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EFFECT OF COLD STORAGE, GA_3 AND FERTILIZATION ON THE GROWTH, FLOWERING AND CHEMICAL COMPOSITION OF *Iris tingitana* CV. WEDGWOOD

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ABSTRACT

Two field experiments were carried out with *Iris tingitana* cv. Wedgwood during seasons 2000/2001 and 2001/2002.

The first experiment was designed to study the effect of soaking the bulbs in GA_3 at 50 and 100 ppm for 24 hours before or after cold storage at 8 ^{0}C for 1, 2 and 3 weeks on the vegetative growth, flowering and chemical composition of iris plants. In the second experiment, NPK fertilizers were applied to the bulbs stored at 8 ^{0}C for 1, 2 and 3 weeks. The nitrogen and phosphorus were used at the rates of 0.0, 150 and 200 kg/fed from ammonium nitrate (33.5% N) and calcium super phosphate (15.5% P_2O_5). Potassium was added at the rates of 0.0, 100 and 150 kg/fed from potassium sulphate (K_2O).

The results from the first experiment showed that the treatment of GA_3 at 100 ppm before storage at 8 ^{0}C for 3 weeks caused earlier flowering, increased the flowering stem length as well as the flower diameter. The same treatment produced the heaviest fresh and dry weights of flowering stems, flowers and leaves and gave the highest number of developed bulblets.

All storage periods and GA_3 treatments increased the auxins, phenols and reducing sugars in the bulbs before planting and 15 days after planting as well as increased percentages of N, P, K and total carbohydrates in the leaves and bulbs. The best treatment in this concern was the treatment of GA_3 at 100 ppm before storage at 8^{0} C for 3 weeks.

The results from the second experiment showed that the highest values for the above mentioned characters of the vegetative growth, flowering and percentages of N, P, K and total carbohydrates were obtained from treating with storage bulbs at 8^{0} C for 3 weeks and applying the NPK fertilization at 200: 200; 150 kg/fed.

INTRODUCTION

Iris (*Iris tingitana* L.) is a part of the large family of flowering plants named Iridaceae, which includes also many types of flowering bulbs. Iris used for the bulb frame and the alpine house, for water and bog gardens, for the rock garden and mainly used as popular cut flowers (Cassidy and Linnege, 1982).

Growth and development of iris plants are greatly influenced by storage treatment pre planting, growth substances and fertilizer application. Carlo (1984), Al-Ani (1986), Elphinstone and Rees (1988), Nabih and Aly (1988) and Koriesh (1989) reported that storage of iris bulbs at low temperature for different periods controlled the flowering and improved the quality of flowers and bulbs production.

In addition, Elphinstone and Rees (1990) and Nabih and Saker (1992) found that cold storage treatments of iris bulbs promoted flower bud initiation and differentiation compared to room temperature treatment.

Concerning the effect of GA_3, many workers reported that GA_3 treatments had a stimulating effect on growth and flowering of different flowering bulbs. Koriesh (1989) and Naglaa and Kandeel (2001) on iris, and Lopez *et al.* (1984) on gladiolus, found that soaking the bulbs or spraying the plants with GA_3 increased the vegetative growth, accelerated the flowering and improved both flower quality and bulb production.

On the other side, Fathy and Mohamed (1994), Naglaa and Kandeel (2001) found that the fertilization increased the vegetative growth and flowering of iris plants. Similar results were reported by Bhattacharjee, (1984), El-Hanafy (1985) on dahlia, Badran *et al.* (1989) on *Zantedeschia aethiopica*, Gowada *et al.* (1991) on *Polianthes tuberosa* and Zaghloul and Moghazy (2001) on gladiolus.

The aim of this work was to study the effect of cold storage of bulbs of *Iris tingitana* for different periods, GA_3 soaking and fertilization with NPK on the growth, flowering and chemical composition of iris.

MATERIALS AND METHODS

Two field experiments were carried out at the Experimental Farm of the Faculty of Agriculture, Suez Canal University during 2000/2001 and 2001/2002 seasons.

Uniformly bulbs (10± 1 cm) in circumference of *Iris tingitana* cv. Wedgwood (blue flowering strain) were chosen and planted in both seasons for the two experiments.

First experiment:

Effect of cold storage and GA_3 on the vegetative growth, flowering and chemical composition of iris plants.

Bulbs of *Iris tingitana* were cold stored at 8°C for 1, 2 and 3 weeks before planting on 17th October each season, while the bulbs for control treatments were kept at room temperature (26-28°C). Soaking the bulbs in GA_3 at 50 and 100 ppm for 24 hours was done before or after each cold storage treatment. Sixteen treatments were established in a complete randomized block design with three replicates. The treatments were as follows:

1. Control at room temperature (26-28°C without GA_3 soaking)

   Storage at 8° C for
2. 1 week
3. 2 weeks
4. 3 weeks
5. 1 week followed by soaking at 50 ppm GA_3
6. 2 weeks followed by soaking at 50 ppm GA_3
7. 3 weeks followed by soaking at 50 ppm GA_3
8. 1 week followed by soaking at 100 ppm GA_3

9 2 weeks followed by soaking at 100 ppm GA_3
10. 3 weeks followed by soaking at 100 ppm GA_3

Soaking at 50 ppm GA_3 followed storage at 8^0C for

11. 1 week
12. 2 weeks
13. 3 weeks

Soaking at 100 ppm GA_3 followed by storage at 8^0C for

14. 1 week
15. 2 weeks
16. 3 weeks

Second experiment:

In this experiment, the effect of cold storage and NPK fertilization on the vegetative growth, flowering and chemical composition of iris plants was studied.

After storing the bulbs at 8°C for 1, 2 and 3 weeks, they were planted on 17th October each season. One month after planting, NPK fertilizers were applied 3 times to the plants by side dressing at 3 weeks interval. Fertilization treatments were added at the rates of 0.0, 150 and 200 kg/fed from ammonium nitrate (33.5%N), calcium super phosphate (15.5 % P_2O_5) while potassium sulphate (48.5% K_2O) was added at 0.0, 100 and 150 kg/fed. The control bulbs were kept at room temperature (26-28°C) and none fertilized. This made 10 treatments in a complete randomized block design with three replicates as followed:

1- Control
2- Storage for 1 week + 0.0 fertilizer (F0)
3- Storage for 2 weeks + 0.0 fertilizer (F0)
4- Storage for 3 weeks + 0.0 fertilizer (F0)
5- Storage for 1 week + 150 + 150 +100 NPK kg/ fed (F1).
6- Storage for 2 weeks + 150 + 150 +100 NPK kg/ fed (F1)
7- Storage for 3 week + 150 + 150 +100 NPK kg/ fed (F1)
8- Storage for 1 week + 200 + 200 +150 NPK kg/ fed (F2)
9- Storage for 2 week + 200 + 200 +150 NPK kg/ fed (F2)
10- Storage for 3 week + 200 + 200 +150 NPK kg/ fed (F2)

In both experiments, the bulbs were planted in rows 50 cm apart and 10 cm in between. The experimental plot area was 1 x 1 m and contained 20 bulbs. All other agricultural practices were performed as usual. Physical and chemical analysis of soil are presented in Table (A). Soil properties were prepared and analyzed according to Page (1982).

Table (A): Some physical and chemical properties of the soil used.

Properties			Sand %	Silt %	Clay %	texture	pH	EC (dsm^{-1})
Particle size distribution %			95.9	2.8	1.3	sandy	7.4	1.10
Soluble cations $meqL^{-1}$					Soluble anions $meqL^{-1}$			
Na^+	Ca^+	Mg^{2+}	K^+		CO_3^{-2}	HCO_3^-	Cl^-	SO_4^-
2.60	6.15	1.70	0.43		0.0	1.40	2.50	6.98

Organic C (g/kg^{-1}) = 0.70, Total N (g/kg^{-1}) = 0.05, Available P (mg/kg^{-1}) = 5.80

Data were recorded for the number of days from planting to opening of the first flower (flowering date), flower stem length (cm), number of leaves/plant, fresh and dry weights of flower stems and leaves (g), flower diameter (cm) and fresh and dry weights of flowers.

At the end of experiment, bulbs were dug, cured and then the number of bulblets/plant, fresh weight of bulbs and bulblets were recorded. Before planting the bulbs (after treatments with cold storage and GA_3), and 15 days after cultivation, samples of bulbs were taken to determine the auxins, phenols and reducing sugar contents (mg/g) after the method of Fadi *et al.* (1979).

To study the apical stem development as affected by cold storage and GA_3 soaking during season of 2001/2002, fixation, dehydration and embedding the specimens has been done according to the method described by Sass (1967). Longitudinal medial sections were cut to 12 micron thickness stained as mentioned by Jackson (1926), then cleared by xylol, mounted in Canada balsam and finally the prepared slides were subjected to the microscope examination.

Nitrogen, phosphorus and potassium percentages were determined in both dry leaves and bulbs. Nitrogen and phosphorus were colourmeterically determined as described by Allen (1959) and Jackson (1962) respectively. Potassium content was determined by the flame photometer according to the method mentioned by Pipper (1950).

Leaves and bulbs contents of total carbohydrates were determined according to A.O.A.C. (1975).

Data were computed and analyzed using SAS program and the differences between the means of treatments were determined by LSD test according to Snedecor and Cochran (1968).

RESULTS AND DISCUSSION

1-Effect of cold storage and GA_3 on the growth and flowering of *Iris tingitana* L. cv. Wedgwood

Data in Tables (1 & 2) show that storage of the bulbs pre or after treatment with GA_3 enhanced the flowering date of iris plants. The number of days to flowering decreased as cooling period was increased from 1 to 3 weeks. The treatment with GA_3 at 100 ppm followed by storage at 8°C for 3 weeks significantly produced earlier flowering after 112 and 110 days from planting in both seasons respectively. On the other side, the control plants produced the first flower after 142 and 139 days in the first and second seasons respectively.

However, reducing the days to flowering of *Iris tingitana* as a result of cold storage was reported by Schipper (1982), Nabih and Aly (1988) and Koriesh (1989).

Table (1): Effect of storage at 8°C for different periods and GA_3 on the growth and flowering of *Iris tingitana* L. cv. Wedgwood during the first season 2000/2001.

Treatments	Flowering date (days)	Flower stem length (cm)	Fresh weight of flower stem (g)	Dry weight of flower stem (g)	Fresh weight of flowers (g)	Dry weight of flower (g)	Flower diameter (cm)	Number of leaves/ plant	Fresh weigh of leaves (g)	Dry weight of leaves (g)	Fresh weight of bulbs (g)	Number of bulblets	Fresh weight of bulblets (g)
Control	142.0	40.3	24.66	6.20	3.74	0.83	11.6	5.0	9.94	2.91	7.93	3.6	9.72
1 week at 8°C	135.0	45.0	30.89	7.89	4.64	1.07	12.6	5.3	12.45	3.72	9.62	4.3	11.44
2 weeks at 8°C	132.0	49.0	34.69	8.65	4.84	1.21	14.0	6.3	15.07	4.03	11.15	5.0	12.64
3 weeks at 8°C	121.0	51.0	37.83	9.32	5.10	1.30	14.0	7.3	16.69	4.38	12.60	5.3	13.64
1 wk (8°C) + 50 ppm GA_3	126.0	47.3	38.87	8.07	4.70	1.13	13.3	5.6	14.41	3.69	10.22	5.0	11.62
2 wk (8°C) + 50 ppm GA_3	122.0	49.6	40.19	8.80	5.08	1.27	13.6	6.6	16.90	4.04	12.00	5.6	13.17
3 wk (8°C) + 50 ppm GA_3	118.0	53.0	42.13	9.63	5.43	1.41	14.6	7.0	19.35	4.48	13.30	5.7	13.94
1 wk (8°C) + 100 ppm GA_3	122.0	48.6	35.05	8.43	5.34	1.17	14.3	5.6	15.40	4.03	10.45	5.3	12.85
2 wk (8°C) + 100 ppm GA_3	117.0	51.6	40.35	9.16	6.08	1.34	14.6	6.3	17.82	4.23	12.75	5.6	13.78
3 wk (8°C) + 100 ppm GA_3	116.0	54.1	46.06	10.05	7.28	1.52	15.0	6.6	21.25	4.66	13.60	6.0	14.22
50 ppm GA_3 + 1 wk (8°C)	120.0	48.0	33.86	8.56	4.88	1.13	13.3	6.0	14.25	4.08	11.38	4.6	12.40
50 ppm GA_3 + 2 wk (8°C)	118.0	50.3	38.86	9.14	5.97	1.30	14.3	6.6	17.10	4.25	12.20	5.0	14.17
50 ppm GA_3 + 3 wk (8°C)	117.0	52.6	44.02	9.85	7.11	1.48	15.0	6.7	19.47	4.53	13.57	5.7	15.40
100 ppm GA_3 + 1 wk (8°C)	122.0	49.6	38.25	8.98	6.18	1.31	14.6	6.6	16.56	4.15	11.35	4.6	13.65
100 ppm GA_3 + 2 wk (8°C)	116.0	52.3	41.81	9.65	7.03	1.49	15.3	6.3	18.19	4.47	13.40	5.3	14.48
100 ppm GA_3 + 3 wk (8°C)	112.0	54.6	49.28	10.45	8.80	1.72	15.6	7.0	21.42	4.78	14.20	6.0	15.72
L.S.D at 0.05	1.60	1.50	3.26	1.71	0.38	0.10	0.90	0.8	1.0	0.28	0.44	0.80	0.49

Table (2): Effect of storage at 8°C for different periods and GA_3 on the growth and flowering of *Iris tingitana* L. cv. Wedgwood during the second season 2001/2002.

Treatments	Flowering date (days)	Flower stem length (cm)	Fresh weight of flower stem (g)	Dry weight of flower stem (g)	Fresh weight of flowers (g)	Dry weight of flower (g)	Flower diameter (cm)	Number of leaves/ plant	Fresh weigh of leaves (g)	Dry weight of leaves (g)	Fresh weight of bulbs (g)	Number of bulblets	Fresh weight of bulblets (g)
Control	139.0	41.0	24.45	6.41	3.79	0.88	11.3	4.6	9.51	2.49	8.04	3.3	9.61
1 week at 8°C	132.0	45.3	34.01	7.29	4.55	1.01	12.3	5.6	12.93	3.62	9.24	4.3	11.32
2 weeks at 8°C	128.3	48.0	34.34	8.46	4.86	1.17	13.6	6.0	14.77	3.93	10.76	5.0	12.84
3 weeks at 8°C	120.0	50.3	37.55	9.19	5.04	1.28	14.3	7.0	16.87	4.28	12.58	5.3	13.69
1 wk (8°C) + 50 ppm GA_3	124.0	47.3	32.54	7.98	4.74	1.05	12.6	6.0	13.82	3.73	10.12	4.6	11.60
2 wk (8°C) + 50 ppm GA_3	120.0	48.6	36.66	8.67	5.08	1.22	14.0	6.3	16.35	4.03	11.99	5.3	13.25
3 wk (8°C) + 50 ppm GA_3	116.0	52.3	41.27	9.50	5.33	1.37	14.3	6.6	18.91	4.43	13.15	5.6	13.77
1 wk (8°C) + 100 ppm GA_3	120.0	49.3	34.86	8.37	5.22	1.16	13.6	6.0	15.42	3.94	11.01	5.3	12.68
2 wk (8°C) + 100 ppm GA_3	115.0	51.0	40.16	9.04	6.17	1.35	14.3	6.0	17.87	4.17	12.95	5.6	13.58
3 wk (8°C) + 100 ppm GA_3	114.0	53.3	46.68	9.87	7.42	1.48	15.0	6.6	21.06	4.62	13.73	5.7	14.13
50 ppm GA_3 + 1 wk (8°C)	118.0	48.3	33.88	8.48	4.95	1.10	13.0	5.6	14.37	4.07	11.40	4.6	13.00
50 ppm GA_3 + 2 wk (8°C)	116.0	49.6	38.26	9.02	5.94	1.27	14.0	6.3	16.66	4.25	12.15	5.3	14.12
50 ppm GA_3 + 3 wk (8°C)	115.0	52.3	43.37	9.66	6.74	1.42	14.6	6.3	19.37	4.45	13.42	5.7	15.28
100 ppm GA_3 + 1 wk (8°C)	120.0	49.3	38.20	8.81	6.18	1.27	15.0	6.3	16.51	4.12	11.23	4.6	13.48
100 ppm GA_3 + 2 wk (8°C)	114..0	51.0	42.36	9.54	6.98	1.45	15.6	6.3	18.52	4.39	13.33	5.3	14.02
100 ppm GA_3 + 3 wk (8°C)	110.0	55.3	48.62	10.33	8.48	1.68	16.0	6.7	21.23	4.73	14.11	5.7	15.84
L.S.D at 0.05	1.6	1.2	2.68	1.71	0.55	0.74	0.7	0.8	1.35	0.29	0.51	0.93	0.49

Wk = week

It can be concluded that cold storage had a significant effect on the acceleration of flowering earlines In this concern the obtained data show new approach by storage of the iris bulbs for short period at 8°C in order to attain early flowering.

The variation of flower initiation between the treated and non-treated plants might be related to the differences of endogenous growth substances that responded to shifting the vegetative growth stage to flowering phase. In this concern, Suskov and Lapteva (1969) found that storage of iris at 10°C increased the growth of the developing organs and stimulated the formation of axillary buds. Halevy and Shoub (1964) suggested that GA_3 affected on the enzymatic and hormonal system in the plant, while Rees (1972) attributed the failure of flowering to an insufficient amount of gibberellin like substances in the bulb scales.

On the other hand, the enhancement effect of storage and GA_3 on flowering date coincides with the anatomical behaviour of stem apex. It is clear from Fig. (1) that bulbs stored at room temperature showed little development in height and width of the stem apex. In this case, the rate of cell division is very low. While, the bulbs stored at low temperature and soaked in GA_3 (Fig 2 and Fig. 3) showed an increase in the height and width of apex as a first sign to transition from the vegetative to the flowering stage.

Elephinston and Rees (1988) reported that the greater part of leaf and inflorescence initiation occurs during the storage period. They added that the temperature must be the most important environmental factor affecting on the rate of development at this stage.

However, the anatomical behaviour of shoot apex as affected by GA_3 and cold storage was in parallel with the data presented in Tables (1&2), which indicated that such treatments are required to reduce the time from planting to flowering.

As for the length of flowering stem, data presented in Tables (1&2) indicate that cold storage and GA_3 treatments affected the flowering stem length. The promising effects were recorded from the bulbs soaked at 100 ppm GA_3 then stored at 8°C for 3 weeks. This treatment significantly increased the flowering stem to 54.6 and 55.3 cm compared to 40.3 and 41 cm for control plants in the first and second seasons respectively.

Similar conclusions were reported by Tonecki (1980) and Koriesh (1989) who found that the cold storage periods and GA_3 treatments increased the flowering stem of iris, since the GA_3 had stimulating effect on cell division, elongation and differentiation.

Regarding the fresh and dry weights of flowering stems and flowers, it is clear from the data in Tables (1&2) that increasing both storage periods and GA_3 concentrations significantly increased the fresh and dry weights of flowering stems and flowers. In both seasons, the heaviest fresh and dry weights of both were resulted from the treatment with GA_3 at 100 ppm before cold storage for 3 weeks. While the control treatments (storage at room temperature without GA_3) produced the lowest values. In this concern, the statistical differences were significant.

Fig. (2): Longitudal section of shoot apex of Iris after treating with cold storage for 3 weeks at 8°C (15 days from planting) showing an increase in height and width of stem apex.

Fig. (1): Longitudal section of shoot apex of Iris (15 days from planting) (control-room temperature) showing stem apex was still growing in vegetative stage and apical meristem was less in height and width.

Fig. (3): Longitudal section of shoot apex of Iris with treating GA_3 100 ppm and cold storage for 3 weeks at 8°C (15 days from planting) showing more development and more increase in height and width of the apical dome accompanied by the clear appearance of the flattening top of the original dome surface as well as the beginning of the initiation of the small protrusions.

These results are in agreement with those of Suskov and Lapteva (1969), Walla and Kristofferson (1969), Sano (1975) and Koriesh (1989) who reported that treating the iris bulbs with low temperature and GA_3 improved growth and flower quality. Also, Sebanek *et al.*, (1976) found that GA_3 lengthened the flower stem of tulip by 13 –27% through its effect on cell division and cell elongation.

As for the flower diameter, data in Tables (1&2) indicate that the flower diameter was affected by storage and GA_3 applications. The best results in this concern were observed with soaking the bulbs at 100 ppm GA_3 before storage for 3 weeks. However, this treatment increased the flower diameter by 34.4 and 41.5% over the control in the first and second seasons respectively.

A similar trend of results was reported by Bose *et al.* (1980) and Bhattacharjee (1984) who found that GA_3 increased the flower diameter of *Hippeastrum hybridum* and gladiolus respectively. On iris, Al-Ani (1986) and Koriesh (1989) stated that the cold storage and GA_3 treatments increased the flower diameter.

Concerning the number of leaves/plant, the results indicate that the greatest number of leaves was obtained from the treatment with GA_3 at 100 ppm followed by storage at 8°C for 3 weeks in comparison with control. The differences were significant in both seasons.

It is obvious from the data in Tables (1&2) that the treatments gave the largest number of leaves per plant were the same treatments, which increased the fresh and dry weights of leaves. It means that increasing the storage period and GA_3 concentrations before or after storage gradually increased the fresh and dry weights of leaves. The heaviest fresh and dry weights as 21.42, 21. 23 and 4.78 and 4.73 g were produced by treatment of GA_3 at 100 ppm followed by storage at 8°C for 3 weeks in the first and second seasons respectively.

Similar results were reported by Koriesh (1989) who stated that cold storage and application of GA_3 had a promoting effect on the plant growth and increased the fresh and dry weights of leaves of iris plants.

Concerning the effect on the bulb production, data presented in Tables (1&2) show that storage and GA_3 treatments had significant effects on increasing the fresh weight of bulbs, the number of developed bulblets and the fresh weight of bulblets. Therefore, increasing the storage period and GA_3 levels produced biggest and heaviest fresh weight of bulbs in both seasons. Treating with GA_3 at 100 ppm before storage for 3 weeks was the best treatment, which significantly increased the fresh weight of bulbs, the number of developed bulblets as well as the fresh weight of bulblets.

The obtained results are in accordance with those reported by Bhattacharjee (1984), Arora *et al.* (1992) on gladiolus and Fahmy (1982) and Koriesh (1989) on iris.

On this ground, storage of iris bulbs at 8°C for 3 weeks after soaking in GA_3 at 100 ppm for 24 hours could be practiced and recommended for improving the growth, flowering and increasing the bulbs productively of *Iris tingitana* cv. Wedgwood.

2-Effect of cold storage and GA_3 on the chemical composition of *Iris tingitana* L. cv. Wedgwood.

2-1 Auxins, phenols and reducing sugars in the bulbs

Data in Table (3) show the effect of cold storage and GA_3 treatments on the auxins-like substances, total phenols and reducing sugars in the bulbs of iris before planting and 15 days after planting.

An increase in the auxins, total phenols and reducing sugar contents was observed with increasing the period of cold storage and GA_3 concentrations. The highest values were recorded with bulbs soaked at 100 ppm GA_3 then stored for 3 weeks at 8°C. This observation was true in both seasons.

However, this treatment was the same treatment that produced the better growth and flowering of iris. This means that there was a relation between the contents of auxins, phenols and reducing sugars in the stored bulbs and the vegetative growth and flowering of iris plants.

This may be explained by the influence of cold storage on promoting the metabolism in the stored bulbs. In this respect, Halevy (1962) reported that storage of iris bulbs at 13^0 C gave a sharp rise in the total soluble sugar contents in the bulbs. In addition, Sano (1975) stated that the cold storage of iris might promote the metabolism in the stored bulbs by changing the polysaccharides into monosaccharides. So it could be stated that such treatments promoted flowering.

Similar observations concerning the increasing of auxins and reducing sugars as a result for treating the bulbs with chilling and GA_3 were reported by Jana and Biswas (1979) on tuberose and Koriesh (1989) on iris.

2-2 N, P, K and total carbohydrates % in the leaves and bulbs

Data in Table (4) indicate that storage of the iris bulbs at 8°C for different periods as well as application of GA_3 caused an increase in the N, P, K and total carbohydrates percentages in both dry leaves and bulbs. The highest values were recorded by soaking the bulbs in GA_3 at 100 ppm for 24 hours and storing at 8°C for 3 weeks. On the other hand, the untreated bulbs (control) gave the lowest percentages of N, P, K and carbohydrates in both seasons.

These results are in agreement with Rodrigues (1962) who concluded that an increasing has been happened with stored bulbs of iris. Sano (1975), Al-Ani (1986) and Naglaa and Kandeel (2001) reported that application of chilling period and GA_3 increased N, P, K and total carbohydrates contents on iris.

3- Effect of cold storage and fertilization on the growth and flowering of *Iris tingitana* L. cv. Wedgwood.

Data in Table (5) show the effect of cold storage at 8°C with NPK fertilization at rates of 150 +150 +100 kg/fed (F1) and 200 + 200 +150 NPK kg/ fed (F2) on the vegetative growth and flowering of iris during two seasons.

Table (3): Effect of storage at 8°C for different periods on the contents of auxins, total phenols and reducing sugars in the bulbs of *Iris tingitana* L. cv. Wedgwood during 2001/2002.

Treatments	First season						Second season					
	Auxins (mg/g)		Total phenols (mg/g)		Reducing sugars (mg/g)		Auxins (mg/g)		Total phenols (mg/g)		Reducing sugars (mg/g)	
	I	II	I	II	I	II	I	II	I	II	I	II
Control	0.001	0.010	0.080	0.094	0.010	0.015	0.002	0.013	0.089	0.092	0.012	0.017
1 week at 8°C	0.003	0.011	0.085	0.098	0.035	0.037	0.003	0.014	0.091	0.096	0.036	0.035
2 weeks at 8°C	0.004	0.020	0.092	0.099	0.040	0.042	0.005	0.022	0.096	0.098	0.043	0.041
3 weeks at 8°C	0.007	0.021	0.098	0.101	0.041	0.049	0.007	0.024	0.102	0.102	0.044	0.051
1 wk (8°C) + 50 ppm GA_3	0.010	0.017	0.101	0.105	0.046	0.050	0.012	0.019	0.107	0.103	0.048	0.052
2 wk (8°C) + 50 ppm GA_3	0.015	0.023	0.106	0.109	0.048	0.056	0.017	0.025	0.109	0.107	0.049	0.058
3 wk (8°C) + 50 ppm GA_3	0.021	0.028	0.112	0.114	0.050	0.062	0.020	0.029	0.111	0.111	0.052	0.061
1 wk (8°C) + 100 ppm GA_3	0.014	0.021	0.109	0.111	0.048	0.055	0.018	0.023	0.108	0.116	0.049	0.057
2 wk (8°C) + 100 ppm GA_3	0.017	0.029	0.116	0.121	0.059	0.058	0.021	0.031	0.118	0.113	0.061	0.060
3 wk (8°C) + 100 ppm GA_3	0.024	0.035	0.118	0.123	0.063	0.065	0.026	0.037	0.120	0.121	0.065	0.064
50 ppm GA_3 + 1 wk (8°C)	0.013	0.025	0.114	0.120	0.048	0.054	0.016	0.028	0.116	0.126	0.050	0.058
50 ppm GA_3 + 2 wk (8°C)	0.018	0.032	0.119	0.121	0.052	0.060	0.022	0.035	0.121	0.123	0.054	0.064
50 ppm GA_3 + 3 wk (8°C)	0.021	0.042	0.121	0.125	0.060	0.068	0.025	0.044	0.123	0.126	0.063	0.069
100 ppm GA_3 + 1 wk (8°C)	0.018	0.090	0.117	0.121	0.054	0.069	0.027	0.850	0.120	0.124	0.056	0.070
100 ppm GA_3 + 2 wk (8°C)	0.025	0.101	0.126	0.131	0.066	0.085	0.029	0.109	0.124	0.130	0.068	0.083
100 ppm GA_3 + 3 wk (8°C)	0.028	0.123	0.128	0.135	0.078	0.098	0.032	0.179	0.126	0.138	0.075	0.096

Wk = week

I: determination on samples 15 days after planting

II: determination on samples pre planting

Table (4): Effect of storage at 8°C for different periods on N, P, K and carbohydrates % in leaves and bulbs of *Iris tingitana* L. cv. Wedgwood during 2000/2001 and 2001/2002 seasons.

Treatments	Leaves								Bulbs							
	First season				Second season				First season				Second season			
	N %	P %	K %	Carb. %	N %	P %	K %	Carb. %	N %	P %	K %	Carb. %	N %	P %	K %	Carb. %
Control	1.15	0.10	3.10	8 92	1.13	0.11	3.04	8.70	0.86	0.07	2.42	5 65	0.81	0.08	2.31	5.51
1 week at 8°C	119	0.14	3 14	9.70	1.16	0.12	3.08	9 60	0.90	0.08	2.48	5.78	0.87	0.09	2.37	5.75
2 weeks at 8°C	1.21	0.16	3.17	9.93	1.20	0.13	3.11	9.85	0.95	0.11	2.51	5.90	0.90	0.10	2.42	5.88
3 weeks at 8°C	1.30	0.17	3.20	10.12	1.29	0.15	3.13	10.01	0.98	0.12	2.54	5.96	0.93	0.11	2.48	5.92
1 wk (8°C) + 50 ppm GA_3	1.33	0.16	3.14	9.76	1.31	0.14	3.12	9.65	0.95	0.09	2 50	5.80	0.98	0.10	2.53	5.83
2 wk (8°C) + 50 ppm GA_3	1.37	0.18	3.19	9.97	1.34	0.16	3.16	9.92	0.99	0.12	2.55	5.94	1.00	0.14	2.57	5.97
3 wk (8°C) + 50 ppm GA_3	1.39	0.19	3.21	10.10	1.37	0.18	3.18	10.04	1.01	0.14	2.58	5.98	1.02	0.17	2.61	6.00
1 wk (8°C) + 100 ppm GA_3	1.38	0.20	3.18	9.88	1.35	0.17	3.15	9.78	0.97	0.11	2.54	5.85	0.98	0.13	2.58	5.92
2 wk (8°C) + 100 ppm GA_3	1.40	0.22	3.20	10.0	1.38	0.18	3.17	9.98	1 00	0.14	2.59	5.97	1.03	0.18	2.62	5.99
3 wk (8°C) + 100 ppm GA_3	1.45	0.24	3.24	10.14	1.40	0.20	3.20	10 10	1.04	0.16	2.62	6.00	1 06	0.20	2.65	6.03
50 ppm GA_3 + 1 wk (8°C)	1.36	0.18	3.19	9.97	1.33	0.16	3.15	9 94	1.03	0.10	2.57	5.89	1.05	0.13	2.59	5.94
50 ppm GA_3 + 2 wk (8°C)	1.41	0.21	3.21	10.05	1.36	0.18	3.18	9.99	1.08	0.14	2.60	5.99	1.10	0.17	2.64	6.04
50 ppm GA_3 + 3 wk (8°C)	1.43	0.25	3.24	10.15	1.38	0.20	3.21	10.08	1.10	0.18	2 64	6.02	1.12	0.21	2.68	5.98
100 ppm GA_3 + 1 wk (8°C)	1.39	0.21	3.22	10.08	1.37	0.18	3.18	10.02	1.02	0.13	2.58	5.94	1.04	0 18	2.60	6 10
100 ppm GA_3 + 2 wk (8°C)	1.44	0.24	3.25	10.16	1.40	0.19	3.22	10.11	1.09	0.17	2.64	6.08	1.11	0.22	2.67	6.17
100 ppm GA_3 + 3 wk (8°C)	1.48	0.27	3 30	10.20	1.44	0.22	3.27	10.16	1.14	0.19	2.68	6.13	1 17	0.25	2 71	6.20

Wk = week

Table (5): Effect of storage at 8°C for different periods and fertilization on the growth and flowering of *Iris tingitana* L. cv. Wedgwood during 2000/2001 and 2001/2002 seasons.

Treatments	Flowering date (days)	Flower stem length (cm)	Fresh weight of flower stem (g)	Dry weight of flower stem (g)	Fresh weight of flowers (g)	Dry weight of flower (g)	Flower diameter (cm)	Number of leaves/ plant	Fresh weigh of leaves (g)	Dry weight of leaves (g)	Fresh weight of bulbs (g)	Number of bulblets	Fresh weight of bulblets (g)
	First season												
Control	139.0	41.0	24.45	6.41	3.79	0.88	11.3	4.7	9.51	2.94	8.04	3.3	9.61
1 week at 8°C + F.0	132.0	45.3	30.38	7.29	4.55	1.01	12.3	5.7	12.93	3.62	9.24	4.3	11.32
2 weeks at 8°C+ F.0	128.0	48.0	34.34	8.46	4.85	1.17	13.6	6.0	14.77	3.93	10.76	5.0	12.84
3 weeks at 8°C + F.0	120.0	50.3	37.55	9.19	5.08	1.28	14.3	7.0	16.87	4.28	12.58	5.3	13.69
1 week (8°C) + F.1	130.0	48.3	36.39	10.0	6.07	1.52	13.3	6.3	14.94	4.71	10.73	4.7	13.43
2 weeks (8°C) + F 1	125.0	53.0	41.84	10.45	7.54	1.61	14.3	7.0	17.49	4.86	12.52	4.7	14.52
3 weeks (8°C) + F 1	118.0	56.0	43.47	10.81	7.81	1.72	15.0	7.7	18.56	4.98	13.73	5.3	16.02
1 week (8°C) + F 2	129.0	51.7	40.84	10.55	7.84	1.64	14.3	7.0	17.45	4.91	12.42	4.7	14.00
2 weeks (8°C) + F 2	121.0	56.0	46.24	11.17	8.20	1.81	15.3	7.3	19.90	5.11	13.77	5.3	15.13
3 weeks (8°C) + F 2	116.0	59.0	50.20	12.24	10.05	1.94	16.6	7.7	21.54	5.71	15.01	6.3	16.93
L.S.D at 0.05	1.45	1.3	1.71	1.40	0.75	0.00	0.8	0.7	1.54	0.31	0.71	0.8	0.46
	Second season												
Control	142.0	40.3	24.66	6.20	3.74	0.83	11.7	5.0	9.94	2.91	7.93	3.6	9.72
1 week at 8°C + F.0	135.0	45.0	30.89	7.89	4.64	1.07	12.6	5.3	12.45	3.72	9.62	4.3	11.44
2 weeks at 8°C+ F 0	132.0	49.0	34.69	8.65	4.84	1.21	14.0	6.3	15.03	4.03	11.15	5.0	12.64
3 weeks at 8°C + F 0	121.0	51.0	37.83	9.32	5.10	1.30	14.0	7.3	16.69	4.38	12.60	5.3	13.64
1 week (8°C) + F 1	131.0	48.0	36.73	9.97	6.53	1.44	13.3	6.7	15.19	4.65	10.83	4.6	13.64
2 weeks (8°C) + F 1	119.0	54.3	40.46	10.51	7.49	1.60	14.0	7.3	16.51	4.91	12.60	5.0	14.85
3 weeks (8°C) + F 1	126.0	55.3	44.33	10.91	8.05	1.82	15.0	7.3	18.61	5.04	13.91	5.6	16.15
1 week (8°C) + F 2	130.0	50.0	41.08	10.53	7.94	1.55	14.6	7.3	18.01	4.88	12.98	5.0	14.23
2 weeks (8°C) + F 2	122.0	54.3	45.30	11.38	8.30	1.82	15.6	7.7	19.24	5.26	14.05	5.6	15.15
3 weeks (8°C) + F 2	117.0	58.7	51.20	12.25	10.17	1.93	16.7	8.0	22.16	5.55	15.66	6.0	17.27
L.S.D at 0.05	1.56	1.2	1.65	1.68	0.69	0.13	0.7	0.7	1.07	0.22	0.47	0.7	0.42

F1= 150+150+100 NPK Kg/Fed F2= 200+200+150 NPK Kg/ Fed

It is clear from the results that both storage and fertilization affected the flowering date of iris. The long period of cold storage (3 weeks) combined with the highest rate of fertilization as 200 + 200 +150 NPK kg/ fed (F2) produced the earlier flowering in both seasons. With this treatment, the first flower opening was attained after 116 and 117 days from planting in first and second seasons respectively. The statistical differences between the treatments were significant in both seasons.

The effect of cold storage and NPK fertilization on decreasing the number of days to flowering was also recorded by Al-Ani (1986) on iris. While Zaghloul and Moghazy (2001) found that increasing the fertilization rates produced earlier flowering on gladiolus plants.

Data in Table (5) clearly indicate that storage the bulbs at 8°C for 3 weeks with the fertilization at the highest rate (200 + 200 +150 NPK kg/ fed (F2) significantly increased the flowering stem length to 59.0 and 58.7 cm comparing to control which gave 41.0 and 40.3 cm in the first and second seasons respectively.

On the other side, the fresh and dry weights of flowering stems and flowers were significantly increased by increasing the periods of cold storage and fertilization rates. The heaviest fresh and dry weights of flowering stems and flowers in the both seasons were produced from the treating with storage at 8°C for 3 weeks and fertilization at 200 + 200 +150 NPK kg/ fed (F2)

Regarding the flower diameter, data presented in Table (5) show that the best treatment, which gave the broadest diameter of iris flowers, was storage at 8°C with 200 + 200 +150 NPK kg/ fed fertilization (F2). The flower diameter reached 16.6 and 16.7 cm compared to 11.3 and 11.7 cm for control treatments in the first and second seasons respectively

In general, the data presented in Table (5) indicate that all periods of storage as well as levels of fertilization had significant stimulatory effects on the vegetative growth, flowering and bulb productivity of iris in comparison with control (room temperature without fertilization).

The treatment with storage at 8°C for the longest period (3 weeks) combined with the highest rate of fertilization 200 + 200 +150 NPK kg/ fed was the best treatment which significantly increased the number of leaves per plant, the fresh and dry weights of leaves, the fresh weight of bulbs, the number of developed bulblets and the fresh weight of bulblets. The statistical analysis concerning the above mentioned characters were significant in both seasons

The nutrition with NPK improved the plant growth and provided the plants with the requirements of essential elements needed for growth Better vegetative growth should be directly reflected on various flowering aspects In this respect, Jones (1969) found that fertilization treatments influenced the plant growth stimulation and assimilation of carbon dioxide and photosynthesis rate.

Many investigators as Fernandes et al. (1977) on gladiolus and Al-Ani (1986) on iris came to similar conclusion and stated that storage of the bulbs at low temperature with fertilization improved the flower quality and produced the largest number of bulblets.

It could be concluded that the treatment with storage of the bulbs at 8°C for 3 weeks beside the fertilization with 200 + 200 +150 NPK kg/ fed (F2) is the recommended treatment for improving the growth and flowering of *Iris tingitana*.

4- Effect of cold storage and fertilization on the chemical composition of *Iris tingitana* L. cv. Wedgwood.

Data in Table (6) show that the cold storage of iris bulbs and the fertilization with NPK raised the contents of N, P, K and total carbohydrates in both dry leaves and bulbs of iris comparing to control.

The percentages were gradually increased by the gradual increase in the periods of storage and the rates of fertilization. This was true in both seasons. The highest values in this concern were obtained from the treatment with cold storage at 8°C for 3 weeks combined with the highest rate of fertilization as 200 + 200 +150 NPK kg/ fed. The increase in the N, P, K, and total carbohydrate contents could be resulted from the increase in the uptake of the nutrients through the root system, which became more capable of absorbing more amounts of nutrients.

Table (6): Effect of storage at 8°C for different periods on N, P, K and carbohydrates % in leaves and bulbs of *Iris tingitana* L. cv. Wedgwood during 2000/2001 and 2001/2002 seasons.

Treatments	Leaves				Bulbs			
	N %	P %	K %	Carb. %	N %	P %	K %	Carb. %
	First season							
Control	1.15	0.10	3.10	8.92	0.86	0.07	2.42	5.65
1 week at 8°C + F.0	1.19	0.14	3.14	9.70	0.90	0.08	2.48	5.78
2 weeks at 8°C+ F.0	1.21	0.16	3.17	9.93	0.95	0.11	2.51	5.90
3 weeks at 8°C + F.0	1.30	0.17	3.20	10.12	0.98	0.12	2.54	5.90
1 week (8°C) + F.1	1.34	0.18	3.42	10.68	0.96	0.11	2.56	6.40
2 weeks (8°C) + F 1	1.46	0.19	3.48	10.96	1.07	0.14	2.68	6.70
3 weeks (8°C) + F 1	1.62	0.23	3.59	11.08	1.10	0.18	2.80	6.81
1 week (8°C) + F 2	1.48	0.21	3.44	10.97	1.06	0.17	2.69	6.57
2 weeks (8°C) + F 2	1.68	0.25	3.62	11.13	1.16	0.19	2.84	6.85
3 weeks (8°C) + F 2	1.76	0.27	3.81	12.25	1.20	0.21	2.98	6.98
	Second season							
	1.13	0.11	3.04	8.70	0.81	0.08	2.31	5.51
Control	1.16	0.12	3.08	9.60	0.87	0.09	2.37	5.75
1 week at 8°C + F.0	1.20	0.13	3.11	9.85	0.90	0.10	2.42	5.88
2 weeks at 8°C+ F 0	1.29	0.15	3.13	10.01	0.93	0.11	2.48	5.92
3 weeks at 8°C + F 0	1.31	0.16	3.35	10.65	0.95	0.11	2.51	6.31
1 week (8°C) + F 1	1.40	0.18	3.42	10.90	1.03	0.13	2.65	6.65
2 weeks (8°C) + F 1	1.58	0.20	3.53	11.02	1.08	0.16	2.75	6.75
3 weeks (8°C) + F 1	1.45	0.19	3.38	10.95	1.08	0.15	2.65	6.50
1 week (8°C) + F 2	1.60	0.22	3.50	11.03	1.12	0.17	2.80	6.75
2 weeks (8°C) + F 2	1.71	0.24	3.73	12.10	1.17	0.19	2.95	6.92

F1= 150+150+100 NPK Kg/Fed F2= 200+200+150 NPK Kg/ Fed

On the other hand, the increase in the N, P, K and carbohydrates may be attributed with the effect of fertilization on the protein synthesis and photosynthesis which reflected on better metabolism and translocation of metabolites to different organs of plant.

The obtained results were in accordance with those reported by Rodrigues (1962), Al-Ani (1986) and Naglaa and Kandeel (2001) on *Iris tingitana*.

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تأثير فترات التخزين البارد ، حمض الجبريللين و التسميد على النمو و الازهار و المحتوى الكيماوى للايرس صنف ويدج وود

حمدى كمال عطاالله و مصطفى زغلول
قسم البساتين كلية الزراعة جامعة قناة السويس الإسماعيلية ٤١٥٢٢ مصر

أجرى هذا البحث بمزرعة كلية الزراعة جامعة قناة السويس خلال موسمى ٢٠٠٠/٢٠٠١ و ٢٠٠١/٢٠٠٢ على أبصال الايرس صنف ويدج وود. اشتمل البحث على تجربتين التجربة الأولى تهدف إلى دراسة تأثير النقع فى حمض الجبريللين قبل و بعد التخزين البارد على النمو و الازهار و المحتوى الكيماوى لنباتات الايرس. فى هذه التجربة تم تخزين أبصال الايرس على درجة حرارة ٨ مئوية لمدة ١ ، ٢ و ٣ أسبوع و كذلك النقع فى حمض الجبريللين بتركيزات ٥٠ و ١٠٠ جزء فى المليون لمدة ٢٤ ساعة قبل التخزين أو بعد انتهاء التخزين. بينما كان الهدف من التجربة الثانية دراسة تأثير التخزين البارد و التسميد على النمو و الازهار و المحتوى الكيماوي لنباتات الايرس.و فى هذه التجربة تم زراعة الأبصال بعد التخزين البارد على درجة ٨ مئوية لمدة ١، ٢ و ٣ أسبوع. و بعد شهر من الزراعة تم إضافة السماد بمعدل صفر، ١٥٠ + ١٥٠ +١٠٠ كيلو جرام/فدان و ٢٠٠ + ٢٠٠ + ١٥٠ كيلو جرام/ فدان من سماد نترات الامونيوم(٣٣و٥ % نيتروجين) ، سوبر فوسفات الكالسيوم (١٥و٥% فوء أ) و سلفات البوتاسيوم (٤٨% بوء أ)
و كانت أهم النتائج المتحصل عليها كالآتى:

١- أدى نقع الأبصال فى حمض الجبريللين قبل التخزين أو بعد التخزين على درجة ٨ مئوية إلى التبكير فى الازهار و حدوث زيادة فى طول الساق الزهرى و قطر الزهرة و الوزن الطازج و الجاف للسيقان الزهرية و الازهار و الأوراق. كما حدثت زيادة فى الوزن الطازج للابصال و البصيلات الناتجة و الوزن الطازج للبصيلات. و بصفة عامة فان المعاملة بنقع الأبصال فى حمض الجبريللين بتركيز ١٠٠ جزء فى المليون قبل التخزين لمدة ٣ أسابيع كانت أفضل المعاملات و التى أدت إلى حدوث زيادة معنوية فى الصفات السابق ذكرها.

٢- زادت المعاملة بنقع الأبصال فى حمض الجبريللين بتركيز ١٠٠ جزء فى المليون قبل التخزين لمدة ٣ أسابيع من محتوى الأبصال فى الأكسينات و الفينولات و السكريات المختزلة سواء قبل زراعة الأبصال أو بعد الزراعة بخمسة عشر يوما. كما زادت تلك المعاملة من النسب المئوية لكل من النيتروجين و الفوسفور و البوتاسيوم و الكربوهيدرات الكلية فى أوراق و أبصال الايرس.

٣ -أدى كل من التخزين البارد و التسميد إلى حدوث زيادة معنوية فى الصفات الخضرية و الزهرية للايرس. و عموما كانت معاملة التخزين على درجة ٨ درجة مئوية لمدة ٣ أسابيع مع التسميد بمعدل ٢٠٠ + ٢٠٠ + ١٥٠ كيلو جرام/ فدان من سماد نترات الامونيوم(٣٣و٥ % نيتروجين) ، سوبر فوسفات الكالسيوم (١٥و٥% فوء أ) و سلفات البوتاسيوم (٤٨% بوء أ) هى أفضل المعاملات. حيث انها زادت أيضا من محتوى الاوراق و الأبصال من النيتروجين و الفوسفور و البوتاسيوم و الكربوهيدرات الكلية.

و من النتائج السابقة و لكى نحصل على أفضل معدل النمو و أيضا التبكير فى الازهار فى نبات الايرس فانه يمكن التوصية بنقع الأبصال فى حمض الجبريللين بمعدل ١٠٠ جزء فى المليون قبل التخزين لمدة ٣ أسابيع على درجة ٨ مئوية. كذلك يوصى بتخزين الأبصال كما سبق ثم التسميد على ٣ دفعات ٢٠٠ + ٢٠٠ + ١٥٠ كيلو جرام/ فدان من سماد نترات الامونيوم و سوبر فوسفات الكالسيوم و سلفات البوتاسيوم.للحصول على أفضل صفات جودة للأزهار و أعلى محصول من الأبصال.