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EFFECT OF FOLIAR SPRAY WITH BA (BENZYLADENINE) AND B-9 (*Daminozide*) ON GROWTH AND YIELD OF *Majorana hortensis*, MOENCH PLANT.

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ABSTRACT

This experiment was carried out at the Agriculture Experimental Station, Faculty of Agriculture, Cairo University, Giza in two successive seasons of 2005-2007and 2006-2008. The aim of this research was to study the effect of foliar spray with BA and B-9 on the growth and yield of marjoram plant. The plants were sprayed with BA at the rates of 50, 100 and 150 ppm, and B-9 at the rates of 500, 1000 and 2000 ppm in addition to control treatment which sprayed with distilled water. The obtained results can be summarized as follows:

All concentrations of BA or B-9 increased all recorded parameters as compared with the control treatment with significant differences in most cases during the two seasons. In the first season, the highest values of plant height, fresh weight of herb, dry weight of herb, dry weight of leaves and flowering tops, total seasonal yield of dry weight of herb and total seasonal yield of dry weight of leaves and flowering tops were produced from using BA at 150 ppm, while the highest dry weight of stems was obtained from B-9 at 2000 ppm. The lowest values of all recorded characters were resulted in control treatment. In the second season, the highest values of plant height, dry weight of herb and total seasonal yield of dry weight of herb were produced from BA at 100 ppm, whereas the highest values of fresh weight of herb and dry weight of stems were obtained from BA at 150 ppm. Also the highest values of dry weight of leaves and flowering tops and total seasonal yield of dry weight of leaves and flowering tops were resulted in B-9 at 500 ppm. Generally, in combined analysis BA at 150 ppm was the most effective treatment in increasing total seasonal yield of dry weight of herb and total seasonal yield of dry weight leaves and flowering tops. Different cuts as a general mean had a significant effect on all recorded parameters in the two seasons. In the first season, the highest values of plant height and fresh weight of herb were produced from the second cut. Also, the highest values of dry weight of herb, dry weight of leaves and flowering tops and dry weight of stems were produced from the third cut. In the second season, the highest values of fresh weight of herb, dry weight of herb, dry weight of leaves and flowering tops and dry weight of stems were obtained from fourth cut, whereas the highest value of plant height was produced from the first cut. The interaction between the growth regulators (BA or B-9) and the different cuts increased all recorded parameters as compared with the control in any cut during the two seasons with significant differences in most cases.

INTRODUCTION

Marjoram plant belongs to family Lamiaceae (Labiatae) used for oil production, analgesic, anaphrodisiac, anti-oxidant, antiseptic, antispasmodic, antiviral, bactericidal, carminative, cephalic, cordial, diaphoretic, digestive, diuretic, emmenagogue, expectorant, fungicidal, hypotensive, laxative, nervine, sedative, stomachic, tonic, vuscodilator and vulnerary (Lawless, 1992). The production of medicinal and aromatic plants is affected by many factors, i.e. genetic information, climatic and edaphic factors as well as agricultural practices. One of these is the application of growth regulators. Spraying BA on some medicinal and aromatic plants had a clear effect on

increasing the growth and yield of the plants. This conclusion was reported by many researches, El-Sayed *et al.* (1989) on *Polianthus tuberosa*, Menesi *et al.* (1991) on *Calendula officinalis*, Talaat and Youssef (1998) on *Borago officinalis*, Mousa *et al.* (2001) on *Nigella sativa*, Abd El-Aziz (2002) on *Majorana hortensis*, Pol *et al.* (2003) on a shwagandha plant, Youssef (2004) on *Pelargonium graveolens*, Agamy (2005) on *Hibiscus sabdariffa* and Koodziej (2005) on American ginseng. On the other hand Figueireda *et al.* (2006) on *Cymbopogon citratus*, found the opposite response with BA.

Also foliar spray by diminozide (B-9) on some medicinal and aromatic plants had a clear effect on increasing the growth and yield. This conclusion was stated by many scientists, Eid and Rofaeel (1980) on *Pelargonium graveolens* , El-Sharkawy (1981) on *Majorana hortensis*, Meawad *et al.* (1984) on *Matricaria chamomilla*, Mohandass and Sampath (1985) on *Pelargonium graveolens*, Abdellah *et al.* (1986) on *Calendula officinalis*, Shedeed *et al.* (1990) on *Ocimum basilicum*, Suparna *et al.* (1993) on *Gloriosa superba*, Singh (2003) on *Calendula officinalis*, Koodziej (2005) on American ginseng and Barbara *et al.* (2006) on American ginseng. On the other hand Figueiredo *et al.* (2006) on *Cymbopogon citratus*,found the opposite response with B-9.

This experiment aimed to study the effect of foliar spray with some growth regulators (BA or B-9) on growth and yield of marjoram (*Majorana hortensis,* Moench) plant to improve the growth and the yield.

MATERIALS AND METHODS

This research was carried out in two successive seasons of 2005-2007 and 2006-2008 at the Agriculture Experimental Station, Faculty of Agriculture, Cairo University, Giza. Soil of the experiment is sandy clay loam with contained 24.15% clay, 1.12% silt, 47.16% fine sand, 27.18% coarse sand, 7.70 pH value, 2.50 EC value, 11.56, 12.15, 2.35 and zero meq/L from SO_4^-, Cl^-, HCO_3^- and CO_3^-, respectively, 8.65, 7.13, 10.64 and 1.30 meq/L from Na^+, Mg^{++}, Ca^{++} and K^+, respectively. Also it contained 30% N^+ and 0.100% P^+.

Marjoram seeds were sown in plastic trays (40×60×15 cm), which were filled with a mixture of peatmoss: sand (1:1) on October 15th ,2005 and 2006 for the first and second seasons , respectively. The seeds were covered with fine soil and irrigated regularly till the seedlings reached about 12 cm in height. The seedlings were transplanted on December, 25th in both seasons. Only one uniform seedling was left to grow in each pot (25 cm diameter).

The plants were sprayed with BA at the rates of 50, 100 and 150 ppm, and B-9 at the rates of 500, 1000 and 2000 ppm in addition to control treatment which sprayed with distilled water, the volume of the sprayed solution of BA or B-9 was maintained just to completely covered the plant foliage till drip. The first spray was done after 30 days from planting, while the second spray was carried out after 30 days from the first one. After each cut in the two seasons, the plants sprayed twice, between the first spray and the second one about 30 days. All the plants received equal dose from NPK

fertilizer (10 gm/plant) divided into two portions of NPK at the ratio of 20:10:15 after each cut. Seven treatments were carried out and the experimental unit consisted of 10 plants, one plant/pot (25 cm diameter). The treatments were replicated three times. The pots were distributed in randomized complete system. Four cuts were carried out during each season at the following dates:

Cut No.	First season 2005 - 2007	Second season 2006 - 2008
1	12/5/2006	15/5/2007
2	30/8/2006	26/8/2007
3	20/11/2006	25/11/2007
4	5/4/2007	4/4/2008

The following data were recorded after each cut:

1- Plant height (cm).
2- Fresh weight of herb (gm/plant).
3- Dry weight of herb (gm/plant).
4- Dry weight of leaves and flowering tops (gm/plant).
5- Dry weight of stems (herb without leaves) gm/plant.
6- Total seasonal yield of herb dry weight (gm/plant).
7- Total seasonal yield of dry weight of leaves and flowering tops (gm/plant).

The statistical analysis of the experiment was split plot in randomized complete blocks design. Data were statistically analyzed using MSTAT-C software package according to Freed *et al.* (1989) and the data were subjected to analysis of variance according to Steel *et al.* (1997). The parameters of total seasonal yield of dry weight of herb, leaves and flowering tops/plant were statistically analyzed in randomized complete blocks design for each season separately and combined analysis of variance was computed for the two seasons in each character.

RESULTS AND DISCUSSION

1- Plant height (cm):

The data in Table (1) showed that, spraying the growth regulators on marjoram plants had a significant effect on increasing plant height as a general mean of the treatments when compared with control treatment in the two seasons. In the first season, it was noticed that the tallest plants (36.65, 34.99, 34.71 and 34.00 cm) were resulted from BA at 150, 50, 100 ppm and B-9 at 500 ppm, respectively. While the shortest plants (28.95 cm) was produced from the control treatment. In the second season, the tallest plants (34.98, 34.38, 34.08 and 32.41 cm) were produced from BA at 100, 150, 50 ppm and B-9 at 1000 ppm, respectively, whereas the shortest plants (28.53 cm) was produced from control treatment. The different cuts as a general mean had a significant effect on plant height in the two seasons. In the first season the second cut gave the tallest plants (38.57 cm) then decreased to 37.99, 31.68 and 25.93 cm in the third, first and fourth cuts, respectively. In the second season the tallest plants (43.37 cm) was produced from the first cut then decreased to 33.64, 27.85 and 25.38 cm in the third, fourth and the

second cut, respectively. The interaction between the growth regulators treatments and the different cuts had a significant effect on increasing plant height in the two seasons. In the first season the highest value (41.59 cm) was produced from BA at 150 ppm in the second cut.

Table (1): Plant height (cm) of sweet marjoram (*Majorana hortensis*, Moench) as affected by growth regulators.

Growth regulators concentrations	First season (2005 -2007)					Second season (2006 -2008)				
	Cuts					Cuts				
	1st	2nd	3rd	4th	Mean	1st	2nd	3rd	4th	Mean
Control	25.88	33.77	33.40	22.74	**28.95**	38.42	21.00	29.89	24.80	**28.53**
BA 50ppm	33.96	38.22	40.39	27.37	**34.99**	43.79	25.93	36.54	30.04	**34.08**
BA 100ppm	34.00	39.51	38.45	26.86	**34.71**	46.38	27.88	37.42	28.22	**34.98**
BA150ppm	34.84	41.59	40.28	29.89	**36.65**	44.54	26.63	34.96	31.38	**34.38**
B-9 500ppm	32.71	40.22	38.24	24.82	**34.00**	42.63	25.17	33.15	27.31	**32.07**
B-9 1000ppm	30.13	37.64	37.54	24.10	**32.35**	43.88	26.08	32.46	27.23	**32.41**
B-9 2000ppm	30.25	39.07	37.63	25.72	**33.17**	43.92	24.96	31.09	25.99	**31.49**
Mean	**31.68**	**38.57**	**37.99**	**25.93**		**43.37**	**25.38**	**33.64**	**27.85**	
L.S.D at 0.05 for : Growth regulators treatments						= 1.60				=1.35
: Cuts						= 0.71				=1.34
: Interaction						= 3.21				=2.70

Also the tallest plants in the second season (46.38 cm) was resulted with BA at 100 ppm in the first cut. The control plants gave the shortest plants in all cuts as compared with different levels of growth regulators. These results were in agreement with those found by Abd El-Aziz (2002) on *Majorana hortensis.* He found that BA at 20 or 40 ppm resulted in an increase in plant height and the effect was greater at 20 ppm. Also Singh (2003) on *Calendula officinalis* , indicated that SADH (daminozide) at 1000 ppm enhanced growth parameters.

2- Fresh weight of herb(gm/plant):

The data in Table (2) showed that, spraying the plants with growth regulators had a significant effect on general mean of fresh weight of herb per plant as compared with control plants. The highest plant fresh weight (116.20 and 124.38 gm/plant) were obtained from BA treatment at 150 ppm in the first and second seasons, respectively, while the lowest values (89.50 and 104.45 gm/plant) were produced from the control plants in the first and second seasons, respectively. Concerning to general mean of cuts, it was clear that in the first season, the second cut was the most productive one which gave 126.64 gm/plant, while in the second season, the highest fresh weight of herb (172.14 gm/plant) was obtained from the fourth cut.

Table (2): Fresh weight of herb (gm/plant) of sweet marjoram (*Majorana hortensis*, Moench) as affected by growth regulators.

Growth regulators concentrations	First season (2005 -2007)					Second season (2006 -2008)				
	Cuts					Cuts				
	1st	2nd	3rd	4th	Mean	1st	2nd	3rd	4th	Mean
Control	110.80	115.20	86.08	45.92	**89.50**	59.85	82.95	120.00	155.00	**104.45**
BA 50ppm	113.10	119.40	105.80	59.94	**99.56**	60.14	96.75	130.40	157.60	**111.22**
BA 100ppm	129.00	104.10	86.88	47.87	**91.96**	66.46	89.17	142.50	179.00	**119.28**
BA150ppm	132.10	142.30	112.10	78.30	**116.20**	64.21	101.40	157.90	174.00	**124.38**
B-9 500ppm	126.50	129.90	82.80	47.61	**96.70**	64.25	89.96	131.80	179.10	**116.28**
B-9 1000ppm	111.70	134.00	91.43	42.44	**94.89**	66.88	93.38	126.80	169.90	**114.24**
B-9 2000ppm	127.70	141.60	98.99	52.87	**105.29**	72.00	86.88	127.90	190.40	**119.30**
Mean	**121.56**	**126.64**	**94.87**	**53.56**		**64.83**	**91.50**	**133.90**	**172.14**	
L.S.D at 0.05 for : Growth regulators treatments					=14.85					=12.41
: Cuts					= 9.47					=12.03
: Interaction					=29.70					=24.83

There were significant differences between general mean of different cuts in both seasons. The interaction between growth regulators and the cuts had a significant effect on fresh weight of herb, it was obvious that in the first season, the highest fresh weight of herb (142.30 gm/plant) was produced from BA at 150 ppm in the second cut, while in the second season, the highest value (190.40 gm/plant) was produced from B-9 at 2000 ppm in the fourth cut. In general all growth regulators increased the plant fresh weight in all cuts compared with the control in all cuts while the control treatment produced the lowest values in all cuts.

Similar results were found by Abd El-Aziz (2002) on *Majorana hortensis*, who found that BA at 20 or 40 ppm resulted in an increase in fresh weight per plant and per feddan and the effect was greater at 20 ppm. Also Koodziej (2005) on American ginseng, stated that daminozide (B-9) at the rate of 100-200 mg/L had a positive effect on growth of plants.

3- Dry weight of herb (gm/plant):

The data in Table (3) showed that using the different concentrations of growth regulators had a significant effect on plant dry weight of herb as a general mean of treatments. It was clear that, in the first season, the highest value of plant dry weight (32.99 gm/plant) was resulted in the plants that were sprayed with BA at 150 ppm, while in the second season, the highest value (36.95 gm/plant) was obtained from the plants were sprayed with BA at 100 ppm. The lowest values of dry weight of herb (23.72 and 29.62 gm/plant) were obtained from the control plants in the first and second seasons, respectively. Concerning to the general mean of cuts, in the first season, the plants produced the highest dry weight/plant in the third cut (37.25 gm/plant), while the lowest mean value (17.75 gm/plant) was observed in the plants of the fourth cut. The opposite was found in the second season, which the highest value (48.96 gm/plant) was produced from the fourth cut, whereas the lowest value (25.41 gm/plant) was resulted from the first cut.

Table (3): Dry weight of herb (gm/plant) of sweet marjoram (*Majorana hortensis,* Moench) as affected by growth regulators.

Growth regulators concentrations	First season (2005-2007)					Second season (2006 -2008)				
	Cuts					Cuts				
	1st	2nd	3rd	4th	Mean	1st	2nd	3rd	4th	Mean
Control	24.88	25.00	31.99	13.01	**23.72**	21.03	25.08	29.03	43.34	**29.62**
BA 50ppm	28.42	29.70	41.33	20.21	**29.92**	24.27	31.83	34.25	47.52	**34.47**
BA 100ppm	31.59	26.54	33.99	16.56	**27.17**	27.04	31.00	37.84	51.92	**36.95**
BA150ppm	32.13	32.43	41.78	25.60	**32.99**	25.96	32.67	39.29	49.11	**36.76**
B-9 500ppm	31.67	33.32	34.64	16.03	**28.92**	25.08	30.34	36.27	51.79	**35.87**
B-9 1000ppm	27.04	34.25	37.39	15.13	**28.45**	26.88	30.50	33.08	47.96	**34.61**
B-9 2000ppm	30.88	35.51	39.60	17.73	**30.93**	27.58	28.46	32.46	51.09	**34.90**
Mean	**29.52**	**30.96**	**37.25**	**17.75**		**25.41**	**29.98**	**34.60**	**48.96**	
L.S.D at 0.05 for : Growth regulators treatments						= 3.82				= 3.29
: Cuts						= 3.12				= 4.64
: Interaction						= 7.63				= 6.59

The interaction between growth regulators and the cuts had a significant effect on dry weight of herb. In the first season, the highest value of dry weight of herb (41.78 gm/plant) was obtained from BA at 150 ppm in the third cut, while in the second season the highest value (51.92 gm/plant) resulted with BA at 100 ppm in the fourth cut. In general the lowest values were produced from the control plants in all cuts as compared with growth treatments in all cuts.

These results were in harmony with those obtained by El-Sayed *et al.* (1989) on *Polianthus tuberosa* , they found that BA at 25 mg/L increased the dry weight of the leaves. Also Shedeed *et al.* (1990) on *Ocimum basilicum* they found that B-9 at 250 ppm increased fresh and dry weight of the plant.

4- Dry weight of leaves and flowering tops (gm/plant):

The data in Table (4) showed that growth regulators treatments had a significant effect on increasing the general mean of dry weight of leaves and flowering tops as compared with control plants. In the first season, the highest value (20.08 gm/plant) was resulted from BA at 150 ppm, whereas the lowest value (13.72 gm/plant) was obtained from control plants. In the second season, the highest value (23.42 gm/plant) was produced from B-9 at 500 ppm, while control plants produced the lowest value (18.00 gm/plant). Concerning to the general mean of the cuts, it was clear that in the first season, the highest value (22. 40 gm/plant) was obtained from the third cut followed by the second cut (17.04 gm/plant) then decreased to 16.57 and 12.84 in the first and fourth cuts, respectively. In the second season, the highest value (27.25 gm/plant) was produced from fourth cut while the lowest value (15.97 gm/plant) was obtained from the first cut.

The interaction between growth regulators and different cuts had a significant effect on dry weight of leaves and flowering tops. It was clear in the first season, that the highest value (26.17 gm/plant) was resulted in BA at 150 ppm in the third cut. Also in the second season the highest values (29.67 and 29.67 gm/plant) were produced from B-9 at 500 ppm in the fourth cut and at B-9 2000 in the fourth cut, respectively. Whereas the lowest values of dry weight of leaves and flowering tops were produced from the control

treatments in different cuts in the two seasons. In general all growth regulators treatments increased the dry weight of leaves and flowering tops as compared with the control treatment in different cuts.

Table (4): Dry weight of leaves and flowering tops (gm/plant) of sweet marjoram (*Majorana hortensis,* Moench) as affected by growth regulators.

Growth regulators concentrations	First season (2005-2007)					Second season (2006 -2008)				
	Cuts					Cuts				
	1st	2nd	3rd	4th	Mean	1st	2nd	3rd	4th	Mean
Control	13.03	14.04	18.00	9.80	**13.72**	12.00	18.01	20.00	22.00	**18.00**
BA 50ppm	16.10	18.20	24.44	14.55	**18.32**	15.20	22.97	22.11	25.83	**21.53**
BA 100ppm	18.07	15.81	20.70	11.77	**16.59**	16.88	23.00	24.63	27.58	**23.02**
BA150ppm	17.29	18.92	26.17	17.92	**20.08**	16.00	22.88	25.59	26.71	**22.80**
B-9 500ppm	17.78	19.65	19.84	11.39	**17.17**	16.59	22.63	24.78	29.67	**23.42**
B-9 1000ppm	15.81	16.21	24.78	11.33	**17.03**	17.67	22.29	22.92	29.32	**23.05**
B-9 2000ppm	17.92	16.48	22.90	13.11	**17.60**	17.42	21.59	23.13	29.67	**22.95**
Mean	**16.57**	**17.04**	**22.40**	**12.84**		**15.97**	**21.91**	**23.31**	**27.25**	
L.S.D at 0.05 for : Growth regulators treatments					= 2.17					= 2.02
: Cuts					= 1.43					= 3.07
: Interaction					= 4.34					= 4.04

These results were in accordance with those of Talaat and Youssef (1998) on *Borago officinalis*, they found that the highest growth, flowering were obtained in plants treated with BA at 20 mg/L. Also, Barbara *et al.* (2006) on American ginseng, found that daminozide (B-9) at 100 or 200 mg/L caused a significant increase in air dry weight of roots.

5- Dry weight of stems (gm/plant):

The data in Table (5) showed that, growth regulators treatments had a significant effect on general mean of dry weight of stems. In the first season, the highest plant dry weight of stems (13.33 gm/plant) was produced from the plants were sprayed with B-9 at 2000 ppm. Whereas in the second season the highest value (13.97 gm/plant) was produced from BA at 150 ppm. The lowest values (10.00 and 11.62 gm/plant) were produced from the control treatment in the first and second seasons, respectively. Concerning to general mean of different cuts, it was clear that in the first season, the highest plant dry weight of stems (14.86 gm/plant) was produced from the third cut, followed by second cut (13.92 gm/plant) then the first (12.95 gm/plant) and fourth cuts (4.42 gm/plant), while in the second season, the highest value (21.71 gm/plant) was produced from the fourth cut followed by the third cut (11.30 gm/plant) then the first cut (9.44 gm/plant) and the second cut (8.07 gm/plant).

The interaction between the growth regulators treatments and the cuts had a significant effect on plant dry weight of stems. In the first season, the highest plant dry weight of stems (19.02 gm/plant) was obtained from B-9 at 2000 ppm in the second cut whereas the lowest value (3.21 gm/plant) was obtained from control plants in the fourth cut.

On the other hand, in the second season the highest value (24.34 gm/plant) was produced from BA at 100 ppm in the fourth cut, while the

lowest value (6.87 gm/plant) was resulted in B-9 at 2000 ppm. in the second cut. In general growth regulators treatments increased the plant dry weight of stems when compared with the control treatment in all cuts.

Table (5): Dry weight of stems (herb without leaves gm/plant) of sweet marjoram (*Majorana hortensis,* Moench) as affected by growth regulators.

Growth regulators concentrations	First season (2005-2007)					Second season (2006-2008)				
	Cuts					Cuts				
	1st	2nd	3rd	4th	Mean	1st	2nd	3rd	4th	Mean
Control	11.85	10.96	13.99	3.21	**10.00**	9.03	7.07	9.03	21.34	**11.62**
BA 50ppm	12.32	11.50	16.89	5.66	**11.59**	9.07	8.86	12.14	21.69	**12.94**
BA 100ppm	13.52	10.73	13.42	4.79	**10.62**	10.17	8.00	13.21	24.34	**13.93**
BA150ppm	14.84	13.51	15.61	7.68	**12.91**	9.96	9.79	13.71	22.40	**13.97**
B-9 500ppm	13.89	13.67	14.80	4.64	**11.75**	8.50	7.71	11.49	22.12	**12.46**
B-9 1000ppm	11.24	18.04	12.62	3.81	**11.43**	9.21	8.21	10.16	18.64	**11.56**
B-9 2000ppm	12.96	19.02	16.70	4.62	**13.33**	10.16	6.87	9.33	21.42	**11.95**
Mean	**12.95**	**13.92**	**14.86**	**4.92**		**9.44**	**8.07**	**11.30**	**21.71**	
L.S.D at 0.05 for : Growth regulators treatments						= 2.43				= 1.40
: Cuts						= 2.25				= 1.77
: Interaction						= 4.86				= 2.80

These results were in agreement with those obtained by Abdalla *et al.* (1985) on *Adonis autumnalis,*they found that alar-85 [daminozide] at 250, 500, 1000 and 2000 ppm decreased plant height, but increased stem diameter, branches number and plant weight. Also, Pol *et al.* (2003) on ashwagandha plant, stated that BA at 10 ppm increased plant height, number of branches, root dry matter and total dry matter.

6-Total seasonal yield of dry weight of herb (gm/plant):

The data in Table (6) showed that growth regulators treatments had a significant effect on the total seasonal yield of dry weight of herb/plant in the first, second seasons and in combined over seasons.

It is clear that the total seasonal yield of dry weight of herb per plant in the second season was higher than in the first and in combined over seasons. In the first season, the heaviest total seasonal yield of dry weight of herb (131.94 gm/plant) was produced from BA at 150 ppm, followed by B-9 at 2000 ppm which gave (123.72 gm/plant) then decreased to 119.66, 115.66, 113.81 and 108.81 gm/plant with BA at 50 ppm, B-9 at 500, 1000 ppm and BA at 100 ppm, respectively. While the lightest total seasonal yield of dry weight of herb (94.88 gm/plant) was produced from control treatments. In the second season, the highest value (147.80 gm/plant) was obtained from BA at 100 ppm, followed by BA at 150 ppm which gave 147.03 gm/plant then decreased to 143.48, 139.59, 138.42 and 137.87 gm/plant with B-9 at 500, 2000, 1000 ppm and BA at 50 ppm, respectively. Whereas the lowest value (118.48 gm/plant) was noticed in control plants. The combined analysis showed that, the highest total seasonal yield of herb dry weight (139.49 gm/plant) was produced from BA at 150 ppm followed by B-9 at 2000 ppm which gave 131.66 gm/plant then decreased to 129.57, 128.77, 128.31 and 126.12 gm/plant with B-9 at 500 ppm, BA at 50, 100 ppm and B-9 at 1000

ppm, respectively. While the lowest value (106.68 gm/plant) was obtained from control treatment. In general all growth regulators treatments significantly increased total seasonal yield of dry weight of herb in the second season and in combined analysis over season as compared with the control treatment. As well as in the first season all growth regulators treatments increased the total seasonal yield of dry weight of herb as compared with control treatment.

These results pointed out the importance of growth regulators (BA or B-9) in increasing the total seasonal yield per plant. These results were in agreement with those obtained by Abd El-Aziz (2002) on *Majorana hortensis,* who found that BA at 20 or 40 ppm resulted in an increase in plant height, fresh and dry weight per plant and per feddan and the effect was greater at 20 ppm. also Barbara *et al.* (2006) on American ginseng found that B-9 [daminozide] at 100 or 200 mg/L caused a significant increase in air dry weight of roots and above ground parts and the increase in root size was observed at 200 mg/L.

Table (6): Total seasonal yield of dry weight of herb (gm/plant) of sweet marjoram (*Majorana hortensis,* Moench) as affected by growth regulators.

Growth regulators concentrations	First season (2005-2007)	Second season (2006-2008)	Combined means over seasons
Control	94.88	118.48	106.68
BA 50ppm	119.66	137.87	128.77
BA 100ppm	108.81	147.80	128.31
BA150ppm	131.94	147.03	139.49
B-9 500ppm	115.66	143.48	129.57
B-9 1000ppm	113.81	138.42	126.12
B-9 2000ppm	123.72	139.59	131.66
L.S.D at 0.05	**25.56**	**10.45**	**13.08**

7-Total seasonal yield of dry weight of leaves and flowering tops (gm/plant):

The data in Table (7) showed that, growth regulators treatments had a significant effect on the total seasonal yield of dry weight of leaves and flowering tops in the first, second seasons and in combined over seasons. It was clear that the total seasonal yield of dry weight of leaves and flowering tops per plant in the second season was higher than in the first and in combined over seasons. In the first season, the heaviest total seasonal yield of dry weight of leaves and flowering tops (80.30 gm/plant) was produced from BA at 150 ppm, followed by BA at 50 ppm which gave (73.29 gm/plant) then decreased to 70.41, 68.66, 68.13 and 66.35 gm/plant with B-9 at 2000, 500, 1000 ppm and BA at 100 ppm, respectively. Whereas the lowest value (54.87 gm/plant) was obtained from control plants. In the second season, the highest value (93.67 gm/plant) was produced from B-9 at 500 ppm, followed by B-9 at 1000 ppm which gave 92.20 gm/plant then decreased to 92.09, 91.81, 91.18 and 86.11 gm/plant with BA at 100 ppm, B-9 at 2000 ppm, BA at

150 and 50 ppm, respectively. Whereas the lowest value (72.01 gm/plant) was produced from the control treatment.

Concerning to the combined analysis it was clear that the highest total seasonal yield of leaves and flowering tops (85.74 gm/plant) was obtained from BA at 150 ppm followed by B-9 at 500 ppm which gave 81.17 gm/plant then decreased to 81.11, 80.17, 79.70 and 79.22 gm/plant with B-9 at 2000, 1000 ppm, BA at 50 and 100 ppm, respectively. Whereas the lowest value (63.44 gm/plant) was produced from the control treatment. In general all growth regulators treatments significantly increased total seasonal yield of dry weight of leaves and flowering tops in the second season and in combined analysis over season as compared with the control treatment. As well as in the first season all growth regulators treatments increased the total seasonal yield of dry weight of leaves and flowering tops as compared with control treatment. These results were in harmony with that found by El-Sharkawy (1981) who concluded that using B-9 solution at different concentrations tended to increase the mean fresh weight of marjoram plants compared with the control plants. El-Sayed *et al.* (1989) on *Polianthus tuberosa,* stated that BA at 25 mg/L increased dry weight of leaves. Also Barbara *et al.* (2006) on American ginseng found that B-9 [daminozide] at 100 or 200 mg/L caused a significant increase in air dry weight of roots and above ground parts and the increase in root size was observed at 200 mg/L.

Table (7): Total seasonal yield of dry weight of leaves and flowering tops (gm/plant) of sweet marjoram (*Majorana hortensis,* Moench) as affected by growth regulators.

Growth regulators concentrations	First season (2005-2007)	Second season (2006-2008)	Combined means over seasons
Control	54.87	72.01	63.44
BA 50ppm	73.29	86.11	79.70
BA 100ppm	66.35	92.09	79.22
BA150ppm	80.30	91.18	85.74
B-9 500ppm	68.66	93.67	81.17
B-9 1000ppm	68.13	92.20	80.17
B-9 2000ppm	70.41	91.81	81.11
L.S.D at 0.05	**14.31**	**6.73**	**7.49**

REFERENCES

Abdalla, N.M.; S. El-Gengaihi; I. Sadrak (1986): A study on the influence of Cycocel and Alar on growth, flowering and active ingredients of *Calendula officinalis,* L. Acta Agronomica-Hungarica; 35(1/2):41-45.

Abdalla, N.M.; S.E. El-Gengaihi; T. Solomos and A.A. Badawy (1985): The effects of kinetin and Alar-85 application on the growth and flowering of *Adonis autumnalis* L. Proceedings,- twelfth-annual-meeting-Plant-Growth-Regulator-Society-of-America-Boulder,- Colorado; 249-255.

Abd El-Aziz, N.G. (2002): Effect of some growth regulators on *Majorana hortensis,* Moench plant. Ph.D. Thesis, Fac. Agric., Cairo Univ., Egypt.

Agamy, R.A. (2005): Botanical Studies on roselle plants (*Hibiscus sabdariffa* L.) as affected by benzyladenine and/or decapitation. Annals of Agric. Sci., Moshtohor; 43(2):611-626.

Barbara, K.; K. Ewa; K. Jerzy and C. Aleksander (2006): The effect of growth regulators on quality parameters and ginsenosides accumulation in *Panax quinquefolium* L. roots. Plant-Growth-Regulation; 48(1):13.19.

Eid, M.N. and I.S. Rofaeel (1980): Effect of B-9 and CCC on the growth and essential oil of geranium (*Pelargonium graveolens,* L.) Research. Bulletin, Fac. of Agric., Ain Shams Univ., (1238):15pp.

El-Sayed, A.A.; M.A. Salem and E.I. El-Maadawy (1989): Effect of gibberellic acid (GA_3) and benzyladenine (BA) on *Polianthus tuberosa,* L. J. Agric. Res. Tanta Univ., 15(2):301-311.

El-Sharkawy, F.A.A. (1981): Effect of some hormonal and agricultural treatments on the oil yield and chemical constituents of marjoram plants (*Majorana hortensis,* Moench). Ph. D. Thesis, Fac. Agric., Ain Shams Univ. Egypt.

Figueiredo, R.O.; M.E.A. Delachiave and L.C. Ming (2006): Growth regulators in biomass production and essential oil in *Cymbopogon citratus* (DC.), Stapf, in different seasons. Revista, Brasileira de Plantas Medicinais; 8(3):31-35.

Freed, R.S.; P. Einensmith; S. Gutez; D. Reicosky; V.W. Smail and P. Wolberg (1989): User's Guide to MSTAT-C Analysis of Agronomic Research Experiments Michigan State Univ. East Lansing. USA.

Koodziej, B. (2005): The effect of foliar application of growth regulators on American ginseng (*Panax quinquefolium,* L.) Herba-Polonica., 51(3/4):13-19.

Lawless, Julia (1992): The Encyclopaedia of Essential Oils. Element Book Ltd. Longmead, Shaflesbury, Dorset. U.K.

Meawad, A.A.; A.E. Awad and A.Afify (1984): The combined effect of N. fertilization and some growth regulators on chamomile plants. Acta. Hort., (144): 123-134.

Menesi, Fardous, A.; E.M.S. Nofal and E.M. El-Mahrouk (1991): Effect of some growth regulators on *Calendula officinalis,* L. Egypt. J. Appl. Sci., 6(2):1-15.

Mohandass, S. and V. Sampath (1985): Studies on the regulation of growth and yield in geranium with some hormonal sprays. South, Indian Hort., 33(5):344-346.

Mousa, G.T.; I.H. El-Sallami and E.F. Ali (2001): Response of *Nigella sativa,* L. to foliar application of gibberellic acid, benzyladenine, iron and zinc. Assiut. J. of Agric., Sci., 32(2):141-156.

Pol, K.M.; D.G. Mukhekar and V.R. Awari (2003): Physiological studies on influence of foliar spray of growth hormones and micronutrients on growth and yield of ashwagandha plant. Annals of Plant Physiology,17(1):45-49.

Shedeed, M.R.; K.M. El-Gamassy; M.E. Hashim and A.M. Kandeel (1990): Physiological studies on the growth, oil yield and chemical constituents in basil plants (*Ocimum basilicum,* L.). Annals of Agric. Sci. Cairo, 35(2):971-979.

Singh, A.K. (2003): Effect of SADH and PP333 on growth and flowering attributes in *Calendula officinalis.* Journal of Medicinal and Aromatic Plant Sc., 25(2):424-426.

Steel, R.G.D.; J. H. Torrie and D.A. Dickey (1997): Principles and Procedures of Statistics: Abiometrical approach. 3rd ed. Mc. Graw-Hill, New York.

Suparna, M.R.; A.A. Farooqi and K.T. Subbaiah (1993): Influence of CCC, Cytozyme and Alar Sprays on vegetative growth and tuber yields in *Gloriosa superba,* L. Indian Journal of Forestry, 16(1):54-57.

Talaat, I.M. and A.A. Youssef (1998): Effect of kinetin and benzyladenine on the growth and chemical constituents of *Borago officinalis*, L. plants. Annals of Agric. Sci. Moshtohor. 36(2):827-837.

Youssef, A.A. (2004): Influence of foliar spray with brassinosteroid and benzyladenine on the growth, yield and chemical composition of *Pelargonium graveolens,* L. plants. Annals of Agric. Sci., Cairo 49(1):313-326.

تـأثير الـرش الـورقي بالبنزايـل أدينـين (BA) و الآلار (9 - B) علـى النمـو و المحصول في نبات البردقوش

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هذه التجربة نفذت في محطة التجارب الزراعية - كلية الزراعة – جامعة القاهرة – جيزة و ذلك خلال موسمين متتاليين ٢٠٠٥- ٢٠٠٧ و ٢٠٠٦- ٢٠٠٨ بغرض دراسة تأثير الرش الورقي بالبنزايل آدينين و ب-٩ على النمو و المحصول في نبات البردقوش. النباتات رشت بالبنزايل آدينين بمعدلات ٥٠، ١٠٠، و ١٥٠ جزء في المليون بينما رشت النباتات بالـ ب-٩ بمعدلات ٥٠٠، ١٠٠٠ و ٢٠٠٠ جزء في المليون بالاضافة الى معاملة الكنترول التي رشت بالماء المقطر. و النتائج المتحصل عليها يمكن تلخيصها فيما يلي:

جميع تركيزات البنزايل آدينين أو ب-٩ أدت الى زيادة جميع الصفات المسجلة بالمقارنة بمعاملة الكنترول مع وجود اختلافات معنوية في معظم الحالات في كلا الموسمين.

ففي الموسم الأول أعلى القيم بالنسبة لارتفاع النبات و الوزن الطازج للعشب و الوزن الجاف للعشب و الوزن الجاف للأوراق و القمم الزهرية و المحصول الموسمي الكلي من الوزن الجاف للعشب و المحصول الموسمي الكلي من الوزن الجاف للأوراق و القمم الزهرية تم الحصول عليه باستعمال البنزايل آدينين بمعدل ١٥٠ جزء في المليون بينما أعلى وزن جاف للسيقان تم الحصول عليه باستخدام ب-٩ بمعدل ٢٠٠٠ جزء في المليون. أقل القيم من جميع الصفات المسجلة نتجت من معاملة الكنترول. و في الموسم الثاني وجد أن أعلى القيم بالنسبة لارتفاع النبات و الوزن الجاف للعشب و المحصول الموسمي الكلي من الوزن الجاف للعشب تم الحصول عليه من استعمال البنزايل أدينين بمعدل ١٠٠ جزء في المليون في حين أن أعلى القيم بالنسبة للوزن الطازج للعشب و الوزن الجاف للسيقان نتج من استعمال البنزايل أدينين بمعدل ١٥٠ جزء في المليون. أيضاً أعلى القيم من الوزن الجاف للأوراق و القمم الزهرية و المحصول الموسمي الكلي من الوزن الجاف للأوراق و القمم الزهرية نتجت من استعمال ب-٩ بمعدل ٥٠٠ جزء في المليون. عموماً في تحليل الـ combined وجد أن استعمال بنزايل آدينين بمعدل ١٥٠ جزء في المليون كان أكثر المعاملات تأثيراً في زيادة المحصول الموسمي الكلي من الوزن الجاف للعشب و المحصول الموسمي الكلي من الوزن الجاف للأوراق و القمم الزهرية. كان للحشات المختلفة كمتوسط عام تأثير معنوي على جميع الصفات المسجلة في كلا الموسمين. ففي الموسم الأول أعلى القيم من ارتفاع النبات و الوزن الطازج للعشب نتج من الحشة الثانية. أيضاً أعلى القيم من الوزن الجاف للعشب و الوزن الجاف للأوراق و القمم الزهرية و الوزن الجاف للسيقان نتج من الحشة الثالثة. و في الموسم الثاني كانت أعلى القيم من الوزن الطازج للعشب و الوزن الجاف للعشب و الوزن الجاف للأوراق و القمم الزهرية و الوزن الجاف للسيقان تم الحصول عليه من الحشة الرابعة بينما أعلى قيمة من ارتفاع النبات نتجت من الحشة الأولى. التداخل بين منظمات النمو (البنزايل آدينين أو ب-٩) مع الحشات ادى الى زيادة جميع الصفات المسجلة بالمقارنة بمعاملة الكنترول في أي حشة مع وجود اختلافات معنوية في معظم الحالات في كلا الموسمين.