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Effect of Growth Regulators on Growth and Flower Production of a Popular Indoor Plant, Peace Lily (*Spathiphyllum wallisii*)

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ABSTRACT

Field trials with *Spathiphyllum wallisii* were conducted at the experimental farm of ICAR-Directorate of Floricultural Research, Pune during 2018 to 2020 growth seasons. The aim of this research was to investigate the effect of foliar application with benzyladenine (BA) at 100,150 and 200 mg L-1 gibberellic acid (GA_3) at 100,150 and 200 mg L-1 and naphthalene acetic acid (NAA) at 100,150 and 200 mg L-1 on the vegetative growth as well as floral traits of *Spathiphyllum wallisii*. Most of the criteria of vegetative growth expressed as plant height, number of leaves / plants, leaf length without petiole, leaf width, leaf area and petiole length were significantly affected by application of the plant growth regulators. All foliar applications of BA, GA_3 and NAA promoted all aforementioned characters in this study, compared with control plants.

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INTRODUCTION

Spathiphyllum wallisii is a perennial evergreen, belonging to the genus of about 40 species of monocotyledonous flowering plants in the family Araceae. It is native to tropical regions of the America and South-eastern Asia. Certain species of *Spathiphyllum* are commonly known as Peace lily, White sails, or Spathe flower. Several species of *Spathiphyllum* are popular as indoor houseplants grown for its lush dark green foliage and showy white flowers. *Spathiphyllum* has been reported as an indoor air purifying plant capable of removing toxins from the air. It filters indoor air from many environmental contaminants, including benzene, formaldehyde, and other pollutants. It cleans best at one plant per 10 m3 (Ali *et al*. 2014). It thrives best in shade and needs little sunlight to survive. With the advancement of technology, indoor air pollutants like benzene, formaldehyde, xylene, carbon monoxide, ammonia. are easily trapped in our homes or offices. Source of such pollutants which pollute indoor atmosphere are polished furniture, insulations, curtains, carpets and other painted household articles. Indoor air pollution results in frequent illness, allergies, asthma, bronchial infection, sore throat, sinus, headache, cancer and many other inconveniences. Considering the present scenario, there is a pressing need to initiate research work in this area and select a proper strategy including plants for mitigating indoor air pollution. It is reported that *Spathiphyllum* cleans indoor air from many environmental contaminants and hence can be relied upon for alleviating the indoor air pollution. The present experiment is initiated to study the effects of exogenous application of plant growth regulators in improving the growth and flowering of *Spathiphyllum wallisii.* The main objective of the present experiment is to study the effects of different plant growth regulators viz. Benzyl adenine, Gibberellic acid and 1-Naphthaleneacetic acid on the growth and flowering of *Spathiphyllum wallisii*. Plant growth regulators are generally used in floriculture industry for controlling height, increasing the lateral branches and flowering. Cytokinins are important plant hormones that regulate various processes of plant growth and development, apart from its function of endogenous physiological and morphological factors which affect root formation in cuttings (Hartman *et al*. 2002). Cytokinins play vital role in the regulation of cell division, differentiation and organogenesis in developing plants, enhancement of leaf expansion, nutrient mobilization and delayed senescence (Skoog and Armstrong 1970 and Hall 1973). Shudok (1994), opined that chemical structure of cytokinin active substances has determined two groups of adenine cytokinins and urea cytokinins with similar physiological effects, it has pronounced effect of cotyledon growth and expansion and other processes. Effect of cytokinins particularly benzyl adenine on the plant growth and chemical constituents of different plants have mentioned by Eraki *et al*. (1994) on salvia plants, Mazrou (1992) on Datura, Mazrou *et al*. (1994) on sweet basil, Mansour *et al*. (1994) on soybean plants and Vijayakumari (2003) on *Andrographis paniculata*. Taking into account these considerations, this paper aims to present the results of the plant growth regulators effect on the growth and development of *Spathiphyllum wallisii*.

MATERIALS AND METHODS

The present work was conducted during the successive seasons of 2018-'19 at glass house of ICAR-Directorate of Floricultural Research, Pune. Plastic pots 30 cm in diameter were used for cultivation that were filled with media containing a mixture of sand, soil and compost as 1:2:1 by volume. Seedlings of *Spathiphyllum wallisii* were planted at the first week of March in both seasons. The plants were fertilized with 1% liquid fertilizer (19:19:19) at biweekly intervals. The pots were arranged in Completely Randomized Design with 10 treatments and three replicates. Application of benzyladenine (100, 150 and 200 mg L-1) ; Gibberellic acid (100, 150 and 200 mg L-1) and 1-Naphthaleneacetic acid [100, 150 and 200 mg l^{-1}] was done at two stages for each pot with 30 days interval. The first was at the first week of April, the second was one month from the first at both seasons while the control pots was sprayed with distilled water. The following data were recorded: Plant height (cm), number of leaves / plant, leaf length without petiole (cm), leaf width (cm), leaf area (cm^2) and petiole length (cm). The statistical analysis was performed on data using WASP and comparisons were made using one-way analysis of variance (ANOVA). Differences were considered to be statistically significant at $p < 0.05$.

RESULTS AND DISCUSSION

The different growth and yield attributes as influenced by treatment with different concentrations of growth regulators on growth and flowering of *Spathiphyllum wallisii* recorded during the experimental period are presented in the Tables 1- 3. Results of this study showed that various concentrations of plant growth regulators exhibited significant differences on the growth and flowering of *Spathiphyllum wallisii* and is depicted in the Fig. 1. Plant height increased significantly with the application of Gibberellic acid @ 200 mg L-1 over all the other treatments and it was least with the untreated control (Table 1). Among the treatments, plant height was maximum (41.37 cm) in Gibberellic acid @ 200 mg L-1. Control treatment recorded minimum plant height (16.42 cm) (Table 3). The effect of GA_3 on increasing rate of dry material of plant can be attributed to its effect on increasing photosynthesis rate through increasing leaf surface (Lester *et al.* 2002). Stimulative response of GA_3, which is known to be one of the endogenous growth regulators, could be attributed to its unique role in plant growth and development as reported by many investigators. GA_3 has the capability of modifying the growth pattern of treated plants by affecting the DNA and RNA levels, cell division and expansion,

Table 1. Growth attributes of *Spathiphyllum wallisii* as influenced by different growth regulator treatments three months after planting.

Treatments	Plant height	No. of leaves	Leaf length without petiole	Leaf width	Petiole length	Total leaf length
Benzyl adenine: 100 mg. L-1	18.14	14.4	10.70	3.77	6.37	17.33
Benzyl adenine :150 mg. L-1	18.81	16.53	10.90	3.96	6.49	18.00
Benzyl adenine: 200 mg. L-1	19.13	17.00	11.10	3.97	6.98	18.13
Gibberellic acid: 100 mg. L-1	20.08	19.33	12.34	4.36	7.41	19.66
Gibberellic acid: 150 mg. L-1	22.01	22.13	12.64	4.81	8.43	20.73
Gibberellic acid: 200 mg. L-1	22.20	25.73	12.56	4.85	9.56	22.20
1-Naphthaleneacetic acid: 100 mg L-1	19.16	17.47	11.13	4.19	7.12	18.20
1-Naphthaleneacetic acid: 150 mg L-1	19.51	18.27	12.03	4.29	7.16	19.05
1-Naphthaleneacetic acid: 200 mg L-1	19.53	19.07	12.31	4.30	7.32	19.44
Control	15.05	9.27	7.32	2.30	5.81	9.48
SEM+	1.22	2.69	0.93	0.42	0.52	1.31
CD @ 5%	3.67	8.07	2.78	1.27	1.55	3.93

biosynthesis of enzymes, protein, carbohydrates and photosynthetic pigments (Leopold and Kriedmann 1975).

The plants subjected to treatment with Gibberellic acid @ 200 mg L-1 recorded maximum number of leaves (28.13), while minimum number of leaves (11.47) was noticed in control (Table 3). GA_3s accelerate cellular division by stimulating existing cells in phase G1 to enter phase S and shortening phase S (Baninasab and Rahemi 1994). Gibberellins play significant role in several processes including seed germination, shoot elongation, cell division and cell elongation (Rademacher 1993, Hooley 1994, Kende and Zeevaart 1997).

Similar trend was noticed for leaf length (Table 2). Beevers (1966) opined that GA_3 has the capacity to induce mRNA synthesis and increase cell enlargement eventually leading to increased internodal length. These results are in line with previous investigations as reported by Chen *et al.* (2003) where in leaf length in *Philodendron* 'Black Cardinal' increased as applied GA_3 concentrations increased. Results reported by Soner and Osman (2010) were similar who opined that stem length in golden rod was extended by GA_3 treatment. GA_3 have shown better effect than BA and NAA by effecting cellular processes such as cellular division stimulation, lengthening cells caused to increase growing growth (Stuart and Jones 1977). GA_3 stimulate growth by increasing cell elongation in few plant species and by increasing both cell elongation and cell division in others (Metraux 1987, Jupe *et al.* 1988). Gibberellins by increasing tension of cellular

Table 2. Growth attributes of *Spathiphyllum wallisii* as influenced by different growth regulator treatments six months after planting.

Treatments	Plant height	No. of leaves	Leaf length without petiole	Leaf width	Petiole length	Total leaf length
Benzyl adenine: 100 mg L-1	19.40	15.27	11.9	4.12	7.01	18.50
Benzyl adenine :150 mg L-1	20.22	17.70	12.5	4.15	7.05	19.20
Benzyl adenine: 200 mg L-1	20.26	18.40	13.1	4.46	7.25	19.63
Gibberellic acid: 100 mg L-1	21.27	21.93	14.4	5.26	8.17	21.31
Gibberellic acid: 150 mg L-1	22.79	24.97	14.6	5.36	8.47	22.96
Gibberellic acid: 200 mg L-1	23.13	26.33	15.8	6.97	11.15	28.20
1-Naphthaleneacetic acid: 100 mg L-1	20.33	19.60	13.3	4.51	7.39	20.37
1-Naphthaleneacetic acid: 150 mg L-1	20.48	19.73	13.9	4.87	7.87	20.64
1-Naphthaleneacetic acid: 200 mg L-1	21.10	19.93	14.1	4.94	7.91	21.17
Control	16.26	11.40	7.33	2.85	6.50	13.80
SEM+	1.00	0.59	1.01	0.53	0.74	2.84
CD @ 5%	3.02	7.79	3.03	1.58	2.22	8.52

Table 3. Growth attributes of *Spathiphyllum wallisii* as influenced by different growth regulator treatments nine months after planting.

Treatments	Plant height	No. of leaves	Leaf length without petiole	Leaf width	Petiole length	Total leaf length	Stalk length of inflorescence	Length of spathe	Width of spathe
Benzyl adenine: 100 mg L-1	22.52	17.20	12.40	4.51	9.18	21.75	23.37	9.28	4.47
Benzyl adenine :150 mg L-1	23.63	18.50	13.40	4.81	9.23	21.87	24.29	10.66	4.74
Benzyl adenine: 200 mg L-1	23.83	18.80	13.50	4.86	9.64	22.51	25.44	11.38	5.00
Gibberellic acid: 100 mg L-1	26.60	27.40	14.60	5.89	10.03	24.39	18.56	8.46	3.89
Gibberellic acid: 150 mg L-1	29.53	27.53	14.70	6.00	10.39	24.99	20.47	8.82	4.00
Gibberellic acid: 200 mg L-1	41.37	28.43	17.10	7.75	15.49	31.25	22.59	9.27	4.38
1-Naphthaleneacetic acid: 100 mg L-1	25.08	19.33	13.80	5.05	9.72	22.81	12.05	6.98	3.07
1-Naphthaleneacetic acid: 150 mg L-1	25.61	22.93	14.10	5.25	9.94	23.71	16.43	7.34	3.58
1-Naphthaleneacetic acid: 200 mg L-1	25.87	24.00	14.60	5.79	9.95	23.88	17.31	8.13	3.77
Control	16.42	11.47	9.69	3.37	6.53	13.85	8.50	6.79	2.03
SEM	2.52	3.27	1.42	0.66	1.05	2.28	2.65	0.77	0.49
CD @ 5%	7.56	9.81	4.25	1.97	3.15	6.85	7.96	2.30	1.49

wall, i.e.wall extension though hydrolysis of starch to sugar that follows decrease of potential of cellular water, cause to enter water inside cell and lengthen cell (Arteca 1996). Beneficial effects of GA_3 were reported by Shedeed *et al*. (1991) on croton, Eraki (1994) on Queen Elizabeth rose, Bedour *et al*.(1994) on *Ocimum basillicum* and Soad (2005) on Jojoba, wherein it was reported that GA_3 is used for plant growth regulation through increasing cell division and cell elongation.

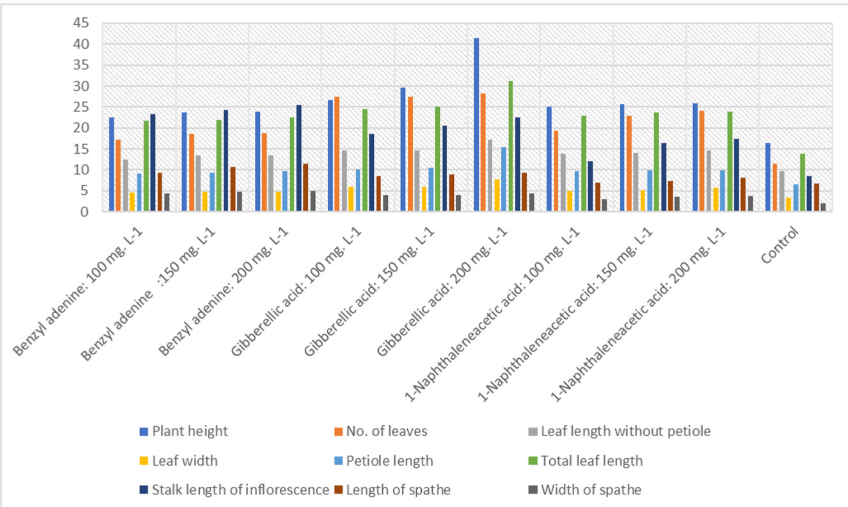

Fig. 1. Growth attributes of *Spathiphyllum wallisii* as influenced by different growth regulator treatments one year after planting.

Spathiphyllum plants subjected to Gibberellic acid @ 200 mg L-1 treatment recorded maximum leaf width (Table 3.). An important desired characteristic of foliage plant cultivars is production of wider leaves to give a pleasing appearance. The increase in breadth of the leaf with the application of GA_3 seems to be due to enhanced cell division and cell enlargement, promotion of protein synthesis coupled with higher dry matter accumulation in the plant. Similar results were earlier reported in *Gerbera* wherein GA_3 through alpha amylase activity, auxin stimulating effect and cell wall loosening, increased cell elongation along with cell enlargement. All these causes effect to increase leaf area, resulted in more photosynthetic area (Chauhan *et al* 2014).

Market value of *Spathiphyllum* heavily depends on the presence of flowers (Chen *et al*. 2005). The floral quality traits like stalk length of the inflorescence, length and width of the spathe have registered positive differences for all the treated variants compared to the control. Significantly maximum (25.44 cm) stalk length of the inflorescence was noticed by the application of Benzyl adenine: 200 mg L-1. The maximum average length of the spathe, which is the main decorative element recorded the highest values (11.38 cm) in plants treated with Benzyl adenine: 200 mg L-1. Similarly, maximum width (5.00 cm) of the spathe was recorded by the application of Benzyl adenine: 200 mg L-1 (Table 3). Luria *et al*. (2005) reported that Benzyl adenine, foliage-applied at a concentration of 400 mg × dm-3 in plants grown in an unheated plastic tunnel and in the soil, increased the number and fresh weight of inflorescence shoots of *Zantedeschia*.

CONCLUSION

Spathiphyllum with their attractive dark green foliage and beautiful white flowers is considered as one of the top selling indoor plant throughout the world. The results of the present study suggest that application of plant growth regulators during the vegetative growth stages can improve the plant growth and development of *Spathiphyllum wallisii*. The results showed that: Gibberellic acid @ 200 mg L^{-1} treatment has the best effect on the plant height, number of leaves/plant , leaf length and leaf width ; Benzyl adenine: 200 mg L-1 treatment has the best effect on the stalk length of the inflorescence, length and width of the spathe with better quality. The treatments with plant growth regulators significantly influenced the vegetative and floral quality traits, the obtained values being superior for all the treated variants compared to the untreated control plants. Thus recognition of treatments which could assure good yield and quality of *Spathiphyllum wallisii* would satisfy the needs of consumers for indoor gardening. In the present investigation, maximum stalk length of the inflorescence with better quality was recorded by the application of Benzyl adenine: 200 mg L-1 and hence this can be recommended for commercial production of *Spathiphyllum wallisii*.

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