Vegetative Growth and Chemical Constituents of Croton Plants as Affected by Foliar Application of Benzyl adenine and Gibberellic Acid

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Abstract A pot experiment was conducted during 2008 and 2009 seasons at National Research Centre, Dokki, Cairo, Egypt, Research and Production Station, Nubaria. The aim of this work is to study the effect of foliar application with benzyl adenine (BA) at (50, 100 and 150 ppm) and gibberellic acid (GA_3) at (100, 150 and 200 ppm) on the vegetative growth and some chemical constituents of croton plants. Most of the criteria of vegetative growth expressed as plant height, number of branches and leaves/plant, root length, leaf area and fresh and dry weights of stem, leaves and roots were significantly affected by application of the two factors which were used in this study.All foliar applications of BA and GA_3 separately promoted all the aforementioned characters in this study, as well as chemical constituents i.e. Chl. (a and b), carotenoids, total soluble sugars, total indoles ,total soluble phenols and N, P and K content compared with control plants. The highest recorded data were obtained in plants treated with GA_3 200 pm for all chemical constituents and growth parameters, except stem diameter and number of branches/plant, and N, P and K % while BA 150 ppm gave the highest stem diameter and number of branches and N, P and K % and content. [Journal of American Science 2010;6(7):126-130]. (ISSN: 1545-1003).

Keywords: croton plant, benzyl adenine (BA) , gibberellic acid (GA3) .

1. Introduction

Croton with their colorful, glossy foliage and variation of leaf types are one of the most popular plants in Egypt. It is a native of the tropics from Java to Australia and South Sea Islands. The agricultural strategy of Egypt gives much attention (interest) to ornamental plants production for local and exportation. Croton (*Codiaeum variegatum*) Family: Euphorbiaceae is one of the beautiful indoor and out door plants need extensive agriculture development. 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 (1970) and Hall (1973). Shudo (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.,l* (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 GA_3 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 some chemical constituents of croton plants.

2. Material and Methods

The present work was conducted during the two successive seasons of 2008 and 2009 at greenhouse of National Research Centre (Research and Production Station, Nubaria). Plastic pots 30 cm in diameter were used for cultivation that were filled with media containing a mixture of sand and peat as 1:1 by volume. Seedlings of (*Codiaeum variegatum*)

pactum L. cv. Norma 23-25 cm height with 30-35 leaves were planted at the first week of March in both seasons. . The plants were fertilized with 20 g/pot kristalon in four doses after 4, 8, 16 and 20 weeks from transplanting.

The pots were arranged in complete randomize design with 6 treatments and 3 replicates (each replicate contained 5 plants) in addition to the control. Application of benzyladenine (50, 100 and 150 ppm) and gibberellic acid (100, 150 and 200 ppm) were carried out twice as foliar spray. 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 2008 and 2009, the following data were recorded: plant height (cm), stem diameter (mm), number of branches /plant, number of leaves/plant, leaf area (cm^2), root length (cm) fresh and dry weights of stem, leaves and roots (g). Total soluble sugars were determined in the methanolic extract by using the phenol-sulphoric method according to Dubois *et al.*, (1956), photosynthetic pigments including Chlorophyll (a and b) as well as carotenoids content were determined in fresh leaves as mg/gm fresh weight, according to the procedure achieved by Saric *et al*., (1976). The total indoles were determined in the methanolic extract, using P-dimethyl aminobenzaldhyed test " Erlic's reagent" according to Larsen *et al*., (1962). Total soluble phenols were determined calorimetrically by using Folin Ciocalte a reagent A.O.A.C. (1985). Nitrogen , phophorus and potassium were determined according to the method described by Cottenie *et al*., (1982) ., then the leaves contents of N, P and K were calculated. The data were statistically analyzed for each season and then a combined analysis of the two seasons was carried out according to the procedure outlined by Steel and Torrie (1980).

3. Results and Discussion

Growth parameters

Data presented in Table 1 and 2 show that, the foliar application of different concentrations of benzyl adenine (BA) and gibberellic acid (GA_3) had significantly stimulatory effect on growth parameters of croton plants in term of plant height, number of branches, and leaves/plant, root length and leaf area as well as fresh and dry weights of stem, leaves and roots (g)/plant compared with the untreated plants, in this respect Rawia and Bedour (2006) on croton mentioned that, benzyl adenine increased general growth compared with control plants. The most effective treatment which had the tallest plants, the largest leaf area and the highest number of leaves and fresh and dry weights of stems, leaves and roots /plant was (GA_3) when applied at concentration of 200 ppm. The results herein are in agreement with Shedeed *et al.*, (1991) and Rawia and Bedour (2006) on croton, Ibrahim *et al* .,(1992) on ment plant and Soad (2005) on Jojoba plant. However, (GA_3) is used to regulating plant growth through increased meristimatic activity due to enhance cell division and elongation Bhattuchajee *et al*., (2002) on *Corchourus olitorius* L. Treatment with BA at 150 ppm gave the highest value of the number of branches/plant and stem diameter compared with the other treatments and control.

Table 1: Effect of foliar application of benzyladenine (BA) and gibberellic acid (GA3) (on the growth of croton plants (average of the two seasons)

Treatments	Conc. (ppm)	Plant height	Stem diameter	Number / plant		Root length	Leaf area
		cm	mm	branches	leaves	cm	cm^2
Control		43..48	5.65	4.56	140.8	20.41	51.98
BA	50	49.02	7.49	6.56	195.1	23.69	67.91
	100	55.79	8.11	8.63	202.2	24.85	98.33
	150	61.48	8.47	9.57	210.8	27.29	117.82
GA_3	100	57.56	7.64	10.97	172.4	21.87	55.49
	150	68.33	7.41	9.49	228.9	24.25	84.08
	200	70.53	6.22	7.48	261.4	27.21	122.71
LSD 5%		6.69	NS	0.69	19.4	3.57	4.40

Table 2: Effect of foliar application of BA and GA3 on fresh and dry weights of stems, leaves and roots of croton plants (average of the two seasons)

Treatments	Conc. (ppm)	Fresh weights (g)			Dry weights (g)		
		Stem	Leaves	Roots	Stem	Leaves	Roots
Control		19.38	32.02	29.39	7.40	9.36	10.52
BA	50	26.24	45.22	32.50	10.41	11.32	11.53
	100	33.62	52.56	34.12	13.36	13.29	12.86
	150	35.97	65.39	36.55	14.25	16.37	12.96
GA_3	100	28.44	46.71	33.53	11.63	10.59	10.69
	150	36.24	67.35	35.85	14.57	16.50	11.47
	200	41.35	71.37	40.78	16.75	17.29	14.99
LSD 5%		3.28	4.16	3.75	1.65	2.27	0.17

Chemical constituents:

Pigments content

According to Table 3 it was found that the leaves content of three photosynthetic pigments chlorophyll (a and b) and carotenoids were gradually increased as the concentration of BA and GA_3 were increased. The highest value of Chl (a and b) and carotenoids was obtained at the highest concentration of GA_3 (200 ppm). 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 GA_3 treatments were more effective than kinetin in increasing photosynthetic pigments in croton leaves.

Table 3: Effect of foliar application of BA and GA3 on chemical constituents of croton plants (average of the two seasons) (mg/gm F.W.)

Treatments	Conc. (ppm)	Chlorophyll		Carotenoids	Total sugars	Total indoles	Total soluble phenoles
		(a)	(b)				
Control		2.29	1.74	0.23	0.94	0.63	1.35
BA	50	2.89	2.16	0.29	1.55	1.38	1.52
	100	3.82	2.27	0.33	1.97	1.75	1.64
	150	4.13	2.82	0.38	2.05	2.48	1.75
GA_3	100	3.31	2.22	0.35	1.56	0.82	1.62
	150	4.15	2.72	0.38	1.97	1.56	1.79
	200	4.64	2.95	0.42	2.22	2.07	2.28
LSD 5%		0.05	0.05	0.02	0.02	0.02	0.01

Total soluble sugars:

Data in Table 3 show that, the application of BA and GA_3 with different concentrations were favourable for accumulation of total soluble sugars in leaves of the tested plants compared with the control. The greatest content of total soluble sugars occurred in the leaves of plants treated with BA at 150 ppm and GA_3 at 200 ppm. In harmony with these results were those obtained by Rawia and Bedour (2006) and Nahed (2007) on croton and Sheren (2005) on flax plants recorded that GA_3 and BA application resulted in an increase of total soluble sugars content.

Total indoles and total soluble phenoles: Data in Table 3 reveal that, spraying croton plants with different concentration of BA and (GA_3) stimulated the content of total indoles and total soluble phynoles in croton plants compared with the control treatment. The greatest values of total indoles and total soluble phenols were obtained from plants sparyed with 150 ppm BA and 200 ppm (GA_3). These results are in line with those obtained by Lobna *et al*., (2008) on *Paulownia kowakamii*, who indicated that using BA at high concentration remarkably augmented the endogenous level of total indoles and total soluble phenols.

Table 4: Effect of foliar application of BA and GA3 on leaves percentage and content (mg) of Nitrogen, Phosphorus and Potassium of croton plants (average of the two seasons) .

Treatments	Conc. ppm	leaves DW %			leaves content (mg)		
		N	P	K	N	P	K

Control		1.73	0.252	2.851	159.1	23.4	266.7
BA	50	2.05	0.265	3.174	226.4	29.4	358.8
	100	2.21	0.283	3.305	292.3	37.2	438.5
	150	1.94	0.263	3.213	311.0	42.5	523.8
GA_3	100	1.63	0.244	2.726	169.4	25.4	288.0
	150	1.53	0.226	2.533	247.5	36.3	417.5
	200	1.42	0.205	2.456	242.1	34.5	423.6
LSD 5%		0.01	0.004	0.018	12.4	1.9	25.4

Leaves percentage of Nitrogen, Phosphorus and Potassium : Table (4) show a gradual reduction in the percentage of the three applied nutrients, nitrogen, phosphorus and potassium parallel to the increase in the concentration of GA_3 was sloping upward up to 200 ppm. The differences were statistically significant for N, P and K %. In harmony with the prementioned results were the findings of Mohammed (2003) on *Acacia saligna* and Soad (2005) on Jojoba plants. Table (4) also shows that the highest percentage of N, P and K were recorded in the plants sprayed with BA at concentration 100 ppm. However, increasing the concentration of BA from 100 ppm up to 150 ppm, decrease the percentage of N, P and K. These results pointed in the same direction of Nahed (2007) and Rawia and Bedour (2006) on croton plants.

Leaves content of Nitrogen , Phosphorus and Potassium : Data in Table (4) reveal that, spraying croton plants with different concentration of BA and GA_3 stimulated the leaves content of N, P and K in croton plants compared with the control treatment. The greatest leaves content of N, P and K were obtained from plants sprayed with 150 ppm BA. The increase in the leaves contents of such three nutrients due to GA_3 application is attributed to the influence of GA_3 in augmenting the leaves dry weights to a higher degree than its effect in reducing leaves percentages of each N, P and K. The role of increasing leaves contents of N, P and K by GA_3 application was emphasized by Sayed (2001) on *Khaya senegalensis* and Soad (2005) on jojoba.

5. References

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