

EFFECT OF ACTOSOL (HUMIC ACID), KRISTALON AND MAGNETIC IRON ON FLOWERING AND BULBS PRODUCTIVITY OF *IRIS TINGITANA* CV. WEDGEWOOD UNDER DIFFERENT STORAGE CONDITIONS

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ABSTRACT: In a trial to solve some of the most important problems facing the production and quality of *Iris tingitana* cv. Wedgewood plant under local conditions in Egypt including the short and late blooming season in spring. Moreover, the study aimed also to solve the problem of the deterioration of bulbs productivity year after year. So, two separate field experiments were conducted throughout two successive seasons (2017/2018 and 2018/2019) at the nursery of Horticulture Research Institute, Agriculture Research Center, Giza, Egypt. In the first experiment, bulbs of 8-9 cm circumference were treated with different types of storage treatments pre-planting (room temperature, cold storage at 5 °C for 3 and 6 weeks (main factor), besides, some soil additives (sub factor) of kristalon and magnetic iron at 2 g/pot, as a soil dressing and actosol at 5 ml/l as a soil drench for 6 times throughout the growth cycle at open field conditions. While, in the second experiment, bulblets of 5-6 cm circumference, were treated with the same soil additives, besides the same storage treatments. Results showed that cooling the bulbs for 3 weeks proved its mastery in improving most plant traits comparing with other storage treatments (experiment 1). The registered values indicated the prevalence of storage the bulblets pre-planting at cold storage condition for 3 weeks in giving the utmost highest values of number of bulbs/plot (bulbs yield), followed in the second rank of bulblets stored at room temperature (experiment 2). On other side, the different soil additives were differed in their effects in improving plant traits, where the best treatment was a result of applying kristalon treatment followed in the second category with actosol (experiments 1 and 2). A negligible effect was observed regarding chemical constituents in the two experiments. From the aforementioned results, it could be recommended to use the different types of storage treatments for prolonging the flowering season. Besides, supplying plants with kristalon or actosol in some instances for achieving the hope of obtaining *Iris tingitana* flowers of high quality throughout a pronounced prolongation of the flowering season and high yields of bulbs resulted from bulblets.

Key words: *Iris tingitana* cv. Wedgewood, kristalon, Actosol (humic acid), magnetic iron, storage condition.

INTRODUCTION

Iris is a flowering popular plant and comprises about 300 species native of South America and belongs to the family Iridaceae (Baiely, 1963). The main important problem

in the production of Iris flowers in Egypt is the very short blooming season in late winter, which is considered very late for exportation. However, the advanced methods and techniques offered the possibility of

producing many ornamental bulb flowers in the time required for exportation by subjecting the bulbs to different cold storage treatments pre-planting. In this respect Yue *et al.* (1991) mentioned that it was possible to force Dutch Iris cv. Bule Magic early and produce good quality cut flower, long flower stalk with short leaves, with pre-cooling bulbs at 9 °C for 9 weeks. Eliwa (2000) on two iris cultivars (Wedgewood and Purple Sensation) found that cold storage treatments at 5 °C for 3, 5 and 7 weeks advanced flowering date more than room temperature storage (28 ± 3 °C). They decreased number of leaves/plant, spike stem length and diameter, fresh weight of cut spike and flowering percentage. El-Hanafy *et al.* (2005) on Iris cv. Purple Sensation added that cold storage treatments for 5 weeks at 5 °C decreased plant height with inducing early flowering. Stem apex development was enhanced as a result of cold storage treatment. On the other side, many authors agreed that cold storage treatment pre-planting accelerated stem apex development of Iris bulbs in comparison with the effect of room temperature storage (Nabih, 1982; Nabih and Sakr, 1992; Eliwa, 2000; Badawy, *et al.*, 2002 and El-Hanafy *et al.*, 2005).

The beneficial effect of cold storage treatment on Iris floral bud initiation might be attributed to the accumulation of the stimulating plant hormones such as gibberellins and cytokinins under the condition of low temperature, also the optimal balance between the levels of those stimulators and inhibitors inside the bud tissues (Einert *et al.*, 1972 and Rakhimbaev *et al.*, 1978 on tulip). Also the cold temperature effect could be referred to the increase in content of soluble carbohydrates (Hobson, 1975 on tulip) as well as the activities of enzyme system especially the invertase (Hobson, 1975 on tulip). These physiological activities possibly bring about faster initiation and development of the floral bud in the bulbs stored at cold temperature than in case of room temperature treatment.

The commercial product of kristalon 19:19:19 is a complete fertilizer with macro and micro elements proved its superiority for improving flowering quality of various ornamental bulb plants as mentioned by many scientists (Soliman, 2002) on *Iris tingitana* cv. Purple Sensation and Mansour *et al.*, (2015) on *Gladiolus grandiflorus* cv. Peter Pears. Such great effect of kristalon might be attributed to its content of N, P and K as they play a major role in growth and development of any plant. Besides, its content of micronutrients which play an important role in most vital processes of plants although they are needed in small quantities (Marschner, 1995).

Actosol is an organic fertilizer containing humic acid (H.A.) and other nutritional elements (El-Seginy, 2006). Using actosol seems to be valuable in correcting the probable occurrence of certain deficiency symptoms. This is attained through increasing the soil water holding capacity, improving soil structure and enhancing the metabolic activity of microorganisms. It also act as a source of nitrogen, phosphorus, sulfur and other elements for plants (Petrovic *et al.*, 1982 and Higa and Wididana, 1991). Moreover, Stevenson (1994) concluded that humic substances isolated from different materials contained 45-65% carbon, 30-48% oxygen, 2-6% nitrogen and 5% hydrogen. Humic substances (HS) are important as a soil component because they constitute a stable fraction of carbon (C), thus regulating the carbon cycle and release nutrients including nitrogen (N), phosphorus (P) and sulphur (S). Additively, the presence of HS improves pH buffering and thermal insulation. Dorer and Paenock (1997) added that, a salt of humic acid reaction is one of several humic substances which can provide soil microbes with energy and improve nutrients retention in the soil. In this connection, many efforts had been done on the effect of actosol on growth of various plant species. Hanel and Muller (2006) observed that *Gladiolus imbricatus* grew well in moderately and strongly acidic humic acid. Eliwa *et al.*

(2009), on *Iris tingitana* cv. Wedgewood concluded that supply plants with actosol as a foliar spray at the rate of 2.5 ml/l was the best treatment for increasing plant height and number of leaves/plant. El-Sayed *et al.* (2010) on two *Gladiolus* cvs. (White and Rose Prosperity) concluded that soaking the corms before planting in actosol solution (a humic acid 10:10:10) liquid organic fertilizer at the rate of 20 ml/l for 0, 12 and 24 hours increased plant parameters.

On the other side, it is well known that magnetic iron enhances N, P, K and Fe uptake which stimulate plant growth. Moreover, it induces cell metabolism and mitosis of meristematic cells (Belyavskaya, 2001). It is believed that new protein bands are formed in plants treated with magnetic iron and these proteins are responsible for increasing growth (Hozyan and Adul, 2010). Moreover, it decreases the hydration of salt ions and colloids having a positive effect on salt stability leading finally to leach the salts. So, it is successfully used to reclaim soils with high cations and anions content such as Ca, Na and HCO₃ (Mostafazadeh *et al.*, 2012).

In this connection, Ahmed *et al.* (2016) worked on *Acalypha wilkesiana* and concluded that the means of various root growth characters were gradually increased with increasing magnetic iron dose to reach the maximal values by the rate of 6 g/pot that gave the highest means over control in the two seasons.

Therefore, the work embodied in this paper aimed to study the effect of the individual as well as the combined effects of different types of storage treatments (room temperature storage and cold storage at 5 °C for three and six weeks for either bulbs or bulblets and different soil additives of kristalon and magnetic iron applied as a soil dressing and actosol applied as a soil drench.

MATERIALS AND METHODS

Two separate field experiments were consummated throughout two successive seasons (2017/2018 and 2018/2019) on *Iris*

tingitana cv. Wedgewood at the nursery of Horticulture Research Institute, Agriculture Research Center, Giza, Egypt with the aim to extend flowering season and improving flowers and bulbs quality.

Therefore, the individual as well as the combined effects of different storage treatments (room temperature and cold storage at 5 °C for 3 and 6 weeks of 8-9 cm circumference bulbs (first experiment) and bulblets of 5-6 cm circumference (second experiment) and different soil additives for the planted bulbs and bulblets (actosol at 5 ml/l applied as a soil drench and kristalon and magnetic iron at 2 g/pot were applied as a soil dressing. The scheme of the two experiments (1 and 2) was similar, except for the size of the planted bulbs or bulblets (bulbs of 8-9 cm circumference for the first experiment and bulblets 5-6 cm circumference for the second one in which the later (second experiment) aimed to raise new formed bulbs from bulblets.

Materials:

- Bulbs of 8-9 cm circumference in the first experiment and bulblets of 5-6 cm circumference for the second experiment were used in both seasons.
- 25 cm plastic pots.
- Chemical fertilizer (the commercial fertilizer kristalon 19:19:19 at 2 g/pot
- Organic fertilizer (actosol) at 5 ml/l.
- Magnetic iron at 2 g/pot.

Growing medium of sand + clay (1:1, v/v). The chemical properties of the growing medium are presented in Table (a).

Procedures:

The bulbs and bulblets were lifted on May 15th, in both seasons. After examining and cleaning, bulbs of 8-9 cm circumference and bulblets of 5-6 cm circumference were selected and kept at room temperature of 26±3 °C during May, 27±3 °C during June, 28±3 °C during July and August, 27±3 °C during September and 26±3 °C during October. On October, 15th the bulbs (first

Table a. Chemical properties of the growing media used in plantation according to Reclamation & Development Center for Desert Soil, Faculty of Agriculture, Cairo University according to Page (1982).

Soil type	Particle size distribution (%)				S.P.	E.C (dS/m)	pH	Cations (meq/l)				Anions (meq/l)		
	Coarse sand	Fine sand	Silt	Clay				Ca ⁺⁺	Mg ⁺⁺	Na ⁺	K ⁺	HCO ₃ ⁻	Cl ⁻	SO ₄ ⁻
Sand	89.03	2.05	0.40	5.52	25.00	7.75	6.73	11.11	6.08	58.20	10.34	0.96	58.99	25.78
Clay	7.54	22.28	30.55	39.63	40.00	7.80	1.97	4.96	3.10	10.64	1.09	1.02	1.32	7.45

experiment) and bulblets (second experiment) were planted (one bulb or bulblet per pot). After one month from planting the three groups of bulbs and bulblets of storage treatments were redivided into another four groups for studying the effect of the different soil additives for either the planted bulbs or bulblets. Actosol at 5 ml/l was applied as a soil drench and kristalon and magnetic iron at 2 g/pot were applied as a soil dressing. In this connection, the growing plants received the different soil additives at 15 days interval commencing from one month from planting (6 times throughout the growth season).

Twelve treatments (3 types of storage × 4 types of soil additives) were carried out in every experiment (1 and 2). Every experimental unit contained 3 bulbs or bulblets in the first and second experiment, respectively. A factorial experiment in a randomized complete design (RCD) with three replicates was employed in both experiments. The main factor represented storage treatments, whereas subfactor represented the soil additives. Every treatment contained 9 bulbs or bulblets, replicated three times (3 bulbs or bulblets in every experimental unit). Regular agricultural practices such as weeding, irrigation ... etc. were carried out whenever needed.

The following data were recorded:

- First experiment: plant height (cm), number of leaves/plant at flowering stage, number of days from planting to flowering (flowering date), spike stem length (cm), spike stem diameter (cm) and fresh weight of cut spike (g).

- Second experiment: plant height, number of leaves/plant, No. of bulbs/plot (bulbs yield), number of bulblets/plot (bulblets yield), fresh weight of bulb (g), fresh weight of bulblet (g) and pigments content of the fresh leaves (chlorophyll a, b and carotenoids (mg/g f.w.), which were determined according to Wettstein (1957).

The layout of each experiment was randomized complete design (RCD) with three replicates. The main factor for both experiments was storage treatments, whereas, the sub-factor represented by soil additives of actosol (5 ml) which was applied as a soil drench, kristalon (2 g/pot) and magnetic iron (2g/pot) which were applied as a soil dressing. Every experimental unit contained three bulbs (first experiment) and three bulblets (second experiment) and every treatment contained 9 bulbs or bulblets.

Chemical analysis:

The following determinations were carried out in the second season

- Determination of chlorophyll (a and b) and total carotenoides content (mg/g f.w) in fresh leaves were carried out according to Wettstein (1957).
- Total carbohydrates % in newly formed bulbs in the second experiment was determined using colorimetric method described by Dubois *et al.* (1956).

Data were tabulated and statistically analyzed using SAS program (1994) and means were compared by L.S.D. method according to Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

First experiment: Effect on plant parameters:

Plant height:

Data exhibited in Table (1) exert that subjecting the bulbs before planting at cold storage condition (for 6 weeks) caused a decrement in plant height with significant effect in both seasons. In this connection, the decrement of plant height due to cold storage treatments was in accordance with the findings of Yue *et al.* (1991). They mentioned that it was possible to force Dutch Iris cv. Blue Majic early with short leaves. El-Hanafy *et al.* (2005) on Iris cv. Purple Sensation added that cold storage treatment

for 5 weeks decreased plant height with inducing early flowering.

On the other side, the different soil additives significantly differed in their effect. Treating plants with either kristalon or actosol proved their mastery in producing the tallest plant height in both seasons. In contrast, the least scores were obtained as a result of untreated control plants. Meanwhile, magnetic iron gave an intermediate effect in this regard. In this respect, a lot of scientists recorded the beneficial effect of treating plants with either kristalon or actosol for improving plant quality as Soliman (2002) on *Iris tingitana* cv. Purple Sensation and Mansour *et al.* (2015) on *Gladiolus grandiflora* cv. Peter

Table 1. Effect of storage bulbs, some soil additives and their interaction on plant height (cm.) and No. of leaves/plant of *Iris tingitana* cv. Wedgewood in the two seasons (2017/2018 and 2018/2019).

Soil additives	Room	Storage treatments						
		3 weeks	6 weeks	Mean	Room	3 weeks	6 weeks	Mean
Plant height (cm)				Number of leaves/plant				
1st season								
Control	80.83	82.83	77.33	80.33	6.00	6.66	5.20	5.95
Kristalon	86.33	89.65	72.67	82.88	6.70	7.07	6.00	6.59
Iron	82.17	84.00	79.33	81.83	6.25	6.85	5.45	6.18
Actosol	84.33	86.67	80.50	83.83	6.60	7.00	5.75	6.45
Mean	83.41	85.79	77.46		6.39	6.89	5.6	
LSD at 0.05		A= N.S. B=N.S. A×B=N.S.			A= 1.325 B= 2.250 A×B= 3.689			
2nd season								
Control	82.25	84.22	79.58	82.02	7.30	7.60	7.15	7.35
Kristalon	90.80	92.02	84.46	89.09	8.01	8.15	7.70	7.95
Iron	84.15	85.41	80.25	83.27	7.60	7.82	7.25	7.56
Actosol	87.55	88.53	82.54	86.21	7.80	7.95	7.55	7.77
Mean	86.19	87.54	81.71		7.67	7.88	7.41	
LSD at 0.05		A= N.S. B= N.S. A×B= N.S.			A= 1.809 B= 3.007 A×B= 4.513			

Pears. The improvement effect of kristalon might be attributed to its content of P and K as they play a major role in growth and development of the plant. Moreover, the beneficial effect of actosol (humic acid) in improving plant quality might be attributed to its effect in increasing the soil water holding capacity, improving soil structure and enhancing the metabolic activity of microorganisms. It also acts as a source of nitrogen, phosphorus, sulfur and other elements for plants (Petrovic *et al.*, 1982 and Higa and Widiana (1991). Moreover, Eliwa *et al.* (2009) on *Iris tingitana* concluded that supplying the plant with actosol as a foliar spray at the rate of 2.5 ml/l was the best treatment for increasing plant height.

With respect to the interaction, it is evident from data that the highest plant height was obtained due to bulbs which received either room storage or cold storage for 3 weeks and treated with kristalon in both seasons.

Number of leaves/plant:

Data outlined in Table (1) recorded slight effects on number of leaves/plant, with insignificant effects in both seasons, it could be mentioned that storing the bulbs at either room temperature or at cold storage condition for 3 weeks pre-planting were the best treatments used for raising number of leaves/plant in both seasons. Whereas, the least scores in this respect were related to bulbs, which stored for 6 weeks at cold storage condition in the two seasons.

On the other hand, treating plants with either kristalon or actosol slightly raised number of leaves/plant in the two seasons, with insignificant effects in both seasons.

In the matter of the interaction, the obtained values showed an increment in number of leaves/ plant due to bulbs stored at room temperature and received kristalon treatment as well as the bulb, stored at cold storage for 3 weeks and treated with actosol in the two seasons.

In this connection, the prevalence of actosol in increasing number of leaves/plant

was also recorded by Eliwa *et al.* (2009) as they concluded that supplying the plant of *Iris tingitana* cv. Wedgewood with actosol as a foliar spray at the rate of 2.5 ml/l was the best treatment for increasing number of leaves/plant. Moreover, El-Sayed *et al.* (2010) on two *Gladiolus* cultivars (White and Rose Prosperity) concluded that soaking the corms before planting in actosol at the rate of 20 ml/l for 0, 12 and 24 hours improved plant parameters.

Flowering parameters:

1. Number of days from planting to flowering, (flowering date):

Using cooled stored bulbs accelerated flowering date in both seasons, comparing with those stored at room temperature. In this connection, the earliest flowering in the two seasons was a result of bulbs stored at cold storage for 6 weeks, followed with those gained from bulbs cooled for 3 weeks. However, such results agreed to a great extent with the finding of many authors. Eliwa *et al.* (2009) on two *Iris tingitana* cultivars (Wedgewood and Purple Sensation) found that cold storage treatment at 5 °C for 3, 5 and 7 week advanced flowering date more than room temperature storage (28±2 °C). Moreover, El-Hanafy *et al.* (2005) on *Iris* cv. Purple Sensation added that, cold storage treatment for 5 weeks at 5 °C decreased plant height with inducing early flowering.

In brief, the different storage treatments caused a pronounced prolongation of the flowering season.

On the other side, and concerning the effect of the different soil additives, kristalon treatment proved its mastery in inducing the earliest flowering as it recorded the least number of days for flowering in the two seasons. Whereas, untreated control plants recorded the latest flowering as indicated in Table (2).

In the matter of the interaction, it is evident from data listed in Table (2) that bulbs which received cold storage treatment for 6 weeks and kristalon treatment induced

Table 2. Effect of storage bulbs, some soil additives and their interaction on number of days from planting to flowering and spike stem length (cm) of *Iris tingitana* cv. Wedgewood in the two seasons (2017/2018 and 2018/2019).

Soil additives	Storage treatments							
	Room	3 weeks	6 weeks	Mean	Room	3 weeks	6 weeks	Mean
	Number of days flowering				Spike stem length (cm)			
1st season								
Control	142.33	136.67	134.00	137.67	42.33	44.17	38.17	54.89
Kristalon	138.00	132.33	129.67	133.33	46.17	49.67	41.67	61.50
Iron	140.00	136.08	133.67	136.58	43.53	45.67	39.66	55.95
Actosol	139.07	135.33	132.00	135.47	45.50	48.17	40.67	59.78
Mean	139.85	135.10	132.33		61.88	57.92	54.29	
LSD at 0.05		A= 2.580 B= 3.056 A×B= 5.213			A= 1.580 B= 2.335 A×B= 2.978			
2nd season								
Control	144.78	138.58	136.21	139.86	45.41	47.25	44.22	57.96
Kristalon	140.51	132.36	131.50	134.79	49.26	52.75	48.74	64.58
Iron	142.11	138.27	135.88	138.75	46.61	49.77	46.76	59.05
Actosol	141.35	137.78	134.58	137.90	47.59	51.25	47.78	62.87
Mean	142.19	136.75	134.54		64.97	61.01	57.38	
LSD at 0.05		A= 2.893 B= 3.547 A×B= 6.547			A= 1.852 B= 2.770 A×B= 3.098			

the earliest flowering (the least number of days from planting to flowering) whereas, the latest one was a result of bulbs stored at room temperature and untreated with the different soil additives in both seasons.

2. Spike stem length:

With respect to the effect of the different storage treatments on spike stem length data exhibited in Table (2) exert that room stored bulbs gave the utmost highest values of spike stem length in the two seasons, whereas, cooled stored bulbs for 6 weeks resulted in the lowest means in the two seasons.

Concerning the effect of the different soil additives, data listed in Table (2) cleared that kristalon treatment was the best for increasing spike stem length, followed by

plants which received actosol treatment in both seasons. In contrast, the least scores were obtained due to untreated control plants in both seasons. Referring to the interaction the highest values were obtained due to bulbs cold stored for 6 weeks and received kristalon treatment in both seasons.

In this respect, the superiority of kristalon in increasing spike stem length was in conformity with other scientists on the role of kristalon in improving quality of various ornamental bulbs as mentioned by Soliman (2002) on *Iris tingitana* cv. Purple Sensation and Mansour *et al.* (2015) on *Gladiolus grandiflora* cv. Peter Pears. Such great effect of kristalon might be attributed to its content of N, P and K as they play a major role on growth and development of

many plants. Besides, micronutrients content which also play an important role in most vital processes of plants although they are needed in small quantities (Marschner, 1995).

3. Spike stem diameter:

Insignificant effects were observed on spike stem diameter in both seasons as a result of the effect of the different storage treatments, soil additives treatments or their interactions as shown in Table (3).

4. Fresh weight of cut spike:

Marked influence were observed in fresh weight of cut spike due to the effect of the different storage treatments used in both seasons. In this connection, the heaviest fresh weight was observed due to the effect

of room stored bulbs or those which received cold storage for 3 weeks whereas the least scores were a result of the effect of cooled stored bulbs for 6 weeks in the two seasons.

In this respect, the decrement in fresh weight of cut spike due to supplying plants cold storage treatments was in agreement with Eliwa *et al.* (2009) on two *Iris tingitana* cultivars (Wedgewood and Purple Sensation), recording that cold storage treatments for 3, 5 and 7 weeks decreased fresh weight of cut spike.

On the other side, and regarding the effect of soil additives, the heaviest fresh weight of cut spike was a result of treating plants with kristalon followed by those which received actosol treatment in both seasons.

Table 3. Effect of storage bulbs, some soil additives and their interaction on spike stem diameter (mm) and fresh weight of cut spike (g) of *Iris tingitana* cv. Wedgewood in the two seasons (2017/2018 and 2018/2019).

Soil additives	Storage treatments							
	Room	3 weeks	6 weeks	Mean	Room	3 weeks	6 weeks	Mean
	Spike stem diameter (mm)				Fresh weight of cut spike (g)			
1st season								
Control	0.66	0.70	0.63	0.78	33.30	36.30	31.22	33.61
Kristalon	0.75	0.78	0.70	0.92	37.50	39.25	35.08	37.28
Iron	0.71	0.72	0.65	0.81	35.28	36.75	33.77	35.27
Actosol	0.73	0.75	0.68	0.86	36.66	37.50	34.60	36.25
Mean	0.91	0.84	0.76		35.68	37.45	33.67	
LSD at 0.05		A= N.S. B=N.S. A×B=N.S.			A= 1.325 B= 2.250 A×B= 3.689			
2nd season								
Control	0.72	0.74	0.70	0.85	38.25	40.58	34.50	37.78
Kristalon	0.79	0.84	0.77	1.06	44.77	45.50	38.12	42.80
Iron	0.73	0.77	0.71	1.00	41.52	42.42	35.55	39.83
Actosol	0.76	0.81	0.75	1.03	42.33	43.00	37.68	41.00
Mean	1.05	1.01	0.91		41.72	42.87	36.46	
LSD at 0.05		A= N.S. B= N.S. A×B= N.S.			A= 1.809 B= 3.007 A×B= 4.513			

The interaction, on the other hand, indicated the great influence on fresh weight of cut spike, resulting from treating plants which received room storage or cold storage for 3 weeks, kristalon followed in the second rank by those of bulbs stored at room temperature and received actosol treatment in the two seasons.

Pigments content in the leaves:

Data exhibited in Table (4) reveal negligible effects on pigments content in the leaves due to treating plants with either the different storage treatments or that of the different soil additives.

Second experiment: Effect on plant parameters:

Plant height:

Data registered in Table (5) reveal that storage the bulblets pre-planting at cold storage condition for three weeks gave the utmost highest values of plant height in both seasons comparing with those gained from other storage treatments used with significant effects in most cases. Meanwhile, the lowest record was gained due to using cold storage for 6 weeks.

On the other hand, marked influence on plant height was observed in both seasons as a result of applying the different soil additives, where the utmost highest values were recorded due to using kristalon treatment, followed by the effect of receiving plants actosol treatment comparing with either that gained from magnetic iron treatment or untreated control plants in the two seasons.

Concerning the interaction, it is evident from data scored in Table (5) the prevalence of bulblets cold stored for 3 weeks and treated with kristalon in giving the highest values of plant height in both seasons.

Number of leaves/plant:

As shown from data outlined in Table (5), bulblets which received room temperature storage gave the highest means of number of leaves/plant in the two seasons.

However, bulblets stored at cold storage for 6 weeks gave the lowest means in the two seasons.

On the other side, the obtained data indicated that supplying plants with kristalon was the best for increasing number of leaves/plant in the two seasons, followed by plants treated with actosol in both seasons.

In the matter of the interaction, it is evident from the registered values, the great influence of supplying bulblets stored at cold storage for 3 weeks kristalon treatment followed by bulblets stored at the same condition (3 weeks cold storage) and treated with actosol for producing the highest values of number of leaves/plant in both seasons.

Bulbs and bulblets productivity:

1. Number of bulbs/plot:

Data exhibited in Table (6) exert the beneficial effect of storing bulblets at cold storage condition for 3 weeks before planting. Such treatment gave rise to the utmost highest values of number of bulbs/plot, with significant effect in both seasons followed by bulblets stored at room temperature in both seasons. Meanwhile, bulblets received cold storage for 6 weeks gave the lowest means in this regard.

Referring to the effect of the different soil additives, it is evident from scored values, the great influence of receiving plants kristalon treatment followed by those which received actosol, with significant effect in most cases.

Concerning the interaction, it is clear from scored values that bulblets which received cold storage for 3 weeks and treated with kristalon was the best treatment used in elevating number of bulbs/plot in the two seasons, followed by bulblets which received cold storage for three weeks and treated with actosol in the two seasons.

2. Number of bulblets/plot and bulblets yield:

Evidently, data exhibited in Table (6) indicate the prevalence of storing bulblets at

Table 4. Effect of storage bulbs, some soil additives and their interaction on chlorophyll a, b and carotenoids (mg/g f.w.) of *Iris tingitana* cv. Wedgewood in the season (2018/2019).

Soil additives	Storage treatments											
	Room	3 weeks	6 weeks	Mean	Room	3 weeks	6 weeks	Mean	Room	3 weeks	6 weeks	Mean
	Chlorophyll a				Chlorophyll b				Carotenoids			
Control	0.71	0.77	0.70	0.73	0.42	0.45	0.40	0.42	0.50	0.55	0.48	0.51
Kristalon	0.78	0.82	0.76	0.79	0.46	0.49	0.45	0.46	0.55	0.59	0.53	0.56
Iron	0.73	0.79	0.72	0.75	0.43	0.46	0.42	0.43	0.51	0.56	0.50	0.52
Actosol	0.75	0.80	0.74	0.76	0.45	0.47	0.44	0.45	0.53	0.58	0.51	0.54
Mean	0.74	0.79	0.73		0.44	0.47	0.43		0.52	0.57	0.50	

Table 5. Effect of storage bulbs, some soil additives and their interaction on plant height (cm) and No. of leaves/plant of *Iris tingitana* cv. Wedgewood in the two seasons (2017/2018 and 2018/2019).

Soil additives	Storage treatments							
	Room	3 weeks	6 weeks	Mean	Room	3 weeks	6 weeks	Mean
	Plant height (cm)				Number of leaves/plant			
1st season								
Control	70.33	72.78	68.78	70.63	4.10	4.25	3.95	4.1
Kristalon	76.60	77.52	73.00	75.71	4.70	4.80	4.40	4.63
Iron	73.08	74.77	70.58	72.81	4.25	4.43	4.10	4.26
Actosol	75.20	76.58	71.60	74.46	4.53	4.57	4.20	4.43
Mean	73.80	75.41	70.99		4.39	4.51	4.16	
LSD at 0.05								
		A= 0.528				A= 0.255		
		B= 0.716				B= 0.327		
		A×B= 1.880				A×B= 0.589		
2nd season								
Control	76.23	78.24	74.25	76.24	4.85	5.06	4.70	4.87
Kristalon	83.35	84.61	81.54	83.17	5.53	5.75	5.30	5.53
Iron	79.25	80.54	77.22	79.00	4.97	5.38	4.83	5.06
Actosol	81.60	82.32	79.29	81.07	5.20	5.50	5.05	5.25
Mean	80.10	81.42	78.07		5.14	5.42	4.97	
LSD at 0.05								
		A= 0.655				A= 0.408		
		B= 0.812				B= 0.522		
		A×B= 2.091				A×B= 0.956		

Table 6. Effect of storage bulbs, some soil additives and their interaction on number of bulbs/plot and number of bulblets/plot of *Iris tingitana* cv. Wedgewood in the two seasons (2017/2018 and 2018/2019).

Soil additives	Storage treatments							
	Room	3 weeks	6 weeks	Mean	Room	3 weeks	6 weeks	Mean
	Number of bulbs/plot				Number of bulblets/plot			
1st season								
Control	3.67	4.33	3.50	3.83	9.06	10.00	8.50	9.19
Kristalon	4.95	5.00	4.50	4.82	16.00	18.00	15.00	16.33
Iron	4.00	4.51	3.67	4.06	11.67	12.78	10.33	11.59
Actosol	4.33	4.75	3.85	4.31	13.00	14.00	13.45	13.48
Mean	4.24	4.65	3.88		12.43	13.69	11.82	
LSD at 0.05								
		A= 0.151				A= 0.602		
		B= 0.556				B= 0.933		
		A×B= 1.026				A×B= 2.586		
2nd season								
Control	4.25	4.58	4.05	4.29	12.11	13.11	10.15	11.79
Kristalon	5.00	5.35	4.95	5.1	18.05	20.17	16.12	18.11
Iron	4.50	4.75	4.20	4.48	14.78	15.22	12.55	14.18
Actosol	4.80	4.90	4.50	4.73	16.00	17.30	14.27	15.86
Mean	4.64	4.89	4.42		15.23	16.45	13.27	
LSD at 0.05								
		A= 0.225				A= 0.862		
		B= 0.671				B= 1.023		
		A×B= 1.589				A×B= 2.898		

cold storage condition for three weeks pre-planting in elevating number of bulblets/plot (bulblets yield) with significant effect comparing with those gained from either bulblets stored at either room temperature or at cold storage for 6 weeks.

On the other side, number of bulblets/plot considerably increased with significant effect due to applying kristalon treatment in the two seasons. The other treatments of soil additives gave means closely near together and occupied the second rank in this concern in both seasons.

In the matter of the interaction, a great influence on number of bulblets/plot was obtained due to storing the bulblets pre-planting at cold storage condition for 3 weeks and treated with kristalon. Such

treatment gave rise to the utmost highest values in the two seasons.

3. Fresh weight of the produced bulb:

Data presented in Table (7) indicated that receiving bulblets either stored at room temperature or at cold storage for 3 weeks were the best treatments for producing the heaviest fresh weight of bulb in both seasons.

The different soil additives were differed in their effects on the fresh weight of the newly bulbs, where using kristalon treatment was the best in this regard formed producing the heaviest fresh weight of newly formed bulb in the two seasons, followed by the effect of actosol in improving the same trait. The least scores were a result of untreated bulbs (control) in both seasons.

Table 7. Effect of storage bulbs, some soil additives and their interaction on fresh weight of the produced bulb and fresh weight of the produced bulblets of *Iris tingitana* cv. Wedgewood in the two seasons (2017/2018 and 2018/2019).

Soil additives	Storage treatments							
	Room	3 weeks	6 weeks	Mean	Room	3 weeks	6 weeks	Mean
	Fresh weight of the produced bulb				Fresh weight the produced bulblets			
1st season								
Control	10.90	11.34	10.20	10.81	1.88	2.13	1.68	1.90
Kristalon	12.21	12.75	11.90	12.29	2.35	1.80	2.24	2.13
Iron	11.50	11.85	10.80	11.38	1.92	1.76	1.85	1.84
Actosol	11.90	12.10	11.35	11.78	1.98	1.97	1.83	1.93
Mean	11.63	12.01	11.06		2.03	1.91	1.90	
LSD at 0.05								
		A= 0.330				A= 0.102		
		B= 0.652				B= 0.283		
		A×B= 1.107				A×B= 0.560		
2nd season								
Control	11.67	12.09	10.96	11.57	1.79	1.95	1.65	1.80
Kristalon	13.09	14.30	12.01	13.13	2.20	2.50	2.00	2.23
Iron	11.73	13.15	11.27	12.05	1.89	2.05	1.85	1.93
Actosol	12.50	14.10	11.75	12.78	2.10	2.25	1.90	2.08
Mean	12.25	13.41	11.50		1.99	2.19	1.85	
LSD at 0.05								
		A= 0.409				A= 0.120		
		B= 0.751				B= 0.205		
		A×B= 1.298				A×B= 0.602		

With respect to the effect of the interaction, it is clear from data, the prevalence of treating bulblets cooled for 3 weeks with kristalon in the two seasons for increasing fresh weight of the produced bulb.

4. Fresh weight the produced bulblets:

Cooling the bulblets for 3 weeks pre-planting or those stored at room temperature gave rise to an increment in fresh weight of the newly formed bulblets in the two seasons.

Concerning the effect of the different soil additives, kristalon proved its mastery in elevating fresh weight of the produced bulblets in the two seasons, followed by bulblets treated with actosol in both seasons.

The interaction, on the other side, indicate that bulblets which received cold storage for 3 weeks and treated with either kristalon or actosol was the best treatment used for producing the heaviest fresh weight of bulblets in the two seasons.

Chemical constituents:

1. Pigments content in leaves:

It is evident from data presented in Table (8) that negligible effects on pigments content in the leaves were noticed as a result of treating plants with either the different storage treatments or that of the different soil additives.

Table 8. Effect of storage bulbs, some soil additives and their interaction on chlorophyll a, b and carotenoids (mg/g f.w.) of *Iris tingitana* cv. Wedgewood in the season (2018/2019).

Soil additives	Storage treatments											
	Room	3 weeks	6 weeks	Mean	Room	3 weeks	6 weeks	Mean	Room	3 weeks	6 weeks	Mean
	Chlorophyll a				Chlorophyll b				Carotenoids			
Control	0.70	0.76	0.69	0.72	0.41	0.44	0.40	0.42	0.49	0.53	0.47	0.50
Kristalon	0.75	0.80	0.73	0.76	0.44	0.49	0.43	0.45	0.54	0.59	0.51	0.55
Iron	0.72	0.77	0.71	0.73	0.42	0.45	0.41	0.43	0.43	0.54	0.49	0.51
Actosol	0.73	0.79	0.72	0.75	0.43	0.47	0.42	0.44	0.51	0.56	0.50	0.52
Mean	0.72	0.78	0.71		0.42	0.46	0.41		0.51	0.55	0.49	

2. Total carbohydrates % of the newly formed bulbs:

The different storage treatments as well as the different soil additives revealed negligible effects on total carbohydrates % in the newly formed bulbs (Table, 9).

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Table 9. Effect of storage bulbs, some soil additives and their interaction on total carbohydrates % of *Iris tingitana* cv. Wedgewood in the two seasons (2018/2019).

Soil additives	Storage treatments			Mean
	Room	3 weeks	6 weeks	
1st season				
Control	19.50	20.20	19.33	19.68
Kristalon	20.83	22.20	20.15	21.06
Iron	19.60	20.90	19.60	20.03
Actosol	19.75	21.75	19.80	20.43
Mean	19.92	21.26	19.72	
2nd season				
Control	19.40	19.65	19.30	19.45
Kristalon	20.05	20.65	19.90	20.20
Iron	19.77	19.90	19.60	19.76
Actosol	19.95	20.15	19.75	19.95
Mean	19.79	20.09	19.64	

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تأثير الأكتوسول و الكريستالون و الحديد الممغنط على إنتاج الأزهار و الأبصال في نبات الأيرس صنف Wedgewood تحت ظروف مختلفة من التخزين

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في محاولة لحل بعض المشاكل التي تواجه إنتاج وجودة نبات الأيرس (*Iris tingitana* cv. Wedgewood) تحت الظروف المصرية متضمنة قصر موسم الإزهار وتأخره عن الميعاد المطلوبة فيه الأزهار للتصدير والسوق المحلي، بالإضافة إلى أن الدراسة تضمنت كذلك حل مشكلة تدهور إنتاج الأبصال سنة بعد الأخرى وعلى هذا تم إجراء تجربتين حقليتين منفصلتين تم تنفيذهما خلال الأعوام ٢٠١٧/٢٠١٨ و ٢٠١٩/٢٠١٨. تم تنفيذ التجربة الأولى على أبصال إيرس ذات حجم ٨ - ٩ سم في المحيط بهدف تحقيق الأمل في تمديد موسم الإزهار على إنتاج أزهار ذات صفات جيدة و ذلك باستخدام أنماط متباينة من معاملات التخزين قبل الزراعة (أبصال مخزنة) على درجة حرارة الغرفة، أبصال مخزنة على درجة حرارة ٥°م لمدة ٣ ، ٦ أسابيع (العامل الرئيسي)، هذا بالتفاعل مع بعض العوامل الفرعية متضمنة معاملة النباتات ببعض إضافات التربة و التي بينها الكريستالون والحديد الممغنط بمعدل ٢ جم/أصيص لكل منها بالإضافة إلى استخدام الأكتوسول بمعدل ٥ مل/لتر حيث بدأت الإضافات بداية من ١٥ نوفمبر ثم كل ١٥ يوماً أي بمعدل ستة مرات خلال موسم النمو للنباتات بالحقل. أما التجربة الثانية فقد تم تنفيذها للحصول على أبصال جيدة بعد تربية البصيلات ذات محيط ٥ - ٦ سم على إضافة نفس أنماط الإضافات التي تم تنفيذها في التجربة الأولى متضمنة الحديد الممغنط والكريستالون والأكتوسول هذا مع استخدام نفس معاملات التخزين التي تم تنفيذها في التجربة الأولى كعامل رئيسي. أظهرت النتائج أن تبريد الأبصال

لمدة ثلاثة أسابيع أبدى تفوقاً واضحاً على معظم خصائص النبات مقارنة بما تم الحصول عليه من معاملات التخزين الأخرى التي تم استخدامها (التجربة الأولى). كما أنه كان هناك تفوق واضح لتخزين البصيلات تخزيناً بارداً قبل الزراعة لمدة ثلاثة أسابيع في إعطاء أفضل النتائج بالنسبة لعدد الأبصال الناتجة بالنسبة للوحدة التجريبية (محصول الأبصال) بتأثير إيجابي إحصائي متبوعاً في الدرجة الثانية بتلك التي تم تخزينها على درجة حرارة الغرفة (التجربة الثانية). ومن جانب آخر فقد لوحظ اختلاف التأثير الناتج من استخدام الإضافات المختلفة للتربة على خصائص النباتات حيث تم ملاحظة أن أفضل معاملة كانت نتيجة إضافة الكريستالون متبوعاً في الدرجة الثانية بتأثير إضافة الأكتوسول بينما أظهر تأثير الحديد الممغنط تأثيرات غير محسوسة في هذا المقام بكلا التجربتين. كما كانت هناك تأثيرات غير محسوسة فيما يتعلق بالمحتوى الكيماوي بكلا التجربتين. يمكن النصح باستخدام معاملات التخزين المختلفة وذلك لإطالة موسم الإزهار هذا بالإضافة إلى إمداد النباتات بالمستحضر التجاري كريستالون أو الأكتوسول في بعض الحالات وذلك لتحقيق الهدف من الحصول على أزهار من نبات *Iris tingitana* cv. Wedgewood ذو صفات عالية الجودة خلال فترة مطولة هذا بالإضافة إلى الحصول على محصول وفير عالي الجودة باستعمال المعاملات السابقة.