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Effect of Ethrel and Gibberelic Acid on Growth, Flowering, Sex Ratio and Yield to Luffa Plant

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ABSTRACT
The present field experiment was consummated throughout two successive seasons (2016/2017 and 2017/2018) at the nursery of Horticulture Research Institute, Agriculture Research Center, Giza, Egypt on *Luffa cylindrical*. The aim to study the effect of some growth regulators (ethrel and gibberellic acid) at different levels on growth, flowering and sex ratio of *Luffa cylindrical* on February 28th in both seasons at 4 m distance between plants. After planting, the plants were treated with the first spray after two leaves grown, and the second spray was received after 4 leaves grown, then after that the plants were treated with spraying every 21 days until June 16th. The experiment was incorporated in randomized complete design with three replications and nine treatments viz 4 concentrations each of ethrel (50, 100, 150 and 200 ppm) and GA_3 (100, 150, 200 and 250 ppm) and control i.e. tap water spray were investigated. The results emphasized that, ethrel treatments especially at 100 ppm showed beneficial effect on improving most plant traits in both seasons (stem length, stem diameter, No. of leaves/plant, No. of branches/plant, fruit length, fruit circumference and its yield). Meanwhile, GA_3 gave was less effect on plant quality and in some instances caused a decrement on some plant parameters. The obtained results exert also the great effect of treating plants with ethrel at 100 ppm for raising number of female flowers/plant, besides raising sex ratio. Also, the growth regulators used (ethrel and GA_3) caused an improvement in chemical constituents of the newly formed plants (N, P and K and chlorophyll a, b and carotenoids in both seasons). On the other hand, an economic feasibility study was made that was inferred through the economic evaluation of some economic indicators (total revenue per feddan, gross profit margin, ratio of total revenue to costs), which was calculated to evaluate the ethrel treatment at a concentration of 100 ppm and found it was achieved positive results at the level of the indicators mentioned and also it was found that it achieved high productivity per acre compared to control and other transactions. From the results, it could be recommended to foliar spraying plants with ethrel at the level of 100 ppm as such treatment proved its mastery in most cases on plant traits.

***Keywords*:** *Luffa cylindrical*, Ethrel, Gibberellic acid (GA_3), Economic Feasibility

Introduction

Luffa cylindrica (Linn M. Roem), Family Cucurbitaceae is one of the important cucrbitaceous crop, grown extensively in India. The tender fruits are used as vegetable or as cooked vegetables. Besides, its use as vegetable, this gourd is utilized for various purposes (e.g. ornamental purposes, good pot holders, table mats, bathroom mats, slipper soles have been made out from the fibers). The sponge gourd *Luffa cylindrica* (Linn M. Roem) posses monoecious forms as well as a great diversity of the pistillate and staminate flowering ratio. In monoecious forms the production of staminate flower is far in excess of pistillate counter part. Since the yield of the crop depends upon the production of pistillate flowers, it is worth while to study the possibility of bringing about a shift in favour of sucf flowers, Sex ratio and thus increase the yield.

Plant growth regulators have profound influence on fruit production in cucurbits. It can modify growth and sex expression, improve fruit set and ultimately increase the yield in number of curbits. A relationship between growth substances and sex expression probably exists in these plants. Sex modification shift towards femaleness by exogenous application of auxin, gibberellins, growth retardants, other plant growth regulators (PGR_s) (GA_3 and ethrel) play an important role in morphology and physiology of the plants and influence on the plant growth and morphogenesis. They should be applied in optimal concentrations in stage of application, species specificity, seasons, etc. Also, they have important roles in many processes such as germination, seedling growth and product performance

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and yield and ripening (Alkhassawnch *et al.,* 2006). Accurately (Birader and Navalagatti, 2008) found that PGR_s such as auxin and gibberellins include many aspects of plant growth and development. Seed priming with PGR_s caused an increase in seed germination and seedling vigor (Chauhan *et al.,* 2010; Jamil and Rha, 2007). In recent years, plant growth, flowering and yield have been manipulated with the help of growth regulating substances. Some PGR_s have important effect on sex expression in various cucurbitaceons crops. Also, by decreasing the male or female flowers, it causes change in yield (Hilli and Vyakaranahal, 2005). PGR_s are chemical materials that are used in low concentration to change the growth of plant usually by stimulating part of the natural growth regulators system. Ethrel spray at 400 ppm in four to six leaf stage significantly increased the number of female flowers per plant (35.23%) and reduced the sex ratio (3.69) compared to control (19.8 and 224.5 respectively) in cucumber (Vadigeri *et al.,* 2001). Ethrel at 100 ppm enhanced the total yield cucumber (Thappa *et al.,* 2011). Trailing method plays very important role in growth and quality of Cucurbitaceae family crops. Part *et al.* (2008) reported that GA_3 increased the growth and quality of characteristics and total flowering of jujube. Asrey *et al.* (2001) studied the effect of seed priming with GA_3 on growth and fruiting in muskmelon and reported that GA_3 at 400 ppm significantly enhanced the yield when compared to control. . Ethrel at 300 and 500 ppm had little effect on 1000 seed weight and seed germination was not influenced by ethrel in *Cucurbita maxima* (Korzeniewska and Niemirowiez, 1993). Gad *et al.* (1993) showed that ethrel at 225 or 300 ppm was very effective on summer squash sex expression and enhanced number of fruit per plant and total yields.

Materials and Methods

The present experiments was consummated throughout two successive seasons (2016/2017 and 2017/2018) at the nursery of Ornamental Plant and Landscape Department, Horticulture Research Institute, Agriculture Research Center, Giza, Egypt with the aim to study the effect of some growth regulators (ethrel and gibberellic acid) at different levels (ethrel at 50, 100, 150 and 200 ppm) and (GA_3 at 100, 150 200 and 250 ppm) and control (i.e. tap water spray). The seeds were planted on February 28th in both seasons at 4 m apart and the growth regulators were applied as a foliar spray every 21 days commencing from 2nd and 4th leaf stage till June 16th in the two seasons. The experiment was incorporated in randomized complete design (RCD) with three replications and nine treatments viz, four concentration each of ethrel (50, 100, 150 and 200 ppm) and GA_3 (100, 150 200 and 250 ppm) and control (i.e. tap water spray) were investigated.

Data collected were on vegetative growth parameters, fruit parameters (stem length (cm.), stem diameter (cm.), No. of leaves/plant, No. of branches/plant, fruit length (cm.), fruit circumference (cm.), fruit weight (g.), No. of seeds/fruit, weight of seeds/fruit (g.), No. of fruits/plant, leaf area (cm^2), number of days from planting to flowering, No. of male flowers, No. of female/flowers and sex ratio% were also estimated.

Regular agricultural practices such as weeding, watering… etc were carried out whenever needed.

Chemical constituents of the plant were determined as nitrogen (Blake, 1965), phosphorus (John, 1970), and potassium (Dewis and Freitas, 1970).

Photosynthetic pigments content (chlorophyll a, b and carotenoids mg/g.f.w.) were determined according to the methods of Saric *et al.* (1976)

Data were statistically analyzed using SAS program (1994) and means of were compared by L.S.D. test at 5% level of probability (Snedecor and Cochran, 1980).

Results

All growth regulators treatments caused an improving in plant parameters comparing with that gained from control treatment in the two seasons.

- **Growth characters:**

1- Effect of ethrel and GA_3 on stem parametes:

a- Effect of ethrel and GA_3 on stem length:

Insignificant effects were observed in stem length due to the application of the different ethrel or GA_3 treatments on such traits in both seasons as indicated in Table (1).

b- Effect of ethrel and GA_3 on stem diameter:

As shown from data outlined in Table (1), using ethrel at 100 ppm proved its mastery in producing the thickest stem in the two seasons. However, receiving plants GA_3 at 250 ppm recorded the lowest means in both seasons. Meanwhile, the other treatments gave an intermediate effects in this concern.

Table 1: Effect of ethrel and gibberellic acid on stem length (cm.) and stem diameter (cm.) of *Luffa cylindrica* during the two seasons (2016/2017 and 2017/2018)

	Stem length (cm.)		Stem diameter (cm.)	
	1st Season	2nd Season	1st Season	2nd Season
Control	180	208	1.10	1.18
Ethrel 50 ppm	265	320	1.30	1.42
Ethrel 100 ppm	280	315	1.53	1.62
Ethrel 150 ppm	273	307	1.17	1.29
Ethrel 200 ppm	230	327	1.47	1.53
GA_3 100 ppm	277	342	1.20	1.33
GA_3 150 ppm	242	276	1.43	1.54
GA_3 200 ppm	210	234	1.23	1.39
GA_3 250 ppm	225	275	1.16	1.25
LSD at 0.05	11.962	12.358	0.235	0.358

2- Effect of ethrel and GA_3 on No. of leaves/plant and No. of branches/plant:

a- Effect of ethrel and GA_3 on No. of leaves/plant

Evidently, data scored in Table (2) indicate the prevalence of receiving plants the lowest level of ethrel (50 ppm), with significant effect in the two seasons. In contrast, the lowest means were gained as a result of applying GA_3 at 200 ppm in the first season or applying GA_3 treatments at either 150 ppm or at 250 ppm in the second one.

b- Effect of ethrel and GA_3 on No. of branches/plant:

Great influence on No. of branches/plant with significant effect was observed in the two seasons due to applying ethrel treatment at 50 ppm comparing with that gained from the other treatments used in this respect. On the contrary, considerable decrease in number of branches/plant was noticed in both seasons due to treating plants with GA_3 at 250 ppm as mentioned in Table (2).

Table 2: Effect of ethrel and gibberellic acid on No. of leaves/plant and No. of branch/plant of *Luffa cylindrica* during the two seasons (2016/2017 and 2017/2018)

	No. of leaves/plant		No. of branch/plant	
Treatments	1st Season	2nd Season	1st Season	2nd Season
Control	19.00	20.00	1.2	1.4
Ethrel 50 ppm	32.00	46.50	6.2	7.8
Ethrel 100 ppm	31.00	43.00	5.5	6.5
Ethrel 150 ppm	28.00	30.00	4.3	5.6
Ethrel 200 ppm	29.00	32.50	4.5	5.8
GA_3 100 ppm	28.50	30.50	3.5	4.3
GA_3 150 ppm	27.00	28.50	2.5	3.4
GA_3 200 ppm	22.00	29.50	2.3	2.5
GA_3 250 ppm	23.50	28.50	1.5	1.7
LSD at 0.05	0.961	1.523	3.852	4.153

3- Effect of ethrel and GA_3 on fruit parameters:

a- Effect of ethrel and GA_3 on fruit length:

Considerable increment in fruit length was observed in the two seasons as a result of receiving plant ethrel treatment at the level of 100 ppm. However, the opposite was right as a result of supplying plants the highest level of GA_3 at 50 ppm in the two seasons. The other treatments, on the other side gave intermediate effects on such trait in both seasons, as indicated in Table (3).

b- Effect of ethrel and GA_3 on fruit circumference:

Obviously, data exhibited in Table (3) confirm the superiority of using ethrel at 50 ppm in raising fruit circumference in the two seasons. Meanwhile, the opposite was right on such trait due to using GA_3 at 250 ppm in the two seasons, as this treatment gave the lowest means in this regard. The other treatments, on the other side, gave an intermediate effect in this respect.

c- Effect of ethrel and GA_3 on fruit weight:

As shown from data presented in Table (3) applying GA_3 at 100 ppm considerably increased fruit weight comparing with that gained from the most other treatments applied in the two seasons. In contrast, receiving plants ethrel at 50 ppm gave the lowest means in this respect.

Table 3: Effect of ethrel and gibberellic acid on fruit length (cm.), fruit circumference (cm.) and fruit weight (g.) of *Luffa cylindrica* during the two seasons (2016/2017 and 2017/2018)

	Fruit length (cm)		Fruit circumference (cm)		Fruit weight (g)	
Treatments	**1st Season**	**2nd Season**	**1st Season**	**2nd Season**	**1st Season**	**2nd Season**
Control	20.00	22.00	20.00	22.00	38.00	42.00
Ethrel 50 ppm	34.00	37.00	32.00	43.00	45.00	47.00
Ethrel 100 ppm	36.50	41.00	29.00	41.00	46.50	59.50
Ethrel 150 ppm	32.00	35.00	27.00	33.00	48.00	58.00
Ethrel 200 ppm	30.00	34.00	26.50	30.00	62.00	75.00
GA_3 100 ppm	29.00	32.00	24.50	27.00	98.00	110.00
GA_3 150 ppm	27.00	30.00	23.50	25.00	73.00	88.50
GA_3 200 ppm	25.50	27.00	23.00	24.00	52.50	69.51
GA_3 250 ppm	23.00	25.00	22.00	23.00	58.50	79.50
LSD at 0.05	5.602	6.120	4.980	5.053	5.786	6.223

4- Effect of ethrel and GA_3 on No. of days from planting to flowering:

It is clear from data outlined in Table (4) that plants which treated with GA_3 at 250 ppm took the longest period to flower in the two seasons, comparing with that gained from the other treatments. However, the opposite was right for that recorded from plants treated with ethrel at 100 ppm in both seasons, as they recorded the shortest period for flowering.

5- Effect of ethrel and GA_3 on Leaf area:

Data presented in Table (4) indicate the superiority of applying ethrel at 200 ppm for obtaining the highest value of leaf area in both seasons. However, the opposite was right for receiving plant GA_3 at 200 ppm, which gave the least score in this concern in both seasons.

6- Effect of ethrel and GA_3 on fruit yield:

Data exhibited in Table (4) exert the beneficial effect of applying either ethrel or GA_3 in raising No. of fruits/plant in both seasons, comparing with that gained from untreated plants (control). In this connection applying ethrel at 100 ppm was the best treatment used for increasing No. of fruits/plant with significant effect in the two seasons, followed by that gained from using ethrel at 150 and 200 ppm in both seasons. Meanwhile, all GA_3 levels succeeded also to increase No. of fruits/plant over control but with less effect comparing with that obtained from ethrel treatments in the two seasons.

The previous results indicated the great economic values resulted from using the different growth regulators of either ethrel or GA_3 with the mastery of applying ethrel in raising No. of fruits/plant (fruits yield) in the two seasons.

Table 4: Effect of ethrel and gibberellic acid on number of days from planting to flowering, leaf area (cm^2) and No. fruit/plant (fruit yield) of *Luffa cylindrica* during the two seasons (2016/2017 and 2017/2018)

Treatments	Number of days from planting to flowering		Leaf area (cm^2)		No. fruit/plant (fruit yield)	
	1st Season	1st Season	1st Season	2nd Season	1st Season	2nd Season
Control	80.6	82.4	191.56	205.06	12.50	13.31
Ethrel 50 ppm	82.5	84.7	268.96	290.91	23.52	24.26
Ethrel 100 ppm	78.0	80.5	225.00	244.12	24.31	25.08
Ethrel 150 ppm	86.7	88.3	256.00	284.93	22.30	23.41
Ethrel 200 ppm	89.4	91.5	290.36	316.56	20.57	22.23
GA_3 100 ppm	86.2	88.6	163.84	188.02	18.18	20.71
GA_3 150 ppm	88.6	90.4	208.28	228.37	17.22	19.43
GA_3 200 ppm	87.2	89.5	145.93	165.69	15.82	16.52
GA_3 250 ppm	92.4	94.2	186.05	206.90	13.90	14.42
LSD at 0.05	2.055	3.131	6.245	7.362	1.912	2.533

7- Effect of ethrel and GA_3 on seeds parameters:

a- Effect of ethrel and GA_3 on number of seeds/fruit

As indicated from data outlined in Table (5), supplying plants GA_3 at 100 ppm was the best treatment used in raising number of seeds/fruit in the two seasons. The opposite was right, where ethrel was applied at 100 ppm in the two seasons as they gave the least number of seeds/fruit in the two seasons.

b- Effect of ethrel and GA_3 on weight of seeds/fruit:

Evidently, data registered in Table (5), show the superiority of applying ethrel at 200 ppm in the two seasons, for obtaining the highest values in the two seasons. On the contrary, receiving plant ethrel at 100 ppm in the first season and 50 ppm in the second one were the poorest treatments for the effect of the different growth regulators treatments on weight of seeds of fruits in both seasons. However, the other treatments gave intermediate effects in this regard.

Table 5: Effect of ethrel and gibberellic acid on No. of seeds/fruit and weight of seeds/fruit (g.) of *Luffa cylindrica* during the two seasons (2016/2017 and 2017/2018).

Treatments	No. of seeds/fruit		Weight of seeds/fruit (g.)	
	1st Season	2nd Season	1st Season	2nd Season
Control	130.0	160.0	13.00	17.80
Ethrel 50 ppm	141.0	168.0	28.50	23.00
Ethrel 100 ppm	132.0	163.5	23.00	25.00
Ethrel 150 ppm	145.0	189.0	25.00	27.50
Ethrel 200 ppm	178.0	209.5	30.50	32.00
GA_3 100 ppm	193.0	259.0	29.00	31.00
GA_3 150 ppm	164.0	212.0	27.50	29.50
GA_3 200 ppm	143.0	187.5	24.00	26.50
GA_3 250 ppm	189.0	229.5	26.50	28.00
LSD at 0.05	1.962	2.035	1.612	1.832

8- Effect of ethrel and GA_3 on flowering behavior:

a- Effect of ethrel and GA_3 on No. of male flowers/plant:

Obviously, data exhibited in Table (6) showed the superiority of treating plants with ethrel at the level of 100 ppm as it was the best treatment used in both seasons, as the highest values were obtained in this respect. However, the lowest records were obtained as a result of applying GA_3 at 250 ppm in both seasons.

b- Effect of ethrel and GA_3 on No. of female flowers/plant:

Data exhibited in Table (6) exert the beneficial effect of treating plants with ethrel at 100 ppm for raising number of female flowers plant in both seasons. Meanwhile, the lowest values of female flowers were a result of receiving plants GA_3 at 250 ppm. The other treatments on the other hand, gave intermediate effects in both seasons.

c- Effect of ethrel and GA_3 on Sex ratio:

Data presented in Table (6) showed the beneficial effect of supplying plants with ethrel treatment at 100 ppm in raising sex ratio value as such treatment gave rise to the utmost highest values in both seasons. In contrast, the least scores of sex ratio were a result of treating plants with GA_3 at 250 ppm in the two seasons.

Table 6: Effect of ethrel and gibberellic acid on male flowers, female flowers and sex ratio% of *Luffa cylindrica* during the two seasons (2016/2017 and 2017/2018)

	Male flowers		Female flowers		Sex ratio (%)	
Treatments	**1st Season**	**2nd Season**	**1st Season**	**2nd Season**	**1st Season**	**2nd Season**
Control	231.00	232.50	12.71	13.94	5.5%	6.0%
Ethrel 50 ppm	296.40	308.47	36.45	40.71	12.3%	13.2%
Ethrel 100 ppm	300.83	320.70	40.61	46.50	13.5%	14.5%
Ethrel 150 ppm	290.62	303.62	34.29	37.98	11.8%	12.5%
Ethrel 200 ppm	279.50	295.05	30.78	34.50	11.0%	11.7%
GA_3 100 ppm	264.30	278.32	27.75	32.28	10.5%	11.6%
GA_3 150 ppm	251.25	265.39	24.12	27.37	9.6%	10.3%
GA_3 200 ppm	243.11	255.90	21.39	24.05	8.8%	9.4%
GA_3 250 ppm	232.35	246.69	19.09	20.96	8.2%	8.5%
LSD at 0.05	10.334	11.210	7.355	8.562	1.834	1.955

9- Effect of ethrel and GA_3 on Pigments content:

Data presented in Table (7) indicate the prevalence of treating plant with Ethrel at 200 ppm for raising pigments content in both seasons, comparing with that gained from the other growth regulators used in both seasons. Meanwhile, the lowest records were a result of plants treated with ethrel at 50 ppm for chlorophyll (a) and 150 ppm of ethrel for chlorophyll (b) and carotenoids.

Table 7: Effect of ethrel and gibberellic acid on chlorophyll a, b and carotienods (mg/g.f.w.) of *Luffa cylindrica* during the two seasons (2016/2017 and 2017/2018)

	Chlorophyll a		Chlorophyll b		Carotienods	
Treatments	**1st Season**	**2nd Season**	**1st Season**	**2nd Season**	**1st Season**	**2nd Season**
Control	0.324	0.437	0.146	0.153	0.231	0.252
Ethrel 50 ppm	0.431	0.542	0.151	0.162	0.276	0.281
Ethrel 100 ppm	0.633	0.678	0.182	0.189	0.282	0.287
Ethrel 150 ppm	0.711	0.752	0.131	0.138	0.192	0.199
Ethrel 200 ppm	0.823	0.902	0.197	0.199	0.290	0.296
GA_3 100 ppm	0.615	0.645	0.164	0.171	0.250	0.265
GA_3 150 ppm	0.522	0.580	0.156	0.166	0.255	0.240
GA_3 200 ppm	0.743	0.886	0.187	0.190	0.261	0.282
GA_3 250 ppm	0.689	0.705	0.174	0.181	0.254	0.270

10- Effect of ethrel and GA_3 on Chemical constituents:

Data exhibited on the effect of the different growth regulators of different levels revealed the increment of N% due to applying GA_3 at 150 ppm in the first season and with applying ethrel at 100 ppm in the second one. However, the highest values of P% was a result of receiving plants GA_3 at 100 ppm in both seasons. Meanwhile, the highest values of K% was a result of applying ehtrel at 50 ppm in both season.

Table 8: Effect of ethrel and gibberellic acid on nitrogen, phosphours and potassium% of *Luffa cylindrica* during the two seasons (2016/2017 and 2017/2018)

	N%		P%		K%	
Treatments	**1st Season**	**2nd Season**	**1st Season**	**2nd Season**	**1st Season**	**2nd Season**
Control	3.356	3.865	0.458	0.489	0.925	1.053
Ethrel 50 ppm	3.791	4.035	0.653	0.703	1.206	1.432
Ethrel 100 ppm	3.964	4.324	0.320	0.478	0.837	0.978
Ethrel 150 ppm	3.569	4.153	0.545	0.598	1.232	1.786
Ethrel 200 ppm	2.827	3.436	0.537	0.576	0.947	1.108
GA_3 100 ppm	2.881	3.633	0.546	0.582	1.341	1.812
GA_3 150 ppm	4.061	4.267	0.315	0.453	0.857	1.033
GA_3 200 ppm	2.756	3.124	0.364	0.475	0.785	0.958
GA_3 250 ppm	2.636	3.025	0.607	0.712	1.122	1.352

Discussion

The aforementioned results of the morphological traits may lead to the following: Patel *et al.* (2009) experimented the effect of ethrel on sex ratio of *Luffa cylindrica*. They concluded that the response of different concentrations of ethrel on number of male flowers, number of female flowers and sex ratio was found significant when compared to control. The reduced level of endogenous gibberellins and increased level of auxin after ethrel spray was reported by Rudinch *et al.* (1972). This may be a probable reason for increasing number of female flowers, decreasing number of male flowers and then by lowering sex ratio. Further it can be supported by the hypothesis suggested by Herrison (1957) that sexual differentiation is controlled by endogenous level of auxin in regions neightouring the flowering primordia and during the flowering formation of pistillate organs which may be favourd by high auxin level in the vicinity of differentiation primordia and of staminate organs by the low level. The above findings are in accordance with those of Pandya and Dixit (1997) on bottle gourd, Singh and Singh (1984) and Kshirsagar *et al.* (1995) on cucumber. The probable reason for increase the fruit length and diameter was due to respiration and photosynthesis of treated plants remained higher than the check (Audus, 1960). This may be due to greater accumulation of carbohydrates due to photosynthesis, which resulted in increasing weight and size of fruits. The another possible reason may be explained due of the report of Crane and Overbeek (1965) who stated that the sole function of fertilized ovules or seeds in relation to growth of fruit is to synthesis one or more hormones which initiate and maintaine a metabolic gradient along which foods can be translocated from the parts of the plants towards the fruits. These results are in agreement with those of Arora *et al.* (1987) on sponge gourd and Singh and Choudhury (1989) on bottle gourd and cucumber. Ethrel significantly increased the fruit yield over control. An increase in fruit yield in treated plants may further be attributed to that plants remain physiologyically more active to build up sufficient food stock for developing of flowers and fruits, hence leading to higher yield. The above results were in consonance with those of Pandy and Dixit (1997) on bottle gourd and Arora *et al.,* (1987) on sponge gourd.

Economic feasibility

The economic evaluation of the experiments generally depends on the technical results of these experiments that have been applied, which had carried out in research stations and field experiments in different production areas, According to the results of the experiments related to the addition of growth regulators (ethrel and gibberellic acid) at different levels, And that was during two consecutive

agricultural seasons (2016/2017) and (2017/2018), And it has been evident to increase the plant productivity of these transactions of growth regulators. (David, 1996).

However, there are several of indicators that must be taken in consideration when conducting the economic evaluation to estimate or predict the economic viability of these growth regulators, as these indicators usually reflect the economic efficiency of transactions, and the most important of these indicators are average productivity, total revenue, total costs, net revenue, Total revenue-to-cost ratio (the benefit-to-cost ratio, it equals the total monetary value of aggregate production to total feddan costs), Hinkelmann and Kempthorne, (2007) and Dean *et al.* (2015).

It is clear from data outlined in Table (9) that plants which treated ethrel at 100 ppm for obtaining Feddan profit that it reached about 36.13 thousand pounds / feddan due to addition ethrel at 100 ppm comparing with that gained from untreated plants (control) in 1st season, Mosbah *et al.,* (2019).

The results also indicated the preference of the treatment of ethrel at 100 ppm on level of producing cost of the fruit, in addition to the ratio of the revenue to the costs compared to the control treatment, as well as the other transactions that depending on the feddan productivity for the treatment ethrel at 100 ppm.

As indicated from data outlined in Table (10), supplying plants ethrel at 100 ppm in 2nd season indicated an increase in feddan profitability at about 30.18 thousand pounds / feddan over its counterpart to the control treatment, That treatment is in relation to plant productivity and hence the percentage of its profit.

Table 9: Economic feasibility of ethrel 100 ppm treatment compared to untreated plants (control) for 1st season

Transactions	No. Fruit/plant (Fruit Yield)	No. Fruit / feddan	Average price of a Fruit	Total costs (pounds / feddan)	Total revenue (return) pounds / feddan	Net return (profit)	cost of per a Fruit (pounds	Revenue / cost (%)
ppm E 100	24.695	6420.7	10	28075	64207	36132	4.37	2.29
Control	12.5	3250.0		27655	32500	4845	8.51	1.18
Deviation from Control	12.195				31707	31287	−4.14	1.11
Deviation from (%)Control	97.56						−48.61	94.60

Table 10: Economic feasibility of ethrel 100 ppm treatment compared to untreated plants (control) for 2nd season

Transactions	No. Fruit/plant (Fruit Yield)	No. Fruit/ feddan	Average price of a Fruit	Total costs (pounds / feddan)	Total revenue (return) pounds / feddan	Net return (profit)	cost of per a Fruit (pounds)	Revenue / cost (%)
ppm E 100	25.08	6520.8	10	28075	65208	37133	4.31	2.32
Control	13.31	3460.6		27655	34606	6951	7.99	1.25
Deviation from Control	11.77				30602	30182	-3.69	1.07
Deviation from Control (%)	88.43						-46.12	85.61

The results also indicated the preference of the treatment of ethrel at 100 ppm during the two seasons on level of producing cost of the fruit, in addition to the ratio of the revenue to the costs compared to the control treatment, as well as the other transactions that depending on the feddan productivity for the treatment ethrel at 100 ppm.

From the results of the economic indicators that were calculated to evaluate the treatment of ethrel at 100 ppm on level of the two consecutive agricultural seasons (2016/2017), (2017/2018), it was found that it achieved an feddan productivity exceeding other transactions, and it also achieved positive results at the level of the indicators mentioned in the tables above, whether from total feddan revenue, total profit, or revenue / cost (%) compared to the control, and also the other transactions that depending on the per-feddan productivity for ethrel at 100 ppm.

On other hand, the total area of luff crop in Egypt season 2017/2018 was about 2.87 thousand feddan Ministry of Agriculture and Land Reclamation, (2017/2018).

Conclusion

It is recommended from the aforementioned that to obtain the best growth and fruiting of *Luffa cylindrical* plant should be sprayed with ethrel at 100 ppm 4 times beginning from the transplant stage with 21 days interval.

References

Al-Khassawaneh, N.M., N.S. Karam and R.A. Shibli, 2006. 2006. Growth and flowering of black iris (*Iris nigricans* Dinsm.) following treatment with plant growth regulators. Sci Hortic., 107:187-193.

Arora, S. K., M. L. Pantida and M. S. Dahiya, 1987. Effect of plant growth regulators on vegetative growth, flowering and yield of ridge gourd (*Luffa acutangula* Roxb) Haryona Agric. Univ. J. Res., 17(4): 319 – 324.

Asrey, R., G.N. Singh, H.S. Shukla, and R. Singh, 2001. Effect of seed soaking with Gibberellic acid on growth and fruiting of muskmelon (*Cucumis melo* L.). Haryana J Hort Sci., 30(3-4):277-278.

Audus, L.J., 1960. In "Encyclopedia of Plant Physiology" (ed L. Ruhland). Springer, Berlin, 3(2): 360 – 387.

Birader G,and C.M. Navalagatti, 2008. Effect of plant growth regulators on physiolog y and quality in bittergourd (*Momordica charantia*). MSc thesis, university of agricultural sciences, Dharwad.

Blake, C.A., 1965. Methods of Soil Analysis. Part I and II. Amer. Soc. Agron. in Pupl. Madison. Wise U.S.A.

Chauhan, J.S., YK Tomar, A. Badoni, N. Indrakumar, S. Seema, and A. Debarati, 2010. Morpholog y, germination and early seedling growth in *Phaseolus mungo* L. with reference to the influence of various plant growth substances. J Am Sci 6(1):34-41.

Crane, J.C. and J.V. Overbeek, 1965. Induction of parthenocarpy in figs by kinin. Sci., 147: 1468.

David, G.D., 1996. The Economic Evaluation of Projects", Papers from a Curriculum Development Workshop, Economic Development Institute of The World Bank.

Dean, A., M. Morris, J. Stufken, and D. Bingham, 2015. Handbook of design and analysis of experiments ", Chapman & Hall/CRC handbooks of modern statistical methods.

Dewis, J. and F. Freitas, 1970. Physicological Methods of Soil and Water Analysis. Food and Agric. Organization of the United Nations of Soils Bulletin No. (10): 275.

Gad, A.A., A.A. Alsadon,and H.M. Wahdan,1993. Sex expression and yield response of summer squash to ethrel. Ann Agric Sci, Ani Shams Univ Cairo 38:251-259.

Herrison, H.J., 1957. The experiment modification of sex expression in flowering plants. Biol. Rev., 32: 38 – 90.

Hilli, J.S. and B.S. Vyakaranahal, 2005. Studies on seed production and post-harvest techniques in ridge gourd (*Luffa acutangula*, L. Roxb). Ph. D. Thesis, University of Agricultural Sciences, Dharwad.

Hinkelmann, K. and O. Kempthorne, 2007. Design and Analysis of Experiments. Introduction to Experimental Design", second edition, Wiley Series in Probability and Statistics.

Jamil, M.,and E.S. Rha, 2007. Gibberllic acid (GA3) enhance seed water uptake germination and early seedling growth in sugar beet under salt stress. Pak J Biol Sci 10(4):654-658.

John, M.K., 1970. Colorimetric determination of phosphorus in soil and plant materials with ascorbic acid. Soil Sci., 109 (4): 214 - 220

Korzeniewska, A.,and S.K. Niemirowiez,1993. Effect of ethrel on fruit and seed related characters in four inbred lines of Cucurbita maxima duch. Gatenbauwissenschaff 58:266-271

Kshirsagar, D.B., U.T. Desai, B.T. Partil, and B.G. Pawar, 1995. Effect of plant growth regulators on sex expression and fruiting in cucumber cv. Himangi J. Maharashtra agric. Univ., 20(3): 473 – 474.

Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, "Bulletin of Agricultural Statistics", Part (2), Summer & Nili Crops 2017/2018.

Mosbah, M.K., E.E. Shaker, S.A. Ali and Hanan A. Zahran, 2019. An Analytical Study to Costs and Returns of the Egyptian Lupine Plant", 9th International Conference for Sustainable Agricultural Development 4-6 March 2019 Fayoum J. Agric. Res,&Dev.,Vol.33 No. 1(B) March.

Pandy, M.B. and C.K. Dixit, 1997. Effect of plant growth regulators on bottle gourd *Lagenaria siceraria* (Mol. Standl.) cv. PUSA Summer Prolificlong. J. Applied Hort., 3(2): 105 – 111

Part, L., C. Botti, and T. Fichet, 2008. Effect of plant growth regulators on floral differentiation and seed production in Jojoba (*Simmondsia chinensis* (Link) Schneider). Indus Crops Products 27:44-49

Patel, H.B., D.K.Kakade, S.T. Rukam, G.U. Kulkarni, P.G. Memane, N.A. Deshmukh, J.S. Sharma and C.D. Patel, 2009. Effect of plant growth regulators on sex expression and yield of sponge gourd *Luffa cylindrica* (Roem) cv. PUSACHIKNI. The Asian Journal of Horticulture 4 (2): 108 – 110.

Rudich, J.J., A.H. Harley, and N. Kedar, 1972. Ethylene evolution from cucumber plants as related to sex expression. Plant physiology. 49: 998-99.

Saric, M., R. Kastrori, R. Curei, T. Capina, and I. Geric, 1976. Chlorophyll determination. Univ. Unoveu sadu Parktikum is Fizologize Bibijoke, Beagard, Haunca, Anjiga, p125.

SAS, 1994. SAS ISTAT User's Guide; Statistics. Vers. 6. 04, 4th ed SAS Institute Inc. Cary. N. C., USA.

Singh, G.P. and R.K. Singh, 1984. Chemical sex modification and its effect on fruiting in cucumber (*Cucumis sativus*, L.). South Indian. J. Hort., 32(3): 127 – 131.

Singh, R. K. and B. Choudhury, 1989. Different responses of three genera of cucurbits to boron and plant growth regulators, Indian. J. Hort., 46(2): 215 – 221.

Snedecor, N.W. and W.G. Cochran, 1980. Statistical Methods, 6th ed. The Iowa State Univ. Press. Ames Iowa U.S.A.

Thappa, M., S. Kumar,and R. Rafiq, 2011. Influence of plant growth regulators on morphological, floral and yield traits of cucumber (*Cucumis sativus*, L.). Kasetsart J (Nat Sci) 45:177-188.

Vadiger, B.G., B.B. Madalageri, and M.N. Sheelavantar, 2001. Effect of ethrel and gibberellic acid on yield and quality of two cucumber varieties. Karnataka J Agric Sci., 14:727-730.