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International journal of Advanced Biological and Biomedical Research

Volume 2, Issue 1, 2014: 230-237

Stimulatory Effect of benzyladenine and gibberellic acid on Growth and Photosynthetic pigments of (Spathiphyllum wallisii Regel) Plants

Parviz rahbarian[1], Ali Salehi Sardoei[2*] and Afshar Fallah Imani[2]

[1] *Department of Horticulture, Jiroft Branch, Islamic Azad University, Jiroft, Iran*
[2] *Young Researchers ans Elite Club, Jiroft Branch, Islamic Azad University, Jiroft, Iran*

Abstract

Field trials with *Spathiphyllum wallisii* Regel were conducted at the experimental farm of Faculty of Agriculture, University Azad Jiroft in 2012 growth seasons. The aim of this work is to study the effect of foliar application with benzyladenine (BA) at 0, 100, 200 and 400 mg.L^{-1} and gibberellic acid (GA_3) at 0, 100 and 200 mg.L^{-1} on the vegetative growth constituents of Spathiphyllum plants. Most of the criteria of vegetative growth expressed as number of leaves/plant, leaf area and petiole length and were significantly affected by application of the two factors which were used in this study. All foliar applications of SPAD BA and GA_3 separately promoted all the aforementioned characters in this study, as well as chl. a, petiole length, number of leaves/plant, leaf area and spad compared with control plants. The most number of produced leaves was in a plant in applications of 400 mg l^{-1} of BA, 100 mg l^{-1} of BA, 400 mg l^{-1} BA+100 mg l^{-1} GA_3 , 400 mg l^{-1} BA+mg l^{-1} of GA_3 and respectively, with average of 11/33, 11,10/66, 10/66 that they did not show a meaniful diference, statically.

Key words: benzyl adenine (BA), gibberellic acid (GA_3), Leaf Area, Photosynthetic pigments, *Spathiphyllum wallisii* Regel.

Introduction

Spathiphyllum is a genus of about 40 species of monocotyledonous flowering plants in the family Araceae, native to tropical regions of the Americas and southeastern Asia. Certain species of *Spathiphyllum* are commonly known as Spath or Peace Lilies. Several species are popular indoor houseplants. *Spathiphyllum* cleans indoor air of many environmental contaminants, including benzene, formaldehyde, and other pollutants. It cleans best at one plant per 10 m3. It lives best in shade and needs little sunlight to thrive. It is watered approximately once a week. The soil is best left moist but only needs watering if the soil is dry. Apart from the function of endogenous physiological and morphological factors which affect root formation in cuttings (Hartman et al., 2002), Cytokinins are important plant hormones that regulate various processes of plant growth and development, cytokinins appeared to play an important role in the regulation of cell division, differentiation and organogenesis in developing plants, enhancement of leaf expansion, nutrient mobilization an delayed senescence, Skoog and Armstrong

Corresponding Author E-mail: alisalehisardoei1987@gmail.com

(1970) and Hall (1973). Shudok (1994), reported 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. The effect of cytokinins especially benzyl adenine on the plant growth and chemical constituents of different plants have mentioned by Eraki *et al*., (1993) on saliva plants, Mazrou (1992) on Datura, Mazrou *et al*.,(1994) on sweet basil, Mansour *et a.,* (1994) on soybean plants and Vijakumari (2003) on *Andrographis panculata*. The stimulative response of gibberellic acid, which known to be one of the endogenous growth regulators, could be attributed to its unique roles in plant growth and development as reported by many investigators. Leopold and Kriedmann (1975) suggested that GA3 has the capability of modifying the growth pattern of treated plants by affecting the DNA and RNA levels, cell division and expansion, biosynthesis of enzymes, protein, carbohydrates and photosynthetic pigments. The beneficial effects of gibberellic acid on different plants were recorded by Shedeed *et al*., (1991) on croton plant, Eraki (1994) on Queen Elizabeth rose plants, Bedour *et al*., (1994) on *Ocimum basillicum* and Soad (2005) on Jojoba plant, they concluded that gibberellic acid is used to regulation plant growth through increasing cell division and cell elongation.

The main object of the present work is to study the effect of benzyladenine and gibberellic acid on the growth and Photosynthetic pigments of *Spathiphyllum wallisii* Regel plants.

Material and Methods

The present work was conducted during the successive seasons of 2012 at greenhouse of Azad University, jiroft. Plastic pots 30 cm in diameter were used for cultivation that were filled with media containing a mixture of sand, Rice husk, Leaf composts and peat as1:1:1:1 by volume. Seedlings of *Spathiphyllum wallisii* Regel leaves were planted at the first week of March in both seasons. The plants were fertilized with 3% liquid fertilizer in one doses after 4, 6 and 8 weeks from transplanting. The pots were arranged in factorial based complete randomize design with 12 treatments and four replicates. Application of benzyladenine (0, 100, 200 and 400 $mg.L^{-1}$) and gibberellic acid (0, 100 and 200 $mg.L^{-1}$) each containing 10 ml (0.l'%) Tween-20 surfactant, at three stages that for each pot was used 40 cc of solution at each stage with 15 days intervals.

The first was at the first week of April, the second was one month from the first at both seasons while the control was sprayed distilled water. An agricultural processes were performed according to normal practice. At the first week of October 2012, the following data were recorded: petiole length (cm), number of leaves /plant, leaf area (cm^2), Chlorophyll index (SPAD) and Photosynthetic pigments (mg/ml) method according to Lichtenthaler, (1987) were calculated.

analysis was performed on data using SPSS ver 16. Comparisons were made using one-way analysis of variance (ANOVA) and Duncan's multiple range tests. Differences were considered to be significant at $P < 0.05$.

Results and Discussion

The most number of produced leaves was in a plant in applications of 400 mg l^{-1} of BA, 100 mg l^{-1} of BA, 400 mg l^{-1} BA+100 mg l^{-1} GA_3 , 400 mg l^{-1} BA+ mg l^{-1} of GA_3 and respectively, with average of 11/33, 11,10/66, 10/66 that they did not show a meaniful diference, statically (table 1). In a research, by Zieslin and Tsujita (1998) on lilium and Hamano *et al* (2002) on cabbage, using usage of GA_3 on plants can cause to increase leaf than application that was seen. The effect of GA_3 on increasing rate of

dry material of plant can b attributed to its effect on increasing photosynthesis rate through increasing leaf surface (Lester *et al*, 2002).

The application witnessed 100 mg l^{-1} BA+100 mg l^{-1} GA_3 and 100 mg l^{-1} BA with least number of leaves, with averages of 7/66, 8/33 and 8/66 respectively that they showed a meaningful difference with application of 400 mg l^{-1} BA. Application of *Zantedeschia aethiopiea* caued to increase number of leaves by spraying solution of BA (Majidian *et al*, 2012).

In view of results of table (1), maximum length of leaf tail was obtained in applications of 100 mg l^{-1} BA with average of 38/33 cm. The results show, by increasing concentration of regulators of growth, length of tail leaf is increased, too. It seems regulators of growth of length GA_3 have shown better effect than BA in index of length of tail leaf. GA_3 by effecting cellular processes such as cellular division stimulation, lengthening cells caused to increase growing growth (Stuart and Jones, 1977). GA_3 s by increasing tension of cellular 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)

Leaf surface was under a meaningful effect of regulators of growth, maximum leaf surface was in application of 400 mg l^{-1} BA+100 mg l^{-1} GA_3 with averages of 157/36 and 148/56 cm^2, respectively. Results of table (1) showed, by increasing concentration of regulators of growth, leaf surface increased as meaningful, too. Minimum value of leaf surface in witness application, was obtained as 100 mg l^{-1} GA_3, 100 mg l^{-1} BA+100 mg l^{-1} GA_3 and 200 mg l^{-1} GA_3, on average as 74/04, 83/38, 83/6 and 103/99 cm^2, respectively. Levels of 400 mg l^{-1} BA had a meaningful difference to each other in comparison with levels of mg. GA_3s cause to accelerate cellular division by stimulating existing cells in phase G_1 to enter phase S and shortening phase S (Baninasab and Rahemi., 1994).

Foliar sprays should be made in such a way as to contact the plant leaves, stems, and meristems as cytokinins will not travel very far in the plant from the point of contact (Fox and Weis, 1965; Zhu and Matsumoto, 1987). In order for cytokinins to affect branching or flowering, they must be absorbed by the meristem or on the stem below it. Spray solutions should be pH adjusted to neutral pH levels to improve absorption. Foliar sprays may be made with hand sprayers, boom sprayers, and air blast sprayers.

Usually, the entire plant should be covered, but there are some applications where only certain parts of the plant should be targeted. In Easter lily, it is best to target only the lower leaves in order to prevent lower leaf yellowing (Whitman et al., 2001). In watermelon, sprays should be limited to the ovaries in order to stimulate parthenocarpy (Maroto et al., 2005). Lower stem sprays have been used to stimulate branching in *Monstera* and *Alocasia* (Henny and Fooshee, 1990a, 1990b). Crown sprays have been used on *Hosta* (Keever and Warr, 2005).

Table 1. Effect of GA_3 and BA on growth parameters of *Spathiphyllum* "*wallisii*" kept for 60 day

BA	GA_3	leaf Chlorophyll Index (SPAD)	petiole length (cm)	Leaf area (cm^2)	No. of leaves/plant
0	0	10.42g	20.46c	74.04f	7.66f
	100	15.81def	19.2c	83.38def	11ab
	200	17.16cde	24.2bc	103.99cdef	9.33cde
100	0	12.94fg	38.33a	78.29e	8.66def
	100	13.91efg	21.26c	83.62def	9.66bcde
	200	12.42fg	19.43c	112.02cde	8.33ef
200	0	19.79bcd	25.03bc	107.81cdef	10bcd
	100	20.88bc	21.66bc	116.77bcd	9.66bcde
	200	18.94cd	22.8bc	121.29bc	9de
400	0	23.46b	25.56bc	118.46bcd	11.33a
	100	20.5bc	25.7bc	148.56ab	10.66abc
	200	29.6a	30.26b	157.36a	10.66abc

*Means separated by Duncans multiple ranges test at the $P< 0.05$ level

In view of results of table (1), maximum index of chlorophyll was obtained in application of 400 mg l^{-1} BA+200 mg l^{-1} GA_3 with average of 29/6. By increasing concentration of regulators of growth, index of chlorophyll was increased, too. Using regulators of growth of GA_3 and BA, increased rate of chlorophyll in leaves of *Zantedeschia aethiopiea* plant (Majidian *et al*, 2011). Minimum value of index of chlorophyll was obtained in witness application. It seems, regulator of growth of BA has shown a better effect than GA_3 in index of chlorophyll content. GA_3 causes to stimulate sucrose synthesis and transfer it from leaf to filter vessel (Arteca, 1996). Maybe, stimulation of sucrose synthesis and transfer of it to filter vessel in effect of applying application of GA_3 not only causes to increase growth in aerial parts of a plant that are discussed as consumption place, but another part are transferred from material inside underground limbs, too that causes to increase growth of root. In short, it can be said that variability of growth rate by GA_3 may be stimulation of photosynthesis rate , increase of activity of some enzyme or change in distribution of photosynthesis materials and or participative effect of these cases, due to increase in effective level of leaf (Arteca, 1996; Aggarwal and Sachar., 1995). On the one hand, GA_3s cause to transform proteins to amine acid such as tryptophan that is prerequisite of oxine, by stimulating activity of some enzyme of protease. Therefore, they apply some of their effects as indirect through oxine, too (Leshem, 1973).

GA_3 causes to increase plasticity of cellular wall, too. This problem can be due to acidification of cellular wall or as a result of absorption of calcium ion inside cytoplasm (Baninasab and Rahemi., 1994). it has been proved that GA_3 increases activity of Oxigenase Carboxilase non phosphate Ribolose (Rabisco) enzyme that is a main photosynthesis enzyme in plants. The results of this test indicated this problem that regulators of BA and GA_3 were effective on photosynthesis pigments. The highest value of chlorophyll of a, b was total and sum of pigments in level of 400 mg l^{-1} BA+100 mg l^{-1} GA_3 with average of 18/48, 10/74, 28/73 and 33/87 mg l^{-1}. By increasing concentration of GA_3, value of chlorophyll a is increased.

Results related to attribution, showed chlorophyll of leaf that application of GA_3 has a meaningful difference with witness application that these results adapted with results of Mynett et al (2001) in Freesia and Yaghoubi et al (2013) in Bellis perennis about effect of GA_3 on increase of greenness index. GA_3 has structural role in membrane of chloroplast and causes to stimulate photosynthesis (Janowsk and Jerzy., 2003). Minimum value of chlorophyll of a, b and total was in witness application with average of 10/88, 6/4 and 17/19 mg l^{-1}. Statistically, a meaningful difference was seen among application of 400 mg l^{-1} BA+100 mg l^{-1} GA_3 with witness. Chlorophyll has primary basic role from view of absorption and use of light energy in photosynthesis. So, effect of regulators of plant growth are effective on biosynthesis and decomposition of chlorophyll on photosynthesis, directly (Arteca., 1996) .

Table 2. Effect of foliar application of benzyladenine (BA) and gibberellic acid (GA_3) on the Photosynthetic pigments of *Spathiphyllum* "*wallisii*" Plant kept for 60 day

BA	**GA_3**	(mg/ml fresh weight)				
		Chl. (a)	Chl. (b)	Total Chl. a+b	Carotenoids	Total pigments
0	0	10.88e	6.4f	4.63c	17.19e	21.82g
	100	11.03de	7.5def	5.31a	18.53de	23.84ef
	200	11.97de	8.58cd	5.04abc	20.55bcd	25.59cde
100	0	10.8e	7.76cdef	4.99abc	18.56de	23.56fg
	100	10.87e	7.67def	5.08ab	18.54de	23.63efg
	200	12.19cd	9.22bc	4.66c	20.91bc	26.1cd
200	0	11.64de	7.56def	5.2ab	19.2cde	24.4def
	100	11.75de	6.99e	5.24ab	18.75de	23.99ef
	200	15.24b	10.29ab	4.86bc	21.03bc	30.39b
400	0	11.4de	8.48cde	5.01abc	19.89bcd	24.9def
	100	18.48a	10.74a	5.14ab	28.73a	33.87a
	200	13.22c	8.79cd	5.21ab	22.01b	27.22c

*Means separated by Duncans multiple ranges test at the $P< 0.05$ level

The highest value of Cartenoid was obtained in application of 100 mg l^{-1} of GA_3 with average of 5/31 mg l^{-1}. The done studies show in field of growth regulators such as GA_3 that they can cause to increase rate of dominant pigments like Catenoids (Kim et al, 2006; Hyun Jin et al, 2007; Glick et al, 2007).

2007). Minimum value of Cartenoid was in witness application and 100 mg l^{-1} of BA+200 mg l^{-1} GA_3 with average of 4/63 and 4/66 mg l^{-1}. From statistical view, they did not a meaningful difference, but this difference was meaningful with application of 100 mg l^{-1} of GA_3 (table 2). Application of 400 mg l^{-1} BA +100 mg l^{-1} GA_3 and 200 mg l^{-1} Ba +200 mg l^{-1} GA_3 with averages of 33/87 and 30/ 39 mg l^{-1}followed highest value of sum of pigments and its minimum was obtained in witness application with average of 21/82 mg l^{-1} (table 2).

Conclusion

In view of the obtained results, growing growth of a plant *Spathiphyllum* "*wallisii*" can be stimulated through increase of synthesis of photosynthesis pigments by GA_3 and BA.

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