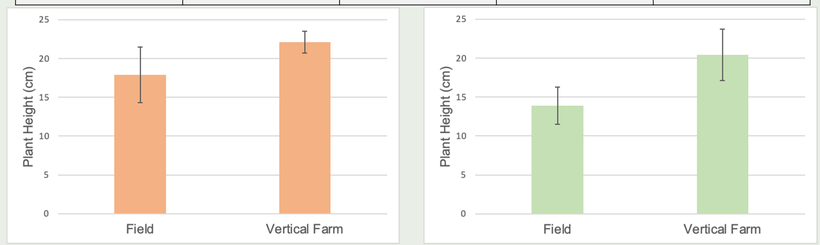

Fig. 3. Average plant height of African marigold (left) and sage (right) grown in field vs. vertical farm conditions.

Results

Table 2. Air temperature and relative humidity for the young plant stage and finishing stage in both vertical farm and field conditions.

	Young Plant Stage (9/12-10/3)	Finishing Plant Stage (10/4-10/31)	
	Vertical Farm	Vertical Farm	Field
Temperature (°C)	22.4±1.5	21.8±1.2	29.5±10.8
Relative Humidity (%)	53.8±5.3	52.7±4.7	37.6±6.1

Table 3. Comparison of total water consumption of African marigold and sage per plant per individual plant and per treatment. (* = field water consumption per treatment data altered to show consumption if all plants had survived).

Water consumption (L)	African marigold		Sage	
	Vertical farm	Field	Vertical farm	Field
Per plant	3.9	5.2	3.9	5.3
Per treatment	77.2	105.2*	77.2	105.2*

Conclusions

- Vertical farm production increased survival rates of both species.
- Vertical farm production required less water per plant and per treatment.
- Vertical farm production resulted in greater average plant height.
- Vertical farm production increased average plant leaf number resulting in fuller growth.
- Field production promoted more efficient flowering in African Marigolds.