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Short Communication

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Standardization of Media and Nutrients for Arrowhead Plant (*Syngonium podophyllum*) under Vertical Green Walls

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Not long ago, cities were surrounded by broad extensions of rural areas. Nowadays, rural populations are declining while urban populations are continuously increasing, leading to a rapid expansion of cities. Urban greening initiatives are a way of achieving ecological goals while reducing the undesirable effects of urban growth (Currie and Bass 2008). However, the development and expansion of cities has traditionally been guided by the criterion of maximizing the constructed area to increase profitability. This leads to situations in which enjoying open green areas is becoming a difficult task for dwellers of many cities. Vertical gardens, which allow growth of various species of plants in the complicated city life, balance urban ecology and enhance the quality of urban life. The choice of plant species for vertical gardens is strictly dependent on climate conditions and exposure of the wall. The good physical environment means the physical make-up of the growing media viz. maximum water holding capacity (WHC), bulk density (BD), air-filled porosity (AFP), water retention characteristics at a particular matric potential and the mechanical support to the plant growth. Cocopeat, vermiculite, perlite and greenosil suits to the requirements due to their properties such as light in weight, water holding capacity, aeration etc. Soilless plant culture is the novel method of growing plants without the use of soil as a rooting medium (Savvas *et al*. 2013). This relatively simple definition encompasses a diverse range of plant growth systems which generally involves containerization of plant roots within a porous rooting medium known as a 'substrate' or 'growing medium'. Compared with soil-based cultivation, soilless production can be more cost-effective (Grafiadellis *et al*. 2000), producing higher yields and prompter harvests from smaller areas of land (Nejad and Ismaili 2014). Soilless systems also have higher water and nutrient use efficiencies and as a result, they have become increasingly important globally over the last 50 years (Schmilewski 2008).

The visual quality of ornamental plants is necessarily linked the nutritional requirements of plants often resulting in inefficient use of chemical and organic fertilizers, the needs of each species as well as the proper time for application. Foliar application seems to be promising for ensuring use efficiency of applied nutrients. Fertilizer sticks, also referred to as fertilizer spikes or stakes or tablets, are compressed fertilizers that are manufactured in various forms. They produce a constant supply of nutrients into the soil or media. According to Kumar *et al.* (2018), the ideal fertilizer should release nutrients in a sigmoidal pattern for optimal plant nutrition and reduction in nutrient losses by processes that compete with the plant's nutrient requirements. With all these facts, the present investigation was formulated two nutrients and four media and its combinations with Arrow head plant (*Syngonium podophyllum*) (for modular containers under vertical green walls.

The present investigation was carried out in the Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalai Nagar, Tamil Nadu during the year 2018 to 2020. The experiment comprised of four media viz. Coco peat, Greenosil, Perlite and Vermiculite and their combinations and two nutrients viz. Foliar nutrition (Grosure NPK 19:19:19 and @ 1% twice (30 and 90 days after planting)) and fertilizer stick (Greenstix sticks were inserted to the modular containers @ one per container at 30 and 90 days after planting). Modular containers of size 12 cm x11 cm x 8 cm were fabricated in a netted vertical panel equipped with drip irrigation system. Growing media were filled up leaving one inch form the top

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of the modular containers. In addition, 50 grams of vermicompost was added to all the modular containers to enhance the initial growth. Arrow head plant (*Syngonium podophyllum*) of uniform size were planted in the modular containers and grown in the fabricated vertical green wall. The experiment was conducted in factorial completely randomized design. Three plants were selected at random from each treatment and tagged for the purpose of recording various biometric observations in all the three ornamental species. The plant growth characters like plant height, number of leaves per plant, leaf length, leaf width, leaf area, shoot weight, root weight, biomass, size index, and visual quality were observed at 150 days after planting.

The data on various characters of arrow head plant showed significant differences due to media and nutrients (Table 1). Among the media, the maximum plant height (31.79 cm), maximum number of leaves (6.87), highest leaf length (14.11 cm), maximum leaf width (8.09 cm), highest leaf area (66.04 cm^2), maximum shoot weight (16.66 g $plant^{-1}$), highest root weight (9.73 g $plant^{-1}$), maximum biomass (25.83 g $plant^{-1}$), maximum size index (22.63 cm) and maximum visual quality value (9.30) was observed in M_4 (Vermiculite) was significantly higher than M_3 (Perlite). However, minimum plant height (24.18 cm), number of leaves (4.22), lowest leaf length (11.91 cm), minimum leaf width (6.30 cm), lowest leaf area (52.53 cm^2), minimum shoot weight (12.15 g $plant^{-1}$), lowest root weight (6.25 g $plant^{-1}$), lowest biomass (19.17 g $plant^{-1}$), minimum size index (16.33 cm) and minimum visual quality (6.49) was observed in M_2 (Greenosil).

Table 1 Influence of media and nutrients on growth and performance of arrow head plant (*Syngonium podophyllum*)

Treatment	Plant height (cm)	Number of leaves	Leaf length (cm)	Leaf width (cm)	Leaf area (cm^2)	Shoot weight (g $plant^{-1}$)	Root weight (g $plant^{-1}$)	Biomass (g $plant^{-1}$)	Size index (cm)	Visual quality
M_1N_0	29.41	4.01	12.31	5.99	49.49	10.12	5.04	15.75	17.87	7.76
M_2N_0	22.13	3.41	11.56	5.13	48.16	9.01	4.87	14.22	15.43	6.21
M_3N_0	26.05	6.23	13.01	6.95	52.21	12.43	6.32	18.75	19.87	8.34
M_4N_0	27.45	6.71	13.21	7.35	58.72	14.51	8.44	22.95	21.06	8.97
M_5N_0	22.51	3.91	12.23	5.92	51.12	9.87	5.21	14.91	15.87	6.33
M_6N_0	22.61	4.42	11.75	6.02	52.29	11.65	5.01	16.66	18.33	8.07
M_7N_0	23.66	4.66	12.17	6.84	49.61	10.88	5.99	16.11	18.46	6.73
M_1N_1	29.77	5.01	12.91	6.84	56.17	13.01	7.32	19.47	18.24	8.42
M_2N_1	25.17	3.58	12.04	6.75	53.23	12.45	6.01	20.21	16.65	6.44
M_3N_1	32.91	6.46	13.92	7.47	63.41	14.87	8.43	23.30	21.78	9.01
M_4N_1	33.02	6.72	13.97	8.01	66.21	16.12	9.78	24.19	22.28	9.12
M_5N_1	24.62	4.25	13.01	6.78	54.43	13.06	7.76	20.38	16.76	6.66
M_6N_1	23.66	5.21	11.91	7.61	54.22	13.98	7.77	21.75	20.01	8.32
M_7N_1	25.72	5.07	12.32	7.40	53.26	13.46	7.23	20.24	20.33	7.82
M_1N_2	30.21	6.42	14.12	7.66	60.91	14.52	8.44	22.52	18.77	8.72
M_2N_2	25.25	5.72	12.12	7.02	56.21	14.98	7.87	23.09	16.92	6.81
M_3N_2	34.18	6.82	14.75	8.27	70.75	16.78	10.07	25.87	23.01	9.19
M_4N_2	34.92	7.18	15.17	8.91	73.21	19.36	10.98	30.34	24.56	9.82
M_5N_2	26.69	4.52	13.92	7.17	56.25	14.45	8.11	22.89	16.99	7.19
M_6N_2	29.91	5.73	12.99	8.18	57.16	14.22	8.32	22.54	20.98	8.92
M_7N_2	26.92	5.71	12.91	8.02	56.25	14.65	8.01	22.53	20.47	7.92
S.Ed.	0.35	0.16	0.21	0.26	1.11	0.50	0.24	0.81	0.55	0.26
CD (0.05%)	0.72	0.34	0.42	0.52	2.24	1.00	0.50	1.64	1.12	0.54
M_1	29.79	5.14	13.11	6.83	55.42	12.55	6.93	19.25	18.29	8.30
M_2	24.18	4.22	11.91	6.30	52.53	12.15	6.25	19.17	16.33	6.49
M_3	31.04	6.50	13.89	7.56	62.12	14.69	8.27	22.64	21.55	8.85
M_4	31.79	6.87	14.11	8.09	66.04	16.66	9.73	25.83	22.63	9.30
M_5	24.60	4.28	13.05	6.62	53.93	12.46	7.02	19.39	16.54	6.72
M_6	25.39	5.12	12.21	7.27	54.56	13.28	7.36	20.31	19.77	8.44
M_7	25.43	5.14	12.46	7.42	52.91	12.99	7.07	19.63	19.75	7.49
S.Ed.	0.20	0.08	0.08	0.15	0.66	0.28	0.14	0.47	0.36	0.15
CD (0.05%)	0.41	0.18	0.18	0.30	1.34	0.58	0.28	0.95	0.72	0.31
N_0	24.83	4.76	12.32	6.13	51.66	11.21	5.84	17.05	18.13	7.49
N_1	27.84	5.18	12.86	7.26	57.27	13.85	7.75	21.36	19.43	7.97
N_2	29.72	6.01	13.71	7.89	61.53	15.56	8.83	24.25	20.24	8.36
S.Ed.	0.14	0.07	0.13	0.09	0.44	0.18	0.09	0.30	0.18	0.10
CD (0.05%)	0.29	0.14	0.24	0.19	0.89	0.38	0.20	0.62	0.38	0.20

Plants grown under vermiculite (M_4) showed maximum values for vegetative characters ultimately resulted in enhancement visual quality and ornamental importance. Vermiculite is the most common physical growth substrate which is known for its high water holding, inert chemical nature, and moderate level of aeration, absence of substrate for microbial growth and effective cation exchange capacity which may be the reason in enhancing the morphology of all the three foliage ornamentals. Further, it can hold 3 - 4 times its weight of water and positive-charged nutrients such as K, Mg and Ca. The results of the present study are in consonance with the study made by Indrasumunar and Gresshoff (2013). The primitive effect of vermiculite are in accordance of the findings of Zhang *et al*. (2012) in petunia and (El-Naggar 2005) in gladiolus.

Among the nutrient treatments, maximum plant height (29.72 cm), maximum number of leaves (6.01), maximum leaf length (13.71 cm), maximum leaf width (7.89 cm), maximum leaf area (61.53 cm^2), maximum shoot weight (15.56 g $plant^{-1}$), maximum root weight (8.83 g $plant^{-1}$), maximum biomass (24.25 g $plant^{-1}$), maximum size (20.24 cm) and highest visual quality (8.36) was observed in N_2 (Fertilizer stick) was significantly higher than N_1 (Foliar nutrition) . However, minimum plant height (24.83 cm), number of leaves (4.76), minimum leaf length (12.32 cm), minimum leaf width (6.13 cm), minimum leaf area (51.66 cm^2), minimum shoot weight (11.21g $plant^{-1}$), root weight (5.84 g $plant^{-1}$), minimum biomass (17.05 g $plant^{-1}$), minimal size index (18.13 cm) and lowest visual quality (7.49) was observed in Control N_0.

The superiority of the treatment N_2 on various vegetative characters may be due to plant growth conditions, such as reduction of stress and specific toxicity resulting from excessive nutrient supply in the root zones. The fertilizer sticks produce a constant supply of nutrients into the media which dissolve slowly and release the nutrients, where they are taken up by the roots. The results of Kumar *et al.* (2018) evinced that the Enhanced Efficiency Fertilizers are more efficient from fertilizer sticks compared to conventional fertilizer formulations with respect to nutrient uptake by the crops and persistent behaviour in the substrate soil for a longer period of time. Similar findings were reported by Geicu-Cristea *et al.* (2016) in *Petunia* and *Dainthus* sp, Jagadeeswaran *et al.* (2007) in *Turmeric*, Dehgan *et al*. (2004) in *Zamia floridana*.

Interaction of media and nutrients showed significant difference for plant height in Arrow head plant. However, the maximum plant height (34.92 cm), maximum number of leaves (7.18), maximum leaf length (15.17 cm), maximum leaf width (8.91 cm), highest leaf area (73.21 cm^2), highest shoot weight (19.36g $plant^{-1}$), highest root weight (10.98 g $plant^{-1}$), maximum biomass (30.34 g $plant^{-1}$), maximum size index (24.56 cm) and maximum visual quality (9.82) was observed in M_4N_2 (Vermiculite + Fertilizer stick). However, minimum plant height (22.13 cm), number of leaves (3.41), minimum leaf length (11.56 cm), minimum leaf width (5.13 cm), lowest leaf area (48.16 cm^2), lowest shoot weight (9.01 g $plant^{-1}$), lowest root weight (4.87 g $plant^{-1}$), lowest biomass (14.22 g $plant^{-1}$), minimum size index (15.43 cm) and minimum visual quality (6.21) was observed in M_2N_0 (Greenosil + Control).

Media and nutrients are the two major factors influencing the containerized ornamental plants. Plants grown under suitable media and supply of essential quantities of nutrients at right time determines the compact growth of plants. The synergetic effect of media and nutrients results in better plant growth and development. In the present investigation, the influence of media and nutrients are found to be significant in expressing commendable results. The enhanced effect of fertilizer stick may be due to increase in the availability of nutrients due to the controlled release of nutrients into a “fixing” medium during the fixation processes in the media (vermiculite) as well as supplying nutrients in the forms preferred by plants; in that way the synergistic effect between nutrients and media. Further, the controlled release fertilizer improves nutrient use efficiency (NUE) and reduces losses of surplus nutrients. The results obtained from Chen *et al*. (2011), Jagadeeswaran *et al*. (2007), Sempeho *et al.* (2014), Geicu-Cristea *et al.* (2016) are in agreement with the present study. Hence, from the present experiment, it could be concluded that Arrowhead plant (*Syngonium podophyllum*) performed better under the media vermiculite and applied with fertilizer stick Greeenstix @ 1 per container at 60 days interval.

SUMMARY

An investigation was carried out to standardize the media and nutrients for Arrowhead plant (*Syngonium podophyllum*) under vertical green walls in the Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalai Nagar, Tamil Nadu during the year 2018 to 2020. The experiment comprised of four media viz. Coco peat, Greenosil, Perlite and Vermiculite and their combinations and two nutrients viz. Foliar nutrition (Grosure NPK 19:19:19 and @ 1% twice (30 and 90 days after planting)) and fertilizer stick (Greenstix sticks were inserted to the modular containers @ one per container at 30 and 90 days after planting). The plant growth characters like plant height, number of leaves per plant, leaf length, leaf width, leaf area, shoot weight, root weight, biomass, size index, and visual quality were observed at 150 days after planting. From the experiment, it could be concluded that Arrowhead plant (*Syngonium podophyllum*) performed better under the media vermiculite and applied with fertilizer stick (Greeenstix @ 1 per container at 60 days interval).

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