Journal of Horticultural Science & Ornamental Plants 14 (2): 98-110, 2022
ISSN 2079-2158

DOI: 10.5829/idosi.jhsop.2022.98.110

Effect of Spraying Sitofex (CPPU) and Gibberellic Acid (GA_3) on the Yield and Fruit Quality "Haied and Amal" Apricot Cultivars

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Abstract: The problem of "Haied" and "Amal" apricot cvs is small size fruits that are directly reflected on the low final yield and total income. So the main goal of this study is to find out the role played by spraying Sitofex (CPPU) at 5 or 10 ppm in the beginning of fruit set stage with or without Gibberellic Acid (GA_3) at 20 ppm in pit hardening stage of 6 years old "Haied" and "Amal" apricot cvs. planted on sandy soil at 5×4 m apart under drip irrigation system at a private orchard in Nobaria, Behera governorate through 2020 and 2021 seasons. The results showed that, all the present treatments clearly enhanced fruit yield and quality than control but decreased fruit firmness may be as a reflection of increasing fruit size. As for the two cultivars, Amal cv was more responsive for treatments to increase fruit yield (68.27 , 38.07 Kg/tree) and decrease fruit drop (29.11 , 45.29 %) than "Haied" cv. (30.95 , 26.06 Kg/tree) for yield and (64.31 , 66.96 %) for fruit drop through the two studied seasons respectively. Furthermore, the best result in Amal cv was spraying with (CPPU 10 ppm + GA_3 20 ppm) which gave the highest fruit yield (87.37, 52.41 Kg/tree). On the other hand, "Haied" cv spraying with (CPPU 5 ppm + GA_3 20 ppm) gave better results in fruit yield (45, 40 Kg/tree). All estimated fruit quality characteristics (fruit weight, size, firmness, diameter, length, shape index, TSS, acidity, TSS/acidity ratio in addition flesh thickness & weight) were improved in the two cultivars comparing with control. The economical study cleared that, total income/feddan overcome the costs of spraying CPPU and GA_3 and gave twice of total income than the control income. In final, spray CPPU 10 ppm + GA_3 20 ppm in Amal and CPPU 5 ppm + GA_3 20 ppm in "Haied" gave highest fruit yield and income.

Key words: Apricot · Haied · Amal · Sitofex · CPPU · GA_3 and fruit quality

INTRODUCTION

Apricot (*Prunus armeniaca* L.) is a deciduous fruit tree belonging to Rosaceae family, subfamily prunoideae, which produces stone fruits (drupe).Total planted area of apricot trees is 10896 feddan, with productivity 65511 ton according to Agriculture Statistics of Ministry of Agriculture and Land Reclaimed Areas [1]. "Haied and Amal" apricot trees cultivars have spread due to their disenable feature as low chilling requirements, suitability for Egyptian climatic, early ripening, good taste and having a red cheek for (Amal cultivar), the growing of both "Haied and Amal" cv have increased enormously en the resend decade. Yet the productivity of trees is influenced by climatic changes and sensitivity to fluctuations in day and night temperature these which increase fruitlets drop and also these cultivars bear the small size thus fruits affecting the final production of trees at the period of harvest So to solve this problem it is essential to know the phonological stages of fruit development up on which size depends (a): The number of cells present at fruit set, (b): number of cells devised that occur subsequently and (c): the extent to which these cells expand. Cell division through the early stage of fruit development has a main impact on final fruit size [2, 3]. The traditional methods of agricultural practices to enlarge the size of the fruits such as manual thinning of the fruits and girdling of the branches are very costly, time consuming techniques and very stressful. Therefore, it is essential to use helpful and low cost alternatives such as plant growth regulators. Cell division and cell elongation of fruits are altered by plant growth regulators to increase the ending fruit size at harvest time.

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The plant growth regulators (PGR) such as Gibberellic acid and Sitofex acting as a messenger, are needed in small quantities and the minor effect on fruits is enhancing cell elongation and cell enlargement with increase the fruit length and size [4]. Such as Gibberellic acid and Sitofex [5]. Also, PGRs as foliar appliance are the most powerful tools for manipulating tree growth, flowering, yield and fruit quality particularly fruit size, plus, controlling fruit maturing [6]. In addition, by hastening or retarding fruit maturation the growers can use top demands, avoid unfavorable environmental conditions and extend the maintaing period. It was well confirmed that, both cytokinins and Gibberellins improve size of many fruits by stimulating cell division and/ or cell expansion [7].

Sittofex (CPPU) one a plant growth regulators .with high physiological activity which has been widely studied recently by Kassem, *et al*. [8], Mahaveer [9] , cell division in the early stage of fruit development has a larger influence on last fruit size at harvest period and early fruit cells division is normally induced by the natural growth hormones particularly cytokinin [10-13]. Cytokinin has action clear effect by inducing fruit growth although using low rates where plays a role in cell division, cell elongation Ajay and Sanjeev [14] and great role in activating the biosynthesis of proteins, RNA and DNA [15]. The enhancement effect of CPPU on fruit size is due to stimulating cell division in early stage and promoting cell enlargement in the late stage of fruit expansion [16, 17]. Also, application with several concentrations of CPPU enhanced cell division, increased cell size, fruit weight, size and fruit yield [18]. Several investigations mentioned that, synthetic cytokinin CPPU {(N-(2-chloro-1-pyridinyl)-N-phenylurea) is one of the major treatments affecting fruit growth and fruit size and spraying deciduous fruit trees with several concentrations enhanced cell division, increased cell size, increased fruit weight, size and fruit yield. Foliar Spray with sitofex 100 Ml 100L on two apricot cultivars “Nafsika and Niovi” 10-15 days after full bloom and artificial auxin at the start of pit hardening increased fruit diameters 5 or 10 ppm CPPU on “Hollywood and Santarosa” plum after 1 week of full bloom and spray 10 or 15 ppm CPPU on “Le-cont” pear augmented yield, monetary value, fruit weight, size, length, diameter, firmness and acidity and the lowermost values of fruit fall and TSS [13, 19, 20].

Gibberellic acid (GA_3) affect fruit formation, abscission, cell elongation, apical dominance and photoperiod [21, 22]. Mode of action for GA_3: The first is that GA_3 intensifies an organ ability to function as a nutrient sink [23]. The second action is the faculty of GA_3 to increase the manufacture of IAA in plant tissues [24]. The third one involves accelerating manufacture of hydrolytic enzymes as amylase in the aleurone layer of seeds [25]. GA_3 has the same effect for acceleration the cell enlargement and improving fruit quality all of that is reflected on wider diameter and longer width so that fruit weight and size were increasing than control [16, 17]. Assad [19] on Hollywood and Golden Japanese Plum cultivars sprayed Gibberellic acid (25 and 50 ppm) twice at full bloom and 2 weeks later this increased yield and enhanced fruit quality and dissimilar levels of GA_3 treatment; 20 and 25 ppm GA_3. On ‘0900 Ziraat’ Sweet Cherry was significantly affected with 15 ppm GA_3 [26]. Trees treated with the topmost concentration of GA_3 (25 ppm) in two different sites yielded more fruits and superior weight in Sweet Cherry [27]. Also, Zhang and Whiting [28] found that, GA_3 at 200 mgl^{-1} applied at 9 DAFB was the most effective treatment as and enhanced final fruit weight by 15% on ‘Bing' sweet cherry. Foliar spraying with GA_3 at 20 ppm at full bloom on “Canino” Apricot increasing fruit set, yield and fruit quality compared with control [29].

For combination between the tow studding compounds some researches indicated that (CPPU and GA_3) has an effective effect on rising the final size of the fruits. Application $GA_3$40 ppm + 15 ppm CPPU or GA_3 20 ppm + 15 ppm CPPU raised the percentage of fruit size, yield and fruit weight in addition to enhancing the appearances of fruit quality of “Kelsey” Plum [18].

The purpose of this research was to ensure economical yield with a high-quality for “Haied and Amal "cvs. apricot trees by applying the dissimilar concentrations of Sitofex (CPPU) and gibberellic acid GA_3 alone or in mixture to enhance fruit size, yield and fruit quality.

MATERIALS AND METHODS

This study was applied during two successive seasons of 2020 and 2021 on “Haied and Amal "cvs. apricot trees. There were grown (6 years old) grown at 5 x 4 meters apart in sandy soil of a private orchard at Nobaria, Beheria governorate, Egypt. The total chill hours of Nobaria, Beheria governorate prevailing from 1/10 / 2019 to 1/3/2020 for the first season and from 1/10/2020 to 1/3/2021 for the second season according to Egyptian Ministry of Agricultural & Land Reclamation- Agricultural Research Center - Central Laboratory for Agricultural Climate (CLAC) [30] calculation 10 or + 10 as the following; Total chilling hours in the season are shown in Table (1):

Table 1: Total Chill hours of Nobaria, Beheria governorate +10 °C during 2019/2020 and 2020/2021 seasons

Winter season	Total chilling Hours
2019/2020	712
2020/2021	423

Eighteen uniform" Haied" cv trees and eighteen uniform" Amal" cv trees were selected .They were healthy and similar in the vigor, as much as possible, same cultural practices and drip irrigation was adopted in this area for the investigation. The trees were exposed to the ordinary orchard management. Each treatment companied of three replicates with one tree for each replicate and four adult branches carrying spurs were selected on each replicate for measurements.

Twelve treatments (6 treatments were applied on "Haied" cv and six treatments were applied on Amal) each season on the same tree include two materials Sitofex and Hockley Gib-T:- Sitofex is the commercial name of (CPPU 0.1 %) and a synthetic cyto-kinin N-(2-chloro-4-pyridmyl)-N urea phenyl) is a product of ALZ Chem-Germany, Trans Fridge Inter., Comp and Hockley Gib-T is the commercial name of tablet of GA_3 contains 1 grame GA_3 (GA_3 10 %) the 12 treatments as the following:

- Haied cv. trees Sprayed with (CPPU) at 5 ppm.
- Haied cv. trees Sprayed with (CPPU) at 5 ppm + (Gibberellic acid GA_3) at 20 ppm.
- Haied cv. trees Sprayed with (CPPU) at 10 ppm.
- Haied cv. trees Sprayed with (CPPU) at 10 ppm + (Gibberellic acid GA_3) at 20 ppm.
- Haied cv. trees Sprayed with (Gibberellic acid GA_3) at 20 ppm.
- Haied cv. trees Control (sprayed with water).
- Amal cv. trees Sprayed with (CPPU) at 5 ppm.
- Amal cv. trees Sprayed with (CPPU) at 5 ppm + (Gibberellic acid GA_3) at 20 ppm.
- Amal cv. trees Sprayed with (CPPU) at 10 ppm.
- Amal cv. trees Sprayed with (CPPU) at 10 ppm + (Gibberellic acid GA_3) at 20 ppm.
- Amal cv. trees Sprayed with (Gibberellic acid GA_3) at 20 ppm.
- Amal cv. trees Control (sprayed with water).

Sitofex (CPPU) was sprayed at beginning of fruit set stage with cover spray 2.5L per tree and Gibberellic acid was sprayed at pit hardening stage with cover spray 5L per tree.

Experimental Measurements

Fruit Drop (%): Was calculated one week before harvesting by the following equation according to Westwood [31]:

Fruit drop percent = Total no of fruit let – No of fruits retained X 100

No of Fruit Lets

Fruit Yield (Kg /Tree): The date of yield harvest was recorded when fruits retched the maturity stage at the commercial picking date and became salable at (11/5/2020) to "Haied", (16/5/2020) for "Amal" in the first season and (15/5/2021) for "Haied", (20/5/2020) to "Amal" in the second season. Fruit yield was calculated by number of fruits per tree x Average fruit weight in the mature stage.

Fruit Quality: Ten fruits from each tree were picked to assess the Physical and chemical properties of mature fruits that carried out when fruits of control attained maturity. Physical and chemical characteristics were evaluated as following:

Physical Characteristics of Fruit

Fruit Weight (g): Average of fruit weight was determined by weight a sample of fruits from each replicate and the mean fruit weight was calculated.

Fruit Size (cm^3): Using water displace meter method.

Fruit Dimensions (cm): Fruit length and diameter in cm were measured by using a vernier caliper.

Fruit L/D Ratio: It was measured by separating the fruit length on fruit diameter.

Fruit Firmness ($Lb/Inch^2$): It was determined from the two sides of fruits by using a pressure tester (Advance Force Gorge RH13, UK).

Flesh Thickness (cm): Was measured by using a vernier caliper.

Flesh Weight (g): Average of fruits pulp was determined by weight a sample of fruits pulp from each replicate and the average fruit pulp was calculated.

Chemical Characteristics of Fruit

Total Soluble Solids (TSS%): It was determined in fruit juice sample of fruits by hand refractometer model (Portable Refractometer ATC).

Total Acidity (%): It was determined as anhydrous malic acid as a percentage after titration by 0.1 N sodium hydroxide using phenolphthalein as an indicator [32].

TSS/Acid Ratio: It was calculated by dividing total soluble solids on total acidity.

Economic Study: The price of Sitofex (850 LE)/Liter and tablet of GA_3 (18 LE) / (each tablet). Each feddan requires 7 liters of sitofix 10% for treatment 3.5 liters of sitofix 5% for treatment and 21 tablet of GA_3.

Average cost LE / fed = Cost of material sprayed for one tree x number of additions x number of tree / fed (210 tree).

Yield ton / feddan = Fruit yield kg/tree x No. of trees / fed (210 tree).

Total income/fed LE = Price of one kg apricot in the farm x fruits yield ton/fed

The farm gate price of one kg apricot (8.5 & 8 LE) in the first and second season

Net income (LE)/feddan = Total income/feddan (LE) - Average cost (LE) /feddan.

Statistical Analysis: The trial treatments were arranged in factorial experiment in a randomized complete block design (with 3 replicates. Each replicate consisted of one tree). Obtained data were exposed to testing of variance according to Snedecor [33]. Means were compared using the new L.S.D test at 5% level.

RESULTS AND DISCUSSION

Data in Table (2) show the impact of the studied spraying materials on fruit drop and yield, during the two considered seasons.The interaction results of treatments with cultivars show that the application CPPU at 10 ppm + 20 ppm GA_3 resulted in the highest yield for "Amal" cv (87.37 and 52.41 kg / tree) for both seasons in the second order treatment of CPPU at 10 ppm alone compared with control (Fig. 1) this difference in the yield of the two seasons may be due to the climatic changes mentioned later .For the lowest fruit drop (13.96%) in the first season where as for the second season all treatments where statistically equal to control. Whis respect to "Haied" cultivar highest yield was dedicated to spraying 5 ppm CPPU + 20 ppm GA_3 in both seasons (45.00 and 40.00 kg / tree) for both seasons respectively. As for the percentage of fruit drop lowest percentage in the first season was due to the 5 ppm CPPU + 20 ppm GA_3 treatments (57.08%) where as in the second season it was due to 10 ppm CPPU + 20 ppm GA_3 (59.26%).

Whereas for "Haied" cv application CPPU 5 ppm + 20 ppm GA_3 results (45.00 and, 40.00 kg / tree) and lowest fruit drop in the first season only compared with control (Fig. 2).

But the results showed the best combinations for the cultivars were CPPU 5 & 10 ppm + 20 ppm GA_3 in both seasons have the supreme values for yield and decrease fruit drop without differences between them. And for the effect of the response of the cultivars to other treatments, it was found that "Amal"cv best response than "Haied" cv. "Amal" cv the best significant values of yield (68.27 and 38.07 kg / tree) may be as a result of decrease the percent of fruit drop (29.11 and 45.29 %) for the two seasons respectively for the same cultivar. It is also noticed that, the fruit yield of "Amal" cv. was (68.27 kg/tree) in 2020 season and dropped to (38.07 kg/tree) in 2021 season as a result of an increase in fruit drop percentage from (29.11 %) in the 1 st season of study to (45.29 %) in the 2 nd one. May also due to the finding of more chilling units (712) in the first season than the second season (423) as shown in table of calculating chilling units for the both seasons (Table 1) and "Haied" cv as the same. However, when deciduous fruits have sufficient chilling requirements, they become more productivity. Sufficiently of cold requirement more than the optimal limit for the needs and requirement of the cultivar working on the entire female organs and the absence of abnormal flower bud consequently increased fruit set and production in stone fruit crops [34]. Also, in 23 March 2021, the day temperature (maximum) was 36°C, while the night temperature)minimum) was 13°C. As for 19 April 2021, the day temperature (maximum) was 41°C, while the night temperature)minimum) was 17°C (Egyptian Ministry of Agricultural & Land Reclamation- Agricultural Research Center-Central Laboratory for Agricultural Climate). Because of this fluctuation and the sudden change in temperature between day (maximum) and night) minimum), this led to the death of embryos and the absussion of fruits Sawicki, *et al*. [35] in the stage before the hardening of the pit, which led to a decrease in the amount of the yield, especially in the "Al-Amal" cultivar compared to the "Al-Haied" cultivar because it is more affected by fluctuations in temperature and unsuitable weather conditions, because it is a late cultivar compared with the Haied cultivar by about 10 to 15 days.

The above results are in agreement with those obtained by Assed [19] on "Hollywood and Golden" Japanese Plum cultivars they sprayed Gibberellic acid (25 and 50 ppm) twice at full bloom and 2 weeks later which raised yield. Sprayed gibberellic acid on "Hollywood" and "Golden Japanese" plum cultivars

Table 2: Effect of Sitofex and Gibberellic acid spraying on fruit drop (%) and yield (Kg/tree) of "Haied" and "Amal " apricot cultivars during 2020 and 2021 seasons

	Season 2020						Season 2021					
	Haied		Amal		Mean (A)		Haied		Amal		Mean (A)	
Treatments	Fruit drop (%)											
CPPU 5 ppm	60.49	bc	44.46	d	52.47	cd	73.83	a	47.07	d	60.45	A
CPPU 5 ppm + GA_3 20 ppm	57.08	c	22.29	e	39.69	Ab	72.69	a	41.43	d	57.06	A
CPPU 10 ppm	66.63	ab	22.35	e	44.49	Bc	68.17	ab	46.03	d	57.10	A
CPPU 10 ppm + GA_3 20 ppm	64.37	ab	13.96	f	39.17	Ab	59.26	c	45.20	d	52.23	A
GA_3 20 ppm	67.61	a	23.39	e	45.50	A	61.07	bc	43.14	d	52.11	A
Control	69.70	a	48.22	d	58.96	D	66.71	abc	48.85	d	57.78	A
Mean (B)	64.31	A	29.11	B			66.96	A	45.29	B		
L.S.D 0.05%	(A) 4.913 (B) 2.837 (AXB) 6.948						(A) 5.562 (B) 3.211 (AXB) 7.866					
	Yield (kg/tree)											
CPPU 5 ppm	40.07	de	58.03	c	49.05	C	36.19	de	25.45	f	30.82	B
CPPU 5 ppm + GA_3 20 ppm	45.00	d	77.70	ab	61.35	A	40.00	bcd	44.43	b	42.22	A
CPPU 10 ppm	25.76	fg	76.92	ab	51.34	BC	19.19	g	43.02	bc	31.11	B
CPPU 10 ppm + GA_3 20 ppm	29.70	efg	87.37	a	58.53	AB	33.55	e	52.41	a	42.98	A
GA_3 20 ppm	23.29	g	74.00	b	48.65	C	16.23	g	39.09	cd	27.66	B
Control	21.89	g	35.59	def	28.74	D	11.17	h	23.99	f	17.58	C
Mean (B)	30.95	B	68.27	A			26.06	B	38.07	A		
L.S.D 0.05%	(A) 7.497 (B) 4.329 (AXB) 10.60						(A) 3.367 (B) 1.944 (AXB) 4.762					

*Mean followed by the same letter (s) within the same column was not significantly different ($P \leq 0.05$; LSD test).

*Factor (A): The present treatments. Factor (B): Apricot varieties. Factor (A×B): The interaction

Fig. 1: Effect of Effect of spraying Sitofex and Gibberellic acid spraying on yield (Kg/tree) of "Amal " apricot cultivar

improved yield and fruit quality [36]. Application GA_3 50 mg / liter induced highest value of average yield /tree for "Royal" apricot cultivar [37]. Foliar spraying of GA_3 at 20 ppm at full bloom on "Canino" Apricot Abd El-Mageed, *et al*. [29], on pear Chitu *et al*. [38] resulted in, the highest fruit set, yield and fruit quality compared with control. Guirguis *et al*. [39] recorded that, the higher yield and the less fruit drop with "Le – Cont" pear trees by 10 CPPU+20ppm GA_3 in the two seasons. Application CPPU with (100 cm3/20 L water) on "Anna" apple increase yield and decrease fruit drop compared with control [40]. Ajay and Sanjeev [14] showed that, the foliar application of CPPU 5 ppm at petal fall caused a significantly greater fruit yield in "Kiwifruit". Also, Application GA_3 10 ppm + 5 ppm CPPU at fruit set stage increased growth, yield Fathi *et al*. [41] on "Costata" Persimmon lowest fruit drop, highest yield and fruit quality on "Mackawa Jior" Kaki cv [42]. Also application of GA_3 + CPPU on mango and grapes [43, 44].

Data in Table (3) show the effect of conducted treatments on fruit weight, size and firmness. It is evident that for "Haied" cv, GA_3 at 20ppm alone or combined with CPPU increased significantly the average fruit weight and size for both seasons. Yet in the second season all

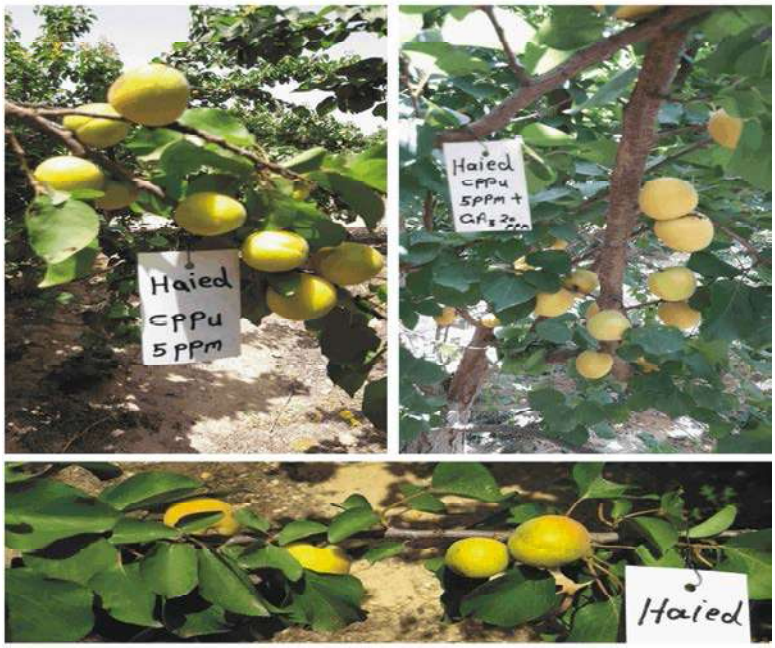

Fig. 2: Effect of Effect of spraying Sitofex and Gibberellic acid spraying on yield (Kg/tree) of "Haied" apricot cultivar

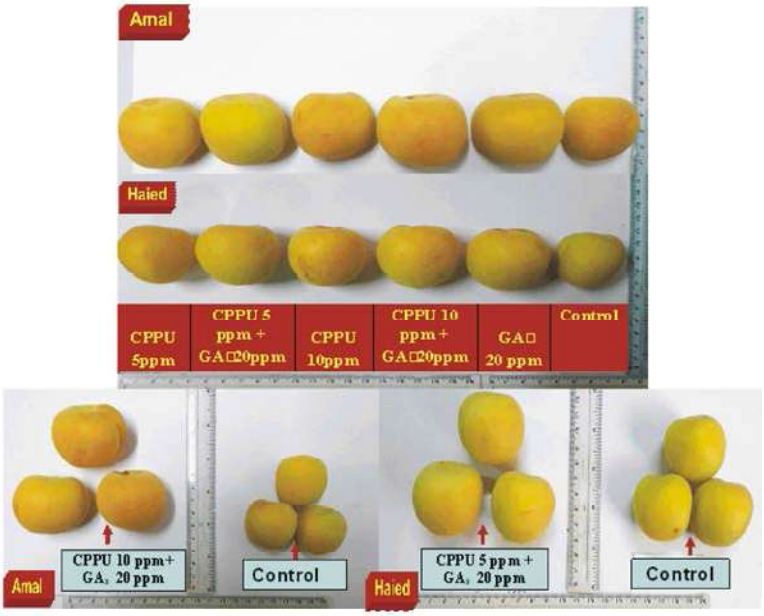

Fig. 3: Effect of conducted treatments on fruit of "Amal " and "Haied" apricot cultivars.

treatments increased fruit size significantly compared with control. While in "Amal" cv CPPU 10 ppm + 20 ppm GA_3 (36.33 and 34.94 g) in fruit weight and (34.36 and 33.32 cm^3) in fruit size in both seasons respectively compared with control this result led to the mode of action for GA_3: The first is that GA_3 intensifies an organ ability to function as a nutrient sink [23]. The second action is the faculty of GA_3 to raise the manufacture of IAA in plant tissues [24]. The third one involves accelerating manufacture of hydrolytic enzymes as amylase in the aleurone layer of seeds Addicott and Addicott, [25] showed that reflected on big diameter and longest width so that fruit weight and size were increasing than control [16, 17]. But the results showed the best compounds for the varieties were CPPU 10 ppm +20 ppm GA_3 in both seasons have the highest values for weigh (37.85 and 32.33 g) and size (34.88 and 31.24 cm^3) compared with control (Fig. 3).

Table 3: Effect of Sitofex and Gibberellic acid spray on fruit weight (g), fruit size (cm^3) and fruit firmness ($lb/inch^2$) of "Haied" and "Amal" apricot cultivars during 2020 and 2021 seasons

	Season 2020						Season 2021					
	Haied		Amal		Mean (A)		Haied		Amal		Mean (A)	
Treatments	Fruit weight (g)											
CPPU 5 ppm	36.10	bcd	28.18	f	32.14	BC	30.61	abcd	24.40	fg	27.51	BC
CPPU 5 ppm + GA_3 20 ppm	40.02	ab	33.10	de	36.56	AB	31.94	abc	26.46	defg	29.2	AB
CPPU 10 ppm	36.54	bcd	33.12	de	34.83	AB	28.61	cdef	30.26	abcde	29.43	AB
CPPU 10 ppm + GA_3 20 ppm	39.36	abc	36.33	bcd	37.85	A	29.71	bcde	34.94	a	32.33	A
GA_3 20 ppm	42.15	a	30.59	ef	36.37	A	34.17	ab	26.23	defg	30.20	AB
Control	34.38	cde	23.06	g	28.72	C	25.51	efg	22.17	g	23.84	C
Mean (B)	38.09	A	30.73	B			30.09	A	27.41	B		
L.S.D 0.05%	(A) 1.0700 (B) 0.6179 (AXB) 1.5140						(A) 3.064 (B) 1.769 (AXB) 4.333					
	Fruit size (cm^3)											
CPPU 5 ppm	33.32	bcd	23.60	e	28.46	B	29.16	ab	25.39	bcd	27.27	B
CPPU 5 ppm + GA_3 20 ppm	37.49	ab	33.32	bcd	35.40	A	33.32	a	25.94	bcd	29.63	AB
CPPU 10 ppm	33.32	bcd	31.24	cd	32.28	A	29.16	ab	27.78	bc	28.47	AB
CPPU 10 ppm + GA_3 20 ppm	35.40	abc	34.36	abcd	34.88	A	29.15	ab	33.32	a	31.24	A
GA_3 20 ppm	39.58	a	29.16	d	34.37	A	33.32	a	24.44	cd	28.88	AB
Control	31.24	cd	20.83	e	26.03	B	24.99	cd	22.22	d	23.60	C
Mean (B)	33.32	bcd	28.75	e			29.85	A	26.51	B		
L.S.D 0.05%	(A) 3.802 (B) 2.195 (AXB) 5.377						(A) 3.008 (B) 1.737 (AXB) 4.254					
	Fruit firmness ($lb/inch^2$)											
CPPU 5 ppm	6.040	c	5.340	cd	5.690	D	7.667	bcd	7.430	cde	7.548	B
CPPU 5 ppm + GA_3 20 ppm	8.227	ab	6.507	bc	7.367	B	6.993	def	9.060	abc	8.027	B
CPPU 10 ppm	6.510	bc	5.373	cd	5.942	D	5.760	def	5.533	f	5.647	C
CPPU 10 ppm + GA_3 20 ppm	8.560	a	4.000	d	6.280	B	7.263	def	6.763	def	7.013	B
GA_3 20 ppm	8.400	ab	5.853	cd	7.127	ABC	7.433	cde	7.573	cd	7.503	B
Control	9.620	a	8.260	ab	8.940	A	9.370	ab	10.000	a	9.687	A
Mean (B)	7.893	A	5.889	B			7.414	A	7.727	A		
L.S.D 0.05%	(A) 1.265 (B) 0.7306 (AXB) 1.79						(A) 1.254 (B) 0.7237 (AXB) 1.773					

*Mean followed by the same letter (s) within the same column was not significantly different ($P \leq 0.05$; LSD test).

*Factor (A): The present treatments. Factor (B): Apricot varieties. Factor (A×B): The interaction

And for the effect of the response of the varieties to other treatments, it was found that Haied best response than "Amal" cv. That significant increased fruit weight (38.09 and 30.09 g) and size (35.06 and 29.85 cm^3). may be as a result to decrease fruit yield of "Haied"cv compared with "Amal" cv (Table 3) and (Fig. 2).

Fruit firmness, The results showed the best compounds for the cultivars all treatments gaven lowest value firmness in both seasons for "Haied and Amal" compared with control. But the effect of response varieties to another usages in 1st season gave significant differences in fruit firmness (7.893 and 5.889 $cb/inch^2$) of "Haied and Amal" respectively. While in 2st season no significant differences between them (7.414 and 7.727 $cb/inch^2$).

The same results taken by Ennab and Abo ogiela [18] GA_3 40 ppm + 15 ppm CPPU or GA_3 20 ppm + 15 ppm CPPU resin fruit quality of "Kelsey" Plum. Also, Zhang and Whiting [28] found that, GA_3 at 200 mgl^{-1} applied at 9 DAFB was the most effective and improved final fruit weight by 15% on 'Bing' sweet cherry. GA_3 (25 ppm) greater weight in Sweet Cherry [27]. GA_3 at 20 and 25 ppm on '0900 Ziraat' Sweet Cherry [26]. Also Hatem *et al*. [45] found that application of 1% CPPU three weeks after full bloom raised the best result to fruit size and quality of "Meski" table grapes. Hoda [46] found GA_3 at 25 mg dm_3 and CPPU at 10 mg dm_3 treatments on clusters of "Flame Seedless" increased weight and fruit firmness. Ajay and Sanjeev [14] showed that, the foliar application of CPPU 5 ppm higher yield. Similarly, fruit weight in "Kiwifruit". Kano [47] recorded that "Costata" persimmon fruit size could be attributed directly to the CPPU effects by exogenous application of CPPU acts early on cell division in the fruitlet and also on subsequent growth. Thus, raised in size due to the efficient of cells, the building blocks of fruit mass and the cells have been able attract so much water, minerals and carbohydrates that enable the fruit to expand to large size.

Table 4: Effect of Sitofex and Gibberellic acid spray on fruit diameter (cm), fruit length (cm) and fruit shape index (L/D ratio) of "Haied" and "Amal" apricot cultivars during 2020 and 2021 seasons

Treatments	Season 2020						Season 2021					
	Haied		Amal		Mean (A)		Haied		Amal		Mean (A)	
						Fruit diameter (cm)						
CPPU 5 ppm	3.710	bc	3.660	bc	3.685	BC	3.563	bcde	3.463	cde	3.513	A
CPPU 5 ppm + GA_3 20 ppm	3.950	ab	3.710	bc	3.830	AB	3.687	ab	3.420	def	3.553	A
CPPU 10 ppm	3.950	ab	3.733	abc	3.842	AB	3.530	bcde	3.647	abc	3.588	A
CPPU 10 ppm + GA_3 20 ppm	3.943	ab	3.910	abc	3.927	A	3.613	abcd	3.610	abcd	3.612	A
GA_3 20 ppm	4.023	a	3.620	cd	3.822	AB	3.803	a	3.410	def	3.607	A
Control	3.690	bc	3.323	d	3.507	C	3.393	ef	3.233	f	3.313	B
Mean (B)	3.878	A	3.659	B			3.598	A	3.464	B		
L.S.D 0.05%	(A) 0.2208 (B) 0.1275 (AXB) 0.3122						(A) 0.14660 (B) 0.08467 (AXB) 0.20740					
						Fruit length (cm)						
CPPU 5 ppm	3.990	ab	3.700	abc	3.845	A	3.730	ab	3.527	cd	3.628	A
CPPU 5 ppm + GA_3 20 ppm	4.113	ab	3.837	abc	3.975	A	3.767	ab	3.423	de	3.595	A
CPPU 10 ppm	3.94	abc	3.810	abc	3.875	A	3.590	bcd	3.620	bc	3.605	A
CPPU 10 ppm + GA_3 20 ppm	4.107	ab	3.963	abc	4.035	A	3.630	abc	3.590	bcd	3.610	A
GA_3 20 ppm	4.213	a	3.630	bc	3.922	A	3.820	a	3.400	de	3.610	A
Control	3.930	abc	3.400	c	3.665	A	3.453	cde	3.293	e	3.373	B
Mean (B)	4.049	A	3.723	B			3.665	A	3.476	B		
L.S.D 0.05%	(A) 0.4078 (B) 0.2354 (AXB) 0.5767						(A) 0.13650 (B) 0.07882 (AXB) 0.19310					
						Fruit shape index (L/D ratio)						
CPPU 5 ppm	1.070	a	1.020	ab	1.045	A	1.040	a	1.010	a	1.025	A
CPPU 5 ppm + GA_3 20 ppm	1.040	ab	1.030	ab	1.035	AB	1.017	a	1.000	a	1.008	A
CPPU 10 ppm	0.990	b	1.017	ab	1.003	B	1.010	a	0.986	a	0.998	A
CPPU 10 ppm + GA_3 20 ppm	1.033	ab	1.010	b	1.022	AB	1.000	a	0.990	a	0.995	A
GA_3 20 ppm	1.040	ab	1.000	b	1.020	AB	1.010	a	0.993	a	1.002	A
Control	1.040	ab	1.020	ab	1.030	AB	1.013	a	1.013	a	1.013	A
Mean (B)	1.036	A	1.016	A			1.015	A	0.998	A		
L.S.D 0.05%	(A) 0.03786 (B) 0.02186 (AXB) 0.05355						(A) 0.03186 (B) 0.21860 (AXB) 0.05355					

*Mean followed by the same letter (s) within the same column was not significantly different ($P \leq 0.05$; LSD test).

*Factor (A): The present treatments. Factor (B): Apricot varieties. Factor (A×B): The interaction

Early fruit cells division is normally influenced by the natural growth hormones especially cytokinin [10-13]. Also GA_3 has the same effect for acceleration the cell enlargement and improving fruit quality all of that reflected on big diameter and longest width so that fruit weight and size were increasing than control [16, 17].

Table (4) shows the effect of treatments on the fruit length, width and shape index. Treatments with cultivars showed that the application 20 ppm GA_3 given highest fruit diameter (4.023 and 3.803 cm) and fruit length (4.213 and 3.820 cm) of "Haied" cv while CPPU 10 ppm alone & CPPU 10 ppm + 20 ppm GA_3 gaven highest fruit diameter (3.733 and 3.910 cm) (3.647 and 3.610 cm) and fruit length (3.810 and 3.963 cm) (3.620 and 3.590 cm) of "Amal" cv compared with control in both seasons.

The best compounds for the cultivars is CPPU 10 ppm +20 ppm GA_3 in both seasons have the highest values for fruit diameter (3.927 and 3.612 cm) compared with control (3.507 and 3.313 cm) in both seasons may be as a result to risen fruit weight (Table 3). But no significant differences in fruit length between control and other treatments in 1st season while in 2st season control gained the lowest value with significant differences between all treatments.

In shape index no significant differences for the response of the varieties to other treatments while the uppermost value of treatments for the varieties recorded by CPPU 5 ppm in twin seasons without significant differences between the other treatments.

This results are in harmony with Guirguis, *et al.* [42] recorded that 5 ppm CPPU + 20 ppm GA_3 followed by 10 ppm CPPU + 20 ppm GA_3 and 5 ppm CPPU + 20 ppm GA_3 for "Kaki" recorded the higher value in length increasing in both seasons .Foliar Spray with sitofex 100 Ml 100L on two apricot cultivars "Nafsika and Niovi" and synthetic auxin raise fruit diameters 5 or 10 ppm CPPU on "Hollywood and Santarosa" plum [13, 19]. Hoda [46] found that GA_3 at 25 mg dm_3 and CPPU at 10 mg dm_3

treatments on clusters of "Flame Seedless" increased length, berry and diameter. CPPU that plays an important role in enhancing cell division and elongation as well as great role in activating the biosynthesis of proteins, RNA and DNA [48].

As for Table (5) The interaction results of treatments with cultivars showed that the appliction 20 ppm GA_3 gave the highest values with "Haied" cultivar for flesh thickness (1.315 and 1.360 cm) and also for flesh weight (40.30 and 30.92 g) in the first & second seasons respectively. while, for "Amal" cv more responsple for CPPU 10 ppm + 20 ppm GA_3 (1.080 and 1.220 cm) and (35.52 and 30.34 g) for flesh thickness and weight respectively.

The best treatments for the cultivars is 10 ppm CPPU + 20 ppm GA_3 and 20 ppm GA_3 alone (1.080 and 1.115 cm) (1.182 and 1.170 cm) in flesh thickness for "Haied and Amal" in both seasons respectively compared with control.

For the effect response of the cultivars to each other to the treatments, it is appearing that superiority of "Haied" cultivar over "Amal" cv that was shown with a significant differences in both characteristics in the two studied seasons. The same trend was noticed by Mikhail [49] found that using CPPU influenced significantly flesh weight in "Kalamata" olive.

Table (6): The interaction results of treatments with cultivars showed that the application of CPPU 5ppm & CPPU 5ppm + 20ppm GA_3 with "Haied" cultivar gave higher percentages of TSS (10 and 9.5%) & (10.5 and 10.83%) comparing to the control treatment which gave the lowest TSS % in both seasons. While the best treatments for the cultivars all studied treatments increased TSS percentage than control without significant differences between them in the two seasons. For the effect response of the cultivars to each other to the treatments, there is no significant difference between the two type cultivars "Haied and Amal" (8.889 and 8.389%) but for 2nd season there is significant difference between them as "Haied" cultivar gave higher result than "Amal" cv for TSS % (9.639 and 8.361 %) respectively. Related to acidity comparing between treatments for cultivars control treatment has higher value (0.198 and 0.200%) in the two seasons respectively without significant difference between it and the other treatments . But the effect response of the cultivars "Haied" cultivar recorded the best acidity values (0.1656 and 0.1756%) than "Amal" cv (0.2022 and 0.2106%) in both seasons respectively. For the results of TSS/acidity ratio Regarding the treatments for cultivars the control treatment gave the lowest values (39.76 and 43.17) in both seasons.

For the effect response of the cultivars to other treatments, showed that, "Haied" apricot cv .significantly has higher ratio (53.89 and 55.11) than "Amal" cv. (41.14 and 37.6) through the two studied seasons. So, we can use this distinction to recognize fruits of "Haied" apricot cv.

The above results are in line with those mentioned by Ennab and Abo ogiela [18] spraying GA_3 and CPPU led to improve TSS%, total acidity and TSS/ acid ratio in "Kelsey" plum fruit juice. Spray 10 or 15 ppm CPPU on "Le-cont" Pear increased acidity and the lowest values of TSS [20]. Foliar spraying GA_3 at 20 ppm at full bloom on "Canino" Apricot Abd El-Mageed, *et al.* [29], on pear Chitu *et al.* [38] found that, the highest fruit quality compared with control. On "Hollywood" and "Golden Japanese" Plum cultivars spray Gibberellic acid (25 and 50 ppm) improved fruit quality [19]. Hoda [46] recorded that a significant decrease in total soluble solids content was obtained by using GA_3+ CPPU compared to the control in "Flame seedless" grapevine.

The Economic Study: From Table (7) It is cleared that, from the economic study, trees yield production and the main economic criteria were the cost of each compound (CPPU, GA_3 and combination between them). The economic feasibility table showed that all different compounds cost more than control but in the same time all of them gave higher yield ton /feddan than control in the two seasons but in different proportion. Other expenses such as the costs of supervision and royalties, wages and cost of agricultural service were not taken into consideration in this study.

It could be notice that, increasing of the final average cost LE /fed with the same value (6.327 LE) in the both seasons of combination of CPPU 10 ppm + GA_3 20 ppm is the most expensive than the rest of the treatments, but in return it gave the highest net income LE/feddan in "Amal" cv (140.449 and 87.224 LE) in the two seasons respectively. While the response of "Haied" cv to CPPU 5 ppm + GA_3 20 ppm during the two studied seasons gave highest net income LE/feddan (75.600 and 71.400 LE) compared with other treatments. Similar results were obtained with, Ennab and Abo Ogila [18] reported that, the exogenous application of CPPU and GA_3 aimed to ensure economical yield for "Kelsey" plum trees. Also, Application GA_3 10 ppm + 5 ppm CPPU at fruit set stage increased growth, yield and income Fathi *et al.* [41] on "Costata", highest yield and fruit quality on "Mackawa Jior" Kaki cultivar [42].

Table 5: Effect of Sitofex and Gibberellic acid spray on flesh thickness (cm), flesh weight (g) of " Haied" and "Amal" cultivars during 2020 and 2021 seasons

	Season 2020						Season 2021					
Treatments	Haied		Amal		Mean (A)		Haied		Amal		Mean (A)	
					Flesh thickness(cm)							
CPPU 5 ppm	1.020	cd	0.946	d	0.983	cd	1.213	b	0.950	de	1.082	c
CPPU 5 ppm + GA_3 20 ppm	1.170	b	1.010	cd	1.090	Ab	1.233	b	0.990	d	1.112	bc
CPPU 10 ppm	1.000	cd	1.040	bcd	1.020	Bc	1.200	bc	1.020	d	1.110	bc
CPPU 10 ppm + GA_3 20 ppm	1.080	bc	1.080	bc	1.080	Ab	1.143	bc	1.220	b	1.182	A
GA_3 20 ppm	1.310	a	0.920	d	1.115	A	1.360	a	0.980	d	1.170	Ab
Control	1.080	bc	0.733	e	0.906	D	1.113	c	0.873	e	0.993	D
Mean (B)	1.110	A	0.955	B			1.211	A	1.006	B		
L.S.D 0.05%	(A) 0.09275 (B) 0.05355 (AXB) 0.13120						(A) 0.06558 (B) 0.03786 (AXB) 0.09275					
					Flesh weight (g)							
CPPU 5 ppm	32.85	cd	26.72	E	29.78	B	27.10	bc	23.76	de	25.43	B
CPPU 5 ppm + GA_3 20 ppm	35.09	bc	32.52	cd	33.80	A	28.83	ab	23.76	de	26.30	B
CPPU 10 ppm	34.86	bc	32.92	cd	33.89	A	25.98	bcd	27.88	ab	26.93	AB
CPPU 10 ppm + GA_3 20 ppm	37.28	ab	35.52	bc	36.40	A	26.78	bcd	30.34	A	28.56	A
GA_3 20 ppm	40.30	a	30.25	de	35.28	A	30.92	a	24.06	cde	27.49	AB
Control	32.34	cd	22.21	F	27.28	B	22.76	ef	19.91	F	21.34	C
Mean (B)	35.45	A	30.02	B			27.06	A	24.95	B		
L.S.D 0.05%	(A) 2.86 (B) 1.651 (AXB) 4.045						(A) 2.213 (B) 1.278 (AXB) 3.130					

*Mean followed by the same letter (s) within the same column was not significantly different (P ≤ 0.05; LSD test).

*Factor (A): The present treatments. Factor (B): Apricot varieties. Factor (A×B): The interaction

Table 6: Effect of Sitofex and gibberellic acid spray on TSS (%), Acidity (%) and TSS / Acidity ratio of " Haied" and "Amal" cultivars during 2020 and 2021 seasons

	Season 2020						Season 2021					
Treatments	Haied		Amal		Mean (A)		Haied		Amal		Mean (A)	
						TSS (%)						
CPPU 5 ppm	10.000	a	8.500	abc	9.250	A	10.500	a	8.500	cd	9.500	AB
CPPU 5 ppm + GA_3 20 ppm	9.500	ab	8.000	bc	8.750	Ab	10.830	a	8.000	d	9.417	AB
CPPU 10 ppm	8.000	bc	8.000	bc	8.000	B	9.000	bcd	8.000	d	8.500	C
CPPU 10 ppm + GA_3 20 ppm	9.000	abc	9.167	abc	9.083	A	10.000	ab	9.167	bc	9.583	A
GA_3 20 ppm	9.000	abc	8.667	abc	8.833	AB	9.000	bcd	8.500	cd	8.750	BC
Control	7.833	c	8.000	bc	7.917	D	8.500	cd	8.000	d	8.250	C
Mean (B)	8.889	A	8.389	A			9.639	A	8.361	B		
L.S.D 0.05%	(A) 1.0700 (B) 0.6179 (AXB) 1.5140						(A) 0.8005 (B) 0.4622 (AXB) 1.1320					
						Acidity (%)						
CPPU 5 ppm	0.160	bc	0.200	ab	0.180	A	0.190	abc	0.220	ab	0.205	A
CPPU 5 ppm + GA_3 20 ppm	0.160	bc	0.200	ab	0.180	A	0.180	abc	0.203	abc	0.191	A
CPPU 10 ppm	0.140	c	0.193	abc	0.166	A	0.170	bc	0.200	abc	0.185	A
CPPU 10 ppm + GA_3 20 ppm	0.180	abc	0.190	abc	0.185	A	0.183	abc	0.190	abc	0.186	A
GA_3 20 ppm	0.183	abc	0.203	ab	0.193	A	0.160	c	0.220	ab	0.190	A
Control	0.170	bc	0.226	a	0.198	A	0.170	bc	0.230	a	0.200	A
Mean (B)	0.165	B	0.202	A			0.175	B	0.210	A		
L.S.D 0.05%	(A) 0.03788 (B) 0.02186 (AXB) 0.05355						(A) 0.03786 (B) 0.02186 (AXB) 0.53550					
						TSS/ Acidity						
CPPU 5 ppm	62.50	a	42.50	cdef	52.50	A	55.26	ab	38.71	cd	46.99	A
CPPU 5 ppm + GA_3 20 ppm	60.93	a	40.00	def	50.47	A	60.63	a	32.91	d	46.77	A
CPPU 10 ppm	57.14	ab	38.09	ef	47.61	AB	52.94	b	40.00	c	46.47	A
CPPU 10 ppm + GA_3 20 ppm	50.00	bc	48.21	cd	49.10	A	55.59	ab	39.01	cd	47.3	A
GA_3 20 ppm	48.68	c	42.62	cdef	45.65	AB	56.25	ab	38.63	cd	47.44	A
Control	44.11	cde	35.41	f	39.76	B	50.00	b	36.33	cd	43.17	A
Mean (B)	53.89	A	41.14	B			55.11	A	37.6	B		
L.S.D 0.05%	(A) 5.426 (B) 3.133 (AXB) 7.674						(A) 4.461 (B) 2.576 (AXB) 6.309					

*Mean followed by the same letter (s) within the same column was not significantly different (P ≤ 0.05; LSD test).

*Factor (A): The present treatments. Factor (B): Apricot varieties. Factor (A×B): The interaction

Table 7: Economic study by using treatments on total yield kg and total income LE

Treatments	Average cost LE / fed	Yield ton / feddan		Total income/fed LE		Net income (LE)/ feddan	
		Haied	Amal	Haied	Amal	Haied	Amal
				Season 2020			
CPPU 5 ppm	2973	8.414	12.186	67312	97488	64339	94515
CPPU 5 ppm + GA_3 20	3351	9.45	16.317	75600	130536	72249	127185
CPPU 10 ppm	5949	5.409	16.153	43272	129224	37323	123275
CPPU 10 ppm + GA_3 20	6327	6.237	18.347	49896	146776	43569	140449
GA_3 20	378	4.890	15.540	39120	12432	38742	123942
Control	Water	4.596	7.473	36768	59784	36768	59784
				Season 2021			
CPPU 5 ppm	2973	7.599	5.344	64591	45424	61618	42451
CPPU 5 ppm + GA_3 20	3351	8.400	9.330	71400	79305	68049	75954
CPPU 10 ppm	5949	4.029	9.034	34246	76789	28297	70840
CPPU 10 ppm + GA_3 20ppm	6327	7.045	11.006	59882	93551	53555	87224
GA_3 20 ppm	378	3.360	8.208	28560	69768	28182	69390
Control	Water	2.345	5.037	19932	42814	19932	42814

CONCLUSION

In brief, the results showed that, all treatments CPPU and GA_3 singly or combination clearly enhanced fruit yield and quality for the two cultivars “Haied” and “Amal” than control. However, the “Amal” cultivar was more responsive to these treatments and gave a large amount of crop, compared to the “Haied” cultivar.

Finally, If farm is planted with the cultivar of “Amal”, we must recommend combination of CPPU 10 ppm + GA_3 20 ppm while if planted with “Haied” cv the combination of CPPU 5 ppm + GA_3 20 ppm which gained the best results in the most of determinations especially fruit yield and net income LE/Feddan for two cultivars and the two seasons.

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