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Response of False Aralia Plant to Gibberellic Acid and Benzyladenine Application

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Abstract

False aralia (*Dizygothecaelegantissima*) also known as spider aralia or threadleaf aralia, is grown for its attractive foliage. The long, narrow, dark green leaves with saw-tooth edges are coppery colored at first, but as they mature they turn dark green, appearing almost black on some plants. Field trials with False aralia (*Dizigotheecaelegantissima*) were conducted at the experimental greenhouse of Faculty of Agriculture, Azad University Jiroft in growth seasons of 2013. The aim of this work was to study the effect of foliar application of gibberellic acid (GA_3) and benzyladenine (BA) both at 0, 100 and 200mgL^{-1} on the growth and photosynthetic pigments of *Dizygothecaelegantissima* plant. Effect of $GA_3$and interaction significant ($p<0.01$) also effect BA on leaf area was non significant. Results showed that, 200 mg L^{-1} GA_3+ 200 mg L^{-1} BA increased leaf area of False aralia as 43.87% compared to control treatment. 200 mg L^{-1} GA_3 + 200 mg L^{-1} BA increased chlorophyll index, plant height and leaf area of False aralia as 61.62, 24.48 and 43.87% compared to control treatment. Also 200 mg L^{-1} BA cause increased chl. (b), total chl. a+b and sum pigments of False aralia as 15.65, 38.03 and 36.91% compared to control treatment.

Keywords: Benzyladenine, False aralia, Gibberellic acid, Leaf area, Plant height

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1. Introduction

Dizygothecaelegantissima (formerly called *Schefflerаelegantissima* and *Plerandraelegantissima*) also known as False aralia is a species of flowering plant in the Araliaceae family, native to New Caledonia (Lowry et al., 2013). Growing to 8-15m tall by 2m broad, it is an evergreen shrub or tree. Its leaves are thin, coppery red to dark green with toothed edges and on adult plants the leaves are much broader. In autumn it bears clusters of pale green flowers followed by black fruits. With a minimum temperature of 13-15 °C, in temperate zones it is grown as a houseplant and is much more compact, typically reaching heights of 2-3m (Anonymous, 2008). This plant has gained the Royal Horticultural Society's Award of Garden Merit.

Cytokinins are important plant hormones that regulate various processes of plant growth and development, including cell division and differentiation, enhancement of leaf expansion and nutrient mobilization (Hassan and El-Quesni, 1989; Shudok, 1994). The response of plants to cytokinins have been also discussed in more research where Eraki (1994a) on *Hibiscus sabdariffa* L. plants mentioned that application of BA significantly increased plant height, number of branches as well as fresh and dry weights of leaves than the control. Hassanein (1985) on *Pelargonium graveolens,* Hassan Pour Asil et al. (2011) on *Polianthus Tuberosa*, Menesi et al. (1991) on *Calendula officinalis* and Mazrou et al. (1994b) on sweet basil, they found that foliar application of BA increased growth of different organs, active constituents production of these plants and increased total carbohydrates content on comparison to the untreated plants. It has been known that growth regulators among the agriculture practices is most favourable for promoting and improving plant growth. The effect of cytokinins, especially benzyladenine on the plant growth and chemical constituents of different plants have mentioned by Eraki et al. (1993) on salvia plants, Mazrou (1992) on Datura, Mazrou et al. (1994) on sweet basil, Mansoure et al. (1994) on soybean plants. Also the beneficial effect of gibberellic acid on different plants were recorded by Shedeed et al. (1991) on croton plant, Eraki (1994a) on Quen Elizabeth rose plants, Bedour et al. (1994) on *Ocimum basillicum*, they concluded that gibberellic acid is used to regulating plant growth through increasing cell division and cell elongation.

The main object of the present work is to study the response of False aralia (*Dizigotheecaelegantissima*) plant to GA_3 and BA application, 120 days after spray.

2. Materials and methods

2.1. Plant material and cultivation conditions

The present work was conducted during the successive seasons of 2013 year at greenhouse of National Research Centre (Research and Production Station). 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 as 1:1:1:1(v/v). The plants were fertilized with 3% liquid fertilizer in some doses after 4, 6 and 8 weeks from transplanting. Was the treatments of GA_3 and BA(0, 100 and 200mg L^{-1}) each treatment was contain 10ml (0.1 %) Tween-20 surfactant. For each plant 40 cc of solution was used at each stage (three stages) with 15 days intervals (Lowry et al., 2013; Salehi Sardoei, 2014a). Treatments to GA_3 and BA that the combination was as follows:

1: Control; 2: 100 mg l^{-1} of BA; 3:200 mg l^{-1} of BA; 4:100 mg $L^{-1}GA_3$; 5:100 mg $L^{-1}GA_3$ + 100 mg l^{-1} of BA; 6:100 mg $L^{-1}GA_3$ + 200 mg l^{-1} of BA; 7: 200 mg $L^{-1}GA_3$; 8: 200 mg $L^{-1}GA_3$ + 100 mg l^{-1} of BA; 9: 200 mg $L^{-1}GA_3$ + 200 mg l^{-1} of BA.

2.2. Character evaluation

Observation were recorded on: Plant height (cm), stem diameter (with helps of caliper in mm), number of leaves/plant, leaf area (cm^2), chlorophyll index(using Spad-502, Mirolta Co.) and photosynthetic pigments($mg.ml^{-1}$).

2.3. Estimation of chlorophyll and carotenoids

Photosynthetic pigments were measured using Lichtentaller method (Lichtenthaler, 2013). 0.2g of fresh leaf tissue was weight by laboratory balance with accuracy of 0.0001g and pulverized with mortar in the presence of 10ml of 80% acetone. The resulted solution was filtered through wattman filter paper mounted in glass funnel. The solution volume was increased to 15ml by addition of 80% acetone. 3ml of the solution containing chlorophyll a and b and carotenoid was poured in cuvet and its absorbance was measured in wavelengths of 663.2nm

(chlorophyll a), 646.8nm (chlorophyll b) and 470nm (carotenoids) using spectrophotometer device, concentration of the pigments were calculated using.

$$Chl_a\ (mg.ml^{-1}) = (12.5 \times A663.2) - (2.79 \times A646.8)$$
$$Chl_b\ (mg.ml^{-1}) = (21.51 \times A646.8) - (5.1 \times A663.2)$$
$$Chl\ T\ (mg.ml^{-1}) = Chl.a + Chl.b$$
$$Car\ (mg.ml^{-1}) = (1000 \times A470) - (1.8 \times Chl.a) - (85.02 \times Chl.b)$$

Where chl.a, chl.b, ch1 total and car are concentration of chlorophyll a, chlorophyll b and carotenoids (carotene and xanthophyll); and $A_{663.2}$, $A_{646.8}$ and A_{470} stand for absorbance in 663.2nm (chlorophyll a), 646.8nm (chlorophyll b) and 470nm (carotenoids), respectively.

2.4. Experimental design and statistical analysis

Experiment was arranged in a factorial test with completely randomized design with four replications. Analysis of variance was performed on the data collected using the general linear model (GLM, procedure of the SPSS software, version 16, IBM Inc.). The mean separation was conducted by Duncan analysis in the same software (p= 0.05).

3. Results and discussion

3.1. Chlorophyllindex

Effects of the interaction level ($p<0.05$) and effect of $GA_3$and BA level ($p<0.01$) on chlorophyllindex was significant (Table 1). Results showed that 200 mg L^{-1} GA_3 + 200 mg L^{-1} BA and 200 mg L^{-1} GA_3 + 100 mg L^{-1} BA increased leaf chlorophyllindex of False aralia as 61.62 and 46.48% compared to control treatment (Table 2).

3.2. Plant height

Effects of GA_3, BA and the interaction significant ($p<0.01$), also effect of BA on plant height was significant (Table 1). Results showed that 200 mg L^{-1} GA_3 + 200 mg L^{-1} BA, and 200 mg L^{-1} GA_3 + 100 mg L^{-1} BA cause increased plant height of False aralia as 24.48 and 22.99% compared to control treatment (Table 2). Results related to attribution, showed growth of leaf that bean applicated with GA_3 and BA had significant effect with control treatments. GA_3 is used to regulating plant growth through increased meristimatic activity due to enhance cell division and elongation Bhattuchajee et al. (2002) on *Corchourusolitorius* L. These results adapted with results of Rahbarian et al. (2014) and Salehi Sardoei et al. (2014a) about effect of GA_3 on increase of growth index.

3.3. Stem diameter

Effects of GA_3 and BA was significant ($p<0.01$), also interaction effect on stem diameter was non significant (Table 1). Results showed that control treatment, 200 mg L^{-1} BA and 100 mg L^{-1} GA_3 + 200 mg L^{-1} BA increased stem diameter of False aralia as 125% compared to 200 mg L^{-1} GA_3 + 200 mg L^{-1} BA (Table 2). In this respect Rawia and Bedour (2006) on croton mentioned that, BA increased general growth compared with control plants.

3.4. Leaf area

Effects of GA_3 and interaction was significant ($p<0.01$), also effect of BA on leaf area was non significant (Table 1). Results showed that, 200 mg L^{-1} GA_3 + 200 mg L^{-1} BA increased leaf area of False aralia as 43.87% compared to control treatment (Table 2).

3.5. No. of leaves/plant

Effects of BA and interaction was significant ($p<0.01$) also effect GA_3 on No. of leaves/plant was non significant (Table 1). Results showed that, 200 mg L^{-1} GA_3 + 100 mg L^{-1} benzyladenine, 100 mg L^{-1} GA_3+ 200 mg L^{-1} BA, 200 mg L^{-1} GA_3 and 200 mg L^{-1} GA_3 + 200 mg L^{-1} BA increased No. of leaves/plant of False aralia as 24.33, 23.80, 23.28 and 6.87% compared to control treatment (Table 2). Results related to attribution, showed growth of leaf that bean applicated with of GA_3 and BA was significant in comparison to control treatment. These result adapted with results of Rahbarian et al. (2014) and Rahbarian et al. (2014); Salehi Sardoei (2014a) about the effect of GA_3 on increase of growth parameters.

Table 1
Analysis of variance for False Aralia (*Dizigotheecaelegantissima*) plant to evaluate effects of GA_3 and BA treatments on studied traits, 120 day after spray.

		MS									
Source of variance	df	Leaf chlorophyll index	Plant height	Stem diameter	Leaf area	No. of leaves/plant	Chl. (a)	Chl. (b)	Total chl. a+b	Carotenoids	Sumpigments
Gibberellic acid	2	39.62**	44.25**	0.008**	24.24**	13.77^{ns}	1.92^{ns}	1.004*	5.06*	0.023^{ns}	5.15^{ns}
Benzyladenine	2	18.93*	26.77**	0.009**	1.30^{ns}	75.02**	6.97^{ns}	0.49*	11.13**	0.022^{ns}	12.30**
Gibberellic acid × benzyladenine	4	18.61*	40.98**	0.002^{ns}	14.99**	121.23**	17.05**	0.19^{ns}	19.87**	1.39*	30.88**
Error	27	5.10	2.25	0.001	1.08	11.33	2.39	0.136	1.15	0.354	2.16
C.V	-	14.50	3.15	7.69	6.75	7.54	18	7.95	6.11	17.01	6.99

^{ns} Non Significant at 0.05 probability level and *, ** Significant at 0.05 and 0.01 probability levels, respectively.

Table 2
Effects of GA_3 and BA on plant growth parameters of False aralia (*Dizigotheecaelegantissima*) plant, 120 days after spray.

GA_3	BA	Leaf ChlorophyllIndex (SPAD)	Plant height (cm)	Stem diameter (cm)	Leaf area (cm^2)	No. of leaves/plant
0	0	12.22e	41.87d	0.45a	13.22e	47.25e
	100	13.36de	45.72c	0.42ab	13.15de	50.50de
	200	14.86bcde	48.12b	0.45a	14.97cd	52de
100	0	14.02cde	48.37b	0.37bc	14.52de	52de
	100	14.33bcde	46.25bc	0.41abc	15.20cd	53.75bc
	200	17.60abc	46.62bc	0.45a	16.49bc	58.50ab
200	0	16.12bcd	48.62b	0.41abc	15.20cd	58.25ab
	100	17.90ab	51.50a	0.37bc	17.03b	58.75ab
	200	19.75a	52.12a	0.36c	19.02a	50.50a

Means followed by same letter are not significantly different at P<0.05 probability using Duncan's test.

3.6. Chl. (a)

Effects of the interaction between GA_3 and BA was significant ($p<0.01$) and also effects of $GA_3$and BA on chl. (a) was non significant (Table 1). Results showed that, 200 mg L^{-1} BA, 100 mg L^{-1} GA_3 + 200 mg L^{-1} BA and 200 mg L^{-1} GA_3 + 200 mg L^{-1} BA cause increased chl. (a) of False araliaas 47.57, 35.83 and 20.25% compared to control treatment (Table 3). Results related to attribution, showed chlorophyll of leaf that bean applicated with of GA_3 and BA had significant effects in comparison to control treatment. The results herein are agreement with the finding of Mousa et al. (2001) on *Nigella sativa*, Shedeed et al. (1991) and Rawia and Bedour (2006) they mentioned that plant growth regulators were more effective than kinetin in increasing photosynthetic pigments in croton leaves. These results adapted with results of Rahbarian et al. (2014) and Salehi Sardoei et al. (2014b) about the effects of GA_3 on increased of chlorophyll and carotenoids contents.

3.7. Chl. (b)

Effects of GA_3 and BA was significant ($p<0.01$), also interaction effect on chl. (b) was non significant (Table 1). Results showed that, 200 mg L^{-1} BA, 100 mg L^{-1} GA_3 + 100 mg L^{-1} BA and 100 mg L^{-1} GA_3 + 200 mg L^{-1} BA cause increased chl. (b) of False aralia as 15.65, 6.52 and 3.26% compared to control treatment (Table 3).

3.8. Total chl. (a+b)

Effects of level of GA_3 ($p<0.05$), and BA and the interaction level of GA_3 and BA ($p<0.01$) on Total chl. a+b was significant (Table 1). Results showed that, 200 mg L^{-1} BA, 100 mg L^{-1} GA_3 + 200 mg L^{-1} BA, 100 mg L^{-1} BA, 200 mg L^{-1} GA_3 + 200 mg L^{-1} BA and 200 mg L^{-1} GA_3 + 100 mg L^{-1} BA increased total chl. a+b of False aralia as 38.03, 26.17, 15.60, 12.50 and 11.08% compared to control treatment (Table 3).

Table 3
Effect of Foliar application of GA_3 and BA on the photosynthetic pigments of False aralia (*Dizigotheecaelegantissima*) plant, 120 days after spray.

		(mg.ml^{-1} Fresh weight)				
GA_3	BA	Chl. (a)	Chl. (b)	Total Chl. a+b	Carotenoids	Sumpigments
0	0	10.91c	4.60bc	15.51b	2.98bc	18.50c
	100	13.23abc	4.70bc	17.93ab	3.72abc	21.41b
	200	16.10a	5.32a	21.41a	3.92ab	25.33a
100	0	11.40bc	4.49bc	15.89b	3.47abc	19.03ab
	100	12.09bc	4.90ab	17b	2.79c	19.78ab
	200	14.82ab	4.75abc	19.57ab	4.11a	23.96a
200	0	12.16bc	4.14c	16.30b	3.40abc	19.70ab
	100	12.76abc	4.47bc	17.23ab	3.40abc	20.64ab
	200	13.12abc	4.33bc	17.45ab	3.63abc	21.09b

Means followed by same letter are not significantly different at P<0.05 probability using Duncan's test.

3.9. Carotenoids

Results showed that, 100 mg L^{-1} GA_3 + 200 mg L^{-1} BA increased carotenoids of False aralia as 37.91% compared to control treatment.

3.10. Sumpigments

Effects of BA and the interaction was significant ($p<0.01$) also effect of GA_3 on sumpigments was non significant (Table 1). Results showed that, 200 mg L^{-1} BA and 100 mg L^{-1} GA_3+ 200 mg L^{-1} BA increased sumpigments of False aralia as 36.91 and 29.51% compared to control treatment (Table 3). Results related to attribution, showed chlorophyll of leaf that bean applicated with GA_3 and BA has significant effect with control treatment. These results adapted with results of Rahbarian et al. (2014) and Rahbarian et al. (2014); Salehi Sardoei (2014a) on effects of GA_3 on increase of growth parameters, chlorophyll and carotenoids contents.

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