Results and Discussion

4. RESULTS AND DISCUSSION

4.1. The first Experiment: Effect of gamma radiation on seed germination, growth, flowering, seeds production and chemical constituents of *Delphinium ajacis* and *Mathiola incana* plants.

4.1.1. Germination:

Concerning the effect of gamma radiation on the germination percentage and rate of delphinium and mathiola seeds, data in Tables (I & 2) and Figure (1) show that gamma rays irradiation at doses of 25, 50 and 75 gray significantly increased the two parameters in the two seasons comparing with the control. The maximum increase was achieved at the dose of 25 gray in both plants. Whereas, the dose of 100 gray caused a significant decrease in germination percentage and had no effect on germination rate of the two plants in the two seasons. Delphinium plant responsed to gamma irradiation treatments more than mathiola plant where germination percentage of delphinium was higher specially at low doses (25, 50 and 75 gray). The highest germination percentage and rate were obtained with gamma rays at 25 gray.

These results agreed with those obtained by Chandra and Tarar (1988) and Zaharia *et al*., (1991).

Table (1): Effect of gamma radiation on seed germination of *Delphinium ajacis* plant during the two successive seasons of 1998/1999 and 1999/2000

Gamma rays (Gy)	Germination percentage		Germination rate (day)	
	First season	Second season.	First season	Second season.
0	61.3	62.7	0.356	0.354
25	83.3	82.7	0.374	0.373
50	79.3	79.3	0.369	0.368
75	77.3	77.3	0.362	0.363
100	44.0	44.0	0.357	0.354
L.S.D. 5 %	1.8	1.9	0.004	0.003

Table (2): Effect of gamma radiation on seed germination of *Mathiola incana* plant during the two successive seasons of 1998/1999 and 1999/2000

Gamma rays (Gy)	Germination percentage		Germination rate (day)	
	First season	Second season.	First season	Second season.
0	68.7	69.3	0.442	0.439
25	74.0	76.7	0.452	0.454
50	72.0	73.3	0.451	0.448
75	71.3	72.7	0.451	0.444
100	62.7	66.0	0.440	0.439
L.S.D. 5 %	2.3	2.5	0.005	0.003

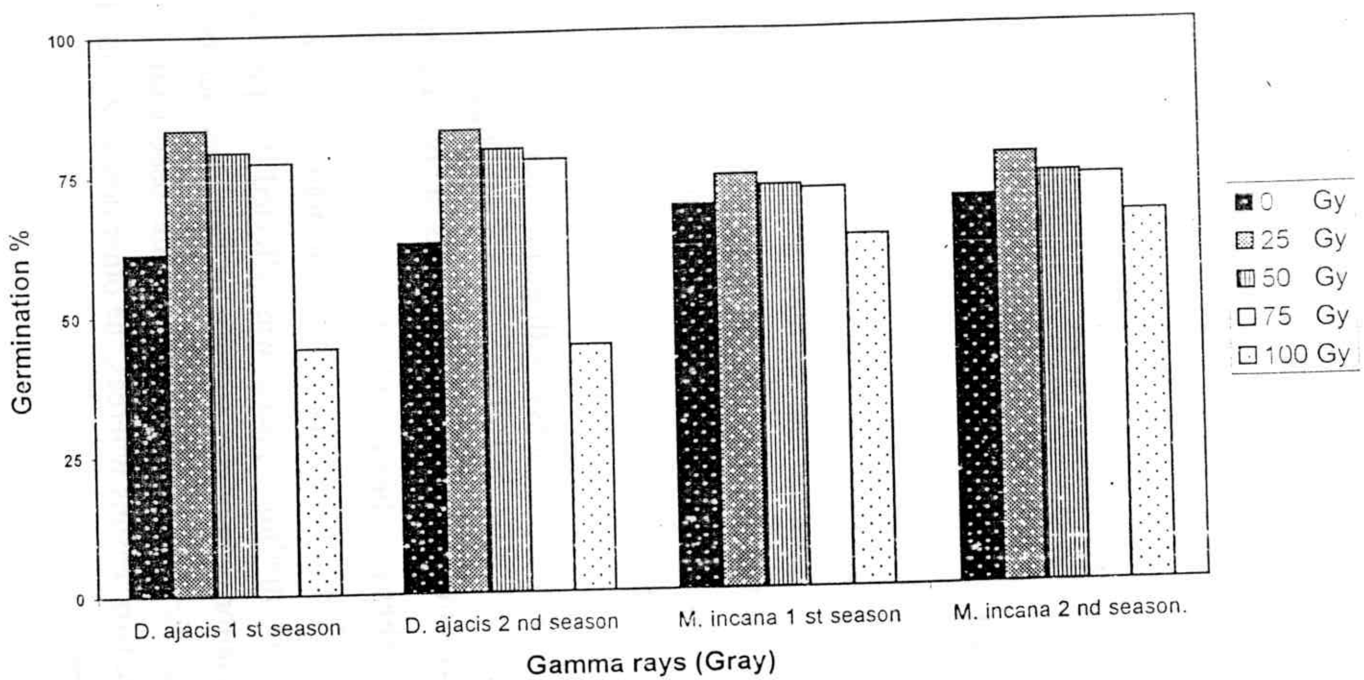

Fig. (1): Effect of gamma radiation on seed germination percentage of *Delphinium ajacis* and *Mathiola incana* plants.

Generally, the increase in germination percentage and stimulating germination rate may be due to radiation action on enhancing the hydrolysis of the complex compounds (carbohydrates, fats, proteins.... etc) in seeds to simple compounds (sugars, fatty acids, amino acids...etc). This could happen directly or indirectly by affecting the enzymatic reactions in seeds **(El-Esawy, 1995).**

4.1.2. Growth:

4.1.2.1. Plant height:

With respect to the effect of gamma radiation on growth, plant height of delphinium and mathiola plants was significantly increased by most doses of gamma irradiation as shown in Table (3, a) and Figure (2). The doses of 25 and 50 gray significantly increased plant height of delphinium plant while the doses of 25, 50 and 75 gray caused the same effect on mathiola plant. The tallest plant height was obtained with gamma rays at dose of 25 gray. Whereas, the dose of 100 gray gave a significant decrease comparing with the control of the two plants in both seasons.

4.1.2.2. Branches number per plant:

Data in Table (3, a) also show that branches number of delphinium and mathiola plants was affected by pre-sowing gamma irradiation where the average of branches number per plant was significantly increased only by the used gamma dose 25 gray in the two seasons whereas, the other doses had no effect in this concern.

Table (3, a): Effect of gamma radiation on the vegetative growth of *Delphinium ajacis* and *Mathiola incana* plants during the two successive seasons of 1998/1999 and 1999/2000

	Gamma rays (Gy)	Plant height (cm)		Branches number/plant		Stem diameter (mm)/plant	
		First season	Second season.	First season	Second season.	First season	Second season.
Delphinium ajacis	0	87.50	89.25	19.53	20.00	11.00	11.50
	25	94.50	94.75	20.93	21.50	12.38	12.50
	50	90.25	91.75	19.88	20.25	11.48	12.00
	75	89.75	91.50	19.23	20.00	11.33	12.00
	100	84.00	86.75	19.10	19.50	10.63	11.25
	L.S.D. 5%	2.26	2.27	0.44	0.66	0.55	0.60
Mathiola incana	0	58.00	58.35	17.90	18.00	11.00	11.00
	25	64.75	62.25	19.83	19.00	11.50	11.63
	50	60.75	60.00	18.58	18.50	11.23	11.38
	75	60.25	59.75	17.90	18.00	11.00	11.13
	100	56.25	55.00	17.58	17.50	7.63	7.63
	L.S.D. 5%	1.54	1.39	0.75	0.89	1.05	1.01

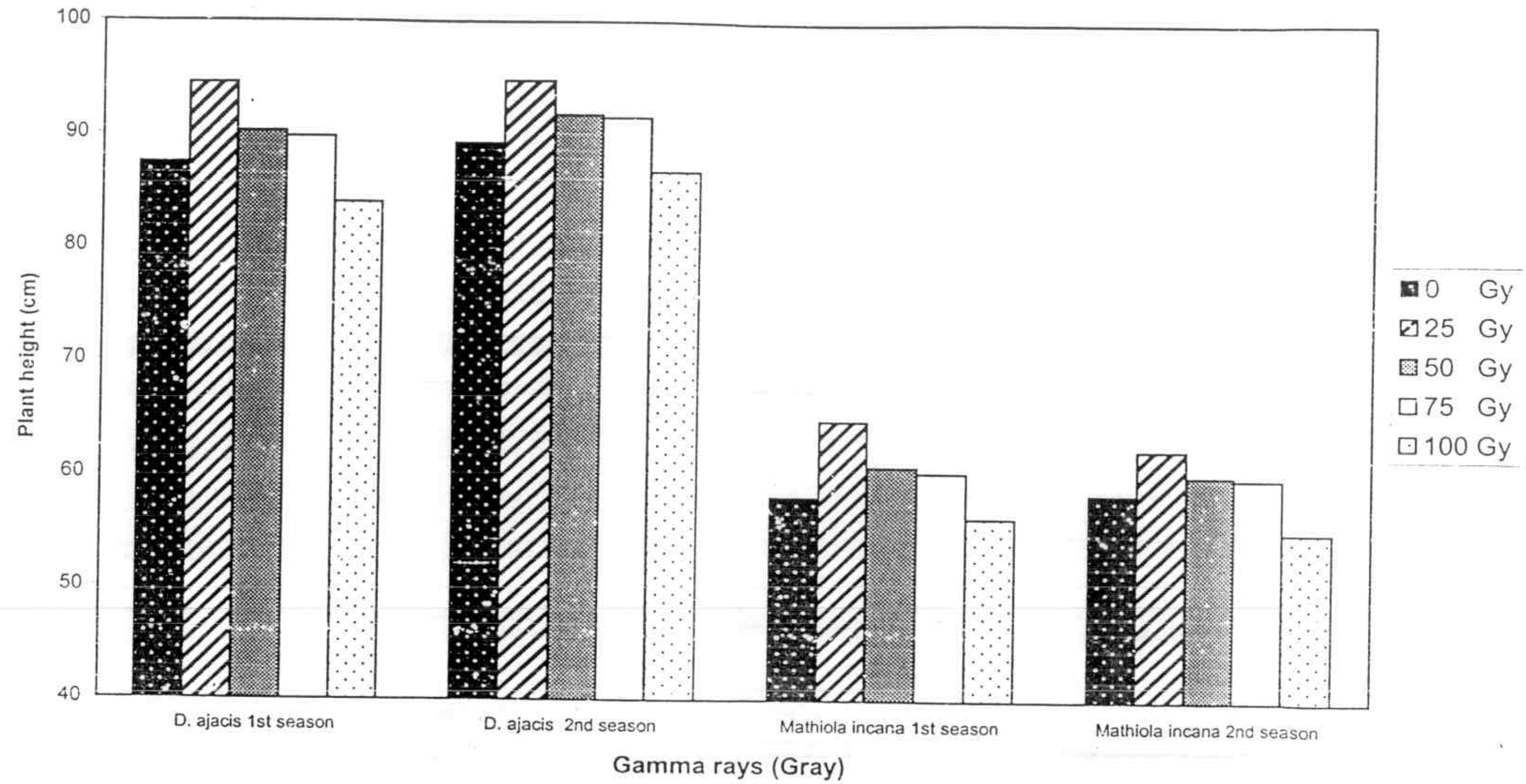

Fig.(2): Effect of gamma radiation on plant height of *Delphinium ajacis* and *Mathiola incana* plants

4.1.2.3. Stem diameter:

Data in Table (3, a) also revealed that gamma radiation had some effects on stem diameter, which varied in delphinium and mathiola plants. Concerning delphinium plant, treatment of 25 gray was the only significant effective dose, which significantly increased stem diameter comparing with the control of the first and second seasons. For mathiola plants, stem diameter was significantly decreased by the dose of 100 gray of gamma rays comparing to the control of both seasons whereas, the other doses had no significant effect.

4.1.2.4. Leaves fresh weight:

Concerning the effect of gamma radiation on leaves fresh weight, data in Table (3, b) show that doses of 25, 50 and 75 gray significantly increased this parameter in delphinium plant whereas, the dose of 100 gray significantly decreased it in the two seasons. With mathiola plant, only doses of 25 and 50 gray significantly increased leaves fresh weight whereas, 100 gray decreased it. The highest increment was observed with 25 gray in both seasons with delphinium and mathiola plants.

4.1.2.5. Leaves dry weight:

Leaves dry weight of the two plants nearly took the same trend of leaves fresh weight. In this concern data in Table (3, b) show that doses of 25 and 50 gray significantly increased this parameter in the two plants. Whereas, the dose of 100 gray significantly decreased leaves dry weight of the two plants except for the second season of mathiola plant which was not significant.

Table (3, b): Effect of gamma radiation on the vegetative growth of *Delphinium ajacis* and *Mathiola incana* plants during the two successive seasons of 1998/1999 and 1999/2000

	Gamma rays (Gy)	Leaves fresh weight (g)/plant		Leaves dry weight (g)/plant		V.G. fresh weight (g)		V.G.dry weight (g)		Root fresh weight (g)/plant		Root dry weight (g)/plant	
		First season	Second season.	First season	Second season.	First season	Second season.	First season	Second season.	First season	Second season.	First season	Second season.
Delphinium ajacis	0	47.11	47.24	6.12	6.24	100.93	100.16	15.99	16.02	31.64	30.75	5.70	5.54
	25	51.70	51.85	6.88	6.81	109.13	109.95	17.37	17.49	33.96	34.36	6.11	6.19
	50	50.50	49.88	6.74	6.48	106.93	105.88	17.04	16.88	32.73	31.81	5.77	5.60
	75	48.58	49.73	6.36	6.42	103.13	105.55	16.47	16.83	32.44	31.81	5.71	5.55
	100	41.98	43.63	5.30	5.94	98.30	98.38	15.76	15.82	31.04	30.25	5.52	5.39
	L.S.D. 5%	1.29	1.50	0.25	0.22	1.70	1.69	0.33	0.31	0.62	0.70	0.11	0.12
Mathiola incana	0	87.26	90.72	12.20	12.68	115.12	119.70	18.27	18.95	42.90	42.91	8.15	8.15
	25	91.58	94.85	13.09	13.37	120.83	125.15	19.13	19.77	52.90	53.16	10.05	10.06
	50	89.49	94.15	12.79	13.21	118.33	124.23	18.75	19.64	47.20	47.74	9.10	9.07
	75	88.02	91.45	12.21	12.86	116.13	121.12	18.64	19.27	43.70	43.74	8.78	8.79
	100	86.37	89.77	11.69	12.37	113.16	117.12	18.00	18.77	42.75	42.74	8.12	8.12
	L.S.D. 5%	1.27	1.13	0.34	0.37	1.80	1.49	0.30	0.23	1.28	1.19	0.51	0.57

V.G. =Vegetative growth

4.1.2.6. Vegetative growth fresh weight:

Data in Table (3, b) and Figure (3) show that vegetative growth fresh weight was influenced by gamma rays irradiation. Vegetative growth fresh weight of delphinium plants was significantly increased by the doses of 25, 50 and 75 gray whereas vegetative growth fresh weight of mathiola plants were significantly increased by the doses of 25 and 50 gray. Inversely, the dose of 100 gray significantly decreased vegetative growth fresh weight of the two plants in both seasons.

4.1.2.7. Vegetative growth dry weight:

Vegetative growth dry weight was also influenced by gamma irradiation, which was estimated as a real index of plant growth. This parameter took nearly the same trend as the previous one. Data in Table (3, b) show that vegetative growth dry weight of delphinium and mathiola plants were significantly increased by the doses of 25, 50 and 75 gray comparing to the control in both seasons. This increase was declined as the dose increased.

4.1.2.8. Root fresh weight:

With respect to root fresh weight, data in Table (3, b) clearly show that 25, 50 and 75 gray gamma rays doses increased root fresh weight of delphinium plant whereas the doses of 25 and 50 gray increased root fresh weight of mathiola plant comparing to the control in both seasons. This increase was highly significant.

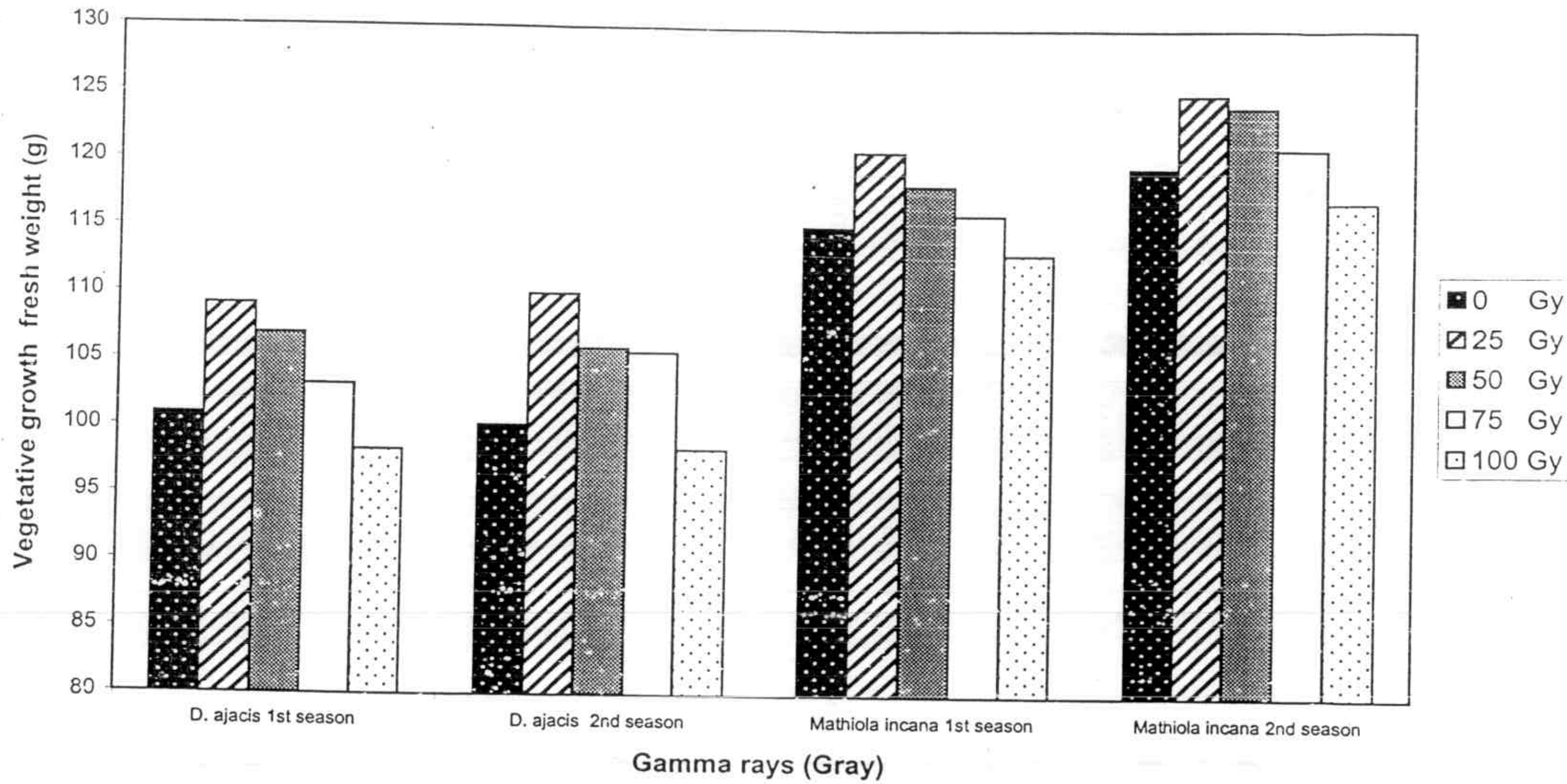

Fig.(3): Effect of gamma on vegetative growth fresh weight of *Delphinium ajacis* and *Mathiola incana* plants.

4.1.2.9. Root dry weight:

Root dry weight/plant was markedly influenced by gamma rays especially with mathiola plant. Data in Table (3, b) show that the dose of 25 gray caused the only significant increase in root dry weight of delphinium plant comparing to the control in the two seasons whereas, 100 gray significantly decreased it in the two seasons. For mathiola plant, the doses of 25, 50 and 75 gray significantly increased root dry weight comparing to the control in both season.

These results of growth parameters were in agreement with those obtained by Nikolova and Vasileva (1979) and Venkatachalam and Jayabalan (1997) on *Zinnia elegans*, Shalaby and Razin (1989) and El-Sherbeny *et al*., (1997) on *Hibiscus sabdariffa,* Hussein *et al.,* (1995) on *Datura metel* Zheljazkov *et al.,*(1996) on *Mentha arvensis,* Youssef and Moussa (1998) on chamomile and Youssef *et al.,* (2000) on geranium.

The stimulative effect of the low doses of gamma rays irradiation on growth, may be due to the increase of cell length or cell number and size, shifting in metabolism which promoted the stimulating effect of photohormones on biosynthesis of nucleic acids (Pitirmovae, 1979).

4.1.3. Flowering:

4.1.3.1. Flowering date:

The period from sowing till flowering of delphinium and mathiola plants was markedly affected by pre-sowing gamma irradiation during the two seasons of study (Table, 4, a) and

Table (4, a): Effect of gamma radiation on the flowering of *Delphinium ajacis* and *Mathiola incana* plants during the two successive seasons of 1998/1999 and 1999/2000

	Gamma rays (Gy)	Flowering date (days)		Inflorescence No./ plant		Inflorescence length (cm)/plant		Flowering portion length (cm)/inflo.	
		First season	Second season.	First season	Second season.	First season	Second season.	First season	Second season.
Delphinium ajacis	0	120.0	119.3	19.3	20.0	44.95	45.00	20.25	21.25
	25	115.0	114.0	21.0	21.3	46.95	48.75	23.00	24.00
	50	117.0	116.0	19.8	20.5	45.58	46.00	22.00	23.00
	75	119.0	119.0	19.5	20.3	45.5	45.50	20.25	22.00
	100	121.0	120.0	18.3	19.0	43.73	43.50	18.50	19.50
	L.S.D. 5%	1.05	1.03	1.13	1.30	1.261	1.320	1.099	1.258
Mathiola incana	0	105.5	106.0	17.5	17.8	31.13	31.50	12.98	13.75
	25	99.0	99.3	19.5	19.0	33.50	34.50	14.80	16.00
	50	102.0	101.5	18.3	18.3	32.53	33.40	14.00	15.25
	75	104.0	103.0	17.5	18.0	31.80	32.50	13.50	14.50
	100	106.0	106.8	17.0	16.6	29.15	29.50	12.50	13.50
	L.S.D. 5%	1.13	1.25	0.99	1.00	1.306	1.285	1.128	1.116

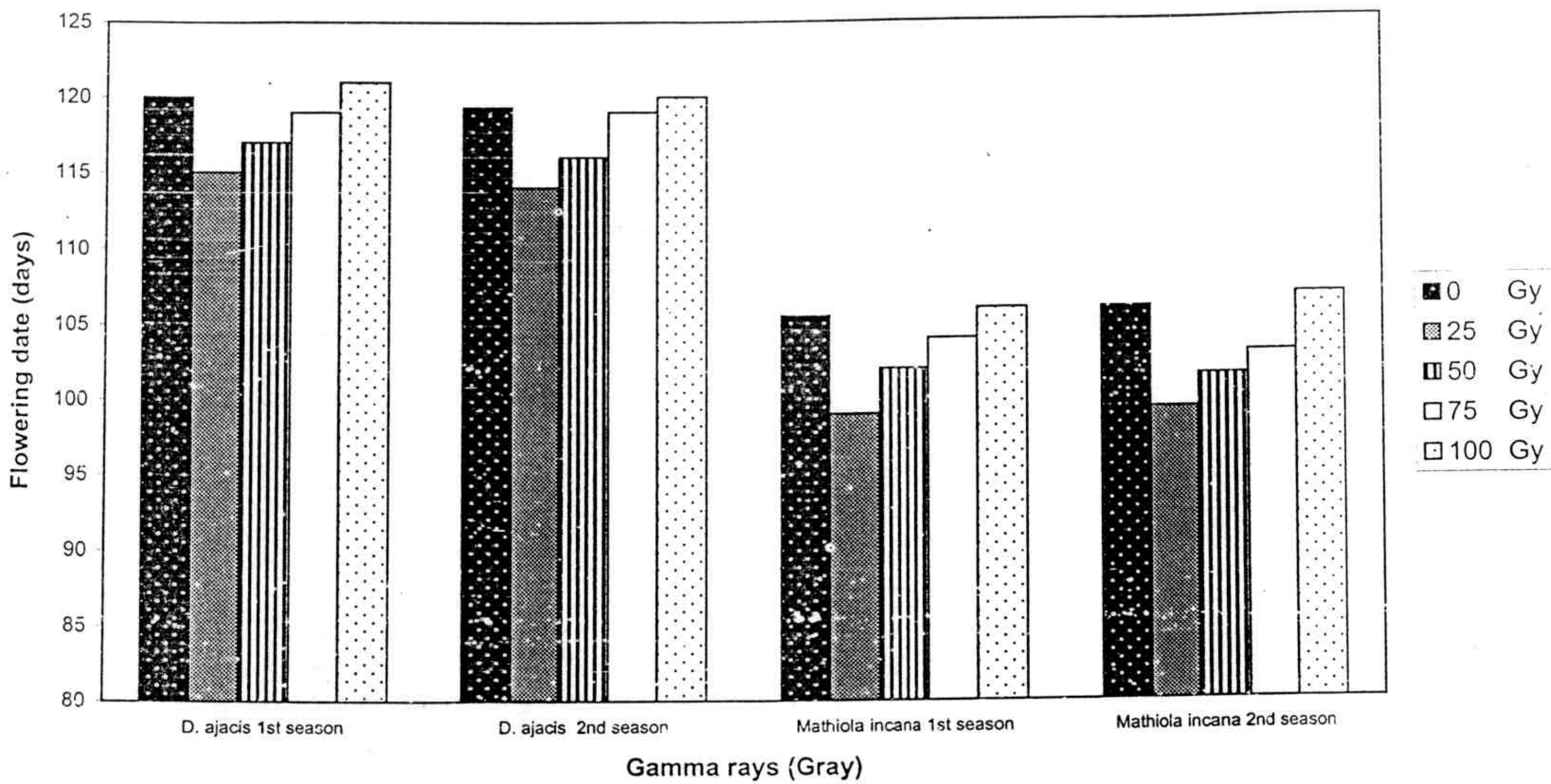

Fig. (4): Effect of gamma radiation on flowering date of ***Delphinium ajacis*** and ***Mathiola incana*** plants

Figure (4). In this regard, the doses of 25 and 50 gray significantly decreased the average of flowering period of delphinium plant comparing to control in both seasons. Whereas, in mathiola plant the doses of 25, 50 and 75 gray significantly decreased the average of period to flowering, comparing to the control in both seasons.

4.1.3.2. Inflorescence number:

Inflorescence number per plant was little affected by pre-sowing gamma irradiation as shown from data in Table (4, a). The dose of 25 gray significantly increased the inflorescence number of the two genera in the first and second seasons.

4.1.3.3. Inflorescence length:

Data in Table (4, a) clearly show that inflorescence length was significantly increased by the dose of 25 gray in delphinium plant and 25 and 50 gray in mathiola plant for the two seasons. On the other hand, the dose of 100 gray of gamma rays irradiation significantly decreased inflorescence length of mathiola plant in both seasons.

4.1.3.4. Flowering portion length:

Data in Table (4, a) and Figure (5) clearly show that flowering portion length per inflorescence of the two plants was significantly increased by the doses of 25 and 50 gray in the first and second except for the dose of 50 gray in the first season of mathiola plant, which was not significant. Inversely, the dose of 100 gray significantly decreased flowering portion length of delphinium plant in both seasons.

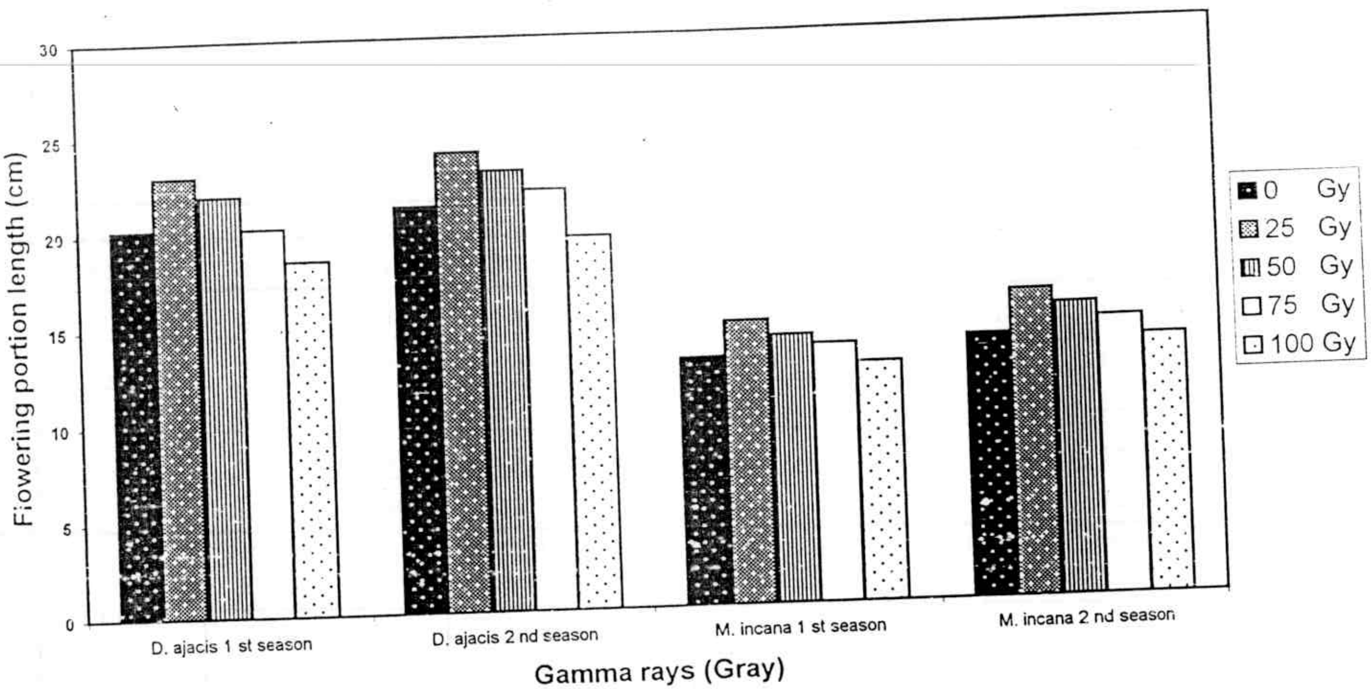

Fig. (5): Effect of gamma radiation on flowering portion length of *Delphinium ajacis* and *Mathiola incana* plants.

Table (4, b): Effect of gamma radiation on the flowering of *Delphinium ajacis* and *Mathiola incana* plants during the two successive seasons of 1998/1999 and 1999/2000

	Gamma rays (Gy)	Flowering portion weight (g)/ inflo.		Florets number /inflorescence		Florets weight (g) /inflorescence		Vas life (days)	
		First season	Second season.	First season	Second season.	First season	Second season.	First season	Second season.
Delphinium ajacis	0	5.46	5.56	6.9	7.3	2.50	2.59	13.6	13.4
	25	6.10	6.03	7.8	8.2	2.74	2.83	14.9	14.6
	50	5.55	5.65	7.5	7.8	2.65	2.73	14.7	14.3
	75	5.50	5.58	7.0	7.5	2.50	2.65	14.4	14.0
	100	5.37	5.45	6.4	6.7	2.35	2.44	13.4	13.3
	L.S.D. 5%	0.15	0.17	0.4	0.4	0.10	0.12	0.6	0.5
Mathiola incana	0	18.53	18.25	10.1	10.7	12.99	13.81	16.0	15.5
	25	19.44	19.13	11.2	12.0	14.63	15.62	17.0	16.3
	50	19.30	19.00	11.1	11.7	14.38	15.33	16.0	16.0
	75	18.78	18.50	10.5	11.3	13.53	14.50	16.0	15.5
	100	18.25	18.00	9.7	10.5	12.40	13.50	15.8	15.0
	L.S.D. 5%	0.58	0.55	0.9	0.9	1.30	1.25	0.7	0.7

4.1.3.5. Flowering portion weight:

Data in Table (4, b) clearly show that the dose of 25 gray significantly increased flowering portion weight per inflorescence of delphinium comparing to the control in both seasons. Whereas, with mathiola plants, the doses of 25 and 50 gray significantly increased it comparing with control plants in both seasons.

4.1.3.6. Florets number:

Florets number per inflorescence was affected by gamma rays irradiation. In this concern, data in Table (4, b) show that doses of 25 and 50 gray significantly increased it in both seasons of the two plants. The dose of 25 gray caused higher increase than 50 gray comparing to the control. There was a decrease at 100 gray which was significant in delphinium plant and was non significant in mathiola plant during the two seasons of this study.

4.1.3.7. Florets weight:

Concerning the fresh weight of florets weight per inflorescence, data in Table (4, b) show that radiation doses at 25 and 50 gray significantly increased it in the first and second seasons in both plants. This increase was greater at 25 than any other doses. Inversely, the dose of 100 gray decreased it in the two plants under this study, where this decrease was significant in delphinium plant.

4.1.3.8. Vase life:

With respect to the effect of radiation on flower vase life, data in Table (4, b) show that there was a slight effect in this concern. Despite that, there was a significant increase with the doses of 25, 50 and 75 gray in the two seasons of delphinium plant whereas with mathiola plant using the dose of 25 gray only had a significantly increase flower vase life in both seasons..

These results of flowering parameters agreed with those obtained by Nikolova and Vasileva (1979) on Zinnia, El-Bahr (1980), Shaeb (1993) and El-Esawy (1995) on gladiolus, Stepanenko and Regir (1982) on *Calendula officinalis*, El-Shafie *et al.,* (1987) on carnation, Datta and Banerji (1993) on chrysanthemum, De *et al.*, (1997) on rose and Venkatachalam and Jayabalan (1997) on *Zinnia elegans*.

The stimulative effect of low doses of gamma rays irradiation on growth, may be due to the increase of cell length or cell number and size, shifting in metabolism which promoted the stimulating effect of photohormones on biosynthesis of nucleic acids (Pitirmovae, 1979).

4.1.4. Seed yield:

4.1.4.1. Seed yield per plant:

Data in Table (5,a) show that the average of seed yield of delphinium plant was significantly increased by the dose of 25 gray whereas, with mathiola plant, seed yield was significantly increased by the doses of 25 and 50 gray compared to the control in both seasons. On the contrary, seed yield of the two plants was significantly decreased by the dose of 100 gray in both seasons except for the second season of mathiola plant, which was not significant.

Table (5,a): Effect of gamma radiation on seed yield (g/plant) of *Delphinium ajacis* and *Mathiola incana* plants during the two successive seasons of 1998/1999 and 1999/2000

Gamma rays (Gy)	*Delphinium ajacis*		*Mathiola incana*	
	First season	Second season.	First season	Second season.
0	3.93	3.92	4.80	5.93
25	4.15	4.76	5.20	6.74
50	4.05	3.98	5.00	6.73
75	4.00	3.93	4.85	6.00
100	3.55	3.80	4.50	5.92
L.S.D. 5 %	0.14	0.12	0.17	0.15

Table (5,b): Effect of gamma radiation on seed yield (kg/fedden) of *Delphinium ajacis* and *Mathiola incana* plants during the two successive seasons of 1998/1999 and 1999/2000

Gamma rays (Gy)	*Delphinium ajacis*		*Mathiola incana*	
	First season	Second season.	First season	Second season.
0	125.60	125.36	153.60	189.60
25	132.80	152.32	166.40	215.60
50	129.60	127.28	160.00	215.20
75	128.00	125.68	155.20	192.08
100	113.60	121.44	144.00	189.44
L.S.D. 5 %	4.32	3.82	5.48	4.88

4.1.5.2. Seed yield per fedden:

Seed yield per fedden was affected by gamma rays irradiation in the same trend as in seed yield/plant in both plants. In this concern data in Table (5,b) show that the average of seed yield per fedden of delphinium plants was significantly increased by the dose of 25 gray whereas, with mathiola plants, the increase was significantly with the doses of 25 and 50 gray compared to the control in both seasons. On the contrary, the dose of 100 gray caused a significant decrease in seed yield/fedden in both seasons except for the second season of mathiola plants which was not significant.

These results agree with those obtained by Arinshtein *et al.*, (1973) on coriander plant, Ponnuswamy and Muthuswami (1981) on *Coriandrum sativum* and Sirtautaite (1996) on carrot.

Gamma radiation is one of the most effective factors in improving plant production. Generally, low doses stimulate plant growth, while high doses have harmful effect as reported by many references (Hussein *et al.*, 1990), (El-Sherbeny *et al.*, 1997) and (Youssef and Moussa, 1998).

4.1.5. Chemical constituents:

4.1.5.1. Total chlorophyll:

Data in Table (6) and Figure (6) show that the total chlorophyll content in the leaves of delphinium plant was significantly increased by doses of 25 and 50 gray in the two seasons. Whereas with mathiola plant, there was significant increase at doses of 25, 50 and 75 gray. The highest increase was

Table (6): Effect of gamma radiation on chemical constituents of *Delphinium ajacis* and *Mathiola incana* plants during the two successive seasons of 1998/1999 and 1999/2000

	Gamma rays (Gy)	Total leaf chlorophyll (mg/g. d.wt.)		Soluble sugars content in V.G. (mg/g. d.wt.)		% Nitrogen in V.G. dry weight		% Phosphorus in V.G. dry weight		% Potassium in V.G. dry weight	
		First season	Second season.	First season	Second season.	First season	Second season.	First season	Second season.	First season	Second season.
Delphinium ajacis	0	2.49	2.31	40.24	39.62	2.19	2.34	0.368	0.388	4.79	4.94
	25	3.48	3.43	47.66	46.42	2.56	2.74	0.408	0.438	6.19	5.37
	50	3.36	3.11	46.97	45.97	2.31	2.46	0.385	0.418	5.72	5.79
	75	2.70	2.53	41.70	40.99	2.29	2.44	0.383	0.413	5.18	5.25
	100	2.32	2.11	36.07	34.73	1.69	1.84	0.358	0.378	4.05	4.12
	L.S.D. 5%	0.21	0.29	1.03	1.08	0.20	0.22	0.014	0.014	0.23	0.24
Mathiola incana	0	3.30	3.24	46.77	48.03	2.13	1.98	0.200	0.195	4.18	4.44
	25	4.26	4.47	52.77	53.92	2.90	2.75	0.222	0.215	4.98	5.22
	50	3.75	4.20	49.23	50.70	2.43	2.28	0.207	0.205	4.97	5.22
	75	3.56	3.86	47.78	50.06	2.24	2.09	0.207	0.203	4.66	4.91
	100	3.16	3.08	44.16	45.88	2.08	1.93	0.195	0.190	3.90	4.09
	L.S.D. 5%	0.17	0.19	0.81	0.77	0.13	0.15	0.011	0.012	0.38	0.37

V.G. = Vegetative growth

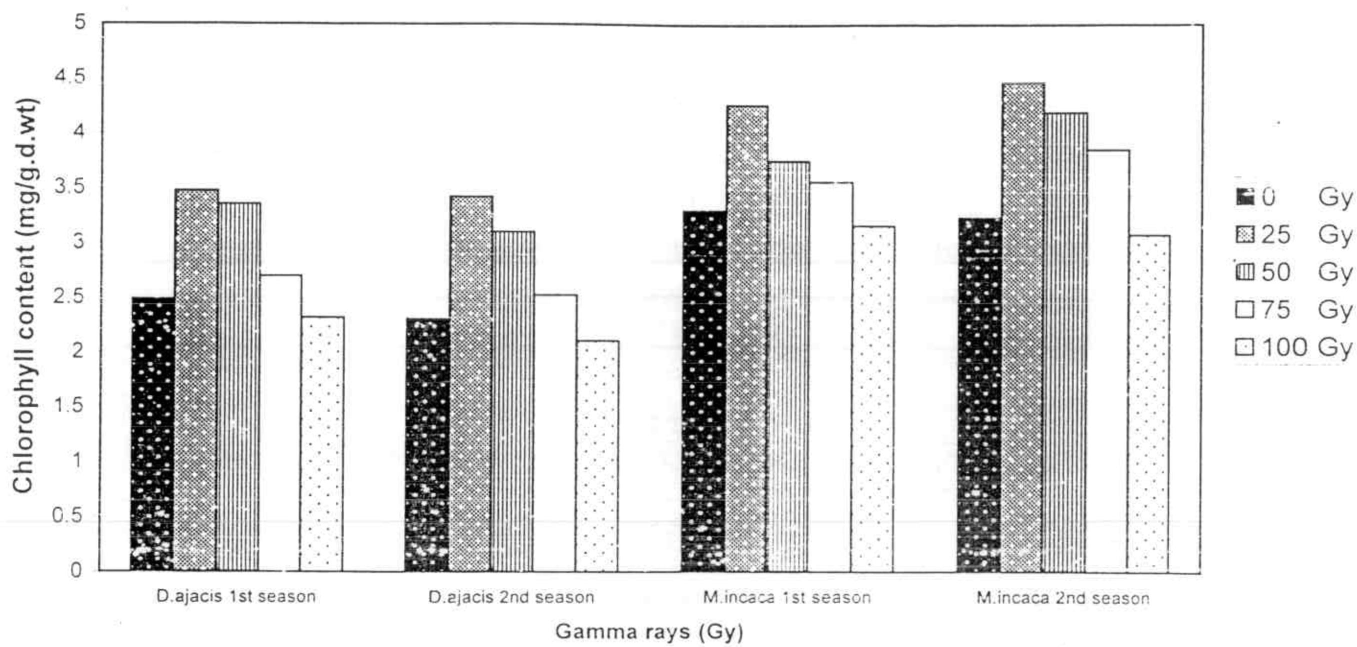

Fig. (6): Effect of gamma radiation on total chlorophyll content in leaves of *Delphinium ajacis* and *Mathiola incana* plants.

achieved by 25 Gray in the both seasons with two genera of plants.

Several investigators also found similar trends where a positive correlation was found between gamma doses and pigment accumulation in seedlings of *Tagetes erecta*, *Zinnia elegans* and *Callistephus chinensis* (Zaharia *et al.*, 1991).

4.1.5.2. Soluble sugars:

Data in Table (6) and Figure (7) show that soluble sugars content in the vegetative growth of both plants was significantly affected by gamma irradiation during the two seasons. In this regard, there was a significant increase in the average of soluble sugars content in the vegetative growth of the two plants by the doses of 25, 50 and 75 gray of gamma rays whereas the dose of 100 gray significantly decreased it comparing with control. The highest increase was achieved by 25 gray in the first and second seasons with two plants.

These results agree with those obtained by Meawad (1981) and Pandey and Gaur (1984) on gladiolus.

<u>4.1.5.3. Nutrients</u>:

4.1.5.3.1. Nitrogen:

Nitrogen content % in the vegetative growth of delphinium and mathiola plants clearly responsed to gamma radiation as shown from data in Table (6). With delphinium plant the average of N % was significantly increased by the dose of 25 gray whereas, in mathiola plant the doses of 25 and 50 gray

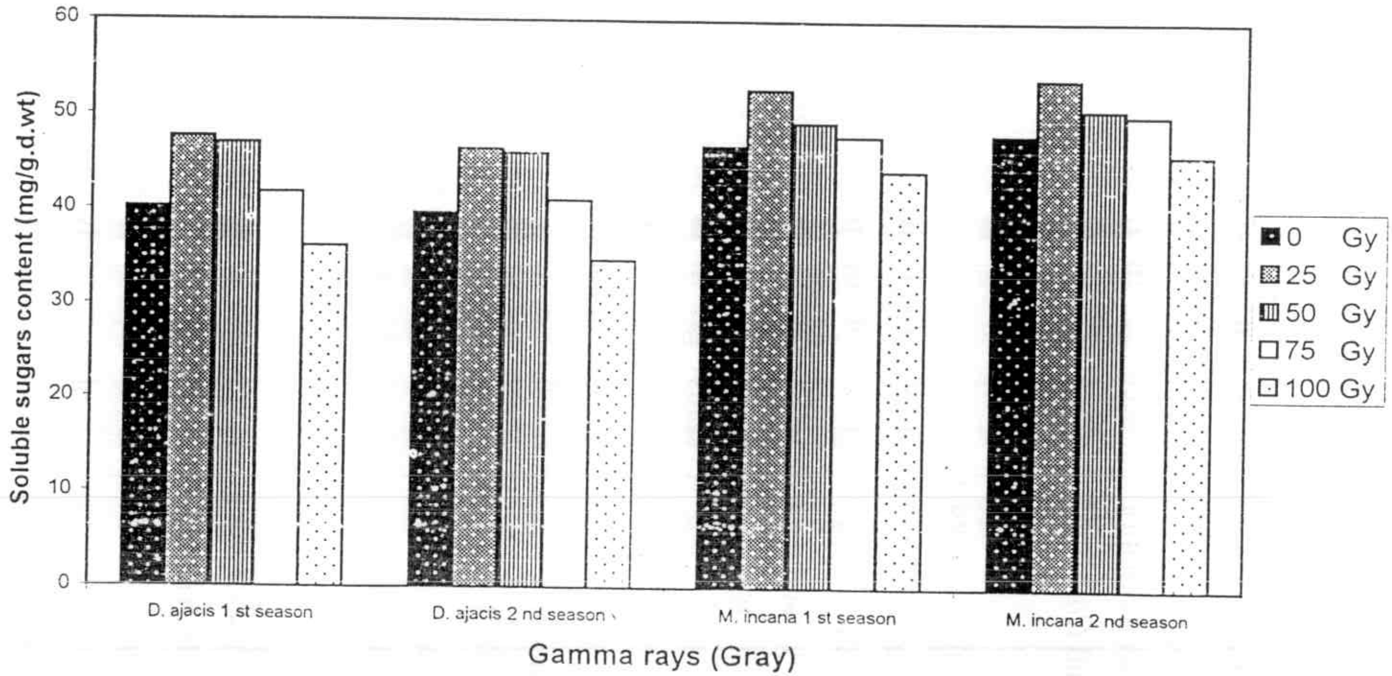

Fig.(7): Effect of gamma radiation on solubie sugars content in vegetative growth of *Delphinium ajacis* and *Mathiola incana* plants significantly increased N% in the vegetative growth in both seasons. Inversely, the dose of 100 gray decreased N% in the vegetative growth of the two plants in both seasons but this decrease was only significant with delphinium plant.

These results of nutrients agree with those obtained by Meawad (1981) on gladiolus, El-Shafie *et al.*, (1987) on carnation, Habba (1989) on *Hyoscyamus muticus* and *Atropa belladonna,* El-Esawy (1995) on gladiolus, Hussein *et al*., (1995) on *Datura metel*,

4.1.5.3.2. Phosphorus:

Data in Table (6) also show that phosphorus percentage % in vegetative growth of the two plants was increased by gamma irradiation and then decreased by increasing gamma doses in the two seasons which reached the peak at the dose of 25 gray. With delphinium plant, the doses of 25, 50 and 75 gray significantly increased this parameter whereas in mathiola plant this increase was only significant at the dose of 25 gray. On the other hand, the dose of 100 gray decreased (but not significantly) phosphorus percentage % in the vegetative growth of the two plants in both seasons.

These results of nutrients agree with those obtained by Meawad (1981) on gladiolus, El-Shafie *et al.,* (1987) on carnation and El-Esawy (1995) on gladiolus and Hussein *et al*., (1995) on *Datura metel*,

4.1.5.3.3. Potassium:

For potassium percentage, data in Table (6) show that gamma radiation at doses of 25, 50 and 75 gray significantly increased K% in the vegetative growth of both plants in the two seasons. The highest increase was obtained by the dose of 25 gray for delphinium plants in the first season only. But the doses of 25 and 50 gray produced the highest increase of potassium percentage with mathiola plants in both seasons. While the dose of 75 gray gave the next value in this concern. Inversely, the dose of 100 gray decreased potassium % in vegetative growth of the two plants in both seasons

These results of nutrients agree with those obtained by Meawad (1981) on gladiolus, El-Shafie *et al.,* (1987) on carnation and El-Esawy (1995) on gladiolus.

From the nutrients results, it might be suggested that ionizing radiation could influence the mineral metabolism of plant through its effect on cell membranes, as reported by Hussein *et al., (*1995) on *Datura metel*, L.

4.2. Experiment (2): Effect of GA_3 on seed germination, growth, flowering, seeds production and chemical constituents of *Delphinium ajacis* and *Mathiola incana* plants.

4.2.1. Germination:

Concerning the effect of GA_3 on the germination percentage and germination rate of delphinium and mathiola seeds, data in Tables (7 & 8) and Figure (8) show that all concentrations (50-200 ppm) of GA_3 significantly increased the germination percentage in both plants in the first and second seasons compared to the control treatment. The highest increase was obtained by using of 100 ppm of GA_3 for the two seasons. With germination rate, mathiola plant had the same response to GA_3 as in germination percentage in the two seasons. Whereas, there was no apparent response with delphinium plant in both seasons.

Generally, it could be seen that gibberellic acid had an apparent effect on germination process. This effect may be due to GA action, which increases the production of α-amylase and certain other digestive enzymes in seeds **(Carbonell and Jones, 1984)**. These enzymes hydrolyses the reserved complex foods present in seeds which is transported to the meristematic regions of the embryo where it is needed.

Table (7): Effect of GA_3 on seed germination of *Delphinium ajacis* plant during the two successive seasons of 1998/1999 and 1999/2000

GA_3 (ppm)	Germination percentage		Germination rate (day)	
	First season	Second season.	First season	Second season.
0	62.0	62.7	0.377	0.381
50	68.7	70.7	0.377	0.381
100	80.7	82.0	0.379	0.383
150	72.0	72.7	0.379	0.382
200	70.7	70.7	0.378	0.381
L.S.D. 5 %	1.6	1.9	N.S.	N.S.

N.S.= 0.78 N.S.= 1.82

Table (8): Effect of GA_3 on seed germination of *Mathiola incana* plant during the two successive seasons of 1998/1999 and 1999/2000

GA_3 (ppm)	Germination percentage		Germination rate (day)	
	First season	Second season.	First season	Second season.
0	69.3	71.3	0.436	0.427
50	74.0	76.0	0.440	0.443
100	78.0	80.0	0.443	0.445
150	78.0	78.7	0.441	0.445
200	77.3	78.7	0.441	0.444
L.S.D. 5 %	1.3	1.6	0.004	0.005

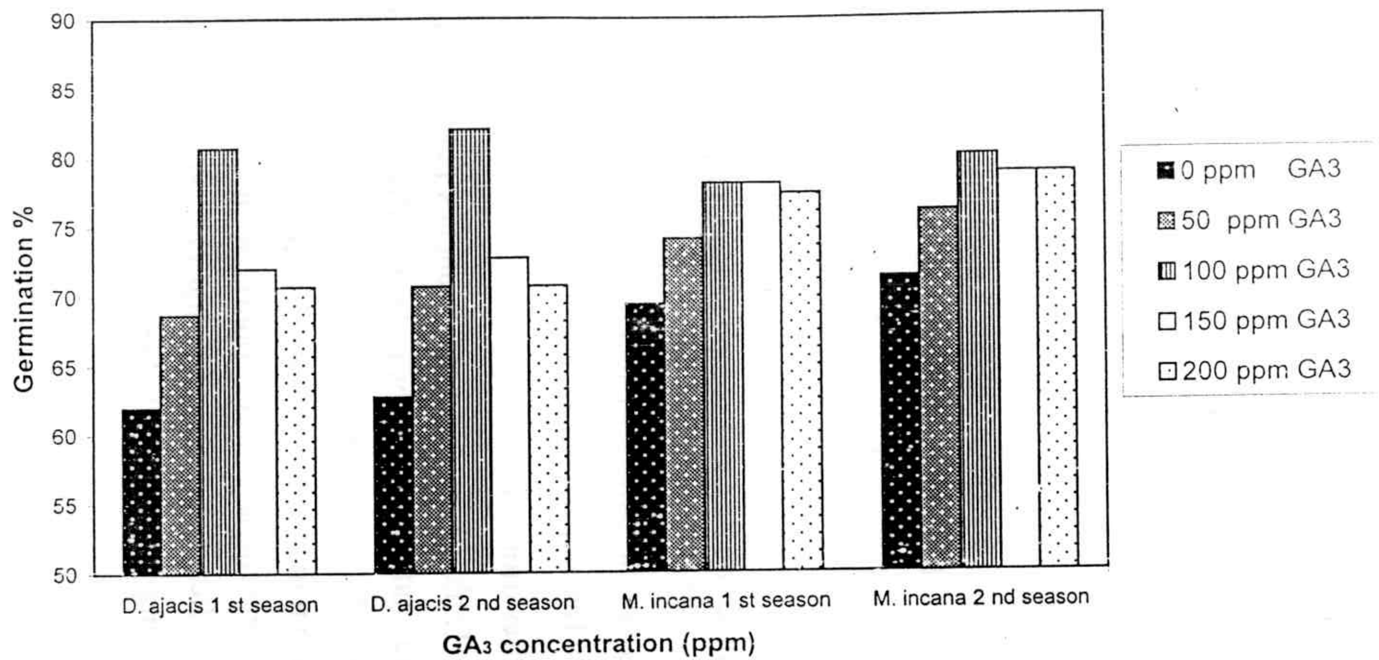

Fig. (8): Effect of GA_3 on seed germination percentage of *Delphinium ajacis* and *Mathiola incana* plants.

These results agreed with those obtained by Shedeed *et al.*, (1986,a) on delphinium and antirrhinum plants, Grzesik and Chojnowski (1992) on *Zinnia elegans* and Grzesik (1995) on *Mathiola incana* plants.

4.2.2. Growth:

4.2.2.1. Plant height:

With respect to plant height of delphinium and mathiola plants, data in Table (9, a) and Figure (9) show that all GA_3 treatments clearly increased plant height particularly with delphinium plant which responsed more to GA_3 application. All GA_3 treatments significantly increased plant height of delphinium plant with a peak at 100 ppm GA_3 treatment. The obtained increases by using 100 GA_3 were 19.8 % and 19.4 % over the control in the first and second season, respectively. With mathiola plant, GA_3 treatments (100-200 ppm) significantly increased plant height, which reached the maximum value at 200 ppm GA_3 in the two experimental seasons.

4.2.2.2. Branches number:

Data in Table (9, a) show that branches number/plant of delphinium and mathiola plants was fairly affected by treating the plants with GA_3. However, the average of branches number per plant of delphinium plant was significantly increased by the used GA_3 concentrations (50-200 ppm). With mathiola plant, there was a significant increase by using GA_3 at 100, 150 and 200 ppm comparing to the control plants in both seasons.

Table (9, a): Effect of GA_3 on the vegetative growth of *Delphinium ajacis* and *Mathiola incana* plants during the two successive seasons of 1998/1999 and 1999/2000

	GA_3 (ppm)	Plant height (cm)		Branches number/plant		Stem diameter (mm)/plant	
		First season	Second season.	First season	Second season.	First season	Second season.
Delphinium ajacis	0	87.00	88.75	19.75	20.00	11.90	12.20
	50	95.53	97.20	21.55	22.00	11.80	11.70
	100	104.25	106.00	23.50	24.00	11.50	11.60
	150	102.53	104.60	23.00	22.75	11.60	11.65
	200	97.83	99.40	22.20	22.50	11.60	11.65
	L.S.D. 5%	2.49	2.47	0.78	0.69	0.37	0.58
Mathiola incana	0	61.50	62.90	18.00	19.75	11.60	12.00
	50	62.25	63.30	18.25	20.50	11.25	11.80
	100	64.25	65.35	18.75	20.75	11.00	11.28
	150	65.25	66.43	18.75	21.50	11.00	11.23
	200	65.50	66.88	19.00	22.00	10.90	11.23
	L.S.D. 5%	1.27	1.24	0.68	0.92	0.54	0.67

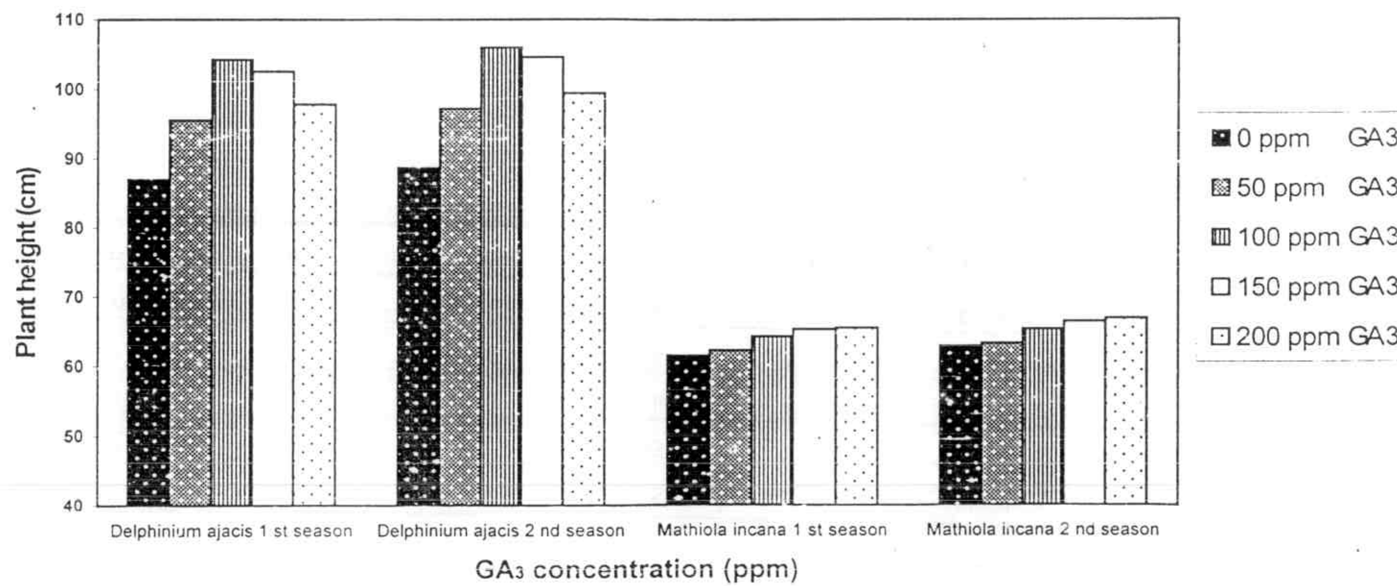

Fig. (9): Effect of GA_3 on plant height of *Delphinium ajacis* and *Mathiola incana* plants.

4.2.2.3. Stem diameter:

From the data in Table (9, a) it was clear that GA_3 treatments slightly affected stem diameter of delphinium and mathiola plants. However, using GA_3 at 100 ppm significantly decreased stem diameter of delphinium plant whereas, with mathiola plant GA_3 at of 200 ppm significantly decreased it in the two seasons.

4.2.2.4. Leaves fresh weight:

With respect to the effect of GA_3 on leaves fresh weight of delphinium plant, data in Table (9, b) show that all GA_3 treatments (50-200 ppm) caused highly significant increases in leaves fresh weight with a peak at 100 ppm GA_3 in the two seasons. With mathiola plants also treatments of 100, 150 and 200 ppm GA_3 caused highly significant increases in fresh weight of leaves. These increases were higher as the concentration of GA_3 increased.

4.2.2.5. Leaves dry weight:

Leaves dry weight was typically in the same trend as in leaves fresh weight in both plants (Table, 9,b). Moreover, all values were significant in the two seasons of delphinium and mathiola plants.

4.2.2.6. Vegetative growth fresh weight:

Vegetative growth fresh weight was clearly influenced by application of gibberellic acid. Data in Table (9, b) and Figure (10) show that fresh weight of vegetative growth of delphinium and mathiola plants was significantly increased by GA_3 at 50, 100, 150 and 200 ppm comparing to the control in both seasons.

Table (9, b): Effect of GA_3 on the vegetative growth of *Delphinium ajacis* and *Mathiola incana* plants during the two successive seasons of 1998/1999 and 1999/2000

	GA_3 (ppm)	Leaves fresh weight (g)/plant		Leaves dry weight (g)/plant		V.G. fresh weight (g)		V.G. dry weight (g)		Root fresh weight (g)/plant		Root dry weight (g)/plant	
		First season	Second season.	First season	Second season.	First season	Second season.	First season	Second season.	First season	Second season.	First season	Second season.
Delphinium ajacis	0	46.79	47.92	6.08	6.26	103.23	105.64	16.49	17.85	31.78	31.33	5.80	5.64
	50	52.35	53.44	6.81	6.97	111.04	113.35	16.66	18.00	32.74	32.23	5.85	5.77
	100	58.04	59.18	7.55	7.69	123.12	125.52	19.47	19.83	33.63	33.05	6.05	5.95
	150	56.91	58.27	7.40	7.58	120.72	123.59	19.11	19.54	33.02	32.90	5.94	5.88
	200	53.85	54.85	7.00	7.13	114.22	116.34	18.13	18.45	32.75	32.26	5.95	5.81
	L.S.D..5%	1.63	1.61	0.26	0.29	1.42	1.41	0.22	0.21	0.84	0.85	0.14	0.14
Mathiola incana	0	93.95	92.21	13.15	12.91	123.95	121.65	19.59	19.25	43.32	44.00	8.14	8.36
	50	95.43	94.19	13.56	13.29	125.89	124.41	19.86	19.64	43.49	44.21	8.26	8.40
	100	99.56	96.58	13.94	13.52	131.34	127.41	20.70	20.12	44.41	44.74	8.44	8.54
	150	100.90	96.99	14.13	13.58	133.11	127.95	20.97	20.20	44.44	45.08	8.52	8.72
	200	103.96	97.40	14.56	13.64	137.16	128.49	21.56	20.28	46.74	47.64	8.88	9.05
	L.S.D..5%	2.19	2.28	0.31	0.30	1.22	1.32	0.19	0.21	1.18	1.27	0.40	0.38

V.G. = Vegetative growth

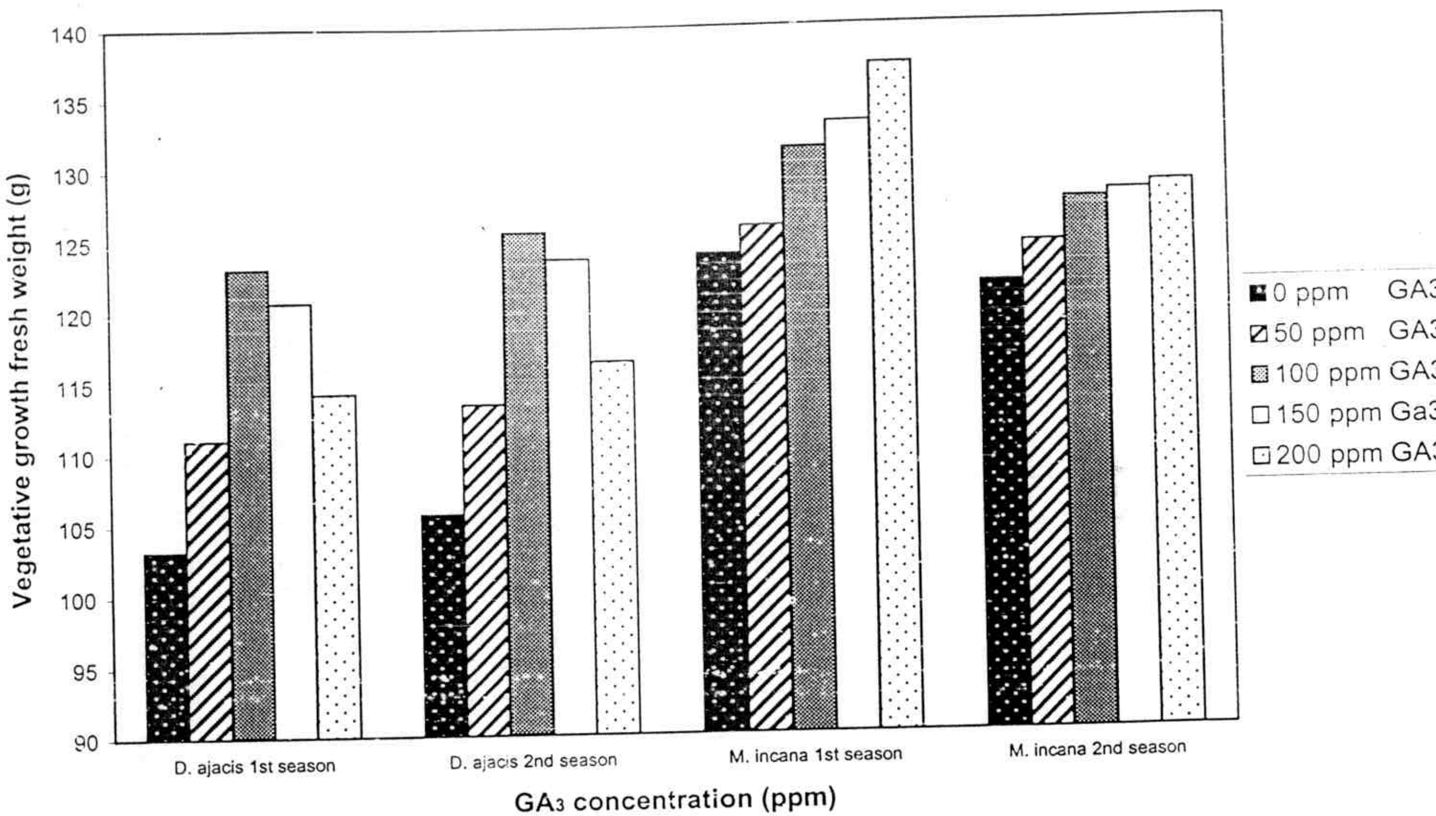

Fig.(10): Effect of GA_3 on vegetative growth fresh weight of *Delphinium ajacis* and *Mathiola incana* plants

This increase had a peak at 100 ppm GA_3 with delphinium plant whereas with mathiola plant, fresh weight of vegetative growth was increased by increasing the concentration of the used GA_3

4.2.2.7. Vegetative growth dry weight:

Concerning the effect of gibberellic acid treatments on the vegetative growth dry weight, it was clear that these plants under this work responded to GA_3 application. This response was in a trend typically the same as in the vegetative growth fresh weight for both plants in the first and second seasons except for the concentration of 50 ppm in delphinium plant which was not significant (Table, 9,b).

According to **Macleod and Millar (1962)** GA may cause cell elongation by the induction of enzymes that weaken the cell walls. Also, the mechanism by which gibberellins might stimulate cell elongation is that the hydrolysis of starch resulting from the production of GA induced α –amylase which might increase the concentration of sugars, thus raising the osmotic pressure in the cell sap so that water enters the cell and tends to stretch it **(Kogl and Elemo, 1960).**

4.2.2.8. Root fresh weight:

Root fresh weight of delphinium plant was clearly and significantly increased by GA_3 treatments (50-200 ppm) with a peak at 100 ppm GA_3 treatment in the two seasons (Table, 9, b). It took the same trend as in fresh weight of vegetative growth. For mathiola plant, there was no significant response except for 200 ppm GA_3 treatment which increased root fresh weight in the two seasons (Table, 9, b). Therefore GA_3 at 100 ppm for delphinium plant or 200 ppm for mathiola plant was more suitable for accumulation of minerals and dry matter in roots.

4.2.2.9. Root dry weight:

Data in Table (9, b) show that root dry weight of delphinium plant was significantly increased by GA_3 treatments (100, 150 and 200 ppm) with a peak at 100 ppm and trend as in plant dry weight of both seasons. For mathiola plant, as in root fresh weight, there was no significant response except for 200 ppm GA_3 treatment which significantly increased it in both seasons (Table, 9, b).

These results of growth parameters were in agreement with those obtained by Hamza and Helaly (1983) on *Mathiola incana* and *Althaea rosea* plants, Shedeed *et al.,* (1986,a,b) on some winter and summer plants, El-Sayed *et al.,* (1986) on *Tagetes erecta*, El-Shamy (1988) on violet, Abou-Talib (1989) on *Callistephus chinensis*, Shedeed *et al.,* (1991,a) on aster, Grzesik (1995) on *Mathiola incana,* Zaghloul (1998) on *Antirrhinum majus* and Desouky *et al.*, (1999) on *Pelargonium grandiflorum.*

4.2.3. Flowering:

4.2.3.1. Flowering date:

The period from sowing till flowering of delphinium and mathiola plants was slightly affected by GA_3 treatment (Table, 10, a and Figure, 11). However, the average of flowering date of delphinium plant was significantly decreased by GA_3 treatment at 100 ppm in both seasons, compared with control

Table (10, a): Effect of GA_3 on the flowering of *Delphinium ajacis and Mathiola incana* plant during the two successive seasons of 1998/1999 and 1999/2000

	GA_3 (ppm)	Flowering date (days)		Inflorescence No./ plant		Inflorescence length (cm)/plant		Flowering portion length (cm)/inflo.	
		First season	Second season.	First season	Second season.	First season	Second season.	First season	Second season.
Delphinium ajacis	0	118.5	118.5	20.0	20.3	45.30	46.50	20.50	21.00
	50	118.3	118.0	20.3	20.8	46.68	47.25	22.50	23.00
	100	117.0	117.0	22.3	22.5	47.63	49.25	23.50	24.75
	150	117.5	117.5	21.3	21.5	46.75	47.75	23.50	23.75
	200	117.5	117.5	21.0	21.0	46.70	47.75	22.50	23.00
	L.S.D. 5%	1.3	1.0	1.4	1.4	1.48	1.30	0.70	0.99
Mathiola incana	0	106.0	107.0	17.5	19.3	31.50	32.00	13.68	14.20
	50	106.0	106.5	17.8	20.0	32.75	32.50	14.05	14.55
	100	105.0	106.0	18.5	20.8	34.00	34.75	14.90	15.05
	150	104.5	105.0	18.8	21.5	34.50	35.50	15.60	16.00
	200	104.0	104.5	19.0	22.0	35.25	35.75	16.90	17.40
	L.S.D. 5%	1.4	1.6	0.9	0.9	1.39	1.50	0.54	0.45

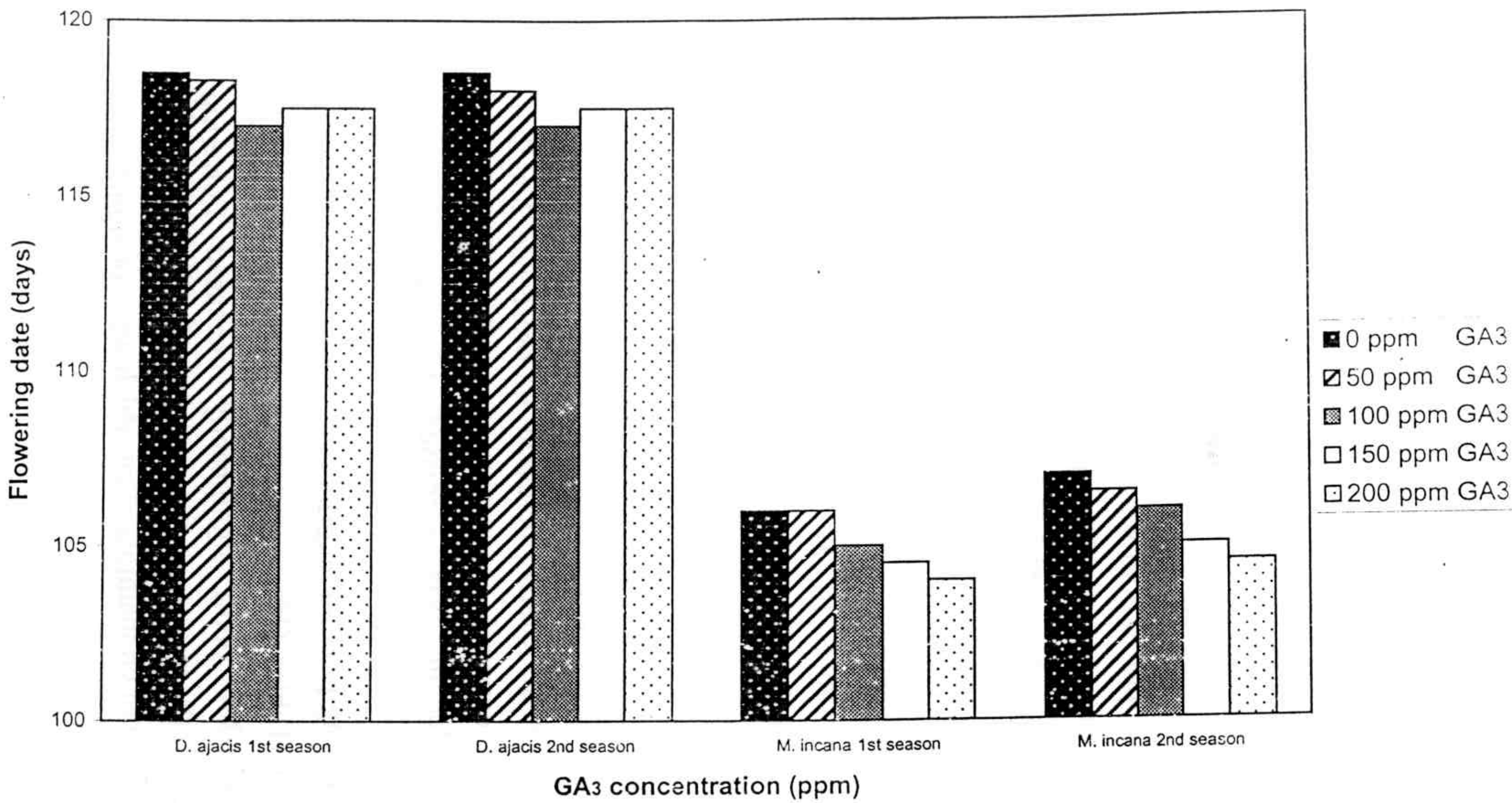

Fig.(11): Effect of GA_3 on flowering date og *Delphinium ajacis* and *Mathiola incana* plants.

plants. With mathiola plant, there was significant decrease caused by GA_3 concentrations of 150 and 200 ppm in the first and second seasons.

4.2.3.2. Inflorescences number:

Data in Table (10, a) show that GA_3 treatment slightly affected the number of inflorescences of delphinium plant. However, there was a significant increase in this concern caused by GA_3 at 100 ppm in both seasons. With mathiola plant, there was more response to GA_3. Treatments of 100, 150 and 200 ppm GA_3 significantly increased inflorescence number/plant in both seasons. This increment was higher by increasing GA_3 concentrations.

4.2.3.3. Inflorescences length:

Data in Table (10, a) clearly show that inflorescence length of delphinium plant was slightly responsed to GA_3 treatment. However, concentration of 100 ppm GA_3 significantly increased inflorescence length in both seasons. Also, inflorescence length in mathiola plant took the same trend as in inflorescence number. In this respect, GA_3 treatments at 100, 150 and 200 ppm significantly increased inflorescence length of mathiola plant comparing with the control in both seasons. Inflorescence length was increased by increasing GA_3 concentration.

4.2.3.4. Flowering portion length:

Data in Tables (10, a) and Figure (12) show that GA_3 treatments (50-200 ppm) significantly increased flowering portion length of the two plants in the two seasons, except for the treatment of 50 ppm on mathiola plant which was not significant.

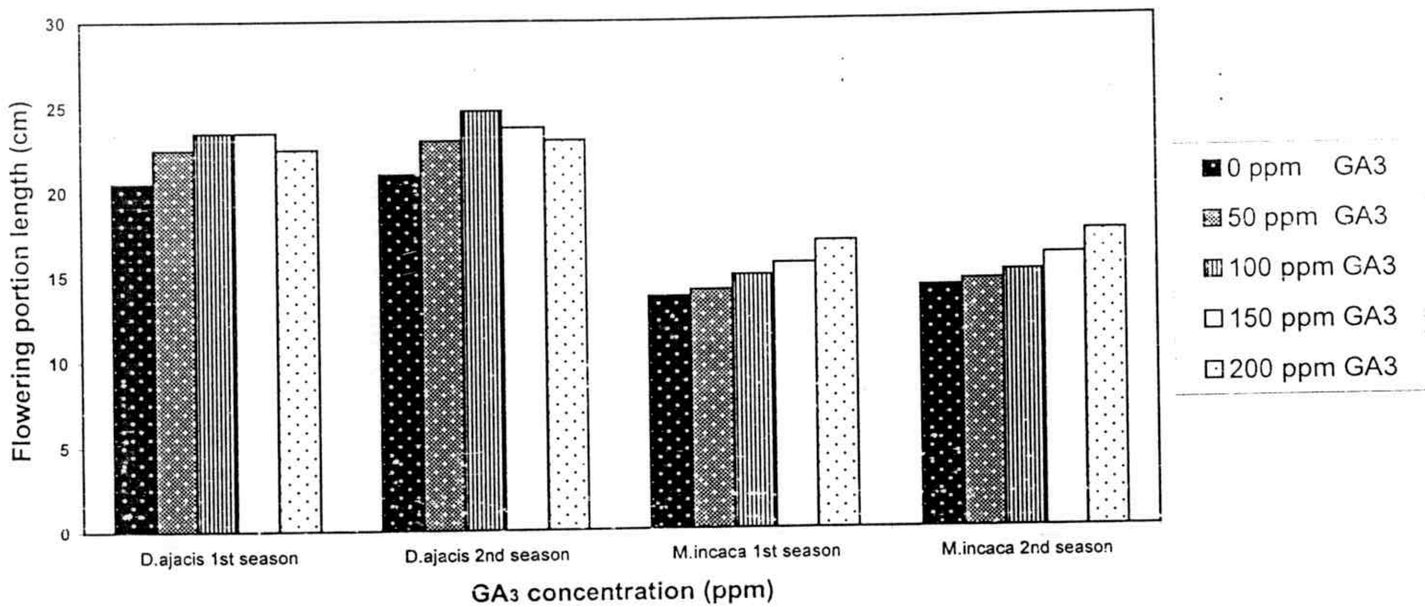

Fig. (12): Effect of GA_3 on flowering portion length of *Delphinium ajacis* and *Mathiola incana* plants.

Flowering portion length was increased by increasing GA_3 concentration.

4.2.3.5. Flowering portion weight:

Data in Table (10, b) show that flowering portion weight of the two plants had the same response of inflorescence length to GA_3 application. With delphinium plant, all GA_3 treatments (50-200 ppm) increased flowering portion weight with a peak at 100 ppm. Treatments of 100 and 150 ppm only gave a significant increase in the two seasons. With mathiola plant all the used GA_3 concentrations also increased flowering portion weigh where the highest increase was obtained by 200 ppm in both seasons (Table, 10, b).

4.2.3.6. Florets number:

With respect to florets number per inflorescence as affected by GA_3 treatments, data in Table (10, b) show that all the used GA_3 concentrations (50-200 ppm) increased it in the two plants under this studying. This increase was significant at all used concentrations for delphinium plants with a peak at 100 ppm GA_3. Whereas, in mathiola plants, only treatments of 100, 150 and 200 ppm GA_3 significantly increased florets weight. Values were higher as the concentration increased through the two seasons.

4.2.3.7. Florets weight:

Data in Table (10, b) show that florets weight per inflorescence was in the same trend and significant values were as in florets number per inflorescence in the two seasons of the two plants.

Table (10, b): Effect of GA_3 on the flowering of *Delphinium ajacis and Mathiola incana* plant during the two successive seasons of 1998/1999 and 1999/2000

	GA_3 (ppm)	Flowering portion weight (g)/ inflo.		Florets number /inflorescence		Florets weight (g) /inflorescence		Vas life (days)	
		First season	Second season.	First season	Second season.	First season	Second season.	First season	Second season.
Delphinium ajacis	0	5.71	5.70	7.0	7.2	2.52	2.56	15.5	15.5
	50	5.97	6.12	7.4	7.8	2.64	2.71	15.5	15.5
	100	6.96	7.16	8.0	8.4	2.77	2.89	16.5	16.5
	150	6.68	6.91	8.0	8.1	2.76	2.81	16.8	17.0
	200	6.03	6.12	7.6	7.8	2.67	2.73	17.3	17.5
	L.S.D. 5%	0.42	0.44	0.3	0.3	0.08	0.09	0.8	0.8
Mathiola incana	0	18.39	18.33	10.7	11.1	13.73	14.44	15.5	15.5
	50	18.49	18.65	10.9	11.3	14.15	14.80	15.5	15.5
	100	19.06	18.96	11.4	11.8	15.20	15.30	16.5	16.5
	150	19.21	19.04	12.2	12.5	16.05	16.60	16.8	17.0
	200	19.45	19.33	13.2	13.6	17.63	18.29	17.3	17.5
	L.S.D. 5%	0.25	0.33	0.5	0.7	0.64	0.60	0.8	0.8

4.2.3.8. Vase life:

With respect to vase life response to GA_3 treatments, data in Table (10, b) show that GA_3 treatment at 100 and 150 ppm were the most effective concentrations which significantly increased vase life of delphinium plant in both seasons. With mathiola plant, data in Table (10, b) also show that using GA_3 treatments increased vase life where the increase was greater as the concentration of GA_3 increased. It was significant with 100, 150 and 200 ppm GA_3 in the first and second seasons.

Gibberellins play a role in flowering, probably it is further elaborated into florigen by the plant. Hence, gibberellin can not be the same substance as florigen but at least it may act as its precursor. The propounder of "florigen concept" florigen is made up of two substances, namely gibberellins and anthesins. The latter are considered to be nitrogen rich compounds.

These results of flowering parameters agree with those obtained by Shedeed *et al.,* (1986,a) on delphinium and antirrhinum plants, Abou-Talib (1989) on *Callistephus chinensis*, Grzesik and Chojnowski (1992) on *Zinnia elegans*, Abo-El-Ghait and Wahba (1994) on *Viola odorata,* Grzesik (1995) on *Mathiola incana,* Dutta *et al.,* (1998) on chrysanthemum and Hisamatsu *et al.,* (1999) on *Mathiola incana.*

4.2.4. Seed yield:

4.2.4.1. Seed yield per plant:

Data in Table (11,a) show that seed yield of delphinium plant was significantly increased by all the used treatments of

Table (11,a): Effect of GA_3 on seed yield (g/plant) of ***Delphinium ajacis*** and *Mathiola incana* plants during the two successive seasons of 1998/1999 and 1999/2000

GA_3 (ppm)	*Delphinium ajacis*		*Mathiola incana*	
	First season	Second season.	First season	Second season.
0	4.19	4.00	4.90	6.07
50	4.43	4.35	5.00	6.19
100	4.79	4.91	5.03	6.60
150	4.66	4.79	5.23	6.61
200	4.60	4.70	5.25	6.69
L.S.D. 5 %	0.17	0.19	0.13	0.15

Table (11,b): Effect of GA_3 on seed yield (kg/fedden) of ***Delphinium ajacis*** and *Mathiola incana* plants during the two successive seasons of 1998/1999 and 1999/2000

GA_3 (ppm)	*Delphinium ajacis*		*Mathiola incana*	
	First season	Second season.	First season	Second season.
0	134.08	128.00	156.80	194.24
50	141.68	139.28	160.00	198.00
100	153.28	156.96	161.00	211.04
150	149.12	153.36	167.24	211.52
200	147.20	150.40	168.00	214.00
L.S.D. 5 %	5.42	6.15	4.15	4.87

GA_3 (50-200 ppm) in both seasons with a peak at 100 ppm. mathiola plant also responded to GA_3 treatments where the seed yield was significantly increased by GA_3 at 100, 150 and 200 ppm. This increase was higher as the concentration of GA_3 increased.

4.2.5.2. Seed yield per fedden:

Seed yield per fedden of the two plants was significantly increased by the GA_3 treatments. In this concern, the data in Table (11,b) show that the concentrations of 50-200 ppm were significant with delphinium plants in both seasons. Whereas, the concentrations of 100, 150 and 200ppm were significant with mathiola plants in both seasons.

These results agreed with those obtained by Shedeed *et al.,* (1986,a) on delphinium and antirrhinum plants and Grzesik (1995) on *Mathiola incana,*

4.2.5. Chemical constituents:

4.2.5.1. Total chlorophyll:

Data in Table (12) and Figure (13) show that GA_3 concentrations (100, 150 and 200 ppm) decreased total chlorophyll content in the leaves of delphinium and mathiola plants in the two seasons comparing with control plants. GA_3 at 50ppm increased total chlorophyll content in the fresh leaves in both seasons while the control plants gave the next value in this concern. The differences between control and treatments was significant in both seasons

Table (12): Effect of GA_3 on chemical constituents of *Delphinium ajacis* and *Mathiola incana* plants during the two successive seasons of 1998/1999 and 1999/2000

	GA_3 (ppm)	Total leaf chlorophyll (mg/g. d.wt.)		Soluble sugars content in V.G. (mg/g. d.wt.)		% Nitrogen in V.G. dry weight		% Phosphorus in V.G. dry weight		% Potassium in V.G. dry weight	
		First season	Second season.	First season	Second season.	First season	Second season.	First season	Second season.	First season	Second season.
Delphinium ajacis	0	3.28	3.02	40.54	40.01	1.94	2.16	0.375	0.385	4.85	4.88
	50	3.67	3.49	41.22	40.28	2.01	2.24	0.368	0.378	5.12	5.12
	100	2.68	2.67	46.56	45.88	2.37	2.59	0.383	0.390	5.98	6.02
	150	2.41	2.40	43.99	43.00	2.14	2.37	0.380	0.388	5.71	5.74
	200	2.20	2.20	41.41	40.69	2.13	2.35	0.343	0.373	5.44	5.47
	L.S.D. 5%	0.11	0.10	0.91	0.72	0.18	0.18	0.012	0.012	0.30	0.25
Mathiola incana	0	4.11	3.97	46.25	48.33	2.16	1.96	0.202	0.195	4.33	4.40
	50	4.42	4.39	51.37	53.73	2.58	2.35	0.187	0.183	5.11	5.18
	100	3.71	3.41	52.11	54.95	2.69	2.49	0.177	0.168	5.23	5.30
	150	3.04	3.17	52.86	55.45	3.04	2.56	0.219	0.210	5.25	5.30
	200	3.07	3.21	55.54	58.31	3.05	2.78	0.222	0.213	5.38	5.46
	L.S.D. 5%	0.17	0.16	1.01	0.98	0.27	0.25	0.012	0.012	0.19	0.18

V.G. = Vegetative growth

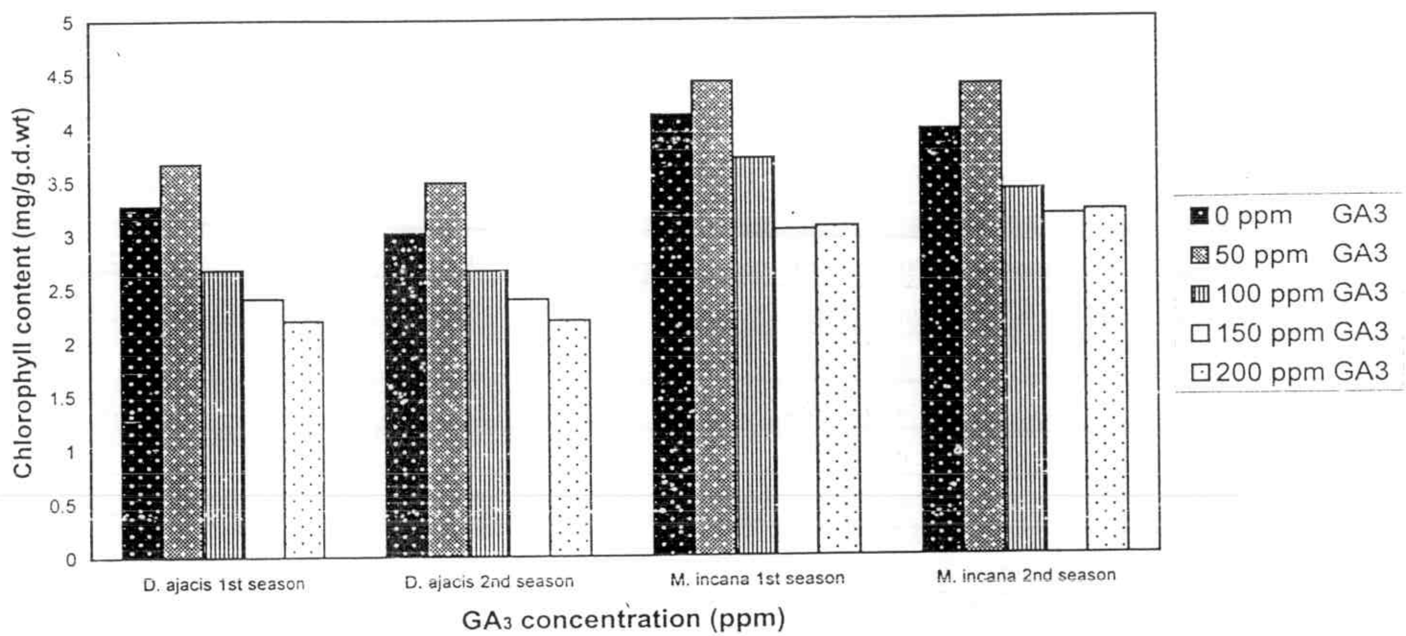

Fig.(13): Effect of GA_3 on total chlorophyll content in leaves of *Delphiniumajacis* and *Mathiola incana* plants.

These results agreed with those obtained by Salem (1984) on *Chrysanthemum frutescens*, Selim (1985) on Bougainvillea, Shedeed *et al.*, (1991,b) on aster and Sakr (1995) on chrysanthemum plants.

4.2.5.2. Soluble sugars:

Concerning the effect of GA_3 on soluble sugars content in the vegetative growth of delphinium plants, data in Table (12) show that GA_3 concentrations (50-200 ppm) increased sugar content with a peak at 100 ppm. However, the significant increase was connected with 100 and 150 ppm GA_3 in the two seasons. With mathiola plant, all the used concentrations of GA_3 significantly increased sugar content in the vegetative growth in the two seasons. This increase was higher when the concentration of 200 ppm GA_3 was used (Table, 12).

These results agree with those obtained by El-Shafie *et al.,* (1980) on carnation, El-Leithy (1987) on tagetes, Abou Talib (1989) on *Callistephus chinensis*, Shedeed *et al.,* (1991,b) on aster plants, Haggag (1997) on chrysanthemum and Desouky *et al.*, (1999) on *Pelargonium grandiflorum*.

4.2.5.3. Nutrients:

4.2.5.3.1. Nitrogen:

Data in Table (12) show that GA_3 application (50-200 ppm) increased nitrogen percentage in the vegetative growth of delphinium plant with a peak at 100 ppm. Significant increases were connected with treatments of 100, 150 and 200 ppm. For mathiola plant, all used GA_3 treatments significantly increased nitrogen percentage in the vegetative growth. There was higher increase by increasing GA_3 concentrations in the two seasons (Table, 12). In this connection **Copalarishan and Sircar (1974)** demonstrated that GA enhanced protein synthesis.

4.2.5.3.2. Phosphorus:

Data in Table (12) show that GA_3 application slightly affected P percentage in the vegetative growth of delphinium plants. However, using GA_3 at 150 and 200 ppm increased percentage in the vegetative growth of plant tissues whereas, the concentrations of 50 and 200 ppm GA_3 decreased it in the vegetative growth of delphinium plants in the two seasons. With mathiola plant, applied GA_3 at 50, 100, 150 and 200 ppm had a significant effect on P content. In this concern, concentrations of 150 and 200 ppm increased it whereas, treatments of 50 and 100 ppm GA_3 decreased P percentage in mathiola plants in the two seasons. (Table, 12).

4.2.5.3.3. Potassium:

Concerning the effect of GA_3 on K percentage in the vegetative growth of delphinium plants, data in Table (12) show that all GA_3 concentrations (50-200 ppm) increased it with a peak at 100 ppm. Adding GA_3 at 100, 150 and 200 ppm gave significant effect. With mathiola plant, all the used GA_3 concentrations (50-200 ppm) significantly increased K percentage in the vegetative growth. This increment was higher by increasing GA_3 concentrations in the two seasons (Table, 12).

These results of nutrients agreed with those obtained by El-Leithy (1987) on tagetes, Shedeed *et al.,* (1990) on croton, Shedeed *et al.*, (1991,b) on aster, Abd-El-Wahid (1995) on *Strelitzia reginae*, Haggag (1997) on chrysanthemum. Zaghloul (1998) on *Antirrhinum majus* and Desouky *et al.*, (1999) on *Pelargonium grandiflorum*.

4.3. Experiment (3): Effect of ascorbic acid on seed germination, growth, flowering, seeds production and chemical constituents of *Delphinium ajacis* and *Mathiola incana* plants.

4.3.1. Germination:

Concerning the effect of ascorbic acid on seed germination of delphinium and mathiola plants, data in Tables (13 & 14) and Figure (14) show that all the used concentrations (50-200 ppm) increased it with a peak at 100 ppm ascorbic acid in both seasons of the two plants. This increase was significant in germination percentage with plants and germination rate of mathiola plant, whereas germination rate of delphinium plant

Table (13): Effect of ascorbic acid on seed germination of *Delphinium ajacis* plant during the two successive seasons of 1998/1999 and 1999/2000

Ascorbic acid (ppm)	Germination percentage		Germination rate (day)	
	First season	Second season.	First season	Second season.
0	67.3	67.3	0.369	0.372
50	78.7	79.3	0.371	0.377
100	82.0	81.3	0.383	0.381
150	78.7	79.3	0.374	0.376
200	74.7	74.0	0.370	0.372
L.S.D. 5 %	1.9	1.9	0.004	0.004

Table (14): Effect of ascorbic acid on seed germination of *Mathiola incana* plant during the two successive seasons of 1998/1999 and 1999/2000

Ascorbic acid (ppm)	Germination percentage		Germination rate (day)	
	First season	Second season.	First season	Second season.
0	68.7	68.7	0.442	0.439
50	78.0	80.0	0.447	0.444
100	82.0	86.0	0.459	0.448
150	80.0	80.7	0.455	0.446
200	72.0	76.7	0.446	0.444
L.S.D. 5 %	1.9	1.6	0.004	0.004

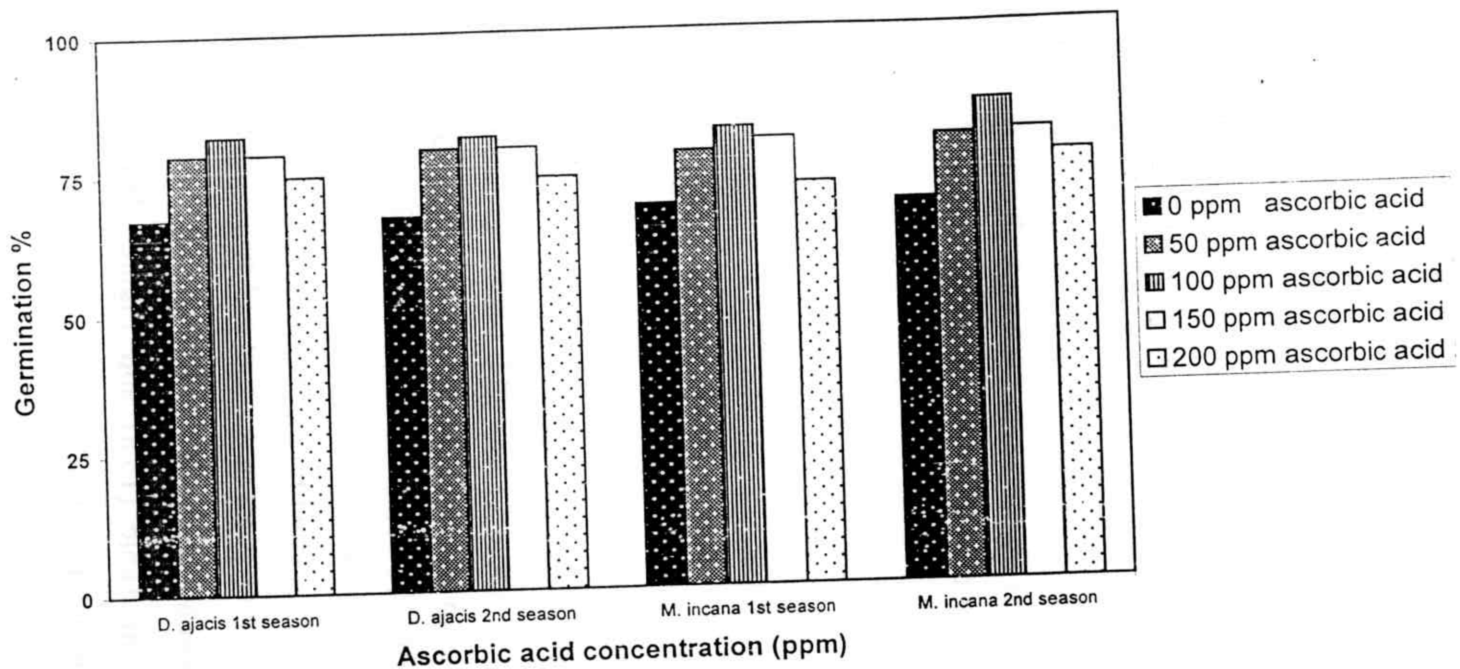

Fig.(14): Effect of ascorbic acid on seed germination percentage of *Delphinium ajacis* and *Mathiola incana* plants.

was significantly increased by using ascorbic acid at 100 and 150 ppm in the two seasons and 50 ppm in the second season.

The high value of seed germination due to ascorbic acid treatment may also be induced through the effect of this substance on enzyme and/or hormone activity. In this respect, **Khan (1977)** reported that *Datura innoxia* seeds succeeded to germinate by applying aqueous ascorbic acid (reducing agent). This could operate by inactivating on interfering enzyme or hormone. Moreover, the same author, with barley, pointed out that ascorbic acid oxidase is particularly active in cell wall material in the tissues of covering structures

These results agree with those obtained by Singh and Rao (1993) on sunflower and Abd-El-Hamid *et al.,* (1994) on *Opuntia ficus*-indica.

4.3.2. Growth:

4.3.2.1. Plant height:

Data in Table (15,a) and Figure (15) show that plant height with two plants was clearly increased by ascorbic acid treatments (50-200 ppm) with a peak at 100 ppm. However this increase was only significant at concentrations of 100 and 150 ppm of ascorbic acid with delphinium plant, and 50, 100 and 150 ppm with mathiola plant in the first and second seasons.

4.3.2.2. Branches number:

Data in Table (15,a) and Figure (16) also show that number of branching with two plants was increased by ascorbic

Table (15, a): Effect of ascorbic acid on the vegetative growth of *Delphinium ajacis* and *Mathiola incana* plants during the two successive seasons of 1998/1999 and 1999/2000

Plant	Ascorbic Acid (ppm)	Plant height (cm)		Branches number/plant		Stem diameter (mm)/plant	
		First season	Second season.	First season	Second season.	First season	Second season.
Delphinium ajacis	0	89.50	90.80	19.78	20.00	11.63	11.75
	50	92.00	91.75	20.78	20.78	11.75	11.88
	100	95.75	97.00	21.75	21.53	12.25	12.38
	150	93.75	93.38	21.20	21.10	11.88	12.00
	200	92.00	91.25	20.30	20.58	11.63	11.80
	L.S.D. 5%	2.59	2.30	0.31	0.35	N.S.	N.S.
Mathiola incana	0	60.75	61.25	18.53	18.50	11.00	11.25
	50	64.50	65.25	19.43	19.25	11.63	12.13
	100	70.00	70.25	21.43	21.75	12.25	12.88
	150	66.50	67.00	20.08	20.50	11.75	12.25
	200	62.00	62.20	18.58	18.68	11.38	12.00
	L.S.D. 5%	1.42	1.39	0.67	0.55	0.64	0.99

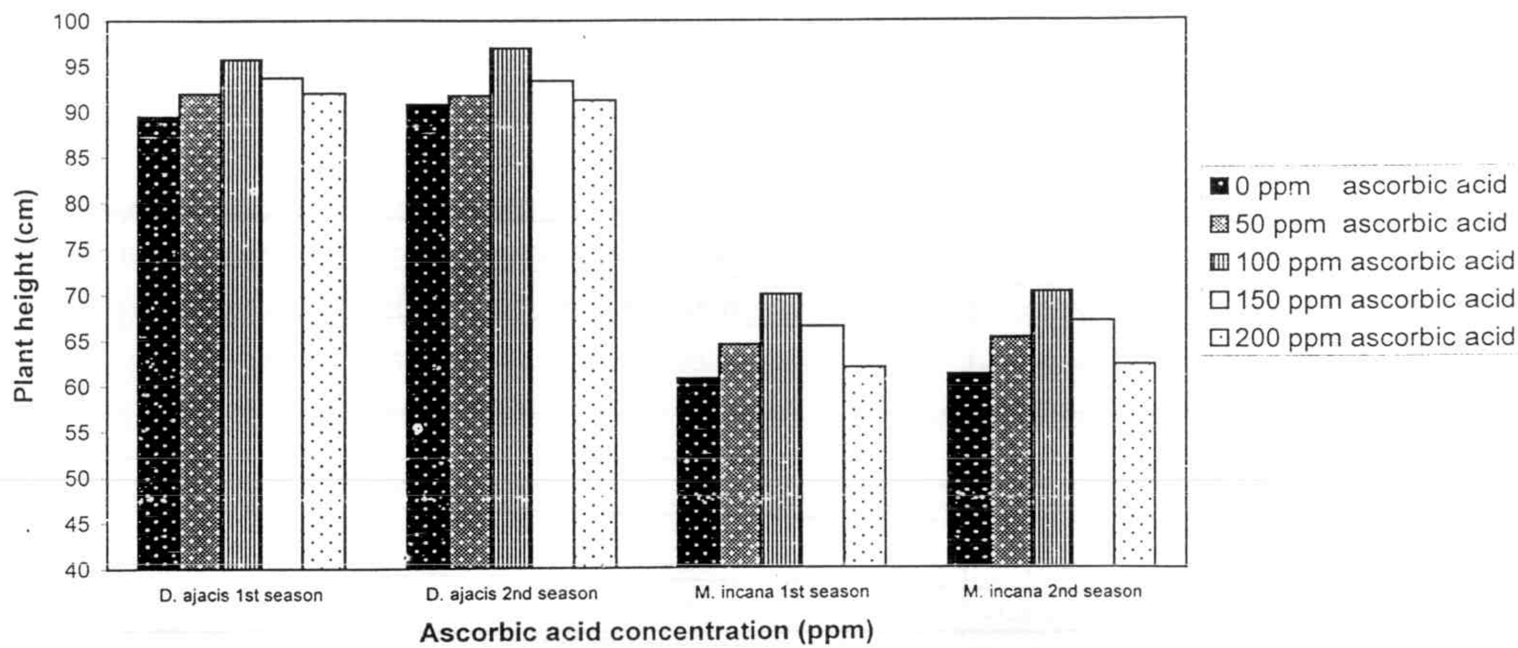

Fig.(15): Effect of ascorbic acid on plant height of *Delphinium ajacis* and *Mathiola incana* plants.

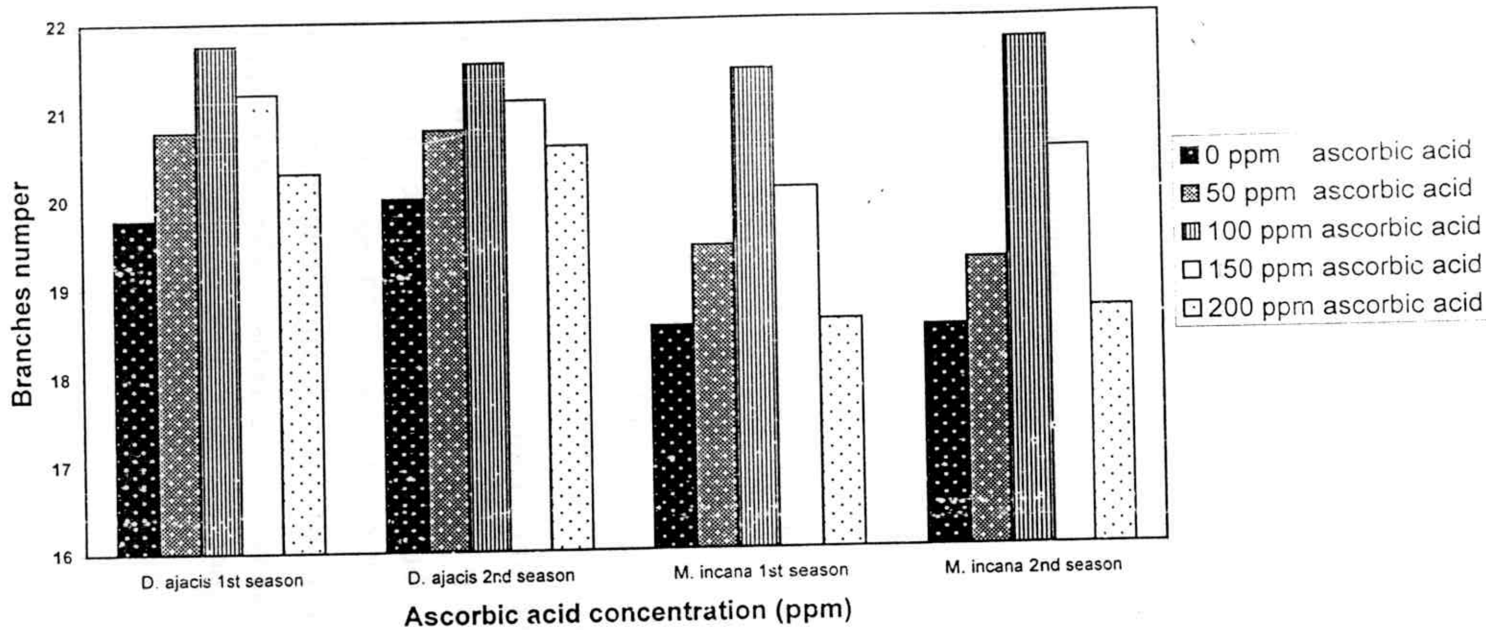

Fig.(16): Effect of ascorbic acid on branches number per plant of *Delphinium ajacis* and *Mathiola incana* plants.

acid treatments. This increase was significant at all the used concentrations (50-200 ppm) for delphinium plant with a peak at 100 ppm ascorbic acid. The same trend was observed with mathiola plant, except for the concentration of 200 ppm ascorbic acid which was not significant.

4.3.2.3. Stem diameter:

Stem diameter was slightly affected by ascorbic acid. There were non-significant increases in stem diameter of delphinium plant. Whereas, with mathiola plant this parameter was significantly increased by 100 and 150 ppm ascorbic acid (Table 15, a).

4.3.2.4. Leaves fresh weight:

Data in Table (15, b) clearly show that all the used concentrations using of ascorbic acid (50-200 ppm) increased leaves fresh weight of delphinium and mathiola plants with a peak at 100 ppm. This increase was significant at treatments of 50, 100 and 150 ppm in both plants, except for 50 ppm in the first season of mathiola plant which was not significant.

4.3.2.5. Leaves dry weight:

The same trend of leaves fresh weight was observed in leaves dry weight (Table, 15, b). There were significant increases at treatments of 50, 100 and 150 ppm ascorbic acid with delphinium plant whereas the significant increases in mathiola plant were observed at treatments of 100 and 150 ppm ascorbic acid in 1998 / 1999 and 1999 / 2000 seasons.

Table (15, b): Effect of ascorbic acid on the vegetative growth of *Delphinium ajacis* and *Mathiola incana* plants during the two successive seasons of 1998/1999 and 1999/2000

	Ascorbic acid (ppm)	Leaves fresh weight (g)/plant		Leaves dry weight (g)/plant		V.G. fresh weight (g)		V.G. dry weight (g)		Root fresh weight (g)/plant		Root dry weight (g)/plant	
		First season	Second season.	First season	Second season.	First season	Second season.	First season	Second season.	First season	Second season.	First season	Second season.
Delphinium ajacis	0	48.42	49.21	6.30	6.25	104.48	104.93	16.91	16.87	32.16	31.08	5.87	5.60
	50	50.18	50.37	6.53	6.55	106.36	106.75	17.11	17.01	33.01	32.48	6.08	5.67
	100	52.49	53.31	6.83	6.80	111.74	113.13	17.76	18.01	33.64	32.67	6.33	5.70
	150	51.21	50.95	6.66	6.62	108.13	108.90	17.12	17.24	33.10	32.53	6.23	5.68
	200	50.05	49.53	6.51	6.51	106.06	105.75	16.97	16.99	32.43	31.76	5.90	5.61
	L.S.D. 5%	1.69	1.52	0.22	0.29	2.04	2.48	0.30	0.37	0.76	0.77	N.S.	N.S,
Mathiola incana	0	91.50	90.88	12.81	12.62	121.10	120.23	18.19	18.91	42.87	45.25	8.15	8.32
	50	93.22	94.13	13.05	12.98	123.23	124.37	18.82	19.70	43.54	46.50	8.26	8.77
	100	99.25	99.03	13.90	13.84	130.75	130.72	21.05	20.81	47.05	49.35	8.94	9.36
	150	94.07	94.55	13.17	13.24	124.25	124.90	18.95	19.81	44.19	46.50	8.39	8.80
	200	93.21	91.65	13.05	12.83	122.23	121.12	18.81	19.45	43.50	46.00	8.20	8.73
	L.S.D. 5%	1.84	2.09	0.26	0.28	1.92	1.94	0.76	0.82	1.43	1.40	0.49	0.48

V.G. = Vegetative growth

4.3.2.6. Vegetative growth fresh weight:

Concerning the effect of ascorbic acid on vegetative growth fresh weight, data in Table (15, b) show apparent increases in both genus. These increases were significant at 100 and 150 ppm in delphinium plant and at 50, 100 and 150 ppm ascorbic acid in mathiola plant. The maximum increase in fresh weight of vegetative growth was obtained at 100 ppm ascorbic acid.

4.3.2.7. Vegetative growth dry weight:

Data in Table (15, b) show that vegetative growth dry weight took the same trend of vegetative growth plant fresh weight. However, there was no significant increases, except for 100 ppm ascorbic acid which was significant with delphinium plant and 100, 150 ppm with mathiola plant in the two seasons.

4.3.2.8. Root fresh weight:

Data in Table (15, b) show that root growth was affected by ascorbic acid treatment. In this concern, using ascorbic acid at 50, 100 and 150 ppm significantly increased the average of root fresh weight of delphinium plant whereas,100 ppm was only significant in mathiola plant. The maximum increase was obtained by using 100 ppm ascorbic acid in the two seasons with both plants.

4.3.2.9. Root dry weight:

Root dry weight took the same trend of root fresh weight as affected by ascorbic acid application where concentration of 100 ppm gave the highest increase. This increase was only significant at 100 ppm with mathiola plant in the two seasons Table (15, b).

These results of growth parameters agree with those obtained by Serebryakova and Kalanova (1977) on *Rosa cinnaniemea,* Mukhopadhyay *et al.,* (1982) on *Hibiscus rosa-sinensis,* Bose *et al.,*(1982) on *Tagetes patula*, *Cosmos sulphureus* and *Corchorus olitorius*, Deore and Bharud (1990) on fenugreek plants, Singh and Rao (1993) on sunflower and Tarraf *et al.,* (1999) on lemongrass plants.

Ascorbic acid is an organic compound in higher plants which is required in trace amount to maintain normal growth (**Samiullah** and **Afridi, 1988**).

These results can be attributed to one or more of the following cases:

1-Ascorbic acid could be involved in the main metabolic processes especially with energy transfer coenzymes carbohydrate metabolism and improved photosynthetic activity **Aberg (1961). Sana and Ota (1977)** mentioned that ascorbic acid had a regulating effect upon oxidation reduction potential of cytoplasm. On the level of plant organ growth, many investigators obtained similar positive effects of ascorbic acid on other plants, i.e. **Reda *et al.*, (1977) on** *Ammi visnaga* **L. (Lam.), Saraswathamma and Jayachandra (1981) on** *Trigonella foenum* **L. and Abd-El-Halim (1995)** on tomato.

4.3.3. Flowering:

4.3.3.1. Flowering date:

Data in Table (16,a) and Figure (17) show that all ascorbic acid treatments (50-200 ppm) accelerated the flowering of two plants. The least number of days to flowering was achieved at 100 ppm comparing with control. Treatments of 100 and 150 ppm were significant in two seasons with two plants (delphinium and mathiola).

4.3.3.2. Inflorescences number:

Concerning the number of inflorescences in delphinium and mathiola plants, data in Table (16,a) and Figure (18) show that ascorbic acid treatments (50, 100 and 150 ppm) significantly increased this parameter with a peak at 100 ppm. These results were obtained in two seasons.

4.3.3.3. Inflorescences length:

Inflorescence length was also affected and increased by different concentrations of ascorbic acid treatments with a peak at 100 ppm. Data in Table (16,a) show that levels of 100 and 150 ppm significantly increased inflorescence length of two plants in both seasons.

4.3.3.4. Flowering portion length:

With respect to flowering portion length, all ascorbic acid concentrations (50-200 ppm) increased it in both seasons for the two plants with a peak at 100 ppm (Table, 16, a) and Figure (19). These increases were only significant at 50, 100 and 150 ppm ascorbic acid.

Table (16, a): Effect of ascorbic acid on the flowering of *Delphinium ajacis* and *Mathiola incana* plants during the two successive seasons of 1998/1999 and 1999/2000

	Ascorbic acid (ppm)	Flowering date (days)		Inflorescence No./ plant		Inflorescence length (cm)		Flowering portion length (cm)/inflo.	
		First season	Second season.	First season	Second season.	First season	Second season.	First season	Second season.
Delphinium ajacis	0	118.5	118.5	19.8	20.0	44.68	45.00	20.63	21.25
	50	117.5	118.0	20.8	21.0	45.10	46.30	21.75	22.50
	100	115.0	114.0	22.3	21.8	46.90	48.50	23.25	23.75
	150	116.5	116.3	21.4	21.2	46.40	46.75	21.88	22.50
	200	118.0	118.0	20.5	20.0	44.83	45.50	21.25	21.50
	L.S.D. 5%	1.1	1.2	0.9	1.1	1.59	1.73	0.69	0.92
Mathiola incana	0	105.5	104.5	18.0	19.0	31.13	31.75	13.70	14.25
	50	104.5	103.5	19.0	20.3	32.70	33.25	15.43	16.50
	100	102.0	101.0	22.0	22.3	34.00	34.25	16.95	17.75
	150	104.0	103.0	20.5	21.3	33.13	33.75	16.15	17.00
	200	105.0	104.0	18.0	19.3	32.38	33.00	14.15	14.75
	L.S.D. 5%	1.4	1.3	1.0	0.9	1.70	1.68	0.82	0.73

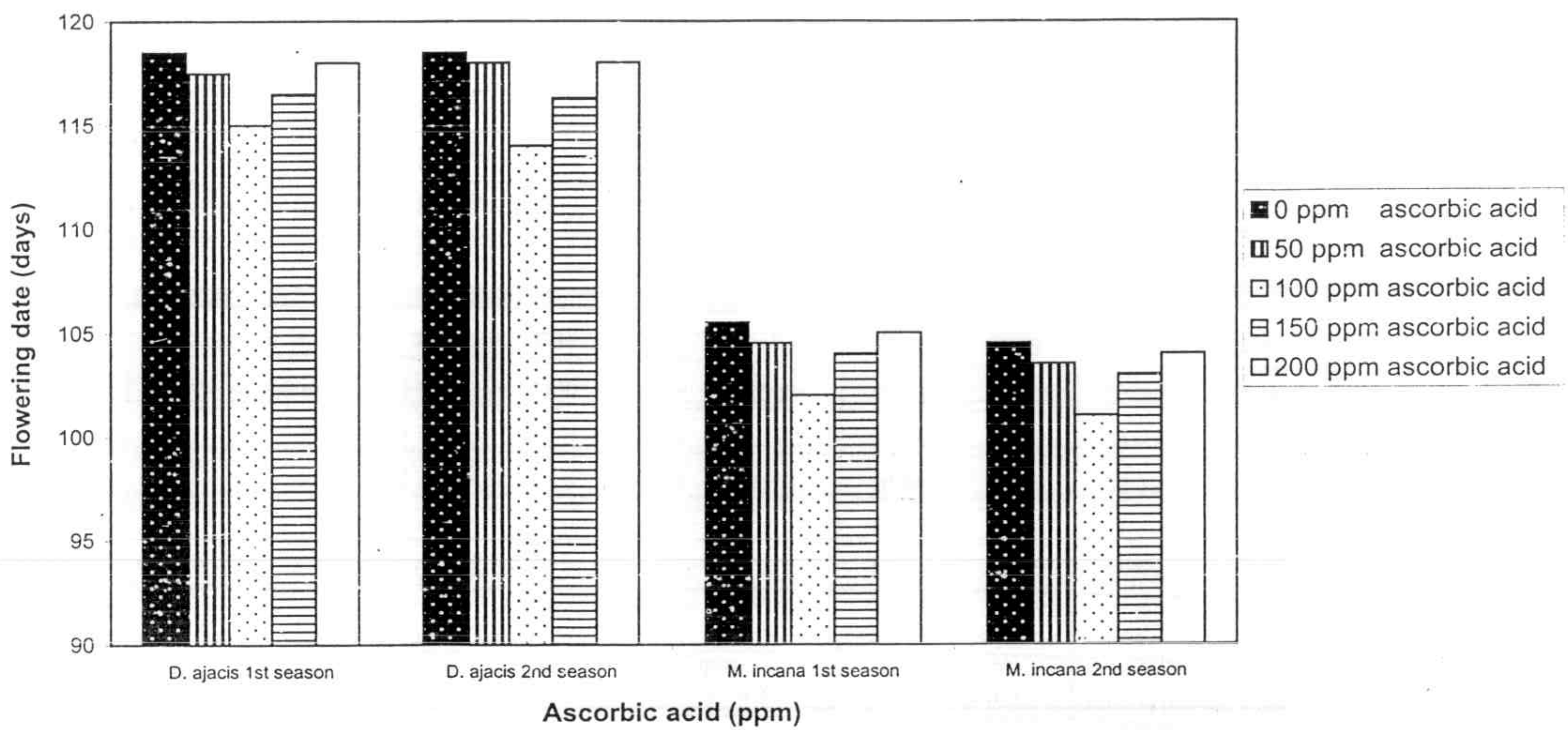

Fig. (17): Effect of ascorbic acid on flowering date of *Delphinium ajacis* and *Mathiola incana* plants.

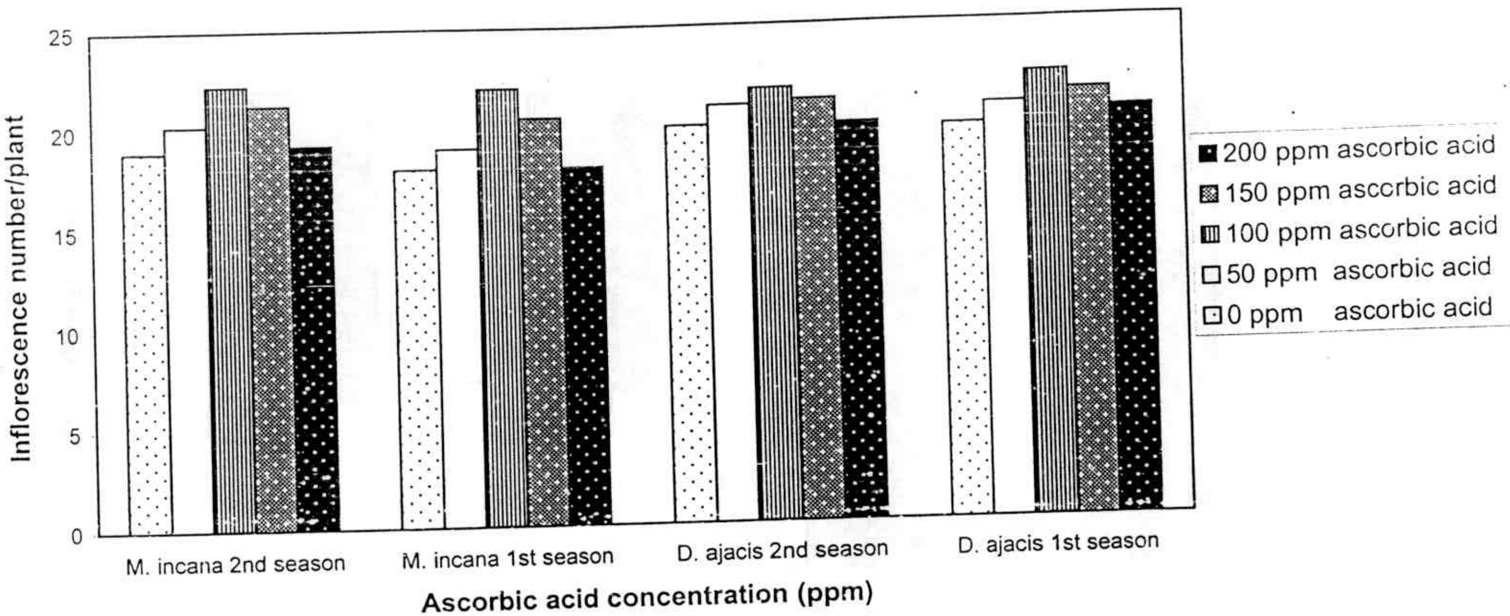

Fig. (18): Effect of ascorbic acid on inflorescence number of *Delphinium ajacis* and *Mathiola incana* plants.

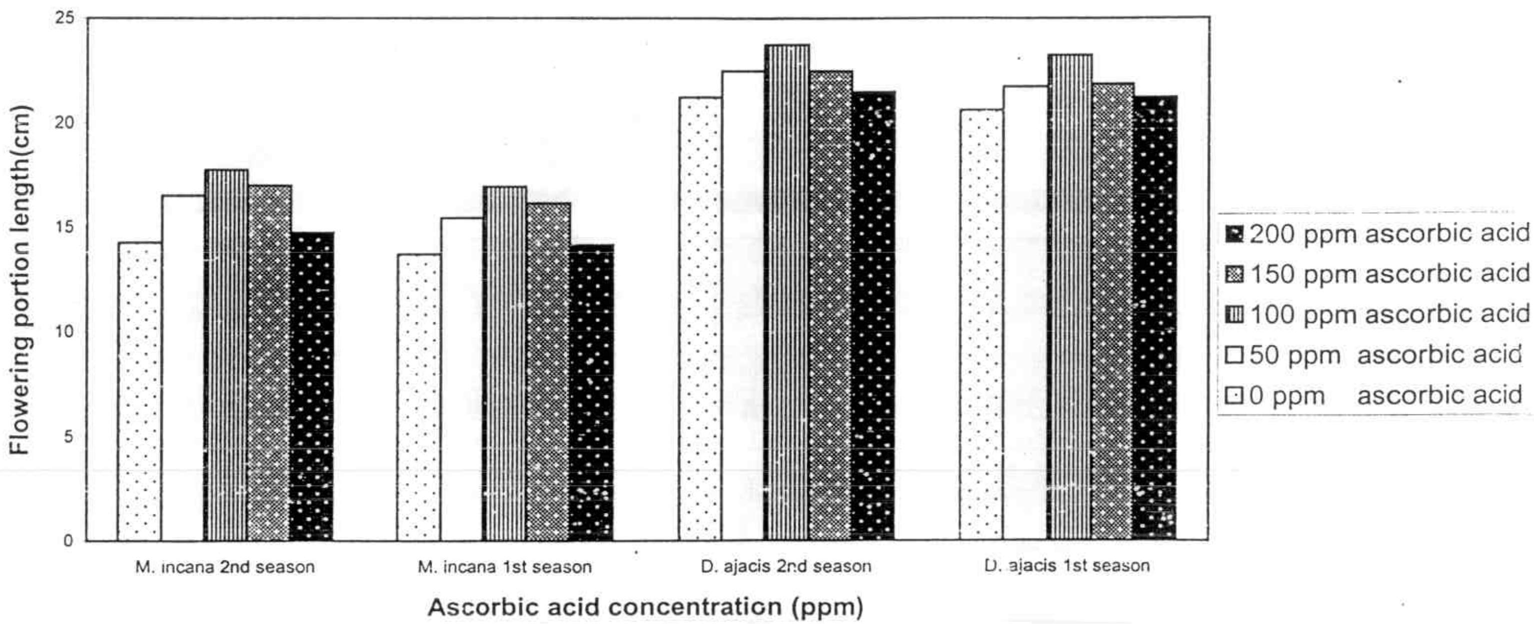

Fig. (19): Effect of ascorbic acid on flowering portion length of *Delphinium ajacis* and *Mathiola incana* plants.

4.3.3.5. Flowering portion weight:

Data in Table (16,b) show that using ascorbic acid concentrations at 50, 100 and 150 ppm significantly increased flowering portion weight of delphinium plant with a peak at 100 ppm in two seasons. The same trend was observed with mathiola plant but the significant increasing value included also 200 ppm ascorbic acid in the two seasons (Table, 16, b).

4.3.3.6. Florets number:

Data in Table (16, b) show that all levels of ascorbic acid (50-200 ppm) increased florets number per inflorescence with a peak at 100 ppm in the first and second seasons of both plants. These increases were significant at concentrations 50, 100 and 150 ppm of the two plants.

4.3.3.7. Florets weight:

Florets weight per inflorescence was typically in the same trend and significant values as in florets number (Table, 16, b).

4.3.3.8. Vase life:

Vase life of delphinium and mathiola inflorescences was slightly affected by ascorbic acid treatments. However, treatments of 50, 100 and 150 ppm of ascorbic acid significantly increased vase life of delphinium inflorescences whereas, concentrations at 100 and 150 ppm were only significant and increased vase life of mathiola inflorescences (Table, 16, b). The highest increase was observed at 100 ppm ascorbic acid on both plants in the two seasons.

Table (16, b): Effect of ascorbic acid on the flowering of *Delphinium ajacis* and *Mathiola incana* plants during the two successive seasons of 1998/1999 and 1999/2000

Plant	Ascorbic acid (ppm)	Flowering portion weight (g) /inflo.		Florets number /inflorescence		Florets weight (g) /inflorescence		Vas life (days)	
		First season	Second season.	First season	Second season.	First season	Second season.	First season	Second season.
Delphinium ajacis	0	4.50	4.53	7.0	7.3	2.14	2.19	16.0	16.3
	50	5.21	5.42	7.4	7.7	2.23	2.30	16.8	17.0
	100	6.38	6.43	7.9	8.1	2.37	2.41	17.3	17.5
	150	5.37	5.56	7.5	7.7	2.24	2.30	17.3	17.5
	200	4.50	5.26	7.2	7.4	2.19	2.21	16.3	16.5
	L.S.D. 5%	0.11	0.14	0.23	0.29	0.05	0.08	0.8	0.7
Mathiola incana	0	18.39	18.24	10.7	11.1	13.83	14.45	15.6	15.8
	50	19.02	19.06	12.0	12.9	15.78	17.13	15.9	16.2
	100	19.29	19.27	13.3	13.8	17.68	18.65	17.6	17.9
	150	19.12	19.18	12.6	13.3	16.70	17.75	16.6	16.9
	200	18.59	18.87	11.0	11.3	14.40	15.23	15.6	15.9
	L.S.D. 5%	0.14	0.12	0.6	0.6	0.90	0.86	0.9	0.6

These results of flowering parameters agree with those obtained by El-Kholy and Salem (1980) on Matricaria chamomilla plants.

The stimulative effect of vit. C on flowering parameters could be attributed to the effect of vitamin C on photosynthetic and respiration rates and leaf carbohydrate **(Dhopte and Lall, 1987)**

4.3.4. Seed yield:

4.3.4.1. Seed yield per plant:

Data in Table (17,a) show that the seed yield of delphinium and mathiola plants was significantly increased by using ascorbic acid at 100 ppm during the two seasons compared to the control treatment.

4.3.5.2. Seed yield per fedden:

Seed yield per fedden was typically in the same trend as in seed yield/plant in both plants (Table, 17,b), where the concentration of 100 had a significant increase in seed yield/fedden with the two plants in both seasons.

These results agreed with those obtained by Serebryakova and Kalanova (1977) on *Rosa cinnaniemea*, Tripathi and Singh (1989) on mustard plants and Agwah (1990) on lettuce plants.

Table (17,a): Effect of ascorbic acid on seed yield (g/plant) of *Delphinium ajacis* and *Mathiola incana* plants during the two successive seasons of 1998/1999 and 1999/2000

Ascorbic acid (ppm)	*Delphinium ajacis*		*Mathiola incana*	
	First season	Second season.	First season	Second season.
0	3.85	3.96	5.21	6.08
50	3.90	3.98	5.30	6.11
100	4.20	4.40	5.38	6.31
150	3.95	4.04	5.30	6.17
200	3.85	3.97	5.23	6.10
L.S.D. 5 %	0.10	0.11	0.17	0.17

Table (17,b): Effect of ascorbic acid on seed yield (kg/fedden) of *Delphinium ajacis* and *Mathiola incana* plants during the two successive seasons of 1998/1999 and 1999/2000

Ascorbic acid (ppm)	*Delphinium ajacis*		*Mathiola incana*	
	First season	Second season.	First season	Second season.
0	123.20	126.80	166.56	194.56
50	124.80	127.20	169.60	195.60
100	134.32	140.8	172.00	201.92
150	126.40	129.28	169.60	197.28
200	123.20	127.28	167.20	195.12
L.S.D. 5 %	3.25	3.53	3.78	3.23

4.3.5. Chemical constituents:

4.3.5.1. Total chlorophyll:

Data in Table (18) show that the total leaf chlorophyll content in delphinium and mathiola plants was clearly affected by treating with ascorbic acid during the two seasons. In this regard, there was a significant increase of leaf chlorophyll content with two plants due to ascorbic acid treatments (50-200 ppm) with a peak at 100 ppm during the two seasons, comparing to the control treatment.

These results agreed with those obtained by Tewary and Mookerjee (1982) on wheat and maize plants.

Ascorbic acid could be involved in the main metabolic processes especially with energy transfer coenzymes carbohydrate metabolism and improved photosynthetic activity **(Aberg, 1961).**

4.3.5.2. Soluble sugars:

Ascorbic acid treatments clearly affected sugars content in vegetative growth of delphinium and mathiola plants. Data in Table (18) show that all the used concentrations of ascorbic acid (50-200 ppm) caused a highly significant increase in this parameter with a peak at 100 ppm in the two seasons of the two plants.

These results agree with those obtained by Agwah (1990) on lettuce plants, Hanafy *et al.,* (1990) on pepper plants and Tarraf *et al.,* (1999) on lemongrass plants.

Table (18): Effect of ascorbic acid on chemical constituents of *Delphinium ajacis* and *Mathiola incana* plants during the two successive seasons of 1998/1999 and 1999/2000

	Ascorbic acid (ppm)	Total leaf chlorophyll (mg/g. d.wt.)		Soluble sugars content in V.G. (mg/g. d.wt.)		% Nitrogen in V.G. dry weight		% Phosphorus in V.G. dry weight		% Potassium in V.G. dry weight	
		First season	Second season.	First season	Second season.	First season	Second season.	First season	Second season.	First season	Second season.
Delphinium ajacis	0	2.58	2.60	40.26	39.18	1.90	2.18	0.370	0.383	4.90	4.92
	50	3.18	3.11	45.33	44.29	2.04	2.31	0.390	0.405	5.68	5.70
	100	3.80	3.55	47.95	46.87	2.40	2.68	0.423	0.430	5.99	6.01
	150	3.21	3.34	46.75	45.67	2.09	2.36	0.405	0.418	5.88	5.90
	200	3.15	2.98	45.17	44.26	2.00	2.28	0.378	0.390	5.06	5.08
	L.S.D. 5%	0.21	0.27	1.29	1.05	0.10	0.12	0.013	0.012	0.17	0.17
Mathiola incana	0	3.11	2.97	46.87	48.87	2.15	2.00	0.200	0.218	4.29	4.41
	50	3.80	3.57	51.83	53.71	2.83	2.68	0.208	0.218	5.04	4.84
	100	4.04	3.60	53.36	55.16	2.84	2.69	0.213	0.230	5.14	4.96
	150	4.04	3.60	53.36	55.16	2.83	2.68	0.210	0.225	5.14	4.96
	200	3.74	3.53	50.33	52.19	2.45	2.30	0.200	0.218	4.74	4.49
	L.S.D. 5%	0.27	0.28	0.89	0.74	0.24	0.28	0.012	0.010	0.46	0.41

V.G. = Vegetative growth

Functions of vit. C are reversal of stress effects (temperature and poisons), antioxidant, protection of chloroplast and electron transport system. It also stimulates respiration activities, cell devision and many enzymes activities **(Oertli, 1987).**

4.3.5.3. Nutrients:

4.3.5.3.1. Nitrogen:

Nitrogen percentage in the vegetative growth two plants was significantly increased by ascorbic acid treatments (50-200 ppm) except for 200 ppm on delphinium plant which was not significant. The highest increase in nitrogen was obtained at 100 ppm ascorbic acid in both seasons with two plants (Table, 18).

These results of nutrients content agree with those obtained by Hanafy *et al.*, (1990) on pepper, Gonzalez *et al.*, (1994) on *Allium cepa,* Tarraf *et al.*, (1999) on lemongrass plants and Arisha (2000) on potato plants.

4.3.5.3.2. Phosphorus:

Data in Table (18) show that P percentage in the vegetative growth of delphinium plants was in the same trend as in N percentage. Ascorbic acid at 50, 100 and 150 ppm significantly increased it comparing to control of the two seasons. For mathiola plant, it was different where P content was significantly increased only at 100 ppm in the two seasons of study (Table, 18).

These results of nutrients content agree with those obtained by Gonzalez *et al*., (1994) on *Allium cepa* Tarraf *et al*., (1999) on lemongrass plants.

4.3.5.3.3. Potassium:

Trends of increase in K percentage were similar in the vegetative growth of the two plants. Data in table (18) show that all the used treatments of ascorbic acid (50-200 ppm) increased K percentage in the vegetative growth of the two plants through the two seasons of study. Significant values were observed at 50, 100 and 150 ppm of ascorbic acid whereas 200 ppm was not significant.

These results of nutrients content agreed with those obtained by Gonzalez *et al*., (1994) on *Allium cepa* and Tarraf *et al*., (1999) on lemongrass plants.

This stimulation was accompanied by a significant increase of DNA synthesis per primordium. After a 24-h. imbibition, ascorbate and ascorbate free radical also increased cell length on onions **(Cabo *et al*., 1996)**