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Effect of Plant Growth Regulators (IBA, BA, and CCC) on Some Vegetative Characters of Three Hybrid Lily Cultivars of (*Lilium spp.* L.)

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Abstract

The present study was conducted in the nursery of Floriculture Unit, University of Baghdad in Iraq during September to December of 2013. Vernalized bulbs of hybrid lily cultivars were imported from the Netherlands. The experiments were included some hybrid lily cultivars which represent the main groups of lily (longiflorum hybrids, Asiatic hybrid and trumpet hybrids). The three lily cultivars named as Tiger (Oriental), Brunello (Asiatic) and White Heaven (Longiflorum) were sprayed two times, at five weeks after planting and at eight weeks after planting with a solution of Cycocel (100 mg /l), solution of Indole butyric acid (50 mg/l) and Benzyl adenine (50 mg /l). The results indicated that foliar spray with IBA lead to increase in plant height, leaf number, leaf area, fresh weight of leaf and stem and dry weight of stem in Brunello. It increased in plant height, leaf area, and fresh and dry weight of stem in White Heaven. Tiger Edition increased in fresh and dry weight of the bulb while decreasing in dry weight by the application of IBA. BA leads to increase in plant height, dry and fresh weight of a leaf, and leaf number in Brunello. It increased in dry weight of a leaf and bulb, and leaf area in Tiger Edition . Also increased in dry weight of stem and bulb, and fresh weight of bulb in White Heaven. While foliar spray with CCC lead to increase in leaf number, leaf area, dry weight of a leaf, dry and fresh weight of stem, and fresh weight of the bulb in Brunello. Dry weight of leaf, and dry and fresh weight of bulb increased in Tiger Edition . Also lead to decrease in fresh weight of a leaf, and increase in fresh and dry weight of bulb in White Heaven. From these results, Brunello was more responsive to PGRs. CCC more PGRs was affected on lily cultivars.

Keywords: *Lilium*, IBA, BA, CCC, Vegetative characters

تأثير منظمات النمو (IBA و BA و CCC) في بعض الصفات الخضرية لثلاثة اصناف مهجنة من ال *Lilium spp.* L.

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الخلاصة

اجريت التجربة في مشتل جامعة بغداد ،العراق. خلال الفترة من ايلول الى كانون الاول ٢٠١٣. تم استيراد ابصال لأصناف مختلفة من الليليوم من هولندا.هذه الابصال تابعة للمجاميع (Longiflorum hybrids ، Asiatic hybrids و Trumpet hybrids).تم رش ثلاث اصناف وهي Tiger ,(Asiatic) Brunello White Heaven ,(Longiflorum) (Oriental) مرتين،في الاسبوع الخامس و الاسبوع الثامن من الزراعة ب ١٠٠ ملغ/لتر من ال Cycocel، ٥٠ ملغ/ لتر من Benzyl adenine و ٥٠ ملغ/ لتر من ال Indole . butyric acid بينت النتائج ان رش صنف ال Brunello بال IBA ادى الى زيادة بعدد الأوراق ، مساحة ألورقة ، الوزن الطري للأوراق و الساق ،و الوزن الجاف للساق، في حين سبب زيادة مساحة الورقة و الوزن الطري والجاف للساق في صنف ال White heaven. و ادت ايضا الى زيادة بالوزن الطري و الجاف للبصلة و نقصان بالوزن الجاف للورقة في صنف ال Tiger Edition . ان الرش بال BA ادى الى زيادة بالوزن الطري و الجاف للورقة ، وعدد الاوراق في ال Brunello. و زيادة بالوزن الجاف للورقة و البصلة والمساحة الورقية بال Tiger Edition . وأدت ايضا الى زيادة بالوزن الجاف للساق و البصلة و الوزن الطري للبصلة في ال White heaven. بينما لوحظ ان الرش بال CCC ادى الى زيادة بعدد الاوراق ، مساحة الورقة ، الوزن الجاف للورقة ، الوزن الطري والجاف للساق ، و الوزن الطري للبصلة في ال Brunello. ادى رش ال CCC الى زيادة الوزن الجاف للأوراق ، الوزن الطري و الجاف للبصلة في ال Tiger Edition . وعمل على نقصان بالوزن الطري للأوراق و زيادة بالوزن الطري و الجاف للبصلة في ال White heaven. نستنتج من هذه الدراسة ان Brunello هو اكثر الاصناف استجابة لمنظمات النمو. وان اكثر المنظمات تأثيرا هو ال CCC.

Introduction

The genus *Lilium* belongs to family Liliaceae and comprises over 80 species [1]. Hybrid lilies are excellent cut flowers [2], and highly prized by horticulturists because of their outstanding fragrance, a range of colors, hardiness and adaptability to diverse environmental conditions [3]. Lily has been used for different purposes including bouquet formation, decoration of hotels, houses, luxury buildings, marriages, funeral and religious ceremonies for over 2000 years[4].

The most important factor determining the market of Lilium flower value is the accuracy and uniformity with which the crop flowers in time for sales. Plants that are not in flower immediately are not marketable. In contrast, plants that flower too early must be held in coolers until the market date, adding substantial production costs while reducing quality [5]. Also color considered one of the most important characters in combination with flower shape and size [1].

Foliar application of nutrients and plant growth regulators may improve flower quality parameters [6]. Stem length control also required in order to obtain bulb plants that are proportional to their pot size and to reduce post- harvest stem elongation [7]. An effective means of controlling plant height is to use plant growth regulators [8].

Several studies in overseas showed the effective role of cycocel, indole butyric acid and benzyl adenine on vegetative, flowering characters [9-11]. However, little attention has been drawn to the effect of plant

growth regulators on the lilies in the world particularly in Iraq. Therefore, this study aiming to improve vegetative characters of hybrid lily cultivars by using plant growth regulators.

Materials and methods

In this experiment the bulbs of three hybrid lily cultivars ; white heaven ,Brunello and Tiger Edition (14 to 16 cm in circumference) were potted inside the plastic house of the nursery. Each cultivar divided into four treatment (without any plant growth regulator), indole butyric acid (IBA), benzyl adenine (BA) and cycocel (CCC).

The whole plant was sprayed two times at five weeks and eight weeks after planting. The solution of CCC (100 mg /l), solution of IBA (50 mg/l) and BA (50 mg /l) were applied by foliar spray until obvious drops appeared on the leaves. Water did not apply for plant on three days after each application.

The preparation of plant growth regulators

1. Cycocel: 100 mg of CCC dissolved in 1000 ml of distal water.
2. IBA: 50 mg of IBA dissolved in 5 ml of NAOH (5 g of NAOH /250 ml of distal water) and then completed to 1000 ml by distal water.
3. BA: 50 mg of BA dissolved in 5 ml of HCL (8 ml of HCL / 1000 ml distal water) and then completed to 1000 ml by distal water.
4. The control treatment used D.D. water of foliar spray.

Morphological parameters

During the period of this experiment the bulbs were monitored and the data were collected as follows:

1. The stem length (cm) and leaves number/ plant each two weeks from planting to flowering.
2. Plant height, diameter of the stems and number of leaves per plant (after flowering).
3. Total, leaves, stem and bulb fresh and dry weight per plant after end of flowering for three replications of each treatment.

Statical analysis

This experiment was arranged in a completely randomized design (CRD). Each treatment consisted of three replications, and each replication consisted of five bulbs. Data were subjected to analysis of variance using statistical analysis system (SAS) program [12] and the separation was performed using least significant differences test to compare the differences between treated and un treated plants, at the 5% level of significance.

Result and discussion

Stem length and diameter

According to the results in (table 1), spraying with IBA stimulated plant elongation in both white heaven by (9.14%) and Brunello by (7.79%) compared with the control. Auxins has an important role in cell elongation and increase their division [13]. Its increase cell division in the apical meristem [14]. These results agree with Al-hasnawi [15] on his study about *Zinnia haageana*, when the plant height increased due to foliar spray with 50 mg/l of IBA.

Plant height is longer by (8.18%) by spraying with a BA (table 1) compared with the control. This increase in stem lengthdue to the role of the BA in cell elongation and division [16]. Cytokinins lead to increase the nitrogen content on leaves which is important in the formation of protein, nucleic acid, chlorophyll, enzyme, vitamins and plant hormones. In addition to the formation of cell membrane, ATP and NADP and amides [16]. These results in agreement with Carey *et al.* [11] by their study on Petunia. They observed an increasing of plant height due to applied of 40 ppm of BA. Al-Abbasi [17] reported an increase in plant height of *Dianthus caryophyllus* L. by treated with 50 mg/l of kinetin. Al-Hasnawi [16] also agree with these results, as increased in plant height of Chrysanthemum *Chrysanthemum hortorum* Hort. by treated with BA.

Cycocel had no effect in stem length of three lily cultivars (table 1). This result is in agreement with Bhat *et al.* [18] that observed no effect on plant height of *Erysimum marshallii* (Henfr) Bios due to treat with 500 mg/l of CCC. Also agree with North *et al.* [19] that observed no differences in plant height of *Dombeya burgessiae* due to treat with 50 mg/l of CCC. In addition, there is no significant effect in stem diameter in all three plant growth regulators compared to control (table 1).

Fresh weight of stem

The foliar spray with IBA showed increased fresh weight of stem of both White heaven by (12.21%) and Brunello by (15.78%) compared with the control, This may be due to increase in the plant height as stem diameter is the same (table 1). This effect agrees with Rahdari *et al.* [20] by their studies on *Avene sativa L*. They reported an increased in fresh weight of stem due to treat with 50 mg/l of NAA.

The results showed an increase in fresh weight of stem in Brunello (16.22%), due to foliar spray of BA. This effect may be due to the increase in plant height as stem diameter is the same (table 1). CCC decrease in fresh weight of stem in White Heaven (table 1).

Dry weight of stem

According to the results this treat was increased in both White heaven by (32.23%) and Brunello by (25.96%), due to increase in plant height (table 1). This increase agrees with Rahdari *et al.* [20] by their studies on *Avene sativa*. They observed an increase in this trait due to treatment with 50 mg/l of NAA .

This trait was increased in White heaven by (13.54%), due to spray with a BA (table 1). Cytokines stimulate the movement and accumulation of food in leaves and increase dry weight. In addition to cells weight related to wall cellulose and water in it [20]. That observed increase in fresh weight of stem in *Avene sativa* due to treat with BA.

CCC increased dry weight of stem in Brunello by (30.41%) (table 1). This increase agrees with Asgarian *et al.* [21] by their studies on *Zinnia*, it was showed, that increase in this trait due to sprayed with 1000

ppm of CCC. Bhat [18] showed an increase in dry weight of stem of *Erysimum marshallii* (Henfr) Bios. due to sprayed with 500 mg/l of CCC. Kashid *et al.* [22] also agree with these results. They found an increase in stem dry weight by foliar sprayed of sunflower with 500 ppm of CCC.

Table1- Effect of IBA, BA, and CCC on stem length, stem diameter, fresh and dry weight of stem after flowering.

Cultivars	PGRs	Stem length (cm)	Stem diameter	Fresh weight of stem(gm)	Dry weight of stem (gm)
White heaven	Control	74.50	1.00	53.20	5.36
	IBA	82.00	1.00	60.60	7.91
	BA	78.00	1.25	54.08	6.20
	CCC	73.00	1.00	45.52	5.05
LSD (0.05)		**6.43 ***	**NS**	**7.63 ***	**1.15 ***
Brunello	Control	71.00	1.05	42.84	5.56
	IBA	77.00	1.00	50.87	7.51
	BA	77.33	1.03	51.14	5.78
	CCC	70.66	0.96	47.71	7.99
LSD (0.05)		**5.75 ***	**NS**	**6.33 ***	**1.19 ***
Tiger Edition	Control	85.50	0.60	28.60	5.23
	IBA	90.17	0.60	29.30	5.65
	BA	87.15	0.70	30.19	5.29
	CCC	81.70	0.70	26.89	5.05
LSD (0.05)		**6.85 ***	**NS**	**NS**	**NS**

Number of leaves

The result showed that the number of leaves increased in Brunello by (14.10%) due to foliar sprayed with IBA (table 2). This increase caused by the role of auxins in the activation of the photosynthesis process by activating the synthesis of P700, its play an important role in the photo system light reaction (Hill reaction) and by consumption of CO2 by the activation of Rubulose- Biphosphate Carboxylase enzyme ie. activation of dark reaction. Which lead to increase nutrition material synthesis in leaves [15]. This effect agrees with Al-Hasnawi [15] by his study on *Zinnia haageana*. He showed an increase in leaf number due to foliar spray of IBA (50 ppm). Also Zia Ullah *et al.* [10] observed an increase in leaf number of marigold (*Tagetes erecta* L.) due to treatment with IBA. But high concentration (200 ,300 ppm) caused a decrease in leaf number.

It was obvious from table 2 that the leaf number of Brunello was increased by (17.63%), as a result of spraying with BA. This increase caused by the effect of cytokinins in stimulate leaf primodia and increase cell division [17]. This effect is in agreement with Al-Hasnawi [16] in his studies on *Chrysanthemum hortorum* Hort. . He observed an increase in leaf number due to sprayed with 50 mg/l of BA. Al-Abbasai [17] also agree with these results, he showed an increase in leaf number due to treat of *Dianthus caryophyllus* L. With 50 mg/l of Kinetin.

Spraying with cycocel lead to increase in leaf number of Brunello (table 2). This effect agrees with Zheng *et al.* [23], they published that leaf number of Sorbonne increase by treated with 300 mg/l of CCC.

Asgarian *et al*.. [21] through their study on *Zinnia*, found an increase in leaf number due to spray with CCC. While disagreeing with Al-Abbasi [17] that found CCC decreased in leaf number of *Dianthus caryophyllus* L. due to spray with 2000 mg/l.

Leaf area

Results in table 2 showed that spraying with IBA lead to increase in leaf area for both White heaven by (13.58%) and Brunello by (26.47%). Auxins has an important role in elasticity and plasticity of the cell wall. Auxins helps in activation of type of genes for RNA constructing that is important to building of proteins. so the water potential become more negatively, which lead to decrease the compacting pressure and increase the passing of water and nutrient material and increase the size of a cell [24]. This result agrees with Dawood [25] who observed an increase in leaf area of Strawberry due to treat with 10 ppm of IAA. Zia Ullah [10] observed an increase leaf area of Marigold due to treat with 200 ppm of IBA.

Leaf area was increased in Tiger Edition by (37.52%) and Brunello by (29.23) due to spray with a BA (table 2). Cytokinins have an important role in the movement of dissolvent to the side of sink source. Or maybe delay senescence and consequently increase leaf number [16]. This effect agrees with Al-Hasnawi [16] who observed increase in leaf area of *Chrysanthemum hortorum* Hort. due to spray with 50 mg/l of BA.

Leaf area was increased in Brunello, as a result of spraying with cycocel (table 2). This effect agrees with Zheng *et al*. [23] that showed an increase in leaf area of Sorbonne due to treat with 300 mg/l of CCC.

Fresh weight of leaf

Fresh weight of a leaf was increased in Brunello by (15.14%) due to foliar spray with IBA. This increase as a result to increase in leaf area and leaf number of Brunello (table 2).

Treatment with foliar spray containing BA increased in fresh weight of a leaf in Brunello by (25.15%). Which attribute to increase in leaf area and leaf number (table 2).

The same table showed decreases in this trait in White Heaven by (33.16%) and Tiger Edition by (32.53%). While Brunello increased by (17.34%) due to the foliar spray with CCC. This increase as a result to increase in leaf area and leaf number of Brunello. This effect is in agreement with Bhat *et al*. [18] that observed a significant increase in fresh leaf weight of *Erysimum marshallii* to spray with 500 mg/l of CCC.

Dry weight of leaf

Foliar spray with IBA significantly decreased dry weight of a leaf in Tiger Edition by (16.01%) although there is no effect on leaf area of Tiger Edition (table2). This may be as a result of the decrease in the accumulation of nutrient material of leaf.

Treatment with foliar spray containing BA increased dry weight of leaf in both Tiger Edition by (7.23%) and Brunello by (22.35%) (table 2). BA stimulates dry mass production by increase cell division and chlorophyll accumulation that lead to activate photosynthesis and accumulation of dry matter [26].

CCC increased this trait in both Tiger Edition by (9.31%) and Brunello by (21.71%), while a decrease in White Heaven by (29.34%) (table 2). This effect agrees with Bhat *et al.* [18] that observed an increase in dry leaf weight of *Erysimum marshallii* to spray with 500 mg/l of CCC.

Table 2- Effect of IBA, BA, and CCC on no. of leaves, leaf area, fresh and dry weight of leaf after flowering

Cultivars	PGRs	Number of leaves/plant	Leaf area (cm2)	Fresh weight of leaf (gm)	Dry weight of leaf (gm)
White heaven	Control	60.50	53.00	64.20	7.60
	IBA (50 mg/l)	63.50	61.33	65.93	7.76
	BA (50 mg/l)	59.50	50.66	59.25	7.53
	CCC (100 mg/l)	56.00	48.16	42.91	5.37
LSD (0.05)		**4.88 ***	**7.34 ***	**8.91 ***	**1.25 ***
Brunello	Control	103.50	25.00	58.12	6.67
	IBA (50 mg/l)	120.50	34.00	68.49	7.70
	BA (50 mg/l)	125.66	35.33	77.65	8.59
	CCC (100 mg/l)	110.33	28.16	70.32	8.52
LSD (0.05)		**12.48 ***	**6.53***	**5.85 ***	**NS**
Tiger Edition	Control	34.00	50.50	28.95	4.87
	IBA (50 mg/l)	31.00	51.5	23.94	4.09
	BA (50 mg/l)	33.00	80.83	29.36	5.25
	CCC (100 mg/l)	28.00	49.16	19.53	5.37
LSD (0.05)		**NS**	**12.63 ***	**6.47 ***	**0.536 ***

Fresh weight of bulb

Treatment with IBA increased the fresh weight of the bulb in Tiger Edition by (59.71%) (table 3). This effect disagrees with Kurtar and Ayan [27] that observed increase in bulb weight of Tulip (*Tulipa gesneriana* Var. Cassini) due to spray with 500 ppm of IAA.

Foliar spray with BA increased this trait in White heaven by (36.57%) (table 3). This increase may be due to increase in vegetative growth. As the total dry weight was improved (table 3).

CCC increased fresh weight of bulb in White heaven by (47.59%), Brunello by (18.57%) and Tiger Edition by (73.76%) (table 3). This effect agrees with Taha [28] who showed an increase in bulb weight of Iris plants due to spray with 250 ppm of CCC. Zheng *et al.* [23] observed an increase in bulb weight of *Lilium* Oriental hybrids 'Sorbonne' to treat with 300 mg/l of CCC.

Dry weight of bulb

According to the results foliar spray with IBA increased this trait in Tiger Edition by (78.08%) (table 3). Foliar spray with BA increased the dry weight of the bulb in Tiger Edition by (52.94%) and White

heaven by (45.60%) (table 3). CCC increased this trait in White heaven by (57.87%) and Tiger Edition by (87.72%) (table 3).

This increase may be due to increase of carbohydrate accumulation in the bulb, which helps bulb to regrow at next year. The bulb depends on stored carbohydrate to growth until the leaf appearance and become able to photosynthesis, at this stage leaves supply stem, root, flowers and even bulb in nutrient material [29].

Total fresh weight

IBA had no significant effect on total fresh weight for all three lily cultivars (table 3). Total fresh weight of Brunello was increased by (17.93%) as a result of spraying with a BA (table 3).

Spraying of shoot tip with cycocel lead to increase in total fresh weight of Brunello by (17.06%), decrease in White Heaven(10.55%) (table 3). The decrease in total fresh weight of White Heaven agrees with Al-Abbasi [17] who observed increase in total fresh weight of *Dianthus caryophyllus* L. due to treatment with 100 mg/l of kinetin. North *et al.* [19] agree with these results, when found a decrease in total fresh weight of *Dombeya burgessiae* due to spray with 50 mg/l of CCC.

Total dry weight

IBA did not effect on total dry weight in all three lily cultivars as (table 3). Total dry weight increased in White heaven by (19.41%) as a result of spraying with a BA (table 3). This increase is due to the role of cytokinins in cell divisions and increase their size by cell enlargement [30]. Its play important role in the formation of enzymes, proteins, amino acid and nucleic acid that are important constituent in purine and pyrmidene formation. Thus considered the building unit of chlorophyll and cytochrome which are important in photosynthesis [30]. This effect agrees with Al-Hasnawi [16] due to foliar spray of *Chrysanthemum hortorum* Hort. With 50 mg/l of benzyl adenine. Cycocel did not effect in all three lily cultivars (table 3).

Table 3- Effect of IBA, BA, and CCC on bulb and total fresh and dry weight after flowering.

Cultivars	PGRs	Fresh weight of bulb (gm)	Dry weight of bulb (gm)	Total fresh weight(gm)	Total dry weight(gm)
White heaven	Control	16.44	3.96	133.94	16.93
	IBA	20.02	4.28	136.56	19.95
	BA	25.92	7.28	139.25	21.01
	CCC	31.37	9.40	119.8	19.82
LSD (0.05)		5.52 *	2.74 *	9.57 *	3.74 *
Brunello	Control	23.36	7.38	124.53	19.61
	IBA	23.95	6.77	143.31	19.89
	BA	26.38	7.56	151.74	21.93
	CCC	28.69	8.60	150.15	25.11
LSD (0.05)		NS	NS	22.69 *	NS
Tiger Edition	Control	4.50	0.48	62.05	10.58
	IBA	11.17	2.19	64.41	11.93
	BA	5.70	1.02	65.25	11.56
	CCC	17.15	3.91	63.57	14.33
LSD (0.05)		6.36 *	0.78 *	NS	NS

Conclusion

From these results, Brunello was more responsive to PGRs. CCC more PGRs was affected on lily cultivars. Foliar application with IBA and CCC gave more effect on vegetative growth than flowering growth while foliar application of BA gave negative effect on flowering growth.

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