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Effect of Media on Lablab (*Lablab purpureus var. typicus*) for Yield and Quality under Soilless Vertical Farming System

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ABSTRACT

Background: Lablab (*Lablab purpureus var. typicus*) is one of the important leguminous vegetable crops known for its highest content of protein. The area under cultivation is shrinking due to conversion of farm land into non-agricultural purposes. Under these circumstances, soilless vertical farming system is the only alternate cultivation system for increasing production of vegetables. Media play a major role in growth and yield of vegetables under soilless conditions. With this background, the present experiment was carried out to study the effect of growing media in lablab for high yield and quality under soilless vertical farming systems.

Methods: Two lablab varieties *viz*., CO 5 (V_1) and Arka Prasidhi (V_2) were raised under five different media combinations *viz*., 100% cocopeat (M_1), 50% cocopeat + 50% Vermicompost (M_2), 50% cocopeat + 50 % FYM (M_3), 50% cocopeat + 25% vermicompost + 25% FYM (M_4) and Control (M_5) with three replications during 2021-2022 and 2022-2023. This experiment was laid out in FCRD. The growth and yield parameters were recorded and the data was subjected to statistical analysis.

Result: The experimental results revealed that both the varieties and growing media provided significant impact on growth, yield, quality and uptake of nutrients whereas dry matter content exhibited no significant impact among the different media. The pooled season data revealed that variety CO 5 observed for the overall superior performance while the media combination of 50% cocopeat + 50% Vermicompost considered superior for growth and yield characters where 50% cocopeat + 25% vermicompost + 25% FYM showed superiority for the quality parameters and uptake of nutrients.

Key words: *Lablab purpureus*, Nutrient uptake, Soilless cultivation, Vertical farming.

INTRODUCTION

Lablab (*Lablab purpureus var. typicus*) is one of the important leguminous annual originated from South Asia and widely grown throughout the tropical and subtropical regions of the world. The crop is well known for its edible pods that are consumed as vegetable. The pods are rich in protein (20-25%) and also contain iron, magnesium, phosphorous, potassium, zinc and copper in significant quantities. In order to increase the cultivable area for increasing food production for growing population, usage of vertical space is the only best option. System of producing crops in vertically stacked layers is known as vertical farming. This system of cultivation paves way for sustainable agriculture as the natural resources are effectively utilized. Selection of variety is an important criterion in vertical farming for yield and quality enhancement. Production of lablab was greatly affected by soil borne constraints such as acidity, alkalinity, salinity, pests, diseases and weeds (Khan *et al.,* 2020). Cocopeat is a widely used soilless media having good water holding capacity due to porous nature and higher amount of organic matter. Vermicompost contains higher level of nitrogen in the form of nitrate or ammonium, exchangeable phosphorous, soluble potassium, calcium, and magnesium. Cocopeat and vermicompost together increased the levels of organic carbon, C/N ratio and nutrient content of the soil. The humic acid present in vermicompost increases the rhizosphere microbial activity which increases the activity of phosphatase and catalase farm yard manure (FYM) was commonly used as manure to the plants with the ability to hold the nutrients for the availability of plants (Sharma and Verma, 2011). With this background, the present investigation was undertaken to standardize the suitable variety and media for growing lablab under the soilless vertical system of cultivation.

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MATERIALS AND METHODS

The experiment was conducted at Horticultural College and Research Institute for Women, Tiruchirappalli, Tamil Nadu

for two years *viz*., 2021-2022 and 2022-2023. The experiment was laid out in factorial completely randomized design (FCRD) and replicated thrice.

Following lablab varieties are taken for this experiment.

V_1 - CO 5 (Released from TNAU, Coimbatore).

V_2- Arka Prasidhi (Released from ICAR IIHR, Bengaluru).

The media combinations used in this experiment were as follows:

M_1 - 100% Cocopeat.

M_2 - 50% Cocopeat + 50% Vermicompost.

M_3 - 50% Cocopeat + 50% Farm yard manure (FYM).

M_4 - 50% Cocopeat + 25% vermicompost + 25% FYM.

M_5 - Control (Field soil - sandy loam).

The seeds were sown in the 5″ net pots under trellis model of vertical farming system. Net pots were kept at the spacing of 15 cm between each pot under the trellis system. Thinning was performed to maintain two plants per pot. Five plants were selected randomly and tagged for recording the observations under each treatment. The growth parameters *viz.,* vine length, leaf area and root length; yield parameters *viz.,* number of pods per plant, single pod weight, yield per plant and dry yield per plant; quality parameters *viz.,* nitrogen, phosphorous, potassium, calcium, crude fibre, crude protein and dry matter.

The per cent of dry matter was estimated by the method of Ahmed *et al.* (1999). The crude protein content in the tender pods was estimated as per the procedure suggested by Lowry *et al*. (1951). The crude fibre content of pods was estimated by the method of Chopra and Kanwar (1976). Uptake of major nutrients *viz.,* nitrogen, phosphorous, potassium and calcium were calculated and expressed in g plant^{-1}.

Statistical analysis

The pooled data was subjected to statistical scrutiny by Panse and Sukhatme (1985). The ANOVA and critical difference at five per cent level of significance were calculated. Regression results were interpreted statistically using Graphpad Prism software (version 8.4.2).

RESULTS AND DISCUSSION

Growth parameters

The results revealed that significant difference exhibited in both variety and media for vine length and root length while the leaf area exhibited significance for media alone (Table 1).

The maximum length of vine (374.63 cm) observed under the media combination of 50% cocopeat + 50% Vermicompost for both the varieties of lablab (CO 5 and Arka Prasidhi). Similarly, highest leaf area (77.18 cm^2) was observed under 50 % cocopeat + 50% Vermicompost. There is no significant differences were recorded among the varieties for leaf area. The lablab variety CO 5 recorded highest root length (106.61 cm) followed by Arka Prasidhi (102.41 cm). Among the different media combinations studied, lablab grown under 50 % cocopeat + 50% Vermicompost recorded highest root length (117.46 cm) compared over the control (90.80 cm). Increased root length obtained from the addition of vermicompost to the substrate was in accordance with the findings of Artursson *et al.* (2006) where humic acid present in vermicompost enhanced the occurrence of arbuscular mycorrhizal fungi and rhizobial colonization in plant roots by providing nutrients to the microorganisms.

The present experimental results were supported by Brunda and Singh (2023) in capsicum. Gruda *et al.* (2016) reported that cocopeat improved the physical stability with high cation exchange capacity and water holding capacity. This in turn might increase the growth and quality of the plants. The availability of nitrogen in the vermicompost at the form of NH_4^+ ion contributes for the high cation exchange

Table 1: Effect of varieties and growing media on growth and yield parameters of lablab.

Treatments	Growth parameters			Yield parameters			
	Vine length (cm)	Leaf area (cm^2)	Root length (cm)	Yield plant^{-1} (g)	No. of pods plant^{-1}	Single pod weight (g)	Dry yield plant^{-1} (g)
Variety							
V_1	329.07	72.69	106.61	360.74	23.46	7.76	27.64
V_2	321.52	71.34	102.41	342.71	21.03	7.14	25.22
SEd	2.74	0.75	0.99	2.80	0.20	0.06	0.31
CD(P=0.05)	5.76	NS	2.08	5.89	0.42	0.13	0.65
Media							
M_1	302.47	70.24	98.37	312.53	19.28	7.09	23.75
M_2	374.63	77.18	117.46	403.70	27.02	8.49	30.67
M_3	310.09	71.51	104.75	341.95	22.30	7.78	25.66
M_4	366.14	74.01	111.19	394.60	25.78	7.40	29.80
M_5	273.17	67.15	90.80	300.86	16.88	6.50	22.28
SEd	4.34	1.19	1.57	4.43	0.32	0.10	0.49
CD(P=0.05)	9.11	2.49	3.30	9.31	0.67	0.21	1.03

V_1- CO 5; V_2- Arka Prasidhi.

M_1- 100% coco peat; M_2- 50% coco peat + 50% Vermicompost; M_3- 50% coco peat + 50% FYM; M_4- 50% coco peat + 25% vermicompost + 25% FYM; M_5- Control (soil).

capacity. Vermicompost possess higher amount of humic substances and this enhanced plant growth, increased porosity and microbial activity in soil, thereby improving water retention and aeration (Rehman *et al.,* 2023). Cocopeat and vermicompost were commonly used together often in order to retain more amount of moisture and providing essential nutrients for the better growth of plants.

Yield parameters

Yield parameters exhibited significant variation with the different varieties and media for all treatments (Table 1).

The variety CO 5 inferred significantly the highest yield per plant (360.74 g), number of pods per plant (23.46), single pod weight (7.76 g) and dry yield per plant (27.64 g). A marked variation was noticed among the different media combinations where lablab under 50 % cocopeat + 50 % Vermicompost depicted highest yield per plant (312.53 g), number of pods per plant (19.28), single pod weight (7.09 g) and dry yield per plant (23.75 g).

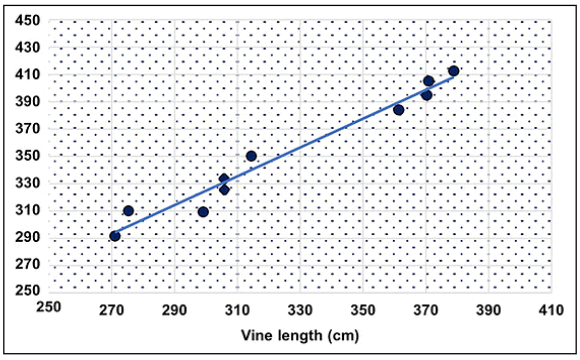


Fig 1: Relationship between vine length and yield per plant.

Yield per plant (g)

Cocopeat increased the porosity, absorbs more nutrient and release them according to the plants need (Kavitha and Vadivel, 2008). Increased yield obtained from the addition of vermicompost could be due to the proliferation of the microbial community in the substrate combined with the low C: N (carbon:nitrogen) ratio (Alcantara and Gonzaga, 2020). This was also supported with the findings of Bhadauria *et al.* (2014). Vermicompost improved physical, chemical and biological properties of soil which in turn increased the yield. Regression analysis revealed that vine length was closely related to the yield per plant (R^2= 0.97) and inferred that increasing vine length continuously increased the yield per plant (Fig 1).

Quality parameters

The results revealed that various quality parameters *viz.,* nitrogen, phosphorous, potassium and calcium contents varied significantly among varieties and media whereas dry matter content showed no significance among media but varied significantly among varieties (Table 2).

Crude fibre and crude protein showed significant variation for the media alone. Among the two varieties, the highest contents of nitrogen (0.47%), phosphorous (0.40%), potassium (0.52%) and calcium (1.18%) were observed in the variety CO 5. The varieties grown under 50% cocopeat + 25% vermicompost + 25% FYM recorded highest levels of nitrogen (0.55%), phosphorous (0.51%), potassium (0.58%) and calcium (1.26%).

The highest amount of crude fibre (9.94%) and crude protein (32.16%) were observed significantly under the media combination of 50% cocopeat + 25% vermicompost + 25% FYM. There is significant difference observed for

Table 2: Effect of varieties and growing media on quality parameters of lablab.

Treatment	Nitrogen (%)	Phosphorous (%)	Potassium (%)	Calcium (%)	Crude fibre (%)	Crude protein (%)	Dry matter (%)
Variety							
V_1	0.47	0.40	0.52	1.18	9.43	31.20	7.65
V_2	0.44	0.37	0.48	1.14	9.31	30.97	7.35
SEd	0.00	0.00	0.00	0.01	0.09	0.27	0.08
CD (P=0.05)	NS	NS	0.00	0.03	NS	NS	0.13
Media							
M_1	0.40	0.31	0.46	1.11	9.15	30.70	7.48
M_2	0.45	0.38	0.50	1.17	9.29	31.07	7.60
M_3	0.52	0.45	0.55	1.23	9.48	31.42	7.50
M_4	0.55	0.51	0.58	1.26	9.94	32.16	7.55
M_5	0.37	0.28	0.44	1.05	9.00	30.08	7.40
SEd	0.00	0.00	0.00	0.02	0.15	0.43	0.13
CD (P=0.05)	0.01	0.01	0.02	0.05	0.31	0.90	NS

V_1- CO 5; V_2- Arka Prasidhi.

M_1- 100% coco peat; M_2- 50% cocopeat + 50% Vermicompost; M_3- 50% cocopeat + 50% FYM; M_4- 50% cocopeat + 25% vermicompost + 25% FYM; M_5- Control (soil).

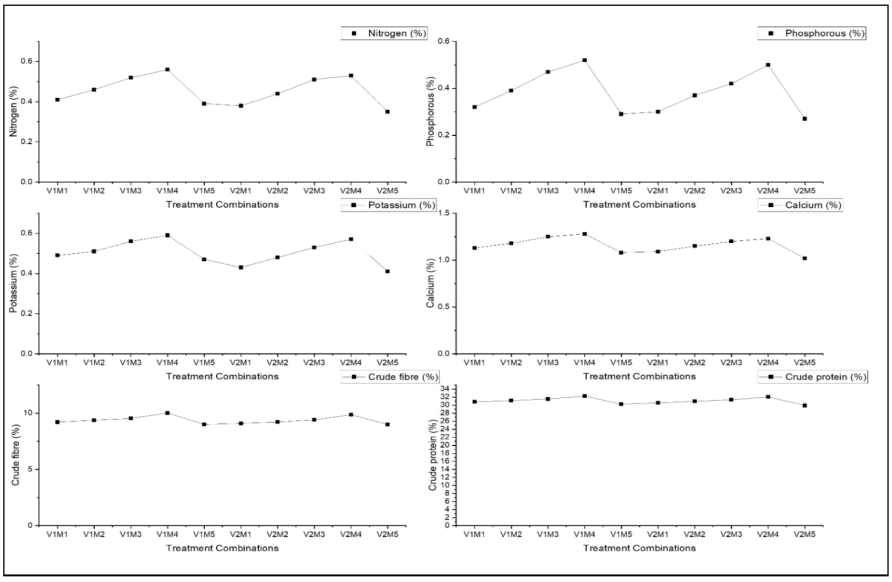


Fig 2: Influence of variety and media on quality parameters of lablab.

Table 3: Effect of varieties and growing media on uptake of nutrients in lablab.

Treatment	Nitrogen uptake (g plant^{-1})	Phosphorous uptake (g plant^{-1})	Potassium uptake (g plant^{-1})	Calcium uptake (g plant^{-1})
Variety				
V_1	0.13	0.11	0.15	0.33
V_2	0.11	0.10	0.12	0.29
SEd	0.00	0.00	0.00	0.00
CD (P=0.05)	NS	NS	NS	0.01
Media				
M_1	0.09	0.07	0.11	0.26
M_2	0.14	0.12	0.15	0.35
M_3	0.13	0.11	0.14	0.32
M_4	0.16	0.15	0.17	0.37
M_5	0.08	0.06	0.10	0.24
SEd	0.00	0.00	0.00	0.00
CD (P=0.05)	NS	0.01	0.01	0.02

V_1- CO 5; V_2- Arka Prasidhi.

M_1- 100% cocopeat; M_2- 50% cocopeat + 50% Vermicompost; M_3- 50% cocopeat + 50% FYM vermicompost +25% FYM; M_4- 50% cocopeat + 25%; M_5- Control (soil).

varieties (Fig 2) and the variation exhibited higher in variety CO 5 (7.65 %).

The present findings were in accordance with Spehia *et al.* (2020) in tomato. In general, vermicompost were rich in humic acid, which could improve the plant nutrition and soil fertility. Superiority of vermicompost in increasing the quality of the produce was supported with the findings of Maji *et al.* (2017). Vermicompost added to the cocopeat enhanced the quality and this might be due to the increased microbial activities in the substrate (Bending *et al.,* 2002 and Bice *et al*., 2022).

Nutrient uptake

Nutrient uptake shows the ability of plants to uptake the nutrients that was available in the substrate and provide the economic yield. The present results depicted in Table 3 interpreted that uptake of various nutrients *viz.,* nitrogen, phosphorous, potassium and calcium showed significant differences within variety and media combination.

The nutrient uptake studies elucidated that the two varieties of lablab showed better accumulation of nutrients through the effective uptake of nutrients that was available in the different growing media evaluated compared over the control. Control showed minimum uptake of all the nutrients due to the poor ability of uptake and minimal availability of nutrients in the soil than the other soilless growing media. Both the variety and media played a major role in the uptake of nutrients in providing economic yield.

The results on uptake of nutrients were in accordance with the findings of Spehia *et al.* (2020) in tomato. Cocopeat contains significant amount of natural phosphorus and potassium (Rymbai *et al*., 2024). Vermicompost contains nitrogen (NH_4^+ and NO_3^- ions), phosphorous and potassium in readily available form and facilitated the easy uptake of nutrients by the media. The findings of Pathma and Sakthivel (2012) revealed that humic substances present in vermicompost boosts up the growth and development of indigenous microorganisms and this in turn increased the availability of more nutrients in the substrate. The low C:N ratio in the addition of vermicompost to the substrate insisted for easy decomposition and mineralization (Vennila *et al*., 2024). Mineralization favoured for the effective uptake of nutrients to the plants from the media. Farm yard manure improved the soil structure, increased the capacity of the soil to hold more water and nutrients thereby noticed for improved delivery of nutrients (Yitbarek *et al*., 2024).

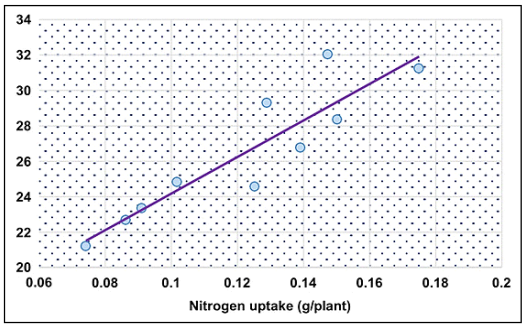


Fig 3: Relationship between nitrogen uptake and dry yield per plant.

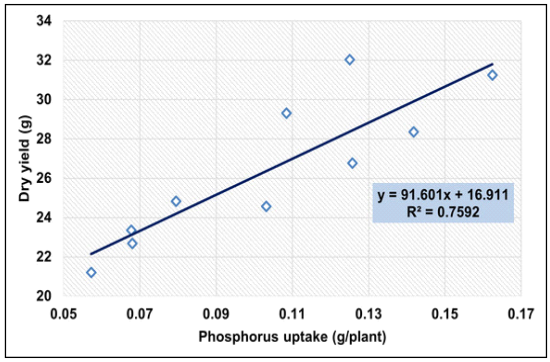


Fig 4: Relationship between phosphorous uptake and dry yield per plant.

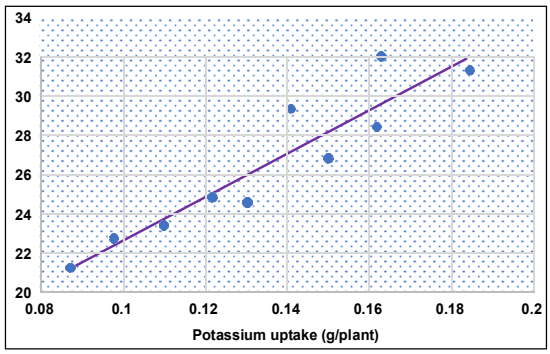


Fig 5: Relationship between potassium uptake and dry yield per plant.

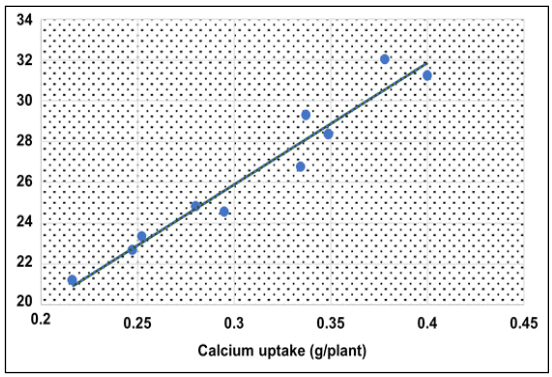


Fig 6: Relationship between calcium uptake and dry yield per plant.

The difference in the uptake of nutrients under soilless media and control interpreted that there was a greater potential in using the soilless media for increased economic yield and better accumulation of nutrients. The uptake of nutrients largely depends on the dry matter produced and nutrient accumulation in the pods. Highest dry yield and accumulation of nutrients in variety CO 5 resulted in the highest uptake of nutrients. Among the media, lablab grown under 50% cocopeat + 25% vermicompost + 25% FYM greatly increased the accumulation of nutrients than the other media and this favored for the better uptake of nutrients. Comparatively though the dry yield produced under the media combination of 50% cocopeat + 25% vermicompost + 25% FYM was not the highest; the richness of nutrient availability in the media encouraged for the better nutrient uptake and nutrient accumulation.

The regression analysis depicted that the dry yield of plant was associated with uptake of nutrients *viz.*, nitrogen (0.82%), phosphorous (0.76%), potassium (0.87%) and calcium (0.94%). Among various nutrients, the uptake of calcium is closely related to the dry yield per plant (Fig 3-6).

CONCLUSION

The experimental results revealed that both variety and growing media had a significant effect on growth and yield attributes while media alone exhibited significant for quality parameters of lablab produced under soilless vertical farming system. Among the varieties, CO 5 was considered superior over the other variety Arka Prasidhi for growth yield, and quality parameters and uptake of nutrients. Among the growing media, 50% cocopeat + 50% Vermicompost considered superior for growth and yield characters where 50% cocopeat + 25% vermicompost + 25% FYM showed superiority for the quality parameters and uptake of nutrients.

Conflict of interest

All authors declare that they have no conflicts of interest.

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