Annals of Biology **39** (2) : 305-309, 2023

Impact Score : 0.32 (Scopus)

Impact of Different Growing Media on Growth, Productivity and Storability of Red Amaranthus Microgreens

PENAMAKURU PURNA PRADEEPA[1], DEEPAK MAURYA*, DASHRATH BHATI[1], HARENDRA, VINOD JATAV AND PUSHPENDRA KUMAR[1]

Department of Horticulture, School of Agricultural Sciences, GD Goenka University, Sohna-122 103, Gurgaon, (Haryana), India
**(e-mail : mauryadeepak0077@gmail.com; Mobile : 86014 50443)*

(Received : October 15, 2022; Accepted : December 5, 2022)

ABSTRACT

Microgreens are newly germinated seed that people harvest just as the seed begins to grow and before their leaves develop. The present study was conducted to study the effect of growing media on the growth of amaranthus microgreen. Six growing media viz., soil 100% (T_1), cocopeat 60%+soil 40% (T_2), vermiculite 60%+soil 40% (T_3), vermicompost 60%+soil 40% (T_4), farm yard manure 60%+soil 40% (T_5) and poultry manure 60%+soil 40% (T_6) were selected for investigation. It was found that the combined application of poultry manure+soil (60 : 40) was considered best growing media followed by cocopeat+soil (60 : 40), vermicompost+soil (60 : 40) and farm yard manure (FYM)+soil (60 : 40) of all the treatments as maximum yield of good quality amaranthus microgreen. Further, application of poultry manure increased the growth of the plant, maintaining the quality of plant. Among various packaging materials, the gunny bag was observed as best packaging material for longer storability of microgreens.

Key words: Microgreens, nutrients, poultry manure, cocopeat, vermicompost

INTRODUCTION

Vegetables are regarded as a crucial component of diets as a balanced source of vitamins and minerals such as iron, calcium, magnesium, phosphorus, carotene, folic acid, vitamin B, C and E as well as dietary fiber and phytochemicals. It also provides a decent quantity of protein, calories and carbohydrates. Each vegetable possesses the distinct mix and quantity of the phyto-nutraceuticals. Among vegetables, green leafy vegetables constitute an excellent source of nutrition such as minerals, vitamins and proteins. *Amaranthus cruentus* L., commonly known as red amaranth, is one of the most important leafy vegetables that grown in India. The genus name "*Amaranthus*" is originated from Greek word "Amarantos" which means "immortal" or "everlasting" (Rezwana *et al.,* 2017). It is an exceptional crop that grows quickly, having a very high yield potential, less susceptible to diseases that transmitted through the soil, easy to grow, suitable for both home gardens and commercial cultivation, and responses more favourable to fertilizers and manure than other vegetable groups.

Amaranthus has recently gained popularity as a promising food crop, largely because of its ability to withstand heat, drought, diseases and pests as well as the high nutritional value of leaves (Jangde *et al.,* 2017). Protein, carbohydrates, dietary fiber, calcium (397 mg/100 g), iron (25.6 mg/100 g), manganese, zinc and vitamins (vitamin-A as 9108 IU/100 g; riboflavin as 0.30 mg/100 g; niacin as 1.2 mg/100 g) are abundant in leaves and tender stem of amaranthus. Out of 300 g of veggies per day, the ICMR advises consuming 125 g of leafy greens daily. In plants, the levels of phytonutrients often decrease from the seedling stage to the fully developed stage (Choe *et al.,* 2018). Microgreens are tender immature greens mostly growing to two inches of height and harvested at 7-14 days after germination without root. It consists of stem, cotyledons and first set of true leaves which are called as micro greens. Because of the possible nutritional advantages of microgreens, their popularity has increased (Turner *et al.*, 2020) and microgreens have started to appear at grocery shops. Apart from considering its high nutritional value,

[1]Department of Horticulture, School of Agriculture, ITM University, Sithouli-474 001, Gwalior (M. P.), India.

microgreens are considered as functional foods as they have health promoting and disease preventing properties (Wojdylo *et al.*, 2020). In comparison to mature plants, microgreens often had high levels of vitamins and carotenoids that were around five times higher (Choe *et al.,* 2018). Amaranth, sunflower, green basil, lemon balm, broccoli, etc. are popular microgreens (Wojdylo *et al.*, 2020). Fresh cut microgreens are strongly respiring products that are made up of young tissues as a result, their decline is more associated with a stress-induced reaction than with ageing naturally. Fresh cut microgreens shelf-life has been examined in relation to pre-harvest and post-harvest treatments, various packaging materials and modified atmosphere packaging (MAP) (Kyriacou *et al.*, 2016).

Soil less media such as coco coir, vermiculite and organic manures such as FYM and poultry manure are also used as the growing medium for microgreens. Coir dust makes up the growth medium known as cocopeat. It has a high-water holding capacity, and a pH of 5.7 to 6.5 that is good for plant development (Carlile *et al.*, 2019). N, P, K, Ca, Mg, S, Fe, Mn, Zn, Cu and B are among the plant nutrients found in vermicompost, and their absorption benefits plant nutrition, photosynthesis, the amount of chlorophyll in leaves, and the nutritional content of various plant parts (Singh, 2018; Rohith *et al.,* 2022). Plants are grown using vermiculite as a moisture retentive medium. Considering the significance of growing media for germination and growth of microgreens, the present investigation was carried out to evaluate the growth, productivity and storability performance of microgreens of amaranthus grown on various growing media.

MATERIALS AND METHODS

The present research work related to different growing media on growth of microgreens-Amaranthus was conducted at Department of Horticulture, School of Agriculture, ITM, University Gwalior (M. P.) during the year 2022. The experiment was laid out in completely randomized block design with six treatments. The red amaranth seed was taken for the research and was raised in trays (30×20×7 cm) using of mixture of six different growing media of soil (100%), cocopeat (60%)+soil (40%), vermiculite (60%)+soil (40%), vermicompost (60%)+soil (40%), farmyard manure (60%)+soil (40%), and poultry manure (60%) + soil (40%). Seeds were sown in line at the rate of 1.0 g seeds per tray. The seed was not sown very deep and kept up and then covered by growing media.

The germination percentage was calculated using towel paper method as per the procedure of International Seed Testing Association (Anonymous, 2019). However, the seeds were germinated on the top of one layer paper enclosed with appropriate moisture level and kept at the room temperature. Data were taken after four days. The germination percentage of microgreens was calculated as:

$$\text{Germination (\%)} = \frac{\text{Number of normal seedlings}}{\text{Number of seeds set for the test}} \times 100$$

The microgreen height was measured by using of centimeter scale and seedling weight was computed using digital electronic balance.

The chlorophyll content (mg/ml) of the leaves was estimated using the absorbance of acetone extract (optical density) at 645 and 663 nm visual wavelength in UV-VIS Spectrophotometer taking 1000% acetone as blank.

Total chlorophyll : 20.2 (A645) + 8.02 (A663)

Five g samples were crushed, and the extract of each sample was used to analyze the pH value of microgreens of amaranthus by using pH meter. Acidity was estimated by titrating the extract against 0.01 N sodium hydroxide.

The state of health of plants was accomplished through the continuous observations of appearance of the symptoms. The heath state of plant was noted in ascending order with grades from 1-9, with the maximum grade corresponding to a perfect health state (Table 1).

Shelf life of microgreens of amaranthus was determined by qualitative analysis of stored sample. The physiological loss in the weight of microgreens of amaranthus was up to 10% and discolourations of samples indicated the shelf life of microgreens of amaranthus. The harvested microgreens were washed and dried out for the excess water. Then these were packed in different packaging materials such as tissue paper and gunny bags. Five g of microgreens was packed in each packaging material and stored under normal conditions.

Table 1. Grade of health status of plants (Moraru *et al.,* 2022).

Note for attack intensity	Surface attacked
1	If the attack is not observed
2	When the attack is incipient, with less obvious symptoms
3	If the stains occupy up to 5% of the surface
4	When the stains cover between 5-15% of the surface
5	When the stains cover between 15-25% of the surface
6	When the stains cover between 25-40% of the surface
7	When the stains cover between 40-50% of the surface
8	When the stains cover between 50-75% of the surface
9	When the stains cover between 75-100% of the surface

RESULTS AND DISCUSSION

Different parameters related to growth and productivity of microgreen amaranthus reflected a significant variation under different growing media (Table 2). Germination percentage ranged from 68.67 to 81.33% with the overall mean of 75.94%. The highest germination percentage was fond in poultry manure (81.33% followed by cocopeat manure (79.33%), FYM (78.00%) while the lowest germination percentage observed in vermiculite manure (68.67%). The fastest emergence of true leaves was found in poultry manure (6.67 days) followed by cocopeat (7.67 days) and farm yard manure (8.33 days), while the lowest emergence of true leaves was observed in soil (9.33 days). The lowest microgreen height was observed in vermiculite (3.10 cm) followed by vermicompost (3.27 cm), farm yard manure (3.47 cm) and highest in poultry manure (5.13 cm).

The health state of plants was noted in ascending order with grades from 1 to 9, with the maximum grade corresponding to a perfect health state. The result in case of microgreens of amaranthus attack was not observed. The fresh weight ranged from 3.56 to 9.42 g with maximum in poultry manure (9.42 g) followed by cocopeat manure (5.90 g), farm yard manure (5.37 g), while the lowest was observed in vermicompost (3.56 g). The dry weight also followed the trend like fresh weight of microgreen. The total yield of microgreen ranged from 7.56 to 13.42 g. The highest yield of microgreen was found in poultry manure (13.42 g) followed by cocopeat (9.90 g), farm yard manure (9.37 g) and the lowest in vermicompost manure (7.56 g).

The pH ranged from 4.53 to 5.97 pH. The highest pH was recorded in poultry manure (5.9 pH) followed by farm yard manure (5.7 pH) and vermicompost (5.5 pH). The lowest pH was observed in vermiculite manure (4.5 pH). The highest acidity percentage was found in poultry manure (0.77) followed by farm yard manure (0.40) and vermiculite (0.30), while the lowest acidity value of microgreens was observed in vermicompost (0.20) and soil (0.20). The highest total chlorophyll was observed in vermicompost (1.06 mg/ml) followed by poultry manure (1.03 mg/ml) and soil (0.92 mg/ml), while the lowest total chlorophyll was observed in vermiculite (0.57 mg/ml).

Table 2. Growth and productivity of microgreen amaranthus in different growing media

Treatment	G	ETL	MH	FW	DW	Y	P	A	TC
Soil (100%)	77.33	9.33	4.27	5.34	2.77	9.34	5.77	0.20	0.92
Cocopeat+soil (60 : 40)	79.33	7.67	4.37	5.90	3.86	9.90	5.27	0.23	0.67
Vermiculite+soil (60 : 40)	68.67	9.00	3.10	3.67	1.76	7.67	4.53	0.30	0.57
Vermicompost+soil (60 : 40)	71.00	9.00	3.27	3.56	1.16	7.56	5.50	0.20	1.06
FYM+soil (60 : 40)	78.00	8.33	3.47	5.37	2.31	9.37	5.77	0.40	0.77
Poultry manure+soil (60 : 40)	81.33	6.67	5.13	9.42	4.25	13.42	5.97	0.77	1.03
Mean	75.94	8.33	3.93	5.54	2.68	9.54	5.47	0.35	0.83
SE(m±)	2.26	0.27	0.15	0.64	0.54	0.63	0.10	0.06	0.12
C.V.	5.17	5.66	6.62	19.84	34.74	11.52	0.46	30.12	25.83
C. D. at 1%	9.78	1.18	0.65	2.74	2.33	2.74	0.39	0.26	0.54
Range highest	81.33	9.33	5.13	9.42	4.25	13.42	5.97	0.77	1.06
Range lowest	68.67	6.67	3.10	3.56	1.16	7.56	4.53	0.20	0.57

G–Germination (%), ETL–Emergence of true leaves (days), MH–Microgreen height (cm), FW–Fresh weight (g), DW–Dry weight (g), Y–Yield (g), P–pH, A–Acidity (%) and TC–Total chlorophyll (mg/ml).

Table 3. Storability of microgreen in different packaging materials under room temperature

Treatment	Tissue paper packaging (days)	Polybag packaging (days)	Gunny bag packaging (days)
Soil (100 %)	3.00	3.67	5.00
Cocopeat+soil (60 : 40)	3.67	4.67	4.67
Vermiculite+soil (60 : 40)	3.67	3.67	3.67
Vermicompost+soil (60 : 40)	3.33	4.67	4.67
FYM+soil (60 : 40)	3.67	3.33	4.67
Poultry manure+soil (60 : 40)	4.00	4.33	5.67
Mean	3.56	4.06	4.72
SE(m±)	0.36	33.00	0.38
C.V.	17.54	14.24	14.12
C. D. at 1%	1.56	1.44	1.66
Range highest	4.00	4.67	5.67
Range lowest	3.00	3.33	3.67

The present investigation confirmed the significance of poultry manure as growing media for better growth and productivity of microgreens which could be associated with the additional availability of nutrients to seeds for better germination and emergence of plumules and leaves. Impact of poultry manure was very high in comparison to other treatments as it released balanced nutrients for better metabolic activities in plants resulting in the higher biomass production and yield of microgreens (Anmol and Singh, 2018). This confirmed the possibilities of use of other nutrient releasing growing media or addition of micro or macro nutrients like organic manures (Tyagi *et al.*, 2022), minerals (Kaur *et al.*, 2018; Singh *et al.,* 2018a), biofertilizers (Kumar *et al.*, 2018; Ramandeep *et al.*, 2018; Singh *et al.,* 2018b) and integrated approach of nutrient management (Lallawmkima *et al.,* 2018a, b; Singh *et al.,* 2018c, d) for quality microgreen productions.

The storability of microgreens under different treatment was significantly higher in gunny bags (Table 3) among different packaging materials. In tissue paper, the highest days of storability were observed from poultry manure microgreen (4 days) followed by farm yard manure (3.67 days) and vermiculite (3.67 days). In polybag, the storability varied from 3.33 to 4.67 days. The highest storage was observed in vermicompost (4.67 days) followed by poultry manure (4.33 days) and soil (3.67 days). In gunny bag, the storability ranged from 3.67 to 5.67 days. The highest storability was observed in poultry manure (5.67 days) of microgreen followed by soil (5.00 days) and cocopeat (4.67 days). The microgreens are highly delicate leafy materials, and their storability depends on proper aeration of packaging materials during storage which might be reason behind high storability in gunny bags under all treatments.

CONCLUSION

The use of poultry manure can be considered as best growing media among all treatments to obtain maximum growth, biomass and yield of microgreen amaranthus. Further, application of poultry manure increased the growth of the plant and maintained the quality of plant. Among various packaging materials, the gunny bag was observed as best packaging material for longer storability of microgreens due to aeration.

ACKNOWLEDGEMENT

The authors thank Department of Horticulture, School of Agriculture, ITM University Gwalior (M. P.) for providing the required materials and indoor space for the conduct of research.

REFERENCES

Anmol and Singh, S. K. (2018). Yield improvement in cucumber through integrated nutrient management practices in Central plain zone (Pb-3) of Punjab, India. *Int. J. Res. Anal. Rev.* **5**: 766-772.

Anonymous (2019). *International Rules for Seed Testing.* ISTA (International Seed Testing Association), Geneva, Switzerland.

Carlile, W. R., Raviv, M. and Prasad, M. (2019). Organic soilless media components. *Soilless Culture*: 303-378.

Choe, U., Yu, L. L. and Wang, T. T. Y. (2018). The science behind microgreens as an exciting

new food for the 21st Century. *J. Agric. Food Chem.* **66**: 11519-11530.

Jangde, B., Asati, B. S., Sahu, P. and Tripathy, B. (2017). Correlation and path coefficient analysis in vegetable amaranthus (*Amaranthus tricolor* L.). *J. Pharmacognosy and Phytochem.* **1**: 409-415.

Kaur, M., Singh, S., Dishri, M., Singh, G. and Singh, S. K. (2018). Foliar application of zinc and manganese and their effect on yield and quality characters of potato (*Solanum tuberosum* L.) cv. Kufri Pukhraj. *Plant Archives* **18**: 1628-1630.

Kumar, M., Kathayat, K., Singh, S. K., Singh, L. and Singh, T. (2018). Influence of bio-fertilizers application on growth, yield and quality attributes of cucumber (*Cucumis sativus* L.): A review. *Plant Arch*ives **18**: 2329-2334.

Kyriacou, M. C., Rouphael, Y., Di Gioia, F., Kyratzis, A., Serio, F., Renna, M., De Pascale, S. and Santamaria, P. (2016). Micro-scale vegetable production and the rise of microgreens. *Trends Food Sci. Technol.* **57**: 103-115.

Lallawmkima, I., Singh, S. K. and Sharma, M. (2018a). Application of azotobacter, vesicular arbuscular mycorrhiza and phosphate solubilizing bacteria for potato cultivation in Central Plain Zone (Pb-3) of Punjab. *J. Environ. Biol.* **39**: 985-989.

Lallawmkima, I., Singh, S. K. and Sharma, M. (2018b). Integrated nutrient management: Soil health, nitrate toxicity and tuber quality in potato (*Solanum tuberosum* L.) grown in sub-tropical punjab. *Carpathian J. Food Sci. Tech.* **10**: 57-67.

Moraru, P. I., Rusu, T. and Mintas, O. S. (2022). Trial protocol for evaluating platforms for growing microgreens in hydroponic conditions. *Foods* **11**: 1327.

Ramandeep Singh, Kumari, S. and Singh, S. K. (2018). Impact of bio-fertilizers and fertilizers on potato (*Solanum tuberosum* L.) cv. Kufri Pukhraj and Kufri Jyoti cultivation. *IJCS* **6**: 29-31.

Rezwana, A., Reshi, Z. A., Jan, S. and Rashid, I. (2017). Biology of amaranthus. An article in Botanical Review. *https://doi.org/10.1007/s12229-017-9194-1.*

Rohith, M. S., Sharma, R. and Singh, S. K. (2022). Integration of panchagavya, neemcake and vermicompost improves the quality of chilli production. *J. Appl. Hort.* **23**: 212-218.

Singh, H., Singh, S., Kumar, D. and Singh, S. K. (2018a). Impact of foliar application of zinc on potato (*Solanum tuberosum* L.) cv. Kufri Pukhraj. *Plant Archives* **18**: 1334-1336.

Singh, S. K. (2018). Productivity of Indian gooseberry trees as function of vermicompost and mustard cake application. 6th International Conference on Advancements in Engineering and Technology (ICAET-2018), Sangrur. pp. 484-492.

Singh, S. K., Sharma, M., Reddy, K. R. and Venkatesh, T. (2018d). Integrated application of boron and sulphur to improve quality and economic yield in potato. *J. Environ. Biol.* **39**: 204-210.

Singh, S. K., Sharma, M. and Singh, P. K. (2018c). Yield, fruit quality and leaf nutrient status of aonla as influenced by intercropping under integrated nutrient management. *J. Crop and Weed* **14**: 9-13.

Singh, T., Rawat, M., Singh, S. K. and Kumar, M. (2018b). Impact of biofertilizer application on dry matter production and harvesting index in *Colocasia esculenta* (L.) Schott var. *antiquorum. Plant Archives* **18**: 1875-1878.

Turner, E. R., Luo, Y. and Buchanan, R. L. (2020). Microgreen nutrition, food safety and shelf life: A review. *J. Food Sci.* **85**: 870-882.

Tyagi, D. B., Nehal, N. and Singh, S. K. (2022). Effect of organic manures and biofertilizers on growth, yield and economics of cauliflower [*Brassica oleracea* (L.) var. botrytis]. *Ann. Plant Soil Res.* **24**: 487-490.

Wojdylo, A., Nowicka, P., Tkacz, K. and Turkiewicz, I. P. (2020). Sprouts vs. microgreens as novel functional foods: Variation of nutritional and phytochemical profiles and their *in vitro* bioactive properties. *Molecules* **25**: 4648.