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Influence of different nutrient management practices on growth performance of potted *Syngonium*

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Abstract
The present investigation was carried out at college of horticulture-Rajendranagar, SKLTGHU during 2023 and 2024. The experiment was laid out completely randomized design with factorial concept with three replicates, results reported that among the interactions the maximum plant height (cm) (52.39, 52.19, 52.29), no. of leaves/plant (41.00, 40.47, 40.73), leaf width (cm) (12.63, 12.95, 12.79), plant spread North-South (cm) (36.47, 37.00, 36.73), was recorded in T_3: (N_2B_1)Water soluble fertilizers (19: 19: 19) 4 g/l + Arka microbial consortium 5 g/plant. The maximum root length (cm) (43.97, 44.23, 44.10) and number of roots per plant (30.53, 31.07, 30.80) was also recorded in T_3: (N_2B_1) Water soluble fertilizers (19: 19: 19) 4 g/l + Arka microbial consortium 5 g/plant. There was no significant difference observed among the interactions with respect to leaf length, plant spread East-West and Leaf area during both years and pooled.

Keywords: Biofertilizers, *syngonium*, nutrient stick, nutrients

Introduction
Indoor plants not only add greenery to the inside environment, but are also capable of reducing air pollution. They absorb toxins from surroundings and release oxygenated air to enrich the same. Among the indoor plants *syngonium* is popular and is grown around the world due to its appealing ornamental foliage. Nutrition influences the growth and quality of indoor plants. Nutrients and the quantity required should be understood before opting for the source of fertilizer to be used and the method of application, as these factors influence the growth and quality of indoor plants. The supply of essential plant nutrients in an optimal proportion is essential for better plant growth, development, and nutrient utilization efficiency (Ruxanabi *et al.* 2020) [13]. Water-soluble fertilizers (WSF), multi-nutrient fertilizers, organic manures, controlled-release fertilizers, and biofertilizers are among the most important nutrient management methods. Using WSF in various crops reduces need for fertilizer by ~ 30%-50% while also reducing irrigation water use.

2. Materials and Methods
The present investigation was conducted at College of Horticulture-Rajendranagar, SKLTGHU during 2023-2024 and 2024-2025. The experiment was laid out in Factorial completely randomized design replicated thrice with eight treatments. It was carried out with different nutrient sources (N) *viz*., N_1: Water soluble fertilizers (19:19:19) 2 g/l, N_2: Water soluble fertilizers (19:19:19) 4 g/l, N_3: 1 Fertilizer stick/polybag, N_4: Water spray (control) and these were scheduled every month. The biofertilizers (B) include B_1: Arka microbial consortium 5 g/plant and B_2: VAM 5 g/plant. The treatment details include T_1 (N_1B_1): WSF (19:19:19) 2 g/l + Arka microbial consortium 5 g/plant, T_2 (N_1B_2): WSF (19:19:19) 2 g/l + VAM 5 g/plant, T_3 (N_2B_1): WSF (19:19:19) 4 g/l + Arka microbial consortium 5 g/plant, T_4 (N_2B_2): WSF (19:19:19) 4 g/l + VAM 5 g/plant, T_5 (N_3B_1): 1 Fertilizer stick/polybag + Arka microbial consortium 5 g/plant, T_6 (N_3B_2): 1 Fertilizer stick/polybag + VAM 5 g/plant, T_7 (N_4B_1): Water spray + Arka microbial consortium 5 g/plant, T_8 (N_4B_2): Water spray + VAM 5 g/plant. The Standard media used for the experiment was cocopeat: sand: vermicompost: 2:1:1 V/V. The following observations were recorded.

2.1 Plant height (cm)
Plant height was measured at 45, 90 and 135 days after planting. The readings were taken for five tagged plants per treatment per replication and the mean was calculated. The height was recorded up to the tip of the longest leaf with the help of a standard meter scale and expressed in centimeters.

2.2 Number of leaves per plant
The number of leaves were counted at 45, 90 and 135 days after planting. The readings were taken for five tagged plants per treatment per replication and averages were done.

2.3 Leaf length (cm)
The length of mature leaf was measured at 45, 90 and 135 days after planting by taking average of five leaves per each plant. The length was recorded from the basal lobe to the tip with the help of standard meter scale and expressed in centimeters.

2.4 Leaf width (cm)
The width of mature leaf was measured at 45, 90 and 135 days after planting by taking average of five leaves per each plant. The width of the middle portion of the fully mature leaves was taken with the help of standard meter scale and expressed in centimeters.

2.5 Leaf area (cm^2 /plant)
The leaf area was calculated at135DAP by taking 10 leaves from a plant by random selection and measured with Leaf Area Meter. The mean was calculated and multiplied with the total number of leaves of 5 randomly selected plants.

2.6 Root length (cm)
The root system of the above sampled plants was cleaned to remove adhered soil and media. The length from collar region to the tip of longest root was measured using a measuring scale, average values were worked out and expressed in centimeter.

2.7 Number of roots per plant
Number of roots per plant was counted by uprooting three plants per treatment per replication at 135 DAP and washed thoroughly then total number of roots per plant was recorded and average was calculated.

3. Results and Discussions
3.1 Plant height (cm)
AT 45 DAP
The data pertaining to the plant height at 45 DAP as influenced by different nutrient sources, biofertilizers and their combinations is presented in Table 1. The pooled data of both years showed that the maximum plant height (31.67 cm) was recorded in N_2-water soluble fertilizers (19:19:19) 4 g/l, followed by N_1-water soluble fertilizers (19:19:19) 2 g/l (30.75 cm). The biofertilizers differed significantly in which the maximum plant height (28.78 cm) was recorded in B_1-Arka microbial consortium 5 g/plant followed by B_2-VAM 5 g/plant, (25.38 cm). The interaction effect between different nutrient sources and biofertilizers was significant. The highest plant height (34.23 cm) was recorded in T_3 (N_2B_1) water soluble fertilizers (19:19:19) 4 g/l + Arka microbial consortium 5 g/plant followed by T_1 (N_1B_1)-water soluble fertilizers (19:19:19) 2 g/l + Arka microbial consortium 5 g/plant (32.53 cm), T_4 (N_2B_2) water soluble fertilizers (19:19:19) 4 g/l + VAM 5 g/plant (29.10 cm), whereas the lowest plant height was recorded in T_8 (N_4B_2)-water spray + VAM 5 g/plant (18.70 cm).

AT 90 DAP
The pooled data revealed the different nutrient sources differed significantly and the maximum plant height (41.65 cm) was recorded in N_2-water soluble fertilizers (19:19:19) 4 g/l, and was on par with N_1-water soluble fertilizers (19:19:19) 2 g/l (40.59 cm). The biofertilizers differed significantly in which the maximum plant height (38.75 cm) was recorded in B_1-Arka microbial consortium 5 g/plant followed by B_2-VAM 5 g/plant, (35.72 cm). The interaction effect was observed to be significant. The highest plant height (42.68 cm) was recorded in T_3 (N_2B_1)-water soluble fertilizers (19:19:19) 4 g/l + Arka microbial consortium 5 g/plant which was on par with T_1 (N_1B_1)-water soluble fertilizers (19:19:19) 2 g/l + Arka microbial consortium 5 g/plant (41.86 cm), followed by T_4 (N_2B_2) water soluble fertilizers (19:19:19) 4 g/l + VAM 5 g/plant (40.32 cm), whereas the lowest plant height was recorded in T_8 (N_4B_2)-water spray + VAM 5 g/plant (27.35 cm)

AT 135 DAP
The pooled data of both years showed that the maximum plant height (50.83 cm) was recorded in N_2-water soluble fertilizers (19:19:19) 4 g/l, and was on par with N_1-water soluble fertilizers (19:19:19) 2 g/l (49.16 cm). The biofertilizers differed significantly in which the maximum plant height (47.18 cm) was recorded in B_1-Arka microbial consortium 5 g/plant followed by B_2-VAM 5 g/plant, (43.29 cm). The interaction effect was significant. The highest plant height (52.29 cm) was recorded in T_3 (N_2B_1)-water soluble fertilizers (19:19:19) 4 g/l + Arka microbial consortium 5 g/plant which was on par with T_1 (N_1B_1)-water soluble fertilizers (19:19:19) 2 g/l + Arka microbial consortium 5 g/plant (50.74 cm), followed by T_4 (N_2B_2) water soluble fertilizers (19:19:19) 4 g/l + VAM 5 g/plant (49.37 cm), whereas the lowest plant height was recorded in T_8 (N_4B_2)-water spray + VAM 5 g/plant (32.66 cm).
The increase in plant height may be due to the crop response to different nutrients, stimulated by the foliar application of nutrients at different growth stages. The spraying of Nitrogen, Phosphorus, and Potassium in combination increased the mobilization of macronutrients as reported by Hatwar *et al.* (2003) [7] in chilli.
In this research, the use of WSF and biofertilizers increased plant height, spread and number of leaves, petiole length, and leaf area, which could be related to increased nutrient availability. The use of essential plant nutrients in accessible form boosts crop growth and productivity. Also, the optimal nutrient schedule improves nutrient-use efficiency by minimizing nutrient loss (Bana *et al*. 2021) [2]. The combined usage of WSF and biofertilizers may have provided an adequate amount of nutrients while also promoting metabolic activity in the plants, resulting in improved growth and development. The beneficial effect of WSF on plant growth was reported by (Mishra *et al.* 2011; Bohane and Tiwari 2014; El-Tohamy *et al*. 2019) [10, 3, 5].

Table 1: Effect of nutrient management on plant height (cm) of *syngonium*

Treatments	45 DAP			90 DAP			135 DAP		
	2023	2024	Pooled	2023	2024	Pooled	2023	2024	Pooled
Nutrients									
N_1	31.07	30.43	30.75	40.92	40.26	40.59	49.48	48.83	49.16
N_2	31.87	31.47	31.67	41.85	41.45	41.65	51.03	50.63	50.83
N_3	25.50	25.20	25.35	36.84	36.54	36.69	44.75	44.60	44.68
N_4	20.70	20.40	20.55	30.15	29.85	30.00	36.45	36.15	36.30
S.Em ±	0.21	0.20	0.21	0.40	0.41	0.38	0.67	0.64	0.66
CD at 5%	0.62	0.61	0.64	1.20	1.22	1.14	2.01	1.93	1.96
Biofertilizers									
B_1	28.92	28.65	28.78	38.88	38.61	38.75	47.32	47.05	47.18
B_2	25.65	28.65	25.38	36.00	35.44	35.72	43.53	43.06	43.29
S.Em ±	0.15	0.14	0.15	0.28	0.29	0.27	0.47	0.45	0.46
CD at 5%	0.44	0.43	0.45	0.85	0.86	0.80	1.42	1.36	1.39
Interactions (Nutrients and Biofertilizers)									
T_1 (N_1B_1)	32.97	32.40	32.53	42.01	41.71	41.86	50.89	50.59	50.74
T_2 (N_1B_2)	29.47	28.47	29.97	39.83	38.81	39.32	48.07	47.07	47.57
T_3 (N_2B_1)	34.33	34.13	34.23	42.78	42.58	42.68	57.39	52.19	52.29
T_4 (N_2B_2)	29.40	28.80	29.10	40.92	40.32	40.62	49.67	49.07	49.37
T_5 (N_3B_1)	26.07	25.87	25.97	37.89	37.69	37.79	45.87	45.67	45.77
T_6 (N_3B_2)	24.93	24.53	24.73	35.78	35.38	35.58	43.63	43.53	43.58
T_7 (N_4B_1)	22.60	22.20	22.40	32.85	32.45	32.65	40.13	39.73	39.93
T_8 (N_4B_2)	18.80	18.60	18.70	27.45	27.25	27.35	32.76	32.56	32.66
S.Em ±	0.29	0.29	0.30	0.57	0.57	0.54	0.95	0.91	0.93
CD at 5%	0.87	0.86	0.90	1.70	1.72	1.61	2.84	2.73	2.78

3.2 No of leaves/ plant

AT 45 DAP

The pooled data showed (Table 2), the maximum number of leaves per plant (8.25) was recorded in N_2-water soluble fertilizers (19:19:19) 4 g/l, followed by N_1-water soluble fertilizers (19:19:19) 2 g/l (7.33). The biofertilizers differed significantly in which the maximum number of leaves per plant (6.69) was recorded in B_1-Arka microbial consortium 5 g/plant followed by B_2-VAM 5 g/plant, (5.29). The interaction effect between different nutrient sources and biofertilizers was observed to be non-significant.

AT 90 DAP

The pooled data showed, the maximum number of leaves per plant (19.05) was recorded in N_2-water soluble fertilizers (19:19:19) 4 g/l, followed by N_1-water soluble fertilizers (19:19:19) 2 g/l (17.43). The biofertilizers differed significantly in which the maximum number of leaves per plant (16.52) was recorded in B_1-Arka microbial consortium 5 g/plant followed by B_2-VAM 5 g/plant, (13.93). The interaction effect between different nutrient sources and biofertilizers was observed to be non-significant.

135 DAP

The pooled data showed, the maximum number of leaves per plant (38.60) was recorded in N_2-water soluble fertilizers (19:19:19) 4 g/l, followed by N_1-water soluble fertilizers (19:19:19) 2 g/l (35.73). The biofertilizers differed significantly in which the maximum number of leaves per plant (33.66) was recorded in B_1-Arka microbial consortium 5 g/plant followed by B_2-VAM 5 g/plant, (28.03). The interaction effect was significant. The highest number of leaves per plant (40.73) was recorded in T_3 (N_2B_1)-water soluble fertilizers (19:19:19) 4 g/l + Arka microbial consortium 5 g/plant followed by T_1 (N_1B_1)-water soluble fertilizers (19:19:19) 2 g/l + Arka microbial consortium 5 g/plant (38.37), T_4 (N_2B_2) (36.47), whereas the lowest number of leaves per plant was observed in T_8 (N_4B_2)-water spray + VAM 5 g/plant (13.87).

Increased number of leaves per metre square due to adequate and continuous supply of major nutrients and nitrogen, the main constituent of chlorophyll, increased the crop photosynthetic efficiency, resulting in higher leaf counts. Similar result was observed by Nehra *et al.* (2001) [9] and Mukherjee (2019) [12] in wheat.

The Arka Microbial Consortium (AMC), comprising N-fixing bacteria, phosphorus solubilizing bacteria, and zinc solubilizers, aids the plant in obtaining more nutrients from the soil, releasing fixed nutrients in soil aggregates, and developing plant resistance to soil-borne diseases caused by various microbes. These results are in conformity with the findings of Airadevi (2010) [1] in chrysanthemum and Geeta Pandey *et al*. (2010) [6] observed in chrysanthemum.

Table 2: Effect of nutrient management on no of leaves of *syngonium*

Treatments	45 DAP			90 DAP			135 DAP		
	2023	2024	Pooled	2023	2024	Pooled	2023	2024	Pooled
Nutrients									
N_1	7.53	7.13	7.33	17.83	17.43	17.63	35.93	35.53	35.73
N_2	8.30	8.20	8.25	19.13	18.97	19.05	38.73	38.47	38.60
N_3	5.27	4.97	5.12	14.30	14.00	14.15	29.80	29.50	29.65
N_4	3.40	3.13	3.27	10.17	9.97	10.07	19.50	19.30	19.40
S.Em ±	0.25	0.25	0.22	0.30	0.28	0.29	0.34	0.37	0.33
CD at 5%	0.74	0.74	0.66	0.90	0.85	0.87	1.03	1.11	0.98

Biofertilizers									
B_1	6.80	6.58	6.69	16.62	16.42	16.52	33.80	33.52	33.66
B_2	5.54	5.13	5.29	14.10	13.77	13.93	28.18	27.88	28.03
S.Em ±	0.17	0.17	0.16	0.21	0.20	0.21	0.24	0.26	0.23
CD at 5%	0.52	0.52	0.46	0.63	0.60	0.62	0.73	0.79	0.70
Interactions (Nutrients and Biofertilizers)									
T_1 (N_1B_1)	8.27	8.07	8.17	18.93	18.73	18.83	38.47	38.27	38.37
T_2 (N_1B_2)	6.80	6.20	6.50	16.73	16.13	16.43	33.40	32.80	33.10
T_3 (N_2B_1)	9.27	9.07	9.17	20.40	20.20	20.30	41.00	40.47	40.73
T_4 (N_2B_2)	7.33	7.33	7.33	17.87	17.73	17.80	36.47	36.47	36.47
T_5 (N_3B_1)	5.80	5.60	5.70	15.13	14.93	15.03	30.80	30.60	30.70
T_6 (N_3B_2)	4.73	4.33	4.53	13.47	13.07	13.27	28.80	28.40	28.60
T_7 (N_4B_1)	3.87	3.60	3.73	12.00	11.80	11.90	24.93	24.73	24.83
T_8 (N_4B_2)	2.93	2.67	2.80	8.33	8.13	8.23	14.07	13.87	13.97
S.Em ±	0.35	0.35	0.31	0.42	0.40	0.41	0.49	0.53	0.46
CD at 5%	NS	NS	NS	NS	NS	NS	1.46	1.58	1.39

3.3 Leaf length (cm)

AT 45 DAP

The pooled data showed (Table 3.) that the maximum leaf length (17.32 cm) was recorded in N_2-water soluble fertilizers (19:19:19) 4 g/l, followed by N_1-water soluble fertilizers (19:19:19) 2 g/l (16.63 cm). The biofertilizers differed significantly in which the maximum leaf length (16.48 cm) was recorded in B_1-Arka microbial consortium 5 g/plant followed by B_2-VAM 5 g/plant, (15.39 cm). The interaction effect was significant. The maximum leaf length (17.96 cm) was recorded in T_3 (N_2B_1)-water soluble fertilizers (19:19:19) 4 g/l + Arka microbial consortium 5 g/plant followed by T_1 (N_1B_1)-water soluble fertilizers (19:19:19) 2 g/l + Arka microbial consortium 5 g/plant (17.41 cm), T_4 (N_2B_2) (16.67 cm), whereas the lowest leaf length was recorded in T_8 (N_4B_2)-water spray + VAM 5 g/plant (13.89 cm).

AT 90 DAP

The pooled data showed that the maximum leaf length (22.06 cm) was recorded in N_2-water soluble fertilizers (19:19:19) 4 g/l, followed by N_1-water soluble fertilizers (19:19:19) 2 g/l (19.73 cm). The biofertilizers differed significantly in which the maximum leaf length (20.40 cm) was recorded in B_1-Arka microbial consortium 5 g/plant followed by B_2-VAM 5 g/plant, (18.53 cm). The interaction effect was found to be non-significant.

AT 135 DAP

The pooled data showed that the maximum leaf length (24.13 cm) was recorded in N_2-followed by N_1 (23.18 cm). The biofertilizers differed significantly in which the maximum leaf length (22.75 cm) was recorded in B_1 followed by B_2 (20.96 cm). The interactions was non-significant.

Table 3: Effect of nutrient management on leaf length (cm) of *syngonium*

Treatments	45 DAP			90 DAP			135 DAP		
	2023	2024	Pooled	2023	2024	Pooled	2023	2024	Pooled
Nutrients									
N_1	16.93	16.32	16.63	21.07	20.68	20.88	23.37	22.98	23.18
N_2	17.29	17.34	17.32	21.99	22.14	22.06	24.05	24.20	24.13
N_3	15.47	15.48	15.47	18.74	18.85	18.80	21.38	21.49	21.43
N_4	14.30	14.33	14.31	16.07	16.19	16.13	18.62	18.74	18.68
S.Em ±	0.07	0.15	0.10	0.21	0.20	0.20	0.66	0.64	0.65
CD at 5%	0.21	0.44	0.30	0.64	0.61	0.60	1.96	1.93	0.94
Biofertilizers									
B_1	16.45	16.51	16.48	20.32	20.47	20.40	22.60	22.75	22.67
B_2	15.55	15.23	15.39	18.61	18.46	18.53	21.11	20.96	21.04
S.Em ±	0.05	0.10	0.07	0.15	0.14	0.14	0.46	0.46	0.46
CD at 5%	0.15	0.31	0.21	0.45	0.43	0.43	1.39	1.36	1.37
Interactions (Nutrients and Biofertilizers)									
T_1 (N_1B_1)	17.41	17.41	17.41	21.97	22.07	22.02	24.02	24.12	24.07
T_2 (N_1B_2)	16.45	15.24	15.85	20.17	19.29	19.73	22.72	21.84	22.28
T_3 (N_2B_1)	17.86	18.05	17.96	22.73	22.99	22.86	24.59	24.85	24.72
T_4 (N_2B_2)	16.71	16.63	16.67	21.24	21.28	21.26	23.52	23.56	23.54
T_5 (N_3B_1)	15.68	15.81	15.75	19.22	19.42	19.32	21.80	22.00	21.90
T_6 (N_3B_2)	15.25	15.15	15.20	18.26	18.28	18.27	20.95	20.97	20.96
T_7 (N_4B_1)	14.84	14.76	14.80	17.35	17.39	17.37	19.99	20.03	20.01
T_8 (N_4B_2)	13.76	13.89	13.83	14.78	14.98	14.88	17.26	17.46	17.36
S.Em ±	0.10	0.21	0.14	0.30	0.29	0.29	0.93	0.91	0.91
CD at 5%	0.30	0.62	0.43	NS	NS	NS	NS	NS	NS

3.4 Leaf width (cm)

AT 45DAP

The pooled data showed (Table 4), the maximum leaf width (cm) (8.18) was recorded in N_2-water soluble fertilizers (19:19:19) 4 g/l, followed by N_1-water soluble fertilizers (19:19:19) 2 g/l (7.67). The biofertilizers differed significantly in which the maximum leaf width (7.49 cm) was recorded in B_1-Arka microbial consortium 5 g/plant

followed by B_2-VAM 5 g/plant, (6.95 cm). The interaction effect was significant. The maximum leaf width (8.63 cm) was recorded in T_3 (N_2B_1)-water soluble fertilizers (19:19:19) 4 g/l + Arka microbial consortium 5 g/plant followed by T_1 (N_1B_1)-water soluble fertilizers (19:19:19) 2 g/l + Arka microbial consortium 5 g/plant (8.06 cm), T_4 (N_2B_2) (7.72 cm), whereas the lowest leaf width was recorded in T_8 (N_4B_2)-water spray + VAM 5 g/plant (6.01cm).

AT 90DAP

The pooled data showed, the maximum leaf width (cm) (11.21) was recorded in N_2-water soluble fertilizers (19:19:19) 4 g/l, followed by N_1-water soluble fertilizers (19:19:19) 2 g/l (10.67). The biofertilizers differed significantly in which the maximum leaf width (10.12 cm) was recorded in B_1-Arka microbial consortium 5 g/plant followed by B_2-VAM 5 g/plant, (9.09 cm). The interaction effect was significant. The maximum leaf width (11.77 cm) was recorded in T_3 (N_2B_1) water soluble fertilizers (19:19:19) 4 g/l + Arka microbial consortium 5 g/plant followed by T_1 (N_1B_1)-water soluble fertilizers (19:19:19) 2 g/l + Arka microbial consortium 5 g/plant (11.32 cm), T_4 (N_2B_2) (10.64 cm), whereas the lowest leaf width was recorded in T_8 (N_4B_2)-water spray + VAM 5 g/plant (6.81cm).

AT 135DAP

The pooled data showed, the maximum leaf width (cm) (12.39) was recorded in N_2-water soluble fertilizers (19:19:19) 4 g/l, followed by N_1-water soluble fertilizers (19:19:19) 2 g/l (11.88).The biofertilizers differed significantly in which the maximum leaf width (11.39 cm) was recorded in B_1-Arka microbial consortium 5 g/plant followed by B_2-VAM 5 g/plant, (10.32 cm). The interaction effect was significant. The maximum leaf width (12.79 cm) was recorded in T_3 (N_2B_1)-water soluble fertilizers (19:19:19) 4 g/l + Arka microbial consortium 5 g/plant which is on par with T_1 (N_1B_1)-water soluble fertilizers (19:19:19) 2 g/l + Arka microbial consortium 5 g/plant (12.47 cm) followed by T_4 (N_2B_2) (12.00 cm), whereas the lowest leaf width was recorded in T_8 (N_4B_2)-water spray + VAM 5 g/plant (7.60 cm).

Table 4: Effect of nutrient management on leaf width (cm) of *syngonium*

Treatments	45 DAP			90 DAP			135 DAP		
	2023	2024	Pooled	2023	2024	Pooled	2023	2024	Pooled
Nutrients									
N_1	7.61	7.73	7.67	10.61	10.73	10.67	11.82	11.94	11.88
N_2	8.05	8.30	8.18	11.08	11.33	11.21	12.24	12.55	12.39
N_3	6.82	6.90	6.86	9.09	9.10	9.10	10.51	10.59	10.55
N_4	6.09	6.28	6.18	7.35	7.54	7.45	8.48	8.67	8.58
S.Em ±	0.05	0.06	0.05	0.08	0.09	0.07	0.12	0.11	0.12
CD at 5%	0.16	0.17	0.16	0.23	0.27	0.22	0.36	0.34	0.35
Biofertilizers									
B_1	7.40	7.52	7.49	10.02	10.22	10.12	11.29	11.49	11.39
B_2	6.89	7.02	6.95	9.05	9.14	9.09	10.24	10.39	10.32
S.Em ±	0.04	0.04	0.04	0.05	0.06	0.05	0.09	0.08	0.08
CD at 5%	0.11	0.12	0.11	0.16	0.19	0.16	0.26	0.24	0.25
Interactions (Nutrients and Biofertilizers)									
T_1 (N_1B_1)	7.85	8.27	8.06	11.11	11.53	11.32	12.26	12.68	12.42
T_2 (N_1B_2)	7.37	7.19	7.28	10.11	9.93	10.02	11.39	11.21	11.30
T_3 (N_2B_1)	8.47	8.79	8.63	11.61	11.93	11.77	12.63	12.95	12.79
T_4 (N_2B_2)	7.63	7.81	7.72	10.55	10.73	10.64	11.85	12.14	12.00
T_5 (N_3B_1)	6.95	6.89	6.92	9.33	9.27	9.30	10.76	10.70	10.73
T_6 (N_3B_2)	6.69	6.91	6.80	8.85	8.94	8.90	10.27	10.49	10.38
T_7 (N_4B_1)	6.31	6.41	6.36	8.03	8.13	8.08	9.51	9.61	9.56
T_8 (N_4B_2)	5.87	6.15	6.01	6.67	6.95	6.81	7.46	7.74	7.60
S.Em ±	0.07	0.08	0.08	0.11	0.13	0.11	0.17	0.16	0.16
CD at 5%	0.22	0.24	0.23	0.32	0.38	0.32	0.51	0.48	0.49

3.5 Plant spread (East-West) (cm)

AT 45 DAP

The pooled data showed (Table 5.) that the maximum plant spread East west (cm) (27.99 cm) was recorded in N_2-water soluble fertilizers (19:19:19) 4 g/l, followed by N_1-water soluble fertilizers (19:19:19) 2 g/l (26.95 cm). The biofertilizers differed significantly and the maximum plant spread East west (25.39 cm) was recorded in B_1-Arka microbial consortium 5 g/plant followed by B_2-VAM 5 g/plant (22.64 cm). The interaction was significant. The maximum plant spread East west (29.82 cm) was recorded in T_3 (N_2B_1)-water soluble fertilizers (19:19:19) 4 g/l + Arka microbial consortium 5 g/plant which is on par with T_1 (N_1B_1)-water soluble fertilizers (19:19:19) 2 g/l + Arka microbial consortium 5 g/plant (28.86 cm), followed by T_4 (N_2B_2) (26.16 cm), whereas the lowest plant spread East west was recorded in T_8 (N_4B_2)-water spray + VAM 5 g/plant (17.24 cm).

AT 90 DAP

The pooled data showed that the maximum plant spread East west (cm) (33.49 cm) was recorded in N_2-water soluble fertilizers (19:19:19) 4 g/l, followed by N_1-water soluble fertilizers (19:19:19) 2 g/l (32.73 cm). The biofertilizers differed significantly and the maximum plant spread East west (31.15 cm) was recorded in B_1-Arka microbial consortium 5 g/plant followed by B_2-VAM 5 g/plant (28.51 cm). The interaction effect between different nutrient sources and biofertilizers was observed to be non-significant.

AT 135 DAP

The pooled data showed that the maximum plant spread East west (cm) (37.16 cm) was recorded in N_2-water soluble fertilizers (19:19:19) 4 g/l, followed by N_1-water soluble fertilizers (19:19:19) 2 g/l (36.45 cm). The biofertilizers differed significantly and the maximum plant spread East west (34.61 cm) was recorded in B_1-Arka microbial consortium 5 g/plant followed by B_2-VAM 5 g/plant (32.10 cm). The interaction effect between different nutrient sources and biofertilizers was observed to be non-significant.

3.6 Plant spread North-South (cm)

AT 45 DAP

Pooled data showed that (Table 6.) among different nutrient sources the maximum plant spread (North-South) (27.99 cm) was recorded in N_2-water soluble fertilizers (19:19:19) 4 g/l, followed by N_1-water soluble fertilizers (19:19:19) 2 g/l (26.95 cm). The biofertilizers differed significantly in which the maximum plant spread (North-South) (25.39 cm) was recorded in B_1-Arka microbial consortium 5 g/plant followed by B_2-VAM 5 g/plant, (22.64 cm). The interactions was significant. The maximum plant spread (North-South) (29.82 cm) was recorded in T_3 (N_2B_1)-water soluble fertilizers (19:19:19) 4 g/l + Arka microbial consortium 5 g/plant followed by T_1 (N_1B_1)-water soluble fertilizers (19:19:19) 2 g/l + Arka microbial consortium 5 g/plant (28.86 cm), followed by T_4 (N_2B_2) (26.16 cm), whereas the lowest plant spread (North-South) was recorded in T_8 (N_4B_2)-water spray + VAM 5 g/plant (17.26 cm).

AT 90 DAP

Pooled data showed that among different nutrient sources the maximum plant spread (North-South) (32.33 cm) was recorded in N_2-water soluble fertilizers (19:19:19) 4 g/l, followed by N_1-water soluble fertilizers (19:19:19) 2 g/l (31.23 cm). The biofertilizers differed significantly in which the maximum plant spread (North-South) (29.85 cm) was recorded in B_1-Arka microbial consortium 5 g/plant followed by B_2-VAM 5 g/plant, (27.35 cm). The interaction effect was found to be non-significant.

AT 135 DAP

Pooled data showed that among different nutrient sources the maximum plant spread (North-South) (35.57 cm) was recorded in N_2-water soluble fertilizers (19:19:19) 4 g/l, followed by N_1-water soluble fertilizers (19:19:19) 2 g/l (34.68 cm). The biofertilizers differed significantly in which the maximum plant spread (North-South) (33.35 cm) was recorded in B_1-Arka microbial consortium 5 g/plant followed by B_2-VAM 5 g/plant, (30.82 cm). The interactions was found to be significant. The maximum plant spread (North-South) (36.73 cm) was recorded in T_3 (N_2B_1)-water soluble fertilizers (19:19:19) 4 g/l + Arka microbial consortium 5 g/plant which is on par with T_1 (N_1B_1)-water soluble fertilizers (19:19:19) 2 g/l + Arka microbial consortium 5 g/plant (35.18 cm), followed by T_4 (N_2B_2) (34.40 cm), whereas the lowest plant spread (North-South) was recorded in T_8 (N_4B_2)-water spray + VAM 5 g/plant (30.83 cm).

The increase in number of branches and plant spread may be attributed to Arka microbial consortium application which might have supplied plant growth promoting micro-organisms (PGPR's) including nitrogen fixers, phosphate solubilizers known to produce amino acids, vitamins and growth promoting substances like IAA, GA and Cytokinins which help in better growth of crop plants. Similar result are reported by Choure and Dubey (2012) [4] in *Cajanus Cajan* L. var. Manak.

Table 5: Effect of nutrient management on plant spread East-West (cm^2) of *syngonium*

Treatments	45 DAP			90 DAP			135 DAP		
	2023	2024	Pooled	2023	2024	Pooled	2023	2024	Pooled
Nutrients									
N_1	27.43	27.49	26.95	32.67	32.79	32.73	36.37	36.53	36.45
N_2	29.17	29.42	27.99	33.37	33.62	33.49	37.00	37.31	37.16
N_3	23.80	23.88	22.61	28.70	28.78	28.74	32.70	32.78	32.74
N_4	19.37	19.56	18.51	24.27	24.46	24.36	26.97	27.16	27.06
S.Em ±	0.23	0.27	0.25	0.68	0.66	0.67	0.55	0.53	0.54
CD at 5%	0.74	0.82	0.75	2.04	1.97	2.00	1.66	1.60	1.63
Biofertilizers									
B_1	26.43	26.56	25.39	31.05	31.25	31.15	34.48	34.73	34.61
B_2	23.45	23.61	22.64	28.45	28.58	28.51	32.03	32.16	32.10
S.Em ±	0.17	0.19	0.18	0.48	0.46	0.47	0.39	0.38	0.38
CD at 5%	0.52	0.58	0.53	1.45	1.39	1.41	1.17	1.13	1.15
Interactions (Nutrients and Biofertilizers)									
T_1 (N_1B_1)	29.07	29.23	28.86	33.93	34.35	34.14	37.33	37.85	37.59
T_2 (N_1B_2)	25.80	25.75	25.04	31.40	31.22	31.31	35.40	35.22	35.31
T_3 (N_2B_1)	31.33	31.65	29.82	34.40	34.72	34.56	37.93	38.38	38.16
T_4 (N_2B_2)	27.00	27.18	26.16	32.33	32.51	32.42	36.07	36.25	36.16
T_5 (N_3B_1)	24.60	24.54	23.10	29.40	29.34	29.37	33.60	33.54	33.57
T_6 (N_3B_2)	23.00	23.22	22.11	28.00	28.22	28.11	31.80	32.02	31.91
T_7 (N_4B_1)	20.73	20.83	19.78	26.47	26.57	26.52	29.07	29.17	29.12
T_8 (N_4B_2)	18.00	18.28	17.24	22.07	22.35	22.21	24.87	25.25	25.01
S.Em ±	0.35	0.39	0.35	0.96	0.93	0.94	0.78	0.76	0.77
CD at 5%	1.04	1.16	1.06	NS	NS	NS	NS	NS	NS

Table 6: Effect of nutrient management on plant spread North-South (cm^2) of *syngonium*

Treatments	45 DAP			90 DAP			135 DAP		
	2023	2024	Pooled	2023	2024	Pooled	2023	2024	Pooled
Nutrients									
N_1	26.87	27.04	26.95	31.17	31.29	31.23	34.73	34.62	34.68
N_2	27.83	28.15	27.99	32.20	32.45	32.33	35.30	35.83	35.57
N_3	22.57	22.65	22.61	27.73	27.81	27.77	31.60	31.68	31.64
N_4	18.47	18.56	18.51	22.97	23.16	23.06	26.37	26.56	26.46
S.Em ±	0.26	0.25	0.23	0.46	0.44	0.45	0.29	0.27	0.28
CD at 5%	0.77	0.76	0.70	1.39	1.33	1.34	0.88	0.80	0.83
Biofertilizers									
B_1	25.27	25.52	25.39	29.75	29.95	29.85	33.28	33.42	33.35
B_2	22.60	22.68	22.64	27.28	27.41	27.35	30.72	30.93	30.82
S.Em ±	0.18	0.18	0.17	0.33	0.31	0.32	0.21	0.19	0.19
CD at 5%	0.55	0.53	0.50	0.98	0.94	0.95	0.62	0.57	0.58
Interactions (Nutrients and Biofertilizers)									
T_1 (N_1B_1)	22.60	29.12	28.86	32.13	32.55	32.34	35.60	35.56	35.58
T_2 (N_1B_2)	25.13	24.95	25.04	30.20	30.02	30.11	33.87	33.69	33.78
T_3 (N_2B_1)	29.60	30.05	29.82	33.20	33.52	33.363	36.47	37.00	36.73
T_4 (N_2B_2)	26.07	26.25	26.16	31.20	31.38	31.29	34.13	34.67	34.40
T_5 (N_3B_1)	23.13	23.07	23.102	28.53	28.47	28.50	32.47	32.41	32.44
T_6 (N_3B_2)	22.00	22.22	22.11	26.93	27.15	27.04	30.73	30.95	30.84
T_7 (N_4B_1)	19.73	19.83	19.78	25.13	25.23	25.18	28.60	28.70	28.65
T_8 (N_4B_2)	17.20	17.28	17.24	20.80	21.08	20.94	24.13	24.41	24.27
S.Em ±	0.36	0.361	0.33	0.65	0.63	0.63	0.42	0.38	0.39
CD at 5%	1.09	1.07	0.99	NS	NS	NS	1.25	1.14	1.17

3.7 Leaf area per plant (cm^2), (135 DAP)

The pooled data showed that (Table 7) among different nutrient sources, significantly the maximum leaf area (1590.82) was recorded in N_2-water soluble fertilizers (19:19:19) 4 g/l, which is on par with N_1-water soluble fertilizers (19:19:19) 2 g/l (1567.52). The biofertilizers differed significantly in which the maximum leaf area (1556.76 cm^2) was recorded in B_1-Arka microbial consortium 5 g/plant followed by B_2-VAM 5 g/plant, (1504.12 cm^2). The interaction effect was found to be non-significant.

Table 7: Effect of nutrient management on leaf area (cm^2), root length (cm) &no. of roots/plant of *syngonium*

Treatments	Leaf area			Root length			No of roots/plant		
	2023	2024	Pooled	2023	2024	Pooled	2023	2024	Pooled
Nutrients									
N_1	1567.33	1567.70	1567.52	39.82	39.50	39.66	26.33	26.27	26.30
N_2	1588.47	1593.17	1590.82	41.85	42.00	41.92	28.57	28.83	28.70
N_3	1514.20	1511.90	1513.05	33.95	34.06	34.00	20.07	19.77	19.92
N_4	1436.13	1436.60	1436.37	23.67	23.98	23.83	13.53	14.07	13.80
S.Em ±	11.78	11.53	11.65	0.57	0.55	0.56	0.34	0.36	0.33
CD at 5%	35.32	34.57	34.94	1.71	1.64	1.67	1.02	1.07	1.00
Biofertilizers									
B_1	1548.02	1551.50	1549.76	37.37	37.55	37.43	24.27	24.37	24.32
B_2	1505.05	1503.18	1504.12	32.28	32.22	32.25	19.98	20.10	20.07
S.Em ±	8.33	8.15	8.24	0.40	0.39	0.39	0.24	0.25	0.24
CD at 5%	24.98	24.45	24.70	1.21	1.16	1.18	0.72	0.76	0.71
Interactions (Nutrients and Biofertilizers)									
T_1 (N_1B_1)	1585.20	1591.33	1588.27	41.93	42.16	42.04	28.40	28.67	28.53
T_2 (N_1B_2)	1549.47	1544.07	1546.77	37.72	36.84	37.28	24.27	23.87	24.07
T_3 (N_2B_1)	1608.00	1615.00	1611.50	43.97	44.23	44.10	30.53	31.07	30.80
T_4 (N_2B_2)	1568.931	1571.331	1570.13	39.72	39.76	39.74	26.60	26.60	26.60
T_5 (N_3B_1)	1526.33	1527.73	1527.03	35.17	35.37	35.27	21.27	21.01	21.17
T_6 (N_3B_2)	1502.07	1496.07	1499.071	32.72	32.74	32.73	18.87	18.47	18.67
T_7 (N_4B_1)	1472.53	1471.93	1472.23	28.39	28.43	28.41	16.87	16.67	16.77
T_8 (N_4B_2)	1399.73	1401.27	1400.50	18.95	19.53	19.24	10.20	11.47	10.83
S.Em ±	16.66	1631.00	16.48	0.81	0.77	0.79	0.48	0.50	0.47
CD at 5%	NS	NS	NS	2.42	2.31	2.36	1.44	1.51	1.42

3.8 Root length (cm), (135 DAP)

The pooled data showed, significantly the maximum root length (41.92 cm) was recorded in N_2-water soluble fertilizers (19:19:19) 4 g/l, followed by N_1-water soluble fertilizers (19:19:19) 2 g/l (39.66 cm). The biofertilizers differed significantly in which the maximum root length (37.46 cm) was recorded in B_1-Arka microbial consortium 5 g/plant followed by B_2-VAM 5 g/plant, (32.25 cm). The interactions was observed to be significant. The maximum root length (44.10 cm) was recorded in T_3 (N_2B_1)-water

soluble fertilizers (19:19:19) 4 g/l + Arka microbial consortium 5 g/plant followed by T_1 (N_1B_1)-water soluble fertilizers (19:19:19) 2 g/l + Arka microbial consortium 5 g/plant (42.16 cm), T_4 (N_2B_2) (39.74 cm), whereas the lowest root length was recorded in T_8 (N_4B_2)-water spray + VAM 5 g/plant (19.24 cm).

3.9 Number of Roots per plant (135DAP)

The pooled data showed, significantly the maximum number of roots per plant (28.70) was recorded in N_2-water soluble fertilizers (19:19:19) 4 g/l, followed by N_1-water soluble fertilizers (19:19:19) 2 g/l (26.30). The biofertilizers differed significantly in which the maximum number of roots per plant (24.32) was recorded in B_1-Arka microbial consortium 5 g/plant followed by B_2-VAM 5 g/plant (20.04). The interaction effect was observed to be significant. The maximum number of roots per plant (30.80) was recorded in T_3 (N_2B_1)-water soluble fertilizers (19:19:19) 4 g/l + Arka microbial consortium 5 g/plant followed by T_1 (N_1B_1)-water soluble fertilizers (19:19:19) 2 g/l + Arka microbial consortium 5 g/plant (28.53), T_4 (N_2B_2) (26.60), whereas the lowest number of roots per plant was recorded in T_8 (N_4B_2)-water spray + VAM 5 g/plant (10.83). WSF increased root system activity and improved root system physiology, suggesting its potential use as a plant growth regulator. The combination of WSF and AMC increased root length and number of roots per plant compared to the control. The root system activity was highly correlated with WSF concentrations. A high concentration of nutrients in the rhizosphere can influence the osmotic pressure of the root system, and thus its growth and activity (Itoh *et al*. 1987; Monsuru and Daud 2016) [8, 11].

4. Conclusion

The present investigation concluded that *syngonium* plants with the nutrient management of T_3 (N_2B_1)-water soluble fertilizers (19:19:19) 4 g/l + Arka microbial consortium 5 g/plant performed well with respect to growth parameters.

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