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Influence of LED spectra on yield and phytochemical content of Chinese Kale (*B. oleracea* var. *alboglabra*) in a Hydroponic Vertical Farming System

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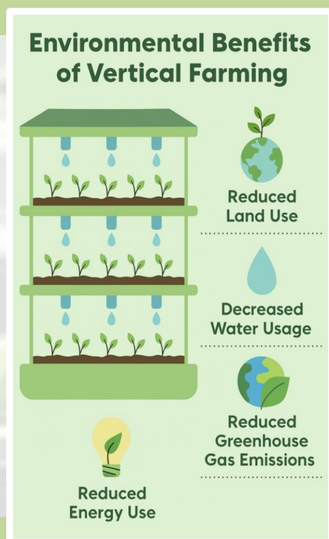
INTRODUCTION & AIMS

- Global population projected to reach 9.7 billion by 2050 and 11+ billion by 2070, with 70 % urban; arable land shrinks and food-security risk rises.
- Conventional farming cannot easily boost output due to land scarcity and environmental degradation.
- Hydroponic Vertical Farming System (HVFS): soil-less, stack-layer, water-efficient, weather-proof – gives higher yields per m² and can be deployed anywhere.
- Integrating LED recipes could further enhance yield & quality of plants
- Chinese kale (Kailan): a nutrient-dense (glucosinolates, phenolics, anthocyanins, vitamins), expanding market, and responds well to red:blue LED spectra.
- Study tests LED spectral recipes in HVFS to maximize both yield and phytochemical quality of Chinese kale.



METHODS

Fig. 2

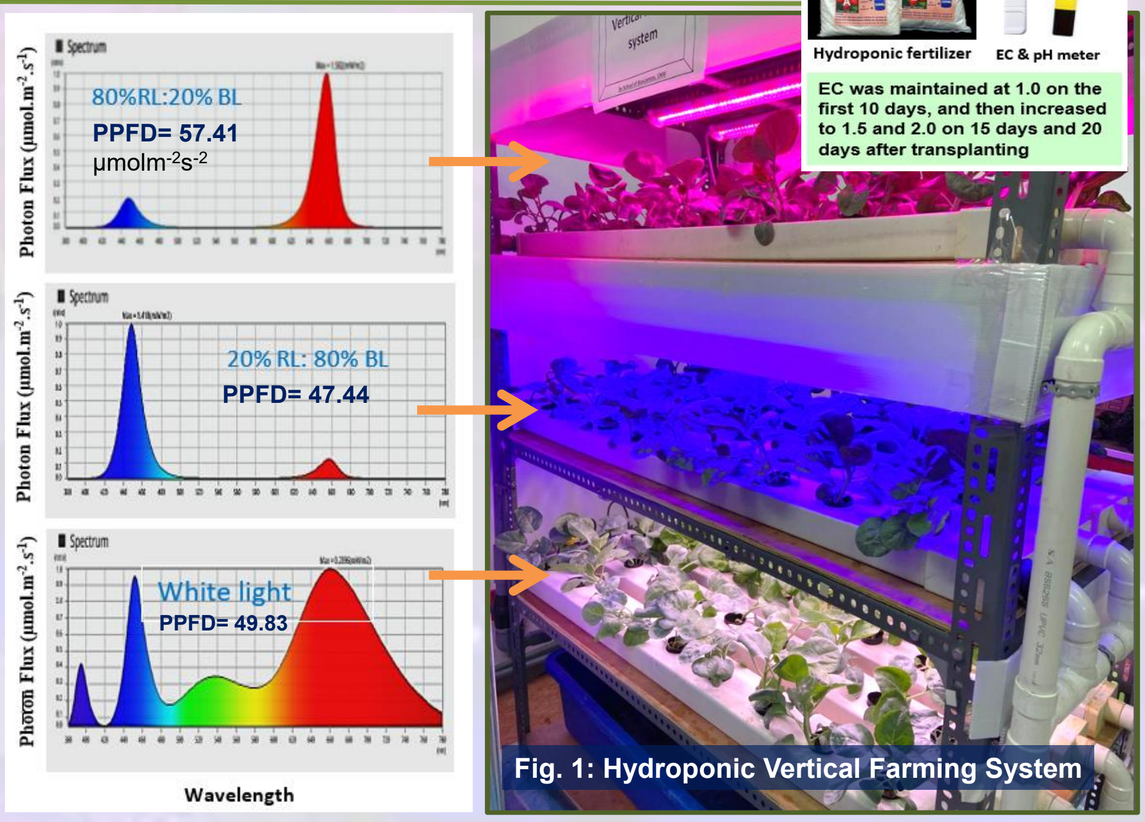


Fig. 1: Hydroponic Vertical Farming System

Data Collection & Analysis: Fresh and dry weight, Quantum yield, Chlorophyll, Anthocyanin and phenolic content. Data analysed using one-way ANOVA using SPSS 29.

RESULTS & DISCUSSION

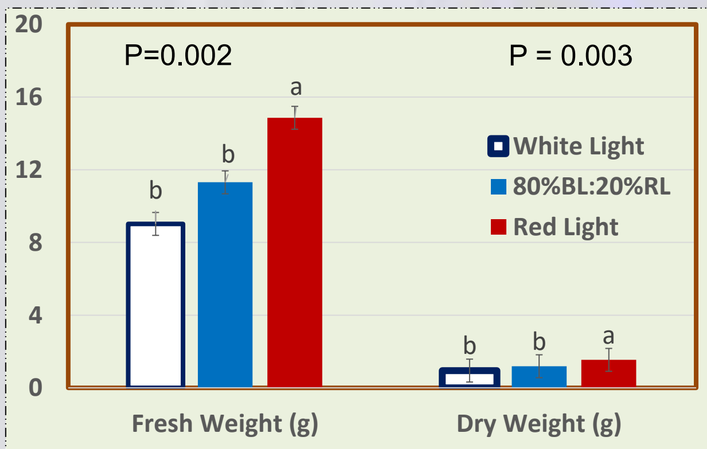


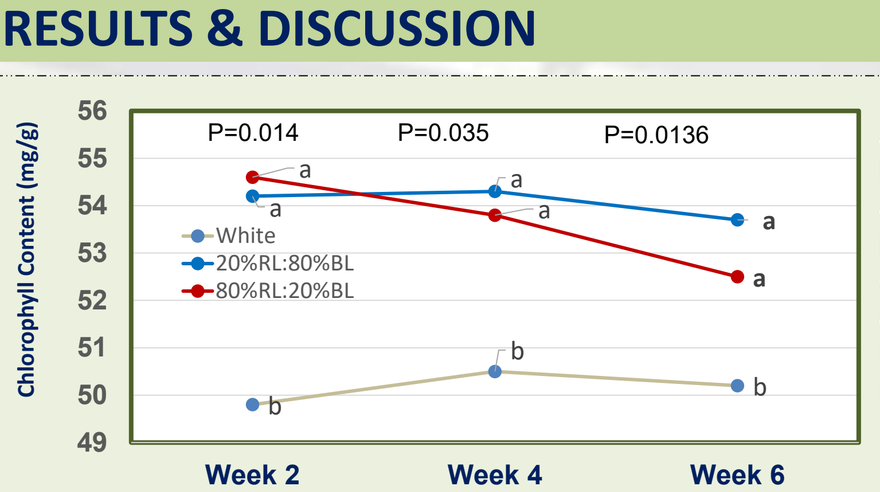
Fig 4: Effects of LED lights on fresh & dry weights of Kailan.

Within a parameter, bars with the same letters are not significantly different

WL=White Light; RL= Red Light; BL=Blue Light

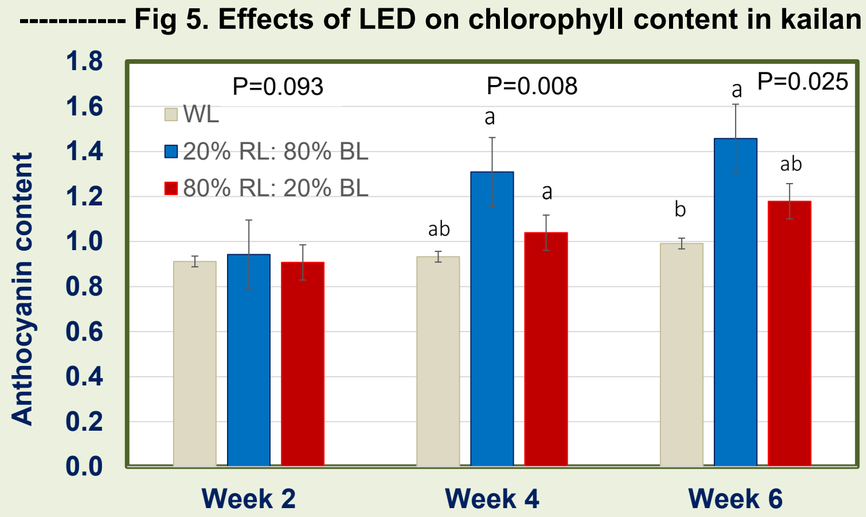
- **80%RL:20%BL maximized biomass: Chlorophyll/ phytochrome absorption (Metallo et al., 2018).**

RESULTS & DISCUSSION



20% blue light boosted chlorophyll, anthocyanin, phenolics through cryptochrome-activated PAL/CHS/DFR genes (Zhang et al., 2020).

---------- Fig 5. Effects of LED on chlorophyll content in kailan at 2, 4 & 6 WAT ----------



80 % red → yield; 20 % red → nutrition; white inferior-tune R:B for balance (Holz et al. 2020).

---------- Fig 6. Effects of LED on anthocyanin content in kailan at 2, 4, & 6 WAT----------

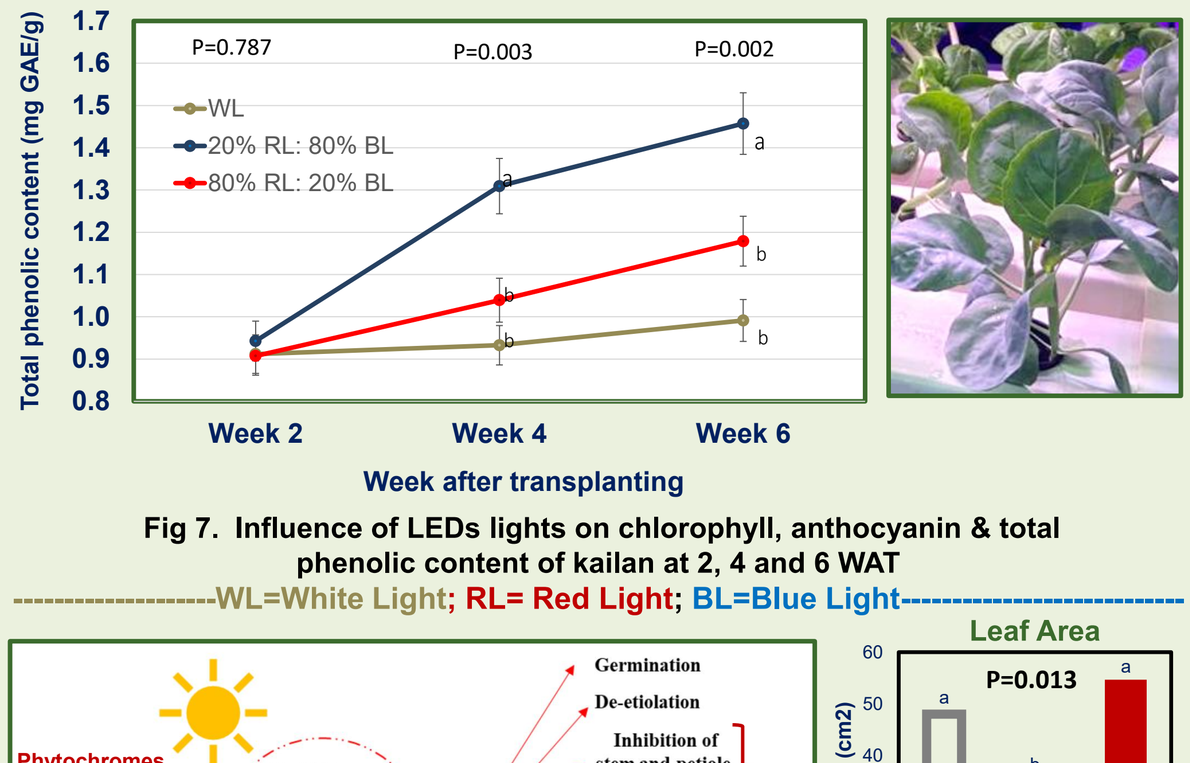


Fig 7. Influence of LEDs lights on chlorophyll, anthocyanin & total phenolic content of kailan at 2, 4 and 6 WAT

----------WL=White Light; RL= Red Light; BL=Blue Light----------

CONCLUSIONS

- **Red Light [80%RL:20%BL] increased biomass/fresh weight & dry weight of kailan.**
- **Blue Light [20%RL:80%BL] increased phenolic (phytochemical) content.**
- **White light triggers shade-avoidance syndrome (increased height, suppressed roots) (not presented)**
- **Growth vs. secondary-metabolism trade-off is light-ratio dependent and species-specific.**

REFERENCES

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