The Pharma Innovation Journal 2022; 11(2): 2601-2607

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(2): 2601-2607

www.thepharmajournal.com
Received: 14-12-2021
Accepted: 23-01-2022

Ramya S
M.Sc., Department of Horticulture and Vegetable Sciences, College of Horticulture, Bengaluru, Karnataka, India

Meenakshi Sood
Assistant Professor, Department of Vegetable Sciences, College of Horticulture, Bengaluru, Karnataka, India

Lingaiah HB
ICAR – Emeritus Scientist, Department of Vegetable Sciences, College of Horticulture, Bengaluru, Karnataka, India

Raghunatha Reddy RL
Assistant Professor, RHREC, College of Horticulture, Bengaluru, Karnataka, India

Rajesh AM
Assistant Professor, Department of Floriculture and Landscape Architecture, College of Horticulture, Kolar, Karnataka, India

Corresponding Author:
Ramya S
M.Sc., Department of Horticulture and Vegetable Sciences, College of Horticulture, Bengaluru, Karnataka, India

Microgreens: A nourishment bootstrapper

Ramya S, Meenakshi Sood, Lingaiah HB, Raghunatha Reddy RL and Rajesh AM

Abstract
Microgreens have gained acceptance as a new culinary trend over the past few years. These microgreens are small in size; they can provide surprisingly intense Flavors, vivid colors, textures and can be served as an edible garnish or a salad ingredient. The present study was conducted to standardize the growing media for cultivation of microgreens, to study and compare the growth and yield of different crops as microgreens and to compare the nutritional status of different microgreens under study vis-a-vis full grown stage. Results showed that cocopeat showed earliest germination, harvest, high yield, high returns and high cation exchange load. Hence, cocopeat was selected as best growing media. On comparing microgreens and mature greens, microgreens were richest sources of ascorbic acid and zinc which are recommended to boost the immunity of body during the present situation of Covid-19 threat. Hence, these may be referred to as natural supplements.

Keywords: Micro greens, mature greens, Covid-19, yield, growth, Nutrition

1. Introduction
Microgreens are tiny plants which are larger than sprouts, grown to just an inch or two in height, and then harvested. They are used as a nutrition supplement and as flavour and texture enhancement.

According to a local industry source, microgreens began materializing on chef's menu in the early 1980's in San Francisco, California. Microgreens are the single stem that is just cut above the soil during harvesting with the pair of scissors. These seedlings are harvested just 7-14 days after germination when cotyledons are fully emerged and before the true leaves have expanded. Microgreens have larger concentrations of phenolics, antioxidants, minerals and vitamins and hence recognized as functional foods consisting of health improving or ailment prevention characteristics apart from their natural benefits. These are recognized as good carriers of biologically active components (Mir *et al*. 2017) [8].

Since the consumption of microgreens are increasing nowadays, consequently their appearance in farmer's market and speciality on grocery stores also began. In this way, microgreens are getting significant for upgraded tinuframe for realistic usability (Mir *et al*. 2017) [8].

Microgreens can be grown in different growing media. Among the common substrates used for the microgreens production, peat based media are the most utilized followed by coconut coir and several synthetic media like perlite, vermiculite etc. This study was conducted with the following objectives-

1. To standardise the growing media for cultivation of microgreens
2. To study and compare the growth and yield of different crops as microgreens
3. To compare the nutritional status of different microgreens under study *vis-à-vis* full grown stage.

2. Materials and Methods
The study was conducted at lab conditions in College of Horticulture, Kolar. In first experiment, the data was analysed using split plot analysis as described by Fisher (1925) [4]. The physicochemical properties of media was analysed for five different growing media in which bulk density, water holding capacity and porosity was estimated using keen's cup method as described by Piper (1966) [11]. Four cations were estimated *viz*., calcium, magnesium, potassium and sodium for cation exchange load in five different growing media. C: N ratio was also estimated where organic carbon of soil was estimated by by Walkley - Black chromic acid wet oxidation method (1934) [16] and nitrogen of soil by Kjeldahl's method (Subbaiah and Asija, 1956) [15].

Organic carbon content of other media was estimated by dry ashing method and nitrogen for media by Kjeldahl's method as described by Jackson (1973) [6]. Four crops namely cabbage, lettuce, fenugreek and wheat were grown in different growing media. The days to first seed germination, days to harvest, stem girth, length at the time of harvest and yield of microgreens were recorded in experiment 1. The cost of cultivation of media and their returns were calculated in order to choose the best growing media.

In experiment 2, the data were analysed using completely randomized design as described earlier by Fisher (1925) [4]. Thirteen crops were grown in selected medium (cocopeat) (Table 01) and the growth and yield performance were recorded along with their nutritional composition.

The days to first seed germination, days to 50% germination and days to harvest was recorded from the date of sowing. Germination per cent was recorded by calculating the number of seeds sown to the number of seeds germinated. Length of ten microgreens were measured from the base to tip and averaged. Stem girth of 10 plants were measured using Vernier Caliper and was averaged. The number of plants/tray was recorded at the time of harvest. Yield/tray was recorded in each crop in all the replications. Vigour index was calculated by multiplying the seedling length with germination per cent. Ten plants volume was calculated by taking known volume of water into the measuring cylinder and by immersing 10 seedlings. The amount of water raised was considered as ten plants volume. Moisture per cent and dry matter content of microgreens were recorded. Shelf life of microgreens under room temperature and refrigeration (4 ^{0}C) was recorded by packing the microgreens in LDPE bags.

The nutritional composition of both microgreens and mature greens were estimated and they were compared. The comparison was done using paired-t-test as described by Student (1908) [14].

The dried plant samples of one gram were taken for estimation except ascorbic acid, chlorophyll and carotenoids content estimation. The dried samples were digested using diacid mixture in fume hood chamber and were used for estimation. Nitrogen content was estimated by kjeldahl's method and phosphorous method by vanadomolybdophosphoric yellow color method (Jackson, 1973) [6]. Potassium content was estimated by flame photometer (Bhargava and Raghupathi, 1993) [3]. Calcium and magnesium was estimated by titration with EDTA. Micronutrient contents (Fe and Zn) were estimated by atomic absorption spectroscopy method. Fresh samples of 0.1 g were taken for chlorophyll and carotenoids content, 0.5 g for ascorbic acid content estimation. Chlorophyll and carotenoids was estimated by DMSO method by Shoaf and Lium (1976) [13]. Ascorbic acid content was estimated titrimetrically using 2, 6-dichlorophenol indophenol dye as per the AOAC procedure (2000) [2].

Benefit Cost ratio of microgreens grown was calculated by taking all the cost of consumable inputs like media and seeds, for each treatment. Returns obtained from each treatment were calculated at selling price as per the rates of super markets.

3. Results and Discussion

A. To standardise the growing media for cultivation of microgreens

Five different growing media *viz*., soil, sphagnum moss, cocopeat, vermiculite and perlite were analyzed for various physicochemical properties *viz*., bulk density and water holding capacity, porosity, cation exchange load and C: N ratio as presented in table 02.

The results showed that, with the increase in bulk density, there was decrease in water holding capacity and porosity. Bulk density was the highest in soil but the water holding capacity and porosity was low, whereas the bulk density was the lowest in sphagnum moss but the water holding capacity and porosity was high. Similar results were reported by Abad *et al.* (2005) [1]. In cation exchange load, calcium, magnesium, sodium and potassium ions were estimated. The total cation exchange load was noticed the highest in cocopeat. Higher the cation exchange load, greater will be the growth and yield of the crop. Hence, high yield, earliest first seed germination and early harvest were seen in cocopeat as presented in table 03, 04 and 05.

In perusal of Table 06, high returns were obtained in cocopeat. Considering all these results, cocopeat was chosen as the best growing medium.

B. Performance of different Microgreen crops on cocopeat medium

The analysis of variance for all growth and yield parameters of different microgreen crops on cocopeat medium showed a significant difference. Among the growth and yield performances studied (Table 07), radish microgreens had maximum number of plants/tray and yield/tray compared to other microgreens. Beetroot microgreens showed least stem girth and ten plants volume compared to other microgreens. Fenugreek microgreens took more days for harvest. Palak took maximum days for first seed germination and 50 per cent germination compared to others. Basil microgreens took less days to first seed germination, 50 per cent germination with minimum seedling height and vigour index. Green gram microgreens had earliest first seed germination and the highest vigour index. Peas showest earliest germination and harvest compared to other microgreens. Lettuce had maximum moisture per cent and minimum dry matter content with less shelf life, whereas maximum dry matter content with minimum moisture content and more shelf life (Table 08) was observed in wheat. Sunflower had maximum stem girth and ten plants volume with less number of plants/tray and yield/tray. Amaranthus had less ten plants volume.

The analysis of variance for nutritional composition of microgreens showed a significant difference. Among thirteen microgreens studied (Table 09), Cabbage microgreens were rich in phosphorous and low in zinc content. Radish microgreens had low level of chlorophyll content. The results of chlorophyll content of radish microgreens were in consonance with findings of Wojdylo *et al*. (2020) Wojdylo. Beetroot microgreens had least ascorbic acid content and highest carotenoids content. The similar results were reported by Xiao *et al.* (2012) [18] on ascorbic acid content and Wojdylo *et al*. (2020) [17] on carotenoids content of beetroot microgreens. Fenugreek microgreens were rich in iron as it is a leafy vegetable and in ascorbic acid content. The results were in consonance with the findings of Mohanty *et al.* (2021) on iron content and Ghoora *et al*. (2020) [5] on ascorbic acid content of fenugreek microgreens. Palak microgreens were rich in potassium content. Green gram microgreens had high concentrations of nitrogen and low concentrations of potassium, calcium, iron and chlorophyll. Similar findings

were reported by Priti *et al*. (2021) [12] on potassium, calcium and iron content of green gram microgreens and Madar *et al.* (2017) [7] on chlorophyll content of green gram microgreens. Lettuce microgreens were good sources of zinc. The results were similar with the findings of Pinto *et al.* (2015) [10]. Wheat microgreens possessed less amounts of phosphorous and magnesium contents. Cucumber microgreens were rich in calcium content.

C. Comparison of nutritional status of microgreens under study *vis-à-vis* under full grown stage

The nutritional status of microgreens was compared with mature greens from which it was evident that microgreens were richest sources of ascorbic acid (Table 10). These results were in consonance with the findings of Yadav *et al.* (2018) [19] on cucumber.

D. B:C ratio

B:C ratio of the thirteen crops was calculated in order to estimate the profit incurred from microgreen cultivation. Sunflower showed the lowest B: C ratio (1.90:1), while the highest B: C ratio was noted in amaranthus (21.67:1) (Table 11).

Table 1: List of crops used for growing microgreens

S. No.	Crops	Scientific name	Family
1	Cabbage	*Brassica oleracea* var. *capitata*	Brassicaceae
2	Radish	*Raphanus sativus*	Brassicaceae
3	Beetroot	*Beta vulgaris* subsp. *vulgaris*	Amaranthaceae
4	Fenugreek	*Trigonella foenum-graecum*	Fabaceae
5	Palak	*Beta vulgaris* var. *bengalensis*	Amaranthaceae
6	Basil	*Ocimum basilicum*	Lamiaceae
7	Green gram	*Vigna radiata* L.	Fabaceae
8	Peas	*Pisum sativum*	Fabaceae
9	Lettuce	*Lactuca sativa*	Compositae
10	Wheat	*Triticum aestivum*	Triticaceae
11	Sunflower	*Helianthus annuus*	Asteraceae
12	Cucumber	*Cucumis sativus*	Cucurbitaceae
13	Amaranthus	*Amaranthus viridis*	Amaranthaceae

Table 2: Physicochemical properties of media

Sl. No.	Media	Bulk density (g/cm^3)	Water Holding Capacity (%)	Porosity (%)	Cation exchange load (meq/100g)					Organic Carbon (%)	Nitrogen (%)	C:N ratio
					Calcium	Magnesium	Sodium	Potassium	Total			
1	Soil	1.46	41.72	42	3.1	1.1	2.69	1.39	8.28	2.60	0.35	8.14:1
2	Sphagnum moss	0.05	1428.27	97	10	5.6	2.73	2.9	21.23	55.94	1.26	44.4:1
3	Cocopeat	0.41	379.93	61	0.04	0.06	56.92	33.86	90.88	95	1.02	93.14:1
4	Vermiculite	0.13	178.79	67.2	7.3	0.2	72.56	2.58	82.64	93.86	0.62	151.4:1
5	Perlite	0.16	463.82	68	4	1.5	3.2	17.93	26.63	1.80	0.29	6.21:1

Table 3: Days taken to first germination and days taken to harvesting of microgreens of different crops in different growing media

	Days to first germination						Days to harvest					
Treatments	**S_1**	**S_2**	**S_3**	**S_4**	**S_5**	**Mean**	**S_1**	**S_2**	**S_3**	**S_4**	**S_5**	**Mean**
M_1	4.00	4.33	3.33	4.33	3.67	3.93	8.67	8.33	8.33	9.00	8.67	8.60
M_2	4.00	4.00	3.33	4.33	4.33	4.00	10.00	10.00	8.33	9.67	10.00	9.53
M_3	3.67	3.67	2.67	3.67	3.67	3.47	9.67	10.00	9.00	9.67	9.67	9.67
M_4	4.00	4.00	3.33	4.00	4.00	3.87	9.67	9.33	8.33	10.00	10.00	9.47
Mean	3.92	4.00	3.17	4.08	3.92		9.50	9.42	8.50	9.58	9.58	
	S.Em. ±			CD (5%)			S.Em. ±			CD (5%)		
M	0.20			NS			0.04			0.14		
S	0.12			0.35			0.04			0.12		
M×S	0.24			NS			0.16			NS		

Tray size – 0.1 sq m

M_1: Cabbage
M_2: Lettuce
M_3: Fenugreek
M_4: Wheat

S_1: Soil
S_2: Sphagnum moss
S_3: Cocopeat
S_4: Vermiculite
S_5: Perlite

M: Main plot treatments (Different crops grown as microgreens)
S: Sub plot treatments (Different growing media)

Table 4: Stem girth and seedling height/length of microgreens of different crops in different growing media

	Stem girth (mm)						Length/seedling height (cm)					
Treatments	**S_1**	**S_2**	**S_3**	**S_4**	**S_5**	**Mean**	**S_1**	**S_2**	**S_3**	**S_4**	**S_5**	**Mean**
M_1	0.77	0.81	0.39	0.81	0.87	0.73	5.81	7.09	6.98	5.61	5.93	6.29
M_2	0.56	0.54	0.48	0.50	0.46	0.51	2.89	3.52	3.04	2.98	2.60	3.01
M_3	1.05	1.02	1.11	1.07	1.13	1.07	6.82	6.66	6.39	5.74	11.84	7.49
M_4	1.13	1.17	1.07	0.96	1.01	1.07	11.83	13.57	13.66	9.96	10.58	11.92
Mean	0.88	0.89	0.77	0.84	0.87		6.84	7.71	7.52	6.07	7.74	

	S.Em. ±	CD (5%)	S.Em. ±	CD (5%)
M	0.01	0.03	0.01	0.03
S	0.01	0.03	0.01	0.03
M × S	0.02	0.06	0.02	0.06

Tray size – 0.1sq m

M_1: Cabbage S_1: Soil M: Main plot treatments (Different crops grown as microgreens)
M_2: Lettuce S_2: Sphagnum moss S: Sub plot treatments (Different growing media)
M_3: Fenugreek S_3: Cocopeat
M_4: Wheat S_4: Vermiculite
S_5: Perlite

Table 5: Yield (g)/tray of microgreens of different crops in different growing media

Treatments	S_1	S_2	S_3	S_4	S_5	Mean
M_1	9.93	13.10	14.73	8.71	12.50	11.79
M_2	1.20	3.20	3.87	4.28	3.73	3.27
M_3	24.43	7.44	39.13	34.50	31.30	27.36
M_4	4.64	10.27	14.40	4.34	7.10	8.07
Mean	10.05	8.50	18.03	12.85	13.93	
	S.Em. ±			CD (5%)		
M	0.04			0.13		
S	0.04			0.11		
M × S	0.06			0.22		

Tray size – 0.1 sq m

M_1: Cabbage S_1: Soil M: Main plot treatments (Different crops grown as microgreens)
M_2: Lettuce S_2: Sphagnum moss S: Sub plot treatments (Different growing media)
M_3: Fenugreek S_3: Cocopeat
M_4: Wheat S_4: Vermiculite
S_5: Perlite

Table 6: Cost of cultivation/tray (0.1 sq m)

Crops	Media			Seeds		Total cost (Rs)	Yield (g)	Selling price of microgreens	Returns per tray (Rs)	Profit per tray (Rs)
	Media	Quantity (g/tray)	Cost (Rs)	Seed rate/ tray (g)	Seed cost (Rs/g)					
Cabbage	Soil	1000	-	10	0.25	0.25	9.93	1.25	12.41	49.64
	Sphagnum moss	325.6	54.65	10	0.25	55.00	13.10	1.25	16.38	0.29
	Cocopeat	1000	6.00	10	0.25	6.25	14.73	1.25	18.41	2.95
	Vermiculite	827.1	24.81	10	0.25	20.06	8.71	1.25	10.88	0.54
	Perlite	366.6	95.32	10	0.25	95.57	12.50	1.25	15.63	0.16
Lettuce	Soil	1000	-	10	0.15	0.15	1.20	2.60	3.12	0.27
	Sphagnum moss	325.6	54.65	10	0.15	54.80	3.20	2.60	8.32	0.15
	Cocopeat	1000	6	10	0.15	6.15	3.87	2.60	10.06	1.64
	Vermiculite	827.1	24.81	10	0.15	24.96	4.28	2.60	11.13	0.45
	Perlite	366.6	95.32	10	0.15	95.47	3.73	2.60	9.70	0.10
Fenugreek	Soil	1000	-	20	0.15	0.15	24.43	0.65	15.88	105.87
	Sphagnum moss	325.6	54.65	20	0.15	54.80	7.44	0.65	4.84	0.09
	Cocopeat	1000	6	20	0.15	6.15	42.13	0.65	27.83	4.53
	Vermiculite	827.1	24.81	20	0.15	24.96	34.50	0.65	22.43	0.89
	Perlite	366.6	95.32	20	0.15	95.47	31.30	0.65	20.34	0.21
Wheat	Soil	1000	-	20	0.04	0.8	4.64	0.85	3.94	4.93
	Sphagnum moss	325.6	54.65	20	0.04	55.45	10.27	0.85	8.73	0.16
	Cocopeat	1000	6	20	0.04	6.8	14.40	0.85	12.24	1.80
	Vermiculite	827.1	24.81	20	0.04	25.61	4.34	0.85	3.69	0.14
	Perlite	366.6	95.32	20	0.04	96.12	7.10	0.85	6.04	0.06

Replications – 3
Cabbage – 250 Rs/kg, Fenugreek – 150 Rs/kg, Lettuce – 150 Rs/kg, Wheat – 40 Rs/kg.
Cocopeat – 150 Rs/25 kg, Sphagnum moss – 260 Rs/kg, Vermiculite – 30 Rs/kg, Perlite – 70 Rs/kg.
Selling prices as per the rates of super markets.

Table 7: Growth and yield performance of different microgreens, on cocopeat medium

Crops	Days to 1st seed germination	Days to 50 per cent germination	Germination per cent (%)	Days to harvest	At the time of harvest				Vigour index (%)	Ten plants volume (ml)	Moisture per cent (%)	Dry matter content (%)
					Length (cm)	Stem girth (mm)	Number of plants/tray	Yield/ tray (g)				
Cabbage	3.00	6.33	89.88	9.33	6.13	0.64	7050.22	45.13	551.75	2.00	94.63	5.37
Radish	2.67	5.33	98.15	8.67	6.16	0.67	8057.22	53.03	606.57	2.03	92.51	7.49
Beetroot	3.33	5.67	91.74	10.33	4.89	0.44	2022.67	44.92	460.91	0.13	93.86	6.14
Fenugreek	3.67	5.33	86.73	10.67	6.51	1.09	3258.44	47.83	564.29	1.50	93.24	6.76

Palak	4.33	7.33	97.66	10.00	5.21	1.08	2037.44	40.73	505.72	3.53	93.61	6.57
Basil	2.33	3.33	98.04	7.33	1.72	0.50	6063.78	40.37	165.94	3.07	91.18	8.82
Green gram	2.33	5.00	95.63	7.00	8.26	1.10	2350.33	46.30	782.53	2.07	93.63	6.37
Peas	2.33	4.00	96.68	6.67	8.20	1.10	922.33	40.56	603.18	1.73	92.60	7.40
Lettuce	3.33	5.33	97.25	9.33	3.19	0.68	1853.61	44.00	308.39	2.13	95.61	4.10
Wheat	2.67	4.33	68.35	7.67	9.63	1.08	884.44	44.49	654.47	2.87	80.85	19.15
Sunflower	3.33	5.67	85.02	8.67	3.69	1.19	146.44	13.13	311.58	6.13	87.43	12.57
Cucumber	2.67	4.67	74.10	8.33	6.33	1.13	370.44	15.83	466.15	2.13	90.03	9.97
Amaranthus	2.67	5.33	94.85	9.33	6.26	1.06	2210.78	41.27	781.64	0.13	92.46	6.97
S.Em. (±)	0.04	0.08	2.13	0.12	0.09	0.03	23.39	0.00	3.89	0.05	0.32	0.24
CD (P=0.05)	0.14	0.24	6.18	0.36	0.26	0.08	68.01	0.01	11.31	0.15	0.93	0.70
CV (%)	2.86	2.85	4.08	2.40	2.94	5.21	1.41	0.02	1.29	3.62	0.61	5.06

Table 8: Shelf life (in days) of different microgreens under refrigeration and room temperature

Crops	Shelf life under refrigeration (4˚C)	Shelf life under room temperature (Average temp. – 28.02˚C, RH – 68.19%)
Cabbage	10.33	8.00
Radish	9.67	7.33
Beetroot	6.67	3.33
Fenugreek	5.00	3.00
Palak	8.33	5.00
Basil	10.33	5.33
Green gram	14.67	9.00
Peas	11.33	5.33
Lettuce	4.33	3.00
Wheat	17.67	10.00
Sunflower	9.67	7.00
Cucumber	13.33	9.00
Amaranthus	9.67	6.33
S.Em. (±)	0.32	0.21
CD (P=0.05)	0.93	0.60
CV (%)	5.50	5.7

Table 9: Nutrient composition of microgreens

Treatments	Total nitrogen (mg/100g DW)	Total phosphorous (mg/100g DW)	Total potassium (mg/100g DW)	Calcium (mg/100g DW)	Magnesium (mg/100g DW)	Iron content (mg/100g DW)	Zinc content (mg/100g DW)	Ascorbic acid content (mg/100g FW)	Chlorophyll content (mg/g FW)	Carotenoids content (mg/g FW)
Cabbage	148.33	243.10	590.19	177.09	146.33	1.51	0.01	69.05	0.73	0.23
Radish	650.80	18.55	87.33	21.55	20.13	0.47	0.02	50.73	0.01	1.50
Beetroot	21.84	75.93	313.44	93.55	82.67	1.16	0.00	10.67	0.25	2.59
Fenugreek	450.71	89.91	299.67	275.84	58.47	3.56	0.03	79.67	0.02	0.19
Palak	196.50	10.67	948.27	352.67	82.47	2.08	0.02	65.87	0.12	0.02
Basil	378.91	66.00	57.00	13.71	12.66	0.58	0.06	65.17	0.40	1.50
Green gram	955.67	13.62	21.03	4.67	14.03	0.05	0.02	33.97	0.01	0.05
Peas	756.17	76.81	803.64	190.67	46.67	1.80	0.05	34.42	0.65	1.20
Lettuce	288.33	89.67	356.03	130.41	58.92	2.13	0.69	61.94	0.13	0.01
Wheat	261.00	14.03	399.30	11.79	12.08	1.28	0.08	50.77	1.57	0.21
Sunflower	53.77	8.79	44.20	15.73	11.08	0.20	0.03	51.20	0.47	1.90
Cucumber	18.51	70.93	897.75	376.73	44.07	1.10	0.01	32.79	0.15	0.04
Amaranthus	99.67	46.93	633.67	85.73	36.27	3.17	0.04	30.00	0.11	0.11
S.Em. (±)	0.58	0.39	0.52	0.32	0.31	0.02	0.002	0.30	0.01	0.01
CD (P=0.05)	1.69	1.13	1.51	0.92	0.91	0.06	0.01	0.87	0.02	0.03
CV (%)	0.30	1.06	0.21	0.41	1.12	2.53	4.42	1.06	2.63	2.29

Table 10: Comparison of the nutritional status of different microgreens under study *vis-a-vis* full grown stage

Crops		Total nitrogen (mg/100g DW)	Total phosphorous (mg/100g DW)	Total potassium (mg/100g DW)	Calcium (mg/100g DW)	Magnesium (mg/100g DW)	Iron (mg/100g DW)	Zinc (mg/100g DW)	Ascorbic acid (mg/100g FW)	Chl. Content (mg/g FW)	Car. Content (mg/g FW)
Cabbage	Microgreens	148.33	243.10	590.19	177.09	146.33	1.51	0.01	69.05	0.73	0.23
	Mature greens	75.00	123.90	435.00	258.00	91.00	1.98	1.50	45.03	3.80	1.52
Radish	Microgreens	650.80	18.55	87.33	21.55	20.13	0.47	0.02	50.73	0.01	1.50
	Mature greens	105.00	15.95	150.00	35.50	8.50	1.86	1.17	85.00	9.50	0.05
Beetroot	Microgreens	21.84	75.93	313.44	93.55	82.67	1.16	0.00	10.67	0.25	2.59
	Mature greens	256.67	43.50	762.00	117.00	62.00	1.59	0.45	39.79	0.08	0.05
Fenugreek	Microgreens	450.71	89.91	299.67	275.84	58.47	3.56	0.03	79.67	0.02	0.19
	Mature greens	410.00	70.00	865.20	640.00	306.00	42.20	2.50	67.05	1.73	0.21
Palak	Microgreens	196.50	10.67	948.27	352.67	82.47	2.08	0.02	65.87	0.12	0.02

	Mature greens	325.00	15.3	980.00	665.00	710.00	22.20	2.05	50.76	3.88	0.16
Basil	Microgreens	378.91	66.00	57.00	13.71	12.66	0.58	0.06	65.17	0.40	1.50
	Mature greens	390.00	56.00	298.00	172.00	64.00	6.98	0.90	27.05	0.03	1.80
Green gram	Microgreens	955.67	13.62	21.03	4.67	14.03	0.05	0.02	33.97	0.01	0.05
	Mature greens	438.50	11.43	392.00	55.50	20.00	0.09	0.01	32.50	1.12	1.98
Peas	Microgreens	756.17	76.81	803.64	190.67	46.67	1.80	0.05	34.42	0.65	1.20
	Mature greens	452.00	702.45	300.00	96.00	55.00	5.05	1.50	24.67	0.84	0.02
Lettuce	Microgreens	288.33	89.67	356.03	130.41	58.92	2.13	0.69	61.94	0.13	0.01
	Mature greens	383.00	179.00	415.00	84.50	38.30	1.52	0.22	15.30	0.65	0.02
Wheat	Microgreens	261.00	14.03	399.30	11.79	12.08	1.28	0.08	50.77	1.57	0.21
	Mature greens	337.60	180.50	650.00	45.00	24.50	1.80	0.08	31.94	1.82	0.07
Sunflower	Microgreens	153.77	8.79	44.20	15.73	11.08	0.20	0.03	51.20	0.47	1.90
	Mature greens	320.00	358.30	245.00	475.00	32.50	10.50	0.02	99.60	4.50	0.24
Cucumber	Microgreens	18.51	70.93	897.75	376.73	44.07	1.10	0.01	32.79	0.15	0.04
	Mature greens	35.00	160.34	858.75	43.50	33.50	6.50	0.01	15.50	6.93	0.18
Amaranthus	Microgreens	99.67	46.93	633.67	85.73	36.27	3.17	0.04	30.00	0.11	0.11
	Mature greens	35.00	575.00	800.00	1185.00	900.00	65.00	2.80	99.00	0.50	0.06
Calculated t value		0.91	2.01	1.72	1.69	1.67	2.17	2.67	0.99	2.85	0.72
Sig.(2 -tailed)		0.38	0.07	0.11	0.12	0.12	0.05	0.02	0.01	0.02	0.48

Table 11: Benefit cost ratio of different microgreens

S. No.	Crops	Cost of cocopeat (Rs)	Cost of seeds (OP) (Rs/kg)	Quantity of seed (g/tray)	Seed cost (Rs/quantity used)	Total cost of cultivation (Rs/tray)	Yield (g)	Selling price of microgreens (Rs/g)	Total returns (Rs)	B:C ratio
1	Cabbage	6.00	250.00	20.00	5.00	11.00	45.13	1.25	56.41	5.13:1
2	Radish	6.00	240.00	20.00	4.80	10.80	53.03	1.43	75.83	7.02:1
3	Beetroot	6.00	120.00	20.00	2.40	8.40	44.92	2.40	107.81	12.83:1
4	Fenugreek	6.00	150.00	20.00	3.00	9.00	47.83	0.65	31.09	3.45:1
5	Palak	6.00	200.00	20.00	4.00	10.00	40.73	0.65	26.47	2.64:1
6	Basil	6.00	105.00	20.00	2.10	8.10	40.37	4.30	173.59	21.43:1
7	Green gram	6.00	130.00	20.00	2.60	8.60	46.30	1.24	57.41	6.68:1
8	Peas	6.00	120.00	20.00	2.40	8.40	40.56	0.85	34.48	4.10:1
9	Lettuce	6.00	150.00	20.00	3.00	9.00	44.00	2.60	114.40	12.71:1
10	Wheat	6.00	40.00	20.00	0.80	6.80	44.49	0.85	37.82	5.56:1
11	Sunflower	6.00	60.00	15.00	0.90	6.90	13.13	1.00	13.13	1.90:1
12	Cucumber	6.00	200.00	15.00	3.00	9.00	15.83	1.50	23.75	2.64:1
13	Amaranthus	6.00	100.00	20.00	2.00	8.00	41.27	4.20	173.33	21.67:1

Media- Cocopeat-150 Rs/25 kg.
Quantity of media used – 1000g – 6 Rs/tray
Replications – 3
Tray size – 0.1 sq m
Costs of open pollinated seeds (OP)
Selling price as per the rates of super markets.

4. Conclusion
Microgreens were found to be concentrated sources of many nutrients during the study, and can be grown in limited space and time. They were also found to contain good amounts of ascorbic acid which are recommended to boost the immunity of body during the present situation of Covid-19 threat. Hence, microgreens can be referred as natural supplements and involving them in daily diet becomes more relevant especially during present situations for sustainable good health.

5. Supplementary data
Supplementary data are provided in the study itself.

6. Author's contribution statement
All the authors have equally contributed to the study.

7. Acknowledgements
This study was supported by College of Horticulture, Bengaluru and College of Horticulture, Kolar. We would like to thank all the staff and non-staff members of both colleges for their support in the entire research programme.

8. Conflict of interest
All the authors declare that there is no conflict of interest.

9. Data availability
The data used to support the findings of this study are included within the study.

10. References
1. Abad M, Fornes F, Carrion C, Noguera V, Noguera P, Maquieira A, *et al*. Physical properties of various coconut coir dusts compared to peat. Horticultural Sciences. 2005;40(7):2138-2144.
2. AOAC. Ascorbic acid in vitamin preparation and juices. Official Method of Analysis, 17th ed. Gaithersburg. 2000.
3. Bhargava BS, Raghupathi HB. Analysis of plant materials for macro and micronutrients. In H.L.S. Tandon, ed. Methods of analysis of soils, plants, waters and fertilizers. 1993, 49-82.
4. Fisher RA. Statistical methods for research workers. Edinburgh: Oliver and Boyd. 1925.
5. Ghoora MD, Babu DR, Srividya N. Nutrient composition, oxalate content and nutritional ranking of

ten culinary microgreens. Journal of Food Composition and Analysis. 2020;91:103495.
6. Jackson ML. Soil Chemical Analysis. Pub. Prentice Hall of Indian Pvt. Ltd., New Delhi. 1973.
7. Madar IH, Asangani AH, Srinivasan S, Tayubi IA, Ogu GI. Nutritional and biochemical alterations in *Vigna Radiata* (Mung Bean) seeds by germination. International Journal of Current Microbiology and Applied Sciences. 2017;6(9):3307-3313.
8. Mir SA, Shah MA, Mir MM. Microgreens: production, shelf life, and bioactive components. Critical Reviews in Food Science and Nutrition. 2017;57(12):2730-2736.
9. Mohanty A, Mahahlik G, Parida S. Nutritional analysis of few edible microgreens in variable growth medium using XRF technique. Asian Journal of Biological and Life Sciences. 2020;9(3):361.
10. Pinto E, Almeida AA, Aguiar AA, Ferreira IM. Comparision between the mineral profile and nitrate content of microgreens and mature lettuces. Journal of Food Composition and Analysis. 2015;37:38-43.
11. Piper CS. Soil and plant analysis. Bombay, India, Hans Publishers. 1966.
12. Priti, Mishra GP, Dikshit HK, Vinutha T, Tontang MT, Stobdan T, Sangwan S *et al*. Diversity in phytochemical composition, antioxidant capacities and nutrient contents among mung bean and lentil microgreens when grown at plain- altitude region (Delhi) and high-altitude region (Leh-Ladakh), India. Frontries of Plant Sciences. 2021;12:1485.
13. Shoaf TW, Lium BW. Improved extraction of chlorophyll a and b from algae using dimethyl sulphoxide. Limnology and Oceanography**.** 1976;21:926-928
14. Student. The probable error of a mean. Biometrika. 1908;6:1-25.
15. Subbaiah BV, Asija GL. A rapid procedure for the estimation of available nitrogen in soils. Current Sciences. 1956;25:259-260.
16. Walkley A, Black IA. An examination of the degtjareff method for determining soil organic matter, and a proposed modification of the chromic acid titration method. Soil Science. 1934;37(1):29-38.
17. Wojdylo A, Nowicka P, Tkacz K, Turkiewicz IP. Sprouts vs microgreens as novel functional foods: Variation of nutritional and phytochemical profiles and their in vitro bioactive properties. Molecules. 2020;25:4648.
18. Xiao ZL, Lester GE, Luo YG, Wang Q. Assessment of vitamin and carotenoid concentrations of emerging food products: edible microgreens. Journal of Agriculture and Food Chemistry. 2012;60(31):7644-7651.
19. Yadav LP, Koley TK, Tripathi A, Singh S. Antioxidant potentiality and mineral content of summer season leafy greens: Comparison at mature and microgreen stages using chemometric. Agricultural Research. 2018;8(2):165-175.