IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)
e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 11, Issue 3 Ver. II (March 2018), PP 12-17
www.iosrjournals.org

The Effect of Foliar Applications With Gibberellic Acid And Benzyladenin on Vegetative And Floral Growth of Pansy Plant (Viola Tricolor)

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Abstract: *The study was carried out in the lath house of the Department of Horticulture ,College of Agriculture , University of Baghdad, The objective of the study was to know the effect of GA3 and Benzyladenin in vegetative and floral growth ofpansy (viola tricolor) plant, pansy cats cultivar, the seeds were planted in 20 cm diameter plastic pots, the plants were sprayed with GA3 and Benzyladenin concentrations twice, the first spraying conducted after a month of planting, the GA3 concentrations 0, 25, 50 and 100 mg.L^{-1} were used, while Benzyladenin concentrations were 0, 15, 30, 45 mg.L^{-1}. Tecnophyt PH was used with solutions to reduce the surface tension of the water and to ensure the complete wetness of the plant leaves, while control treatment plants were sprayed with distilled water only.*

The results can be summarized as follows: The spraying of plants with the GA3 improved most of the characters of vegetative and floral growth, the best increase in plant height (10.59 cm), number of leaves (46.50 leave.plant^{-1}), and leaf area (37.20 cm^2) obtained from concentration of 100 mg.L, also it was the best in early flowering (43 days), period of flowering (5.76 days), flower diameter (5.20cm) , number of flowers (12.22 flower.plant^{-1}) , and dry weight of flowers (3.05gm), while the treatment that gave the highest of branches number was concentration 50mg.L^{-1} which gave 6.20 branch.plant^{-1}, also the spraying of Benzyladenin concentrations have significant differences in most of characters of plant, the concentration 30mg.L^{-1} gave the highest plant height 9.90cm, leaves number per plant 43.20 leaf.plant^{-1}, leaf area 33.08cm^2 and early flowering 42.00 days, while the concentration 45mg.L^{-1} was superior in increase branches number 6.66 branch per plant, dry weight of vegetative part of plant 2.60gm, period of flowering 5.00days, flower diameter 4.57cm and flowers number 12.40 flower per plant .Results show that interaction between factors of study were significant effect, interaction treatment GA$_3$3 x BA3 gave the highest plant height 13.12cm, leaves number per plant 50.27, leaf area 38.28 leaf per plant, early flowering 38.00 days, flowering period 6.50 days, flower diameter 6.55cm, flowers number 13.56 flower per plant and dry weight of flowers 3.39gm, while the interaction treatment GA$_3$ 2 x BA3 was the best in branches number 7.50 branch per plant and dry weight of vegetative of plant 3.20gm.

Keywords*: Plant Hormones ,Foliar Application,Violaceae .*

Date of Submission: 02-03-2018 Date of acceptance: 17-03-2018

I. Introduction

The plant of pansy *Viola tricolor* belongs to the Violaceae family, annual winter plant, its origin Europe, the leaves are oval shape with tip of leaf sharpened, the flower contains five petals and each one has several colors, and not equal in size, it is one of the important plants grown in the pots and may be used for garden fencing (Alchalabi and Al Khayat, 2013). Plant growth regulators are chemical compounds that cause changes in plant growth and development, these compounds are known to control physiological and biochemical processes in the plant through primary and secondary metabolism (Heldet et al., 1997). Growth regulators are divided into several groups depending on their effects on the plant, including gibberellins and cytokinin, Each plant hormone performs specialized functions. However, the responses may be controlled by the interaction between the effect of two or more hormones, hormonal interaction may be cooperative, contradictory, or balanced (Preedakoon, 2009). Gibberellins are Terpenoids compounds containing 19- 20 carbon atoms, naturally produced in new leaves and germinated seed embryos, and more than 136 species have been identified (Sponsel and Hellden, 2004), the effect of Gibberellins is to encourage elongation of the cells and increase their division, the elongation is obtained by the increase of cellular permeability, which helps to increase soluble water transmission and entry in the cell, this leading to increased cell size (Taiz and Zeiger, 2006), several studies have been conducted to determine the effect of Gibberellins on growth and flowering of ornamental plants. Srivastava and Srivastava (2007) refer to the spraying of Rose Periwinkle (*catharanthus roseus)* plants

with a concentration of 1000 mg.L^{-1} of Gibberellin resulted in the elongation of the stems and change of leaf shape, (Pablo, 2005) shows that spray the GA3 with 50 mg.L^{-1} concentration on *Coleus amboinicus* plant led to increased vegetative growth and dry weight through increasing the internodes length, thus increased the accumulation of amino acids and peptides in plant tissues, Cytokinin are a group of other plant growth regulators, including naturally produced in plant or manufactured, Cytokinin is exists freely in cytoplasm or associated with Trna of cytoplasm and chloroplast, cytokinin have many effects, including increased cell division and inhibition ofapical dominant, Common cytokinin used in studies are benzyladenin (BA), zip and Kintein (Hopkins, 1999).Many of studies indicate that the treatment of ornamental plants with benzyladenin (BA) gave positive results in many of the vegetative and floral characters of treated plants, Emami et al, (2011) shows that the treatment of *Lilium longiflorum* plant with concentrations 0, 50, 100, 150, 200, 250 mg.L^{-1}, the concentration of 250 mg.L^{-1} ppm was the best in increasing the number of flowers and number of bulbs formed, Matin et al, (2015) confirmed that *Narcissus tazetta* plants were sprayed with (BA) concentrations 0, 100, 200, 500 mg.L^{-1} increased the number of leaves, leaf area, dry weight of plant, number of flowers per Plant, and observed that the effect of (BA) increases with a concentration increase of 200 - 500 mg.L^{-1}. The objective of this study is to know The effect of foliar applications of growth and flowering of Gibberellic acid and Benzyladenin on Viola tricolor (Pansy Cats).

II. Materials And Methods

The study was carried out in the lathhouse of the Department of Horticulture ,Coolege of Agriculture , University of Baghdad, in spring season 2016,Pansy seedlings (pansy cats cultivar) were obtained from a local nursemaid (Takii seed) in January 2016, the seedlings were 20 day old and contained two real leaves, the seedlings were transferred to a 20 cm diameter plastic pots, one seedling was planted in each pot after filling it with soil composed of a (riverine mixture + peat moss of 3: 1), Table (1) shows some physical and chemical properties of agricultural soil.

Table (1) : some physical and chemical properties of agricultural soil.

Characters	Unit	Value
pH	-	7.20
Ec	dsm^{-1}	1.2
Organic matter	%	0.86
Carbonate minerals	%	17.9
Hco_3	meq .L^{-1}	1.5
ca^{++}		8.1
mg^{++}		4.5
Na^{++}		3.41
Cl		3.5
So_4		13.1
Available N	mg.Kg^{-1}	0.008
Available P		120.5
Available K		71.5
Sodium Adsorption Ratio SAR	$)^{1/2}$mmol.L^{-1}(	1.36
Soil separates		
Sand	g.kg^{-1} g. Kg^{-1}	800
Silt		120
Clay		80
soil texture	loamy sand	

***The analysis was carried out in the Soil Department – College of Agriculture - University of Baghdad.**

Plants were sprayed with GA3 acid and BA concentrations, the first spraying was carried out after a month of plant cultivation, hand spray with (capacity3 liter) was used, the plants were sprayed with the concentrations of the two growth regulators until the full wetness, the Tecnophyt PH was used with solutions to reduce the surface tension of the water and to ensure the complete wetness of the plant leaves, while the control plants were sprayed with distilled water.Four concentrations of GA3 were used 0, 25,50, 100 mg.$L^{-1,}$ it is encoded as follows GA_30, GA_31, GA_32, GA_33 respectively while the Benzyladenin concentrations was 0, 15, 30, 45 mg.L^{-1} ant it was encoded in results tables BA0. BA1, BA2, BA3 respectively, the plant sprayed with GA3 and after two days sprayed with BA, . all the study plants were sprayed with foliar fertilizer (sea weed gold) with a concentration 1.5 ml.L^{-1} and at a rate of one spray per month throughout the experiment period. Table 2 shows the components of foliar fertilizer used.

Table 2 : components of foliar fertilizer sea weed gold.

K2O 4.2%	P2O5 6.35%	N %8.9

A factorial experiment using randomized completely block design RCBD with three replicates, each of it containing 16 experimental units (the experimental unit containing four plants), thus the number of total experimental plants was 64 plants, the SAS program was used to analyze the results statistically and to compare the significant differences between the means using the least significant difference test (2012, SAS).

III. Results And Discussion

Vegetative growth characters :

The table (3- A) shows that the concentrations 50, 100 $mg.L^{-1}$ of GA3 resulted in a significant increase in plant height, with a height 10.16 cm and 10.59 cm, respectively, compared with control plant, while the table indicates that spraying of plants with all concentrations of GA3 led to a significant increase in the number of leaves Compared with control treatment, the increase was directly proportional with increased concentrations until the highest concentration 100 $mg.L^{-1}$ which gave 46.80 leaves per plant compared with control treatment that gave the lowest value 30.90 leaves per plant , the results also showed that a significant increase in leaf area was obtained at the treatment with concentrations 50 and 100 $mg.L^{-1}$ which was 34.10 cm^2 and 37.20 cm^2 respectively, as well as the number of branches per plant was also significantly affected when treating plants with all concentrations of GA3 and the best value obtained from treatment of concentration 50 $mg.L^{-1}$ that gave 6.20 branches per plant, finally the results of table shows no significant differences in dry weight at same concentrations of GA3. The table (3- B) indicates that spraying of plants with concentration (30 $mg.L^{-1}$) of BA resulted in a significant increase in plant height 9.90 cm compared with (8.85 cm) which obtained from control treatment plants and the same concentration 30 $mg.L^{-1}$ gave a significant increase in number of leaves per plant and leaf area (43.20 leaves per plant, 33.08 cm^2) respectively, compared with control treatment which gave (30.60 leaves per plant, 30.02 cm^2) respectively, the table also indicates that a significant increase in the number of branches per plant at concentrations (30 and 45 $mg.L^{-1}$) 6.30 and 6.66 branches per plant compared with control treatment plants and plants treated with a concentration 15 mg L-1, as well as the same concentrations of BA (30 and 45 $mg.L^{-1}$) Resulted in a significant increase in dry weight (2.29 and 0.60 g) compared control treatment plants.The table (3- C) shows there are a significant differences of most interaction treatments between the two growth regulators were significant in plant height, However, the interaction treatment (BA3x $GA_3$3) was the superior in plant height which gave 13.12 cm also gave the highest number of leaves per plant 50.27 leaves, and highest value of leaf area 38.28 cm^2, while the interaction treatment ($GA_3$2 x BA3) was the best in number of branches which gave 8.25 branch per plant, it also had the same effect in dry weight which was 4.10 g,

Table 3: Vegetative growth characters**.**

dry weight of flower (g)	number of branches/ plant	leaf area (cm^2)	number of leaves/ plant	plant height (cm)	the studied characters concentrationsL /M
A= effect of Gibberellic acid					
1.87	5.12	29.50	30.90	8.81	$GA_3$0(0)
1.97	5.50	33.20	43.36	9.58	$GA_3$1(25)
2.25	6.20	34.10	45.30	10.16	$GA_3$2(50)
2.21	6.08	37.20	46.50	10.59	$GA_3$3(100)
NS	0.94	5.49	5.62	1.07	**0.05L.S.D**

B= effect of Benzyladenin					
1.90	5.20	30.02	30.60	8.85	BA0(0)
2.08	5.80	32.10	30.90	9.08	BA1(15)
2.29	6.30	33.08	43.20	9.90	BA2(30)
2.60	6.66	33.60	42.80	9.43	BA3(45)
0.61	0.94	5.49	5.62	1.07	**0.05L.S.D**

C= effect of Gibberellic acid x Benzyladenin

2.20	6.02	28.55	30.65	8.80	BA0	GA_30
2.30	6.30	28.70	30.88	8.95	BA1	
2.61	6.58	29.30	30.90	9.20	BA2	
2.80	6.90	30.15	30.94	9.82	BA3	
2.75	6.80	33.50	41.03	9.10	BA0	GA_31
2.80	6.89	33.70	41.20	9.22	BA1	
2.81	6.92	34.25	41.55	9.28	BA2	
2.98	7.20	34.50	41.86	9.30	BA3	
2.90	7.10	35.70	43.10	10.02	BA0	
2.91	7.13	35.98	43.18	10.11	BA1	GA_32
3.50	7.72	36.30	43.87	10.23	BA2	
4.10	8.25	36.72	43.96	10.50	BA3	
2.95	7.10	37.30	46.22	12.08	BA0	GA_33
3.07	7.25	37.52	47.70	12.12	BA1	
3.23	7.55	37.93	48.15	12.25	BA2	
3.20	7.50	38.28	50.27	13.12	BA3	
1.19	1.67	10.39	9.63	29.63	**L.S.D 0.05**	

Table 4: Flowering growth characters **.**

dry weight of flower (g)	number of flower	diameter of flower (cm)	flowering days (days)	fastened the flowering (days)	the studied characters concentrationsL /M
A= effect of Gibberellic acid					
2.78	11.08	4.83	4.60	49.00	$GA_30(0)$
2.85	11.41	4.33	5.00	48.00	$GA_31(25)$
2.81	11.00	4.12	5.32	45.00	$GA_32(50)$
3.05	12.47	5.37	5.76	43.00	$GA_33(100)$
0.66	1.03	0.57	0.62	3.38	**0.05L.S.D**

B= effect of Benzyladenin

2.80	11.21	4.02	4.00	46.00	BA0(0)
2.96	11.97	4.10	4.75	44.00	BA1(15)
3.02	12.08	4.33	4.92	42.00	BA2(30)
3.10	12.40	4.57	5.00	45.00	BA3(45)
NS	1.03	0.57	0.62	3.38	**0.05L.S.D**

C= effect of Gibberellic acid x Benzyladenin

2.78	11.15	4.08	4.00	49.00	BA0	$GA_3$0
2.88	11.55	4.12	4.10	45.00	BA1	
2.96	11.87	4.15	4.22	44.00	BA2	
2.99	11.98	4.26	4.25	43.00	BA3	
2.88	11.54	4.50	4.50	48.00	BA0	$GA_3$1
2.94	11.76	4.66	4.65	42.00	BA1	
2.97	11.91	4.83	4.80	45.00	BA2	
3.03	12.15	4.96	4.95	44.00	BA3	
3.00	12.00	5.05	5.00	46.00	BA0	
3.05	12.20	5.12	5.08	42.00	BA1	$GA_3$2
3.11	12.45	5.49	5.27	40.00	BA2	
3.22	12.88	5.77	5.55	40.00	BA3	
3.08	12.33	5.97	5.80	44.00	BA0	$GA_3$3
3.15	12.65	6.10	5.97	40.00	BA1	
3.24	12.96	6.30	6.00	41.00	BA2	
3.39	13.56	6.55	6.50	38.00	BA3	
1.17	2.16	1.26	1.29	6.72	**L.S.D 0.05**	

The results of Table (4- A) showed that the spraying of the plants with the GA3 concentrations led to the early flowering compared to the control plants, the increase of concentration is directly proportional to the early flowering. The concentration 100mg.L^{-1} gave 43.00 days only followed by 49.00 days obtained from control treatment plants, the results showed that the GA3 treatments with the same concentration also resulted in a significant increase in flowering period, flower diameter, flowers number and dry weight (5.76 days, 5.20 cm, 12.22 flower per plant and 3.05g) respectively. The effect of BA concentrations, the table (4-B) shows that the BA concentrations treatments led to early flowering, and lowest period of flowering obtained from treatment of concentration 30 mg.L^{-1} which was 42.00 days, the spraying of plants with BA concentration 45 mg.L^{-1} led to a significant increase in flowering period flower diameter and flowers number (5.00 days and 4.57 cm, 12.40 flower per plant) respectively, while dry weight was not differsSignificantly in BA treatments. Table (4-C) indicates that the effect of interaction between GA3 and BA effect was significant in early flowering, the treatment $GA_3$3 x BA3 was the most significant which gave 38.00 days from planting date to flowering, the largest flowering period , the largest flower diameter , the largest flowers number per plant and largest dry weight of plant was obtained from plants treated with the same concentration (11.00 days and 6.58 cm and 6.75 flower per plant and 3.39 g), respectively. The results of tables 3 and 4 show that the spraying of plants and the with GA3 and BA gave a positive effect on most vegetative and floral indicators, this may be due to the most of plants have nutrient uptake when sprayed on the vegetative group through leaves and are more effective than soil fertilizing, the permeability of ions within the leaf by penetrates the cuticle cells or through the stomata or both together (Kuepper, 2003) , Al-Sahaf , 1994 shows that the nutrients that are difficult to obtain from the soil, Which are often unavailable and can be compensated with foliar application, Gholaim, 1997, shows that some of the mineral elements in most of the Iraqi soils were exposed to many factors that limit their movement and availability due to the high values of pH, which necessitates foliar application, Kuepper (2003) explained that increasing the nutrients added in the soil led to increased salinity and degree of (pH), which causes the failure of the roots to absorb these elements from the soil, the method of foliar application is effective in increasing the quantity of yield and improve its quality and vegetative growth. The GA3 have an effect on cell elongation and increased cells division, elongation is obtained by the increase of cellularpermeability, which helps to increase

the flow of water and soluble substances within the cell, thus increasing cell size (Taiz and Zeiger, 2006). The role of the BA is to inhibit the effectiveness of ethylene, this may led to a decrease in the rate and speed of flower respiration, and consequently a decrease in the consumption of nutrients and carbohydrates that prolong the flowering life (Kim et al., 2001).

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