African Journal of Agriculture and Food Science
ISSN: 2689-5331
Volume 4, Issue 1, 2021 (pp. 22-35)
www.abjournals.org

PROFITABILITY OF LILIUM FLOWERS PRODUCTION AS INFLUENCED BY LIGHT AND ASCORBIC ACID IN A GREENHOUSE

A.M. El Sawy, Mona M. Aly and Assem A. A. Mohamed

Central Laboratory for Agricultural Climate, Agriculture Research Center, Giza, Egypt

ABSTRACT: *The experiment was conducted under greenhouse at Dokki- Giza, Egypt during two seasons 2017/2018 and 2018/2019 to study the effects of ascorbic acid and artificial light on vegetative growth and flowering parameters of lilium plants (plant height, plant weight, number of leaves, leaf area, stem diameter, number of flower buds, inflorescence length, number of days to flowering, nitrogen, phosphorus, potassium content and chlorophyll). White LED lamps (11 W- A60 – 1200 lm) were used as an artificial light. They were applied during the night to elongate the photoperiod; Control (without artificial light), Continuous light and Intermittent light. Ascorbic acid treatments were spraying plant foliar at concentration 300 ppm. The results indicated that there was a significant increase in all lilium parameters, achieved by treating plants with intermittent light and spraying ascorbic acid twice. Light is a major factor in the control of lilium height. Using lighting technology and ascorbic acid can improve lilium plants quality. The study reveals that the total production cost of lilium was estimated to be 20048 Egyptian pounds (LE) per 540 square meters area in the first season, while the total production cost of lilium in the second season was estimated to be LE 20213. The (intermittent light+ twice foliar spraying of ascorbic acid) treatment had the highest gross margin which is LE 48251 and LE 48231 for the first and second seasons, respectively. The benefit-cost ratios (BCRs) per 540 squares meters were analysed, and (intermittent light+ twice foliar spraying of ascorbic acid) treatment had the highest BCR with 21.2 in the first season and 21.02 in the second season.*

KEYWORDS: Lilium, Light, Greenhouse, Ascorbic Acid, Benefit- Cost Ratio, Gross Margin

INTRODUCTION

Lilium is a large, horticulturally and genetically complex genus comprising over 100 species (Beattie and White, 1993; Okubo, 2014; Wu *et al.*, 2014). Lilies (*Lilium* spp. and hybrids) are the second largest flower bulb crop in the Netherlands and considered the most important flower bulb crop in the world. Lilium plants are grown for bulbs, as cut flowers, and as potted plants (Benschop *et al.*, 2010; Kamenetsky and Okubo, 2012). Forcing the lily for Easter requires precise scheduling, proper height control, as well as a high bud count for maximum pricing. Furthermore, the use of high intensity discharge (HID) lamps to supplement natural daylight (ND), or to replace ND for photosynthesis, is becoming more commonplace in greenhouses (Heins *et al.*, 1982).

Light is the single most important variable with respect to plant growth and development and is often the most limiting factor in greenhouse production (Nelson, 2012). Using artificial lighting in commercial greenhouses is beneficial for plants and farmers. Using lighting (intermittent and photoperiod) are increasing photosynthesis. Light-emitting diodes (LED) are the most generation lighting sources and are the emerging technology in horticulture (Morrow, 2008).

In the 1990s, light-emitting diodes (LEDs) were investigated for the first time for plant growth and were found to be efficient alternatives to traditional lamps used in lighting systems (Briggs and Christie, 2002). Compared with conventional lamps, LEDs are smaller in size and weight, have a long lifetime, low heat emissions, wavelength specificity, and much lower energy consumption. Light-emitting diodes also have the potential to shorten the crop time, reduce costs, and add new plants for specialty cut flower production during the winter (Massa *et al.*, 2008). Kohyama *et al*., (2014) investigated the efficacy of commercial LED products developed for flowering applications on long-day plants. Treder, (2003) reported that additional lighting significantly increased flower quality, increased leaf area and production of dry matter, accelerated flowering and reduced bud dropping. Most Studies showed that L.E.D light is a promising future after fluorescent light (F.L). Light spectrum from L.E.D can be narrowed to enhance growth as well as save time too (Azmi *et al*., 2015).

Use of light emitting diode (LED) technology is beginning to replace traditional lighting in greenhouses. (Ibibofori *et al*., 2019).

Some organic compounds can be used to increase productivity and plant quality. There is a real need for natural growth and development as it activates the enzymatic system as a key part of controlling the metabolism. Ascorbic acid is one of the essential ingredients necessary in high-end plants to maintain their natural growth, as it performs several functions inside the plant tissue which include- reducing the stress caused by high temperature, toxins and stimulating breathing division of cells and increasing the effectiveness of some enzymes. As well as its participation in the system of transport of electrons, it preserves the chloroplast of oxidation as one of the factors that counteract them. It preserves the cell components, especially chlorophyll from optical oxidation and protection from reactive oxygen species, which consists of photosynthesis and breathing respiration (Conklin and Barth, 2004; Logan *et al*., 2006). Ascorbic acid has an important role in controlling the timing of flowering and aging (Barth *et al*., 2006). From another side Hammoud (2012) found that spraying with ascorbic acid with a concentration of 40 mg. L^{-1} increases the flowering growth of squash. El-Tohamy et al. (2008) found that eggplant plants are sprayed with ascorbic acid a month after planting with concentrations of 100 and 200 mg / L and twice. The period between them 15 days led to improved vegetative growth characteristics of the plant represented by the height and number of leaves and branches and soft and dry plant. Also, it was found that spraying with ascorbic acid at a concentration of 100 mg / L increased the yield of the lettuce and improved its properties by increasing the number of total leaves, total leaves weight, dry matter ratio and plant leaf area compared to other concentrations of zero, 50, 200 mg (Jerry *et al*., 2011). Ascorbic acid is synthesized in higher plants and influences the plant growth and development. It plays an important role in the electron transport system (El-Kobisy et al., 2005). Blokhina et al., (2003) stated that ascorbic acid is the most abundant antioxidant which protects plant cells, and it is currently considered to be a regulator on cell division and differentiation. Moreover, it is involved in a wide range of important functions such as antioxidant defense, photoprotection, regulation of photosynthesis and growth. Pretreatment of cut rose with ASA for 12 h prolonged vase life of plants exposed to water deficit stress (Jin *et al*., 2006). The aim of the present study is to evaluate the economic profitability of lilium plants under suitable times of ascorbic acid spraying, suitable light system in the vegetative growth characteristics and flowering characteristics.

MATERIALS AND METHODS

The experiment was conducted under a greenhouse at Dokki- Giza, Egypt during two seasons 2017/2018 and 2018/2019 to study the viability of ascorbic acid and artificial light on vegetative growth and flowering parameters of lilium plants.

Bulbs of *Lilium* L.A. Hybrid "Litouwen" were imported from VWS Export-Import of Flower bulbs B.V., The Netherlands. The circumferences of these bulbs were 20 to 23 cm. They were planted on 16 November in the first season (2017) and 18 December in the second season (2018).

The experiment was arranged in a split-plot design with three replicates. The main factor was the artificial light supplement (without light as a control, continuous, and intermittent light) while, the sub-main factor was the foliar spray of ascorbic acid (without spray as a control, spray foliar one time, spray two times). The block under each light treatment in each ascorbic acid treatment was contained 5 plants for each replicate (3 Replicates* 3 Light treatments* 3 Ascorbic acid treatments *5 Plants=135 Plants).

In light treatments, white LED lamps (11 W- 60 A- 1200 lm) were used as an artificial light. They were applied during the night to elongate the photoperiod. These light treatments were used as follow:

1. Control (without artificial light) (L1).
2. Continuous light (L2): This treatment contained four LED lambs in each replicate which worked for 4.5 hours from 5:30 to 10 pm.
3. Intermittent light (L3): In this treatment, four lambs were turned on for 15 minutes then turned off for 30 minutes from 5:30 pm to 6:30 am. That means these lambs worked for 4.5 hours but intermittent.

These treatments were started after appearing the stem above the soil surface until the end of the experiment. Black curtains were used to separate between each light treatment and other treatments.

Ascorbic acid treatments were spraying plant foliar with ascorbic acid at concentration 300 ppm. These treatments were:

1. The control treatment (A1):
2. One-time foliar spraying of ascorbic acid (A2): this treatment was done at seven weeks from planting date. The volume of spraying solution per plot was 1.25 litre.
3. Twice foliar spraying of ascorbic acid (A3): leaves were sprayed twice; the first one was applied at seven weeks from planting date while the second application was done after three weeks from the first application. The volume of spraying solution per plot was 1.25 and 2.0 litre for the first and second application, respectively.

African Journal of Agriculture and Food Science

ISSN: 2689-5331

Volume 4, Issue 1, 2021 (pp. 22-35)

www.abjournals.org

Table 1 presented the climate data under experimental conditions. The microclimate is a major factor in this study, thus the following data were recorded:

Average air temperature and relative humidity of the greenhouse were recorded by digital Thermo/hygrometer Art. No. 30.5000/30.5002 (Produced by TFA, Germany) placed at the middle of the greenhouse.

In the end of each season, plant height, plant weight, number of leaves, leaf area, stem diameter, number of flower buds, inflorescence length, number of days to flowering, the content of nitrogen, phosphorus potassium, and chlorophyll were collected from three plants under each treatment.

For calculating the vase life, two stems from each treatment were harvested. Then, the lower leaves were removed from the stems and each stem was put in a vase containing conserved solution. The vase life is measured by calculating the days from putting the stem in the vase until the flowers get wilt.

Data were subjected to conventional methods of analysis of variance according to **Snedecor** and Cochran (1980). The data were statistically analysed for each season and the homogeneity of experimental error, in both seasons, was tested.

The least significant difference (L.S.D.) at 0.05 level of probability was calculated for each determined character under different assigned treatments.

Descriptive statistics such as percentages and frequencies were used in the analysis of prospects of lilium. A cost–benefit analysis approach was the core of getting at the financial reliability of lilium cultivation. BCA's for multiple projects can be compared to determine which treatment has a higher economic return relative to the others with higher BCA's indicating higher return (Perman et al., 2003).

Table 1: Climatic data under experimental conditions

	2017			
	Max. Temp.	Min. Temp.	Max. Rh.	Min. Rh.
November	18.8	13.9	78.2	48.7
December	20.3	16.6	80.5	45.3
January	12.7	10.3	77	33
February	13.2	12.6	53	52
	2018			
November	17.4	12.2	75.1	45.3
December	18.1	14.5	76.3	42.1
January	10.5	9.8	72.6	30
February	10.6	10.1	50	49

RESULTS AND DISCUSSION

According to the presented data in Table 2, the effects of light treatments and ascorbic acid treatments on the plant height and plant weight were significant in the two seasons. Intermittent light showed that the plant highest (114.4 and 118.7 cm for the first and second season, respectively) and the highest values of plant weight (64.8 and 66.7 g for the first and second season, respectively).

Ascorbic acid treatments displayed a significant effect for two seasons. The highest values of plant height (104.7 and 110.8 cm for the first and second season, respectively) and weight (57.3 and 59.5 g for the first and second season, respectively) were recorded with spraying foliar two times by ascorbic acid.

Interaction between light and ascorbic acid treatments had a significant effect. Plants which grew under intermittent light and were sprayed twice with ascorbic acid presented the highest values of plant height (117.5 and 12.3 cm for the first and second season, respectively) and plant weight (72.4 and 74.7 g). These results may be related to the important role of ascorbic acid in the electron transport system (El-Kobisy *et al*., 2005). Blokhina *et al*., 2003, ascorbic acid is the most abundant antioxidant which protects plant cells, and it is currently considered to be a regulator on cell division and differentiation.

Table 2: Effect of foliar spray with ascorbic acid and artificial light supplement on plant height (cm) and plant weight (g) of *Lilium* plants

	Plant height (cm)								Plant weight (g)							
	A1		A2		A3		Mean		A1		A2		A3		Mean	
	First season															
L1	84.3	b	86.1	b	88.9	b	86.4	B	40.5	f	44.9	ef	46.0	def	43.8	C
L2	90.1	b	92.9	b	107.8	a	96.9	B	50.7	cde	54.4	bcd	53.4	cde	52.8	B
L3	111.7	a	114.0	a	117.5	a	114.4	A	58.2	bc	63.7	ab	72.4	a	64.8	A
Mean	95.4	B	97.7	B	104.7	A			49.8	B	54.3	A	57.3	A		
	Second season															
L1	85.0	d	93.0	cd	99.3	c	92.4	B	42.7	e	44.3	de	46.5	de	44.5	B
L2	108.3	b	110.0	b	112.7	ab	110.3	AB	52.8	cd	55.4	c	57.4	bc	55.2	B
L3	116.5	ab	119.3	a	120.3	a	118.7	A	59.5	bc	65.9	ab	74.7	a	66.7	A
Mean	103.3	C	107.4	B	110.8	A			51.6	C	55.2	B	59.5	A		

Control (L1), Connected light (L2), Intermittent light (L3) , control (A1), one time foliar spraying of ascorbic acid (A2), twice foliar spraying of ascorbic acid (A3).

Data of leaves number and leaf area present in Table 3, number of leaves had the same performance of plant height and weight. Intermittent light and spray foliar two times recorded number of leaves more than other treatments (126.6 and 128 for two seasons). Leaf area has a significant difference between light treatments only. The highest values were found in intermittent light treatment (17.70 and 16.57 cm^2 for the first and second season, respectively). **Treder, (2003)** reported that leaf area increased significantly by using additional lighting.

Table 3: Effect of foliar spray with ascorbic acid and artificial light supplement on number of leaves and leaf area (cm^2) of *Lilium* plants

	Number of leaves				Leaf area (cm^2)			
	A1	A2	A3	Mean	A1	A2	A3	Mean
	First season							
L1	93.4 f	95.5 ef	102.9 de	97.3 B	13.47	14.31	14.81	14.20
L2	105.8 cd	106.8 cd	108.7 cd	107.1 B	14.70	16.61	17.90	16.40
L3	113.1 bc	120.8 ab	126.6 a	120.2 A	18.68	19.44	20.38	19.50
Mean	104.1 C	107.7 B	112.8 A		15.62 B	16.79 AB	17.70 A	
	Second season							
L1	97.3 f	104.3 e	106.7 e	102.8 C	12.00	12.32	13.95	12.76
L2	110.7 de	115.7 cd	118.7 bc	115.0 B	14.38	15.98	16.75	15.70
L3	125.0 ab	123.7 ab	128.0 a	125.6 A	16.41	17.67	19.00	17.69
Mean	111.0 C	114.6 B	117.8 A		14.26 C	15.32 B	16.57 A	

Control (L1), Connected light (L2), Intermittent light (L3) , control (A1), one time foliar spraying of ascorbic acid (A2), twice foliar spraying of ascorbic acid (A3).

The data in Table 4 indicated that intermittent light and connected light had the highest result of stem diameter and buds number. Twice foliar spraying of ascorbic acid had the best stem diameter and buds number. There were no significant differences in the interaction between light treatments and ascorbic acid foliar spraying on stem diameter and buds number.

Table 4: Effect of foliar spray with ascorbic acid and artificial light supplement on stem diameter (mm) and buds number of *Lilium* plants

	Stem diameter(mm)				Buds number			
	A1	A2	A3	Mean	A1	A2	A3	Mean
	First season							
L1	0.60	0.83	1.07	0.83 C	3.50	3.67	4.20	3.79 B
L2	1.27	1.47	1.30	1.34 B	4.73	4.93	5.07	4.91 A
L3	1.70	1.73	1.80	1.74 A	5.03	5.50	6.30	5.61 A
Mean	1.19 B	1.34 A	1.39 A		4.42 B	4.70 B	5.19 A	
	Second season							
L1	0.67	0.90	1.07	0.88 C	3.53	4.03	4.17	3.91 C
L2	1.30	1.40	1.40	1.37 B	4.50	4.90	5.03	4.81 B
L3	1.57	1.67	1.77	1.67 A	5.37	6.03	6.43	5.94 A
Mean	1.18 B	1.32 A	1.41 A		4.47 B	4.99 A	5.21 A	

Control (L1), Connected light (L2), Intermittent light (L3) , control (A1), one time foliar spraying of ascorbic acid (A2), twice foliar spraying of ascorbic acid (A3).

Flowering parameters obtained in Table 5, the inflorescence length and number of days to flowering were highly significantly affected by the intermittent light treatment and twice foliar spraying of ascorbic acid treatment without significant differences in the interaction between light treatment and ascorbic acid foliar spraying. The use of LED light effectively promoted growth and flowering in lilium plants (Massa *et al*., 2008; Kohyama *et al*., 2014; Azmi *et al*., 2015 and Ibibofori *et al*., 2019).

Table 5: Effect of foliar spray with ascorbic acid and artificial light supplement on inflorescence length (cm) and number of days to flowering of *Lilium* plants

	Inflorescence length (cm)				Number of days to flowering			
	A1	A2	A3	Mean	A1	A2	A3	Mean
	First season							
L1	11.9	12.8	14.6	13.1 C	93.6	91.6	90.3	91.8 B
L2	15.6	15.9	16.6	16.0 B	86.0	83.0	80.6	83.2 AB
L3	18.5	19.1	20.6	19.4 A	77.0	75.6	74.0	75.5 A
Mean	15.4 B	15.9 B	17.3 A		85.5 B	83.4 AB	81.6 A	
	Second season							
L1	11.4	12.8	15.5	13.3 C	99.3	94.6	92.6	95.5 B
L2	15.8	16.8	17.3	16.6 B	87.0	85.0	82.0	84.6 A
L3	18.7	19.0	19.7	19.2 A	79.3	78.3	77.0	78.2 A
Mean	15.3 B	16.23 B	17.54 A		88.56 B	86.00 A	83.89 A	

Control (L1), Connected light (L2), Intermittent light (L3) , control (A1), one time foliar spraying of ascorbic acid (A2), twice foliar spraying of ascorbic acid (A3).

Chemical content of plants was analysed in Tables 6 and 7, nitrogen, phosphorus, potassium percentage, and chlorophyll content had the same behavior in lilium plants. The highest value was found when intermittent light was used and when twice foliar spraying of ascorbic acid treatment was used. The highest interaction value was observed in intermittent light treatment with all ascorbic acid treatments, except phosphorus percentage had no interaction between all treatments.

Table 6: Effect of foliar spray with ascorbic acid and artificial light supplement on nitrogen content and phosphorus content of *Lilium* plants

	Nitrogen (%)				Phosphorus (%)			
	A1	A2	A3	Mean	A1	A2	A3	Mean
	First season							
L1	0.82 c	0.82 c	0.77 c	0.80 B	0.52	0.60	0.67	0.60 C
L2	1.00 bc	1.25 ab	1.27 ab	1.17 A	0.70	0.72	0.67	0.70 B
L3	1.31 a	1.38 a	1.51 a	1.40 A	0.79	0.85	0.93	0.86 A
Mean	1.04 B	1.15 A	1.18 A		0.67 B	0.72 AB	0.76 A	
	Second season							
L1	1.24 d	1.69 cd	1.72 cd	1.55 B	0.50	0.58	0.65	0.58 C
L2	1.95 bcd	2.27 bc	2.35 bc	2.19 AB	0.68	0.73	0.75	0.72 B
L3	2.47 bc	2.85 b	3.88 a	3.07 A	0.84	0.90	0.94	0.90 A
Mean	1.89 C	2.27 B	2.65 A		0.67 C	0.74 B	0.78 A	

Control (L1), Connected light (L2), Intermittent light (L3) , control (A1), one time foliar spraying of ascorbic acid (A2), twice foliar spraying of ascorbic acid (A3).

Table 7: Effect of foliar spray with ascorbic acid and artificial light supplement on potassium content and chlorophyll of *Lilium* plants

	Potassium (%)				Chlorophyll content (mg/g FW)			
	A1	A2	A3	Mean	A1	A2	A3	Mean
	First season							
L1	2.46 d	2.53 d	2.84 cd	2.61 C	7.66 e	7.80 e	9.02 d	8.16 C
L2	2.76 cd	3.70 bc	4.38 ab	3.61 B	9.48 cd	10.41 bc	11.14 ab	10.35 B
L3	4.53 ab	5.35 a	5.36 a	5.08 A	11.65 a	11.79 a	11.95 a	11.79 A
Mean	3.25 C	3.86 B	4.20 A		9.60 C	10.00 B	10.70 A	

	Second season															
L1	3.44	b	3.51	b	3.51	b	3.48	C	7.56	e	8.72	de	9.05	cd	8.44	C
L2	3.70	b	3.95	b	5.43	a	4.36	B	9.94	bcd	10.58	ab	10.02	bc	10.18	B
L3	5.98	a	6.07	a	6.35	a	6.13	A	10.65	ab	10.91	ab	11.61	a	11.06	A
Mean	4.37	B	4.51	B	5.10	A			9.38	B	10.07	A	10.23	A		

Control (L1), Connected light (L2), Intermittent light (L3) , control (A1), one time foliar spraying of ascorbic acid (A2), twice foliar spraying of ascorbic acid (A3).

Table 8 showed the effect of foliar spray with ascorbic acid and artificial light supplement on vase life of lilium plants. The longer vase lives were found in the intermittent light treatment (11.04 and 11.03 days for the first and second season). Ascorbic acid treatments had a significant effect on vase life for two seasons. Twice foliar spraying showed the highest vase life (12.22 and 12.32 days). These result in agreements with (Jin *et al*., 2006).

Table 8: Effect of foliar spray with ascorbic acid and artificial light supplement on vase life (days) of *Lilium* plants

	Vase life (days)							
	A1		A2		A3		Mean	
	First season							
L1	5.89		6.22		7.00		6.37	C
L2	8.00		9.00		10.00		9.00	B
L3	10.22		10.67		12.22		11.04	A
Mean	8.04	B	8.63	B	9.74	A		
	Second season							
L1	5.99		6.53		7.43		6.65	C
L2	7.87		8.67		9.10		8.54	B
L3	9.67		11.10		12.32		11.03	A
Mean	7.84	C	8.77	B	9.62	A		

Control (L1), Connected light (L2), Intermittent light (L3) , control (A1), one time foliar spraying of ascorbic acid (A2), twice foliar spraying of ascorbic acid (A3).

Economic Considerations

Table 9 shows that total production cost of lilium was estimated to be LE 20048 for 540 square meter area in the first season, while the total production cost of lilium in the second season was estimated to be LE 20213.

Data presented in Table 9, shows the analysis of total production costs for different treatment combinations of lilium in two seasons. The result showed that the (L3A3) treatment was the highest production cost LE 2389 in the first season, followed by (L2A3) treatment (LE 2369), and while the lowest production cost was (L1A1) treatment with LE 1958 in the first season.

In the second season, the (L3A3) treatment was the highest total production cost with LE 2409, followed by (L2A3) treatment LE 2389, while the lowest was (L1A1) treatment with LE 1973.

Analysis of various components of the production costs showed that bulbs were the major component which accounted between 57- 68 percent for the different treatments. Following it is the human labour which constituted between 13- 16 percent of the total production cost for the different treatments.

Table 9: Total production costs analysis for different treatment combinations of *Lilium* (540 m^2) in LE

Treatment combination	Land preparation	Bulbs	Irrigation	Fertilisers	Manure	Ascorbic acid	Electricity	Human labour	Other charges	T. production costs
First season										
L1A1	45	1333	65	200	35	-	-	230	50	1958
L1A2	45	1333	65	200	35	66	-	280	50	2074
L1A3	45	1333	65	200	35	86	-	340	50	2154
L2A1	45	1333	65	200	35	-	135	290	100	2203
L2A2	45	1333	65	200	35	66	135	340	100	2319
L2A3	45	1333	65	200	35	86	135	370	100	2369
L3A1	45	1333	65	200	35	-	135	330	100	2243
L3A2	45	1333	65	200	35	66	135	360	100	2339
L3A3	45	1333	65	200	35	86	135	390	100	2389
Second season										
L1A1	50	1333	65	200	35	-	-	240	50	1973
L1A2	50	1333	65	200	35	66	-	290	50	2089
L1A3	50	1333	65	200	35	86	-	350	50	2169
L2A1	50	1333	65	200	35	-	140	300	100	2223
L2A2	50	1333	65	200	35	66	140	350	100	2339
L2A3	50	1333	65	200	35	86	140	380	100	2389
L3A1	50	1333	65	200	35	-	140	340	100	2263
L3A2	50	1333	65	200	35	66	140	370	100	2359
L3A3	50	1333	65	200	35	86	140	400	100	2409

Control (L1), Connected light (L2), Intermittent light (L3) , control (A1), one time foliar spraying of ascorbic acid (A2), twice foliar spraying of ascorbic acid (A3).

African Journal of Agriculture and Food Science
ISSN: 2689-5331
Volume 4, Issue 1, 2021 (pp. 22-35)

Table 10 shows the grading of lilium spikes for different treatment combinations during two seasons. The average production of the lilium had an estimated value of 1200 stick/ 540 square meter area. Average price for lilium estimated at LE 40 per stick for the first rank, and LE 20 per stick for the second rank.

Table 10: Size grading and total return for different treatment combinations of *Lilium* spikes (540 m^2) in Egyptian pound

Treatment combinations	T. number of spikes	First season				Second season			
		First class		Second class		First class		Second class	
		No	value	No	value	No	value	No	value
L1A1	1333	600	24000	733	14660	666	24000	667	14660
L1A2	1333	730	29200	603	12060	800	29200	533	12060
L1A3	1333	820	32800	513	10260	888	32800	445	10260
L2A1	1333	926	37040	407	8140	926	37040	407	8140
L2A2	1333	1050	42000	283	5660	999	42000	334	5660
L2A3	1333	1080	43200	253	5060	1066	43200	267	5060
L3A1	1333	900	36000	433	8660	950	36000	383	8660
L3A2	1333	1093	43720	240	4800	1093	43720	240	4800
L3A3	1333	1199	47960	134	2680	1199	47960	134	2680

Farm gate price per bulb for the first rank = LE 40.
Farm gate price per bulb for the second rank = LE 20.

Table 11 shows the total cost of production, total return, gross margin, and BCR for different treatment combinations of lilium during planting seasons.

Estimated maximum total return in lilium was found in the (L3A3) treatment with LE 50640, while the minimum total return was found in the control treatment with LE 38660.

Estimated highest gross margin in lilium was about LE 48251 in (L3A3) treatment, while the lowest gross margin was about LE 36702 in the control treatment.

BC Ratio of different treatment combinations of lilium was calculated and it was found maximum in case of (L3A3) treatment with 21.

Table11: Total cost of production, total return, gross margin, and BCR for different treatment combinations of *Lilium* (540 m^2) in LE

Treatment combinations	First season				Second season			
	Total cost of producti on	Total return	Gross margi n	BCR	Total cost of producti on	Total return	Gross margi n	BCR
L1A1	1958	38660	36702	19.74	1973	38660	36687	19.59
L1A2	2074	41260	39186	19.89	2089	41260	39171	19.75
L1A3	2154	43060	40906	19.99	2169	43060	40891	19.85
L2A1	2203	45180	42977	20.51	2223	45180	42957	20.32
L2A2	2319	47660	45341	20.55	2339	47660	45321	20.38
L2A3	2369	48260	45901	20.46	2389	48260	45881	20.29
L3A1	2243	44660	42417	19.91	2263	44660	42397	19.73
L3A2	2339	48520	46181	20.74	2359	48520	46161	20.57
L3A3	2389	50640	48251	21.20	2409	50640	48231	21.02

CONCLUSION

The results indicated that the maximum significant increase in all lilium parameters achieved by treating plants with intermittent light and spraying ascorbic acid twice. Light is a major factor in the control of lilium height. Indeed, light in general appears to play an important role to maintaining or improving crop value is of great interest to growers. By using lighting technology and ascorbic acid can improve lily plants quality.

The Intermittent light and spraying ascorbic acid twice had the highest gross margin (LE 48251 and LE 48231 for the first and second seasons, respectively).

REFERENCES

Azmi, N. S.; Ahmad, R. and Ibrahim, R. (2015). Effect of LED lights, plant growth regulator and photoperiod on shoot production of in vitro propagated Rosa spp., International Conference on Smart Sensors and Application (ICSSA), Kuala Lumpur, pp. 161-165, doi: 10.1109/ICSSA.2015.7322530.

Barth, C.; De Tullio, M. and Conklin, P.L. (2006). The role of ascorbic acid in the control of flowering time and the onset of senescence. Journal of Experimental Botany, 57 (8): 1657-1665.

Beattie, D.J. and White, J.W. (1993). Lilium – hybrids and species. In: De Hertogh A.A., Le Nard M. (eds). The physiology of flower bulbs. Amsterdam: Elsevier, 423–454.

Benschop, M.; Kamenetsky, R.; Le Nard, M.; Okubo, H. and De Hertogh, A. (2010). The global flower bulb industry: production, utilization, research. In: Horticultural reviews. John Wiley & Sons, Hoboken, 1–115.

Blokhina, O.; Virolainen, E. and Fagerstedt, K.V. (2003). Antioxidant, oxidative damage and oxygen deprivations stress: A review. Annals of Botany, 91: 179-194.

Briggs, W.R. and Christie, J.M. (2002). Phototropins 1 and 2: versatile plant blue-light receptors. Trends Plant Sci. 7 (5): 204–209.

Conklin, P.L. and Barth, C. (2004). Ascorbic acid, a familiar small molecule intertwined in the response of plants to ozone, pathogens, and the onset of senescence. Plant, Cell and Environment, 27 (8): 959-970.

El-Kobisy, D.S.; Kady, K.A.; Medani, R.A. and Agamy, R.A. (2005). Response of pea plant (*Pisum sativum* L.) to treatment with ascorbic acid. Egyptian Journal of Applied Science, 20: 36-50.

El-Tohamy, W.A.; El-Abugy, H.M. and El-Gready, N.H.M. (2008). Studies on the effect putrescine, yeast and vitamin C have on growth, yield and physiological responses of eggplant (*Solanum melongena L.*) under sandy soil conditions. Applied Science, 2 (2): 296-300.

Hammoud, J.H. (2012). Effect of spraying with ascorbic acid and chelate iron in the growth and yield of squash (*Cucurbita pepo* L.). Basra Journal of Agricultural Sciences, (1) 22: 25-28.

Heins,R.D.;Harold, F. W. and Heal, W. E.(1982). The Influence of Light on Lily (Lilium longifiorum Thunb.). II. Influence of Photoperiod and Light Stress on Flower Number, Height, and Growth Rate. Journal of the American Society for Horticultural Science,107(2):335-33

Ibibofori, T.M.; Dunn, B.L.; Maness N. and Payton M. (2019). Effect of LED lighting and gibberellic acid supplementation on potted ornamentals. Horticulturae, 5 (3): 51.

Jerry, A. N.; Abdullah, A.A. and Alderawy, K.A. (2011). Effect of foliar of ascorbic acid on yield and quality of lettuce *(Lactuca sativa* L.) growth in southern Iraq. Basra Journal of Agricultural Sciences, 24(1): 13-24.

Jin, J.; Shan, N.; Ma, N.; Bai, J. and Gao, J. (2006). Regulation of ascorbate peroxidase at the transcript level is involved in tolerance to postharvest water deficit stress in the cut rose (*Rosa hybrida* L.) cv. Samantha. Postharvest Biology and Technology, 40 (3): 236–243.

Kamenetsky, R. and Okubo, H. (2012). Ornamental geophytes: from basic science to sustainable production. CRC Press, London.

Kohyama, F.; Whitman, C. and Runkle, E.S. (2014). Comparing flowering responses of long-day plants under incandescent and two commercial light-emitting diode lamps. HortTechnology, 24 (4): 490- 495.

Logan, B.A.; Kornyeyev, D.; Hardison, J. and Holaday, A.S. (2006). The role of antioxidant enzymes in photoprotection. Photosynthesis Research, 88 (2): 119-132.

Massa, G.D.; Kim, H.H.; Wheeler, R.M. and Mitchell, C.A. (2008). Plant productivity in response to LED lighting. HortScience, 43 (7): 1951–1956.

Morrow, R. (2008). LED lighting in horticulture. HortScience, 43 (7): 1947–1950.

Nelson, P. (2012). Greenhouse Operation and Management, 7th ed.; Pearson: Boston, MA, USA.

Okubo, H. (2014). History of *Lilium* species in Asia. Acta Horticulturae, 1027: 11–26.

Perman R. Yue M., James M. and Michael C. Natural resource and environmental economics. Book, Pearson Education Limited, Essex, 2003.

Snedecor, G. W. and Cochran W. G. (1980). Statistical methods Oxford and J.BH Publishing Com., 7th edition.

Treder, J. (2003). Effects of supplementary lighting on flowering, plant quality and nutrient requirements of lily 'Laura Lee' during winter forcing. Scientia Horticulturae, 98 (1): 37-47.

Wu, X.W.; Tian, M.; Wang, L.H.; Cui, G.F.; Yu, R.P.; Lu, Z.H.; Jia. W.J.; Qu, S.P.; Gui, M. and Wang, J.H. (2014). Native species of the genus *Lilium* in China. Acta Horticulturae, 1027: 27–40.